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Does Innovative Development Cause Economic Growth? Study on Evidence from South Korea

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ABSTRACT
This article examines the connection between innovation and economic growth through the example of South Korea, a nation that has effectively transformed its economy via proactive innovation policies. The authors perform an econometric analysis to evaluate the influence of innovation on crucial economic development indicators. Their research demonstrates a significant relationship between innovation and GDP growth, highlighting the vital role of innovation in fostering a sustainable and prosperous future.

Keywords: innovations, sustainable economic development, South Korea, innovative development, GDP

In an era of rapid change and technological advancement, innovation is becoming an indispensable driver of economic development. Looking at South Korea's development experience in the context of the relationship between innovation and economic growth presents a unique opportunity to explore the synergy of these factors to ensure a prosperous future. Having overcome a number of economic challenges in recent decades, South Korea stands as an example of successfully merging innovation strategies with macroeconomic policies. This article examines the key role of innovation in driving economic growth using South Korea as a case study, identifies the factors contributing to this synergy, and seeks to analyse how these lessons can be applied to other regions to achieve similar results.

Investigating the role of innovations and innovative development in the economic growth of these countries will provide a better understanding of the mechanisms that enable prosperity in the face of globalisation and technological advances. This analysis will also help identify successful policies and practices that may be useful for other developing economies seeking to accelerate their growth and improve the well-being of their citizens.

Innovative development is the process of developing and bringing new and improved products, services, processes, and management techniques into the economy. It entails the development and use of new technologies, as well as the enhancement of organizational structures and manufacturing techniques. Innovation activity ensures the economy's long-term growth, a technical and technological production base, competitive products and services produced by businesses, and the ability to penetrate global markets.

Innovation may take many different shapes, such as new goods, technology, organizational structures, and manufacturing and consumption processes. They are the outcome of investments in the creation and production of new, previously untapped knowledge with the goal of rejuvenating people's living spaces while also increasing productivity, profitability, and quality of life. J. Schumpeter was the first to include

the notion of innovation into his works. Schumpeter. He saw innovation as a form of entrepreneurship that generates profit, and he wrote about it in his book The Theory of Economic Development, believing that innovation is a critical component of a dynamic process that includes new resource combinations or technical development.[1] He held onto that when an economy experiences innovation or change, the stationary equilibrium or circular flow alters, and the development process starts. Innovation is described as an entrepreneur's adjustments to the current production system in order to earn profits and minimize expenses. Innovation is inextricably linked to the entrepreneur, who serves as the catalyst for innovation and the pivot around which everything is built.

Michael Porter's book Competitive Strategy defines innovation as the process of establishing a company's distinct market position and gaining a competitive advantage. Porter emphasizes the significance of innovation in many elements of competitive strategy, including product differentiation, cost reduction, and building obstacles to rivals. He sees innovation as a critical component of competitive strategy, assisting businesses in gaining a lasting competitive advantage and strengthening their market position.[2]

In economic development, innovations are becoming a key force for both governments and businesses. As the linchpin, they serve as a catalyst for increased productivity, which in turn is the ultimate source of sustainable economic growth. The creation of new products and services is a direct result of innovation to meet customer needs with greater efficiency. This not only improves the quality of life but also expands market horizons, thereby fuelling economic growth. The hallmark of innovation is a significant increase in labour productivity, achieved by creating better methods or improving existing ones. Improved efficiency allows firms to increase output with the same resources, leading to higher profits and contributing significantly to economic progress. In a competitive environment, innovative companies gain an advantage by offering unique products or services or operating with increased efficiency. A thriving economy is inherently linked to a culture of competitiveness supported by innovation.

The impact of innovation extends to job creation, both directly through the creation of roles to support new products or techniques and indirectly through the growth of supplier and customer networks. Innovation acts as a magnet for investment, attracting both domestic and foreign capital due to the tantalizing returns associated with revolutionary advances. Beyond the economic sphere, innovation has the potential to initiate socio-economic transformation, steering the economy towards more sustainable and inclusive growth. However, the effectiveness of innovation in generating economic growth depends on the existence of an enabling environment. This includes elements such as a sound education system, an effective regulatory framework, access to capital and a cultural environment that not only facilitates innovation, but also recognises and encourages it.

The history of South Korea's economic growth provides examples of how social and organizational innovations have contributed to the country's economic success. In particular, the use of foreign capital and state management of the economy facilitated the long-term financing of external deficits without compromising local economic policy autonomy. In addition, balancing domestic and external sources of economic growth allowed South Korea to successfully overcome the oil shock. Intensive use of human resources and mobilization of the population to achieve economic goals have also played an important role in South Korea's economic development. Social and organizational innovation, including the use of

[1] Schumpeter J. A., Swedberg R. The theory of economic development. – Routledge, 2021. p 64-100
[2] Porter, Michael E. "Competitive strategy." Measuring business excellence 1.2 (1997): 12-17. p 101

foreign capital, state management of the economy and balancing internal and external sources of economic growth, have become a crucial factor in South Korea's economic development.

The development of innovation in the country dates back to the 1960s and 1970s, after the Korean War in the 1960s, when South Korea faced enormous challenges. Determined to rebuild the country, the government focused its efforts on industrialisation and the introduction of advanced technologies. Specialised programmes and institutions emerged to provide crucial support for innovation. This period was the starting point for the further successful development of South Korea as one of the world's leading innovation economies. It is important to note that it was in the 1960s and 1970s that the foundations were laid that enabled the country to become a leader in high technology and innovation. The 1980s-1990s ushered in an era of growth and consolidation, during which South Korea actively developed its innovation landscape by introducing breakthrough technologies and encouraging scientific enquiry.

In 1983, Daedeok Science Town was established as a platform for bringing together researchers and professionals from both public and private companies. This period was characterised by the deepening of the country's innovation policy, increased investment in science and technology, and the active development of the research base. As a result, South Korea continued its journey towards becoming one of the world's innovation leaders. In the 2000s, the modern trend of innovative development took off. South Korea actively focused on the development of innovation, high technology and scientific research. During this period, legislation on technological and scientific innovation was passed, innovation development plans were drawn up, national high-tech projects were established, and specialised scientific institutes were set up.

South Korea has significantly increased its R&D investment in recent years, with R&D investment reaching nearly 5 per cent of GDP in 2021. This level of investment is higher than the average for OECD (OECD) and European Union countries, reflecting a strong commitment to innovation. (Fig. 1)

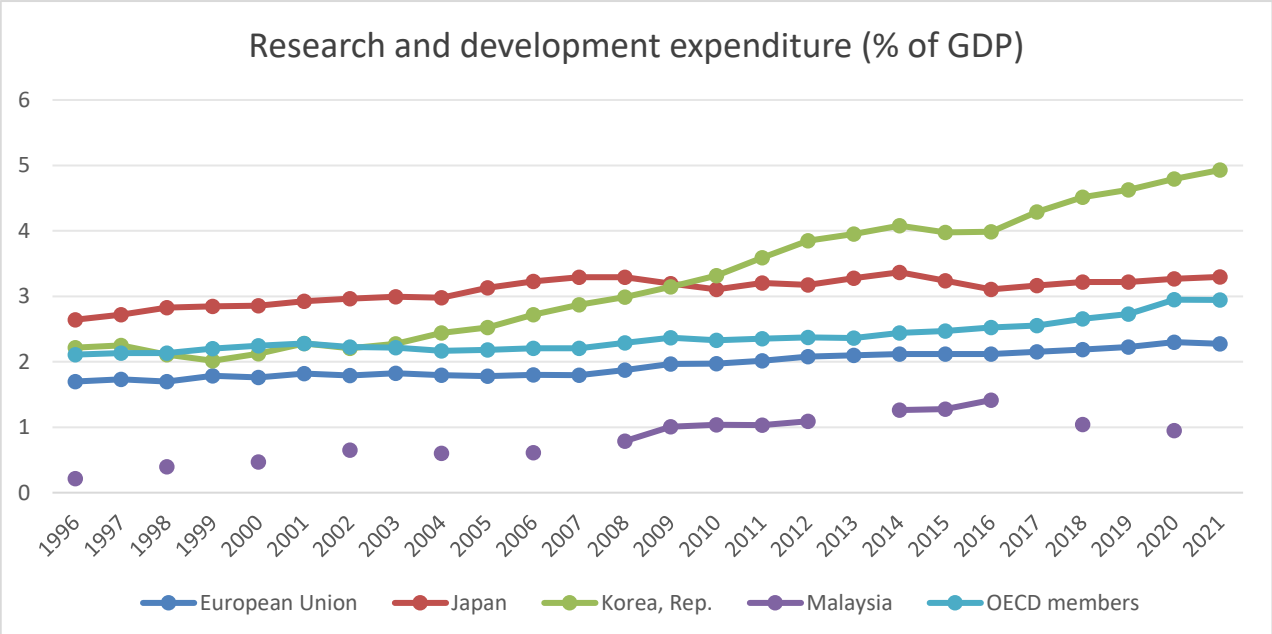

Figure 1. Research and develompent expenditure
Source: World Bank database

Korea has implemented a number of innovation strategies, one of which is the 'Creative Economy Initiative' introduced during the administration of Park Geun-hye (President of the Republic of Korea from 2013-2017), which aimed to promote entrepreneurship and innovation by creating favourable ecosystems for start-ups. This initiative included the establishment of creative economy centres and incubators to provide necessary resources and guidance to aspiring entrepreneurs. Under the Park Geun-hye government, the Ministry of Advanced Planning and 17 incubators ('creative economy centres') were established to support start-ups. Large conglomerates, also known as chaebols, such as Samsung Electronics and Hyundai Motors, have been enlisted to support the incubators, each managing the incubators and investing heavily[3].

In 2013, the government formulated the 'Plan for Establishing an Open Cooperative Ecosystem of Publicly Funded Research Institutes' and in 2014 the 'Plan for Turning Publicly Funded Research Institutes into R&D Centres for SMEs'. They include a mandatory allocation of 5 to 15 per cent of the cost of major projects of publicly funded research institutes to support technology, human resources and equipment in SMEs, and a doubling of the number of subsidised employees in SMEs from 1,500 in 2013 to 3,000 in 2017. The government has also promoted technology start-ups based on state-owned enterprises. Due to the government's active support for technology startups, the number of spin-off companies increased significantly from 46 in 2013 to 339 in 2015. Finally, the government supported the development of startups through innovation hubs such as the Pangyo Tech Valley[4].

In 2020, the European Innovation Scoreboard, which compares the 40 most developed countries on 27 indicators, including R&D investment, business innovation, human capital, etc., ranked South Korea first, noting that the country outperforms the EU average by one-third (Fig. 2)[5]. Over the past 10 years, South Korea has been consistently ranked in the top 10 countries in the Global Innovation Index (GII) released each year by the World Intellectual Property Organisation (WIPO). In 2023, the country ranked tenth globally and second in the Southeast, East Asia and Oceania region. Also according to the GII, Daejeon's science and technology cluster ranks first in Asia and 6th in the world in terms of intensity.[6]

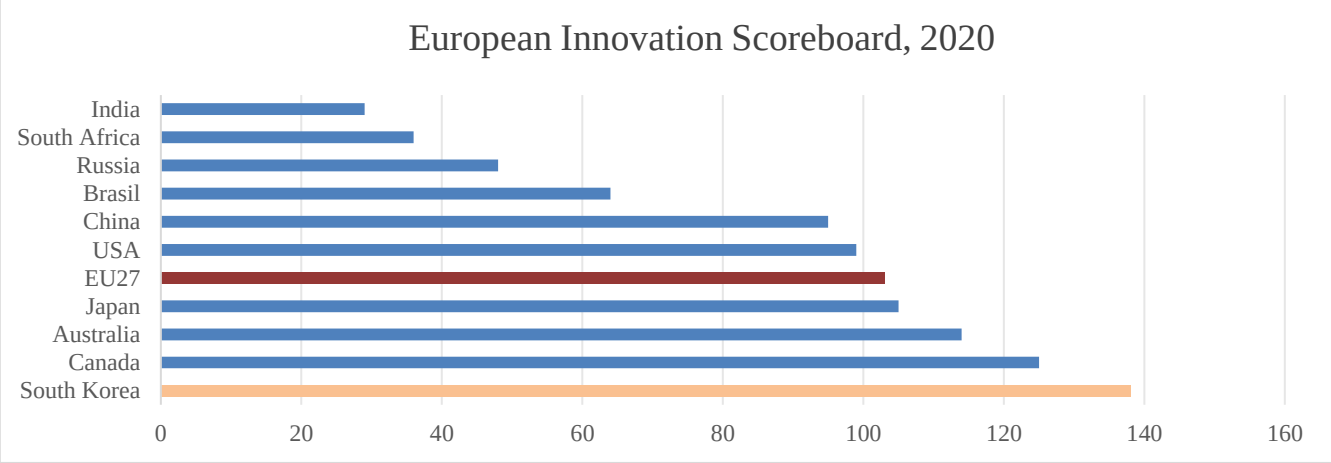

Figure 2. European Innovation Scoreboard

Source: European Innovation Scoreboard, 2020

[3] Hoon Sahib Soh, Koh, Y. and Aridi, A. (2023). Innovative Korea. World Bank Publications. p 102-105
[4] Hoon Sahib Soh, Koh, Y. and Aridi, A. (2023). Innovative Korea. World Bank Publications. p 120-135
[5] Hugo Hollanders, Nordine Es-Sadki, Iris Merkelbach, and Aishe Khalilova. European Innovation Scoreboard, 2020. p 27-28
[6] Global Innovation Index 2023: Innovation Ecosystems for Sustainable Development (WIPO, 2023). p 179

The venture capital market is also developing rapidly in the country, as evidenced by the percentage of R&D investments by venture capital companies. In 2018, investment in technological research by such companies amounted to 11.5% of the total investment, despite the fact that the percentage of venture capital companies themselves is only about 1% of SMEs. In 1997, the country experienced its first venture capital boom, which resulted in the formation of technology companies that could become some of the largest in Korea. Examples of such companies include unicorn internet platform companies Naver (1999) and Kakao (2014), as well as biopharmaceutical company Celltrion, founded in 2002. These companies were among the top 15 in terms of market capitalisation in 2022. There are 18 unicorn companies in 2022, which include high-tech startups in online commerce, video game development, and cosmetics. Government policies are designed to support the creation of unicorns, including through grants for international expansion, a special loan guarantee provided by the Korea Technology Finance Corporation, and government-organised investor networking opportunities.

The World Economic Forum's Global Competitiveness Report 2019 ranked Korea among the top 10 countries in five key indicators: macroeconomic stability (first place), information and communications technology (ICT) adoption (first place), innovation capacity (sixth place), infrastructure (sixth place), and health (eighth place). In terms of competitiveness, Korea ranked fifth in East Asia, a region with a large number of competitive countries, and 13th in the world (WEF 2019)[7].

To analyse in depth the relationship between economic growth (GDP) and innovation, we conducted a study using a methodology based on Granger (1969). An analogous study was conducted by Carolina Zayas and Luis Alfredo Avila-Lopez (2021), which is the case study for this analysis. In this study, our aim was to test two hypotheses:

H0 = Innovation activities does not Granger-cause Economic Growth (GDP Growth)

H1 = Innovation activities Granger-cause Economic Growth (GDP Growth)

This study considers South Korea, and we use the GDP as a reference for our variables. The empirical investigation considers annual data over the period 2000 to 2020 obtained from the World Development Indicators of the World Bank.

Variables used in our analysis are:

Table 1: Definition of variables

GDP	Gross Domestic Product
Labor Force	Total Labour Force
Capital Formation	Gross capital formation (current US$)
RDE	Research and Development Expenditure
PAN	Patents by Non-Residents
PAR	Patents by Residents
ICT_G_Ex	ICT goods exports

[7] World Economic Forum. Global Competitiveness Report 2019. p 17-21

ICT_S_Ex	ICT service exports

Source: Author's Elaborations

Model for this analysis looks like this:

$$\Delta GDP_t = \alpha_1 + \sum_{k=1}^{p} \beta_{1k}\, \Delta GDP_{t-k} + \sum_{k=1}^{q} \lambda_{1k}\, \Delta INN_{t-k} + \delta_1 ECT_{t-1} + \varepsilon_{1t}$$

Where ECT is Error Correction Terms, derived from long-run cointegration and p and q are the the lag length for the estimation.

Table 2: Descriptive statistics of the variables

GDP	Labor Force	Capital Formation	RDE	PAN	PAR	ICT_G_Ex	ICT_S_Ex
1.168/0.377	0.026/0.002	0.351/0.119	0.042/0.023	0.402/0.006	0.133/0.034	0.102/0.033	0.229/0.253

Source: Author's Elaborations.

For reliable modeling and forecasting of time series data, it is essential that the data is stationary. Stationary time series allow for the application of various statistical and econometric models that assume constant properties over time. The Augmented Dickey-Fuller (ADF) test is a statistical test used to check for the presence of a unit root in a time series, which indicates non-stationarity. Conducting the ADF test helps in identifying whether the time series needs to be differenced or transformed to achieve stationarity. In this analysis ADF test is conducted and the results above
(Table 3) represent the Dickey-Fuller value, p-value and differences we used to achieve stationarity.

Table 3. ADF test results

GDP	Labor Force	Capital Formation	RDE	PAN	PAR	ICT_G_Ex	ICT_S_Ex
Dickey-fuller/p-value/diff	Dickey-fuller/p-value/diff	Dickey-fuller/p-value/diff	Dickey-fuller/p-value/diff	Dickey-fuller/p-value/diff	Dickey-fuller/p-value/diff	Dickey-fuller/p-value/diff	Dickey-fuller/p-value/diff
-4.1008/ 0.02**/3	-4.6005/ 0.01*/3	-3.4133/ 0.08***/2	-4.3506/ 0.01*/3	-3.2894/ 0.093***/3	-4.7107/ 0.01*/0	-4.9206/ 0.01*/2	-4.3595/ 0.01*/2

*Statistical significance at 1% level; **statistical significance at 5% level; ***statistical significance at 10% level

Source: Author's Elaborations

The Johansen-Juselius test involves estimating a vector error correction model (VECM) and uses two test statistics: the Trace statistic and the Maximum Eigenvalue statistic. These statistics test the null hypothesis of no cointegration against the alternative of cointegration. The Trace test evaluates the number of

cointegrating vectors by testing the null hypothesis of r cointegrating vectors against the alternative of more than r, while the Maximum Eigenvalue test compares the null hypothesis of r cointegrating vectors against the alternative of r+1.

Table 4. Johansen - Julius Cointegration test results (Cointegration with GDP

Capital Formation	RDE	PAN	PAR	ICT_G_Ex	ICT_S_Ex
-4.199820	20.347029*	64.010665*	-20.397919	6.976748*	-1.122477

*Positive cointegration with GDP in Long-run

Source: Author's Elaborations

Johansen - Julius Cointegration test showed that Research and development Expenditures along with Patents by Non-Residents and ICT Goods ecports has a postitive long-run cointegration. Thus we reject null hypothesis of no cointegration and accept the alternative hypothesis for this variables.

The Granger causality test is used to determine whether one time series can predict another time series. Specifically, it tests whether past values of one variable contain information that helps predict future values of another variable. This is crucial for understanding the direction of causality in time series data.

To test Granger Causality 3 cases were underlied based on the results of cointegration test:

Case 1: RDE Granger cause GDP growth, Case 2: PAN Granger cause GDP growth and Case 3: ICT Goods exports Granger cause GDP growths.

	Granger Causality Test Outcome (p-values)		
	Case 1	Case 2	Case 3
Granger Causality	0.9231	0.0153*	0.902
Instantaneous Causality	0.01152*	0.01108*	0.01125*

** 5% Significance Level

Depending on the results we can make a conclusion that only PAN in case to Granger-cause GDP growth if the information about past is available. However, all of 3 varibles tested (RDE, PAN and ICT goods Exports) have an instantaneous causality with GDP. That means that in the context of Granger causality testing, instantaneous causality refers to the possibility that a variable can immediately influence another variable without any time delay.

In conlusion, generally speaking, innovative activities can boost the economic growth when there is a right implementation of government policies and investment strategies. South Korea's exapmle, as one of the leaders in innovations can become a model for the developing countries aiming to innovative development. Despite the results of analysis suggesting that not all of the innovation activities cause GDP growth in the Republic of Korea, the outcomes might be different for other countries.

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