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The Effects of Energy Consumption and Foreign Direct Investments on Economic Growth in Türkiye: Fourier-Shin Cointegration Test

Türkiye'de Enerji Tüketiminin ve Doğrudan Yabancı Yatırımların Ekonomik Büyüme Üzerine Etkileri: Fourier-Shin Eşbütünleşme Testi

Tacinur AKÇA

Doç. Dr.,
Ordu Üniversitesi, Ünye İktisadi ve İdari Bilimler Fakültesi, İktisat Bölümü
tacinur@windowslive.com
ORCID : 0000-0002-4071-9525

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Abstract

The aim of this study is to explain the impact of shocks in foreign direct investments and per capita energy consumption on real growth shocks in Türkiye between 1970 and 2015. For this purpose, it is planned to evaluate the temporary and permanent effects of the variables on economic growth. To the cointegrated relationship between the variables the Fourier-Shin cointegration test; to determine the stationarity, Augmented Dickey Fuller-Becker, Enders and Lee Fourier KPSS stationarity tests were used. The long-run and short-run coefficients were estimated using the dynamic least squares method (DOLS). According to the findings of the analysis, in the long run, a 1% increase in energy consumption increases economic growth by 0.04%, while a 1% increase in foreign direct investment increases economic growth by 1.6%. In the short run, a 1% increase in FDI increases economic growth by 0.7%. FDI plays a key role for Türkiye's economic growth both in the long and short run. On the other hand, Türkiye needs more permanent energy policies that will cover the long-term rather than short-term energy policies.

Keywords: Economic Growth, Energy Consumption, Foreign Direct Investment, Fourier- Shin Test

JEL Codes: C32, E30, O11, S43

Öz

Bu çalışmanın amacı, 1970-2015 yılları arasında Türkiye'de doğrudan yabancı yatırımlar ve kişi başına enerji tüketimindeki şokların reel büyüme şokları üzerindeki etkisini açıklamaktır. Bu amaçla değişkenlerin ekonomik büyüme üzerindeki geçici ve kalıcı etkilerinin değerlendirilmesi planlanmaktadır.

Değişkenler arasındaki eşbütünleşik ilişkiyi tespit etmek için Fourier-Shin eşbütünleşme testi; durağanlığı belirlemek için ise Augmented Dickey Fuller- Becker, Enders ve Lee Fourier KPSS durağanlık testleri kullanılmıştır. Uzun dönem ve kısa dönem katsayıları dinamik en küçük kareler yöntemi (DOLS) kullanılarak tahmin edilmiştir. Analiz bulgularına göre, uzun dönemde enerji tüketimindeki %1'lik artış ekonomik büyümeyi %0,04 oranında artırırken, doğrudan yabancı yatırımlardaki %1'lik artış ekonomik büyümeyi %1,6 oranında artırmaktadır. Kısa vadede ise doğrudan yabancı yatırımlardaki %1'lik artış ekonomik büyümeyi %0,7 oranında artırmaktadır. Doğrudan yabancı yatırımlar hem uzun hem de kısa vadede Türkiye'nin ekonomik büyümesi için kilit bir rol oynamaktadır. Öte yandan Türkiye'nin kısa vadeli enerji politikalarından ziyade uzun vadeyi kapsayacak daha kalıcı enerji politikalarına ihtiyacı vardır.

Anahtar Kelimeler: Ekonomik Büyüme, Enerji Tüketimi, Doğrudan Yabancı Yatırımlar, Fourier- Shin Testi

JEL Kodları: C32, E30, O11, S43

Introduction

Energy consumption (EC) and foreign direct investment (FDI) are two critical elements for a stable and developing economy. Undoubtedly, one of the most important factors in production is the EC. Increasing dependence on foreign energy leads to an increase in imports and becomes an important problem, especially in countries with high foreign exchange deficit. Another important issue, especially for a developing country, is foreign direct investment. For countries like Türkiye that face capital shortages, foreign direct investments bring many advantages. The increase in foreign direct investments provides many advantages such as contributing directly or indirectly to production, creating employment, providing new technologies, and increasing competition. However, it may not always provide these advantages depending on the country and the characteristics of the incoming investment. In Türkiye, there has been a rapid increase in foreign direct investments, especially with the start of accession negotiations to the European Union in 2005. However, in the period after 2015, foreign direct investments started to decline. Since these years, capital-intensive foreign investments have mostly turned into real estate investments (MITRT, 2022). As of 2019, it can be said that reasons such as the pandemic process, the increase in Türkiye's CDS premium, and the low credit ratings are effective.

The economic literature explaining the relationship between economic growth and energy consumption has become the center of attention

especially after the oil crises in the 1970s. Different views have been presented by theorists on this issue. There are generally four approaches to the relationship between energy consumption and economic growth (Gozgor et al., 2018; Ibrahiem, 2015; Omri et al., 2015; Bouoiyour and Selmi, 2012; Belke, Dreger and De Haan ,2010; Squalli, 2007). The first view is the "Growth Hypothesis" that EC causes EG. According to this view, an increase in EC will contribute to economic growth. Therefore, the implementation of policies that increase energy use is an important issue for EG. The second view, known as the "Conservation Hypothesis", is that EG leads to EC. As production increases, the need for energy increases. The third view is the "Feedback Hypothesis", according to which there is a bidirectional causality between EC-EG. An increase in production increases the need for energy, or as EC increases, production increases. The fourth and final view is the "Neutrality Hypothesis", which denies the existence of any connection between EC and EG. The increase in energy use does not contribute to production or the increase in production does not affect the need for energy.

There are two main theoretical perspectives in explaining the relationship between FDI and economic growth. The first one is the modernization theory, which is the view that FDI supports economic growth. The modernization theory is based on two main theories: neoclassical growth theories and endogenous growth theories. Modernization theory argues that investments and capital accumulation promote economic growth and that causality exists. The other view explaining the relationship between FDI and economic growth is the dependency theory. According to the proponents of this theory, foreign investment dependence negatively affects growth and income distribution. They also argue that increased dependence on foreign capital will lead to stagnant growth and the economy will not develop organically in the future (Pigato, 2000; Adams, 2009; Denisia, 2010; Sichei and Kinyonda, 2012; Makoni, 2015).

The connection between FDI and EC constitutes the third basic element of the study. As the amount of foreign capital growth, the amount of production in the country increases and the need for energy also increases. However, the amount of energy consumption can change depending on the type of foreign investments entering the country. Foreign investments that enter the country in the direction of increasing the capital and production in parallel can increase the amount of energy consumption, conversely short-term, unproductive

and non-employment-generating etc. It cannot be said that there will be a significant change in energy use due to the increase in the intensity of investments (such as real estate). Because of this, the examination of the link between FDI and EC may differ from country to country.

The correlation between EC, FDI, and economic growth (EG) is the main issue of the study. While examining this connection, firstly the interrelation between EC and EG, the second main research element is the interrelation between FDI and EG, and the third main element is the interrelation between EC and FDI.

The main elements of the research subject are briefly;

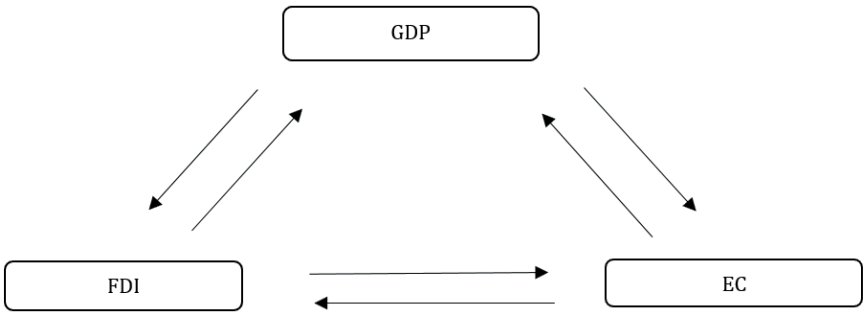
1. The nexus between EC- EG

2. The nexus between FDI- EG

3. The nexus between FDI- EC

Figure 1

The Interrelation EG- EC-FDI



Türkiye is in the category of developing countries. Being dependent on foreign energy and being a country in need of foreign investments has made Türkiye one of the top priorities in the economic policies to be pursued in both areas. Because of this, it is critical to determine the role of energy and FDI in Türkiye's economic growth. In the literature on Türkiye, the general focus has been on the correlation between EC and EG or between FDI and EG. The fact that all three variables are included together and that there are few studies explaining their connection

with each other has increased the tendency towards this issue.

In this study, the connection between EG, EC, and FDI in the period between 1970 and 2015 in Türkiye is analyzed. This time period was preferred since the data obtained for the variables cover these periods. Augmented Dickey- Fuller (Dickey and Fuller, 1979) and Fourier KPSS (Becker, Enders and Lee, 2006) tests were used for the stationarity. Afterwards, the existence of cointegration between the variables was determined by the Fourier-Shin cointegration test. The dynamic least squares DOLS estimator obtained from the Fourier-Shin cointegration analysis was used to determine and interpret the long and short-run coefficients. In the results obtained, it is concluded that increases in both energy consumption and foreign direct investments increase economic growth.

The paper consists of four parts. The first section consists of an introduction. The second part of the study consists of a review of the relevant literature, the third part consists of the description of the data and the methodology used, and the last part, the fourth part, consists of the findings obtained from the analysis.

Literature Review

The literature is analyzed under three main headings. The first section includes approaches to explain the connection between EC and EG, the second section includes approaches to explain the connection between FDI and EG and finally the third section includes literature reviews on the connection between EC and EG.

The Connection between EC and GDP

Kraft et al. (1978) for USA, Öncel, Kırca and İnal (2017) for OECD countries discovered a unidirectional connection from EG to EC in their analysis. According to Belke et al. (2010) and Dobnik (2011) for OECD countries, Yıldırım, Yıldırım and Demirtaş (2019) found bidirectional causality between EC and GDP in their analysis for BRIC-T countries. Ahmed et al. (2016) found one-way causality from EC to EG in 25 countries, one-way causality from EG to EC in 40 countries, bidirectional causality between EC and EG in 18 countries, and no causality in 36 countries. relationship was not detected. Bouoiyour et al. (2012) found in his analysis for MENA countries that 16% support the growth view, 25% support the conservation view 33.33% support the feedback view and 25% support the neutrality view. Kıran (2012) did not find any

relationship between EC and EG in his study for Türkiye. Chen (2012), Shuyun et al. (2011) detected a bidirectional connection between EC and EG in their study for China.

The Connection between FDI and GDP

Adams (2009) examined the connection between FDI and EG in Sub-Saharan Africa in the period 1990-2003 and as a result, detect a positive and significant connection between FDI and EG. According to Alfaro et al. (2004), in their study on OECD countries, found that the relationship between FDI and EG differs from country to country. An analogue result was detected by Borensztein et al. (1998), in his analysis for OECD countries. In his findings, he concluded that FDI would contribute to EG if there is sufficient technological development in the host country. Li et al. (2005) analyzed Alfaro et al. (2004) and Borensztein et al. (1998) and found that FDI positively affect EG for 84 countries included in the study, especially in countries with advanced technology and high human capital. Calvo et al. (2003), in his study for Latin American countries, in conditions of sufficient human capital, economic stability and free market conditions, long-term capital flows accelerate and thus foreign direct investment increases and contributes to EG. Benghoul et al. (2019), in his analysis for Türkiye, concluded that FDI do not contribute to EG. Alzaidy et al. (2017), in his analysis for Malaysia, concluded that well-developed financial sectors facilitate FDI, thereby accelerating EG. Almfraji et al. (2014), FDI and EG in Qatar positively affect each other.

The Connection between EC and FDI

Longe et al. (2020), for Nigeria, Uzar et al. (2019) for Türkiye, Leitão (2014) for Portugal, they found a positive connection between EC and FDI in their analysis. Aali-Bujari et al. (2021), in his study, found a bidirectional connection between EC and FDI in Mexico in the medium and long-term. Salim et al. (2017), in his analysis for China, found that in the short-term a positive connection between EC and FDI, while it found that an increase in FDI in the long-term reduces EC. Parab et al. (2020) detected a long-term and unidirectional connection between EC and FDI in his analysis for 43 selected countries. Dube (2019) did not find a causal connection between EC and FDI in his analysis for South Africa.[1]

There are many studies in the literature for different countries and

1 The summary table is included in the Appendix of the study.

time periods. The results obtained vary from country to country and from time period to time period, and the direction of short and long-run causality has also varied. The general opinion in the findings of the analysis is that many factors such as different economic policies, development level, technological infrastructure, and human capital have been important factors in obtaining different results. Studies on Türkiye have generally analyzed the relationship between EC and EG or the relationship between EG and FDI. This study includes all three variables and is novel in terms of the methodology used. It is thought that the study will make different contributions to the literature in terms of both the difference in the methodology used and the variables.

Data and Methodology

The variables used to detect the influence of EC and FDI on growth are real gross domestic product, daily energy consumption per capita, and FDI. Annual data for the period 1970 and 2015 were used as the time interval. Logarithms of all variables were taken before the analysis. Determination of stationarity of variables Augmented Dickey- Fuller (Dickey et al.,1979) and Fourier KPSS (Becker et al., 2006) unit root test was used. The existence of cointegration between variables Tsong et al. (2016) Fourier-Shin test was used. Finally, the long and short-term connections between the variables were estimated by the dynamic least squares (DLC) method developed by Stock and Watson (1993).

Table 1

The Variable Definitions

Variables	Symbol	Explanation	Source
Real Economic Growth	gdp	Constant (LCU)	The World Bank
Energy Consumption	ec	Kg of per capita	The World Bank
Foreign Direct Investments	fdi	Net inflows*	The World Bank

*% of GDP

Becker et al. (2006) and Kwiatkowski et al. (1992) developed a new stationarity test by incorporating Fourier functions using the stationarity test. The model is established in the first stage of the test and then it is estimated by the DOLS method and the residues are obtained.

$$Y_t = \alpha + \gamma_1 sin\left(\frac{2\pi kt}{T}\right) + \gamma_2 \cos\left(\frac{2\pi kt}{T}\right) + \varepsilon_t \quad (1)$$

$$Y_t = \alpha + \beta_t + \gamma_1 sin\left(\frac{2\pi kt}{T}\right) + \gamma_2 \cos\left(\frac{2\pi kt}{T}\right) + \varepsilon_t \quad (2)$$

The "k" parameter in the equation represents the appropriate frequency number that makes the sum of residual squares of the model the smallest value. The term "t" in the equation indicates the trend and "T" indicates the time dimension.

The equation used for the test statistic;

$$\tau_\mu(k) \quad or \quad \tau_\mu(k) = \frac{1}{T^2} \frac{\sum_{t=1}^{T} S_t(k)^2}{\breve{\sigma}^2} \quad (3)$$

The equation used for the "F Test" is;

$$F(\hat{k}) = \left(\frac{SSR_0 - SSR_1(k)/2}{SSR_1(k)/(T-q)}\right) \quad (4)$$

While the "SSR" coefficients express the residual sum of squares, the term "q" denotes the number of regressors. With respect to the calculated "F" test statistic results, the stationarity of the series is accepted by accepting the main hypothesis.

For the cointegrated relationship, Tsong et al. (2016) added fourier functions to the cointegration test developed by Shin (1994).

$$Y_t = \alpha + \gamma_1 sin\left(\frac{2\pi kt}{T}\right) + \gamma_2 \cos\left(\frac{2\pi kt}{T}\right) + \theta x_1' + \sum_{i=-1}^{1} \psi_i \Delta x_{t-i}' + \varepsilon_t \quad (5)$$

$$Y_t = \alpha + \beta_t + \gamma_1 sin\left(\frac{2\pi kt}{T}\right) + \gamma_2 \cos\left(\frac{2\pi kt}{T}\right) + \theta x_1' + \sum_{i=-1}^{1} \psi_i \Delta x_{t-i}' + \varepsilon_t \quad (6)$$

Tsong et al. (2016), She uses the following formula to obtain the test statistic shown as CI_f^m.

$$CI_f^m = T^{-2} \widehat{w}_1^{-2} \sum_{t=1}^{T} S_t \quad (7)$$

In the equation, $S_t = \sum_{i=1}^{T} \breve{y}_{1t}$, 1t refers to the sum of error terms in the DOLS equation, while the term "$\widehat{w}_1^{-2}$" refers to the long-run variance estimator of "ε_t" If the test statistic (CI_f^m), is less than the critical value of the table, the existence of cointegration between the variables is accepted.

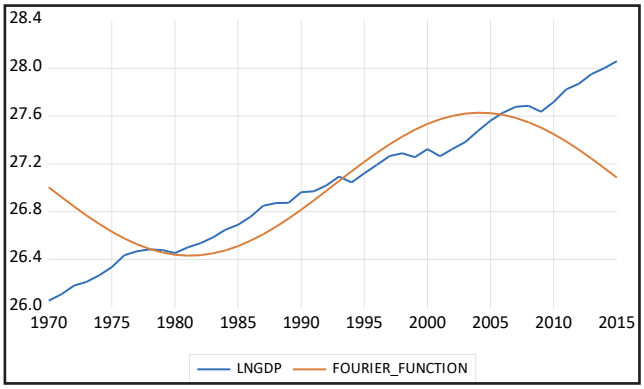
Table 2

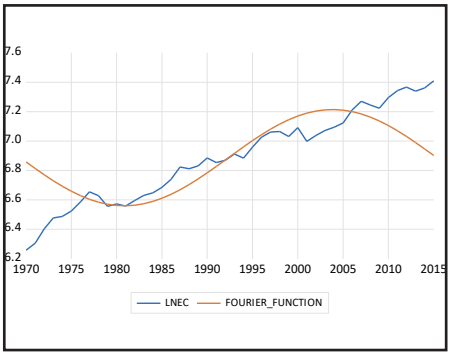
Descriptive Statistics of Variables

	GDP	EC	FDI
Mean	27.03	6.88	-0.95
Median	27.03	6.88	-0.93
Maximum	28.05	7.40	1.28
Minimum	26.05	6.25	-3.93
Std.Dev.	0.56	0.31	1.25
Jarque-Bera	2.25	1.96	0.80

Figure 2

Time Path of the Variables





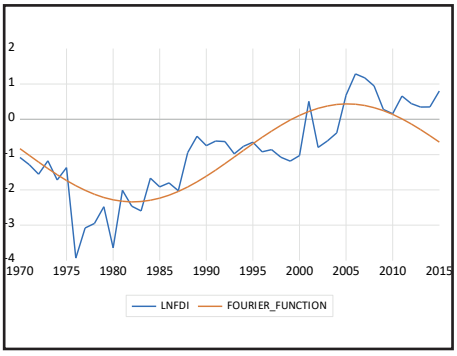


Figure 2 shows that the time path graphs of growth, energy consumption, and foreign investments. The black curve represents the prediction, and the blue curves represent the actual time path. It is seen that the oil crises in the 1970s negatively affected all three variables and appeared to improved afterwards. In Türkiye, the economy is in a continuous growth except for crisis periods[2], but this growth is not sustainable. On the other hand, it can be said that energy consumption is in parallel and at a similar acceleration with economic growth. Foreign direct investments have followed a fluctuating course over time and have gone through periods of ups and downs.

Empirical Results

In the first phase of the study the stationarity of the variables was determined. Both traditional ADF and non-traditional FKPSS tests were performed. As a result, both tests showed that it was determined that all variables were not stationary at level I (0) values but became stationary at I (1) values.

2 1973-1979 Oil Crises, 1994 Turkish Crisis, 1998 Asian Crisis, 2001 Turkish Banking Crisis, 2008 USA Mortgage Crisis

Table 3

ADF and FKPSS Test Results

	ADF				FKPSS			
	Cons.		Trend & Cons.		Cons.		Trend & Cons.	
Variables	**t-Stat.**	**Prob.**	**t-Stat.**	**Prob.**	**tau-m(k)**	**k**	**tau-t(k)**	**k**
lngdp	0.11	0.96	-2.61	0.27	0.31	1	0.066*	1
lnec	-1.20	0.66	-3.63	0.03	0.31	1	0.07*	1
lnfdi	-0.96	0.75	-3.89	0.02	0.19	1	0.08*	1
Δlngdp	-6.41	0.00	-6.35	0.00	0.16*	2	0.12*	2
Δlnec	-6.27	0.00	-6.23	0.00	0.13*	4	0.10*	4
Δlnfdi	-9.50	0.00	-9.48	0.00	0.09*	1	0.07*	4

Notes: *FKPSS for the stationarity test %0.05, n=46, k=1, critical value=0.17

The next step after the stationarity test is to examine whether the trigonometric terms in the model are significant or not in Table 4. For this, the F- test statistical results of the series are considered. According to the F- test results in the appendix, the calculated value of F is bigger than the critical value (Fhes. > F critical value) in both constant and constant and trending conditions. In this case, the H_0 hypothesis is not accepted, and It is concluded that the trigonometric terms are statistically significant.

H_0= The trigonometric terms are not significant

H_1= The trigonometric terms are significant

Table 4

FKPSS "F Test" Results

	Constant		Trend & Constant	
Variables	**Fm (k)**	**minSSR**	**Ft (k)**	**minSSR**
Gdp	25.11	269074	69.35	121203
Ec	28.11	19230	13.40	101630

Notes: For all variables, k=1, at 5% significance level, the F table critical value was found to be 4.96.

The existence of cointegration between the variables was determined by the Fourier-Shin cointegration test in Table 5. According to the test results, the critical value (0.182) was bigger than the calculated test statistic (0.152) (CI0f < critical value). Therefore, the existence of a cointegrated connection between the variables is accepted. The second step of the Fourier-Shin cointegration test is whether the trigonometric terms are meaningful or not. The F- test statistic (12.12 > 4.06), calculated in the results in Table 5, was bigger than the F critical value (Fm(k) > F crit.). Therefore, it is concluded that the trigonometric terms are statistically significant.

Table 5

Fourier-Shin Coıntegration Test Results

Model	**CI0f**	**Critical Value**	**Fm(k)**	**F critical value**	**minSSR**
Lngdp=f(lnec, lnfdi)	0.152	0.182	12.122	4.06	0.01164

Notes: α= %5 p (number of independents) =2, lopt= 3, k (frequency)= 2

After proving the presence of cointegration between the variables, the established model is estimated by the dynamic least squares method. Table 6 show that in the long run, energy consumption, foreign direct investments and cosine coefficients are significant. While a 1% increase in energy consumption increases economic growth by 0.04%, a 1% increment in foreign direct investments increases economic growth by 1.6%.

Table 6

Long-Run Test Results

Variables	coefficient	Std. error	t-stat.
lnec	0.045	0.0166	2.713*
lnfdi	1.6238	0.0712	22.795*
constant term	15.885	0.5133	30.943*
Cos.	-0.019	0.0055	-3.487*
Sin.	-0.008	0.0055	-1.500

Notes: * %5, n>30, Expresses significance with according to "z table value:1.96

Table 7 gives the short-term test results. With respect to the test findings, the error correction coefficient took a value between 0 and -1 and the "probe" value was statistically significant. Therefore, there is a relationship between EG, EC, and FDI in the short run. Therefore, it is accepted that there is a relationship between EG, EC, and FDI in the short-term. Deviations in variables in the short-term balance in the long-term at a rate of 0.63%.

Table 7

Short-Run Test Results

Variables	coefficient	Std. error	p-value
lnec	0.003	0.007	0.642
lnfdi	0.768*	0.115*	0.000*
constant term	-0.1437	-0.2774	0.600
ECT	-0.6394*	0.2692*	0.023*

Notes: ECT is the error correction term, * %5, n>30, expresses significance with according to "z table value:1.96"

In the short- run, while the energy consumption coefficient was insignificant in the variable coefficients, foreign direct investments were statistically significant. A 1% increase in foreign investments increases economic growth by 0.7%.

When the short and long-run analyses are briefly evaluated, increases in foreign direct investments affect economic growth positively in both the short and long run. On the other hand, energy consumption has no effect on economic growth in the short run but has a positive

effect in the long run. However, this positive effect is not as effective as foreign investments. In summary, the positive effect of foreign direct investments on economic growth in Türkiye is higher than that of energy consumption. It is thought that this conclusion is reached because the short-run effect of energy consumption cannot be reflected in the short run due to the presence of lagged effects such as its reflection on the production process. It is estimated that these results have been reached because the effect of the inflows and outflows of foreign direct investments in terms of their characteristics is reflected in the national income in a short period of time.

Conclusion

In this study, the nexus between EG, EC, and FDI is analyzed according to the Fourier-Shin co-integration tests that consider both sudden shocks and smooth transitions. The co-integration test results confirm the relationship between EG, EC and, FDI. After the existence of cointegration, long and short run coefficients were determined by OLS method. As a result of the analysis, both in the long run and in the short run, EG has a direct relationship with both EC and FDI. In the long run, a 1% increase in EC increases EG by 0.04%, while a 1% increase in FDI increases EG by 1.6%. In the short run, the relationship between EG and FDI is significant, while the short- run relationship with EC is insignificant. A 1%-unit increase in FDI increases EG by 0.7%. However, both test results show that the impact of FDI on EG in the long run is approximately twice as high as in the short run. In the short-run causality test results, no causality relationship was detected between EG and EC, but a bidirectional causality relationship was detected between EG and FDI. As a result of the causality test of FDI with EC, a bidirectional causal relationship was detected.

As a result of the obtained results, the short-run coefficients of the variables and the short-run causality test results are in parallel. While there is no link between EG and EC in the short run, FDI has a link with EG both in the short- run and in the long- run. The results of the short-run relationship between EG and EC, Ahmed et al. (2016) for 36 countries, Bouoiyour et al. (2012) gave similar results for some MENA countries with their analysis by Kıran (2012). Long-term results between EG and EC Ahmed et al. (2016) for 25 countries, Atchike et al. (2020), Dinc et al. (2021) and, Lee (2013) obtained similar results with their analysis. Short- and long-term test results between EG and FDI, Alzaidy et al. (2017), Almfraji et al. (2014), Adams (2009), Calvo

et al. (2003) showed similarity. The general idea in the studies in the literature is that EC and FDI positively affect economic growth. In this context, Bölük et al. (2022), Naimoglu (2021), Maheswaraathan (2020), Sapuan et al. (2020), Zeng et al. (2020), Lin et al. (2018), Ibrahim (2015), Kuo et al. (2014), Omri et al. (2014) showed parallelism with the results obtained by Lee (2013). As a result of the positive effect of EC on EG, Öncel et al. (2017), Ahmed et al. (2016), Bouoiyour et al. (2012) and Kraft et al (1978), while their study is similar, Alzaidy et al. (2017), Almfraji et al. (2014), Adams (2009), Alfaro et al. (2004), Calvo et al. (2003), Borensztein et al. (1998) showed similarities.

Especially in the post-1980 period, capital movements have been liberalized in many developing countries. According to the economic conjuncture of the countries, capital accumulation in developed countries started to flow to developing countries. The low level of income in developing countries has led to low savings rates, thus increasing the need for capital in these countries. Foreign investments have become an important source for developing countries that are in great need of capital. Another important issue is the type of FDI inflows into the country, since the maturity of the incoming investment includes many positive and negative aspects such as creating new production, creating employment, introducing new technologies and, accelerating the competitiveness within the country. The study reveals that FDI inflows are important factors for EG both in the short run and in the long run. In this respect, Türkiye's attracting FDI inflows to the country will provide significant gains by playing a key role in its EG. In order to make Türkiye a more attractive country for FDI, the country's authorities need to accelerate the necessary incentives and practices. In order to attract FDI in Türkiye, the "FDI Law" numbered 4875 was put into effect in 2003. With this law, Türkiye has planned to attract more foreign investments. Otherwise, minimizing both economic and political risks in Türkiye will make Türkiye a more attractive country for foreign investments.

Another result of the study reveals that the link between energy consumption and economic growth does not show causality in the short run in Türkiye. In sum, it is concluded that in the short run, the increase in energy use in Türkiye does not affect economic growth, while increases in economic growth do not affect energy consumption. The long-run results, on the other hand, accept the existence of a relationship between energy consumption and economic growth in Türkiye. In Türkiye, there is a need for more permanent long-

term energy policies rather than short-term energy policies. In short, there is a need for more permanent solutions that cover a longer period, both in terms of energy conservation and energy production or importing energy from abroad. These permanent solutions are expected to contribute positively to economic growth in the long run. The implementation and enforcement of policies such as finding alternative energy sources to reduce dependence on foreign energy (imports) or energy conservation are policies that take a long period of time. In addition to all these, it should be ensured that the energy used is encouraged to be consumed in more efficient production channels. Another important point is that, in terms of our future, it is necessary to design appropriate economic programs to minimize the production of fossil fuels and to increase investments in such energy sources in anticipation of the environmental damage caused by increased energy use.

Declaration

In all processes of the article, TESAM's research and publication ethics principles were followed.

There is no potential conflict of interest in this study.

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Appendix

Table 8

Brief Summary of Literature Review- Causality between EC- FDI- EG

Author(s)-Year	Period-Country	Method	Results
Atchike et al. (2020)	1980-2014 Benin	ARDL Method-Toda-Yamamoto Test	One-way causality from EC to EG and FDI.
Bölük et al. (2022)	1987-2015 Türkiye	NARDL Method	FDI and EC confirm positive effects on EG.
Ibrahiem (2015)	1980-2011 Egypt	ARDL Method-Pairwise Granger Test	Renewable energy and FDI have a long-term positive effect on EG.
Dinç and Dinç (2021)	1970-215 Türkiye	Toda-Yamamoto Causality Test	One-way causality from EC and EG to FDI
He et al. (2012).	1985-2010 Shanghai	VAR Method-Granger Test	One-way causality from GDP to EC and FDI, and one-way causality from EC to FDI.
Kuo et al. (2014)	1971-2010 Germany	VAR Method-Granger Test	Unidirectional causality from GDP to EC and FDI.

Lee (2013)	1971-2009 G20 Countries	Panel Data Analysis	Increasing energy use and FDI increase EG.
Lin and Benjamin (2018)	1990-2014 MINT (Mexico-Indonesia-Nigeria-Türkiye)	Panel Dynamic OLS Model	Bidirectional causality between EG and EC, also a unidirectional causality from FDI to EC.
Maheswaraathan (2020)	1970-2017 Sri Lanka	ARDL Method	Positive and significant relationship between EC, FDI and EC.
Mavikela and Khobai (2018).	1970-2016 Argentina	ARDL and VECM Model	Unidirectional causality from FDI to EC and bidirectional causality between EC and EG.
Naimoğlu (2021)	1990-2019 Türkiye	FMOLS-Fourier Engle Granger Test	EC and FDI increased EG in both the short and long-term.
Omri and Kahouli (2014)	1990-2011 65 Countries	Dynamic Panel Data Model	Bidirectional causality between EC, FDI and EG.
Sapuan et al. (2020)	1990-2014 Yemen	ARDL Method	The increase in EC and EG creates a positive effect on FDI.
Zeng et al. (2020)	1993-2017 China	VAR Model-Johansen Cointegration Test	FDI inflow encourages energy consumption, and EC encourages FDI inflow. FDI indirectly stimulates EG through EC.