PISSN 2508-1640 EISSN 2508-1667 an open access journal
East Asian Economic Review vol. 30, no. 1 (March 2026) 35-57
https://dx.doi.org/10.11644/KIEP.EAER.2026.30.1.460

The Impact of Innovation on Economic Complexity: The Role of Institutions

Mohd-Lokman Hamdan†
Universiti Putra Malaysia
gs58987@student.upm.edu.my

W. N. W. Azman-Saini†
Universiti Putra Malaysia
wazman@upm.edu.my

Yasmin Bani†
Universiti Putra Malaysia
nor_yasmin@upm.edu.my

Anitha Rosland†
Universiti Putra Malaysia
anitharosland@upm.edu.my

Institutions play a significant role in spurring a country's innovative activities. However, to the best of our knowledge, the relative importance of institutions in the innovation-economic complexity link remains unexplored. This study examines the role of institutional quality in moderating the impact of innovation on economic complexity for 68 countries from 1996 to 2020. We employed various estimation techniques for the analysis, including the generalized method of moments (GMM), pooled ordinary least squares (OLS), fixed-effects, and random-effects regression. In this study, economic complexity is measured using the Economic Complexity Index (ECI), which captures a country's productive capabilities. At the same time, institutional quality (INS) is constructed from the six governance dimensions of the Worldwide Governance Indicators (WGI). The GMM estimator results reveal that institutions are significant determinants on the innovation-economic complexity link. The positive impact of innovation on economic complexity becomes higher when institutional quality is stronger. Furthermore, institutions and innovation were found to have a direct influence on economic complexity. We are also utilizing research and development (R&D) expenditure as a proxy for innovation, which resulted in similar results. Finally, only export, foreign direct investment (FDI), and capital investment are significant in explaining economic complexity.

Keywords: Economic Complexity, Innovation, Institutional Quality, GMM

JEL Classification: O14, O31, O43

† School of Business and Economics, Universiti Putra Malaysia, UPM Serdang, 43400, Selangor, Malaysia.

I. Introduction

Institutions are the core backbone of a country and can be a crucial factor in driving sustained economic development. Institutions refer to the formal and informal rules that structure economic, political, and social interactions (North, 1990). In this study, we measure institutional quality through the Worldwide Governance Indicators (WGI), which reflect governance effectiveness, rule of law, regulatory quality, corruption control, political stability, and voice and accountability. Collectively, these dimensions represent the capacity of a country's governance system to support innovation and enhance productive capabilities. Strong and well-functioning institutions are associated with positive economic outcomes, including higher levels of productivity, increased investment, and improved governance (Acemoglu et al., 2014; Dollar and Kraay, 2003; Law et al., 2014). Institutions also play a pivotal role in fostering or constraining innovation and influencing the complexity of economic activities within an economy. Hausmann et al. (2007) highlight that the ability to export complex products critically depends on the institutional environment that stimulates entrepreneurs to engage in innovative activities. In the same vein, Donges et al. (2022) show that the strength of institutional frameworks significantly influences firms' incentives and ability to innovate, suggesting that institutional conditions are not merely complementary but foundational to innovation-driven development. Thus, understanding the intricate relationships between institutions, innovation, and economic complexity is essential to promoting sustainable growth and development.

According to the UNESCO (2021), growing interest in innovation leads governments worldwide to ease legislation toward companies protecting their intellectual property rights (IPRs). This reveals that governments knew the importance of innovation and institutions' role in stimulating a country's growth. However, the importance of institutions extends beyond merely facilitating innovation. It also plays a pivotal role in shaping the complexity of economic activities within a country. A robust institutional framework fosters knowledge spillovers, collaboration, and the diffusion of ideas across sectors and regions (Zhang et al., 2021). This knowledge diffusion process not only enhances the adaptability and resilience of economies but also fosters the diversification and sophistication of a country's productive capabilities.

There are several reasons why good institutional quality should have a positive influence on promoting innovative activities and contributing to economic complexity. Firstly, good institutional quality lays the foundation for new economic activities, including new technologies and skills (North, 1990). Secondly, good institutional quality promotes innovative activities (D'Ingiullo and Evangelista, 2020). Thirdly, good institutional quality enables the institution to acquire productive capabilities faster, thus contributing to the sophistication of economic complexity (Lee and Vu, 2020; Vu, 2022). Lastly, cross-country differences in institutional quality affect a country's ability to develop capabilities, which is crucial in understanding variation in economic complexity (Acemoglu et al., 2001). Hence, this study aims to answer whether institutional quality plays a vital role in governing the impact of innovation on economic complexity.

The objective of this paper is to analyze the relationship between innovation and institutions on economic complexity and evaluate the role of institutions in moderating the relationship. This research seeks to answer the following questions. What is the relationship between innovation and institutions on economic complexity? Do institutions further affect the relationship between innovation and economic complexity? To achieve the objective of this study, we utilized data on 68 countries from 1996 to 2020 by employing the generalized method of moments (GMM) and traditional panel regression. Our findings indicate that institutional quality is important in realizing the positive impact of innovation on economic complexity. In addition, innovation and institutions are also directly affecting economic complexity.

There are several important areas where this paper makes an original contribution to the innovation-economic complexity study. Although the impact of innovation on economic complexity has been studied (Ivanova et al., 2017; Nguyen et al., 2020; Sweet and Eterovic, 2015), this study stands out by concentrating on the role of institutions, which has been overlooked by previous researchers. This study takes its uniqueness in the sense that institutional quality plays a vital role in shaping innovation's impact on economic complexity. Furthermore, in an attempt to establish a possible relationship between innovation and economic complexity, previous studies such as Nguyen et al. (2020) used the total patent, while Sweet and Eterovic (2015) employed the GP Index as a proxy for innovation. Given the variety of indicators available to proxy for innovation, this study will incorporate both patents granted and R&D expenditure in its analysis. To the best of our knowledge, no prior research has examined the impacts of patents granted and R&D expenditure on economic complexity.

The rest of the paper is structured as follows. Section II presents a literature review on how innovation impacts economic complexity and the role of institutional quality in the relationship. Section III discusses the method and provides information on the data. Section IV presents the estimation results. Finally, Section V concludes the paper.

II. Literature Review

Starting from the study of Romer (1990) endogenous technological change seminal work, economists have agreed that innovation is vital to economic growth (Law et al., 2020). In the past, innovations of ideas from the know-how in producing things changed our way of life. The creation of the printing machine, steam engine, and airplane originated from scientific discovery to become a commercially successful innovation and speed up the country’s growth. At the same time, economists have started to pay more attention to the diversity and complexity across countries in explaining growth differences (Hartmann, 2014; Hausmann et al., 2013). Thus, introducing economic complexity as an indicator of the knowledge embedded in a country's productive capabilities has led to a new strand of economic growth literature. As a result, several studies have been carried out to investigate the impact of innovation on economic complexity.

With further decreased transportation costs, increased purchasing power, and rapid globalization, competition between manufacturers has changed from price competition to product feasibility and design (Hartmann, 2014). Many manufacturers opt to innovate to stay relevant and survive in global markets. Significant investment in R&D expenditures in improving existing products or producing a new variety of products has been allocated. R&D not only provides new information, but it also improves manufacturers’ ability to digest and utilize existing know-how that is available externally (Cohen and Levinthal, 1990). It also improves the manufacturer’s ability to identify, assimilate, and exploit know-how from other manufacturers.

An institution is defined as any form of guidelines to structure human interaction, comprising formal or informal institutions (North, 1990). Most literature supports the idea that high institutional quality promotes innovative activities. In the innovation-complexity nexus, institutions can influence this relationship through multiple channels. First, strong rules of law and regulatory quality improve the country’s ability to innovate, encouraging firms to engage in knowledge creation (Sweet and Eterovic, 2015). Second, effective governments facilitate knowledge diffusion and capability upgrading through stable policy environments (Donges et al., 2022). Third, low corruption reduces uncertainty and transaction costs, allowing innovative activities to prosper, thereby enhancing economic complexity.

Furthermore, high-performing economies are usually structured upon a robust institutional backbone. Thus, a healthy institutional environment can stimulate entrepreneurs to engage in innovative activities (Hausmann et al., 2007). Nevertheless, the institutions need to have the ability to adapt and integrate new technology to innovate. Cohen and Levinthal (1990) explained this as absorptive capacity, and this ability highly depended on the existing institution's knowledge and environment. Consequently, innovation does not thrive if the institution behind it cannot accommodate incoming technology (Sweet and Eterovic, 2019). In order to increase absorptive capability, allocation in R&D investment is vital (Cohen and Levinthal, 1990).

In another study, Vu (2022) postulates that institutions affect economic complexity by fostering innovation and the accumulation of human capital. Vu is demonstrating this by studying the extent of institutions across-country differences in economic complexity. He found that institution positively impacts ECI, and the effect is more significant in countries with higher institutional quality. In line with this view, Donges et al. (2022) provide evidence that institutional quality directly affects firms' innovation decisions, showing that stronger governance systems enhance experimentation, knowledge creation, and the ability to commercialize new technologies. Their findings highlight that institutional arrangements are a critical prerequisite for innovation to translate into broader economic development.

Recent empirical evidence reveals that the relationship between innovation and economic complexity is mostly positive, which further supports the importance of innovation in increasing economic complexity (Nguyen et al., 2020; Rubbo et al., 2021; Sweet and Eterovic, 2015, 2019). One of the earliest studies empirically investigating innovation's potential in increasing economic complexity is Sweet and Eterovic (2015). This study was carried out on 94 countries from 1965 to 2005, and consists of high, medium, and low-income countries. They found that stringent IPR standards positively impact the Economic Complexity Index (ECI) but are limited to countries with above-average levels of development and complexity. However, IPR exhibits non-significance; some even showed a negative relationship with ECI for developing countries.

Another interesting study by (Nguyen et al., 2020) found that innovation and financial developments appear positively related to economic complexity by employing panel data estimation. The study covered 32 high-income and 20 middle-income countries from 1995 to 2017. However, the impact is more significant when using ECI+, an improvement of the ECI measurement developed by (Tacchella et al., 2012), rather than ECI. The integration of financial development into the model suggests that credit services provided by financial intermediaries can promote innovation, thereby enhancing a country's overall complexity.

III. Methodology

1. Data

This study used panel data of 68 countries spanning over 25 years annually from 1996 to 2020. The selection of year and country is subject to the availability of economic complexity data. The data were averaged over five years, consisting of 5 periods. The dependent variable, economic complexity measured as the Economic Complexity Index (ECI), comes from the Growth Lab provided by Harvard University. Innovation is the main independent variable, proxied by total patents granted (PG) extracted from the World Intellectual Property Organization (WIPO). The patent data will be normalized by per thousand population to yield a measure independent of population size.

The data for control variables, including export (EX), foreign direct investment (FDI), gross domestic product per capita (GDPPC), and capital investment (CI), are collected from the World Development Indicators (WDI). Export account for the value of all goods and services provided to the rest of the world, measured by exports of goods and services as a percentage of GDP. Exports represent productive diversification, with ECI data primarily derived from international trade data. FDI is represented by net inflows as a percentage of GDP, which occurs when MNCs engage in international investment across countries. Previous researchers, such as Nguyen (2020), have included FDI in the model as a potential determinant of economic complexity and successfully established a positive linkage.

Economic development is proxied by GDP per capita and measured in 2015 US dollars. GDP per capita is a country's GDP divided by its population, which is usually used to illustrate a country's economic prosperity and overall wealth per person. This study uses GDP per capita to capture the level of the economy in the sample countries. Capital investment refers to the investment made in the form of physical assets, such as plant, machinery, and equipment. It is another investment alternative from the FDI.

Capital investment is proxied by gross capital formation over GDP and expressed as a percentage of GDP.

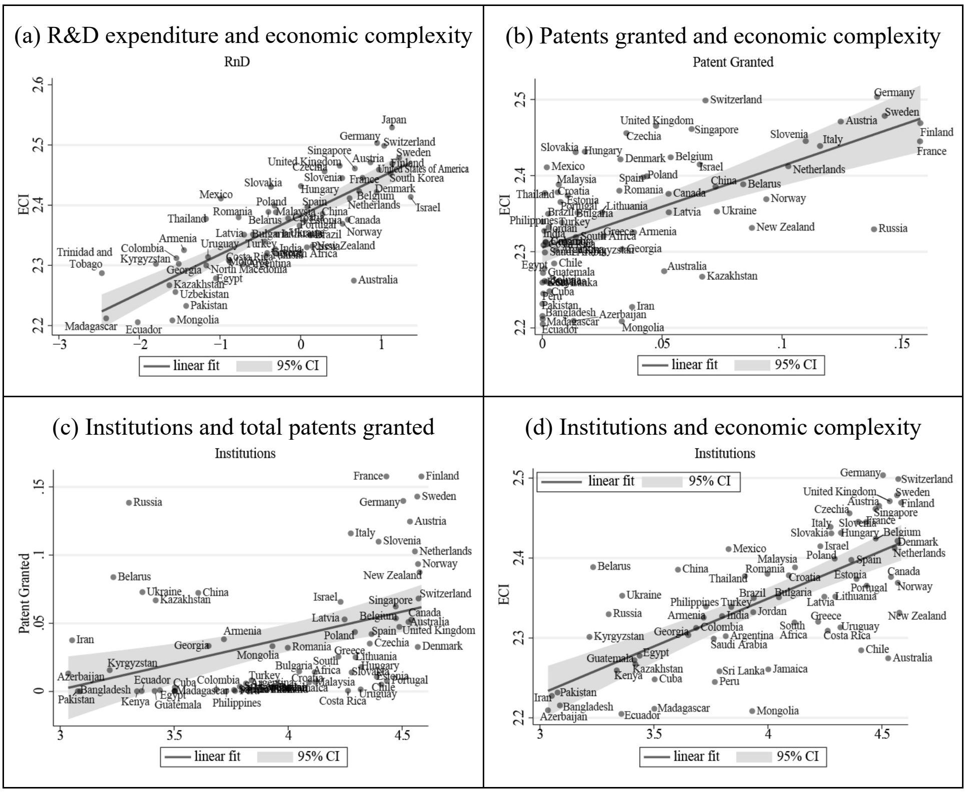
The interaction term institutional quality data comes from the Worldwide Governance Indicators (WGI) provided by the World Bank. Six dimensions of the indicator are measured for the quality of governance: (i) voice and accountability, (ii) political stability, (iii) government effectiveness, (iv) regulatory quality, (v) the rule of law, and (vi) control of corruption. Following Law and Azman-Saini (2012), the institutional quality was measured by averaging these six indicators. Table 1 summarizes the data used in this study.

Table 1. Data Summary

Variable Notation	Variable Name	Variable Description	Measurement Unit	Reference
ECI	Economic Complexity	Economic Complexity Index	Index between -3 and 3	(Ivanova et al., 2017; Nguyen et al., 2020; Sweet and Eterovic, 2015)
PG	Innovation	Total patents granted per thousand population	Percentage (%) per thousand population	(Law et al., 2020; Nguyen et al., 2020)
INS	Institutions	Institutional Quality	Percentile 0-100	(Law et al., 2020; Sadeghi et al., 2020; Vu, 2022)
EX	Export	Exports of goods and services over GDP	Percentage (%) of GDP	(Hausmann et al., 2007)
FDI	Foreign Direct Investment	Net inflows of foreign direct investment over GDP	Percentage (%) of GDP	(Nguyen et al., 2020)
GDPPC	Economic Development	Real GDP Per Capita	US$ at 2015	(Sadeghi et al., 2020; Sweet and Eterovic, 2015)
CI	Capital Investment	Gross capital formation over GDP	Percentage (%) of GDP	(Nguyen et al., 2020)

Figure 1 and Table 2 provide preliminary analysis for the variables used in this study. Figures 1(a), 1(b), and 1(d) indicate that patents granted, R&D expenditure, and institutional quality are all positively associated with economic complexity. Specifically, Figure 1(a) shows that countries with higher R&D expenditure tend to exhibit greater economic complexity, while Figure 1(b) demonstrates a strong correlation between total patents granted and complexity levels. Figure 1(c) further reveals that stronger institutions are linked to higher patent intensity. Taken together, these simple correlation tests suggest that both the innovation proxy used in this study and institutional quality are important in shaping a country's economic complexity.

Figure 1. Scatter Plots of the Main Variables



Source: Author's illustration using data from the Growth Lab, WIPO, and WDI (2024).

Table 2 provides summary statistics based on data averages over the 1996 to 2020 period across 68 countries. As shown in Table 2, there is considerable range variation in most of the variables. This range can be seen for economic complexity, with a minimum value of -2.16 (Azerbaijan in 2010) and a maximum value of 2.52 (Germany in 2000). For the patents granted range, a minimum value of 6.30E-05 (an example was Guatemala in 2015) and a maximum value of 0.24 (Sweden in 2000). The average institutional quality is 3.99, with a score between 2.66 (Azerbaijan in 1995) and 4.60 (Finland in 2000). Another considerable highlight is FDI, with average inflows of 4.64, a minimum value of 4.57 (Austria in 2015), and a maximum value of 4.92 (Netherlands in 2015).

Table 2. Descriptive Statistics

Variables	Mean	Std. Dev.	Min.	Max.
Economic Complexity Index (ECI)	2.35	0.08	-2.16	2.52
Patents Granted (PG)	0.04	0.05	6.30E-05	0.24
Institutional Quality (INS)	3.99	0.48	2.66	4.60
Export (EX)	3.52	0.54	2.01	5.38
Foreign Direct Investment (FDI)	4.64	0.04	4.57	4.92
GDPPC	9.08	1.23	5.90	11.37
Capital Investment (CI)	3.13	0.25	2.17	3.87

In order to quantify the strength and direction of the linear association between dependent and independent variables, Table 3 presents the correlation analysis for all the variables used in this study. All variables show positive relationships with economic complexity, which is in line with the theoretical perspective. The correlation values also show no collinearity problem among the variables (though this notation needs further analysis). As we can see, the patents granted is positively linked with economic complexity at 0.55. The highest correlation is between institutions and GDPPC (0.81), and the lowest is between institutions and capital investment (-0.01).

Table 3. Correlation Matrix

	ECI	PG	INS	EX	FDI	GDPPC	CI.
ECI	1						
PG	0.55	1					
INS	0.65	0.34	1				
EX	0.45	0.22	0.37	1			
FDI	0.09	0.02	0.11	0.41	1		
GDPPC	0.67	0.52	0.81	0.36	0.10	1	
CI	0.04	0.10	-0.01	0.24	0.23	0.01	1

2. Model

We employed a specification that is broadly similar to others (e.g., Nguyen et al., 2020; Sweet and Eterovic, 2015), and the impact of innovation on economic complexity can be expressed as follows:

$$ECI_{i,t} = \beta_0 + \beta_1 ECI_{i,t-1} + \beta_2 PG_{i,t} + \beta_3 INS_{i,t} + \beta_4 X_{i,t} + \mu_{i,t} \quad (1)$$

where *ECI* is the Economic Complexity Index, innovation proxy by *PG* is the patent granted, and *INS* represents institutional quality. *X* is a vector of control variables similarly used by previous researchers (e.g., Nguyen et al., 2020; Sweet and Eterovic, 2015) in the innovation-economic complexity link, including export, FDI, GDP per capita, and capital investment.

This study includes the conditional term of institutional quality in affecting the innovation-economic complexity link. Equivalently, the model may be written as follows:

$$\begin{aligned} ECI_{i,t} = {} & \beta_0 + \beta_1 ECI_{i,t-1} + \beta_2 PG_{i,t} + \beta_3 INS_{i,t} + \beta_4 \left(PG_{i,t} \times INS_{i,t}\right) \\ & + \beta_5 X_{i,t} + \eta_i + \varepsilon_{i,t} \end{aligned} \quad (2)$$

where *i* is the country index, *t* is the time index, η_i is an unobserved country-specific effect term, and ε_{it} is the error term. Within this specification, the interaction term of $PG_{i,t} \times INS_{i,t}$ is used to examine the moderating effect of institutional quality on innovation and economic complexity in the selected countries. Additionally, the inclusion of interaction terms within this specification may give rise to multicollinearity. To address this problem, the interaction term is normalized following Balli and Sørensen (2013):

$$\begin{aligned} ECI_{i,t} = {} & \beta_0 + \beta_1 ECI_{i,t-1} + \beta_2 PG_{i,t} + \beta_3 INS_{i,t} \\ & + \beta_4 \left(PG_{i,t} - \overline{PG}\right)\left(INS_{i,t} - \overline{INS}\right) + \beta_5 X_{i,t} + \eta_i + \varepsilon_{i,t} \end{aligned} \quad (3)$$

where $(\overline{PG})$ and $(\overline{INS})$ are the mean of the patent granted and institutions, respectively. In the context of Equation (3), the incorporation of an interaction term between the innovation (PG) and the institutional quality (INS) serves the purpose of investigating the moderating effect that these variables may have on each other. In their study, Balli and Sørensen argue that subtracting the average coefficient for the interaction term can reduce the problem of multicollinearity and omitted variable bias. Thus, this may potentially affect the conclusion drawn from the study.

3. Constructing the Economic Complexity Index

Economic complexity, introduced by Hausmann et al. (2013), refers to the productive capabilities embedded within a country's economy. These capabilities arise from the combination of production factors and knowledge, enabling the creation of diverse and sophisticated products and services (Hidalgo and Stojkoski, 2025). In essence, economic complexity reflects the structure of knowledge embedded in an economy and the way it interacts, diffuses, and accumulates across sectors. By quantifying the complexity involved in producing various goods, this concept helps explain cross-country differences in development levels, economic growth, and income inequality (Hausmann et al., 2013; Hidalgo, 2021; Hidalgo and Stojkoski, 2025).

By utilizing a method of reflection, matrices of the range of products a country can export (diversity) and the number of countries that can make a given product (ubiquity) are iteratively computed. In the concept of economic complexity, a product that can be produced by many is seen as an abundance (in terms of productive capabilities), while products manufactured by a single or a few countries are seen as scarce.

The formulae for deriving the ECI (Hausmann et al., 2013):

$$\text{Diversity} = \mathrm{k}_{c,0} = \sum_p M_{cp} \tag{4}$$

$$\text{Ubiquity} = \mathrm{k}_{p,0} = \sum_c M_{cp} \tag{5}$$

where M_{cp} is a matrix in which rows represent different countries and columns represent different products, *c* stands for country, and *p* denotes the products. They then compute jointly and iteratively the mean value of diversity and ubiquity to generate a more accurate measure of the number of capabilities available in a country as follows:

$$\mathrm{k}_{c,N} = \frac{1}{k_{c,0}} \sum_p M_{cp} \,.\, k_{p,N-1} \tag{6}$$

$$\mathrm{k}_{p,N} = \frac{1}{k_{c,0}} \sum_{p} M_{cp} \cdot k_{c,N-1} \tag{7}$$

where N stands for the number of iterations. By inserting Equation (7) into Equation (6), we obtain the following equation.

$$\mathrm{k}_{c,N} = \frac{1}{k_{c,0}} \sum_{p} M_{cp} \frac{1}{k_{p,0}} \sum_{c\prime} M_{c\prime p} \cdot k_{c\prime,N-2} = \sum_{c\prime} k_{c',N-2} \sum \frac{M_{cp}M_{c\prime p}}{k_{c,0}k_{p,0}} \tag{8}$$

This can be rewritten as:

$$\mathrm{k}_{c,N} = \sum_{c'} \widetilde{M}_{cc'} \, k_{c',N-2} \tag{9}$$

In which,

$$\widetilde{M}_{cc'} = \sum \frac{M_{cp}M_{c\prime p}}{k_{c,0}k_{p,0}} \tag{10}$$

where $\widetilde{M}_{cc'}$ is a matrix connecting the countries exporting similar products.

Finally, the ECI is computed as:

$$ECI = \frac{\vec{K} - <\vec{K}>}{stdev\ (\vec{K})} \tag{11}$$

where $\vec{K}$ is the eigenvector of $\widetilde{M}_{cc'}$ associated with the second largest eigenvalue, < > represents an average, and *stdev* stands for the standard deviation.

4. Methods

The System Generalized Method of Moments (SGMM) (Arellano and Bover, 1995) has been selected to examine Equation (3). This estimator is appropriate given the dynamic nature of the model and the potential endogeneity among the key variables. The main advantages of this approach over other panel data methods are: (i) controls for the additional lagged dependent variables, which may give rise to autocorrelation, (ii) controls for country-specific effects such as political, social, legal, and cultural characteristics of each county, which cannot be done using country-specific dummies due to the dynamic structure of the model, and (iii) controls for a simultaneity bias as some of the variables such as export may be endogenous. Under this procedure, the validity of SGMM estimation depends on two specification tests: (1) the Hansen test, and (2) no second-order serial correlation in the equation. Following Windmeijer (2005), the corrected two-step SGMM is employed in this study as the estimated asymptotic standard errors of the two-step GMM can be severely downward-biased in small samples. Its advantages lie in its sensitivity towards outliers in the sample and correcting any bias in the two-step SGMM standard errors.

A further justification for the use of SGMM arises from the possibility of reverse causality between the innovation, institutions, and economic complexity nexus. Economic complexity, innovation, and institutional quality are likely to influence one another simultaneously. For instance, countries with higher economic complexity often develop stronger institutions and greater innovative capacity, which introduces reverse causality and simultaneity bias into the estimation. SGMM addresses this issue by using internal instruments that are orthogonal to the error term. Specifically, the lagged levels and differences of the regressors are employed to account for unobserved heterogeneity, endogeneity, and the correlation between the lagged dependent variable and the error term. This approach effectively mitigates reverse causality because past values of innovation and institutional quality cannot be influenced by current shocks in economic complexity. The validity of the instrument set is evaluated using the Hansen J-test and the absence of second-order serial correlation, ensuring that the estimates are consistent and robust. Therefore, SGMM provides a rigorous empirical strategy for isolating the moderating role of institutional quality and producing unbiased estimates of innovation's effect on economic complexity.

IV. Results

Before estimating the SGMM, we present a traditional panel regression estimation for this study. Table 4 reports the (1) Pooled OLS, (2) Random Effect, and (3) Fixed Effect regression results. The traditional regression results indicate that patents granted have a significant positive effect on economic complexity. It implies that innovation contributes to increasing productive capabilities. On the control variables set, only institutions and exports are significant for all three models. Due to its efficiency and unbiasedness, the SGMM estimator is a recommended method for analysis. Moving on, we turn to SGMM estimation.

Table 4. Traditional Panel Regression

Regressor	Pooled OLS (1)	Random Effect (2)	Fixed Effect (3)
Constant	0.484*** (0.359)	0.973*** (0.294)	0.418*** (0.230)
PG	0.518*** (0.057)	0.289*** (0.050)	0.193*** (0.065)
lnINS	0.058*** (0.013)	0.003** (0.016)	0.038** (0.016)
lnGDPPC	0.009* (0.005)	0.014* (0.008)	-0.002 (0.012)
lnEX	0.036*** (0.007)	0.001** (0.009)	0.004** (0.008)
lnFDI	-0.123 (0.037)	0.053** (0.068)	0.023** (0.054)
lnCI	-0.009 (0.014)	-0.007 (0.011)	0.001** (0.010)
Observations	334	334	334
R-squared	0.597		0.221
No. of countries		67	67

Notes: Numbers in parentheses are robust standard errors. ***, **, and * refer to statistical significance at the 1, 5, and 10% levels, respectively.

Table 5 presents the results of the corrected SGMM (following Windmeijer, 2005) estimation of innovation-economic complexity and innovation-economic complexity with institutional quality for 68 countries from 1996 to 2020. As Windmeijer (2005) suggested, the estimated asymptotic standard errors of the two-step GMM can be severely downward-biased in small samples. Alternatively, the bias in two-step SGMM standard errors is corrected by the correction procedure of Windmeijer (2005). As shown in Table 4, all estimations of the lagged response variable are statistically significant, indicating that past economic complexity affects current economic complexity. In addition, the number of instruments between 0.21 and 0.27 remains below the number of cross-sectional units, minimizing the risk of instrument proliferation. Model 1 presents the first estimation of the innovation-economic complexity corrected procedure result. As we can see, the patents granted positively impact economic complexity. This finding is consistent with Nguyen et al. (2020), who state that patents significantly increase productive capabilities. The Hansen J-test also suggests that the instruments are valid. In addition, the serial correlation test fails to reject the null hypothesis of no second-order autocorrelation but rejects the null of no first-order autocorrelation. On the control variable set, only GDP per capita is insignificant in affecting economic complexity.

Next, before testing the roles of institutional quality in moderating the relationship between innovation-economic complexity, we first include institutional quality in the earlier estimation. The result in Model 2 shows that institutional quality significantly impacts economic complexity. This finding is consistent with Vu (2022) and supports the positive effect of institutions on economic complexity. This implies that good institutions, stronger legislation, tight governance structures, and rigid property rights protection can enhance a country's productive capabilities. Besides that, we also see that patents granted, export, FDI, and capital investment are significantly positive in this estimation.

Afterwards, an interaction term of institutional quality is incorporated into the innovation-economic complexity link. Model 3 estimation suggests that the interaction term was found to be positive and significant. This implies that the moderating effect of institutional quality and innovation significantly determines economic complexity. Thus, this result supports previous findings that a good innovative environment (Nguyen, 2020; Sweet and Eterovic, 2015) and high institutional quality (Vu, 2022) contribute to the sophistication of a country’s complexity and better economic performance. Furthermore, high institutional quality ensures that innovative activities thrive by enabling a conducive business environment, lower transaction costs, and stringent regulation (North, 1990). In such environments, innovative activities are more easily transformed into productive capabilities that enable economies to diversify and upgrade their export structures. This explains why the interaction term between innovation and institutional quality is positive and significant.

On the other hand, the results also show that institutional quality directly affects economic complexity. This enables the institution to acquire productive capabilities faster, thus contributing to the sophistication of economic complexity. Therefore, all efforts to effectively utilize innovation to enhance economic complexity should also consider improving institutional quality. In addition, export, FDI, and capital investment remain significantly positive in this model, which suggests that these variables could amplify economic complexity. Thus, our results indicate that higher exports enable more exposure to global knowledge and productive diversification. Similarly, FDI facilitates technology transfer and knowledge diffusion, contributing to diversifying capabilities. Capital investment also supports the development of more sophisticated production systems. Contrastly, the insignificance of GDP per capita suggests that a country's income level alone does not directly translate into higher economic complexity. While richer countries may have greater resources, economic complexity depends more on the structure of productive capabilities and the presence of good institutions rather than on income itself. This result implies that institutional quality and innovation capacity are more critical determinants of economic complexity.

Table 5. Two-step SGMM Estimation of Innovation–Economic Complexity Link (Baseline Results)

Regressor	Model 1	Model 2	Model 3
Constant	-0.879*** (0.269)	-0.886** (0.034)	-0.972** (0.039)
ECI $_{t-1}$	0.754*** (0.092)	0.850*** (0.068)	0.851*** (0.060)
PG	0.438*** (0.162)	0.037** (0.013)	0.032** (0.018)
lnINS		0.008** (0.039)	0.006** (0.036)
PG*INS			0.057* (0.03)
lnEX	0.002** (0.008)	0.051** (0.033)	0.017** (0.095)
lnGDPPC	-0.056 (0.038)	-0.002 (0.065)	-0.002 (0.057)
lnFDI	0.127* (0.099)	0.028* (0.469)	0.029** (0.456)
lnCI	0.025** (0.011)	0.035** (0.062)	0.037** (0.060)
Observations	267	283	283
Number of countries	67	67	67
No. of instruments	17	17	21
AR1 (*p*-value)	0.00	0.00	0.00
AR2 (*p*-value)	0.598	0.403	0.433
Hansen (*p*-value)	0.238	0.271	0.215

Notes: Numbers in parentheses are robust standard errors. ***, **, and * refer to statistical significance at the 1, 5, and 10% levels, respectively.

To shed some light on the effect of institutional quality on innovation, this study further creates a dummy of institutional quality of 1 for any value of 50 and above to indicate better institutional quality (high institutional quality $lnINS_{dummy}$ = 1, or low institutional quality $lnINS_{dummy}$ = 0). In other words, the significance of interaction terms tends to explain the influence of innovation on economic complexity regarding stronger institutional qualities. Table 6 shows the results of the corrected SGMM estimation on the innovation-economic complexity link with the inclusion of the interaction terms for the institutions with a dummy. The findings reveal that the

Table 6. Two-step SGMM Estimation of Innovation–Economic Complexity Link (with Dummy Variables)

Regressor	Model 1	Model 2
Constant	-0.863*** (0.053)	-0.826*** (0.054)
ECI_{t-1}	0.897*** (0.002)	0.887*** (0.006)
PG	0.039** (0.019)	0.032** (0.028)
$lnINS_{dummy}$	0.238** (0.116)	0.114** (0.233)
$PG*INS_{dummy}$		0.169* (0.093)
lnEX	0.288*** (0.094)	0.271** (0.095)
lnGDPPC	-0.062 (0.698)	-0.093 (0.675)
lnFDI	0.138*** (0.008)	0.136** (0.008)
lnCI	0.075** (0.047)	0.077** (0.046)
Observations	287	295
Number of countries	67	67
No. of instruments	18	18
AR1 (*p*-value)	0.00	0.00
AR2 (*p*-value)	0.361	0.366
Hansen (*p*-value)	0.419	0.465

Notes: Numbers in parentheses are robust standard errors. ***, **, and * refer to statistical significance at the 1, 5, and 10% levels, respectively.

interaction terms are positive and statistically significant at a 10% level. Thus, this confirms that the positive effect of innovation on economic complexity becomes higher when institutional quality is stronger.

1. Robustness

To ensure that the estimation results are robust, this study performs a sensitivity analysis by using R&D expenditures as a proxy for innovation. The use of R&D

Table 7. Two-step SGMM Estimation of Innovation–Economic Complexity Link (Robustness Check using R&D Expenditure)

Regressor	Model 1	Model 2	Model 3
Constant	-0.767*** (0.053)	-0.616*** (0.049)	-0.675** (0.033)
ECI $_{t-1}$	0.857*** (0.021)	0.901*** (0.009)	0.921* (0.008)
lnRnD	0.104*** (0.026)	0.094*** (0.033)	0.091** (0.033)
lnINS		0.009*** (0.003)	0.003*** (0.009)
RnD*INS			0.088** (0.193)
lnEX	0.183** (0.027)	0.053*** (0.014)	0.057*** (0.013)
lnGDPPC	-0.039 (0.017)	-0.003 (0.042)	-0.007 (0.049)
lnFDI	0.091** (0.001)	0.003*** (0.095)	0.004* (0.099)
lnCI	0.041** (0.066)	0.087** (0.012)	0.089** (0.011)
Observations	287	313	313
Number of countries	67	67	67
No. of instruments	17	18	21
AR1 (*p*-value)	0.00	0.00	0.00
AR2 (*p*-value)	0.341	0.403	0.433
Hansen (*p*-value)	0.427	0.459	0.315

Notes: Numbers in parentheses are robust standard errors. ***, **, and * refer to statistical significance at the 1, 5, and 10% levels, respectively.

expenditure as a proxy for innovation has been widely used in the literature (Brouwer and Kleinknecht, 1997; Inekwe, 2014; Hartmann, 2014; Sweet and Eterovic, 2015). Table 7 shows the results of the sensitivity analysis. The results generally confirm our initial findings discussed in the previous section. Precisely, innovation with a moderating effect of institutional quality positively impacts ECI. Institutional quality also positively affects economic complexity in Model 2. The inclusion of institutional quality as a moderating effect in Model 3 remains significant in the innovation-economic complexity relationship. In addition, GDPPC is found to be insignificant for this result, while export, FDI, and capital investment remain significantly positive in this corrected two-step GMM model. Hansen test values between 0.31 and 0.46 indicate no overfitting of instruments. Therefore, the previous interpretation of the role of institutional quality in the innovation–economic complexity link is unchanged.

V. Conclusion

This study empirically investigates the role of institutional quality in moderating the impact of innovation on economic complexity. Throughout the estimation, a corrected two-step SGMM estimation was employed for 68 countries from 1996 to 2020. Several important conclusions emerged from the analysis. First, empirical evidence revealed that institutional quality was important in moderating innovation's impact and was a statistically significant determinant of economic complexity. Second, the results also show that innovation positively impacts economic complexity. Third, adding institutional quality to the model's estimation produces a direct positive effect on economic complexity. Furthermore, utilizing R&D expenditures as a proxy for innovation also produces a similar result. Finally, only export, FDI, and capital investment are significant in explaining economic complexity.

While this study offers useful insights into the relationship between innovation, institutions, and economic complexity, several limitations should be acknowledged. First, the analysis uses country-level data, which may hide differences in institutional quality and innovation performance within countries. Second, the institutional quality indicators used in this study are subjective governance indicators and may not fully capture the real enforcement and effectiveness of governance. Third, this study focuses on macro-level relationships and does not explore firm- or industry-level mechanisms through which institutions influence innovation and economic complexity.

Future research could extend this analysis by drawing from alternative datasets and institutional measures. For instance, institutional quality may be examined using the International Country Risk Guide (ICRG) indicators published by the Political Risk Services Group or the Economic Freedom of the World (EFW) index provided by the Fraser Institute. Both of these sources may offer complementary perspectives on governance and institutional performance. Likewise, additional proxies for innovation, such as the Global Innovation Index (GII), may be incorporated to capture different dimensions of innovative activity, as each indicator has its own strengths and limitations. Finally, future studies should also explore whether the moderating role of institutions varies across income groups or regions, since institutions may exert different effects in advanced economies compared to emerging or developing countries.

From a policy perspective, the findings highlight the importance of strengthening institutional quality to maximize the benefits of innovation for economic complexity. Policymakers should design and implement reforms that enhance the effectiveness, transparency, and accountability of institutions, as stronger governance systems create an environment where innovative activities can thrive and translate into more sophisticated production structures. Efforts to improve institutional quality should focus on key governance dimensions such as political stability, regulatory quality, rule of law, and control of corruption. At the same time, governments should promote policies that support efficient business operations, fair competition, and collaboration among firms, while reducing bureaucratic barriers and transaction costs. Strengthening intellectual property protection and ensuring consistent policy enforcement can also encourage private-sector innovation and technology diffusion. Ultimately, a robust institutional framework is essential not only for fostering innovation but also for sustaining the diversification and upgrading of a country's productive capabilities.

REFERENCES

Acemoglu, D., Johnson, S. and J. A. Robinson. 2001. "The colonial origins of comparative development: An empirical investigation." *American Economic Review*, vol. 91, no. 5, pp. 1369-1401. https://doi.org/10.1257/aer.91.5.1369

Acemoglu, D., Gallego, F. A. and J. A. Robinson. 2014. "Institutions, human capital, and development." *Annual Review of Economics*, vol. 6, pp. 875-912. https://doi.org/10.1146/annurev-economics-080213-041119

Arellano, M. and O. Bover. 1995. "Another look at the instrumental variable estimation of error-components models." *Journal of Econometrics*, vol. 68, no. 1, pp. 29-51. https://doi.org/10.1016/0304-4076(94)01642-D

Balli, H. O. and B. E. Sørensen. 2013. "Interaction effects in econometrics." *Empirical Economics*, vol. 45, no. 1, pp. 583-603. https://doi.org/10.1007/s00181-012-0604-2

Brouwer, E. and A. Kleinknecht. 1997. "Measuring the unmeasurable: A country's non-R&D expenditure on product and service innovation." *Research Policy*, vol. 25, no. 8, pp. 1235-1242. https://doi.org/10.1016/S0048-7333(96)00902-X

Cohen, W. M. and D. A. Levinthal. 1990. "Absorptive capacity: A new perspective on learning and innovation." *Administrative Science Quarterly*, vol. 35, no. 1, pp. 128-152. https://doi.org/10.2307/2393553

D'Ingiullo, D. and V. Evangelista. 2020. "Institutional quality and innovation performance: Evidence from Italy." *Regional Studies*, vol. 54, no. 12, pp. 1724-1736. https://doi.org/10.1080/00343404.2020.1765230

Dollar, D. and A. Kraay. 2003. "Institutions, trade, and growth." *Journal of Monetary Economics*, vol. 50, no. 1, pp. 133-162. https://doi.org/10.1016/S0304-3932(02)00206-4

Donges, A., Meier, J. M. and R. C. Silva. 2022. "The impact of institutions on innovation." *Management Science*, vol. 69, no. 4, pp. 1951-1974. https://doi.org/10.1287/mnsc.2022.4403

Hartmann, D. 2014. *Economic complexity and human development: How economic diversification and social networks affect human agency and welfare*. Routledge. https://doi.org/10.4324/9780203722084

Hausmann, R., Hwang, J. and D. Rodrik. 2007. "What you export matters." *Journal of Economic Growth*, vol. 12, no. 1, pp. 1-25. https://doi.org/10.1007/s10887-006-9009-4

Hausmann, R., Hidalgo, C. A., Bustos, S., Coscia, M., Simoes, A. and M. A. Yildirim. 2013. *The atlas of economic complexity: Mapping paths to prosperity*. MIT Press. https://tinyurl.com/Atlas-2013

Hidalgo, C. A. 2021. "Economic complexity theory and applications." *Nature Reviews Physics*, vol. 3, no. 2, pp. 92-113. https://doi.org/10.1038/s42254-020-00275-1

Hidalgo, C. A. and V. Stojkoski. 2025. "The theory of economic complexity." arXiv preprint arXiv:2506.18829. https://doi.org/10.48550/arXiv.2506.18829

Inekwe, J. N. 2014. "The contribution of R&D expenditure to economic growth in developing economies." *Social Indicators Research*, vol. 124, no. 3, pp. 727-745. https://doi.org/10.1007/s11205-014-0807-3

Ivanova, I., Strand, Ø., Kushnir, D. and L. Leydesdorff. 2017. "Economic and technological complexity: A model study of indicators of knowledge-based innovation systems." *Technological Forecasting and Social Change*, vol. 120, pp. 77-89. https://doi.org/10.1016/j.techfore.2017.04.007

Law, S. H. and W. N. W. Azman-Saini. 2012. “Institutional quality, governance, and financial development.” *Economics of Governance*, vol. 13, no. 3, pp. 217-236. https://doi.org/10.1007/s10101-012-0112-z

Law, S. H., Sarmidi, T. and L. T. Goh. 2020. “Impact of innovation on economic growth: Evidence from Malaysia.” *Malaysian Journal of Economic Studies*, vol. 57, no. 1, pp. 113-132. https://doi.org/10.22452/MJES.vol57no1.6

Law, S. H., Tan, H. B. and W. N. W. Azman-Saini. 2014. “Financial development and income inequality at different levels of institutional quality.” *Emerging Markets Finance and Trade*, vol. 50, no. sup1, pp. 21-33. https://doi.org/10.2753/REE1540-496X5001S102

Lee, K. K. and T. V. Vu. 2020. “Economic complexity, human capital and income inequality: A cross-country analysis.” *Japanese Economic Review*, vol. 71, no. 4, pp. 695-718. https://doi.org/10.1007/s42973-019-00026-7

Nguyen, C. P., Schinckus, C. and T. D. Su. 2020. “The drivers of economic complexity: International evidence from financial development and patents.” *International Economics*, vol. 164, pp. 140-150. https://doi.org/10.1016/j.inteco.2020.09.004

North, D. C. 1990. *Institutions, institutional change and economic performance*. Cambridge University Press. https://doi.org/10.1017/CBO9780511808678

Romer, P. M. 1990. “Endogenous technological change.” *Journal of Political Economy*, vol. 98, no. 5, part. 2, pp. S71-S102. https://www.jstor.org/stable/2937632

Rubbo, P., Picinin, C. T. and L. A. Pilatti. 2021. “Innovation and economic complexity in BRICS.” *International Journal of Knowledge Management Studies*, vol. 12, no. 1, pp. 66-79. https://doi.org/10.1504/IJKMS.2021.112222

Sadeghi, P., Shahrestani, H., Kiani, K. H. and T. Torabi. 2020. “Economic complexity, human capital, and FDI attraction: A cross country analysis.” *International Economics*, vol. 164, pp. 168-182. https://doi.org/10.1016/j.inteco.2020.08.005

Sweet, C. and D. Eterovic. 2015. “Do stronger intellectual property rights increase innovation?” *World Development*, vol. 66, pp. 665-677. https://doi.org/10.1016/j.worlddev.2014.08.025

———. 2019. “Do patent rights matter? 40 years of innovation, complexity and productivity.” *World Development*, vol. 115, pp. 78-93. https://doi.org/10.1016/j.worlddev.2018.10.009

Tacchella, A., Cristelli, M., Caldarelli, G., Gabrielli, A. and L. Pietronero. 2012. “A new metrics for countries’ fitness and products’ complexity.” *Scientific Reports*, vol. 2, pp. 1-7. https://doi.org/10.1038/srep00723

UNESCO. 2021. *UNESCO Science Report: The race against time for smarter development*. UNESCO Publishing. https://unesdoc.unesco.org/ark:/48223/pf0000377433_eng

Vu, T. V. 2022. “Does institutional quality foster economic complexity? The fundamental drivers of productive capabilities.” *Empirical Economics*, vol. 63, pp. 1571-1604. https://doi.org/10.1007/s00181-021-02175-4

Windmeijer, F. 2005. “A finite sample correction for the variance of linear efficient two-step GMM estimators.” *Journal of Econometrics*, vol. 126, no. 1, pp. 25-51. https://doi.org/10.1016/j.jeconom.2004.02.005

Zhang, L., Gao, C. and Y. Nakamori. 2021. “Knowledge spillover driven by institutions: Evidence from the big science project in China.” *Journal of Knowledge Management*, vol. 25, no. 1, pp. 48-84. https://doi.org/10.1108/JKM-11-2019-0675

First version received on September 9, 2025
Peer-reviewed version received on November 23, 2025
Final version accepted on December 29, 2025