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INNOVATION AND ECONOMIC GROWTH: THE CONTRIBUTION OF INSTITUTIONAL QUALITY AND FOREIGN DIRECT INVESTMENT

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ABSTRACT

Innovation is considered essential to improving competitiveness and efficiency, thereby promoting economic growth in both theory and practice. This study analyzes the impacts of innovation, measured by the number of researchers, and the number of patents and trademarks, on economic growth. The results represent issues for consideration by policymakers dealing with sustainable economic growth. Besides the literature review, an empirical analysis was undertaken using the two-step system Generalized Method of Moments (GMM). Research data was collected through the World Bank's database, with participants from 69 developed and developing countries between 2006 and 2014. Empirical results show that innovation, together with national openness, foreign direct investment inflows, and government expenditure on education, have directly and positively influenced economic growth. In addition, the study found a positive intermediate role for institutional quality and the spillover effect of foreign direct investment in promoting the relationship between innovation and economic growth. This study suggests that policymakers should focus on improving research and development activities, strengthening economic integration, attracting foreign direct investment, and extensively reforming the institutional environment to facilitate economic development.

Contribution/ Originality: This study systematically explores the role of innovation in economic growth under the influence of institutional quality and foreign direct investment, using data from 69 developed and developing countries from 2006 to 2014.

1. INTRODUCTION

Economic theories and empirical studies have attempted to identify significant factors that determine economic growth in different countries over the short term and long terms. Economic growth is usually measured by the gross national product (GDP) or gross national product per capita (GDPPC) over a single year. Economic theories and empirical studies have shown that economic growth can be improved by (i) increasing the number of inputs, e.g. natural resources, physical capital and labor that the economy uses in the production process; and (ii) increasing productivity through innovation, i.e. creating or improving products and/or production processes. While the physical inputs exhibit diminishing marginal productivity, innovation is considered a critical determinant for economic growth. Solow (1957) predicted that economies could achieve a steady-state equilibrium, and permanent growth could be achieved through technological progress over the long-term. Romer (1986) suggested that endogenous technological change, which was conducted by the accumulation of knowledge, would promote long-term economic growth. He argued that investment in knowledge would drive a natural externality which companies and individuals would take advantage of to create new products, improve old products, or increase production efficiency, so leading to economic growth. Similarly, Porter (1990) argued that economic efficiency and competitive advantage could be achieved through innovation when research and development activities resulted in new products and processes at lower costs. Meanwhile, Aghion *et al.* (2010) recognized that initiatives would lead to the replacement of obsolete products and processes, thereby acting as a precursor to economic growth. Therefore, investing in knowledge and pushing innovation were thought to play an important role in long-term economic growth (Grossman and Helpman, 1994).

However, in addition to physical capital, labor, technology, and natural resources, prior economic theories still lacked the framework to clearly explain the discrepancies in economic growth between countries (Giordano and Giugliano, 2015); (Kurt and Kurt, 2015). The establishment of institutional economics had sought to clarify the impacts of the institutional environment, understood as "the rules of the game in a society, including both "formal" rules, and "informal" constraints" (North, 1993). The development of institutional economic theory contributed to an explanation of differences in savings, investment, and learning across different countries (Almeida, 2015); (Chan *et al.*, 2015). For instance, the European and United State economies have provided stable institutional environments that limit opportunism, manage conflicts and cooperation, provide incentives and choices, and reduce uncertainty (Edquist, 1997); (Coriat and Weinstein, 2002); (Crouch *et al.*, 2004). Former socialist economies are also undergoing a process of institutional transformation where important economic factors have been changed substantially (Peng, 2003). As a result, transition economies have developed rapidly and emerged successfully as a phenomenon in Eastern Europe and East Asia. High institutional quality has encouraged economic activities, e.g., increasing consumption and investment, improving the efficiency of resource allocation, enhancing asset rights protection and promoting freedom, thereby improving economic growth (Park, 2012); (Lucifora and Moriconi, 2015); (Farhadi *et al.*, 2015); (Zhang, 2016). In contrast, a poor institutional environment was thought to be related to the lackluster economic performance of many less-developed countries because it did not encourage entrepreneurship and business growth (Puffer *et al.*, 2010); (Puffer and McCarthy, 2011). Based on institutional theory, recent studies on technology specialization and development considered that technological development and innovation differences were explained by different institutional platforms (Porter *et al.*, 2003); (Whitley, 2000).

Innovation activities are considered to be closely related to foreign direct investments (FDI) inflows and the country's capacity to absorb them. Countries like South Korea, China, India, Malaysia, and Singapore have transformed from technology importers to technology exporters. Behind these stories was the process of acquiring technological knowledge brought by foreign investors to produce high-tech and high value-added products. FDI had been assumed as a behind factor in providing significant financial capital, technological know-how, and management expertise for economic prospects which played a pivotal role in spreading innovation (Erdal and Göçer, 2015). This was called the "spillover effect", in which FDI inflows was converted into increased productivity, thereby escalating economic growth (Grossman and Helpman, 1991); (Barro and Sala-i-Martin, 1997). However, some studies have shown that the spillover effect of FDI was not as expected. The latest technologies were not transferred due to intellectual property and competition issues, or absorption by host countries (Ito *et al.*, 2012); (Monastiriotis and Alegria, 2011). It also triggered crowding effects for indigenous innovation due to significant dependence on foreign technology (Chen, 2007).

This research contributes to the literature in two regards. First, the study acts as a precursor to empirical evidence of the effect of innovation, measured by outputs such as the number of patents and the number of trademark applications to economic growth in the short term, besides the number of researchers. Although many studies acknowledge that promoting the creative and innovative process improves economic growth, our results nevertheless show a discrepancy in the influence of creativity and innovation on economic growth between high-income countries and the rest. These clues lead to our second contribution in which we study expanding economic growth theories to combine the role of institutional quality with the impact of innovation. Research results indicate that better institutional quality optimizes the spillover effect of creativity and innovation, as proposed by Romer (1986). The rest of the article includes: Part 2 literature review; Part 3 the empirical model, variables and method; and Part 4 descriptive statistics and main findings.

2. LITERATURE REVIEW

This section emphasizes the importance of innovation for economic growth. Previously, Schumpeter (1939) conceived that an "entrepreneur" was not only a "businessman" but also a person who got rich through initiatives. He argued that if production was a combination of existing resources to create a product, the entrepreneur was the one who produced another product or coordinated the existing resources differently. This eventually led to a non-equilibrium situation in the economy, but this was dynamic non-equilibrium. According to Schumpeter (1939) there was a situation which referred to the incessant product process and innovation mechanism by which new production units replaced outdated ones in the economy, called "creative destruction". Schumpeter developed the economic growth model where he argued that the competitive advantages achieved by innovation and education were key factors in securing economic growth. Later economic theories also mentioned the impact of innovation on economic growth, notably Solow (1957) and Romer (1986). Solow (1957) claimed that economic growth was sustained by the growth of capital and the labor force, as well as the growth of innovations that are defined as external factors. Meanwhile, Romer (1986) argued that economic growth was endogenously determined and affected by changes in endogenous technology, the process of knowledge accumulation and knowledge spread. Notwithstanding there were differences in approach, these economic theories recognized that innovation played a crucial role in economic growth.

Recent empirical studies have also attempted to investigate the correlation between economic growth and innovation, using both macroeconomic and microeconomic data, as well as examining at the corporate, national and multinational level (Chadee and Roxas, 2013); (Hu and Png, 2013); (Pece *et al.*, 2015). Earlier, Lichtenberg (1992) found that research and development (R&D) spending in the private sector positively affected economic growth, but there was no significant relationship between R&D spending and economic growth in the public sector of 74 countries in the period 1964-1989. Based on the argument that R&D spending played an essential role in economic development by creating increases in innovation and productivity, Samimi and Alerasoul (2009) analyzed panel data for 30 developing countries, and found that R&D expenditures did not catalyze growth in developing countries because such spending was low. Similarly, Pessoa (2007) found that there was no positive link between R&D costs and economic growth in the case of Sweden and Ireland. He said that innovation policy should take account of the complexity of economic growth, including other indicators in addition to research and development costs. Although R&D spending has been widely used as a measure of innovation performance; it should be regarded rather as a measurement of innovative input (Griliches, 1990).

With different approaches to innovation, many studies have mentioned the relationship between economic growth and the number of patents and trademarks, which is considered the output of innovation. Patents were supposed to the representative factor of innovation because it facilitated the creation of effective cost-saving technologies and new product development, thereby fostering economic growth (Blind and Jungmittag, 2008); (Ortiz-Villajos, 2009); (Hudson and Minea, 2013). Previously, Park and Ginarte (1997) did not find any relationship between patents and economic growth for low-income countries; although they found a positive link between patent and R&D expenditure for Organization for Economic Co-operation and Development (O.E.C.D.) countries. However, Ortiz-Villajos (2009) noticed a positive correlation between patent and GDPPC of more than 20 countries from the 19th to the 20th century. Meanwhile, Saini and Jain (2011) discovered the different effects of patent applications on economic growth in nine Asian countries. Their experimental results showed that patent applications contributed insignificantly to economic growth in Singapore, Japan, Thailand, and Vietnam. As well, as they had a negative relationship with economic growth in China, Indonesia and Malaysia, but actively promoted economic growth in India and the Philippines. By contrast, a number of patents were also found as one reason for economic growth (Hasan and Tucci, 2010); (Kacprzyk and Doryń, 2017). Based on previous research results that often favors the positive impacts of innovation on economic growth, the central hypothesis of the study is set forth as follows:

H1: Innovation has a positive effect on economic growth.

Unconvincing results in previous studies on the connection between economic growth and innovation have created the need to apply other socio-economic theories to this issue. Institutional economics is expected to explain these defects. The institutional theory refers to legal systems, governments, and the socio-economic environment which have been used to establish production and exchange mechanisms and distribution facilities. These systems contain formal and informal rules. According to North (1993) "Formal rules include political (and judicial) rules, economic rules and contracts (e.g., constitutions, laws, policies or formal contracts, etc.)." Meanwhile, informal rules include "behavioral norms, practices, and self-limiting rules of conduct". All of these created the social rule system, and jointly restrained the resident 's behavior. Whitley (2000) and Porter *et al.* (2003) considered that technological development and innovational differences could be explained by different institutional platforms. Wu and Wan (2015) provided evidence on the influence of the institutional fundamentals on the technology dynamics of high-tech businesses by different aspects of the system in China, *viz*: property rights; financial environment; political environment; and investment environment. He pointed out that the shortcomings of the financial environment and the legal system were the main obstacles to the technological innovation motivation of businesses. Xu and Feng (2018) analyzed the effects of the institutional environment, e.g., administrative system, legal and cultural credits, and the interaction of various sub-indices on technological innovation. They found that regional governments tended to enforce regional protection and encourage low-tech, high-investment projects, thereby curbing technological innovation under fiscal decentralization. By contrast, technological innovation was enhanced by the optimization of the institutional environment due to reducing transaction costs. Hence, it was important to recognize that institutional quality had an important role in improving technology innovation (North, 1993).

H2: Good institutional environment promotes the positive impact of innovation on economic growth.

The development of economies depends on not only domestic technological capabilities but also the influence of external factors such as FDI, as indicated by new trade theory (Dixit and Stiglitz, 1977); (Krugman, 1979). Developing countries - notwithstanding abundant natural resources - find it overwhelmingly difficult to catch up with the advanced technological levels of developed countries. However, they can import by means of FDI (Erdal and Göçer, 2015). For example, in the 1990s China was the largest single recipient of FDI among developing countries and achieved considerable economic growth. Similarly, to increase FDI inflows, India, Malaysia, Singapore, and South Korea provided tax incentives and cost advantages for multinational corporations. They were then able to acquire technical and technological knowledge from foreign investors to produce high-tech products. Consequently, they grew tremendously and gained the ability to export technologies. This was explained by the fact that FDI played a major role in producing high quality or high-tech export products, resulting in high value-added in the local countries. Therefore, the production and localization process was completed with the convergence of developing economies and developed economies through the diffusion channels of FDI (Zhang, 2014). In addition, multinational corporations were required to produce high-tech and new products to survive in competitive global markets, and reduce their long-term costs. Therefore, the priority of multinational corporations was to invest capital and equipment for R&D in the host countries where they benefited from cheap and abundant labor. R&D costs, scientific research, and skilled technical personnel were known to be the most important determinants for innovation (Hsu and Tiao, 2015). Therefore, we believe that FDI is an intermediary factor in facilitating the positive correlation between innovation and economic prospect, leading to our third hypothesis below.

H3: Foreign direct investment enhances the positive impact of innovation on economic growth.

In summary, the pivotal role of technological innovation in economic growth is known. Nevertheless, previous studies still triggered a plethora of controversial debates with inconsistent results, highlighting the need for further explorations. This study investigates this relationship at the multinational level, using different variables to measure innovation. Based on existing literature, there are several suggestions for enhancing institutional quality which accelerates the process of technological innovation. The study is expected to provide some empirical evidence to explain more clearly the relationship between innovation and economic growth under the influence of institutional quality and foreign direct investment.

3. METHODOLOGY AND DATA

The study investigates both direct impacts and indirect effects of innovation on economic growth through interactions with institutional quality. Based on extended Cobb-Douglas production function, we specify the following empirical model which can explain the association between economic growth and innovation, using panel data from 69 countries. These models are presented thus:

$$GDPPC_{i,t} = \alpha_0 + \alpha_1 GDPPC_{i,t-1} + \alpha_2 INNOV_{i,t} + \alpha_3 EDUC_{i,t} + \alpha_4 FDI_{i,t} + \alpha_5 OPEN_{i,t} + \varepsilon_{i,t} \quad (1)$$

$$GDPPC_{i,t} = \beta_0 + \beta_1 GDPPC_{i,t-1} + \beta_2 INNOV_{i,t} + \beta_3 INNOV_{i,t} * CLASS_{i,t} + \beta_4 EDUC_{i,t} + \beta_5 FDI_{i,t} + \beta_6 OPEN_{i,t} + \varepsilon_{i,t} \quad (2)$$

$$GDPPC_{i,t} = \mu_0 + \mu_1 GDPPC_{i,t-1} + \mu_2 INNOV_{i,t} + \mu_3 INNOV_{i,t} * INST\ QAL_{i,t} + \mu_4 EDUC_{i,t} + \mu_5 FDI_{i,t} + \mu_6 OPEN_{i,t} + \varepsilon_{i,t} \quad (3)$$

$$GDPPC_{i,t} = \mu_0 + \mu_1 GDPPC_{i,t-1} + \mu_2 INNOV_{i,t} + \mu_3 INNOV_{i,t} * FDI_{i,t} + \mu_4 EDUC_{i,t} + \mu_5 FDI_{i,t} + \mu_6 OPEN_{i,t} + \varepsilon_{i,t}$$

Where GDPPC is GDP per capita for country i at time t. GDPPC in many studies is seen as a proxy to quantify the size of the technological development of a country (Furman *et al.*, 2002) and is also a proxy for economic growth Ortiz-Villajos (2009); Hasan and Tucci (2010); Kacprzyk and Doryń (2017). INNOV is used to present the innovation of country i at time t. We use different measures to capture the innovation, including the total number of patents (PATENT), the total of trademark applications (TRADEAPP), and the number of researchers in R&D (RDNUM). Besides the patents and trademark applications, researchers are known to be the critical determinants for innovation (Hsu and Tiao, 2015). The dummy institutional quality (INST QAL) is calculated by extracted indices from World Governance Indicators (WGI). They vary from approximately −2.5 (low) to 2.5 (high), and higher estimated values represent the higher institutional quality (Kaufmann *et al.*, 2013). Moreover, we add foreign direct investment (FDI), national openness (OPEN), and the rate of government expenditure on education (EDUC) as control variables in our models. They are based on the argument that the development of economies depends on not only domestic technological capabilities but also the influence of external factors such as foreign direct investment or national openness (Rivera-Batiz and Romer, 1991; Rivera-Batiz and Romer, 1991); (Melitz, 2003); (Pegkas, 2015). The endogenous growth model argued that national openness and foreign direct investment 's spillover effect could enhance economic growth by promoting domestic productivity and taking advantage of externals (Grossman and Helpman, 1991, Barro and Sala-i-Martin, 1997) or stimulating the competition between domestic and foreign firms to innovate for higher production efficiency (Hadhek and Mrad, 2015). Educational expenditure is also an important determinant where it is expected to enhance human capital, so leading to economic growth (Musila and Belassi, 2004); (Wadad and Kalakech, 2009).

Due to the lack of necessary data, we note the number of countries that can participate in the research sample is 69/193 countries in the world with the nearest available continuous data from 2006 to 2014 (see more at Appendix 1). In our sample, the number of high-income countries is 38 (55.07%), upper-middle income 18 (26.09%), the lower-middle income 11 (15.94%) and low income two (2.09%), according to World Bank's classification. Variables, descriptions, and sources are shown in Table 1:

Table-1. Variables, descriptions, and sources.

Variable	Explanation	Source
GDPPC	The logarithm of current gross domestic product per capita in the dollar.	World Development Indicator
PATENT	The logarithm of the total number of patents, including resident and non-resident.	World Development Indicator
TRADEAPP	The logarithm of the total trademark applications, including resident and non-resident.	World Development Indicator
RDNUM	The logarithm of the total researcher per million people in the R&D area.	World Development Indicator
FDI	Foreign direct investment on the gross domestic product (net inflow, % of GDP).	World Development Indicator
OPEN	The total export and import value on the gross domestic product (% of GDP).	World Development Indicator
EDUC	Government's expenditure on education compared with the gross domestic product (% of GDP).	World Development Indicator
INST QAL	The dummy variable is calculated by the estimated number which is presented for Voice and Accountability, Political Stability and Absence of Violence, Government Effectiveness, Regulatory Quality, Rule of Law and Control of Corruption. It receives 1 if the estimated indicator is greater than 0, and 0 in otherwise.	World Governance Indicators
CLASS	Dummy variable, according to the income classification of the World bank. It receives 1 if the country is classified as "High-income country"; and 0 in otherwise.	World Development Indicator

Source: World Bank.

The neoclassical growth model argues that per capita results in different countries converge in a stable state without exogenous technological changes. However, these predictions are somewhat inconsistent with observations from reality because technological progress has become a significant factor behind economic growth, an endogenous factor. Therefore, to solve the technical aspects of the empirical model, we use two-step system Generalized Method of Moments (two-step sys-GMM) to solve the heterogeneity, and sequence correlation of the model due to the influence of the endogenous technology factor. Furthermore, the two-step sys-GMM system is more efficient than the one-step GMM due to the use of the optimal sub-weight matrix (Blundell *et al.*, 2000). The Hansen test of override restrictions is used for the robustness of the GMM estimation model; while the Arellano-Bond test AR (2) shows the autocorrelation for all level (Roodman, 2009) ensuring free residual. Two-step sys-GMM is also considered effective for unequal data with relatively small ranges and large cross-sectional countries (Blundell and Bond, 1998; Blundell *et al.*, 2001).

4. EMPIRICAL ANALYSIS

Table 2 presents statistics describing the model-related variables. The average value of GDPPC is $ 23,536.18, with a standard deviation of $24,199.28; the largest value at $ 119,255, and the smallest at $ 292.15. It shows there is a significant difference in GDP per capita between countries in the sample. Similarly, the average number of PATENT (including resident and non-resident) in the sample is 27,871.23, with a standard deviation of 98,579.10; the largest value 928,177 and the smallest value 13. In the same line, TRADEAPP average quantity is 50,789.72, standard deviation 164,304.50; the largest value 2,100,000 and the smallest 762. The average number of researchers in R&D (per million people) is 2,706.25; the smallest number 11,587 and the largest 8,250.47. This suggests that there is a significant difference in the area of innovation between developed and underdeveloped countries; and rapid growth and slow growth in the sample. These variables will be taken from natural logarithms. The remaining variables are presented in Table 2 as a percentage. It is noteworthy that the average value of FDI is 8.64% of GDP, the average of OPEN is 101.99% of GDP, and the average of government expenditure on education is 4.90% of GDP. The institutional quality, captured by the World Governance Indicator, receives a 0.50 mean value, and max value and min value are -1.51 and 1.89, respectively.

Table-2. Descriptive statistics.

Variable	Obs.	Mean	Std.	Min	Max
GDPPC	621	23536.18	24199.28	292.15	119225
PATENT	621	27871.23	98579.10	13	928177
TRADEAPP	595	50875.08	164429.50	762	2100000
NUMRD	463	2706.26	2024.11	11.59	8250.47
FDI	621	8.64	28.14	-58.32	451.72
OPEN	621	101.99	73.32	22.11	442.62
EDUC	494	4.90	1.42	1.94	9.51
INST QAL	621	0.50	0.89	-1.51	1.89

Source: World Bank.

Table 3 shows the correlation matrix between the variables in the model. Accordingly, PATENT, TRADEAPP, and NUMRD are positive and statistically significant for GDPCAP at a 10% level. In addition, the correlation matrix also shows that FDI, OPEN and EDUC also have a positive correlation with GDPCAP. Notably, control variables such as trade openness and government expenditure were also correlated with the main explanatory variables (PATENT, TRADEAPP, and NUMRD) which may lead to bias in estimating models (1) to (3).

Table-3. Correlation matrix.

Variable	GDPCAP	PATENT	TRADEAPP	NUMRD	FDI	OPEN	EDUC	INST QAL
GDPPC	1							
PATENT	0.292***	1						
TRADEAPP	0.206***	0.896***	1					
NUMRD	0.780***	0.282***	0.118**	1				
FDI	0.085**	-0.160***	-0.193***	0.028	1			
OPEN	0.238***	-0.217***	-0.261***	0.230***	0.368***	1		
EDUC	0.316***	-0.019	-0.138***	0.392***	0.012	-0.029	1	
INSTQAL	0.880***	0.168***	0.044	0.716***	0.136***	0.301***	0.381***	1

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

Table-4. The relationship between innovation and economic growth.

Independent variable: GDPPC	Using PATENT as INNOV	Using TRADEAPP as INNOV	Using NUMRD as INNOV
LAG. GDPPC	0.571***	0.750***	0.573***
	[31.10]	[87.54]	[40.87]
INNOV	0.128***	0.121***	0.212***
	[8.24]	[15.13]	[10.45]
FDI	0.008***	0.008***	0.005***
	[12.56]	[32.83]	[21.72]
OPEN	0.008***	0.005***	0.006***
	[14.73]	[31.21]	[34.95]
EDUC	0.114***	0.067***	0.010***
	[13.43]	[26.74]	[5.39]
CONSTANT	1.685***	0.359**	1.896***
	[7.31]	[2.49]	[17.38]
Num. Obs.	441	425	335
Num. groups	65	63	56
Num. IVs	51	57	50
AR (2) test	0.203	0.178	0.202
Hansen test	0.146	0.372	0.377

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

Table 4 shows the main findings of the two-step sys-GMM regressions. In Equations 1, 2 and 3 we estimate the relationship between economic growth and innovation which are represented by patents, trademark applications and a number of researchers in R&D, respectively. 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 sys-GMM method is used appropriately, and the estimated results are reliable and unbiased.

In Table 4, economic growth, as expected, is positively impacted at 1% statistically significant by innovation. This implies that an improvement in innovation, captured by increasing in patents, trademark applications or the number of researchers in R&D, will boost economic growth in the short-term. The control variables, such as openness of economy (OPEN), foreign direct investment (FDI), and government spending on education (EDUC), is found to have a positive impact on economic growth at 1% of statistical significance. This can be explained thus: the more the government integrates into the world economy, the more it promotes the competition and specialization of domestic units. As a result, it contributes to economic growth. Foreign direct investment and government spending on education, as argued earlier, play an important role in spreading knowledge, technology and contributing to economic growth.

The above results show a positive relationship between innovation and economic growth. However, in this section, we find out the difference in the impact of innovation on economic growth between countries which have different incomes. Thus, according to World Bank classification, we use dummy variables to separate the sample into two groups: (a) high-income group; and (b) low-income group. High-income groups are high-income countries; while low-income groups include upper-middle-income countries, lower-middle-income and low-income countries. We designed the dummy variable for income thus: income receives 1 if the country is classified as high-income and 0 if otherwise. Using the interaction between innovation and income classification, we achieve the results presented in Table 5:

Table-5. The relationship between innovation and economic growth in the difference in income.

Independent variable: GDPPC	Using PATENT as INNOV	Using TRADEAPP as INNOV	Using NUMRD as INNOV
LAG. GDPPC	0.466***	0.397***	0.552***
	[25.13]	[36.25]	[41.76]
INNOV	0.102***	0.211***	0.184***
	[5.89]	[9.75]	[8.21]
INNOV * CLASS	0.059***	0.094***	0.021**
	[3.03]	[8.36]	[2.30]
FDI	0.006***	0.003***	0.004***
	[8.97]	[4.67]	[20.76]
OPEN	0.008***	0.007***	0.005***
	[14.08]	[18.85]	[36.53]
EDUC	0.109***	0.105***	0.013***
	[10.32]	[8.71]	[6.91]
CONSTANT	2.696***	1.961***	2.212***
	[12.07]	[8.02]	[19.86]
Num. Obs.	441	425	335
Num. groups	65	63	56
Num. IVs	51	51	50
AR (2) test	0.196	0.367	0.191
Hansen test	0.154	0.157	0.345

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

Empirical results show that there is a difference in the impact of innovation on economic growth between developed and non-developed countries. Accordingly, in developed countries, the impact of innovation is higher than in undeveloped countries, and statistically significant at 1%. Although the role of innovation is still positive considering the overall sample, this result leads us to hypothesis H2: in developed countries where have higher institutional quality, it will have a positive indirect effect on innovation and vice versa, as shown in Table 6.

Table-6. The relationship between innovation and economic growth in the difference of institutional quality.

Independent variable: GDPPC	Using PATENT as INNOV	Using TRADEAPP as INNOV	Using NUMRD as INNOV
LAG. GDPPC	0.503***	0.576***	0.767***
	[36.99]	[66.59]	[59.05]
INNOV	0.064***	0.197***	0.075***
	[4.09]	[12.29]	[10.22]
INNOV * INST QAL	0.042***	0.036***	0.002**
	p4.85]	[10.95]	[2.23]
FDI	0.007***	0.007***	0.008***
	[12.02]	[14.24]	[18.64]
OPEN	0.006***	0.006***	0.005***
	[16.25]	[23.23]	[36.44]
EDUC	0.110***	0.101***	0.019***
	[11.88]	[12.59]	[4.76]
CONSTANT	2.825***	0.777***	1.076***
	[13.76]	[3.64]	[9.24]
Num. Obs.	441	425	335
Num. groups	65	63	56
Num. IVs	54	54	53
AR (2) test	0.184	0.248	0.206
Hansen test	0.288	0.328	0.303

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

This is based on an agreement that developed economies have provided a stable institutional environment to limit opportunism, manage conflict and cooperation, provide incentives and choice as well as reduce uncertainty (Coriat and Weinstein, 2002); (Crouch *et al.*, 2004) and technological development and innovation differences could be explained by different institutional platforms (Whitley, 2000); (Porter *et al.*, 2003). In this section, because of the different impact of innovation on economic growth between developed countries and undeveloped countries, we check the moderate impact of institutional quality on the link between innovation and economic growth. According to Cooray (2009) if the estimated number is greater than 0, it means a high or very high institutional quality, and if the estimated number is lower than 0, it means low or very low institutional quality. Dummy variables receive 1 in "high or very high"; and 0 in otherwise. The regression results are presented in Table 6.

As expectation, empirical results show that institutional quality plays an intermediary role to promote the positive impact of innovation on economic growth. According to Table 7, the interaction between INNOV and INST QAL dummy is positive and statistically significant at 1% in all models. This implies that if the institutional quality is high or very high, and will further promote the positive impact of innovation on economic growth. Our results confirm that institutional quality is a factor that can explain the difference in innovative influence on economic growth in different countries.

As per the theory, empirical results indicate that FDI inflows play an intermediary role to promote the positive influence of innovation on economic growth. According to Table 7, the interaction between INNOV and FDI inflows is positive and statistically significant at 1% in all models. This implies that if FDI inflows are positive, the positive impact of INNOV on economic growth will be raised from 0.001 to 0.002. They show that FDI has a positive impact on innovation, illustrating the technology transfer and knowledge spillover of FDI. Our results confirm previous results by Zhang (2014) and Erdal and Göçer (2015).

In addition, control variables are unified in terms of influence, similar to Table 4. Accordingly, the openness of the economy (OPEN), foreign direct investment (FDI), government spending on education (EDUC) positively affected economic growth at 1%, which is statistically significant. This shows that the models are stable and un-biased.

Table-7. The relationship between innovation and economic growth in the difference of institutional quality.

Independent variable: GDPCAP	Using PATENT as INNOV	Using TRADEAPP as INNOV	Using NUMRD as INNOV
LAG. GDPCAP	0.565***	0.718***	0.667***
	[24.07]	[43.81]	[91.58]
INNOV	0.133***	0.177***	0.066***
	[7.78]	[7.43]	[4.64]
INNOV * FDI	0.002***	0.001***	0.001***
	[12.69]	[13.75]	[16.10]
OPENNES	0.009***	0.007***	0.004***
	[13.94]	[17.73]	[18.35]
EDUEXP	0.132***	0.082***	0.031***
	[6.79]	[4.66]	[7.85]
CONSTANT	1.588***	-0.194	2.159***
	[6.68]	[-0.65]	[26.51]
Num. Obs.	441	425	335
Num. groups	65	63	56
Num. IVs	48	48	51
AR (2) test	0.135	0.256	0.146
Hansen test	0.144	0.178	0.336

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

5. CONCLUSIONS

Innovation has a vital role in stimulating economic activities and promoting economic growth. In this article, we collected data for the 2006 to 2014 period for 69 countries. By conducting two-step sys-GMM estimates and using various measurements of innovation, we found that innovation has a positive impact on economic growth. In addition, we also found evidence that this effect is stronger in developed countries, implying influence by institutional development. When we use dummy variables that represent institutional quality, empirical results show that high institutional quality acts as a precursor to the positive impact of innovation on economic growth. Better institutional quality creates a safe and trustworthy environment that can increase investment in research, enhance intellectual property protection, and optimize the positive effects of innovation. The positive spillover effect of foreign direct investment in innovation is also found. New technologies and production processes will be imported and spread by foreign investment flow from developed to developing countries, thereby promoting innovation and economic growth. Finally, the opening-up of the economy, attracting more foreign direct investment, and increasing the level of government investment in education also contribute positively to economic growth. This study also provides implications for economic policymakers who are recommended to focus on innovation incentives, absorbing advantages from economic integration with stronger institutional reforms, as well as substantial investment in education.

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