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Economic Complexity and Institutional Quality in OIC Countries: Evidence from a Panel Fourier Causality Analysis

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Abstract: This study examined the relationship between economic complexity and institutional quality indicators in the member states of the Organization of Islamic Cooperation. A balanced panel dataset covering the period 2002-2023 was constructed using the Economic Complexity Index and the indicators of Rule of Law, Control of Corruption, and Efficiency of Public Administration. The analysis employed the Panel Fourier Toda-Yamamoto causality approach, which allowed structural breaks and institutional fluctuations to be considered within the panel framework. The findings indicated a statistically significant one-way causality running from economic complexity to Rule of Law and Control of Corruption. However, no statistically significant causality was identified from institutional quality indicators to economic complexity in the short term. These results suggest that, in Organization of Islamic Cooperation countries, the development of economic structures plays an important role in shaping institutional mechanisms.

Keywords: Economic complexity, Rule of law, Control of corruption, Government effectiveness, Panel Fourier causality test

JEL Codes: O43, O57, C23

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Introduction

A country's long-term prosperity and growth potential depend not only on the accumulation of physical and human capital, but also on the knowledge intensity embedded in its production structure. Hidalgo and Hausmann (2009) developed the economic complexity framework as the most systematic expression of this approach. For them, the fundamental factor determining a country's productive capacity is "non-tradable capabilities", which are not directly observable but are integrated into production processes. Since these implicit capabilities cannot be measured directly, the method of reflections, based on the network structure between countries and the products they export, was developed. This method evaluates a country's export basket through the dimensions of diversity and ubiquity. Economies that export a diverse range of products, especially products produced by relatively few other countries, are considered to possess more complex productive capabilities (Hidalgo & Hausmann, 2009: 10570). Put differently, the production of high value-added and technologically advanced goods generally requires the integration of specialized and scarce capabilities. Accordingly, a country's capacity to manufacture and export relatively uncommon products can be interpreted as an indirect indicator of knowledge-based productive capacity. From this perspective, economically complex countries are those capable of exporting a wide array of sophisticated products, reflecting high diversification and limited product ubiquity. In contrast, economies concentrated on producing a narrow set of widely available goods tend to display lower economic complexity, indicating constrained productive capabilities (Vu, 2022: 1577).

Drawing on these conceptual foundations, economic complexity can be understood as a composite criterion that captures both the skill intensity and productive capacity of national economies, while simultaneously incorporating the ubiquity of exported goods and the range of countries involved in their production (Karanfil & Kılıç, 2022: 38). At its core, the concept rests on the premise that manufacturing any given good or service necessitates the integration of diverse and often tacit forms of knowledge. This integration creates the conditions for innovation and increasingly sophisticated production, making the economy a complex and continuously evolving system (Pérez Balsalobre et al., 2017: 2). The Economic Complexity Index, constructed in accordance with this reasoning, serves as a measure of the relative knowledge intensity embedded within a given economy (OEC, 2026). Notably, Hidalgo and Hausmann (2009) argued that economic complexity carries greater explanatory leverage than per capita income — not merely for accounting

for prevailing income disparities, but more critically for anticipating future trajectories of economic growth. In line with this view, Pérez Balsalobre et al. (2019: 4) and Khan et al. (2020: 374) argue that complexity-based economic indicators provide a more precise analytical lens for examining the long-term determinants of economic growth.

Economic complexity is both a technological-industrial phenomenon and a process fundamentally intertwined with institutional arrangements. Acemoğlu et al. (2010: 1370-1371) emphasize that a "cluster of institutions" –consisting of effective constraints on the state's power to expropriate, an independent and impartial judiciary, reliable protection of property rights, institutional arrangements ensuring equal access to education, and structures guaranteeing civil liberties – is a primary determinant that incentivizes investment decisions and supports long-term growth. Effective institutional frameworks enhance incentives for innovation-driven entrepreneurship, facilitate the development of human capital, and promote the allocation of labor toward the acquisition of productive competencies. This process fosters a structural transformation toward productive activities, enabling the emergence of more complex and knowledge-intensive production structures, thereby contributing to higher levels of economic complexity (Vu, 2022: 1571). Thus, economic complexity is an indicator that indirectly reflects both the technical content of the productive structure and the institutional infrastructure that sustains it. Research by Nawaz et al. (2014), Şahin (2018), Vu (2022), Hoang and Chu (2023), Şanlı et al. (2024), Shahabadi and Pouran (2024), D'Ingiullo et al. (2024), and Yay et al. (2025) demonstrates that institutional quality has a statistically significant and positive effect on economic indicators. However, economic complexity should therefore be understood as an outcome marked by institutional quality and, at the same time, as a structural force that may transform institutional arrangements over time. Hartmann et al. (2017: 77) similarly argue that the relationship between institutions and economic complexity develops through mutual interaction and co-evolution, rather than through a single direction of influence.

According to North's approach, institutions are the fundamental structures that define the framework of political, economic, and social interactions and guide individual behavior. North (1990: 3) defines institutions as the "rules of the game" that reduce uncertainty and shape incentive structures in human interactions. Simultaneously, institutions represent a broad ensemble of organizations encompassing political, economic, social, and educational spheres. In this framework, political institutions consist of political parties, parliaments, municipal councils, and regulatory agencies, whereas economic institutions comprise firms, trade unions, family busi-

nesses, and cooperatives. Social institutions include places of worship, NGOs, clubs, and sports associations; on the other hand, educational institutions cover schools, universities, and vocational training centers. These institutions are collective entities formed by individuals coming together around common rules and norms to achieve specific objectives (North, 1990: 5). In recent years, the concept of institutions has expanded to include numerous elements such as transaction costs, property rights protection, the rule of law, and political stability; as such, institutions have become a core analytical framework for analyzing relationships among economic actors and explaining how economic activities are shaped (Yamak, 2017: 66).

Institutions have a multi-layered structure composed of formal norms, such as legal regulations and official rules, alongside informal norms, customs, social beliefs, and established patterns of behavior. These formal and informal elements integrate around a common institutional core that determines how economic and political activities are conducted, guiding individual decision-making processes (North, 1990: 3). Consequently, institutions emerge as a fundamental determinant shaping economic performance and long-term development dynamics. Indeed, institutional structures can positively impact economic performance by reducing transaction and transformation costs, making interactions between economic units more predictable and secure, and limiting market failures. Effective institutions lower unnecessary transaction costs arising from asymmetric information and bureaucratic hurdles, enabling resources to be procured at lower costs and directed toward productive areas. Simultaneously, they enhance the reliability of economic transactions, contributing to the development of savings and investment channels, productivity gains in production, and the expansion of trade. The alignment of institutional stability with economic and political stability supports sustainable long-term growth by reducing the misallocation of resources. Furthermore, institutions allow for more effective oversight of economic activities by reducing informality, increasing transparency, and limiting corruption (Yaprakl ı, 2008: 303-304). Shahabadi and Pouran (2024: 8080-8081) also emphasize that an effective institutional structure facilitates participation in economic activities, creating appropriate incentives for adopting new technologies, skill acquisition, and investment in productive capacity development. This mechanism supports the "self-discovery" processes of individuals and firms, which contributes to a more knowledge-intensive and diversified production structure. In contrast, Khan et al. (2020: 378) state that weak institutional quality increases the perceived distance between host and home countries, leading to higher transaction costs that negatively affect investment and production decisions.

Despite the extensive scholarly attention devoted to the nexus between economic performance indicators and institutional quality, no definitive agreement has emerged regarding the precise conditions and transmission channels through which this relationship unfolds. The preponderance of available research has approached institutional quality as an explanatory variable for economic outcomes, whereas the converse possibility – namely, that rising knowledge and technology intensity within productive structures may gradually reshape institutional configurations – has attracted only marginal empirical scrutiny. The present study is motivated by this lacuna and undertakes an empirical investigation of the directional dynamics linking economic complexity with a set of institutional quality indicators. The empirical analysis draws on a balanced panel dataset encompassing the Organization of Islamic Cooperation (OIC) member states over the 2002–2023 timeframe. On the institutional side, the study employs three governance dimensions, including Rule of Law, Control of Corruption, and Government Effectiveness, and operationalizes the knowledge intensity of productive structures through the Economic Complexity Index. Given the pronounced institutional volatility and structural discontinuities characteristic of OIC economies, the Panel Fourier Toda–Yamamoto (PFTY) causality procedure is adopted, as this technique is capable of accommodating both abrupt and gradual structural transitions within the estimation framework. Through this approach, the study endeavors to clarify the causal structure underlying the interaction between economic complexity and institutional quality.

The rest of the paper is structured as follows: initially, prior empirical studies examining the nexus between economic indicators and institutional quality are reviewed, with particular emphasis on identifying prevailing patterns and common conclusions in the literature. Next, the dataset and the econometric methodology are presented in detail. Subsequently, the empirical findings from the PFTY causality test are provided. Finally, a general evaluation is conducted in light of the findings, with policy implications and recommendations discussed in the concluding section.

Literature

Empirical inquiry into the interplay between economic performance and institutional quality has expanded considerably over time, spanning an increasingly heterogeneous range of country samples, analytical periods, and estimation techniques. The studies falling within this domain seek to illuminate the functional role of

institutional arrangements by examining their association with a variety of macroeconomic outcomes, with economic growth and economic complexity featuring most prominently among them. What follows is a structured overview of this literature, organized around the samples employed, the methodological approaches adopted, and the principal findings reported.

Table 1

Summary of the Empirical Findings in the Literature Review

Author(s)	**Country**	**Period**	**Methodology**	**Findings**
Butkiewicz and Yanıkkaya (2006)	100 countries	1970-1999	Seemingly Unrelated Regression (SUR) and Three-Stage Least Squares (3SLS)	The rule of law exerted a statistically significant and positive influence on economic growth. Although voice and accountability appeared statistically insignificant in the SUR estimations, their effects turned positive and significant when IV estimation was applied.
Yapraklı (2008)	36 upper- and middle-income countries	2002-2005	Panel Data Analysis	Economic growth was positively and significantly shaped by government effectiveness and control of corruption. In contrast, other governance dimensions, including voice and accountability, political stability and absence of violence, regulatory quality, and the rule of law, demonstrated a negative association with growth.
Nawaz et al. (2014)	35 Asian countries	1996-2012	Fixed-effects and System GMM	The findings reveal that institutional quality constitutes a significant positive determinant of economic growth.
Alsharif and Bhattacharyya (2016)	157 countries	1962-2012	Fixed-effects Panel Data Analysis	Large-scale oil discoveries delay export diversification, but democratic political institutions mitigate this negative effect.

Hartmann et al. (2017)	Global sample	1963-2008	Pooled OLS and Fixed-effects Panel Data Analysis	Income inequality is significantly and negatively influenced by economic complexity, pointing to the equalizing potential of knowledge-intensive productive structures.
Kočenda and Poghosyan (2017)	101 countries	2001-2015	System GMM	Inadequacies in the rule of law had a negative impact on economic complexity.
Şahin (2018)	12 MENA countries	2002-2015	Random-effects Panel Data Analysis	Economic growth was significantly enhanced by governance quality, whereas political freedoms remained statistically insignificant as a determinant of growth.
Khan et al. (2020)	China	1985-2017	ARDL and VECM Granger Causal Relationships	One-way causal relationship from economic sophistication to foreign direct investment in the short term and a two-way relationship in the long term.
Vu (2022)	115 countries	2000-2010	OLS, Instrument Variables (IV), and System GMM	Higher institutional quality is found to exert a statistically significant and favorable influence on economic complexity.
Shahzad et al. (2022)	28 OECD countries	1990-2019	Quantile Regression, FMOLS, and DOLS	Export quality, economic complexity, and renewable energy have positive and significant effects on growth.
Aygün and Şahbaz Kılınç (2023)	38 OECD countries	2002-2020	Augmented Mean Group (AMG) Panel Data Analysis	While political stability, regulatory quality, and the rule of law were identified as significant contributors to growth, the positive effects of corruption control, government effectiveness, and voice and accountability fell short of statistical significance.

Hoang and Chu (2023)	98 countries	2002-2017	System GMM	Economic complexity is positively shaped by institutional quality, with middle-income countries benefiting more substantially from this relationship compared to high-income economies.
Şanlı et al. (2024)	97 countries	1995-2020	Two-step System GMM	Institutional quality significantly boosted economic complexity across all groups, while education's effect was only positive in the high-income group.
Shahabadi and Pouran (2024)	D-8 countries	1995-2019	FMOLS	Interaction of the active population, institutional quality, and globalization significantly increases economic complexity.
Özgün (2024)	New Fragile Five	2002-2022	Panel ARDL	Economic indicators were positively influenced by regulatory quality and the rule of law in the long term, whereas government effectiveness and corruption control emerged as negative determinants over the same period.
D'Ingiullo et al. (2024)	103 Italian provinces	2004-2016	System GMM	Economic complexity is path-dependent and that institutional quality at the local level is a key determinant.
Yay et al. (2025)	G20 countries	2002-2022	Two-step System GMM	Institutional quality positively impacts economic growth, especially in emerging economies.

A considerable share of the available evidence points to a constructive role for institutional quality and sound governance in sustaining economic growth. Aygün and Şahbaz Kılınç (2023) established that political stability, regulatory quality, and adherence to the rule of law each exert statistically meaningful and growth-enhancing effects. In a similar vein, Butkiewicz and Yanıkkaya (2006) documented that rule of law provisions are conducive to growth acceleration, whereas Şahin (2018) drew attention to a favorable association between governance standards and growth performance. Nawaz et al. (2014), meanwhile, concluded that institu-

tional arrangements yield net positive effects on growth, though the magnitude of this effect proves considerably more pronounced in advanced economies than in their developing counterparts – an observation that underscores the mediating role of development stage in shaping institutional returns.

The relationship between institutional quality and economic growth varies across governance dimensions. Yamak (2017) found that freedom of expression and control of corruption have growth-enhancing effects, whereas the rule of law and regulatory quality are associated with negative outcomes. Yapraklı (2008) reached a similar conclusion, showing that government effectiveness and corruption control support growth, while political stability, regulatory quality, the rule of law, and freedom of expression are negatively related to economic performance.

Academic scholarship has reached a general agreement that well-functioning institutional environments tend to foster higher levels of economic complexity and more sophisticated export structures. Among the contributing studies, Vu (2022) established institutional quality as a primary determinant of economic complexity, and this relationship was subsequently refined by Hoang and Chu (2023), whose analysis revealed that the effect in question is considerably stronger among middle-income countries compared to their high-income counterparts. Building on this trajectory, Şanlı et al. (2024) argued that institutional quality functions as a meaningful predictor of complexity irrespective of a country's income classification. Indirect corroboration comes from Kočenda and Poghosyan (2017), who found that deficiencies in institutional structures – the rule of law in particular – erode the sophistication of export portfolios. Shahabadi and Pouran (2024) drew attention to the compounded effect of institutional quality when combined with globalization and labor force participation, showing that their interaction substantially elevates economic complexity. At the subnational scale, D'Ingiullo et al. (2024) similarly established that local institutional conditions carry decisive weight in determining export complexity patterns. Approaching the matter from a resource endowment perspective, Alsharif and Bhattacharyya (2016) demonstrated that robust democratic governance can counterbalance the adverse effects that significant oil discoveries tend to exert on export diversification.

The literature further suggests that increasing economic complexity generates positive or corrective outcomes for various macroeconomic indicators. Shahzad et al. (2022) demonstrated that economic complexity positively and significantly contributes to economic growth, while Hartmann et al. (2017) showed that higher levels of complexity are associated with lower income inequality, implying that eco-

nomic complexity acts as a negative (improving) predictor of inequality. Khan et al. (2020) emphasized a bidirectional long-run causality relationship between economic complexity and foreign direct investment (FDI). However, studies examining the institutional determinants of FDI reveal mixed findings. Özgün (2024) found that regulatory quality, rule of law, political stability, and freedom of expression positively affect FDI in the long run, whereas government effectiveness and control of corruption unexpectedly exert negative effects.

Although the existing literature provides considerable evidence regarding the relationship between institutional quality, economic growth, and economic complexity, some issues remain open to further discussion. First, a large part of the empirical literature primarily focuses on the relationship between institutional quality and economic growth, whereas studies directly examining the interaction between economic complexity and institutional quality are relatively limited. Second, previous studies generally concentrate on OECD countries, high-income economies, or broad global samples, while OIC countries have received comparatively less attention despite their diverse institutional and economic structures. Third, many existing studies employ conventional panel data techniques that may not fully capture structural changes and institutional fluctuations observed over time. In this context, the consideration of structural shifts may contribute to a more comprehensive evaluation of the causal relationships between the variables.

The present study makes several contributions to this debate. First, it focuses specifically on OIC member states and provides new empirical evidence on a country group that remains relatively underexamined in the economic complexity literature. Second, it uses the Economic Complexity Index as the main measure of productive sophistication, as the index captures the knowledge intensity and technological depth of national production structures beyond conventional output-based indicators. Third, the study applies the PFTY causality framework, which is particularly suitable for analyzing gradual structural transitions and institutional volatility without relying on restrictive break assumptions. These geographical, conceptual, and methodological choices allow the study to offer a more nuanced empirical account of the interaction between institutional quality and economic complexity in OIC countries.

Data and Methodology

This study, which aims to examine the causal relationship between economic complexity and institutional quality in OIC member countries, utilizes indicators for the Rule of Law, Control of Corruption, and Government Effectiveness as proxies for institutional quality, alongside the Economic Complexity Index to reflect the economic structure. In constructing the dataset, countries providing complete observations for all variables during the 2002–2023 period were included in the sample, while those with missing data were excluded. Consequently, the analysis covers 44 OIC member countries[1] where data integrity could be ensured.

Table 2

Variables Used in the Analysis

Variables	Abbreviation	Unit of Measurement	Source
Economic Complexity Index	ECI	ECI values are generally observed within a range of approximately –3 to +3	Growth Lab at Harvard University (2025)
Rule of Law	RL	RL, CC and GE values are observed within a range of approximately –2.5 to +2.5	World Bank (2025)
Control of Corruption	CC		World Bank (2025)
Government Effectiveness	GE		World Bank (2025)

As shown in Table 2, the ECI variable was obtained from the database published by the Growth Lab at Harvard University (2025). The ECI indicator offers structural insights into the development capacity of countries by measuring the knowledge intensity of their production and export structures. In contrast, the RL, CC, and GE variables were sourced from the World Bank's (2025) Worldwide Governance Indicators (WGI) database. These three indicators were specifically selected as proxies for institutional quality because they directly measure the "executive-implementation" axis of the governance system and exert stronger micro-institutional effects on the sustainability of economic activities compared to other WGI components. Furthermore, these selected indicators focus on core instituti-

1 The following countries have been excluded: Brunei Darussalam, Comoros, Djibouti, Gambia, Guinea-Bissau, Guyana, Iraq, Maldives, Palestine, Sierra Leone, Somalia, Suriname, and Syria.

onal mechanisms that directly shape economic decisions, such as market functionality, contract enforcement capacity, public administration performance, and the mitigation of corruption risks. Therefore, these three indicators were preferred for empirically testing the impact of economic complexity on institutional quality[2].

Table 3

Descriptive Statistics of the Dataset

	ECI	**RL**	**CC**	**GE**
Mean	-0.6302	-0.5940	-0.6325	-0.5226
Maximum	1.2870	0.9807	1.5587	1.6043
Minimum	-2.8900	-1.9225	-1.7126	-2.3624
Standard Deviation	0.6922	0.6403	0.6275	0.6682
Skewness	0.0270	0.3490	0.8200	0.5196
Kurtosis	2.9936	2.4496	3.2789	3.3586
Jarque Berra (JB)	0.1192	31.8644	111.6139	48.7449
JB Probability	0.942	0.000	0.000	0.000
Observations	968	968	968	968

The descriptive statistics for the variables are presented in Table 3. The fact that all mean values are below zero indicates that ECI, along with RL, CC, and GE indicators, generally follow low levels in OIC countries. The wide range between minimum and maximum values points toward significant country heterogeneity in terms of both economic structure and institutional quality. Standard deviations ranging approximately between 0.62 and 0.69 suggest a moderate dispersion in the variables. Skewness coefficients are observed to be positive and low, indicating that the distributions are concentrated toward lower values, with a few high-performing countries causing a limited rightward pull. Kurtosis values between 2.45 and 3.36 reveal that the distributions are close to normal. According to the JB test results, while the assumption of normal distribution is rejected for RL, CC, and GE, a structure close to normal distribution is observed for the ECI series. This can be considered a natural reflection of political fluctuations and structural breaks in institutional indicators. The balanced panel structure consisting of 968 observations

2 All empirical analyses were conducted using EViews 13 and GAUSS 25 software packages. The GAUSS codes used for the PFTY causality analysis were obtained from the corresponding author of Yılancı and Görüş (2020). Since the study draws on publicly accessible databases and the relevant GAUSS codes are available upon request, the empirical findings are reproducible by other researchers.

for all variables provides a significant advantage for the Fourier-based method to be applied in the subsequent stage.

In this study, the PFTY causality test, developed by Yılancı and Görüş (2020), is utilized as it offers the most methodologically suitable framework for OIC countries, where institutional fluctuations, abrupt policy breaks, and gradual regime changes are frequently observed. This approach is built upon the synthesis of four fundamental contributions to causality analysis in the empirical literature. The theoretical foundation of the method rests on the works of Toda and Yamamoto (1995), Emirmahmutoğlu and Köse (2011), Enders and Jones (2016), and Nazlıoğlu et al. (2016).

The method proposed by Toda and Yamamoto (1995) highlights the excessive sensitivity of the traditional Granger causality test to pre-tests (unit root, cointegration, lag selection, etc.) and suggests estimating a VAR model of order *(k + dmax)* to overcome this issue. Here, *k* represents the optimal lag length ensuring stability, while *dmax* denotes the maximum degree of integration of the series in the model. This feature allows for the testing of reliable causal relationships among series with different integration levels. The extension of the Toda–Yamamoto approach to a panel data framework was achieved by Emirmahmutoğlu and Köse (2011). This developed panel causality test enables the investigation of causality regardless of the stationary levels of the units or the potential cointegration relationships between them. Bootstrap-based probability values calculated for each unit are aggregated to the panel level using a Fisher-type meta-analysis method. However, since the Fisher statistic loses its validity under cross-sectional dependence, Emirmahmutoğlu and Köse (2011) addressed this issue through bootstrap simulations.

Structural breaks can significantly affect the results of causality analysis, particularly in developing country groups where institutional fluctuations are intense. While sharp breaks are relatively easy to detect, gradual regime shifts are difficult to capture with traditional tests. Therefore, Enders and Jones (2016) developed a causality test that incorporates the Fourier function into VAR models, enabling the simultaneous capture of both abrupt and gradual structural changes. The Fourier approach increases the model's sensitivity to structural changes as it does not require prior specification of the number, dates, or form of the breaks. Accordingly, Nazlıoğlu et al. (2016) integrated the Fourier approach into the Toda–Yamamoto framework, proposing a more flexible and robust time-series causality test. Finally, Yılancı and Görüş (2020) brought these two developments to the panel level, introducing the PFTY causality test to the literature. The PFTY approach combines the

advantages of panel data structure with Fourier flexibility, which provides a causality analysis sensitive to structural breaks and independent of integration degrees. The equations for this test are as follows:

$$y_{i,t} = \mu_i + \sum_{j=1}^{k_i+dmax_i} A_{11,ij} y_{i,t-j} + \sum_{j=1}^{k_i+dmax_i} A_{12,ij} x_{i,t-j} + A_{13} sin\left(\frac{2\pi t f_i}{T}\right) + A_{14} cos\left(\frac{2\pi t f_i}{T}\right) + u_{i,t} \quad (1)$$

$$x_{i,t} = \mu_i + \sum_{j=1}^{k_i+dmax_i} A_{21,ij} x_{i,t-j} + \sum_{j=1}^{k_i+dmax_i} A_{22,ij} y_{i,t-j} + A_{23} sin\left(\frac{2\pi t f_i}{T}\right) + A_{24} cos\left(\frac{2\pi t f_i}{T}\right) + u_{i,t} \quad (2)$$

Equation 1 and Equation 2 represent the two-variable panel VAR structure that forms the basis of the PFTY causality test. This structure models the dynamic relationships between the $y_{i,t}$ and $x_{i,t}$ variables for each country through lagged values and also offers a flexible form that includes Fourier terms. Thus, the model can capture both sudden and gradual structural changes within a single functional framework. The expressions $\sum_{j=1}^{k_i+dmax_i}$ in the equations represent the extended VAR structure obtained by adding the maximum integration degree (dmax) to the optimal lag length (k), as required by the Toda–Yamamoto approach. Thanks to this feature, the fact that the series have different integration levels does not affect the validity of the causality analysis. The terms representing the Fourier components, $sin\left(\frac{2\pi t f_i}{T}\right)$ and $cos\left(\frac{2\pi t f_i}{T}\right)$, incorporate soft and hard regime shifts into the model without requiring prior knowledge about the form, timing, or number of structural breaks. Thus, the non-linear changes in the institutional and economic structure over time are flexibly reflected in the VAR system. In this context, Equation 1 shows how $y_{i,t}$ is determined based on its own lagged values, the lags of $x_{i,t}$, and Fourier terms. Equation 2 expresses the corresponding model established for $x_{i,t}$ within the same structure. When both equations are evaluated together, the presence or absence of a directional relationship between the variables is tested through the statistical significance of the lagged coefficients.

The PFTY approach offers important methodological advantages for panel causality analysis. Since it is based on the Toda-Yamamoto framework, the analysis remains valid even when the series have different orders of integration. This is achieved by augmenting the lag structure with the maximum integration order, allowing causality to be tested independently of stationarity properties. The method also removes the need for preliminary cointegration testing among the variables, thereby reducing the risk of errors arising from pre-test procedures. Another advantage of the method is that it takes into account the cross-sectional dependence frequently encountered in panel data structures through bootstrap-based critical

values. This feature increases the reliability of the method, especially for countries whose economic and institutional structures are affected by similar shocks (Yılancı and Görüş, 2020: 40557).

Empirical Results

This section presents the empirical findings of the analysis. It first tests for cross-sectional dependence in order to identify whether common shocks or similar institutional dynamics exist among the countries in the panel dataset. This assessment guided the subsequent stages of the analysis, including the selection of the appropriate panel unit root test and the configuration of the PFTY approach. The stationarity properties of the series were then examined, and the results obtained from the Im, Pesaran, and Shin (IPS) and Cross-Sectionally Augmented IPS (CIPS) unit root tests were evaluated comparatively. In the final stage, the PFTY causality test was applied to identify the directional relationships between the variables, with the findings interpreted in relation to the structural characteristics of the series. Cross-sectional dependence was assessed using the Cross-Section Dependence (CD) test developed by Pesaran (2004), and the results are presented in Table 4.

Table 4

Findings of the CD Test

Variables	CD Test	Probability
ECI	0.230	0.818
RL	**2.030****	**0.042**
CC	0.440	0.658
GE	0.450	0.650

Note: ** indicates 5% significance level.

The cross-sectional dependence results reported in Table 4 showed no statistically significant dependence for the ECI, CC, and GE variables ($p > 0.05$). By contrast, the CD statistic for the RL variable was significant at the 5% level, indicating the presence of cross-sectional dependence. This result suggests that the Rule of Law indicator was more sensitive to common institutional shocks or similar governance dynamics across the countries in the panel. Overall, the absence of cross-sectional dependence in most variables points to the predominance of country-specific heterogeneity within the dataset. However, the detected dependence in the RL variable required the CIPS results to be taken into account when interpreting the unit root findings. Table 5 presents the results of the IPS test developed by Im et

al. (2003) and the CIPS test developed by Pesaran (2007).

Table 5

Results of Panel Unit Root Tests

Variables	**IPS Test**	**Probability**
ECI	**-6.166*** **	**0.000**
RL	-0.802	0.212
ΔRL	**-13.682*** **	**0.000**
CC	**-1.699** **	**0.045**
GE	0.182	0.572
ΔGE	**-14.256*** **	**0.000**
Variables	**CIPS Test (Constant)**	**Probability**
ECI	**-2.237*** **	**0.001**
RL	-1.630	0.813
ΔRL	**-3.079*** **	**0.000**
CC	-1.570	0.903
ΔCC	**-3.163*** **	**0.000**
GE	-1.514	0.953
ΔGE	**-2.996*** **	**0.000**
Variables	**CIPS Test (Constant and Trend)**	**Probability**
ECI	**-2.615** **	**0.015**
RL	-2.124	0.907
ΔRL	**-3.171*** **	**0.000**
CC	-2.117	0.916
ΔCC	**-3.220*** **	**0.000**
GE	-1.985	0.990
ΔGE	**-3.127*** **	**0.000**

Note: *** and ** indicate 1% and 5% significance levels, respectively.

Table 5 reports the results of the IPS and CIPS unit root tests, providing a comparative assessment of the stationarity characteristics of the variables. The IPS test results indicate that the ECI and CC series are stationary in their level form. However, the RL and GE series exhibit non-stationarity at levels and attain stationarity after first differencing, suggesting the presence of heterogeneous integration orders within the panel dataset. In light of the CD test results, the CIPS test outco-

mes are particularly relevant for interpreting the stationarity properties of the RL variable. The CIPS results confirmed that the ECI series was stationary in both the fixed and fixed-trend specifications. By contrast, the RL, CC, and GE variables were non-stationary at level and became stationary after first differencing. The strong statistical significance of the ΔRL, ΔCC, and ΔGE statistics further supported this result. Taken together, the IPS and CIPS findings indicated a mixed order of integration across the panel, with the series displaying both I(0) and I(1) properties. This structure provided a suitable basis for applying the Toda-Yamamoto-based causality framework, in which the maximum integration order is incorporated into the model. Table 6 presents the findings of the PFTY causality test.

Table 6

Findings of the PFTY Causality Test

Null Hypothesis	Panel Fisher Test	Bootstrap Probability
ECI ↛ RL	**135.8223*** **	**0.001**
RL ↛ ECI	94.7463	0.293
ECI ↛ CC	**127.4670*** **	**0.004**
CC ↛ ECI	94.1170	0.308
ECI ↛ GE	84.1820	0.595
GE ↛ ECI	103.9246	0.118

Note: *** indicates 1% significance level.

When the Panel Fisher statistics and bootstrap probability values shown in Table 6 are evaluated together, a strong causal relationship at the 1% significance level was found from ECI to RL. In contrast, no causality was found from RL to ECI. This finding indicates that as the knowledge intensity of the economic structure increases, the institutional and legal framework tends to strengthen, while the legal-institutional structure alone does not appear to drive economic complexity in the short term, offering a distinct perspective on the dominant arguments in the literature. Indeed, studies by Butkiewicz and Yanıkkaya (2006), Kočenda and Poghosyan (2017), Aygün and Şahbaz Kılınç (2023), and Özgün (2024) argue that the rule of law is a fundamental institutional input that supports economic performance. However, current research findings indicate that the qualitative transformation of the economic structure triggers institutional quality, suggesting that institutional development may be an outcome of economic complexity. On the other hand, the direction of the effect of the rule of law on economic performan-

ce is a subject of debate in the literature. For example, Yapraklı (2008) reached a counterintuitive finding that the rule of law may negatively affect economic performance. The unidirectional causality identified in this study supports the view that developed and complex production structures raise legal and institutional standards, while legal and institutional arrangements do not directly increase economic complexity in the short term.

Table 6 also shows a statistically significant causal relationship at the 1% level from ECI to CC. However, no causality was found from CC to ECI. This result shows that increasing the sophistication level of the production and export structure strengthens the capacity to combat corruption, but that institutional control of corruption does not directly determine economic complexity, adding a new dimension to the ongoing debate in the literature on the relationship between institutional quality and economic performance. A review of the literature reveals that there is no consensus on the effect of corruption control on economic performance. Yapraklı (2008) argues that combating corruption is a critical factor in improving economic performance, whereas Özgün (2024) suggests that controlling corruption can paradoxically have negative effects on economic performance. On the other hand, Aygün and Şahbaz Kılınç (2023) have not found a statistically significant relationship between these two variables. The one-sided causality relationship presented in the study supports the hypothesis that institutional development may be a result of the economic structure becoming more sophisticated.

Furthermore, Table 6 shows that there is no bidirectional causality relationship between ECI and GE. The statistical insignificance of both ECI $\nrightarrow$ GE and GE $\nrightarrow$ ECI relationships indicates that the government effectiveness indicator may be a more static and structural institutional element that does not reflect economic complexity dynamics in OIC countries in the short term. This result reflects the divergent views in the literature and the continuing empirical uncertainty surrounding the role of government effectiveness, one of the core components of institutional quality, in shaping economic performance. In the literature, Yapraklı (2008), who approaches the relationship between government effectiveness and economic performance from a positive perspective, argues that the quality of public bureaucracy and the capacity for service delivery directly improve economic performance. In contrast, Özgün (2024) identifies a negative relationship between government effectiveness and economic performance, indicating that institutional interventions or bureaucratic structures may have restrictive effects on economic performance. On the other hand, the finding by Aygün and Şahbaz Kılınç (2023) that no

significant relationship exists is consistent with the results of this study. This lack of a two-way relationship indicates that the information-intensive and sophisticated structure of economic complexity may follow a development path independent of the government's operational efficiency. Similarly, it reveals that an increase in the government's administrative capacity is not always a sufficient driving force for transforming the technological depth and product diversity of the production structure. In the context of OIC countries, this finding may also be associated with the relatively gradual and structural nature of bureaucratic transformation processes. Government effectiveness generally reflects long-term administrative capacity, public service quality, and institutional coordination mechanisms that may not respond rapidly to changes in production sophistication and technological diversification. In several OIC economies, economic complexity may evolve through external trade integration, natural resource revenues, or private-sector dynamics without generating an immediate transformation in bureaucratic effectiveness. Therefore, the absence of statistically significant causality may indicate that changes in production complexity and changes in administrative effectiveness do not necessarily occur simultaneously in the short run.

Overall, the findings in Table 6 show that economic complexity has a guiding effect on certain components of institutional quality, while the same effect is not observed from institutions to economic complexity. This suggests that, in OIC countries, increases in the knowledge intensity of the production structure are associated with improvements in specific governance dimensions, whereas institutional development alone does not appear to generate economic complexity.

Conclusion

The relationship between economic complexity and institutional quality shows that development cannot be assessed solely through quantitative growth indicators, as it also requires attention to the quality of the productive structure and the capacity of governance mechanisms. The emergence of more knowledge-intensive and diversified production structures depends on technological progress and capital accumulation, while remaining closely connected to the historical formation of institutional functioning. In this sense, economic complexity goes beyond measuring the knowledge embedded in production and export structures and points to the transformative capacity of the social and institutional order. Institutional quality, in turn, provides the framework through which resource allocation, investment decisions, and production choices are shaped by reducing the uncertainties faced

by economic actors. The interaction between these two phenomena is therefore central to understanding development as a dynamic and multidimensional process.

During the analysis, a methodological framework was adopted that moved beyond conventional causality approaches by taking into account the heterogeneity, time-dependent fluctuations, and non-linear breaks observed in the economic and institutional structures of OIC countries. The PFTY causality test used in this study made it possible to test causal relationships regardless of the integration order of the variables and allowed structural changes, whether abrupt or gradual, to be incorporated flexibly into the model. This methodological choice strengthened the reliability of the results, particularly for country groups in which institutional indicators may respond non-linearly to policy shifts, governance reforms, and external shocks.

The empirical findings showed that economic complexity exerted a guiding influence on specific dimensions of institutional quality. Increases in the knowledge intensity of production and export structures were found to strengthen institutional mechanisms related to the Rule of Law and Control of Corruption. No statistically significant causality was detected from institutional quality indicators to economic complexity. The absence of a significant directional relationship between Efficiency of Public Administration and economic complexity may reflect the fact that this indicator captures more stable and long-term institutional characteristics. Overall, the results indicated that rising levels of knowledge and technology in the economic structures of OIC countries can encourage improvements in certain dimensions of institutional functioning, although institutional development does not appear to operate as a direct determinant of economic complexity in the short term. These findings suggest that policies focused on the quality of the productive structure may generate indirect yet meaningful effects on institutional transformation.

The findings also indicated that development policies built solely around institutional reform may produce limited results. For this reason, policies aimed at strengthening institutional quality in OIC countries should be coordinated with industrial, innovation, and education policies designed to increase the knowledge and technology content of production and export structures. Strategies that encourage the production of more sophisticated and less ubiquitous goods may raise levels of economic complexity and, through this channel, produce corrective effects on the functioning of the legal order and the capacity to control corruption. Within this framework, priority should be given to selective industrial policies that

support productive diversification, human capital investments directed toward skill-intensive sectors, and institutional arrangements that facilitate technology transfer.

Since the findings showed that institutional reforms do not automatically increase economic complexity in the short term, improvements in governance should be approached through a long-term and gradual perspective. Regulations concerning the Rule of Law, Control of Corruption, and Efficiency of Public Administration should be integrated with concrete practices that directly support productive activity, as this could strengthen the effect of institutional change on the economic structure. Given the structural differences among OIC countries, flexible strategies should also be developed in line with country-specific production profiles and institutional capacities, instead of relying on uniform policy prescriptions. Such an approach would support more sustainable and realistic policy frameworks aimed at improving institutional functioning through the enhancement of economic complexity.

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