

THE IMPACT OF INNOVATION ON ECONOMIC GROWTH: THE SPILLOVER EFFECT OF FOREIGN DIRECT INVESTMENT

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Abstract

Purpose of the study: Innovation is seen as the key to improving quality and productivity, thereby promoting competition and economic growth. This study analyzes the impact of innovation on economic growth through various measures, such as research and development spending, the number of researchers, number of patents as well as trademark registrations. Research results are evidence to recommend policies for intellectual-based economic growth.

Methodology: Literature review and empirical analysis conducted in the study. The empirical method is a two-step System Generalize Methods of Moments (GMM), aiming at reliable results. Accessing the World Bank Database, research data from 64 developed and developing countries are collected from 2006 to 2014.

Main Findings: The empirical findings show that innovation plays a crucial contribution in promoting economic growth, similar to national openness and government spending on education. This study also finds a positive impact on foreign investment flows and their spillover role in enhancing the correlation between innovation and economic growth.

Applications of this study: The findings of this study focus on the contributions of innovation, foreign direct investment inflows, and other macro factors that can be enforced to improve economic growth by policymakers.

Novelty/Originality of this study: The study uses different measures of innovation, including inputs such as the number of researchers, research and development expenditure, and outputs as the number of patents and number of trademark registrations. Empirical findings are found consistently, thus confirming that innovation is very important for economic growth. The study also shows convincing evidence confirming the positive contribution of foreign direct investment as well as its spillover effect on innovation and economic growth.

Keywords: *Innovation, Economic Growth, Spillover Effect, FDI, Generalize Methods of Moments.*

INTRODUCTION

Studies in the economics line always revolve around the topic of economic growth, which is always attractive to both practical and academic scholars. Gross national product (GDP) or gross national product per capita (GDPCAP) is often regarded as an indicator of economic growth and is the main goal of each country (Quah, 2001); and they can be driven by (1) increasing the number of physical inputs that they use in the manufacturing process such as capital and labor to boost the capacity of production; (2) enhancing productivity through the innovation process, such as creating or improving products or production processes to boost productivity or produce new products for the market. In recent years, innovation is assessed as the potential key to open the road for economic growth, compared with the limitation of physical inputs. Romer (1986) emphasized the important role of knowledge as a non-competitive commodity in his endogenous growth model. He argued that the dissemination of knowledge would create a positive externality to promote the creation of new products, improve old products, and increase productivity. Similarly, Grossman and Helpman (1994) believed that the development of knowledge and innovation was seen as a crucial player in long-term economic growth. Initiatives, therefore, replaced obsolete products and technologies, acting as an incentive on market competitiveness, thereby supporting economic development (Aghion et al., 2010) and ensured the sustainable growth of the economy (Pece et al., 2015).

In addition, the inflow of foreign direct investment (FDI) is considered to be the factor bringing about the spread in innovation activities. For example, China, India, Malaysia, Singapore, and South Korea have successfully transitioned from technology importers to technology exporters. This is closely related to their absorption of knowledge and technology from FDI inflows to create high-tech and high value-added goods, and they become technological exporters. FDIs bring not only financial capital but also technological know-how and management expertise, which result in the spreading innovation (Erdal & Göçer, 2015). This effect is called the spillover effect, in which FDI inflows can be converted into productivity increases, thus escalating economic growth (Grossman & Helpman, 1991; Barro & Xavier, 1995).

OBJECTIVE AND RATIONALE OF THE STUDY

Our study attempts to examine the impact of innovation on economic growth in economies; and the role of FDI in promoting spillover effects for innovation. This is mandatory because economies are open widely to trade and foreign investment that could affect mutual economic growth. First, this study will use various factors that are strongly related to innovation, such as research and development (R&D) expenditure, the number of researchers on R&D, the number of patents, and the number of brands to verify the role of innovation in robustness. Second, the implementation of panel data estimated by the general moment method (GMM), according to which the advantage of this method is that it can take into account the specific effects of the country and the effects simultaneously. Third, the results of the study provide evidence of how innovation contributes to economic growth and whether or not the positive role of FDI in boosting innovation, in both developed and developing countries. The rest of the article includes: Section 2 examines the theory and empirical research on the relationship between creativity and innovation and economic growth. Section 3 describes the empirical model, the variables, and the methodology is used in this study. In Section 4, the authors describe the statistics of variables, present the research results, and discuss the results. Finally, Section 5 provides policy implications derived from the study.

LITERATURE REVIEW

The link from innovation to economic growth has received considerable interest from researchers, notably [Solow \(1957\)](#) and [Schumpeter \(1939\)](#). They suggested the existence of the relationship between economic growth and innovation, and according to this view, economic growth was generated by intermittent internal alteration caused by economic innovation. [Solow \(1957\)](#) mentioned that economic growth was enhanced by capital and labor resource in the neoclassical model. [Nadiri \(1993\)](#) implemented the Cobb Douglas function to present the correlation between innovation, outputs, and productivity, in which innovation was seen as an exogenous element and a technological spillover. However, in the endogenous model, [Romer \(1986\)](#) mentioned that economic growth was defined as endogenous and considers aspects related to entrepreneurship based on process modeling of innovation and affected by changes in technology and the process of knowledge accumulation.

Empirical studies from economic literature have shown the relationship between economic growth and innovation. [Grossman and Helpman \(1991\)](#) found that differences in innovation and creative competencies were mostly responsible for continuous improvement in economic efficiency. Increasing the rate of innovation in economic activities be able to push their productivity and prosperity, and accelerate world economic growth. Also, innovation is an essential factor to help countries deal with global challenges, such as climate change and sustainable development. According to [Furman et al. \(2002\)](#), national innovation capacity is based on several factors: (i) The first factor is a nation's common innovation infrastructure, made up of new knowledge and the process of disseminating new knowledge. The resource for the innovation platform is the R&D cost, investing in higher education and funding for basic research from the government, private, and foreign sectors. Unlike private goods, the use of innovation is not ruled out and makes it easy to be deprived. Thus, the level of innovation depends on the ability to protect creators, so that they can benefit from their creative efforts ([Hu & Png, 2013](#)); (ii) The second factor is the cluster-specific innovation environment whereby the capacity for national innovation depends on the microeconomic environment in the country's industrial clusters. These advantages are the result of a local level network that links technology, resources, information, and talent as well as enhancing competitiveness. Innovation in specific clusters can also complement each other, both by spreading knowledge and other relationships ([Erdal & Göçer, 2015](#)).

Studies on innovation have progressed over time, but the results have been inconsistent. Earlier, [Lichtenberg \(1992\)](#) investigated the impact of R&D spending on economic growth in both the private sectors and public sectors of 74 nations from 1964 to 1989. His results pointed out that R&D spending in the private sector positively affected economic growth, but there was no significant relationship between economic growth and R&D spending in the public sector. [Gittleman and Wolff \(1995\)](#) solved the link between R&D activities, represented by various variables (such as R&D expenditure, number of scientists in R&D, number of engineers in R&D), and economic growth by considering panel data during the period 1960 – 1988. His findings showed that R&D activities were only for growth in developed countries, but there was no role in growth in low-income countries. Similarly, [Ulku \(2004\)](#) provided evidence that innovations, represented by research and development spending, accelerated GDP per capita, either developed or emerging economies by using data of 20 OECD and 10 non-OECD ones during 1981 – 1997. However, [Gurbiel \(2002\)](#) argued that the economy was influenced by both technological and commercial factors, emphasizing the spending on R&D, international trade, competition, and technology gap. Although expenditure on R&D has been used as an indicator of innovation performance, it is an input measurement of the innovation process instead of output or success of innovation ([Gans & Stern, 2003](#)). [Pessoa \(2007\)](#) did not find an active link between R&D costs and economic growth, in the case of Sweden and Ireland. Beside R&D costs, the author said that the policy of innovation did not take into account the complexity of economic development, including other factors. The author was arguing that R&D costs played an essential role in economic development by creating an improvement in productivity. [Samimi and Alerasoul \(2009\)](#) revealed that R&D costs did not drive economic growth in developing countries because they were low rates after examining panel data for 30 developing countries.

While the R&D spending and R&D researchers have been the input of innovation, the role of the patents and trademarks – as the output of innovation – in relation to economic growth has received more considerable attention in recent years. Patents are said to have a positive impact on innovation through cost-saving technologies and new product development, thereby promoting economic growth (Ortiz-Villajos, 2009; Hudson & Minea, 2013). Sooner, Park and Ginarte (1997) did not find any link between patent rights, R&D spending, and economic growth for low-income countries, although they found a positive link between patent rights and R&D costs for OECD countries. However, Ortiz-Villajos (2009) found a positive correlation between patent and GDPCAP of more than 20 countries from the 19th century to the 20th century, indicating an extremely positive effect of technological innovation for economic development. Josheski and Koteski (2011) used the bound test (ARDL) and Johansen cointegration to determine the positive relationship between the number of patents and economic growth in G-7 countries in the long term, but there existed a negative relationship between patents growth and growth of GDP. They determined that this relationship was one-way causal from patent growth to GDP growth. Saini and Jain (2011) showed that patents had an insignificant correlation to economic growth in Japan, Singapore, Thailand, and Vietnam; while they had a negative relationship with economic development in Indonesia, Malaysia, and China; and they positively contributed to the economic growth of India and the Philippines. A similar approach, trademarks are also the intellectual property, reflecting the creative and innovative process in the commercial sector, and therefore, they are a legally protected valuable for service and product differentiation (Sople, 2014). The number of trademark registrations provided a positive clue to patent and R&D intensity (Daizadeh, 2009). However, trademarks are often used as commercial and marketing tool for the establishment of competitiveness to promote market efficiency than a contributor to economic growth. Greenhalgh and Longland (2005) found that brand intensity, measured by the number of brands divided by the number of employees, had a positive correlation with productivity growth; but in low-tech sectors. Cullet (2005) argued that intellectual property was an important factor for economic growth. However, trademarks rarely appear in previous studies as they were not considered to constitute economic growth directly.

In addition, the development of economies depends on not only the country's technological capabilities but also the influence of FDI inflows, according to new trade theory (Dixit & Stiglitz, 1977; Krugman, 1979). Countries, considerably developing nations, even have abundant natural resources; it is too hard to catch up themselves with advanced technology levels in developed countries. However, they can import them through FDI (Erdal & Göçer, 2015). For instance, China was the largest recipient of FDI in developing countries during the 1990s and achieved considerable economic growth after that period. Similarly, Singapore, South Korea, Malaysia, and India offered tax incentives, exclusive rights, and cost advantages for multinational corporations to increase their FDI inflows. Then, they could absorb technical and technological foundations, which were brought by foreign investors, to produce high-tech and high added-value products. Hence, they evolved tremendously to become countries that could export technology. This was explained that FDI inflows played a major role in producing high quality or high-tech products; contribute to value-chain in global. Therefore, the convergence of developing economies to developed economies through diffusion channels of FDI has been completed by the localization process (Zhang, 2014). It not only reduces long-term costs but also increases the survival capacity of multinational corporations in the global competitive market. R&D costs, scientific research, and training skilled technical personnel are the priority of multinational corporations and are considered the most important determinants for innovation (Hsu & Tiao, 2015). That is the reason that we believe that the role of FDI inflows has been an important factor in promoting the positive influence of innovation on the growth of the economy.

Thus, innovation can be considered important for economic growth. Various studies have been conducted at the individual, industrial, and national levels, the results have been inconsistent, which suggests the need for more analysis and discovery.

METHODOLOGY

This study used different measurements to capture the innovation (INNO), including the number of researchers in R&D sectors (R&D NUM); the R&D expenditure (R&D EXP) as inputs of innovation; and the total of patents (PATENT), the total of trademark registrations (TRADEMARK) as outputs of innovation; meanwhile current gross domestic product per capita (GDPCAP) is represented the economic growth. In addition, according to previous studies, we used foreign direct investment (FDI), national openness (OPENNESS), the rate of government expenditure on education (EDUEXP) to ensure the robustness of our models (Shukla, 2017; Bhattacharyya, 2019). We noted that due to the lack of necessary data, the number of countries that can participate in the research sample is 64/193 countries in the world with the nearest available data from 2006 to 2014. In this sample, 37 countries are high-income countries; 15 countries are upper-middle-income countries; 10 countries are lower-middle-income countries, and 02 countries are low-income countries, according to World bank's classification. All data are collected from World Development Indicator (WDI), World bank.

Basing on Erdal and Göçer (2015) model, we specify the empirical models which can study the relationship between economic growth and innovation as well as foreign direct investment, using the panel data. This model is as the following:

$$\begin{aligned} GDPCAP_{i,t} &= \alpha_0 + \alpha_1 GDPCAP_{i,t-1} + \alpha_2 INNO_{i,t} + \alpha_3 EDU_{i,t} + \alpha_4 FDI_{i,t} + \alpha_5 OPENNESS_{i,t} + \varepsilon_{i,t} \\ GDPCAP_{i,t} &= \alpha_0 + \alpha_1 GDPCAP_{i,t-1} + \alpha_2 INNO_{i,t} + \alpha_3 EDU_{i,t} + \alpha_4 FDI_{i,t} + \alpha_5 OPENNESS_{i,t} + \varepsilon_{i,t} \end{aligned} \quad (1)$$

$$GDPCAP_{i,t} = \mu_0 + \alpha_1 GDPCAP_{i,t-1} + \mu_2 INNO_{i,t} + \mu_3 INNO * FDI_{i,t} + \mu_4 EDU_{i,t} + \mu_5 FDI_{i,t} + \mu_6 OPENNESS_{i,t} + \epsilon_{i,t}$$

$$GDPCAP_{i,t} = \mu_0 + \alpha_1 GDPCAP_{i,t-1} + \mu_2 INNO_{i,t} + \mu_3 INNO * FDI_{i,t} + \mu_4 EDU_{i,t} + \mu_5 FDI_{i,t} + \mu_6 OPENNESS_{i,t} + \epsilon_{i,t} \quad (2)$$

Table 1: Variables, description, and sources collected from World Development Indicator (WDI)

| Variable | Explanation | Source |
|-----------|---|--------------|
| GDPCAP | Current gross domestic product per capita in logarithm | WDI database |
| R&D EXP | R&D expenditure on the gross domestic product (% of GDP) | WDI database |
| R&D NUM | Number R&D researcher (per million people) in logarithm | WDI database |
| PATENT | Total number of patents in logarithm | WDI database |
| TRADEMARK | Total trademark registrations in logarithm | WDI database |
| FDI | Foreign direct investment on the gross domestic product (inflows, % of GDP) | WDI database |
| OPENNESS | The total export and import value on the gross domestic product (% of GDP) | WDI database |
| EDUEXP | Government's educational spending on the gross domestic product (% of GDP) | WDI database |

Source: Worldbank

To deal with the technical aspects of the empirical models, we applied two-step system Generalize Methods of Moments (two-step system-GMM) to overcome the heterogeneity and serial correlation problems due to the endogeneity of lagged independent variable. Moreover, it is seen that the two-step system-GMM is more efficient and reliable than one-step GMM because of using the optimal sub-weight matrix (Blundell et al., 2001). Finally, the Hansen test of override restrictions is considered for the robustness of the GMM estimation, while the Arellano-Bond test (AR (2) test) shows the problem of autocorrelation for all levels of residual (Roodman, 2009), ensuring the free error-terms in models.

RESULTS AND DISCUSSION

Table 2 and Table 3 shows the main results of the two-step system-GMM regressions. It can be seen that the p-value of the AR test (2) and the p-value of the Hansen test are not statistically significant. Thus, the error terms are free of unit root and serial correlation. The two-step system-GMM method is used appropriately, and the estimated results are reliable and unbiased.

Economic growth, as assumed, is positively influenced by innovation, which is measured by inputs and outputs of innovation at 1% statistical significance. R&D expenditure and R&D researchers are inputs of innovation, which boosts current gross domestic product per capita; meanwhile, the outputs of innovation, i.e., patents and trademarks, also enhance economic growth. This implies that an increase in innovation, whether inputs or outputs, will be an important factor in boosting economic growth in the short-term. This result is entirely robust when we check 04 different measures of innovation: inputs and outputs. Our research findings are consistent with the hypothesis of Romer (1990), Gurbiel (2002), and Ortiz-Villajos (2009).

Table 2: Innovation and Economic growth between variables

| Independent variable: | INNO: R&D EXP | INNO: R&D NUM | INNO: PATENT | INNO: TRADEMARK |
|-----------------------|---------------------|---------------------|---------------------|---------------------|
| GDPCAP | (1) | (2) | (3) | (4) |
| LI. GDPCAP | 0.435*** (53.08) | 0.677*** (97.23) | 0.678*** (60.48) | 0.764*** (85.08) |
| INNO | 0.340*** (13.39) | 0.063*** (4.89) | 0.068*** (6.68) | 0.109*** (7.80) |
| FDI | 0.003*** (9.96) | 0.006*** (16.39) | 0.009*** (17.50) | 0.008*** (16.20) |
| OPENNES | 0.005*** (28.48) | 0.004*** (18.08) | 0.004*** (18.32) | 0.005*** (26.16) |
| EDUEXP | 0.014*** (2.36) | 0.030*** (7.63) | 0.077*** (8.51) | 0.067*** (10.78) |
| CONSTANT | 4.442*** (44.72) | 2.089*** (26.89) | 1.742*** (15.90) | 0.360** (1.97) |
| Num. groups | 55 | 56 | 60 | 58 |
| Num. IVs | 51 | 51 | 51 | 51 |
| Num. Obs. | 347 | 335 | 405 | 389 |
| AR (2) test | 0.103 | 0.159 | 0.174 | 0.188 |
| Hansen test | 0.399 | 0.323 | 0.208 | 0.262 |

Notes: (*), (**), (***) are significant at 10%, 5%, and 1% level respectively. z-statistic in ()

Source: Based on the collected data, Authors analyzed, 2019

The remaining control variables, such as economic openness (OPENNES), foreign direct investment (FDI), and government spending on education (EDUEXP), positively related to economic growth at 1% significant statistic. Our results confirm the important contributions of FDI and OPENNES in taking off economic growth, as mentioned in the new trade theory (Dixit & Stiglitz, 1977; Krugman, 1979). Through international integration and FDI inflows, technology, physical capital, and management experiences will be pumped into the economy, boosting the escalation of productivity and growth (Grossman & Helpman, 1991; Barro & Xavier, 1995). Finally, under the impetus of government spending on education (EDUEXP), economic growth will increase directly through aggregate demand and indirectly through innovation's results. Educational expenditure is also determined as an important determinant when it is expected to enhance human capital, leading to economic growth (Musila & Belassi, 2004; Saad & Kalakech, 2009). Empirical findings are quite consistent and highly significant.

Table 3: Innovation and Economic growth: The spillover of Foreign Direct Investment

| Independent variable: | INNO: R&D EXP | INNO: R&D NUM | INNO: PATENT | INNO: TRADEMARK |
|-----------------------|---------------------|---------------------|---------------------|----------------------|
| GDPCAP | (1) | (2) | (3) | (4) |
| LI. GDPCAP | 0.386*** (25.33) | 0.667*** (91.58) | 0.581*** (29.28) | 0.697*** (113.65) |
| INNO | 0.347*** (9.90) | 0.066*** (4.64) | 0.109*** (9.25) | 0.152*** (11.59) |
| FDI * INNO | 0.002*** (6.22) | 0.001*** (16.10) | 0.002*** (14.22) | 0.001*** (37.09) |
| OPENNES | 0.007*** (21.34) | 0.004*** (18.35) | 0.008*** (15.00) | 0.006*** (36.45) |
| EDUEXP | 0.034*** (5.63) | 0.031*** (7.85) | 0.137*** (7.56) | 0.096*** (25.64) |
| CONSTANT | 4.583*** (38.00) | 2.159*** (26.51) | 1.656*** (7.20) | 0.284** (1.65) |
| Num. groups | 55 | 56 | 60 | 58 |
| Num. IVs | 48 | 51 | 48 | 55 |
| Num. Obs. | 347 | 335 | 405 | 389 |
| AR (2) test | 0.556 | 0.146 | 0.146 | 0.158 |
| Hansen test | 0.344 | 0.336 | 0.206 | 0.348 |

Notes: (*), (**), (***) are significant at 10%, 5%, and 1% level respectively. z-statistic in ()

Source: Based on the collected data, Authors analyzed, 2019

As mentioned above, this paper state that FDI plays a spreading influence to enhance the positive relationship between innovation and the development of the economy. In this section, we use interactive variables between FDI and variables representing innovation to examine the intermediate role of FDI. The regression findings are presented in Table 2. According to Table 2, the results confirm that these interactions are positive; they imply that any increase in FDI inflows will strengthen the positive correlation between innovation and economic growth. They illustrate the spillover effects through technology transfer and knowledge sharing from developed countries to developing countries. Our results are confirmed by previous studies of Zhang (2014) and Erdal and Göçer (2015).

CONCLUSION

The theory assumes that innovation plays an important role in stimulating research and creative activities, which in turn promotes economic growth. In this article, we collect data from 64 countries in the 2006-2014 period to experiment with the impact of innovation on economic growth. By implementing two-step system-GMM regressions; and use different innovation measurements, i.e., spending in R&D, the number of R&D researchers, the number of patents, and commercial licenses, we find that innovation has a positive impact on economic growth in countries. In addition, the positive spillover effect of foreign direct investment in innovation is also found through interactive variables. Finally, the impact of opening up the economy and increasing government spending on education also contributed to economic growth. The study also provides meaning to policymakers who are encouraged to focus on innovation incentives, gaining benefits from economic integration with significant investment in education.

LIMITATION AND STUDY FORWARD

This study also exits some limitations, such as the proposed variables and model were selected from previous studies; therefore, the discussion may not be comprehensive. For example, selected variables may not represent all aspects of innovation, and the models may not reflect the real economic growth of each country. Moreover, the characteristics of each country may affect this relationship, thus affect the final results due to the limitations of the method. Future studies may develop a better technique to address generalizability issues.

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AUTHORS CONTRIBUTION

Nguyen Tran Thai Ha: writing – original draft, review & editing, conceptualization, analyzing. **Sobar M. Johari:** writing – original draft. **Trinh Thi Huyen Thuong:** review & editing. **Nguyen Thi Minh Phuong:** review & editing. **Le Thi Hong Anh:** collecting data, analyzing.

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