



Examining the Globalization-Economic Complexity-Financial Development Nexus in Turkey¹

Türkiye'deki Küreselleşme-Ekonomik Kompleksite-Finansal Kalkınma İlişkisinin İncelenmesi

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Abstract

Purpose: The purpose of this research is to examine the globalization-financial development-economic complexity link in Turkey for the period 1970-2017.

Design/Methodology: In the first stage of the analysis, a tri-variate model is proposed. In the second stage, cointegration and Granger causality tests that have single Fourier-frequency functions in their testing equations are employed to examine causal links among the employed variables.

Findings: The main findings indicate that (i) globalization and political globalization both indirectly (through financial development) and directly cause economic complexity; (ii) economic globalization indirectly causes economic complexity through financial development; (iii) social globalization and financial development directly cause economic complexity; (iv) bi-directional causality exists between globalization and financial development. These findings reveal that globalization is crucial for economic complexity. Also, ignoring the intermediating and direct roles of financial development in promoting Turkey's economic complexity can be problematic.

Limitations: This study focuses only on Turkey. Further research can focus on other emerging markets to confirm if similar causalities exist.

Originality/Value: By using cointegration and causality tests that have Fourier-components, this study accounts for the possible effects of structural changes. Additionally, this study considers sub-indices of globalization and their causal links with financial development and economic complexity. Lastly, although financial development-economic complexity link and globalization-economic complexity nexus were separately investigated in some studies, these studies used bi-variate models. This study proposes a tri-variate model to examine cointegration and causalities among these variables.

Keywords: Globalization, Economic Complexity, Financial Development, Causality Analysis, Turkey

Öz

Amaç: Bu araştırmanın amacı, Türkiye'deki küreselleşme-finansal kalkınma-ekonomik kompleksite ilişkisini 1970-2017 dönemi için incelemektir.

Tasarım/Yöntem: Analizin birinci basamağında, üç değişkenli bir model oluşturulmuştur. Analizin ikinci aşamasında, test denklemlerinde tek Fourier-frekanslı fonksiyonlar barındıran koentegrasyon ve Granger nedensellik testleri kullanılarak seçilmiş değişkenler arasındaki nedensellik ilişkileri incelenmiştir.

Bulgular: Araştırmanın ana bulguları şunlardır: (i) küreselleşme ve politik küreselleşme hem doğrudan hem de dolaylı olarak finansal kalkınma üzerinden ekonomik kompleksiteye neden olmaktadır; (ii) ekonomik küreselleşme, finansal kalkınma üzerinden ekonomik kompleksiteye neden olmaktadır; (iii) hem sosyal küreselleşme hem de finansal kalkınma doğrudan ekonomik kompleksiteye neden olmaktadır; (iv) küreselleşme ve finansal kalkınma arasında iki yönlü nedensellik olduğu tespit edilmiştir. Bu bulgular, küreselleşmenin ekonomik kompleksite için kritik bir öneme sahip olduğunu göstermektedir. Ayrıca finansal kalkınmanın Türkiye'nin ekonomik kompleksitesi üzerindeki doğrudan ve dolaylı etkilerinin göz ardı edilmesi, sorunlar yaratabilir.

Sınırlılıklar: Bu çalışmada sadece Türkiye üzerine odaklanılmıştır. Gelecekte yapılacak çalışmalarda diğer kalkınmakta olan ülkeler incelenerek benzer nedenselliklerin bu ülkelerde de geçerli olup olmadığı değerlendirilebilir.

Özgünlük/Değer: Bu çalışmada yapısal kırılmaların olası etkileri Fourier-bileşenli koentegrasyon ve nedensellik testleri kullanılarak değerlendirilmiştir. Ayrıca, bu çalışmada küreselleşmenin alt-İndeksleri de dikkate alınarak bu indekslerin finansal kalkınma ve ekonomik kompleksiteyle olan nedensellik ilişkileri incelenmiştir. Son olarak her ne kadar literatürdeki bazı çalışmalarda finansal kalkınma-ekonomik kompleksite ve küreselleşme-ekonomik kompleksite ilişkileri incelenmiş olsa da bu incelemeler genellikle iki değişkenli modeller üzerinden yapılmıştır. Bu çalışmada üç değişkenli bir model üzerinden eş-bütünleşme ve nedensellik ilişkileri incelenmiştir.

Anahtar Kelimeler: Küreselleşme, Ekonomik Kompleksite, Finansal Kalkınma, Nedensellik Analizi, Türkiye

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1. INTRODUCTION

In today's globalized world, a country's degree of economic development is less defined by how much capital it can aggregate but more defined by its productive capabilities (Hausmann & Hidalgo, 2011: 310). Particularly, continual economic growth requires product diversification and complexity for both developed and developing countries (Hartman, 2013: 6). Further, economic diversification may also bring additional benefits such as new venues for employment, more resilience against economic shocks, increased institutional quality, and limited income inequality (Hartman, 2013; Hartmann et al., 2017). However, how to improve the economic complexity of developing countries is still an ongoing debate in the empirical literature. Additionally, the roles of globalization and financial development in influencing economic complexity are usually ignored.

In this research, it is proposed that the economic complexity of Turkey, which is a developing country with a relatively limited productive structure (see Figure 1), can affect and be influenced by globalization and financial development processes. Globalization can directly impact the economic complexity of a country through spillover effects (Ahmad, 2019); it allows the transfer of new technologies that can be employed to develop product diversification. Furthermore, globalization leads to competition (Hatzichronoglou, 1996), and competition can also push product diversification through reformation and innovation. Besides its direct impact(s), globalization can cause economic complexity indirectly through financial development. According to Mishkin (2009: 166), globalization leads to reforms in the financial systems of developing countries and eventually results in increased access to both financial and physical capital. Therefore, a developing economy with a robust financial system can support innovations and increase its economic complexity by encouraging productive investments (Chu, 2020: 1260).

In this respect, examining causal linkages among globalization, economic complexity, and financial development for Turkey may provide new insights. Consequently, these insights can be utilized to propose new policies for improving Turkey's economic complexity. In this vein, this research attempts to make the following contributions:

First, besides globalization, globalization's sub-components such as economic, political, and social globalization processes will be considered separately. By doing this, direct and indirect causalities between different globalization types, financial development, and economic complexity will also be established. This is important because Turkey experienced a multifaceted globalization phase, especially after the 1980s. Accordingly, this globalization phase caused significant structural changes in Turkey's economic, political, and social formations. For instance, Turkey's economy became more open by incentivizing exports, removing import barriers, transforming its exchange rate regime, establishing the Capital Markets Board, joining the Customs Union with the EU, reforming the financial sector, and joining the World Trade Organization (WTO) (see TCMB, 2002).

Second, accounting for structural changes that are partially mentioned in the previous paragraph via dummy variables may be cumbersome and significantly reduce the degree of freedom of the sample. However, not considering these (structural) changes would also alter the stationarity and cointegration properties and the causalities among the selected variables. To overcome this issue, this study utilizes the Fourier approximated methods (these methods are discussed in the data and methodology section) that account for "*structural breaks of unknown form and number*" (Tsong et al., 2016: 1086). By using these methods, more robust results will be obtained. To the author's knowledge, this research would be the first to implement such methods.

Finally, in the literature, financial development-economic complexity and globalization-economic complexity links are usually examined in bi-variate settings for Turkey. As discussed previously, this research will explore the causal connections among globalization, financial development, and economic complexity in a tri-variate setting. This approach will allow the investigation of both direct and indirect causal links and propose more in-depth policies.

The structure of this research is as follows: In the following section, economic complexity and globalization indices are introduced. Also, Turkey's financial development, economic complexity, and globalization indicators are visually and comparatively examined. Section 3 summarizes the theoretical

background and literature. In section 4, the data and methods that are employed in this research are explained. In section 5, empirical findings are discussed. Finally, in the conclusion section, some policy suggestions are offered.

2. A VISUAL EXAMINATION OF TURKEY'S FINANCIAL DEVELOPMENT, ECONOMIC COMPLEXITY, AND GLOBALIZATION INDICES AGAINST JAPAN'S AND SWITZERLAND'S

In this section, Turkey's financial development, economic complexity, and globalization processes are examined in comparison to Japan's and Switzerland's financial development, economic complexity, and globalization processes in three separate graphs. The main reason for selecting these two countries is that according to OEC (2021) data, Japan and Switzerland had the highest economic complexity scores in 2017.

In Figure 1's first graph (Graph A), the economic complexity indices of these three countries are shown. The economic complexity index, which is calculated by Hausmann et al. (2014); Hidalgo & Hausmann (2009), is based on a country's exports products' diversity. There are two notions in classifying a country's export product diversity: "*ubiquity and diversity*" (Hausmann et al., 2014: 20). This index is calculated as an "*eigenvector of a matrix linking countries and their products through the variables of diversity and ubiquity*" (Sweet & Eterovic, 2019: 78-89). Intuitively, export products of a country that has a relatively higher economic complexity should have higher diversity and lower ubiquity (Hartmann et al., 2017: 77). In Figure 1's Graph A, it is clear that among the three selected countries, Turkey has the lowest economic complexity index score. However, after the 1980s, Turkey's economic complexity begins to increase and turns from negative to positive. This might be partly due to the globalization process that Turkey faced during the same era.

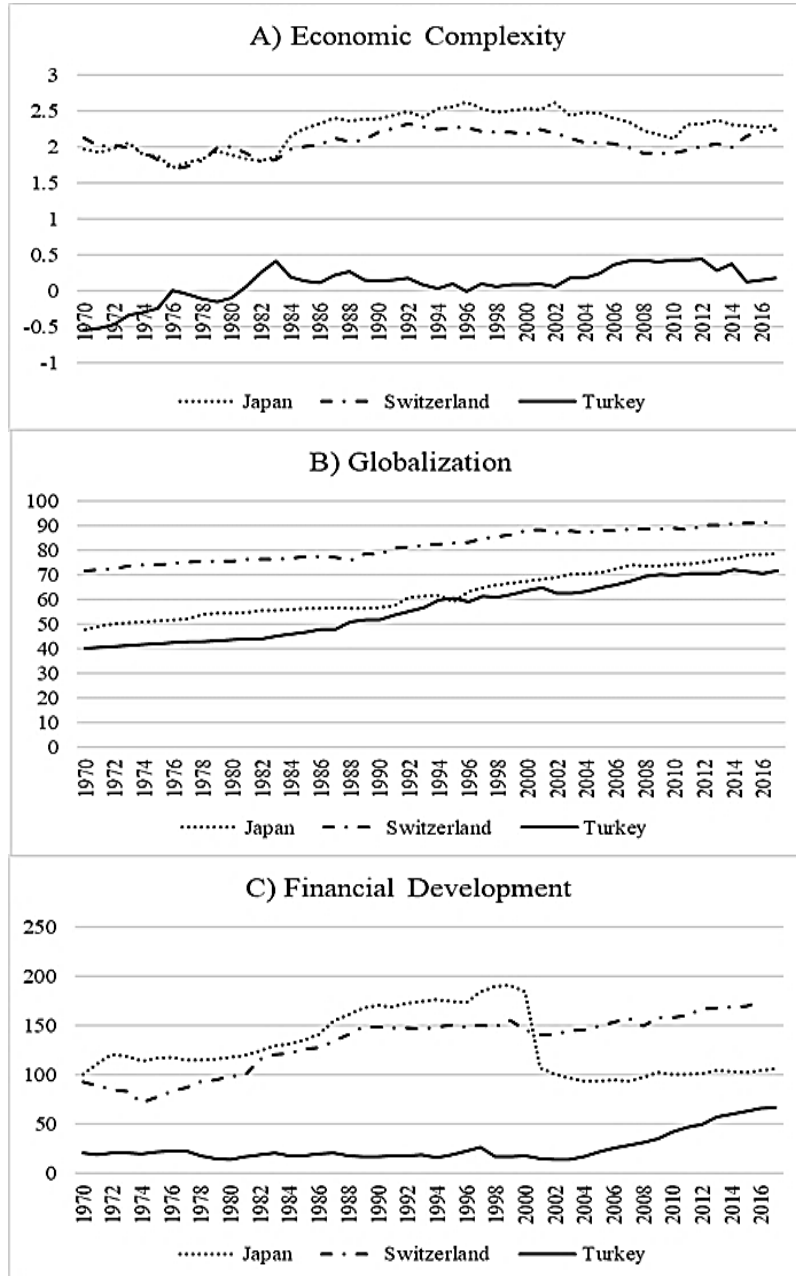
In Figure 1's Graph B, globalization indices of selected three countries are shown. The globalization index used in this research is compiled by Dreher (2006) and Gygli et al. (2019). It is calculated mainly via the principal component analysis and by employing 43 economic, social, and political variables such as trade volume, FDIs, international patents, high technology exports, internet access, and bandwidth, international tourism, migration, international organizations and treaties, television access, civil liberties, press freedom and so on³. In brief, this index is more inclusive and more accurately reflects the globalization level of countries. In Graph B of Figure 1, although it is apparent that Turkey's globalization level begins to accelerate in the 1980s, the globalization level of Turkey is still below the globalization level of Japan, and it is well below the globalization level of Switzerland.

Lastly, Graph C in Figure 1 shows the financial development in three countries. Similar to the globalization levels, the financial development levels of Japan and Switzerland are well above the financial development level of Turkey. Nevertheless, financial development in Turkey sharply increases right after the beginning of the 2000s. This might be due to the financial sector reforms that were implemented after the 2000-01 economic crisis in Turkey (TCMB, 2002: 53-55).

To summarize, a visual investigation of Figure 1 provides the following observations: (i) The economic complexity of Turkey is significantly lower than Switzerland's and Japan's economic complexities. (ii) Similarly, Turkey's globalization level is also lower than Switzerland's and Japan's globalization levels. (iii) Financial development levels of Switzerland and Japan are much higher than of Turkey's. (iv) Lastly, countries with higher economic complexities tend to be more globalized and financially developed.

³ More information about the variables that are used to construct this index can be found in https://ethz.ch/content/dam/ethz/special-interest/dual/kof-dam/documents/Medienmitteilungen/Globalisierungsindex/KOFGI_2020_variables.pdf (access date: 05.08 2021). For further details about this index, see Dreher (2006) and Gygli et al. (2019).

Figure 1: Economic Complexity, Globalization, and Financial Development of Turkey, Japan, and Switzerland (1970-2017)



Notes: Economic complexity and globalization are indices. Financial development is the domestic credit to private sector by banks (% of GDP). Sources of the data are reported in Table 1.

3. THEORETICAL BACKGROUND AND LITERATURE REVIEW

This section discusses the links between globalization, economic complexity, and financial development under three sub-sections. In sub-section 3.1, the globalization-economic complexity nexus is covered. In sub-section 3.2, the globalization-financial development link is established. Finally, sub-section 3.3 includes the nexus between economic complexity and financial development.

3.1. The Globalization-Economic Complexity Nexus

One of the possible gains from globalization is technology spillovers. In other terms, globalization can result in technology transfer, which is called the *technique effect* (Grossman & Krueger, 1991: 4). Through this transfer, countries can enhance their productive capabilities. Another gain from globalization is competition. Hatzichronoglou (1996) defines this type of competition as “*global competitiveness*.” He also claims that as a result of global competition, firms are required to develop and utilize a spectrum of ideas and abilities simultaneously. Therefore, production becomes a synergy of specialized skills brought together from different countries, regions, or continents. This situation also deepens the interdependencies among firms and countries (Hatzichronoglou, 1996: 7). In the end, competition can lead to productive diversification (i.e., economic complexity).

Empirical evidence by various studies almost unanimously confirmed these claims. For instance, Daude et al. (2016) showed that capital inflows to 42 countries have a robust association with the productive capabilities of these countries. Further, Can (2016) investigated how economic globalization impacts South Korea’s economic complexity and revealed that economic globalization positively impacts export products’ diversity. Kurt (2018) investigated the same phenomenon for Turkey; however, besides economic globalization, political and social globalization indices’ impacts were also considered. The findings of Kurt (2018) indicated that while economic and social globalization increase Turkey’s economic complexity, political globalization reduces it. Moreover, Şeker (2019) studied the impact of high-tech exports on Turkey’s economic complexity and confirmed that high-tech exports and patents boost complexity. Additionally, he also found that a bi-directional causality exists between high-tech exports and Turkey’s economic complexity. Another research by Şeker & Şimdi (2019) investigated how the trade between Turkey and CATRs (Central Asian and Turkic Republics) impacts their economic complexity scores. Their findings showed that Turkey’s exports to CATRs cause economic complexity in Turkey and that higher trade volume between the two parties affects both parties’ economic complexities.

Furthermore, a recent causality analysis conducted by Uçar et al. (2019) on G-8 countries partially confirmed that there is a unidirectional causality running from export volume to economic complexity. In another recent study, Lapatinas (2019) examined the effect of internet usage on the economic complexity of 100 developing and developed countries and showed that internet usage increases economic complexity. In addition, Şahin & Durmuş (2020) investigated the determinants of economic complexity in 10 newly industrialized countries and found that foreign direct investments (FDIs) cause economic complexity in China and Mexico. Further, Khan et al. (2020) studied the economic complexity-FDIs link in China. Their analysis revealed that a short-run unidirectional causality runs from economic complexity to FDIs, and a long-run bi-directional causal link exists between these variables. Moreover, Antonietti & Franco (2021) studied if FDIs in 117 economies Granger-causes economic complexity. Their study indicated that, albeit limited, FDIs improve economic complexity; nonetheless, this improving effect exists only in economies with higher economic output, education, and financial development levels. Also, Nguyen & Su (2021) observed that trade openness increases economic complexity in lower-middle and upper-middle-income countries yet decreases it in high-income countries. Finally, Bucak (2022) investigated how economic, political, and social globalization dimensions impact economic complexities in BRICS-T economies. This study’s empirical evidence revealed that globalization in political and economic dimensions improves economic complexity in Russia. Additionally, social globalization decreases economic complexities in Brazil, India, Russia, and South Africa. Lastly, according to this study’s findings on Turkey, only social globalization significantly improves economic complexity.

3.2. The Globalization-Financial Development Nexus

Before establishing the conceptual link between financial development and economic complexity, it would be beneficial for the purpose of this research to identify the globalization-financial development nexus. As stated in Mishkin (2009), globalization necessitates financial reforms because if developing countries seek easier access to capital, they have to attract foreign investors. To do that, these countries should execute necessary reforms to integrate their financial systems into the global economy. These reforms would not only result in financial development but also increase the functionality of financial systems and institutions in these developing countries (Mishkin, 2009: 166). Moreover, if a country has well-developed financial institutions and systems, its globalization process would be less cumbersome and more beneficial.

In summary, it is possible to establish that financial development and globalization are interlinked. Empirical studies on this subject also confirm this bi-directional link. For example, Law et al. (2014) showed that economic globalization has a favorable causal effect on stock market development in East Asia. Similarly, Muye & Muye (2017) found that globalization has a stronger significant impact on financial development in BRICS and MINT economies. Likewise, Kandil et al. (2015) revealed that financial development positively influences globalization in 32 developed and developing countries.

3.3. The Economic Complexity-Financial Development Link

Regarding the financial development-economic complexity link, Chu (2020) summarizes the advantages of having a well-functioning and developed financial system on economic complexity as follows: First, financial development allows new firms that do not have sufficient capital to engage in innovative investments by providing them with new financial venues to obtain financial capital and credits. Second, as a result of asymmetric information and financial barriers, firms usually suffer from the lack of capital; therefore, they do not engage in innovative investment and do not consider improving their productive capabilities. However, a well-developed financial system can alleviate these issues through monitoring and managing risks, better evaluation, and decreasing financial costs and barriers. Finally, a well-integrated financial system also allows firms to seek financial support through foreign sources (Chu, 2020: 1260).

Empirical evidence generally supports the claim that financial development induces economic complexity. For example, Kurt & Azazi (2018) showed that financial development in Turkey increases its economic complexity. Can & Doğan (2018) confirmed this finding and found that financial development positively impacts Turkey's economic complexity. In addition, Şahin & Durmuş (2020) found that financial development causes economic complexity in Turkey and Mexico. The study by Nguyen et al. (2020) indicated that a long-run association and a bi-directional causality exist between financial development and economic complexity in their sample of 52 economies. Additionally, their study's results also suggested that the efficiency of financial markets and institutions is a positive contributor to economic complexity, whereas financial depth and access are likely to be negatively associated with economic complexity in the long run. Similarly, Chu (2020) empirically examined the impacts of developments in the banking sector and the stock market on economic sophistication and showed that both financial development indicators increase product sophistication in a sample of 94 countries. Additionally, Nguyen & Su (2021) verified that financial development leads to increases in economic complexity in a selection of 86 countries. Lastly, for a panel of 120 countries, Yu & Qayyum (2021) studied how financial openness affects economic complexity. Their empirical evidence showed that overall improvements in financial openness could boost economic complexity.

Literature survey above points at some gaps in the empirical literature. First, studies that investigated the Turkish case are rather limited. Second, while there exists a limited number of studies that examined the impact of globalization on economic complexity, these studies mostly do that in a bi-variate setting and ignore the intermediating or direct role that financial development can play in fostering economic complexity. Third, the majority of the empirical research considers the impact of

globalization by proxying it with single-dimensional variables such as trade volume, export volume, internet usage, high-tech exports, and FDIs. Nonetheless, globalization is a multifaceted concept, and covering it with a single-dimensional variable may produce misleading results. Last, none of the studies summarized above employed the methods that allow for unknown number, shape, and form of breaks in their analysis. Thereupon, this research attempts to cover these gaps by 1) examining causal links among globalization, financial development, and economic complexity in a tri-variate model; 2) using a globalization index and globalization's sub-indicators (i.e., economic, political, and social globalization) that also include abovementioned variables (such as trade volume, FDIs, internet usage) (see the previous section); 3) utilizing methods that allow for an unknown number, shape, and form of structural breaks (see the data and methodology section).

4. DATA AND METHODOLOGY

In this section, data and methods are explained. The first sub-section summarizes the data, and the next sub-section outlines the utilized methods.

4.1. Data

This study covers the 1970-2017 period and uses yearly data. The variables, their definitions, and sources are presented in Table 1. Additionally, the descriptive statistics of the utilized variables are displayed in the appendix section. In this research, the globalization index and its sub-indices (economic, political, and social globalization) are considered in separate models to avoid perfect multicollinearity problem because the globalization index score is just an average of these three sub-indices. Therefore, the models that are proposed in this study have three variables: 1) globalization (and its sub-indices), 2) financial development, and 3) economic complexity. Lastly, in this research, based on the globalization index and its sub-indices, four models are proposed, namely, the globalization model, the economic globalization model, the political globalization model, and the social globalization model.

Table 1: Employed Variables

Variable	Definition	Source
<i>eci</i>	Economic Complexity index	OEC (2021a)
<i>fd</i>	Financial Development (Domestic Credit to Private Sector by Banks, % of GDP)	World Bank (2020)
<i>gi</i>	Globalization Index	KOF Swiss Economic Institute (2020)
<i>gi_eco</i>	Economic Globalization Index	
<i>gi_pol</i>	Political Globalization Index	
<i>gi_soc</i>	Social Globalization Index	

Notes: OEC: The Observatory of Economic Complexity.

4.2. Methodology: Unit Root, Cointegration, and Causality Processes

Before testing whether there is a co-movement between the selected variables, stationarity properties of time series should be examined. In this respect, two unit root tests are employed: the Phillips-Perron (*PP*) test of Phillips & Perron (1988) and the Fourier-Lagrange Multiplier (*Fourier-LM*) test of Enders & Lee (2012b). The former one is the typical unit root test selected in many empirical studies, while the latter one is chosen to capture the possible impact(s) of structural breaks. The main advantage of the Fourier-LM unit root test is that the exact dates, forms, and numbers of the breaks are not needed to be known (Enders & Lee, 2012b: 575). Another advantage of the Fourier-LM unit root test is that compared to its counterparts (such as the Fourier-augmented Dickey-Fuller test of Enders & Lee, 2012a), it has more power (Enders & Jones, 2016: 405).

In summary, the Fourier-LM test is based on estimating the following regression:

$$\Delta y_t = \gamma_0 + \gamma_1 \Delta \sin(2\pi kt/T) + \gamma_2 \Delta \cos(2\pi kt/T) + e_t \quad (1)$$

In equation (1), the terms T , t , and k represent the number of observations, trend, and a particular Fourier frequency, respectively. The estimated coefficients are denoted as $\hat{\gamma}_0$, $\hat{\gamma}_1$, and $\hat{\gamma}_2$. From these coefficients, the following detrended series is formed:

$$\hat{S}_t = y_t - \hat{\lambda} - \hat{\gamma}_0 t - \hat{\gamma}_1 \sin(2\pi kt/T) - \hat{\gamma}_2 \cos(2\pi kt/T), \quad t = 2, \dots, T \quad (2)$$

In this equation, $\hat{\lambda} = y_1 - \hat{\gamma}_0 - \hat{\gamma}_1 \sin(2\pi kt/T) - \hat{\gamma}_2 \cos(2\pi kt/T)$ and y_1 is the initial observation of y_t . Subtracting $\hat{\lambda}$ from y_t results in $\hat{S}_1 = 0$. The testing regression for this procedure is presented in the following equation that is derived by using the detrended series:

$$\Delta y_t = \delta \hat{S}_{t-1} + b_0 + b_1 \Delta \sin(2\pi kt/T) + b_2 \Delta \cos(2\pi kt/T) + u_t \quad (3)$$

If the series y_t is stationary, the case $\delta=0$ must be invalid. Therefore, the LM test statistic is: $\tau_{LM} = t\text{-statistic for } H_0: \delta=0$ (Enders & Lee, 2012b: 578).

After determining the stationarity properties of the time series, cointegration between them will be decided by the Tsong et al. (2016) cointegration test. Similar to the Fourier-LM unit root test, this cointegration test also employs trigonometric components to capture (possible) breaks. Tsong et al. (2016) base their test on the following regression:

$$y_t = d_t + x_t' \beta + \omega_t, \quad t = 1, 2, \dots, T \quad (4)$$

Where $\omega_t = \rho_t + v_{1t}$, $\rho_t = \rho_{t-1} + u_t$ with $\rho_0=0$ and $x_t = x_{t-1} + v_{2t}$. Additionally, u_t is *iid* with 0 mean and σ_u^2 variance. Thus, ρ_t is a random process with 0 mean. The deterministic component, d_t , in equation (4) is presented as $d_t = \sum_{i=0}^m \zeta_i t^i + f_t$ with $m=0$ or 1 . Further, $f_t = \alpha_k \sin[2k\pi t/T] + \beta_k \cos[2k\pi t/T]$. Moreover, as v_{1t} and v_{2t} are stationary, both y_t and x_t are integrated of order 1 [i.e., $I(1)$ processes]. Definitely, if $\sigma_u^2 = 0$, $\omega_t = v_{1t}$ is stationary, and this indicates that y_t and x_t are cointegrated. In other words, the null hypothesis of cointegration exists against the alternative hypothesis that cointegration does not exist can be shown as $H_0: \sigma_u^2 = 0$ against $H_A: \sigma_u^2 > 0$.

If the time series are cointegrated, causalities among them can be observed. To do that, this study employs the Granger causality test that is augmented with a flexible Fourier form to account for multiple breaks in a vector autoregression (*VAR*). This procedure, which is referred to as the Fourier Granger causality test in this study, is proposed by Enders & Jones (2016). In summary, similar to the unit root and cointegration tests stated above, this causality test implements a Fourier function into the deterministic part of the *VAR* equation to capture the size, form, and number of the structural breaks. Consider the following *VAR*, which has the flexible Fourier form:

$$z_t = A_0(t) + \sum_{i=1}^L A_i z_{t-i} + \varepsilon_t \quad (5)$$

In equation (5), z_t is a vector in which the time series of interest are included. Also, A_i is the matrix of the coefficients, and ε_t is the error terms vector. The lag length (L) is selected based on the Akaike information criterion (*AIC*). Further, $A_0(t) = [\delta_1(t), \delta_2(t), \delta_3(t)]'$. Lastly, each intercept, $\delta_i(t)$, depends on the Fourier frequencies that can be presented as: $\delta_i(t) = a_i + b_i t + \sum_{k=1}^n a_{ik} \sin(2\pi kt/T) + \sum_{k=1}^n b_{ik} \cos(2\pi kt/T)$ (Enders & Jones, 2016; Ghoshray et al., 2018). Correspondingly, based on this model, the causalities among the selected variables are determined.

5. RESULTS AND DISCUSSION

Before checking for the cointegration, stationarities of the selected variables should be observed. In this respect, the results of the unit-root tests are shown in Table 2.

Table 2: Stationarity Tests' Results

The PP Test		The Fourier-LM Test
<i>variables</i>	<i>t-statistic</i>	<i>LM-statistic</i>
<i>fd</i>	0.180	-2.098
<i>eci</i>	-2.249	-2.870
<i>gi</i>	-1.918	-2.919
<i>gi_eco</i>	-1.707	-4.094*
<i>gi_pol</i>	-2.041	-2.294
<i>gi_soc</i>	-1.596	-3.092
Δfd	-5.225***	-5.017***
Δeci	-7.029***	-6.628***
Δgi	-6.351***	-5.645***
Δgi_eco	-8.106***	-6.436***
Δgi_pol	-5.237***	-7.925***
Δgi_soc	-7.332***	-5.726***

Notes: * and *** indicate significance at 10% and 1% levels, respectively. Frequency (*k*) is set to be 1 for the Fourier-LM test. The unit-root tests' equations include time trend and constant in levels and only constant in their first differences.

Findings in Table 2 show that, according to both tests, all the selected time series turn out to be stationary in their first differences. In other terms, all the variables are *I(1)* at 1% significance level. As all the variables are *I(1)*, it is now possible to apply the cointegration (CI) test to decide if the variables in the proposed models have a co-movement. The results of the Fourier-CI test are presented in Table 3.

Table 3: The Fourier-CI Test Results

<i>Globalization Model</i>	<i>eci=f(fd, gi)</i>	<i>gi=f(fd, eci)</i>	<i>fd=f(eci, gi)</i>			
Fourier-CI test	0.037	0.029	0.025			
F-test	15.455***	638.036***	87.224***			
<i>Economic Globalization Model</i>	<i>eci=f(fd, gi_eco)</i>	<i>gi_eco = f(fd, eci)</i>	<i>fd=f(eci, gi_eco)</i>			
Fourier-CI test	0.040	0.025	0.026			
F-test	8.900***	228.145***	152.989***			
<i>Political Globalization Model</i>	<i>eci=f(fd, gi_pol)</i>	<i>gi_pol = f(fd, eci)</i>	<i>fd=f(eci, gi_pol)</i>			
Fourier-CI test	0.046	0.036	0.028			
F-test	9.789***	340.985***	97.885***			
<i>Social Globalization Model</i>	<i>eci=f(fd, gi_soc)</i>	<i>gi_soc = f(fd, eci)</i>	<i>fd=f(eci, gi_soc)</i>			
Fourier-CI test	0.032	0.030	0.031			
F-test	34.799***	312.324***	61.269***			
<i>CVs for the Fourier-CI test</i>	1%	0.155	5%	0.092	10%	0.070
<i>CVs for the F-test</i>	1%	5.774	5%	4.066	10%	3.352

Notes: Frequency component for the Fourier term is set to be 1. *** shows significance at 1%. CVs: Critical values. CI: Co-integration. F-tests in the table show the significance of the Fourier-terms in the cointegration regressions. Critical values for the tests are collected from the Tsong et al. (2016) study.

In Table 3, there are two statistics presented for each model: the Fourier-CI test statistics and the F-test statistics. The results of the F-tests are presented to decide if the Fourier terms should be included in the equations. As the results clearly indicate, F-tests are significant for all the models. In other words, the Fourier components should be included in the models. The other statistics shown in Table 3 belong to the Fourier-CI test. For all the models, none of the results is significant. As these results are insignificant, the null hypothesis of cointegration cannot be rejected. Correspondingly, these findings indicate that the variables are cointegrated in the proposed models. The results of the Fourier Granger causality analysis are demonstrated in Table 4.

Table 4: The Fourier-Granger Causality Test Results

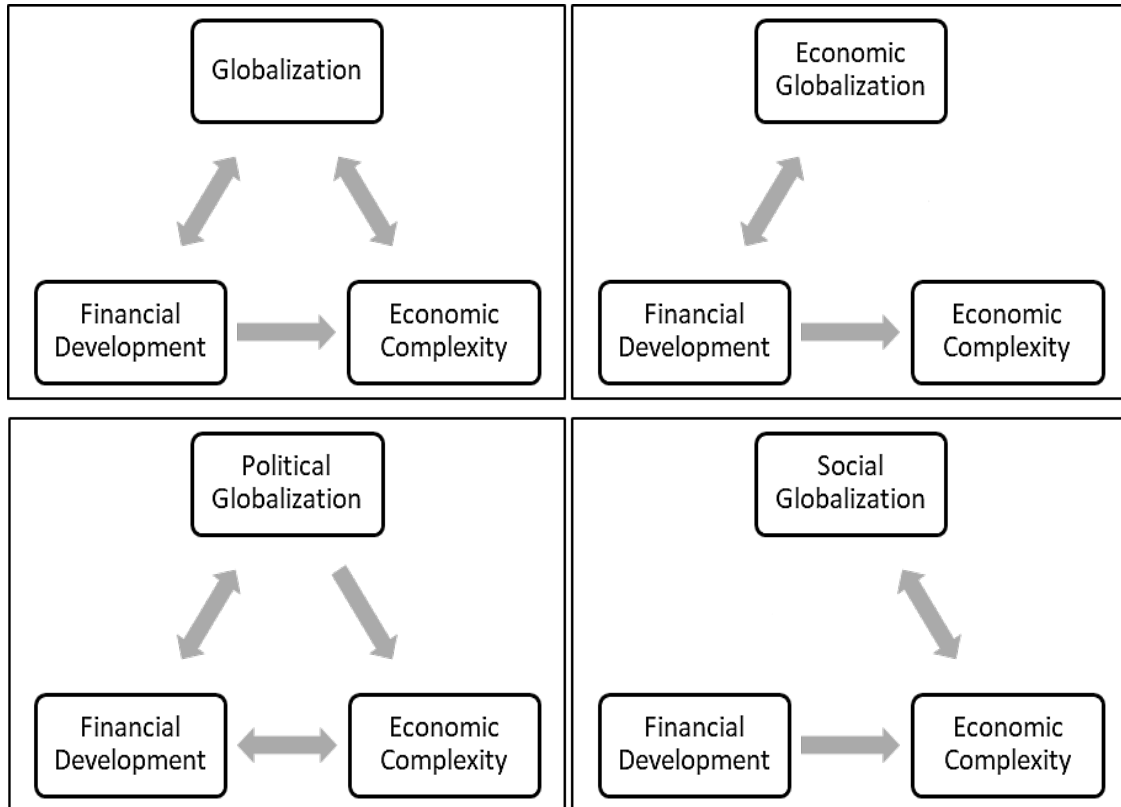
	Wald Test Statistic	Asymptotic p-value	Bootstrap p-value
Globalization model: $eci=f(fd, gi)$			
$eci \rightarrow gi$	5.187*	0.075	0.091
$gi \rightarrow eci$	6.922**	0.031	0.045
$eci \rightarrow fd$	0.234	0.889	0.884
$fd \rightarrow eci$	13.439***	0.001	0.002
$gi \rightarrow fd$	6.269*	0.043	0.057
$fd \rightarrow gi$	5.448*	0.065	0.081
Economic Globalization Model: $eci=f(fd, gi_eco)$			
$eci \rightarrow gi_eco$	4.704	0.095	0.118
$gi_eco \rightarrow eci$	2.566	0.277	0.267
$eci \rightarrow fd$	0.214	0.898	0.886
$fd \rightarrow eci$	10.735***	0.0046	0.005
$gi_eco \rightarrow fd$	12.178***	0.0023	0.005
$fd \rightarrow gi_eco$	6.516*	0.038	0.056
Political Globalization Model: $eci=f(fd, gi_pol)$			
$eci \rightarrow gi_pol$	3.217	0.200	0.214
$gi_pol \rightarrow eci$	5.811*	0.0547	0.071
$eci \rightarrow fd$	7.903**	0.0192	0.021
$fd \rightarrow eci$	7.328**	0.0256	0.034
$gi_pol \rightarrow fd$	13.275***	0.0013	0.004
$fd \rightarrow gi_pol$	7.201**	0.0273	0.039
Social Globalization Model: $eci=f(fd, gi_soc)$			
$eci \rightarrow gi_soc$	8.923**	0.0115	0.010
$gi_soc \rightarrow eci$	7.436**	0.0243	0.032
$eci \rightarrow fd$	0.3101	0.856	0.862
$fd \rightarrow eci$	18.021***	0.0001	0.000
$gi_soc \rightarrow fd$	3.928	0.1402	0.140
$fd \rightarrow gi_soc$	2.672	0.263	0.272

Notes: Maximum lag length is 3. Optimum lag length selection is based on the Akaike information criterion (AIC). The optimum lag length chosen by AIC for each model is 2. The Fourier frequency is set to be 1 in each model. ***, **, and * indicate significance at 1%, 5%, and 10% levels, respectively.

The results in Table 4 indicate that there exist significant causalities between globalization (including its sub-indicators), economic complexity, and financial development. To examine the direct,

indirect, unidirectional, and/or bi-directional relationships between the variables more clearly, based on the results in Table 4, the statistically significant causalities are visually presented in Figure 2.

Figure 2: Causal Links Based on the Fourier-Granger Causality Analysis



According to Figure 2, bi-directional causalities exist between globalization and economic complexity and between globalization and financial development. Moreover, globalization indirectly causes economic complexity through financial development. In the economic globalization model, although economic globalization does not directly cause economic complexity, it causes economic complexity through financial development. Besides, there is a bi-directional causal flow between economic globalization and financial development. Results for the political globalization model show that two-way causalities exist between political globalization and financial development and between financial development and economic complexity. In addition, political globalization causes economic complexity directly and indirectly through financial development. Also, the findings regarding the social globalization model imply that both social globalization and financial development directly cause economic complexity. Finally, there exists a bi-directional causality between social globalization and economic complexity.

To sum up, in Turkey, globalization and its sub-components (such as economic, political, and social globalization) directly and/or indirectly through financial development cause economic complexity. Moreover, financial development in Turkey directly causes economic complexity. This study's results regarding the globalization-economic complexity nexus coincide with the findings of Can (2016); Daude et al. (2016); Kurt (2018); Lapatinas (2019); Şahin & Durmuş (2020); Şeker & Şimdi (2019); Şeker (2019); Uçar et al. (2019), and Khan et al. (2020). The findings regarding the direct causal effect that financial development imposes on economic complexity confirm the results in Can & Doğan (2018); Chu (2020); Kurt & Azazi (2018); Nguyen et al. (2020); Nguyen & Su (2021); Şahin & Durmuş (2020). Lastly, bi-directional causalities between globalization and financialization and between economic globalization and financial development partially confirm the results of Kandil et al. (2015); Law et al. (2014); Muye & Muye (2017).

6. CONCLUSION

Countries have become more interdependent economically, politically, and socially as a result of globalization. Also, in this context, achieving economic complexity (i.e., export product diversification) is considered to be one of the main ways through which developing countries can shift their economic status. Therefore, grasping the globalization-economic complexity-financial development nexus in developing countries can provide new insights into how economic sophistication can be achieved.

Albeit limited, there exist some studies that examine the globalization-economic complexity link. However, these studies mostly do it in a bivariate setting, and they ignore the intermediating or direct causal effect of financial development on economic complexity. Moreover, studies that consider globalization's impact usually do it by proxying it via limited variables (such as trade volume, FDI, high-tech exports). Additionally, the number of studies that examine economic complexity in Turkey is limited. To fill these gaps, this study examined the economic complexity-globalization-financial development link in Turkey for the 1970-2017 period. Besides, to account for the unknown number, shape, and form of (structural) breaks, this research utilized the Fourier approximated methods from unit-root testing procedure to causality analysis to obtain robust results. The findings of this study indicated that (i) globalization and political globalization both directly and indirectly through financial development cause economic sophistication; (ii) economic globalization indirectly causes economic sophistication; (iii) social globalization directly causes economic complexity; and (iv) financial development directly causes economic complexity in Turkey. These findings generally confirm the theoretical framework presented in section 3. Moreover, these results reveal that neglecting financial development's intermediating and direct roles in fostering economic sophistication can curb Turkey's economic development process.

Based on these results, various policy suggestions can be propounded. First, the visual exploration that was done in a previous section indicates that Turkey's globalization and financial development levels, compared to its developed counterparts, are relatively low. Turkey should fill this gap by increasing its connectedness with the world not only economically but also politically and socially. In short, Turkey should become more globalized if it desires to improve its export product diversification. This would allow Turkey to have better access to the latest technological developments and production practices, thus making the country more competitive and innovative. Moreover, the results also implied that while affecting economic complexity through globalization is possible, the direct and intermediating roles of financial development and its bi-directional causality with globalization should not be ignored. Thus, necessary steps should be taken to improve the financial system in Turkey and embed it into the global financial system. By doing this, foreign financial sources would become more accessible, and these sources can be employed to support innovative investments. In addition, improving access to financial markets and increasing its efficiency would also enable more foreign and domestic investors to boost their productive capacities, which in turn may eventually increase Turkey's productive capabilities. Furthermore, in 2016, Turkey passed the "*Implementation Regulation for Technology Development Regions*"⁴ to increase Turkey's innovative capacity by boosting its regional innovative ecosystem. This regulation seems to be the right step to boost Turkey's overall economic capacity, and similar regulations should be implemented to support innovation at the regional level. Nonetheless, these steps should be financially promoted by strengthening regional financial sectors. Moreover, foreign firms should be incentivized to invest in these regions. These incentives can be provided in the form of tax exemptions/refunds and decreased bureaucratic barriers.

Further research should consider other developing countries to confirm whether similar causal patterns exist. Also, as different types of globalization indices (such as *de facto* and *de jure* types) and sub-indices exist, these indices can be separately examined to determine which type of globalization is more beneficial to economic complexity.

⁴ Translated to English by the author(s). For further details about this regulation, see <https://www.resmigazete.gov.tr/eskiler/2016/08/20160810-8.htm> (access date: 22.10.2022).

Ethics Statement: In this study, the methods used do not require the permission of the “Ethics Committee”.

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REFERENCES

- Ahmad, M. (2019). Globalisation, Economic Growth, and Spillovers: A Spatial Analysis. *Margin: The Journal of Applied Economic Research*, 13(3), 255–276. <https://doi.org/10.1177/2347631119841257>
- Antonietti, R., & Franco, C. (2021). From FDI to economic complexity: a panel Granger causality analysis. *Structural Change and Economic Dynamics*, 56, 225–239. <https://doi.org/10.1016/j.strueco.2020.11.001>
- Bucak, . (2022). BRICS-T lkelerinde Ekonomik Karmařıklık ve Kreselleřme İliřkisi: Panel Veri Analizi. *Akademik Arařtırmalar ve alıřmalar Dergisi (AKAD)*, 14(26), 92–105. <https://doi.org/10.20990/kilisiibfakademik.1069570>
- Can, M. (2016). Ekonomik Kreselleřme Sofistike Maml retimini Etkiler mi? : Gney Kore rnekleminde Ampirik Bir Analiz. *Eskiřehir Osmangazi niversitesi İktisadi ve İdari Bilimler Dergisi*, 11(3), 21–38. <https://doi.org/10.17153/oguiibf.272210>
- Can, M., & Doęan, B. (2018). Ekonomik Kompleksite ve Finansal Geliřme İliřkisi : Trkiye rnekleminde Ampirik Bir Analiz. *Finans Politik & Ekonomik Yorumlar 2018*, 55(638), 5–16. <http://www.ekonomikyorumlar.com.tr/files/articles/1529399025.pdf>
- Chu, L. K. (2020). The effects of financial development on economic sophistication: evidence from panel data. *Applied Economics Letters*, 27(15), 1260–1263. <https://doi.org/10.1080/13504851.2019.1676866>
- Daude, C., Nagengast, A., & Perea, J. R. (2016). Productive capabilities: An empirical analysis of their drivers. *The Journal of International Trade & Economic Development*, 25(4), 504–535. <https://doi.org/10.1080/09638199.2015.1073342>
- Dreher, A. (2006). Does globalization affect growth? Evidence from a new index of globalization. *Applied Economics*, 38(10), 1091–1110. <https://doi.org/10.1080/00036840500392078>
- Enders, W., & Jones, P. (2016). Grain prices, oil prices, and multiple smooth breaks in a VAR. *Studies in Nonlinear Dynamics & Econometrics*, 20(4), 399–419. <https://doi.org/10.1515/sn-de-2014-0101>
- Enders, W., & Lee, J. (2012a). The flexible Fourier form and Dickey-Fuller type unit root tests. *Economics Letters*, 117(1), 196–199. <https://doi.org/10.1016/j.econlet.2012.04.081>
- Enders, W., & Lee, J. (2012b). A Unit Root Test Using a Fourier Series to Approximate Smooth Breaks. *Oxford Bulletin of Economics and Statistics*, 74(4), 574–599. <https://doi.org/10.1111/j.1468-0084.2011.00662.x>
- Ghoshray, A., Mendoza, Y., Monfort, M., & Ordoñez, J. (2018). Re-assessing causality between energy consumption and economic growth. *PLOS ONE*, 13(11), e0205671. <https://doi.org/10.1371/journal.pone.0205671>
- Grossman, G. M., & Krueger, A. B. (1991). Environmental Impacts of a North American Free Trade Agreement. In *National Bureau of Economic Research Working Paper Series* (No. 3914; National Bureau of Economic Research Working Paper Series). <https://doi.org/10.3386/w3914>
- Gygli, S., Haelg, F., Potrafke, N., & Sturm, J.-E. (2019). The KOF Globalisation Index – revisited. *The Review of International Organizations*, 14(3), 543–574. <https://doi.org/10.1007/s11558-019-09344-2>
- Hartman, D. (2013). A global comparative perspective on innovation and economic diversification in Turkey. In *Istanbul Policy Center* (pp. 1–28). Istanbul Policy Center (IPC).
- Hartmann, D., Guevara, M. R., Jara-Figueroa, C., Aristarán, M., & Hidalgo, C. A. (2017). Linking Economic Complexity, Institutions, and Income Inequality. *World Development*, 93, 75–93. <https://doi.org/10.1016/j.worlddev.2016.12.020>
- Hatzichronoglou, T. (1996). Globalisation and Competitiveness: Relevant Indicators. In *OECD Science* (1996/05; OECD Science, Technology and Industry Working Papers). <https://doi.org/https://doi.org/10.1787/18151965>
- Hausmann, R., & Hidalgo, C. A. (2011). The network structure of economic output. *Journal of Economic Growth*, 16(4), 309–342. <https://doi.org/10.1007/s10887-011-9071-4>

- Hausmann, R., Hidalgo, C. A., Bustos, S., Coscia, M., Simoes, A., & Yildirim, M. A. (2014). *The Atlas of Economic Complexity: Mapping Paths to Prosperity*. The MIT Press. <https://doi.org/10.7551/mitpress/9647.001.0001>
- Hidalgo, C. A., & Hausmann, R. (2009). The building blocks of economic complexity. In *Proceedings of the National Academy of Sciences of the United States of America* (Vol. 106, Issue 26). <https://doi.org/10.1073/pnas.0900943106>
- Kandil, M., Shahbaz, M., & Nasreen, S. (2015). The interaction between globalization and financial development: new evidence from panel cointegration and causality analysis. *Empirical Economics*, 49(4), 1317–1339. <https://doi.org/10.1007/s00181-015-0922-2>
- Khan, H., Khan, U., & Khan, M. A. (2020). Causal Nexus between Economic Complexity and FDI: Empirical Evidence from Time Series Analysis. *The Chinese Economy*, 53(5), 374–394. <https://doi.org/10.1080/10971475.2020.1730554>
- KOF Swiss Economic Institute. (2020). *KOF Globalisation Index*. <https://www.kof.ethz.ch/en/forecasts-and-indicators/indicators/kof-globalisation-index.html>
- Kurt, Ü. (2018). Küreselleşme ve Ekonomik Kompleksite İlişkisi: Türkiye Örneği. *Hitit Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, 11(3), 2195–2202. <https://doi.org/10.17218/hititsosbil.454395>
- Kurt, Ü., & Azazi, H. (2018). Finansal Gelişme ve Sofistike Ürün Üretimi İlişkisi: Türkiye İçin Ampirik Bir Analiz. *Journal of Turkish Studies*, 13(22), 341–352. <https://doi.org/10.7827/TurkishStudies.13993>
- Lapatinas, A. (2019). The effect of the Internet on economic sophistication: An empirical analysis. *Economics Letters*, 174, 35–38. <https://doi.org/10.1016/j.econlet.2018.10.013>
- Law, S. H., Azman-Saini, W. N. W., & Tan, H. B. (2014). Economic Globalization and Financial Development in East Asia: A Panel Cointegration and Causality Analysis. *Emerging Markets Finance and Trade*, 50(1), 210–225. <https://doi.org/10.2753/REE1540-496X500112>
- Mishkin, F. S. (2009). Globalization and financial development. *Journal of Development Economics*, 89(2), 164–169. <https://doi.org/10.1016/j.jdeveco.2007.11.004>
- Muye, I. M., & Muye, I. Y. (2017). Testing for causality among globalization, institution and financial development: Further evidence from three economic blocs. *Borsa Istanbul Review*, 17(2), 117–132. <https://doi.org/10.1016/j.bir.2016.10.001>
- Nguyen, C. P., Schinckus, C., & Su, T. D. (2020). The drivers of economic complexity: International evidence from financial development and patents. *International Economics*, 164(June), 140–150. <https://doi.org/10.1016/j.inteco.2020.09.004>
- Nguyen, C. P., & Su, T. D. (2021). Financing the economy: The multidimensional influences of financial development on economic complexity. *Journal of International Development*, 33(4), 644–684. <https://doi.org/10.1002/jid.3541>
- OECD. (2021a). *OECD - Economic Complexity Ranking of Countries*. The Observatory of Economic Complexity (OEC). https://legacy.oec.world/en/rankings/country/eci/?year_range=1968-1972
- OECD. (2021b). *OECD - The Observatory of Economic Complexity*. <https://oec.world/en/resources/methods#eci>
- Phillips, P. C. B., & Perron, P. (1988). Testing for a Unit Root in Time Series Regression. *Biometrika*, 75(2), 335–346. <https://doi.org/10.2307/2336182>
- Şahin, D., & Durmuş, S. (2020). Yeni Sanayileşen Ülkelerde Ekonomik Kompleksite Düzeyinin Belirleyicileri. *Ordu Üniversitesi Sosyal Bilimler Enstitüsü Sosyal Bilimler Araştırmaları Dergisi*, 10(2), 334–351. <https://dergipark.org.tr/tr/download/article-file/1206425>
- Şeker, A., & Şimdi, H. (2019). The Relationship Between Economic Complexity Index and Export: the Case of Turkey and Central Asian and Turkic Republics. *Economy of Region*, 15(3), 659–669. <https://doi.org/10.17059/2019-3-3>
- Şeker, Ayberk. (2019). Teknolojik Gelişme ve Yüksek Teknoloji İhracatının Ekonomik Karmaşıklık Endeksi Üzerindeki Etkisi: Türkiye Örneği. *Yönetim ve Ekonomi: Celal Bayar Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, 26(2), 377–395. <https://doi.org/10.18657/yonveek.581397>
- Sweet, C., & Eterovic, D. (2019). Do patent rights matter? 40 years of innovation, complexity and productivity. *World Development*, 115, 78–93. <https://doi.org/10.1016/j.worlddev.2018.10.009>

- TCMB. (2002). *The Impact of Globalization on the Turkish Economy*. <https://www.tcmb.gov.tr/wps/wcm/connect/16555e2a-dfcb-4e4b-9ef9-ec2797f3f2d8/global.pdf?MOD=AJPERES&CACHEID=ROOTWORKSPACE-16555e2a-dfcb-4e4b-9ef9-ec2797f3f2d8-m3fBaj8>
- Tsong, C.-C., Lee, C.-F., Tsai, L.-J., & Hu, T.-C. (2016). The Fourier approximation and testing for the null of cointegration. *Empirical Economics*, 51(3), 1085–1113. <https://doi.org/10.1007/s00181-015-1028-6>
- Uar, M., Soyyiğit, S., & Niřancı, M. (2019). lkelerin İktisadi Geliřmiřlik ve İktisadi Karmařıklık Dzeyleri Arasındaki İliřki: G8 lkeleri rneęi. *Cumhuriyet niversitesi İktisadi ve İdari Bilimler Dergisi*, 20(1), 138–148. <https://dergipark.org.tr/pub/cumuiibf/issue/45599/524670>
- World Bank. (2020). *World Development Indicators*. <http://databank.worldbank.org/data/home.aspx>
- Yu, Y., & Qayyum, M. (2021). Impacts of financial openness on economic complexity: Cross-country evidence. *International Journal of Finance & Economics*. <https://doi.org/10.1002/ijfe.2491>

APPENDIX

Table A1: Descriptive Statistics

	<i>eci</i>	<i>fd</i>	<i>gi</i>	<i>gi_econ</i>	<i>gi_soc</i>	<i>gi_pol</i>
<i>Mean</i>	0.1037	25.6487	56.0208	44.0803	45.4041	78.5780
<i>Median</i>	0.1389	19.6578	57.9381	48.4480	41.1431	82.7398
<i>Maximum</i>	0.4502	66.4259	72.1185	56.3248	67.6390	92.8202
<i>Minimum</i>	-0.5456	13.5883	40.1478	27.5395	31.2531	61.6507
<i>Std. Dev.</i>	0.2453	14.8470	11.1846	10.3193	12.8364	11.6388
<i>Skewness</i>	-0.9040	1.73143	-0.0172	-0.50432	0.5648	-0.1218
<i>Kurtosis</i>	3.6316	4.6484	1.4694	1.6975	1.8518	1.2756