sciendo

Zagreb International Review of Economics & Business, Vol. 28, No. 2, pp. 231-254, 2025

Faculty of Economics and Business, University of Zagreb and Sciendo. Printed in Croatia.
ISSN 1331-5609; UDC: 33+65
DOI: 10.2478/zireb-2025-0023

Radical Innovations and Economic Development: Comparative Role of Social and Human Capital in Developing Countries

Misbah Batool [*]
Faiza Azhar Khan [**]
Saira Tufail [***+]

Abstract: *The last two decades witnessed a surge of radical innovations in developing economies. This surge has expedited the research on understanding the factors that foster innovations and transmit the benefits of innovation to economic development. In this study, we have examined the role of enabling factors, social and human capital, for radical innovations and how these impacts are catalyzed to economic development. Using the data of 59 developing countries for 1980-2022, the results of GMM showed that though both social and human capital foster innovations, the impact of human capital is substantive. However, social capital provides a better linkage between innovations and development. The improvement in institutional quality is recognized as essential for radical innovations, while trade openness and FDI are not aligned with the innovative process of developing economies. To sustain this growth in radical innovations, developing economies should focus on enabling factors along with realigning external sector policies with the structure of innovativeness.*

Keywords: Radical Innovation; System GMM; Social Capital; Trust; Human Capital

JEL Classification: O30; O47

[*] Fatima Jinnah Women University, Rawalpindi, Pakistan
[**] International Islamic University, Islamabad, Pakistan
[***] Fatima Jinnah Women University, Rawalpindi, Pakistan
[+] Corresponding Author E-Mail: sairatufail@fjwu.edu.pk

Introduction

Technological innovations have been recognized as the main engine for long-term economic growth since the seminal contributions of Romer (1990), Grossman and Helpman (1991), and Aghion and Howitt (1993). Innovations are also regarded as crucial development tools for tackling global issues and putting the 2030 Sustainable Development Goals (SDGs) into practice by attending to local needs (Ruhana et al., 2024). Innovation is crucial at every stage of development, but its impact changes as the development moves through successive stages. According to Maradana et al. (2017), in earlier stages of development, incremental innovation, that is, the adoption of foreign technology, is highly recommended. High-tech R&D-based innovation is important in later phases of development, where it serves the dual purpose of competitiveness and learning that is necessary to advance the catching-up process.

The majority of innovations in developing countries are incremental and frequently result from technology spillovers and diffusions from developed economies. However, developing countries have also experienced a rise in radical innovations during the past two decades despite the numerous challenges they face (Vijayagopal et al., 2024). Recent years have seen an increase in the number of low- and middle-income nations that include innovation policy in their national policy frameworks, and multilateral organizations have made innovation programs the center of policymaking (UNESCO, 2021). Nonetheless, hardly any research has been undertaken to determine how the recent explosion of radical innovation in developing countries has affected their economic development.

The link between radical innovation and the economic development of a country may not be as straightforward as it seems. Fu and Shi (2022) believed that innovations are biased and the direction of innovation is essential for making innovation work for development. Innovations that widen the capability gap, do not augment the abundant endowments of the country, and/or produce contrasting social and private returns, may become incompatible with the current stage of development and may not reap the professed benefits for development. Vasin and Timokhina (2024) highlighted that the interaction between innovations and development is not single-handedly decided, but rather is dynamically determined by the interplay of numerous economic factors. In this regard, both social and human capital have gained immense importance over time as factors enabling the intuitive link between innovation and development.

The idea that social capital mediates the effect of innovation on economic development is supported by the argument that social capital steers the incentive structure of the economy either toward 'production' or 'predation.' The relative payoffs to production and subsequent generations of ideas and innovations are higher only in an environment characterized by low transaction costs, contract enforceability, and high social cohesion, which are the features central to economies with higher social capital (North, 1990). The research in the field of social capital and economic growth

is based primarily on the paradigm of trust (Putnam, 1993; Knack & Keefer, 1997; Whiteley, 2000; Zak & Knack, 2001; Roth, 2009), and lack of interpersonal trust is considered a defining element of economic backwardness where predation overtakes production (Arrow, 1992). Along with the microeconomic channels through which trust not only increases the likelihood of innovations but also streamlines the contribution of innovative activities to economic development, a culture of trust enhances the effectiveness of government and the standard of public policies that are supportive of knowledge creation and sharing through macroeconomic and political channels (Vasetylieva et al., 2023). In the recent literature, social exchange theory renders interpersonal trust pivotal for engagement in innovative activities (Wu and Lv, 2024; Anser et al., 2021; Kmieciak, 2020).

There is widespread recognition that human capital accounts for substantial cross-country growth and productivity differences across the world. On the one hand, human capital is considered an independent factor of production that increases productivity for a given level of technology (Lucas, 1988; Mankiw et al., 1992). On the other hand, human capital is seen as an input in the innovation process and therefore as a complement to technology (Benhabib and Spiegel, 1994; Romer, 1990; Nelson and Phelps, 1966). According to this view, higher levels of human capital lead to the generation or diffusion of new technologies or more efficient adoption of a given technology, thereby shifting the frontier of the production possibility set outwards.

Given this background, the objective of the study is twofold: first, to examine the relative role of social and human capital in promoting radical innovations, and second, to examine the impact of innovation induced by social and human capital on economic development. The study contributes to the literature in many ways. The importance of both kinds of capital, that is, social capital and human capital, has been well established in the theoretical literature. Nonetheless, the studies that have considered the role of human and social capital as key factors in fostering innovation have mostly taken place in developed countries. Moreover, the literature is scant regarding the role of different types of capital in enabling the link between innovation and economic development, generally and in developing countries specifically.

Another dimension where the literature on developing countries indicates a clear empirical gap lies in the investigation of the link between radical innovation and economic development. The academic endeavors in this regard often focused on incremental rather than radical innovation. Thus, despite the notable progress in this line of research indicated above, our understanding of radical innovations as the source of economic development for developing economies is still very limited (Audretsch and Aldridge, 2008). In particular, we only have a partial understanding of which socioeconomic or cultural factors support the transmission of the impact of radical innovations on economic development. Rare empirical research has shown that proximity to other types of capital in an economic system spurs innovativeness (Boschma and Frenken, 2010; Fornahl et al., 2011).

However, the study seeks to answer a) what is the relative contribution of social and human capital in explaining radical innovations b) does this social and human capital-induced innovation impact economic development. The remainder of the paper is as follows: section 2 presents the literature review. In section 3 methodology and data are discussed. Section 4 explains the results and section 5 concludes.

Literature Review

The study bridges two lines of research, first examining the effects of social and human capital on innovation and second exploring the effects of innovation on economic development. In this regard, a brief review of the literature is presented here.

Technological progress, either exogenously (Solow, 1956) or endogenously (Romer, 1986; Lucas, 1988) determined, has been deemed crucial in the extensive literature on growth that aims to find the factors underlying cross-country growth differences (Maradana et al., 2017; Diebolt and Hippe, 2022). In this regard, the last few decades have witnessed a growing volume of research ascribed to the empirical investigation of the innovation-led growth hypothesis. For this purpose, literature has predominantly focused on two indicators to account for the innovation process, namely, incremental innovation usually captured by R&D expenditures, and radical innovation measured by patents (Helpman, 1998). In an earlier study, Ejermo and Kander (2006) analyzed literature that investigated the impact of private R&D on economic growth. Although the poorest countries invest more in R&D relative to GDP than middle-income countries, they did not find any evidence of a connection between R&D expenditures and growth in these nations. According to Arouri et al. (2014), the impressive, rapid economic growth in Brazil, India, and China over the past three decades is attributable to these nations' inventive capacities, which have aided these nations in quickly catching up with the world's economic frontiers. Pala (2019) explored the issue by taking different dimensions of the R&D sector and showed considerable heterogeneities among countries with respect to the link between R&D expenditures and economic growth.

Although studies on the impact of R&D on growth have been abundant, there is a gap in the literature regarding the impact of radical innovation measured by patents to explore the link between economic growth and innovation. Patents are an indicator of technology forecasting and technological trends (Chang et al., 2009). The number of patents is argued as a good indicator to evaluate the success of innovation activities (Dang & Motohashi, 2015). However, without using these inventions in production, the patents themselves cannot have a positive impact on economic growth (Anser et al., 2021). Because of this, the effect of patents on economic growth would vary depending on the type of patent and the socioeconomic situation (Pradhan et al., 2018). Maradana et al. (2017) analyzed the supply-driven approach and considered

indicators for both incremental and radical innovation while examining the innovation-led growth hypothesis for a sample of 19 European countries. Their research demonstrated the existence of supply-driven and demand-driven theories of growth and innovation across many countries they examined. Nguyen and Doytch (2022) is another notable contribution in this regard. They examined the impact of total patents and ICT patents on both economic growth and the growth of GDP per capita. The results showed that total patents have a positive impact on economic growth for both emerging and advanced economies, with the effect being stronger in advanced economies.

The crucial significance of innovation in economic development has been one of the lessons of the past 20 years. The development of innovation capacities has been essential to the growth dynamics of prosperous developing nations (OECD, 2001). It is also widely recognized that to have the learning abilities necessary for "catch-up," the innovative capacity needs to be developed early in the development process. The theoretical models that view technological progress as endogenous emphasized intangible capital, particularly human and social capital, as significant elements in determining the innovative capacities of the economy (Seitz and Watzinger, 2017). Similarly, empirical research reckoning innovation crucial for economic growth also attributes the strength of the relationship to the high levels of social and human capital, as Diaconu (2011) declared human and social capital as a prerequisite for development through innovation.

As far as human capital is concerned, it may directly affect economic development or indirectly through the generation of technology. Acemoglu and Autor (2012) asserted that there are several ways that human capital might influence technological advancement directly through the generation of ideas or indirectly through the spillover of positive externalities and heightening the incentives to innovate. However, Eriksson et al. (2023) argue that different policies like taxes and subsidies may not be beneficial for both human capital and innovation at the same time; rather, some tradeoffs do exist. The literature on the impact of human capital and innovation on economic development and growth in the European regions is large (e.g., Rodríguez-Pose and Crescenzi, 2008; Sterlacchini, 2008; Cuaresma, Doppelhofer, and Feldkircher, 2012), but little attention has been given to human capital as an important factor for firms' innovation in the developing world (Liu and Buck, 2007; Grimpe and Sofka, 2009). An exception is Van Uden et al. (2017), who conducted a firm-level study for three developing East African countries, i.e., Tanzania, Kenya, and Uganda, and reinforced the idea that innovation and human capital have a strong relationship even in the developing countries. The positive relationship between formal training, employee education level, and providing slack time suggests that in developing countries, formal training can make up for lower education levels of employees, and slack time can give workers more opportunities to explore new areas that can inspire new ideas and innovations.

Cui and Diwu (2024), in a recent paper, confirmed that human capital upgrading enhances enterprise innovation efficiency, but the impact varies for different industries and scales. Similarly, Diebolt and Hippe (2022) showed that human capital is a key factor explaining current regional disparities in innovation and economic development in European countries. Khatiwada and Arao (2020) examined the impact of human capital measured by the workforce with high school education, the incidence of on-the-job training, and managerial experience on firm-level innovation and found that firms with higher human capital have a high likelihood to engage in innovation. They also found that the quality of the firm's human capital is particularly important to capture the firm's absorptive capacity for new technology and knowledge.

Since the recognition of the role of intangible assets in the innovation process, social capital has received considerable attention in the literature (Wardhani and Mendibil, 2016). Several recent studies have endorsed the findings of Knack and Keefer (1997) on the positive impact of social capital on income growth, i.e., countries with higher social capital are richer (Muringani et al., 2021; Bjørnskov, 2012; Dearmon and Grier, 2009). However, the exact channel through which social capital transforms into innovation was still ambiguous (Akçomak and Ter Weel, 2009). In a study based on a sample of 14 European countries, Akçomak and Ter Weel (2009) highlighted social capital as an important channel linking innovation and GDP per capita growth. Social capital stimulates the growth rate of GDP per capita, indirectly through increasing innovative activities in the region. Furthermore, they have also confirmed the positive impact of innovation on per capita income growth, that is, the environment of trust and cooperation makes R&D activities more efficient, which raises the probability of successful innovation and hence increases per capita income growth of the country.

The empirical findings linking innovation with social capital and growth with social capital are inconsistent. Some studies have concluded a positive link (Coleman, 1988, 1990; Putnam, 1993; Knack and Keefer, 1997; Onyx and Bullen, 2000), while others have shown a negative relationship (Chou et al., 2006). Whereas Dakhli and Clercq (2004) have found partial support for the positive impact of associational activity and trust on innovation and growth for a sample of 59 different countries. However, strong support for the positive association between human capital and innovation has been found. Do (2009) used trust, civic norms, and associational activity to analyze the effect of social capital on innovation. The empirical findings indicated that all constructs of social capital had a favorable impact on a nation's degree of innovation. Overall, the study's findings offer compelling evidence that social capital plays a significant role in stimulating economic growth through the channel of innovation. Doh and Acs (2010) reported that social capital has a beneficial effect on overall innovation in a cross-country empirical investigation involving 53 nations. Additionally, a county's degree of innovation is positively impacted by its human capital. A notable contribution regarding the relationship between social capital and

innovation is extended by Pylypenko et al., (2023), confirming that social capital increases innovative and absorptive capacities of countries.

Studies conducted at the regional level mainly underscored mutual trust, shared values, and geographical proximity between physical and human capital as the main factors affecting regional innovative performance (Bellandi, 2001; Saxanian, 1994). Similar results have been found by Kaasa (2009) that social capital significantly influences patent applications through general trust, institutional trust, networks, and civic participation in European countries. Nevertheless, human capital, trust toward friends, generalized trust, and R&D expenditure positively influence patent filings per million of the population (i.e., innovation). However, indices of civic participation appeared to be negative and insignificant in Asian countries (Kashi and Afsari, 2014). In another study, Pio (2020) investigated how innovation, social capital, and human capital affected economic growth. The study found that social and human capital were the primary drivers of economic growth, whereas innovation's impact on output is not confirmed. On the other hand, Thompson (2018) showed that the production of innovation and, by extension, the increase in overall output of the economy is directly proportional to innovators' capacity for cooperation and sharing, which hinges crucially on the economy's stock of social capital

The perception that radical innovation is only a phenomenon of the most advanced economies is changing rapidly, with a quadrupling emergence of literature on developing economies in the last two decades (Lema et al., 2021). Nonetheless, the existing literature is still lacking in important aspects, thus offering the opportunity to explore the issue further. For instance, the literature is mostly concentrated on fast-growing upper-middle economies where lower-income countries remain marginal in relative terms. Moreover, the literature is developing into two distinct streams, one focusing on what drives innovation and the other exploring the significance of innovation for the economy. Furthermore, the knowledge about the factors that are essential for building radical innovative capacities and how these capacities will be transmitted to aggregate economic development is an untapped area of research for developing countries. Therefore, this study fills the gap in the literature by targeting the area where enough research has not been carried out, and that is to provide empirical evidence on the role of human and social capital in the innovation and growth process for the set of developing countries, and to recommend policy implications based on the obtained results.

Methodology and Data

Most of the existing literature focuses on the relationship between economic development and innovation or the role of human and social capital in economic development. Our study lies at the conjecture of these two strands of literature by accounting

for the mediating role of social and human capital as drivers of economic development through fostering innovation. Since the unit of analysis in our empirical work is a group of developing countries, we set up a panel model.

The first aspect of the theoretical framework of this study, that is, incorporating human capital in the innovation process, is based on the endogenous growth model formulated by Grossman and Helpman (1991), where the growth rate of an economy is the function of endogenous technical change that is produced in the separate R&D sector of the economy with the help of human capital. Human capital then affects growth through technological development, as a certain level of human capital is essentially required for technological innovation (Apergis, 2009).

The second aspect of the study that focuses on the role of social capital in innovation is based on the theory of Fukuyama (1996), which states that innovation cannot be done in isolation it requires individuals and firms to interact with their environment. Therefore, social capital facilitates social interactions and helps in reducing transaction, monitoring, and information costs and also facilitates exchanges and trade even without formal contracts. The social capital literature discusses the role of social capital in the growth process (i.e., Knack and Keefer, 1997; Zak and Knack, 2001). The accumulation of capital generates knowledge that benefits society and increases income. The stock of social capital has a positive effect on the accumulation of knowledge through increasing investment in innovation, which in turn increases output (Akçomak and Ter Weel, 2009). Based on the endogenous growth theories, the theory of Nelson and Phelps (1966), and the relationship of social capital with growth, the framework developed by Akçomak and Ter Weel (2009) has been adopted in this study.

The analysis is carried out in two steps. In the first step, radical innovation has been separately regressed on human capital and social capital while keeping the other control variables identical in both equations (equation (1) and equation (2)). These models have been used to estimate social capital ($Inv\hat{}_{it}^{SK}$) and human capital induced ($Inv\hat{}_{it}^{HK}$) innovation. In the second step of methodology, the contribution of social and human capital induced innovation is estimated for economic development (equation (3) and equation (4)) while adding relevant control variables based on Barro and Sala-i-Martin (2004) and Sala-i-Martin, (1997). This two-step methodology allows us to ascertain the relative and direct contribution of social and human capital for innovation and indirect contribution for economic development through innovation.

$$Inv_{it} = \alpha_i + v_t + \alpha_1 SK_{it} + \alpha_2 PG_{it} + \alpha_3 FDI_{it} + \alpha_4 TO_{it} + \alpha_5 IQ_{it} + \mu_{it} \quad (1)$$

$$Inv_{it} = \beta_i + t_t + \beta_1 HK_{it} + \beta_2 PG_{it} + \beta_3 FDI_{it} + \beta_4 TO_{it} + \beta_5 IQ_{it} + \varepsilon_{it} \quad (2)$$

$$PCIG_{it} = \gamma_i + \upsilon_t + \gamma_1 LPCI_{it} + \gamma_2 Inv\hat{}_{it}^{SK} + \gamma_3 K_{it} + \gamma_4 FR_{it} + \gamma_5 lemp_{it} + \omega_{it} \quad (3)$$

$$PCIG_{it} = \chi_i + \rho_t + \chi_1 LPCI_{it} + \chi_2 Inv\hat{}_{it}^{HK} + \chi_3 K_{it} + \chi_4 FR_{it} + \chi_5 lemp_{it} + \eta_{it} \quad (4)$$

Where,
Inv_{it} = Innovation (number of patent applications in a country for a given year)
$\alpha_i, \beta_i, \gamma_i, \chi_i$ = country-specific fixed effects
SK_{it} = Social capital (generalized trust measured as the percentage of people who can be trusted)
HK_{it} = Human capital index based on years of schooling and economic return
PG_{it} = Population growth of the country (annual %)
FDI_{it} = Foreign direct investment (net capital inflows as % of GDP)
TO_{it} = Trade openness (trade as a percentage of GDP)
IQ_{it} = Institutional quality (index on bureaucratic quality)
$\hat{Inv}_{it}^{HK}$ = Estimated innovation based on human capital
$\hat{Inv}_{it}^{SK}$ = Estimated innovation based on social capital
$PCIG_{it}$ = GDP Per capita growth (annual %)
$LPCI_{it}$ = Log of GDP per capita (constant 2010 US$)
K_{it} = Physical capital (Gross fixed capital formation as % of GDP)
FR_{it} = Fertility rate total, (births per woman)
$Lemp_{it}$ = Log of employment (number of people engaged in employment)
$\mu_{it}, \varepsilon_{it}, \omega_{it}, \eta_{it}$ = Error terms, with respect to i and t
$v_t, t_t, \upsilon_t, \rho_t$ = Time dummies

The dependent variable in equations 1 and 2, that is, innovation, is captured through total patent applications, which is the extensively used proxy of radical innovation in the economic literature (Akçomak and Ter Weel, 2009; Kaasa, 2009; Seitz and Watzinger, 2017). The dependent variable in equations 3 and 4, that is, economic development, is measured by per capita income growth. The inclusion of focused and control variables in empirical models is based on strong theoretical justification. Owing to its radical capabilities, innovation has a vital role to play in the development process by increasing productivity, infrastructure development, and employment opportunities, and bringing improvement in the overall welfare of the people (OECD, 2001; Maradana et al., 2017). Due to the fundamental properties of innovation, its enabling factors are of great importance for governments and policymakers (OECD, 2001).

According to Kim and Kang (2014) the ideal milieu for innovation is one with a higher level of social capital. Tamaschke (2003) refers to social capital as the capital of a multiplicative nature due to the substantial role it plays in the innovation and growth process. Social capital, measured by the general trust in this study, is expected to be positively related to innovation through a variety of channels. By reducing the need for monitoring and control mechanisms, granting freedom from rigid rules, increasing idea generation through increased interactions among people, and lowering transaction, search, information, decision, and bargaining costs, trust reduces the uncertainty associated with the innovative process (Kim and Kang, 2014).

Human capital is another important factor that influences innovation, in addition to social capital. The level of knowledge and skill accumulation is anticipated to encourage innovation and boost regional competitiveness (Eriksson et al., 2023). More entrepreneurs and new products might result from a better level of human capital, which would indirectly boost economic growth through innovation (Diebolt and Hippe, 2022). According to Acemoglu and Autor (2012), the skills and abilities of the workforce could potentially contribute to technological advancement directly and via the externalities produced by human capital.

The way economic agents interact, learn, and exploit knowledge is significantly influenced by various institutions i.e., rules and norms of the society (Axtell, 2007). In an economic setting involving uncertainty, the way economic agents interact and the economic system works would be significantly determined by formal and informal institutions. The key idea is that institutions spur growth by creating an economic milieu that is more conducive to innovative processes (Donges et al., 2023). The rules and regulations set by the institutions assist in the establishment of new business ventures and subsequently foster innovation. According to Acemoglu et al. (2014), inclusive institutions foster an atmosphere where people have equal access to economic opportunities and are inspired to come up with innovative concepts and ventures. Innovation has been claimed to be significantly impacted by the legal environment.

Many economists believe that a rising population has a detrimental impact on economic development (Barro and Sala-i-Martin, 2004). However, it is still unclear how population growth and technical advancement relate to one another. Population growth might spur or hinder innovation and growth through various channels. Endogenous growth models argued that a higher population growth rate stimulates innovation (Kremer, 1993). Arrow (1992) and Romer (1990) argued that the cost of innovation is not related to the number of users of that technology. Young (1990) offered the opposing viewpoint, arguing that population expansion has a detrimental effect on the growth of GDP per capita.

External variables, such as foreign direct investment (FDI) and trade openness, have proven crucial in promoting innovation in addition to domestic ones. FDI can have a beneficial or negative impact on a country's innovation, depending on how well the host economy can absorb it. FDI boosts innovation by providing managerial expertise, technical know-how, and the required amount of financial capital to the host countries (Erdal and Gocer, 2015). Inward FDI causes several positive externalities in host countries, such as the raising competitive pressure due to the entry of foreign firms, motivating native firms to develop and improve. This competitive pressure also prevents native firms from earning monopolistic profits and forces them to indulge in innovative activities to retain their market share (Chung, 2001). On the contrary, Loukil (2006) asserted that FDI has a detrimental impact on innovation in host nations that are emerging because these nations lack the complementary skills, knowledge, and institutional frameworks needed to benefit from inbound FDI's

innovation-related advantages. Developing countries might also prefer imitating foreign technology, instead of creating new ideas, discouraging the innovation derived in these countries (Brambilla, 2009).

Another key factor in the innovation process is trade openness, which is predicted to boost innovation through better market access and enhanced competition. According to Aghion and Howitt (2007), greater market access increases the likelihood of higher profits, which encourages more innovation. Additionally, it lessens the risk of monopoly, and the competitive market pressure encourages local businesses to innovate and develop new, superior products. According to Grossman and Helpman (1991), technological knowledge spillovers from developed countries to underdeveloped ones also occur through international trade. A similar point of view was put forth by Chen and Liu (2022), who claimed that imports from technologically advanced nations cause knowledge spillovers, which increase the importing firm's knowledge accumulation and lower the cost of innovative activities, incentivizing domestic firms to increase innovation.

Along with innovation induced by social and human capital, control factors with strong theoretical underpinnings are incorporated in models predicted for economic development. For instance, in addition to key drivers of economic growth like labor and capital, the log of initial per capita income is also taken into account for examining convergence. The convergence theory was first put forth by Solow (1956), who claimed that poorer countries grow more quickly than richer ones. According to this theory, there should be a negative correlation between the log of initial GDP per capita and the growth of per capita income. Finally, productivity and per capita growth rates are predicted to be inversely related to fertility rates because greater fertility rates result in fewer resources being used for productive reasons and more resources being used for raising children (Barro and Sala-i-Martin, 2004).

A detailed description of the variables and data sources is presented in Table 1. To ensure data quality, data has been sourced from reputable and reliable data sources. As mentioned in Table 1, the data for total patent applications is sourced from the World Intellectual Property Organization (WIPO) database. Data for the second dependent variable, per capita income growth, is sourced from the World Development Indicators Database by the World Bank. The first focused independent variable for innovation, namely, human capital, is measured through the human capital index sourced from Penn World Tables. As far as social capital is concerned, Trust is used as a proxy, which is sourced from the World Values Survey (WVS). The WVS is a commonly used data source for analyzing beliefs, values, and attitudes of people throughout the world, comprising over 600 indicators. The survey is widely used in various research because of its coverage of around 120 countries using the identical questionnaire to facilitate comparative analysis. The WVS is organized in waves, conducted every five years. It consists of 7 waves (or time durations) which are 1981-84, 1990-94, 1995-98, 1999-2004, 2005-2009, 2010-14, and 2017-2022. The

questionnaires and data files are freely accessible on the World Values Survey website. There are 7 time-series observations corresponding to 7 waves of WVS. The question on trust is worded as '*Generally speaking, would you say that most people can be trusted or that you cannot be too careful in dealing with people*'.

Table 1: Description of variables and Data Sources

Variable	Indicators	Data Sources
Innovation (Inv_{it})	Total patent applications (direct and PCT national phase entries) for a given year	WIPO database
Social capital (SK_{it})	Generalized trust as % of most people can be trusted	World Value Survey
Human capital (HK_{it})	Human capital index based on years of schooling and economic return	Penn World Table, 10.0
Population (PG_{it})	Growth rate of Population (total)	WDI 2022
Foreign direct investment (FDI_{it})	Net inflows as % of GDP	WDI 2022
Trade openness (TO_{it})	Trade as % of GDP	WDI 2022
Institutional quality (IQ_{it})	Measured by the index on bureaucratic quality	ICRG 2022
Economic Development ($PCIG_{it}$)	Annual % of GDP per capita growth	WDI 2022
Physical capital (K_{it})	Gross fixed capital formation as % of GDP	WDI 2022
Fertility rate (FR_{it})	Total births per woman	WDI 2022
Log of GDP per capita (constant 2010 US$) ($LPCI_{it}$)	GDP per capita (constant 2010 US$)	WDI 2022
Log of Employment ($lemp_{it}$)	number of people engaged in employment	Penn World Table, 10.0

Source: Authors' own tabulation

Against its reply, the percentage of individuals who respond positively to the question (the percentage frequency of *most people can be trusted*) is used as an indicator of generalized trust within a society or a measure of social capital for a country in a given wave. The data for the remaining variables, namely, population growth, foreign direct investment, trade openness, physical capital, GDP per capita, and fertility rate, are sourced from the World Development Indicators database by the World Bank. Data on employment is taken from Penn World Tables 10.0. Finally, institutional quality, measured through bureaucratic quality, is sourced from the International Country Risk Guide (ICRG) database [see Table 1].

To examine the impact of innovation induced by social and human capital on economic development, the panel data on 59 developing economies for 7 time-series observations (7 waves of WVS) have been utilized. Since the data on social capital were available for 7 waves, the remaining variables have been averaged over each wave duration accordingly. It is worth mentioning for the sake of data quality that the estimation is based on panel data because only those countries are part of the study that are included in each wave of WVS (the list of countries is attached in the appendix). Table 2 contains descriptive statistics of the variables included in the study, while Figure 1 presents the wave-wise analysis of the focused variables in the study.

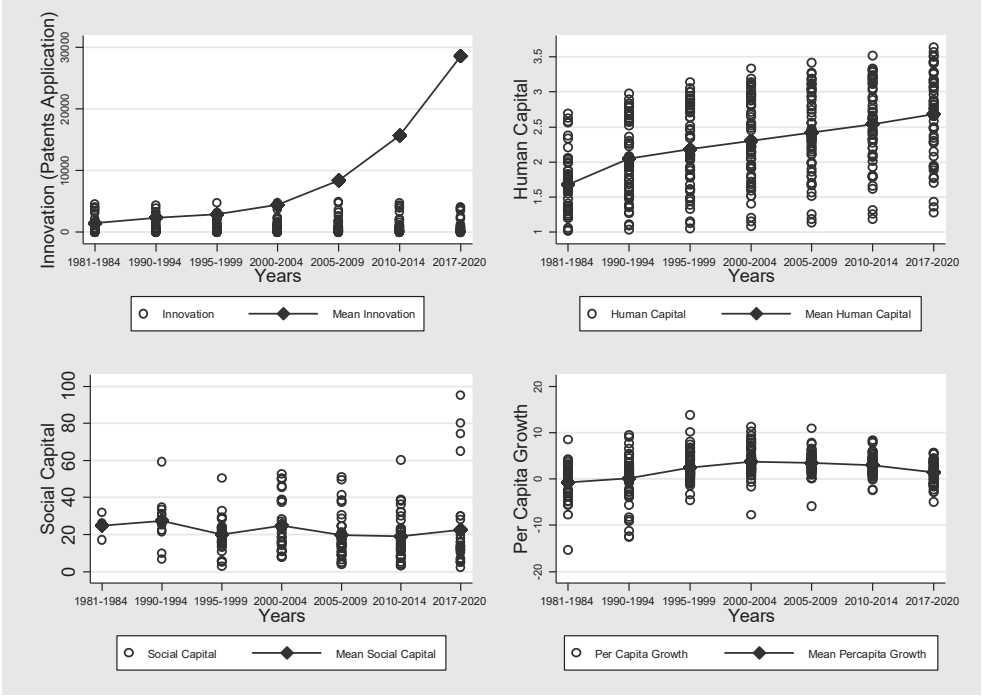
Given the established endogeneity of regressors in per capita income growth regressions as emphasized by numerous growth studies and the nature of panel data with N (number of cross-sections) greater than T (number of time periods), system GMM is the most appropriate technique, which has been used for estimation.

Table 2: Descriptive Statistics

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
Innovation	358	9900.588	85563.512	0	1455354
Human Capital	398	2.281	.626	1.018	3.638
Social Capital	173	21.592	14.946	2	95
Population Growth	412	64213998	1.922e+08	-1.676	1.351e+09
Foreign Direct Investment	385	2.726	3.065	-3.134	30.252
Trade Openness	383	66.913	33.897	0	205.539
Per Capita Growth	386	2.087	3.541	-15.29	13.784
Capital Stock	376	23.38	7.463	0	47.386
Fertility Rate	413	3.209	1.688	1.142	8.832
Log of employment	412	62.739	46.746	.615	799.1

Source: Authors' calculations

Figure 1: Trend of Innovation, Human Capital, Social Capital, and Per Capita Income Growth



Results and Discussions

Table 3 reports the estimation results for the aforementioned sample of countries. In the lower panel of results, the p-value of AR (2) tests signifies that the model does not have second-order autocorrelation, and the probability of the Hansen test confirms the validity of the instruments used in the analysis. Moreover, the standard errors are robust to problems of heteroskedasticity and autocorrelation.

Estimated results show that both social and human capital foster innovations significantly, with human capital exerting a substantive impact. For social capital, our results conform to a number of studies (Knack and Keefer, 1997; Onyx and Bullen, 2000; Akçomak and Ter Weel, 2009; Kaasa, 2009; Doh and Acs, 2010; Kashi and Afsari, 2014) validating that higher social capital increases innovation. The process of innovation is risky, and its financing essentially requires that both capital providers and researchers should trust each other. This environment of trust and cooperation helps complete more successful projects, and therefore results in an increased number of patent applications. According to Knack and Keefer (1997), social capital is important for activities that include future behavior or an element of uncertainty because these kinds of activities call for appropriate contracts and laws. A more socially cohesive workplace will lower the cost of written agreements and their enforcement. In the view of Kim and Kang (2014), trust fosters innovation by minimizing the need for strict control systems. A flexible organizational setup motivates creative thinking and new idea generation, while rigid controls and monitoring systems lessen creative thinking (Dakhli and Clercq, 2004).

Similarly, the results are consistent with the findings of Dakhli and Clercq (2004) and Cristian and Laura (2008), who reckoned human capital as a catalyst for the innovative process. The adoption of new technology and skilled labor is complementary, and human capital is a precondition for the technological development of backward regions (Tondl, 2003). The substantial role of human capital (0.93) in fostering radical innovation is reinforcing the long-standing importance of a skilled and educated workforce to determine firms' capabilities to innovate.

The results of the control variables are consistent with the theory and robust across regressions. Innovation is inversely related to population growth rates. More resources are allocated to break-even investments when there is a higher rate of population expansion, which inhibits innovation. Another negative effect of increased population growth rates that slows the rate of technological advancement is duplication of effort rather than invention (Kremer, 1993). Additionally, increased population growth causes issues with resource management, which hurts technical progress (Coccia, 2014).

Table 3: Role of Social Capital and Human Capital in Innovation

Column	(1)	(2)
Variable	**Coefficient values with standard errors**	**Coefficient values with standard errors**
Intercept	5.9*** (0.731)	3.9*** (1.1)
SK_{it}	0.035** (0.0124)	-
HK_{it}	-	0.93** (0.39)
PG_{it}	-0.472** (0.171)	-0.189 (0.195)
FDI_{it}	-0.052 (0.027)	-0.094** (0.048)
TO_{it}	-0.006 (0.006)	-0.008 (0.01)
IQ_{it}	0.782*** (0.224)	0.84*** (0.224)
No. of observations/ No. of countries	312/57	308/57
AR (2)	0.264	0.669
Hansen test (p-values)	0.458	0.181

Note: Standard errors of each coefficient are reported in (). ***, **, * show level of significance at 1%, 5% and 10% respectively. P- value of the Hansen test and results of AR (2) are also mentioned in the table.

Trade openness and FDI, which represent the external sector of the economy, inhibit the innovation process. Results are consistent with Loukil's (2006) research, which showed that FDI only supports innovation stimulation in nations that have reached a particular stage of technological development. Additionally, FDI promotes incremental innovation and deters the drive for radical innovations, as Chen (2007) posited that inward FDI might lead to crowding out of national innovation and R&D activities, therefore, resulting in a decline in innovation. Similar theoretical hypotheses are advanced regarding the detrimental effects of trade openness on radical innovations. In both regressions, institutional quality stimulates radical innovation, conforming to Sala-i-Martin's (2002) deliberations that sound institutions are prerequisites for radical innovation. Additionally, the positive association between institution quality and innovative performance was confirmed by Tebaldi and Elmslie (2013).

For the second step of the analysis, i.e., to see the effect of innovation on per capita income growth, two separate models have been estimated by using the system GMM estimation technique, in which the estimated values of innovation induced by social and human capital from the previous two models have been used. The results of both estimated equations are reported in Table 4. Even while an environment with a higher degree of human capital drives innovation more, social capital-driven innovation contributes more to economic growth. Social capital offers an additional advantage

in mitigating risk, allowing capitalists to venture into innovative projects (Akçomak and Ter Weel, 2009). Societies endowed with higher social trust are better able to exploit new opportunities (Isham, 2002), resolve disputes (Schafft and Brown, 2000), and confront vulnerability and poverty (Narayan, 1997).

The indirect effect of both social and human capital on economic growth through innovation is calculated using the following equations.

$$\frac{d(PCIG)_{it}}{d(SK)_{it}} = \frac{d(PCIG)_{it}}{d(LInv)_{it}} \frac{d(LInv)_{it}}{d(SK)_{it}} = 0.035 * 0.492 = 0.02$$

$$\frac{d(PCIG)_{it}}{d(HK)_{it}} = \frac{d(PCIG)_{it}}{d(LInv)_{it}} \frac{d(LInv)_{it}}{d(HK)_{it}} = 0.93 * 0.447 = 0.42$$

The indirect of human capital on economic growth is greater than that of social capital.

Table 4: Comparative Role of Social and Human Capital in Innovation and Growth

Dependent variable: Per capita income growth		
Column	**(3)**	**(4)**
Variable	**Coefficient values with standard errors**	**Coefficient values with standard errors**
Intercept	9.6*** (3.53)	12.66*** (3.82)
$LPCI_{it}$	-1.27*** (0.326)	-1.62*** (0.43)
$LInv\hat{}_{it}^{SK}$	0.492** (0.252)	-
$LInv\hat{}_{it}^{HK}$	-	0.447* (0.237)
K_{it}	0.102*** (0.037)	0.102*** (0.038)
LFR_{it}	-2.271*** (0.665)	-2.91*** (0.693)
$LEmp_{it}$	-0.136 (0.254)	0.174 (0.230)
No of observations/ No. of countries	330/56	326/56
AR(2)	0.459	0.514
Hansen test (p-values)	0.897	0.983

Note: Standard errors of each coefficient are reported in (). ***, **,* show level of significance at 1%, 5% and 10% respectively. P- value of the Hansen test and results of AR (2) are also mentioned in the table.

Apart from the focused variables, Table 4 also reports the results of the control variables. Consistent with the theory, addition to capital stock is positively related to per capita growth. Results are consistent with the findings of Shuaib and Ndidi (2015)

among many others. By equipping the labor force with the necessary machinery, equipment, and tools, gross fixed capital formation boosts output growth and aids in the development of economies of scale (Shuaib and Ndidi, 2015). Additionally, to boost market size, capital development also helps to smooth out market flaws by constructing social overhead and financial capital. Thus, it aids in breaking the cycle of poverty by addressing both the supply and demand sides (Jhingan, 2006). On the other hand, another fundamental determinant of per capita growth, that is, the growth rate of employment, turned out to be insignificant, raising serious concerns about the productivity of employed labor. Initial per capita income showed a negative relationship with GDP per capita income growth. These results provide clear support for the convergence hypothesis that poor countries having low levels of initial per capita GDP grow at a faster rate than their rich counterparts after controlling for country-specific factors as control variables (Barro and Sala-i-Martin, 2004). However, as endorsed by the Malthusian theory of population, neo neo-classical growth model by Solow (1956) and the endogenous growth theory (Romer, 1990) fertility rate exerts a negative impact on economic development owing to capital dilution, limited savings, and lower investments in the country.

Conclusions and Policy Implications

In recent decades, developing countries have witnessed a sharp increase in radical innovation, making it important to study the factors that can foster innovation and their consequent contribution to economic development. The present study has contributed to the literature by analyzing the role of two enabling factors, i.e., social capital and human capital in radical innovation for a panel of developing countries for which existing literature offers limited insights. In this empirical analysis, initially, the determinants of innovation have been analyzed by separately estimating the role of human capital and social capital along with other control variables. Subsequently, the relationship between social and human capital induced innovation and per capita income growth has been estimated and compared through two separate models.

Results obtained from the system GMM estimation technique confirm that both forms of capital significantly enhance radical innovations, though their relative sizes differ. Human capital emerges as a stronger determinant of radical innovation, validating the significance of education, skills, and technological capabilities for radical innovation. Also, the indirect effect of human capital on economic development exceeds that of social capital. However, it is noteworthy that the environment where the impact of radical innovation transmits more to economic development is characterized by higher social capital, which is evident from the higher coefficient of social capital-induced innovation in the per capita income growth regression. This result reaffirms that social capital plays its complementary role by enhancing trust,

cooperation, and knowledge sharing, leading to reduced transaction costs and uncertainty in the innovation process.

The analysis also confirms the positive role of institutional quality in strengthening innovation, underscoring the importance of governance, legal frameworks, and credible institutions in creating a conducive environment for technological advancement in developing economies. On the contrary, external factors like FDI and trade openness exhibit negative or insignificant effects on radical innovations, which may indicate that, without adequate absorptive capacity, external sector integration is not beneficial for domestic innovation in developing countries.

Results of control variables align with theoretical expectations. Capital accumulation is instrumental for economic development, while higher fertility and population growth are hindrances to both innovation and economic development through resource consumption and lower productivity. The inverse relationship between initial income and income growth confirms the conditional convergence hypothesis, implying that countries do catch up to their respective steady states.

The study has very important implications for promoting growth through radical innovations. Firstly, the positive and significant role of human capital highlights the need for sustained investments in education, technical training, and research and development capacity. Governments should prioritize improving the quality of higher education, particularly in science, technology, engineering, and mathematics (STEM) fields, to improve technical skills. Secondly, given that the role of social capital is also instrumental in innovation and economic development, policies aimed at promoting social cohesion, community participation, and inclusive institutions can facilitate conducive collaborations with consequent impact on innovative capacities of countries. Moreover, inter-sector partnerships among firms, researchers, and entrepreneurs can encourage knowledge diffusion and hence innovation. Finally, the policies improving the institutional structure of developing countries in the form of governance reforms, efficient bureaucracies cannot be overemphasized.

While this study adds empirical evidence to the understanding of how social and human capital contribute to radical innovation and economic development in developing countries, a few limitations should be acknowledged for context. The study is based on country-level data, which provides a broad overview but may not fully capture variations across industries, urban and rural regions, or specific innovation clusters. Future research using firm-level or regional data could enrich these findings. Moreover, variables such as radical innovation and social capital are captured using widely accepted proxies, but these may not completely represent informal or indigenous innovations that are common in developing economies. This is a general challenge in cross-country studies due to the lack of universal indicators.

Declarations

Funding

This research did not receive any funding.

Conflicts of interest/Competing interests

There is no conflict of interest/Competing interests

Availability of data and material

The data that support the findings of this study are openly available. All data sources are explicitly cited in the manuscript.

Code Availability

The study has used the stata default commands to regress the model.

Authors' Contributions

Misbah Batool: Idea Conception; Data Collection; Data Cleaning; Estimation; Initial Draft
Faiza Azhar Khan: Idea Refinement; Data Collection: Data Cleaning; Estimation; Supervision
Saira Tufail: Idea Refinement; Estimation; Final Writeup; Supervision; Validation

REFERENCES

Acemoglu, D. and Autor, D. (2012). What does human capital do? A review of Goldin and Katz's the race between education and technology. *Journal of Economic Literature*, *50*(2), pp.426-463.

Acemoglu, D., Gallego, F.A. and Robinson, J.A. (2014). Institutions, human capital, and development. *The Annual Review Economics*., *6*(1), pp.875-912.

Aghion, P. and Howitt, P. (1993). A Model of Growth through Creative Destruction. *Econometrica*, 60(2), pp. 323-351.

Aghion, P. and Howitt, P. (2007). Capital, innovation, and growth accounting. *Oxford Review of Economic Policy*, 23(1), pp.79-93.

Akçomak, I. S., & Ter Weel, B. (2009). Social capital, innovation and growth: Evidence from Europe. *European Economic Review*, *53*(5), 544-567.

Anser, M.K., Yousaf, Z., Khan, A. and Usman, M. (2021). Towards innovative work behavior through knowledge management infrastructure capabilities: Mediating role of functional flexibility and knowledge sharing. *European Journal of Innovation Management*, *24*(2), pp.461-480.

Apergis, N., Economidou, C., &Filippidis, I. (2009). International technology spillovers, human capital and productivity linkages: evidence from the industrial sector. *Empirica*, *36*(4), 365.

Arouri, M. E. H., Youssef, A. B., Nguyen-Viet, C., & Soucat, A. (2014). Effects of urbanization on economic growth and human capital formation in Africa.

Arrow, K. J. (1992). Insurance, risk and resource allocation. In *Foundations of insurance Economics* (pp. 220-229). Springer, Dordrecht.

Audretsch, D. B., & Aldridge, T. T. (2008). The knowledge spillover theory of entrepreneurship and spatial clusters. *Handbook of Research on Cluster Theory, Cheltenham, UK, Edward Elgar*, 67-77.

Axtell, R.L. (2007). What economic agents do: How cognition and interaction lead to emergence and complexity. *The Review of Austrian Economics*, *20*(2), pp.105-122.

Barro, R. J. and Sala-i-Martin X. (2004). *Economic Growth*. London: MIT Press.

Bellandi, M. (2001). Local Development and Embedded Large Firms. *Entrepreneurship & Regional Development*, *13*(3), 189-210.

Benhabib, J., & Spiegel, M. M. (1994). The role of human capital in economic development evidence from aggregate cross-country data. *Journal of Monetary economics*, *34*(2), 143-173.

Bjørnskov, C. (2012). How does Social Trust Affect Economic Growth?. *Southern Economic Journal*, *78*(4), 1346-1368.

Boschma, R., & Frenken, K. (2010). The spatial evolution of innovation networks: a proximity perspective. In *The handbook of evolutionary economic geography*. Edward Elgar Publishing.

Brambilla, I. (2009). Multinationals, Technology, and the Introduction of Varieties of Goods. *Journal of International Economics*, *79*(1), 89-101.

Chang, S. B., Lai, K. K., & Chang, S. M. (2009). Exploring technology diffusion and classification of business methods: Using the patent citation network. *Technological Forecasting and Social Change*, *76*(1), 107-117.

Chen, S. and Liu, X. (2022). Innovation spillovers in production networks: evidence from the establishment of national high-tech zones. *China Economic Quarterly International*, *2*(1), pp.42-54.

Chen, C. (2007). Foreign direct investment in China: trends and characteristics after WTO accession. *China---Linking Markets for Growth, Asia Pacific Press, Australian National University, Canberra, Australia*, 197-224.

Chou, T. C., Chen, J. R., & Pan, S. L. (2006). The impacts of social capital on information technology outsourcing decisions: A case study of a Taiwanese high-tech firm. *International Journal of Information Management*, *26*(3), 249-256.

Chung, S. (2001). Unification of South and North Korean innovation systems. *Technovation*, *21*(2), 99-107.'

Coccia, M. (2014). Driving Forces of Technological Change: the Relation between Population growth and Technological Innovation: Analysis of the Optimal Interaction across Countries. *Technological Forecasting and Social Change*, *82*, 52-65.

Coleman, J. S. (1988). Social capital in the Creation of Human Capital. *American journal of sociology*, *94*, S95-S120.

Coleman, J. S. (1990). Foundations of Social Theory Belknap Press of Harvard University Press. *Cambridge, MA*.

Cristian, C., & Laura, D. (2008). THE DETERMINANTS OF HUMAN CAPITAL IN ROMANIA. *Annals of the University of Oradea, Economic Science Series*, *17*(2).

Cuaresma, J. C., Doppelhofer, G., & Feldkircher, M. (2014). The determinants of economic growth in European regions. *Regional Studies*, *48*(1), 44-67.

Cui, Z. and Diwu, S. (2024). Human capital upgrading and enterprise innovation efficiency. *Finance Research Letters*, 65, p.105628.

Dakhli, M., & De Clercq, D. (2004). Human capital, social capital, and innovation: a multi-country study. *Entrepreneurship & regional development*, *16*(2), 107-128.

Dang, J., & Motohashi, K. (2015). Patent statistics: A good indicator for innovation in China? Patent subsidy program impacts on patent quality. *China Economic Review*, *35*, 137-155.

Dearmon, J., & Grier, K. (2009). Trust and Development. *Journal of Economic Behavior & Organization*, *71*(2), 210-220.

Diaconu, L. (2011). The Role of Innovation for the Economic Growth and Development of the States. The Case of the Emerging Countries. *New Challenges for European Regions and Urban Areas in a Globalised World, 2011 Conference*. Barcelona, Spain.

Diebolt, C., & Hippe, R. (2022). The long-run impact of human capital on innovation and economic growth in the regions of Europe. In *Human Capital and Regional Development in Europe* (pp. 85-115). Springer, Cham.

Do, S. G. (2010). *Impacts of social capital on entrepreneurship, innovation, and economic development in the knowledge economy*. George Mason University.

Doh, S., & Acs, Z. J. (2010). Innovation and social capital: a cross-country investigation. *Industry and Innovation*, 17(3), 241-262.

Donges, A., Meier, J.M. and Silva, R.C., (2023). The impact of institutions on innovation. *Management Science*, *69*(4), 1951-1974.

Ejermo, O., & Kander, A. (2006). Trends in R&D, innovation and productivity in Sweden 1985-2002. *CIRCLE Working Paper WP2006/09*.

Erdal, L., & Göçer, İ. (2015). The effects of foreign direct investment on R&D and innovations: Panel data analysis for developing Asian countries. *Procedia-Social and Behavioral Sciences*, *195*, 749-758.

Eriksson, C., Lindén, J. and Papahristodoulou, C., (2023). Human capital, innovation, and growth. *International journal of economic theory*, 19(2), pp.343-369.

Fornahl, D., Broekel, T., & Boschma, R. (2011). What drives patent performance of German biotech firms? The impact of R&D subsidies, knowledge networks and their location. *Papers in regional science*, 90(2), 395-418.

Fu, X., & Shi, L. (2022). *Direction of innovation in developing countries and its driving forces: Economic Research Working Paper No. 69*. WIPO.

Fukuyama, F. (1996). *Trust: The social virtues and the creation of prosperity*. Simon and Schuster.

Grimpe, C., &Sofka, W. (2009). Search Patterns and Absorptive Capacity: Low- and high-Technology Sectors in European Countries. *Research Policy*, *38*(3), 495–506

Grossman, G. M., & Helpman, E. (1991). *Innovation and Growth in the Global Economy*. Cambridge: MIT press.

Helpman, E. (Ed.). (1998). *General purpose technologies and economic growth*. MIT press.

Isham, J. (2002). The effect of social capital on fertiliser adoption: Evidence from rural Tanzania. *Journal of African economies*, *11*(1), 39-60.

Jhingan, M.L. (2006). Economic Development, New Delhi: Vrinda Publications.

Kaasa, A. (2009). Effects of Different Dimensions of Social Capital on Innovative Activity: Evidence from Europe at the Regional Level. *Technovation*, *29*(3), 218-233.

Kashi, K, F., &Afsari, A. (2014). The Impact of Social Capital on Innovation in Selected Countries. *Iranian Journal of Economic Studies*, *3*(2), 81-98.

Khatiwada, S., & Arao, R. M. (2020). Human Capital and Innovation at the Firm-Level. *Asian Development Bank Background Paper.*

Kim, B. Y., & Kang, Y. (2014). Social capital and Entrepreneurial Activity: A Pseudo-panel Approach. *Journal of Economic Behavior & Organization*, *97*, 47-60.

Knack, S., & Keefer, P. (1997). Does social capital have an economic payoff? A cross-country investigation. *The Quarterly journal of economics*, *112*(4), 1251-1288.

Kremer, M. (1993). Population Growth and Technological Change: One million BC to 1990. *The Quarterly Journal of Economics*, *108*(3), 681-716.

Liu, X., & Buck, T. (2007). Innovation Performance and Channels for International Technology Spillovers: Evidence from Chinese High-tech Industries. *Research Policy*, *36*(3), 355–366.

Loukil, K. (2006). Foreign Direct Investment and Technological Innovation in Developing Countries. *Oradea Journal of Business and Economics*, *1*(2), 31-40.

Lucas Jr, R. E. (1988). On the mechanics of economic development. *Journal of monetary economics*, *22*(1), 3-42.

Mankiw, N. G., Romer, D., & Weil, D. N. (1992). A contribution to the empirics of economic growth. *The quarterly journal of economics*, *107*(2), 407-437.

Maradana, R. P., Pradhan, R. P., Dash, S., Gaurav, K., Jayakumar, M., & Chatterjee, D. (2017). Does Innovation Promote Economic Growth? Evidence from European countries. *Journal of Innovation and Entrepreneurship*, *6*(1), 1

Muringani, J., Fitjar, R.D. and Rodríguez-Pose, A. (2021). Social capital and economic growth in the regions of Europe. *Environment and Planning A: Economy and Space*, *53*(6), pp.1412-1434.

Narayan-Parker, D. (1997). *Voices of the poor: poverty and social capital in Tanzania* (Vol. 20). World Bank Publications.

Nelson, R. R., & Phelps, E. S. (1966). Investment in humans, technological diffusion, and economic growth. *The American economic review*, *56*(1/2), 69-75.

Nguyen, C. P., & Doytch, N. (2022). The impact of ICT patents on economic growth: An international evidence. *Telecommunications Policy*, *46*(5), 102291.

OECD (2001). Innovative networks: cooperation in national innovation systems. OECD publishing. Paris.

Onyx, J., & Bullen, P. (2000). Measuring Social Capital in Five Communities. *The journal of applied behavioral science*, *36*(1), 23-42.

Pala, A. (2019). Innovation and economic growth in developing countries: Empirical implication of swamy's random coefficient model (RCM). *Procedia Computer Science*, *158*, 1122-1130.

Pio, J. G. (2020). Effects of innovation and social capital on economic growth: empirical evidence for the Brazilian case. *International Journal of Innovation*, *8*(1), 40-58.

Pradhan, R. P., Arvin, M. B., & Bahmani, S. (2018). Are innovation and financial development causative factors in economic growth? Evidence from a panel granger causality test. *Technological Forecasting and Social Change*, *132*, 130-142.

Putnam, R. (1993). The prosperous community: Social capital and public life. *The american prospect*, *13*(4).

Pylypenko, H.M., Pylypenko, Y.I., Dubiei, Y.V., Solianyk, L.G., Pazynich, Y.M., Buketov, V., Smoliński, A. and Magdziarczyk, M. (2023). Social capital as a factor of innovative development. *Journal of Open Innovation: Technology, Market, and Complexity*, *9*(3), p.100118.

Rodríguez-Pose, A., & Crescenzi, R. (2008). Research and development, spillovers, innovation systems, and the genesis of regional growth in Europe. *Regional studies*, *42*(1), 51-67.

Romer, P. M. (1986). Increasing returns and long-run growth. *Journal of political economy*, *94*(5), 1002-1037.

Romer, P. M. (1990). Endogenous technological change. *Journal of political Economy*, *98*(5, Part 2), S71-S102.

Roth, S. (2009). New for whom? Initial images from the social dimension of innovation. *International Journal of Innovation and Sustainable Development*, *4*(4), 231-252.

Ruhana, F., Suwartiningsih, S., Mulyandari, E., Handoyo, S. and Afrilia, U.A. (2024). Innovative strategies for achieving sustainable development goals amidst escalating global environmental and social challenges. *International Journal of Science and Society*, *6*(1), pp.662-677.

Sala-i-Martin, X. (1997). I Just Ran Four Million Regressions. *The American Economic Review,* 87 (2), pp.178-183.

Sala-i-Martin, X. (2002). Fifteen years of new growth economics: what have we learned?. *Journal Economía Chilena*, *5*(2), pp.41-59.

Schafft, K. A., & Brown, D. L. (2000). Social capital and grassroots development: the case of Roma self-governance in Hungary. *Social problems*, *47*(2), 201-219.

Seitz, M., & Watzinger, M. (2017). Contract enforcement and R&D investment. *Research Policy*, *46*(1), 182-195.

Shuaib, I. M., &Ndidi, N. D. E. (2015). Capital Formation: Impact on the Economic Development of Nigeria 1960-2013. *European Journal of Business, Economics and Accountancy*, *3*(3), 23-40.

Solow, R. M. (1956). A contribution to the theory of economic growth. *The quarterly journal of economics*, *70*(1), 65-94.

Sterlacchini, A. (2008). R&D, higher education and regional growth: Uneven linkages among European regions. *Research Policy*, *37*(6-7), 1096-1107.

Tamaschke, L. (2003). The role of social capital in regional technological innovation: seeing both the wood and the trees. In *Communities and technologies* (pp. 241-264). Springer, Dordrecht.

Tebaldi, E., & Elmslie, B. (2013). Does Institutional Quality Impact Innovation? Evidence from Cross-country Patent Grant Data. *Applied Economics*, *45*(7), 887-900.

Thompson, M. (2018). Social capital, innovation and economic growth. *Journal of behavioral and experimental economics*, *73*, 46-52.

Van Uden, A., Knoben, J., & Vermeulen, P. (2017). Human capital and innovation in Sub-Saharan countries: A firm-level study. *Innovation*, *19*(2), 103-124.

Vasin S.M. and Timokhina D.M. (2024). Specific effect of innovation factors on socioeconomic development of countries in view of the global crisis. *Economies*, *12*(8), p.190.

Vijayagopal, P., Jain, B. and Ayinippully Viswanathan, S., (2024). Regulations and fintech: a comparative study of the developed and developing countries. *Journal of Risk and Financial Management*, *17*(8), p.324.

Wardhani, A. R., Acur, N., &Mendibil, K. (2016). Human Capital, Social Capital and Innovation Outcome: A Systematic Review and Research Agenda. In *Industrial Engineering and Engineering Management (IEEM), 2016 IEEE International Conference* (pp. 355-359): IEEE.

Whiteley, P. F. (2000). Economic growth and social capital. *Political studies*, *48*(3), 443-466.

Wu H. and Lv H. (2024). A meta-analysis on social exchange relationships and employee innovation in teams. *Humanities and Social Sciences Communications*, *11*(1), pp.1-11.

Zak, P. J., & Knack, S. (2001). Trust and growth. *The economic journal*, 111(470), 295-321.

Appendix

List of countries					
s.no	**Name of country**	**s. no**	**Name of country**	**s. no**	**Name of country**
1	Albania	21	India	41	Romania
2	Algeria	22	Indonesia	42	Russian Federation
3	Argentina	23	Iran (Islamic Republic of)	43	Rwanda
4	Armenia	24	Iraq	44	Saudi Arabia
5	Bangladesh	25	Jordan	45	Serbia
6	Brazil	26	Kazakhstan	46	South Africa
7	Bulgaria	27	Kyrgyzstan	47	Tanzania
8	Burkina Faso	28	Latvia	48	Thailand
9	China	29	Lithuania	49	Trinidad and Tobago
10	Colombia	30	Malaysia	50	Tunisia
11	Croatia	31	Mali	51	Turkey
12	Dominican Republic	32	Mexico	52	Uganda
13	Ecuador	33	Moldova	53	Ukraine
14	Egypt	34	Morocco	54	Uruguay
15	El Salvador	35	Nigeria	55	Venezuela
16	Estonia	36	Pakistan	56	Viet Nam
17	Ethiopia	37	Peru	57	Yemen
18	Ghana	38	Philippines	58	Zambia
19	Guatemala	39	Poland	59	Zimbabwe
20	Hungary	40	Qatar		