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Strategic Determinants of Economic Complexity in Türkiye: Knowledge, Technology, and Institutions

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ABSTRACT

This study examines the strategic determinants of economic complexity in Türkiye by exploring the roles of institutional quality, knowledge management, technology transfer, and foreign direct investment (FDI) in shaping national productive capabilities. The analysis uses annual data for the period 1996-2023. Economic complexity is measured by the Economic Complexity Index, while institutional quality, capital goods imports, research and development (R&D) expenditures. The Fourier Bootstrap Autoregressive Distributed Lag (FBARDL) approach is employed to examine long-run relationships while accounting for structural breaks and the relatively small sample size. The empirical findings reveal a stable long-run relationship among the variables. Institutional quality, capital goods imports, and R&D expenditures positively affect economic complexity, indicating that effective governance, technological acquisition, and domestic knowledge creation play important roles in strengthening productive capabilities. In contrast, FDI has a negative long-run effect, suggesting that foreign investment alone may not generate capability upgrading and can reinforce dependency when domestic absorptive capacity and local linkages remain weak. This study provides a more comprehensive understanding of productive capabilities by connecting Economic Complexity Theory with Strategic Management and International Business. The findings indicate that emerging economies need strong domestic capabilities and effective use of external knowledge to improve competitiveness and economic complexity.

Keywords: Institutional Quality, Knowledge Management, Economic Complexity, Foreign Direct Investment
JEL Classifications: O32, O33, F23, O43

1. INTRODUCTION

The global economy has experienced significant changes in the twenty-first century, driven by rapid technological developments, the widespread use of digital technologies, the reorganization of global production networks, and growing international competition. (Baldwin, 2016; OECD, 2021; World Bank, 2020). These developments have prompted both researchers and policymakers to reconsider the main drivers of countries' economic performance. While traditional growth theories primarily explain economic development through capital accumulation, labor supply, and natural resource endowments (Solow, 1956), sustaining competitiveness in today's economy depends much more on the ability to generate knowledge, build technological capabilities, foster innovation, and establish effective institutions (Porter, 1990; Barney, 1991; Teece et al., 1997; Acemoglu and Robinson, 2012). As a result, broader analytical perspectives are needed to understand why some emerging economies have successfully moved into high value-added industries and upgraded their positions within global value chains, while others remain concentrated in low-technology production and struggle to escape the middle-income trap (Hausmann et al., 2007; Hidalgo and Hausmann, 2009; Lee, 2019).

From this perspective, national competitiveness is shaped not only by the resources available to a country but also by how effectively

those resources are transformed into knowledge, technology, and productive capabilities (Hausmann et al., 2007; Hidalgo and Hausmann, 2009). Productive capabilities refer to an economy's capacity to design, manufacture, and compete internationally with sophisticated, high value-added products. These capabilities develop gradually through the interaction of accumulated knowledge, human capital, technological infrastructure, innovation systems, and institutional coordination (Hausmann et al., 2007; Hidalgo and Hausmann, 2009; Hidalgo, 2021). One of the most widely used macro-level indicators of these capabilities is the Economic Complexity Index (ECI), which captures the stock of tacit knowledge embedded in an economy by considering both the diversity and sophistication of its export basket (Hidalgo and Hausmann, 2009; Hausmann et al., 2014). Economies with higher levels of economic complexity tend to produce a wider range of goods and develop more sophisticated products that require advanced technologies, specialized knowledge, and strong institutional support (Hausmann et al., 2007; Hidalgo, 2021).

Although economic complexity has attracted considerable attention in recent years, the factors that drive it are still not fully understood. Much of the existing literature has focused on economic growth, trade patterns, or technological indicators (Hausmann et al., 2007; Hidalgo and Hausmann, 2009; Gala, 2017). Comparatively fewer studies have examined how knowledge management, technology transfer, and institutional quality interact to shape productive capabilities. This suggests the need for a broader perspective that draws on insights from Strategic Management and International Business to explain the sources of national competitiveness (Barney, 1991; Teece et al., 1997; Ferreira et al., 2021).

Within the Strategic Management literature, the Resource-Based View (RBV) argues that sustainable competitive advantage stems from the effective use of valuable, rare, and difficult-to-imitate resources (Barney, 1991; Wernerfelt, 1984). At the national level, these resources extend beyond physical capital and natural endowments to include accumulated knowledge, technological capabilities, human capital, and institutional structures (Penrose, 1959; Barney, 1991). Likewise, the dynamic capabilities perspective emphasizes the importance of continuously adapting to changing global conditions, reconfiguring existing resources, and developing new production capabilities (Teece et al., 1997; Teece, 2007). Economic complexity reflects the productive capabilities and tacit knowledge that countries accumulate over time (Hausmann et al., 2007; Hidalgo and Hausmann, 2009).

This study investigates how knowledge management, technology transfer, and institutional quality influence economic complexity. Knowledge management is associated with the creation of new knowledge through national research and development (R&D) activities and its conversion into economic value (Nonaka, 1994; Roos, 2017). Technology transfer, particularly through imports of capital goods, enables countries to gain access to advanced production technologies (Coe and Helpman, 1995; Grossman and Helpman, 1991). However, access to foreign technology alone is not sufficient. Whether these technologies can be transformed into productive capabilities depends largely on a country's absorptive capacity and institutional environment (Cohen and Levinthal, 1990; Sultana et al., 2023). Institutional quality provides the broader framework within which knowledge and technology can be translated into productive activity by supporting the rule of law, regulatory effectiveness, governance capacity, and a stable investment climate (North, 1990; Kaufmann et al., 2011; Acemoglu and Robinson, 2012).

2. LITERATURE REVIEW AND THEORETICAL FRAMEWORK

The determinants of national competitiveness and economic complexity have been discussed from different theoretical perspectives. A central idea of the resource-based view (RBV) is that sustainable competitive advantage comes from effectively managing resources that are valuable, rare, difficult to imitate, and difficult to substitute (Barney, 1991; Wernerfelt, 1984). Although the RBV was originally developed to explain differences in firm performance, drawing on Penrose's (1959) theory of firm growth, its main ideas have gradually been applied at the national level as well. Originally developed to explain differences in firm performance based on Penrose's (1959) theory of firm growth, the RBV has also been extended to the national level. At this level, accumulated knowledge, technological capabilities, human capital, and institutional quality represent strategic resources that influence long-term competitiveness (Ferreira et al., 2021).

Despite its influence, the RBV has often been criticized for offering a relatively static view of competitive advantage. Possessing strategic resources may not be sufficient in an environment characterized by rapid technological and economic change. The dynamic capabilities perspective extends this discussion by arguing that competitiveness depends on the ability to renew, reconfigure, and adapt existing resources as conditions change (Teece et al., 1997; Teece, 2007). National competitiveness is shaped by how effectively countries transform their existing resources into new knowledge, technologies, and productive capabilities over time, rather than by the resources they possess alone. Therefore, economic complexity can be viewed as a macro-level outcome of this continuous process of capability accumulation, reflecting the combined effects of knowledge, technology, and institutional development (Hausmann et al., 2007; Hidalgo and Hausmann, 2009).

Economic Complexity Theory complements these strategic management perspectives by shifting attention from the quantity of resources to the capabilities embedded within an economy. Hausmann et al. (2013) emphasize that economic development is closely related to the diversity and sophistication of productive capabilities that countries can combine to develop new economic activities, rather than simply the amount of resources available. The Economic Complexity Index (ECI) captures this dimension by measuring the knowledge intensity of an economy through the diversity and sophistication of its export structure (Hidalgo and Hausmann, 2009). Countries with higher levels of economic complexity tend to produce a wider range of sophisticated products that require advanced technologies, specialized knowledge, and effective institutional coordination (Hausmann et al., 2007; Hidalgo, 2021).

Building on these theoretical perspectives, this study focuses on the main strategic mechanisms through which productive capabilities are created and strengthened. Rather than treating economic complexity simply as an export-based indicator, it is considered an outcome of the interaction between domestic capability formation, external knowledge acquisition, and institutional conditions. The literature is therefore organized around four closely related dimensions. The first concerns knowledge management and research and development (R&D), which support the creation of domestic capabilities. The second examines technology transfer through capital goods imports as a channel for acquiring and adapting foreign technologies. The third considers institutional quality as the environment that enables knowledge and technology to be translated into productive activities. Finally, the study discusses foreign direct investment as a mechanism whose contribution to economic complexity depends largely on host-country conditions and domestic absorptive capacity.

2.1. Knowledge Management, R&D, and Absorptive Capacity

Knowledge creation is recognized as one of the main drivers of productive capability development. Knowledge management emphasizes that competitiveness is shaped by the ability to create, accumulate, share, and transform knowledge into economic value through innovation (Nonaka, 1994; Roos, 2017). Within this process, research and development (R&D) activities play a particularly important role. They contribute directly to domestic technological progress while also strengthening the capacity of firms and economies to benefit from external sources of knowledge. This capacity is referred to as absorptive capacity. Cohen and Levinthal (1990) define it as the ability to recognize the value of external knowledge, assimilate it, and apply it to commercial activities. For emerging economies, where technological progress often relies on learning from international sources, absorptive capacity becomes especially important. Countries with stronger innovation systems are generally better positioned to adapt imported technologies, generate learning effects, and transform external knowledge into locally embedded productive capabilities (Roos, 2017; Sultana et al., 2023).

Beyond supporting innovation, R&D expenditures also help strengthen the ability of firms and economies to absorb and make effective use of external knowledge. They strengthen the institutional and technological foundations that allow countries to absorb and effectively utilize external knowledge. Without sufficient domestic capability development, technology transfer is unlikely to generate substantial spillover effects or contribute meaningfully to long-term productive transformation (Cohen and Levinthal, 1990). In other words, the benefits of external knowledge depend not only on access to technology but also on the capacity to understand, adapt, and improve it within the domestic economy.

2.2. Technology Transfer and Capital Goods Imports

Technology transfer represents an important source of productive capability development, particularly for emerging economies. Capital goods imports constitute one of the main channels of technology transfer, as they provide emerging economies with access to advanced production technologies and knowledge developed in more industrialized countries. Machinery, industrial equipment, and other capital-intensive technologies allow domestic firms to improve production processes, increase efficiency, and gradually move toward more sophisticated forms of production (Coe and Helpman, 1995; Grossman and Helpman, 1991). However, importing advanced machinery does not automatically lead to technological upgrading. The potential benefits depend largely on whether firms have the skills, experience, and organizational capacity to operate, adapt, and improve these technologies. In other words, technology transfer is not a matter of purchasing better equipment; it also involves learning how to use and develop that technology over time. As Hausmann et al. (2013) argue, productive capabilities emerge through cumulative learning rather than technology acquisition alone. Thus, capital goods imports can contribute to higher economic complexity, but only when they are supported by strong innovation systems, skilled human capital, and sufficient absorptive capacity.

2.3. Institutional Quality and Capability Development

Institutional quality determines the conditions under which knowledge creation, innovation, and technology transfer develop within an economy. It also affects how effectively countries allocate resources, coordinate economic activities, and support long-term investment in productive capabilities. Regulatory quality, the rule of law, government effectiveness, and control of corruption all reduce uncertainty and create conditions that encourage innovation and technological upgrading (North, 1990; Kaufmann et al., 2011).

Effective institutions encourage cooperation among firms, universities, research organizations, and public agencies. This helps knowledge flow more easily and allows technological investments to generate long-term productivity improvements. By contrast, weak institutional environments often discourage innovation, increase transaction costs, and limit firms' ability to benefit from external sources of knowledge (Acemoglu and Robinson, 2012). Institutional quality affects the extent to which economies can transform knowledge and technology into productive capabilities.

2.4. Foreign Direct Investment and the Assembler Trap Debate

Foreign direct investment (FDI) has traditionally provided developing economies with access to capital, technology, managerial expertise, and international production networks. Traditional International Business literature argues that multinational enterprises (MNEs) generate productivity gains through technology spillovers, labor mobility, supplier linkages, and demonstration effects (Borensztein et al., 1998; Blomström and Kokko, 1998). When domestic firms are able to absorb these benefits, foreign investment can make a meaningful contribution to technological upgrading and productive capability development. However, empirical evidence indicates that the positive effects of FDI depend on specific conditions in the host economy. Rrecent studies point out that the effects of FDI depend heavily on the institutional environment and the absorptive capacity of the host economy. Multinational firms often protect proprietary

technologies, keep high-value activities within their own global networks, and establish limited technological linkages with local firms. Under these conditions, knowledge spillovers remain weak and domestic capability development may be slower than expected (Osinubi and Ajide, 2022; Bhaumik et al., 2025).

These concerns are particularly relevant for economies that participate in global value chains mainly through manufacturing and assembly activities. In such cases, multinational enterprises tend to locate production in countries with relatively low costs, while strategic activities such as product design, research and development, and advanced engineering remain concentrated in their home countries (Szalavetz, 2017). As a result, host economies may experience export growth and increased foreign investment without achieving comparable improvements in domestic technological capabilities. This situation has increasingly been described as the "Assembler Trap," where integration into global value chains does not necessarily translate into sustained capability upgrading or higher economic complexity.

2.5. Türkiye Context

Türkiye provides an important case for examining how institutional quality, knowledge management, technology transfer, and foreign direct investment influence economic complexity and the development of productive capabilities. Previous studies have investigated the relationship between economic complexity and factors such as economic growth, trade performance, innovation, and technological development. However, these factors have been analyzed separately, while less attention has been paid to how domestic capability formation and external knowledge acquisition interact within a broader strategic framework. This study addresses this gap by combining insights from Strategic Management and International Business to develop a more comprehensive understanding of the factors influencing Türkiye's economic complexity.

Türkiye is a particularly relevant case because of its growing integration into global production networks through expanding exports, increasing foreign investment, and greater access to imported technologies. Over the past three decades, the country has become increasingly integrated into the global economy. However, this integration has not resulted in a similar transition toward high-technology production and more sophisticated industrial activities (Hausmann et al., 2014; OECD, 2023). The continued dependence on imported technologies, limited innovation performance, and the concentration of foreign investment in manufacturing raise concerns about whether international integration has been sufficient to strengthen domestic productive capabilities.

Recent studies suggest that export growth alone does not necessarily lead to technological upgrading. In many emerging economies, foreign investment remains concentrated in assembly-oriented production, while domestic firms struggle to build the technological capabilities needed to move into higher value-added activities (Szalavetz, 2017; Osinubi and Ajide, 2022; Bhaumik et al., 2025). This pattern is described as the "Assembler Trap," where countries become integrated into global value chains but continue to depend on externally generated technologies and knowledge. Under such conditions, participation in international production networks may expand exports without creating the domestic capabilities required for sustained improvements in economic complexity.

The role of foreign direct investment in economic complexity depends on how effectively it interacts with domestic capability-building processes. Understanding this relationship requires examining the interaction between internal capability formation and external knowledge flows in Türkiye's long-term productive transformation. This approach helps clarify the conditions under which foreign technologies and investment strengthen domestic capabilities rather than create continued dependence. The study contributes to the literature by providing an integrated view of how institutional quality, knowledge creation, technology acquisition, and foreign investment influence long-term competitiveness in an emerging economy.

The analysis of economic complexity in emerging markets is complicated by frequent structural changes that may affect long-term relationships among variables. Much of the empirical literature relies on conventional linear cointegration techniques that assume structural stability over the sample period. This assumption is difficult to maintain in the case of Türkiye, where the period between 1996 and 2023 includes major events such as the 2001 financial crisis, the 2008 global financial crisis, and a series of institutional and economic policy changes. These developments introduce structural breaks that may distort long-run estimates if they are ignored. For this reason, the empirical analysis adopts an econometric framework that explicitly accounts for both gradual and sharp structural changes, allowing for more reliable estimation of the long-run relationships examined in this study.

Viewed from this perspective, the key issue is not whether foreign direct investment contributes to economic complexity. A broader question concerns how internal capability-building processes and external knowledge flows interact to shape Türkiye's long-term productive transformation. Examining these relationships together provides a more comprehensive understanding of the conditions under which foreign technologies and investment contribute to domestic capability accumulation rather than creating continued dependency. In this regard, the study contributes to the literature by offering an integrated perspective on how institutional quality, knowledge creation, technology acquisition, and foreign investment jointly influence competitiveness in an emerging economy.

In addition to these theoretical considerations, the empirical analysis of economic complexity in emerging markets also faces important methodological challenges. Existing studies have frequently relied on conventional linear cointegration techniques that assume stable relationships among variables throughout the estimation period. However, such an assumption may be problematic for Türkiye, particularly when considering the period between 1996 and 2023. During these years, the Turkish economy experienced several major economic and institutional changes, including the 2001 domestic financial crisis, the 2008 global financial crisis, and subsequent policy and institutional transformations. These developments may have generated

structural breaks that cannot be adequately captured by standard time-series approaches. Ignoring such changes may lead to biased estimations and obscure the underlying dynamics among the variables. Therefore, investigating the strategic determinants of economic complexity requires an econometric framework that explicitly considers both gradual and sudden structural changes in order to provide more reliable evidence on long-run relationships.

3. MODEL, DATA SET AND METHODOLOGY

3.1. Model and Dataset

The Economic Complexity Index functions as a macroeconomic indicator of a nation's accumulated "latent knowledge" and "production capabilities." This index quantifies the multi-dimensional networks of capabilities—comprising institutional quality, technological infrastructure, R&D capacity, and skilled human resources—required for the production of complex goods. Increasing economic complexity is a primary strategic objective of strategic management for emerging markets. This study extends beyond validating the level of economic complexity as a predictor of economic growth; it focuses on investigating the specific macro-environmental determinants that drive complexity itself. For an emerging market like Türkiye, which is undergoing structural transformation, understanding the dynamics of these determinants is crucial for designing strategic industrial policies and international business strategies. The empirical model of this study, which uses annual data on the Turkish economy from 1996 to 2023, is presented below:

$$ECI_t=\beta_1+\beta_2 lnGI_t+\beta_2 lnM_t+\beta_4 lnRD_t+\beta_5 lnFDI_t+\varepsilon_t \quad (1)$$

where ECI is the Economic Complexity Index. This is an indicator that measures not only how many products an economy exports, but also how information-intensive and sophisticated those products are. The ECI is a standardized index where the average of country scores is zero and the standard deviation is one. For most countries, scores range from −3 to +3, and negative values are possible. Positive values in the index indicate that the country's knowledge base regarding its production and export structure is above the global average (zero point) for that year; conversely, negative values indicate that it falls below the global average. The data source is The Growth Lab at Harvard University. GI is an indicator of institutional quality based on governance scores. It is calculated by taking the arithmetic mean of 6 sub-components (Control of Corruption, Government Effectiveness, Political Stability, Regulatory Quality, Rule of Law, and Voice and Accountability) scored on a scale of 0-100 and rescaled between 0 and 1. An index value closer to 1 indicates higher institutional quality. The data source is the Worldwide Governance Indicators (2026), World Bank. M represents the ratio of capital goods imports to GDP. It was calculated using data from the World Bank's World Integrated Trade Solution (WITS, 2026) system and World Development Indicators (WDI, 2026). RD denotes the ratio of research and development expenditure to GDP and FDI is the ratio of foreign direct investment net inflows to GDP. The data source for both variables is the World Bank's WDI.

All variables except the ECI are expressed in natural logarithms. The ECI is a standardized z-score that represents the standard deviation relative to the global mean and can theoretically take negative values. Due to this structural feature, applying a logarithmic transformation can lead to mathematically undefined situations and disrupt the linear variance structure in the index's calculation logic. In these semi-logarithmic models, the coefficients cannot be directly interpreted as elasticities. A semi-elasticity interpretation is appropriate when the dependent variable is in level form and the explanatory variables are logarithmic. A 1% increase in the independent variable causes an absolute change of $\beta_i/100$ units in the dependent variable ECI.

The model assesses how a nation builds its "production capabilities" through four key strategic channels: the establishment of a reliable macro-business environment through institutional quality (GI), physical technology transfer through capital goods imports (M), local knowledge management and innovation through national R&D expenditures (RD), and finally, international capital interaction, particularly foreign direct investment (FDI), on economic complexity. Whether foreign capital is a building block for local economic complexity in Türkiye or a destructive factor for local capacity is the central focus of this model. These four macroeconomic factors are considered the fundamental building blocks of national competitiveness.

3.2. Methodology

Assessing the complex, long-term strategic relationships between institutional quality (GI), capital imports (M), R&D expenditures (RD), foreign investment (FDI), and economic complexity (ECI) necessitates advanced econometric methodologies. When using 28 years (1996-2023) of time series data for a country like Türkiye, two main challenges emerge: limited sample size and the presence of significant, unobservable structural breaks caused by internal policy changes, global financial crises, and geopolitical upheavals.

Under these conditions, standard stationarity and cointegration techniques exhibit significant limitations. Standard unit root tests (ADF, PP, KPSS) lose their power because they ignore structural breaks occurring in the deterministic components of the series and often fail to reject the null hypothesis of a unit root. Traditional break tests (Zivot and Andrews, 1992; Lee and Strazicich 2003, 2004; etc.) assume abrupt breaks. However, the Fourier approximation fully captures the gradual, time-varying, and structurally transformative nature of structural changes (economic reforms, crisis waves, etc.). Enders and Lee (2012) add trigonometric functions to the ADF method as follows:

$$\Delta y_t = \rho y_{t-1}+c_1+c_2 t+c_3 \sin(2\pi kt/T)+c_4 \cos(2\pi kt/T)+\varepsilon_t \quad (2)$$

where ρ functions as the multiplier for the lagged dependent variable, c_1 is the deterministic term, c_2 represents the trend slope parameter, t denotes the deterministic trend, π is the mathematical constant (3.1416), k is the Fourier frequency value, T is the number of observations, c_3 and c_4 are the coefficients of the trigonometric terms, and ε_t is the error term. The optimal lag length can be

determined according to the information criteria, and the optimal Fourier frequency is obtained based on the minimum sum of squared errors (SSR). The procedure examines the null hypothesis $\rho = 0$ in (2). Enders and Lee (2012) adopt a two-step approach, first determining whether there is a nonlinear trend and then applying the unit root test in the second step. In (2), they test the null hypothesis $c_3=c_4=0$ using the F test. If the null hypothesis of a linear trend is not rejected, they apply the usual linear Augmented Dickey-Fuller unit root test.

The ARDL bounds test, developed by Pesaran et al. (2001), produces biased and unreliable estimates when applied to small sample sizes. Standard ARDL models examine the presence of cointegration using a single F statistic and typically account for structural breaks through dummy variables. In macroeconomic reality, changes in institutional quality (GI) or the penetration of imported technology (M) into the local economy occur as smooth and continuous transitions spread over several years. Furthermore, the standard ARDL approach cannot distinguish between "degenerate cases" that may arise in subgroups of the coefficients of the dependent and independent variables. McNown et al. (2018) developed the Bootstrap ARDL (BARDL) method for simultaneously rejecting three different constraint tests for the definite existence of cointegration. Yilanci et al. (2020) extend the BARDL method with the Fourier function, stating that a small number of low-frequency components of the Fourier approximation can capture an unknown number of both gradual and sharp structural breaks. With this approach, Equation 1 can be defined in the form of an unconstrained error correction model (UECM) as follows:

$$\begin{aligned}\Delta ECI_t = {} & \beta + \gamma_1 \sin\left(2\pi kt/T\right) + \gamma_2 \cos\left(2\pi kt/T\right) + \\ & + \alpha ECI_{t-1} + \phi_1 \ln GI_{t-1} + \phi_2 \ln M_{t-1} + \phi_3 \ln RD_{t-1} \\ & + \phi_4 \ln FDI_{t-1} + \sum_{i=1}^{p-1} \psi_i \Delta ECI_{t-i} + \sum_{j=0}^{q_1-1} \delta_{1,j} \Delta \ln GI_{t-j} \\ & + \sum_{j=0}^{q_2-1} \delta_{2,j} \Delta \ln M_{t-j} + \sum_{j=0}^{q_3-1} \delta_{3,j} \Delta \ln RD_{t-j} \\ & + \sum_{j=0}^{q_4-1} \delta_{4,j} \Delta \ln FDI_{t-j} + \varepsilon_t \end{aligned} \quad (3)$$

In the BARDL approach, to eliminate the risk of spurious cointegration (degenerate cases), the following three hypotheses are tested and rejected simultaneously:

i. The $F_{overall}$ statistic tests the coefficients of all lagged level variables. H_0: $\alpha=\phi_1=\phi_2=\phi_3=\phi_4=0$.
ii. The $t_{dependent}$ statistic measures the significance of only the lagged level coefficient of the dependent variable. H_0: $\alpha=0$.
iii. The $F_{independent}$ statistic measures the joint significance of only the lagged level coefficients of the independent variables. H_0: $\phi_1=\phi_2=\phi_3=\phi_4=0$.

The optimal lag length for the selected ARDL model is determined according to the information criteria, and the optimal Fourier frequency is obtained based on the minimum sum of squared errors (SSR).

4. EMPIRICAL FINDINGS

Table 1 presents the results of the unit root tests and F-statistic values derived from the FADF approach. The stationarity properties of the series were tested using linear (ADF) and nonlinear (FADF) unit root tests that consider structural breaks. Due to the limited sample size, critical values were not taken from asymptotic tables but were generated specifically for the series using Monte Carlo simulations. According to the F-test findings, the Fourier terms for the lnGI variable are significant in the constant model, while the Fourier terms for the other variables are insignificant. Therefore, standard ADF tests were applied to both the level and first differences of the variables in the model. The first differences of the ECI, lnM, lnRD, and lnFDI variables are stationary at the 1% level; the first difference of the lnGI variable is stationary at the 10% level. The lnFDI variable is stationary at the 10% level, while its first difference is stationary at the 1% level. This result confirms that the ARDL bounds test approach can be used for cointegration analysis of the ECI, lnGI, lnM, lnRD, and lnFDI variables.

Table 2 presents the cointegration test results based on the Fourier Bootstrap ARDL (FBARDL) approach modeling structural breaks. The ARDL (1,2,2,1,1) model, whose lag lengths were determined by the Schwarz Bayes Information Criterion (SBC), was estimated. Standard iid bootstrap or Wild bootstrap methods fail when autocorrelation or ARCH effects are present in the residuals of the model. In this study, the Moving Block Bootstrap (MBB) approach was applied. Instead of shuffling error terms individually, the MBB algorithm resamples successive residual blocks in packets to preserve the time dependence of the data. Thus, the autocorrelation structure in the series is reliably embedded into the empirical critical values. Furthermore, to prevent residual

Table 1: ADF and FADF unit root tests results

Levels	ADF (c)	ADF (ct)	FADF (c)	F-stat (c)	FADF (ct)	F-stat (ct)	1st diff.	ADF (c)
ECI	−1.7796 (1)	−2.6659 (0)	−1.9430 (1)[2]	0.4827	−4.9277 (0)[1]	7.9199	ΔECI	−7.5886 (0)***
lnGI	−0.6197 (1)	−2.2042 (0)	−3.7489 (1)[1]	14.5187**	−3.7835 (0)[1]	8.2357	ΔlnGI	−2.9996 (0)*
lnM	−2.1816 (0)	−2.9380 (0)	−3.9840 (0)[1]	5.0143	−4.0627 (0)[1]	3.4450	ΔlnM	−7.1224 (0)***
lnRD	−0.4346 (0)	−2.6288 (0)	−1.2338 (0)[1]	1.0724	−2.6889 (0)[1]	0.7591	ΔlnRD	−6.3165 (0)***
lnFDI	−3.2034 (0)*	−2.8491 (0)	−3.3305 (0)[1]	1.0826	−3.4786 (0)[1]	1.8659	ΔlnFDI	−5.5554 (0)***
%1	−4.0338	−5.1057	−5.8067	16.4834	−6.6211	20.7309		−4.0338
%5	−3.2042	−4.1347	−4.7988	11.4409	−5.6006	14.3075		−3.2042
%10	−2.7769	−3.6119	−4.4015	9.0970	−5.1280	11.5675		−2.7769

The values in () and [] denote the optimal number of lags and the number of frequencies. The numbers of optimal lags are based on Schwarz Bayesian Criterion (SBC). ***, ** and * are significant at the 1%, 5% and 10% levels, respectively. All the critical values were generated using Monte Carlo Simulation (2000 replications)

Table 2: FBARDL tests results

Model summary	Long-run coefficients		Short-run coefficients	
Model: ECI=f (lnGI, lnM, lnRD, lnFDI)	**Variables**	**Coefficients**	**Variables**	**Coefficients**
Selected model: ARDL (1,2,2,1,1)	lnGI	1.4506***	ΔlnGI	0.5030***
Fourier frequency (k)=2	lnM	0.7651***	ΔlnGI(−1)	−0.8795***
R-squared=0.9241	lnRD	0.2581***	ΔlnM	0.1222**
Adjusted R-squared=0.8412	lnFDI	−0.0673***	ΔlnM(−1)	−0.6436***
Cointegration test results	**Diagnostic tests**		**ΔlnRD**	**0.3481*** **
$F_{overall}$=72.2842***	JB	0.7589	ΔlnFDI	−0.0412***
$t_{dependent}$=−11.3611***	BG	9.2592***	Constant	7.6601***
$F_{independent}$=89.1301***	BP	13.0601	Sin	0.1225**
Speed of adjustment	ECT=−1.7033***		Cos	−0.0211***

Δ denotes the first difference operator. The numbers of optimal lags are based on Schwarz Bayesian Criterion (SBC). Newey-West (HAC) standard errors were employed. All the critical values were generated specifically for the Moving Block Bootstrap (MBB) approach (2000 replications and block length is 4). ***, ** and * are significant at the 1%, 5% and 10% levels, respectively

low-order autocorrelation and heteroskedasticity due to the degrees of freedom constraint, the standard errors of the model parameters were automatically corrected using the Newey-West (HAC) covariance matrix algorithm. The values of the $F_{overall}$ statistic (72.2842), the dependent variable t-statistic $t_{dependent}$ (−11.3611), and the independent variable F-statistic $F_{independent}$ (89.1301), which test the existence of a cointegration relationship, were found to be statistically significant at the 1% level. These findings confirm the existence of a long-term, definite cointegration relationship between the variables.

An examination of the long-term semi-elasticity coefficients, all of which are statistically significant at the 1% level, reveals that institutional quality (lnGI) exerts the strongest positive impact on the ECI (1.4506). Capital goods imports (lnM) and R&D expenditures (lnRD) also positively drive economic complexity, with coefficients of 0.7651 and 0.2581, respectively. Conversely, foreign direct investment (lnFDI) demonstrates a negative long-term effect on the ECI (−0.0673).

According to the short-term model results, the Error Correction Term (ECT) coefficient was estimated as −1.7033 and found to be significant at the 1% level. The negative coefficient confirms the validity of the long-term relationship. However, the absolute value of the coefficient being >1 (overcorrection) indicates that after a shock in the short term, the system converges to its long-term equilibrium not directly, but by oscillating around it. The statistically significant Fourier frequency terms Sin (0.1225) and Cos (−0.0211), which model structural breaks, confirm the presence of nonlinear trends and structural changes in the model, proving the necessity of choosing the FBARDL approach.

The explanatory power of the model (Adjusted R-squared=0.8412) is quite high; the independent variables explain 84.1% of the variation in the ECI. The Jarque-Bera statistic (0.7589) indicates that the error terms are normally distributed. The Breusch-Pagan statistic (13.0601) proves that there is no heteroskedasticity problem in the model. The Breusch-Godfrey statistic (9.2592) indicates an autocorrelation problem in the residuals, significant at the 1% level. However, as stated in the table note, the use of Newey-West (HAC) standard errors in the estimations mathematically corrected the disruptive effect of autocorrelation and possible heteroskedasticity problems on the test statistics. Since the significance levels of the coefficients were calculated according to these robust standard errors, the results are reliable.

The empirical finding that foreign direct investment (lnFDI) negatively affects economic complexity in the long run challenges the traditional macroeconomic consensus. In the context of emerging markets, this negative coefficient indicates a "crowding-out" effect. Rather than generating positive technological spillovers, uncontrolled FDI allows multinational enterprises (MNEs) with superior resources to displace domestic infant firms and absorb the local talent pool. This phenomenon is symptomatic of the "assembler trap," a condition wherein the host nation is utilized merely as an offshore assembly hub within global value chains. Consequently, export volumes are artificially inflated without the transfer of underlying technological knowledge to the domestic market. Furthermore, the significant and negative error correction term (ECT), exhibiting an absolute value >1, indicates that foreign capital shocks create oscillatory volatility in the local market. This structural oscillation highlights the fragility of relying on external actors for stable capability building.

The empirical findings of this study provide substantial support for the literature emphasizing the critical role of institutional quality, domestic knowledge creation, and technology acquisition in the development of economic complexity. The positive effect of institutional quality on economic complexity supports the arguments of North (1990), Acemoglu and Robinson (2012), and Kaufmann et al. (2011), who highlight that effective institutions provide the necessary environment for innovation, investment, and the accumulation of productive capabilities. Similarly, the positive relationship between research and development expenditures and economic complexity is in line with the findings of Cohen and Levinthal (1990), Hidalgo and Hausmann (2009), and Sultana et al. (2023), suggesting that domestic knowledge generation strengthens absorptive capacity and enables economies to transform external knowledge into higher-value production. The positive impact of capital goods imports also supports the technology transfer perspective emphasized by Coe and Helpman (1995) and Grossman and Helpman (1991), suggesting that imported technologies may enhance productive capabilities when effectively absorbed by domestic firms.

However, the negative effect of foreign direct investment on economic complexity differs from the traditional view that FDI

universally promotes technological upgrading and productivity growth (Borensztein et al., 1998; Blomström and Kokko, 1998). This result is more consistent with recent studies highlighting the conditional nature of FDI spillovers, particularly in emerging economies with limited absorptive capacity and institutional constraints (Osinubi and Ajide, 2022; Bhaumik et al., 2025). The negative coefficient of FDI may be explained by the dominance of assembly-oriented foreign investment structures, limited local supplier linkages, and the concentration of strategic knowledge within multinational enterprises. In this context, the finding supports the "Assembler Trap" perspective discussed by Szalavetz (2017), where countries may increase export volumes through foreign-controlled production networks without achieving equivalent improvements in indigenous technological capabilities. Therefore, the divergence between this study and earlier positive FDI-growth studies can be attributed to differences in the measurement of development outcomes, as economic growth and export expansion do not necessarily imply increases in economic complexity or domestic capability accumulation. The results suggest that the developmental contribution of FDI depends not on the volume of foreign investment itself, but on the institutional environment, domestic innovation capacity, and the extent to which foreign technologies are embedded within local production systems. Thus, this study extends the existing literature by demonstrating that foreign investment inflows should be evaluated not only in terms of their quantity but also in terms of their contribution to domestic capability formation and economic complexity.

5. CONCLUSION AND POLICY IMPLICATIONS

This study investigates the strategic determinants of Türkiye's national competitiveness by integrating economic complexity with perspectives from Strategic Management and International Business literature is study, economic complexity is used as an indicator of productive capabilities, and the analysis examines how knowledge management, technology transfer, institutional quality, and foreign direct investment contribute to capability development. The results show that economic complexity is not determined simply by resource availability or integration into international markets. Rather, it develops through the ability of economies to create knowledge, build technological capabilities, and transform these resources into more advanced production structures.

The empirical results provide important insights into how productive capabilities develop in emerging economies. The positive effects of institutional quality, research and development expenditures, and capital goods imports support previous research emphasizing the importance of effective governance, domestic knowledge creation, and access to advanced technologies (North, 1990; Cohen and Levinthal, 1990; Coe and Helpman, 1995; Hidalgo and Hausmann, 2009). These findings indicate that participation in global markets alone is insufficient to increase economic complexity. What matters is whether economies can absorb external knowledge and convert technological resources into locally embedded capabilities. The negative effect of foreign direct investment presents a different picture from the conventional view that associates FDI with automatic improvements in technological upgrading and productivity (Borensztein et al., 1998; Blomström and Kokko, 1998). However, this result is consistent with recent studies showing that the benefits of foreign investment depend heavily on host countries' absorptive capacity, institutional conditions, and domestic production linkages (Osinubi and Ajide, 2022; Bhaumik et al., 2025). In Türkiye's case, this relationship may be associated with the prevalence of assembly-oriented foreign investment, limited domestic spillovers, and the concentration of strategic knowledge within multinational enterprises. These findings suggest that foreign investment alone does not guarantee capability development. Its contribution to economic complexity depends on whether it is integrated with domestic innovation systems and supported by policies that encourage local R&D cooperation, technology sharing, workforce development, and stronger connections between multinational firms and domestic companies. Such mechanisms can help transform FDI from a source of dependency into a driver of capability accumulation.

The findings also indicate that improving economic complexity requires a shift from passive participation in global production networks toward more active capability-building strategies. Consistent with the resource-based view (RBV), national competitiveness depends on the accumulation and effective use of valuable knowledge-based resources. From this perspective, external integration mechanisms cannot replace the need for developing internal capabilities. Countries need the capacity to absorb, adapt, and improve externally acquired knowledge in order to create indigenous technological capabilities. Therefore, capital goods imports should be considered more than simple production inputs; they can also support technological learning, reverse engineering, and knowledge accumulation. However, the benefits of imported technologies depend largely on the existence of domestic R&D capabilities and sufficient absorptive capacity. Furthermore, the results underline the importance of knowledge management in the process of moving toward higher levels of economic complexity. Domestic R&D activities contribute not only to innovation outcomes but also to the development of the cognitive and organizational capabilities required to utilize external knowledge effectively. Without strong internal knowledge creation processes, imported technologies and foreign investment can generate limited spillovers and have a weaker impact on long-term structural transformation. For this reason, emerging economies need to strengthen their dynamic capabilities by improving their ability to identify technological opportunities, adapt to market changes, and reorganize production activities in response to global developments.

Institutional quality emerges as a critical factor affecting economic complexity. Effective governance structures support knowledge creation, innovation activities, and long-term investment in technologically advanced sectors. The findings indicate that policymakers should move beyond approaches focused only on attracting foreign capital and instead emphasize the quality and developmental impact of international integration. This requires encouraging foreign investments that involve local R&D activities, workforce development, technology-sharing arrangements,

and stronger connections with domestic firms. In addition, improvements in intellectual property protection, regulatory effectiveness, and institutional stability remain necessary for supporting domestic innovation and technological upgrading.

For Türkiye, the findings suggest that increasing economic complexity requires a balanced strategy that combines domestic capability development with selective integration into global networks. Although Türkiye has achieved considerable progress in international economic integration, capital goods imports, foreign investment attraction, and R&D activities, the transition toward more sophisticated production structures remains limited by weaknesses in domestic technological capabilities and institutional effectiveness. Future industrial policies should therefore focus on strengthening innovation ecosystems, improving university–industry collaboration, enhancing firms' absorptive capacities, and supporting movement toward higher-value segments of global value chains.

Overall, this study contributes to the economic complexity literature by showing that national competitiveness is better understood as a process of capability accumulation rather than simply a result of market openness or factor availability. By combining insights from RBV, dynamic capabilities, knowledge management, and international business perspectives, the study extends existing explanations of economic complexity beyond traditional trade and growth approaches. The findings demonstrate that sustainable economic complexity depends on the interaction between domestic capability development and external knowledge integration, where institutional quality, knowledge creation, and strategically managed international linkages jointly influence long-term competitiveness.

This study also has some limitations that should be considered. First, the analysis focuses on Türkiye as a single emerging economy, which may limit the applicability of the findings to countries with different institutional and development characteristics. Future comparative studies involving multiple emerging economies could provide additional insights into how institutional environments and absorptive capacities influence the relationship between foreign investment and economic complexity. Second, although the selected variables capture important dimensions of productive capability development, future research could incorporate additional factors such as human capital quality, patent activity, industrial sophistication, and firm-level innovation capabilities. Finally, sectoral and firm-level analyses may provide a deeper understanding of how knowledge creation, technology transfer, and foreign investment contribute to domestic capability accumulation.

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