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AN ANALYSIS OF THE RELATIONSHIP BETWEEN FOREIGN DIRECT INVESTMENT AND SUSTAINABLE DEVELOPMENT*

Türkiye'de Doğrudan Yabancı Sermaye Yatırımları ve Sürdürülebilir Kalkınma İlişkisinin Analizi

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Keywords:
Foreign Direct Investment, Sustainable Development, International Economics, Economic Growth, Causality Analyses.

JEL Codes:
F0, F63, Q01, O47, C40

Abstract

The development and welfare efforts of countries are transformed over time and creates sustainable development with an approach that considers environmental factors. If the processing of raw materials is based solely on economic benefits, it will hinder environmental and social development in the long run. Thus, the importance of sustainable development is emphasized once again with the circular economy structure. On the other hand, foreign direct investment (FDI) comes to the fore as sustainable development strategy, especially in developing economies. In this context, it is aimed to reveal whether there is a relationship between FDI and sustainable development in Turkey between 1990-2018. Unit root test, co-integration and VECM based causality analyses are included in the estimation of the relationships between these variables by using the Eviews10. The significance of causality relationship is also questioned with variance decomposition and impulse-response analysis. According to the findings, there is a cointegration relationship between the variables and they act together in the long run. In addition, there is one-way relationship from FDI to per capita GDP and per capita energy consumption; bidirectional causality between per capita GDP and per capita energy consumption; one-way relationship from FDI to sustainable development index.

Anahtar Kelimeler:
Doğrudan Yabancı Sermaye Yatırımları, Sürdürülebilir Kalkınma, Uluslararası Ekonomi, Ekonomik Büyüme, Nedensellik Analizi.

JEL Kodları:
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Öz

Ülkelerin kalkınma ve refah arayışları zaman içerisinde dönüşüme uğrayarak sürüdürülebilir gelecek ekseninde sürdürülebilir kalkınmayı doğurmaktadır. Ham maddenin işlenerek ürün haline getirilmesi sürecinin, sadece ekonomik yararlara dayalı olmasının uzun dönemde çevresel ve sosyal gelişmeye engel olacağı düşünüldüğünde, döngüsel ekonomi kurgusuyla sürdürülebilir kalkınmanın önemi bir kez daha vurgulanmaktadır. Özellikle gelişmekte olan ekonomilerde sürdürülebilir kalkınma stratejisi olarak doğrudan yabancı sermaye yatırımları (DYSY) gündeme gelmektedir. Bu bağlamda çalışmada Türkiye'de 1990-2018 yılları arasında doğrudan yabancı sermaye yatırımları ile sürdürülebilir kalkınma arasında ilişki olup olmadığının ortaya konulması amaçlanmaktadır. Bu çalışmada değişkenler arasındaki ilişkilerin tahmininde, birim kök testi, eş-bütünleşme ve VECM temelli nedensellik analizlerine yer verilmektedir. Varyans ayrıştırması ve etki-tepki analizleriyle de nedensellik ilişkisinin anlamlılığı sorgulanmaktadır. Bulgulara göre, değişkenler arasında eş-bütünleşme ilişkisi bulunmakta ve uzun dönemde birlikte hareket etmektedirler. Ayrıca, DYSY'den, kişi başı GSYİH ve kişi başı enerji tüketimine doğru tek yönlü; kişi başı GSYİH ile kişi başı enerji tüketimi arasında çift yönlü; DYSY'den sürdürülebilir kalkınma endeksine doğru ise, tek yönlü nedensellik ilişkisinin varlığı sonuçlarına ulaşılmaktadır.

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1. Introduction

The United Nations has set 17 sustainable development goals for the economies that it aims to achieve by 2030. These are as follows that end poverty, protect the environment, provide equitable and peace-oriented societies that provide well-being for all, etc (United Nations [UN], 2015). Considering the economic dimension of sustainable development, it is seen that it aims to leave the same welfare level to future generations by increasing the welfare of the countries, as well as ensuring its sustainability. At this point, ensuring the continuity of income and consumption is defined as ensuring economic sustainability. At the same time, its environmental and social dimensions also draw the limits of economic growth. In the framework of sustainable development, it has been observed that foreign direct investment has positive and negative effects on the basis of social, environmental and economic factors. The availability of the 17 SDG creates significant investment needs, which can present several challenges for the international community. While the public sector plays an important role in mobilizing capital to achieve this goals, FDI and private sector investments are a major source of external financing, especially developing countries (United Nations Trade and Development Organization [UNCTAD], 2014).

In the global world today, foreign direct investment is a consistent necessity between national and international perspectives and plays an important role in sustainability. For this reason, high foreign direct investment points to growth, productivity, competitiveness and sustainable development. Sustainable industrial development is a priority target, especially in countries that adopt an FDI-oriented integration strategy. In this strategy, which is tried to be coordinated with the increase in internal production capacity, the environmental performance of the industry and employment, the main target is sustainability (Gallagher, 2005, p. 24). It is also thought that the country that makes foreign direct investment will close the investment deficits caused by the savings deficiencies of the host country. It has been observed that the effects of innovation, renewableness, employment, production increase and economic growth in the sectors, in which they invest, have a significant place in the realization of the objectives within the economic dimension of sustainable development. This is also supported by Neo-classical theory. According to the neo-classical theory, FDI will benefit economic development in the host country through the inflow of capital, growth in the labour force, and enhancement of technological progress (Aust, Morais and Pinto, 2020, p. 2). In this context, the economic effects of FDI on sustainable development can be divided into macro and micro effects. While macroeconomic effects focus on economic growth and investments, micro effects focus on firm advantages and disadvantages. Macroeconomic impacts can be expressed as elements such as increasing economic growth, investment and employment; helping to overcome the capital shortage, contributing to closing current account deficits and negatively affecting the balance of payments by causing an increase in imports. Microeconomic effects of FDIs on sustainable development such as increasing labour productivity, enabling the increase of management skills, export and import level, providing new products and equipment. And it may also cause an increase in the production of national firms or a decrease in the production of national firms (Chudnovsky and Lopez, 2008).

In this study, which examines the relationship between sustainable development and foreign direct investment in Turkey, time series of the years 1990-2018 are used. When the studies in the literature are examined, it is seen that variables such as economic growth, carbon emission rate, energy consumption, trade openness, and R&D expenditures are used to represent sustainable development. All these and similar variables are the results of researches on how to

measure and evaluate the progress of sustainable development in terms of countries, which has come to the fore since the 1990s. Along with the sustainable development indicators created by the UN, alternative international organizations such as the Economic Cooperation Organization, the World Bank and the European Union have studies in this field. From this point of view, GDP per capita and energy consumption per capita are chosen in this study, due to its decisive role in macroeconomic performance. On the other hand, Sustainable Development Index (SDI) is chosen as the focus variable, because it contains multiple variables and two modelling has been done.

2. Literature Review

The effects of foreign direct investments on sustainable development cause long and interesting discussions both in theory and in practice. The differentiation of the indicator values representing sustainable development also adds dimension to these discussions. The studies in Table 1 also focus on different indicators representing sustainable development and are presented in a holistic framework regarding the relationship between foreign direct investment and sustainable development.

It is seen that the effects of FDI on economic, social and environmental factors, which are the basic dimensions of sustainable development. While some of the studies in the literature revealed that FDI have positive effects on sustainable development, some of them state that these effects are very limited or not at a level to establish causality.

Table 1. Literature Review of the Relationship between Foreign Direct Investments and Sustainable Development

Study	Time Period	Country	Representative Indicators	Method	Conclusion
Gallagher (2005)	1994-2002	Mexico	FDI, Employment, Export, Environmental Performance	Data Comparison	Despite the increase in FDI inflows and exports in the manufacturing sector, it has little contribution to support internal productivity capacity with the FDI-led integration strategy implemented in Mexico.
Pirtea and Milos (2009)	2001-2006	Romania	FDI, GDP	Regression Analysis	No significant relationship is found between foreign direct investment and economic growth, which is used as an indicator of sustainable development.
Georgantopoulos and Tsamis (2011)	1970-2009	Greece	FDI, GDP	Cointegration and Granger Causality Tests	There is one-way causality running from GDP to FDI.
Pao and Tsai (2011)	Rusya; 1992-2007 Diğerleri; 1980-2007	Brasil, Russia, India China	FDI, CO_2 Emissions, Energy Consumption, GDP	Granger Causality Tests	One-way causality running from energy consumption to emissions and from GDP to FDI; there is two-way causality between emissions and FDI, emissions and GDP, energy consumption and GDP.
Feridun and Sissoko (2011)	1976-2002	Singapur	FDI, GDP	VAR and Granger Causality Tests	There is one-way causality from FDI to economic growth.
Šimelytė and Antanavičienė (2013)	1970-1979 1980-1989 1990-1999 2000-2007 2000-2012 2008-2012	Ireland	FDI, Productivity, Population, GDP, Trade, Labor, Energy, Migration, Green Gas, Electricity	Regression Analysis	There is a relationship between FDI indicators and sustainable growth in different periods of the economic cycle.
Antanavičienė (2014)	2004-2012	LithuaniaLatvia Estonia	FDI, GDP	Data Comparison	FDI may not deliver secure sustainable development.
Omri, Nguyen and Rault (2014)	1990-2011	54 Countries	FDI, CO_2 Emissions, GDP	Dynamic Panel Data Analysis	There is two-way causality between CO_2 emissions and FDI and between FDI and GDP.
Kivyiro and Arminen (2014)	1971-2009	Sub-Saharan Africa	FDI, CO_2 Emissions, Energy Consumption, Economic Development	Cointegration and Granger Causality Tests	GDP, energy consumption and FDI cause CO_2 emissions.

Table 1. Continue

Kardos (2014)	2001-2010	Sweden, Slovakia, Poland, France, Spain and Greece	FDI, Sustainable Society Index	Data Comparison	Emphasizing the importance and relevance of green FDI in EU countries, it is pointed out that it has a very positive potential in terms of sustainable development.
Ren, Yuan, Ma and Chen (2014)	2000-2010	China	FDI, CO_2 emissions, Trade Opening, Exports, Imports and Income Per Capita	Regression Analysis	High FDI inflows increase CO_2 emissions.
Voica, Panait and Haralambie (2015)	2000-2012	EU (28) Countries	Social; GNP, FDI, Life Expectancy at Birth, Poverty and Employment Rate of the Elderly Environmental; FDI, Greenhouse Gas Emissions, Renewable Energy Consumption, Renewable Resources and Tax Economic; FDI, GDP, Primary Energy Consumption	Panel Regression Analysis	The most important impact of FDI is on environmental impact and then on social and economic indicators.
Davidson and Sahli (2015)	2007-2008	Gambia	FDI, Tourism Sector Data	Data Comparison	FDI is concentrated in larger and luxury hotels. It is emphasized that FDI is a complex tool for tourism and poverty reduction. The study shows that different forms of ownership in tourism businesses have advantages and disadvantages, but they create the potential to be complementary in terms of sustainable development.
Güney (2015)	1990-2012	OECD Countries	FDI, Adjusted Net Savings	Panel Data Analysis	FDI does not have any significant impact on sustainable development.
Cho and Ramirez (2016)	1990-2013	South East Asian Countries	FDI and Income Inequality	Panel Cointegration Analysis	FDI inflows tend to increase income inequality in the short run.

Table 1. Continue

Abdouli and Hammami (2017)	1990-2012	17 MENA Countries	FDI, GDP, CO_2 Emissions, Capital Stock, Trade Openness, Financial Development, Energy Consumption and	Panel Regression Analysis	There is one-way causality from FDI to GDP; and two-way causality between FDI and CO_2 emission.
Ridzuan, İsmail and Hamat (2017)	1970-2013	Singapour	FDI, SDI, Environmental Quality, Trade Openness and Financial Development	ARDL	FDI has a positive effect on economic growth and environmental quality. High FDI inflows have negative effects on income distribution.
Simionescu (2017)	2005-2014	Romania	FDI, GDP	VAR	FDI causes economic growth.
Ridzuan, İsmail and Hamat (2018)	1970-2013	Malezia	FDI, Trade Openness, GDP, Income Distribution and Environmental Quality	ARDL	FDI inflows lead to higher growth, better income distribution and lower pollution.
Park (2018)	1991-2015	China	FDI, Human Capital, R&D and GDP	Data Mining and Semantic Network Analysis (SNA)	FDI-Human Capital and R&D-Human Capital have positive effects on GDP in the short and long run. FDI-Human Capital has strong effects on itself in the medium and long term.
Adejumo (2019)	1970-2014	Nigeria	FDI, Market, Manufacturing Exports, Trade Liberalization and Real Exchange Rate	ARDL	In the industrial development indicator of product exports, FDI in the manufacturing sector affects negatively in the short run. There are positive spillovers of FDI inflows in the long run.
Aust et al. (2020)	2014-2017	44 African Countries	FDI, Market, Manufacturing, Export, Trade Liberalization and Real Exchange Rate Sustainable Development Goals Indices	Regression Analysis	FDI has a positive impact on areas such as basic infrastructure, clean water, sanitation and renewable energy. However, the relationship to climate action improvement is negative.
Rana and Sharma (2020)	1980-2014	India	FDI, GDP, CO_2 Emissions, Energy Consumption and Natural Environment	Dynamic Toda-Yamamoto	FDI causes CO_2 emissions, energy consumption and trade deficit.

Table 1. Continue

Ayamba, Haibo, Abdul-Rahaman, Serwaa and Osei-Agyemang (2020)	1996-2016	China	FDI, Sulphur dioxide, Smoke, Dust, GDP, Industrial Solid Waste and R&D	Regression Analysis	The impact of FDI on environmental quality is low in the long run. However, pollution variables have an impact on FDI inflows.
Mukhtarov, Aliyev, Mikayilov, İsmayilov and Rzayev (2020)	1996-2013	Azerbaijan	FDI, CO_2, Emissions, Income Elasticity	Time Series Analysis (STSM)	There is a positive effect of FDI on CO_2 emissions before 2006; a negative effect after 2006.
Odugbesan, Ike, Olowu and Adeleye (2020)	2004-2018	33 Sub-Saharan African Countries	FDI, Sustainable Development, Financial Inclusion, Financial Development, Resource Leases	Panel Cointegration Analysis	There is financial participation and FDI; two-way causality between financial development and FDI; one-way causality from FDI to sustainable development and resource rents.
Karimov (2020)	1970-2014	Turkey	FDI, CO_2 Emission, Renewable Energy Coefficient	Cointegration and Granger Causality Tests	FDI has negative effects on sustainable development.
Zamani and Tayebi (2021)	1995-2018	Economic Cooperation Organization Members	FDI, GDP, Labor, Net Inflows, Trade Volume, R&D Expenditures	Panel Data Analysis	There is an impact of spill overs on economic growth.
Guoyan, Khaskheli, Raza and Şah (2021)	1995-2016	MENA Countries	FDI, CO_2 Emission	Panel Regression (PSTR) Analysis	The link between the FDI and CO_2 emission variables is not linear. Low levels of FDI increase carbon emissions; The higher the ratio, the more negative the relationship becomes.
Nepal, Paija, Tyagi and Harvie (2021)	1978-2016	India	FDI, Energy Use, CO_2 Emissions, GDP and Trade Openness	ARDL VECM	1% increase in FDI results in 0.013% decrease in energy use. There is a long-term link between energy, economy, development and environment.

Source: It was prepared by us by examining the related studies in the literature.

3. Definition of Variables

In this study, which examines the relationship between sustainable development and foreign direct investment in Turkey, time series of the years 1990-2018 are used. The data sets related to the variables are obtained from the World Bank and Eurostat databases, and econometric analyses are carried out in two separate analyses with the licensed Eviews 10 package program. When the studies in the literature are examined, it is seen that variables such as economic growth, carbon emission rate, energy consumption, trade openness, and R&D expenditures are used to represent sustainable development. From this point of view, GDP per capita and energy consumption per capita are chosen in this study, due to its decisive role in macroeconomic performance. On the other hand, SDI is chosen as the focus variable, because it contains multiple variables.

The variables considered in the first model are foreign direct investment, per capita gross domestic product and per capita energy consumption, and in the second model, foreign direct investment and SDI.

Table 2. Definition of Variables

Variable	Definition	Explanation
	MODEL 1	
FDI	Foreign direct investment	World Bank (Million $)
TJ	Energy consumption per person	Eurostat (Kilogram of oil equivalent)
GDP	Gross domestic product per capita	World Bank (Million $)
	MODEL 2	
FDI	Foreign direct investment	World Bank (% of GDP)
SDI	Sustainable development index	Eurostat

Source: It was prepared by us.

In addition, the variation of the variables discussed in the study in the relevant period range in Turkey is shown with the graphs below.

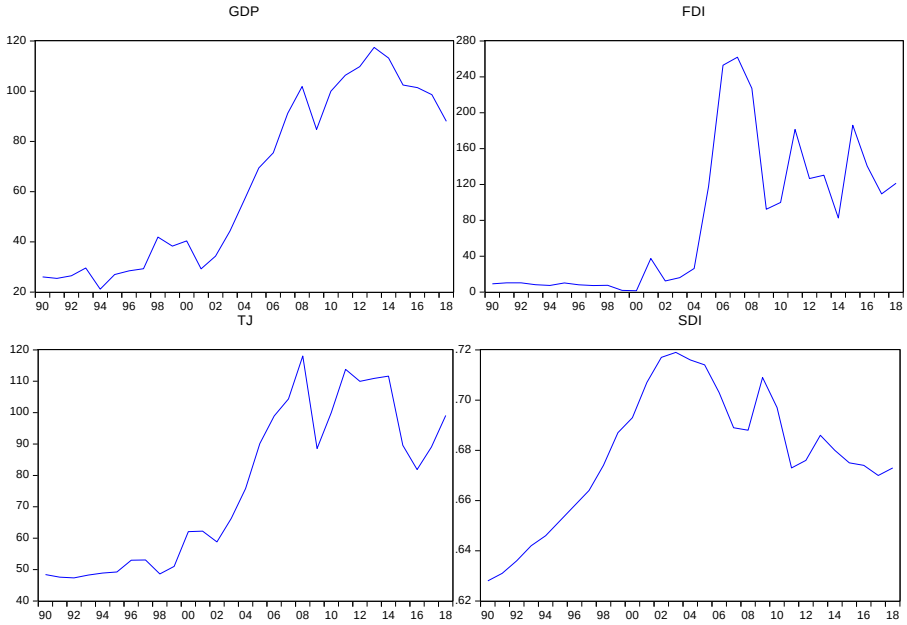

Figure 1. The variation of GDP, FDI, Energy Consumption and SDI

4. Empirical Methodology and Result

In the study, firstly, the lag lengths were determined by using the appropriate lag coefficient Akaike information criterion (AIC). Then the Augmented Dickey-Fuller (ADF) unit root test was used to analyse the stationarity of the variables in order to avoid the spurious regression problem. If the series is stationary, it is analysed to which degree it is stationary. After the series were stationary, Johansen cointegration test was applied and the vector error correction model was created by determining the cointegration relationship between the variables and granger causality was examined. In order to test the suitability of the model, the LM test for the autocorrelation problem, the White test for the heteroscedasticity problem, and the autoregressive unit root test were performed. Finally, the interactions between the variables were investigated using impulse-response functions and variance decomposition. This study ethics committee approval and/or legal/special permission is not required and research and publication ethics were complied with.

4.1. Unit Root Test

In order to obtain meaningful relationships between the variables used in econometric models, the series of the variables should be stationary, in other words, they should not contain unit roots. Extended Dickey-Fuller (ADF) test and Phillips-Perron (PP) test were used in this study to investigate the existence of a unit root. In order to detect significant relationships in series, they must be stationary. In stationary series, the same mean is maintained even if there are long-term fluctuations in the series. It has a time-invariant (finite) variance, and the longer the time lag, the more the correlogram approaches and becomes zero (Kutlar, 2009, p. 318).

The results of the ADF unit root test are obtained using the following equation (Fuller, 1981):

$$\Delta Y_t = \delta Y_{t-1} + \sum_{i=1}^{k} \delta_i \, \Delta_{t-i} + \varepsilon_t \tag{1}$$

$$\Delta Y_t = \mu + \delta Y_{t-1} + \sum_{i=1}^{k} \delta_i \, \Delta_{t-i} + \varepsilon_t \tag{2}$$

$$\Delta Y_t = \mu + \beta T + \delta Y_{t-1} + \sum_{i=1}^{k} \delta_i \, \Delta_{t-i} + \varepsilon_t \tag{3}$$

Here Δ represents the difference operator, V_t represents the variable under consideration, and ε_t represents the error term. The ADF test tests whether the coefficient δ is statistically equal to zero. This test is performed by comparing the calculated ADF-t statistic with the MacKinnon critical values. The fact that the ADF test statistic is greater than the MacKinnon critical values shows that the time series in question does not contain a unit root.

The results of the PP unit root test are obtained using the following equation:

$$\widehat{t_\alpha} = t_\alpha \left(\frac{\gamma_0}{f_0}\right)^{-1/2} - \frac{T\,(f_0 - \gamma_0)(s_e(\hat{\alpha}))}{\alpha f^{1/2} s} \tag{4}$$

In equation (4), $s_e(\hat{\alpha})$ is the coefficient standard error, s is the standard error of the equation, T is the number of observations, γ_0 is the consistent estimate of the error variance, and

f_0 is the residual spectrum at zero frequency. In the PP test, the hypothesis is that there is a unit root. With the ADF test, the distributions of the statistics are compared with the MacKinnon critical value for the same.

Finding a unit root in the analysis shows that the series are not stationary. This situation causes the spurious regression problem to be encountered in the series and the analysis does not yield correct results. Augmented Dickey-Fuller and PP unit root test were used to determine the stationarity of the series in practice.

Table 3. ADF and Phillips-Peron Unit Root Test Results

Country (Period)	Variable	ADF Unit Root Test			Phillips-Perron Unit Root Test		
		t-Statistics	Critical Value	Level of Significance	t-Statistics	Critical Value	Level of Significance
				Model 1			
Turkey (1990-2018)	LFDI	-6.869479	%1 → -4.374307	Stable I(1), 0.01	-23.38558	%1 → -4.356068	Stable I(1), 0.01
	LGDP	-5.836068	%1 → -4.374307	Stable I(1), 0.01	-14.07946	%1 → -4.356068	Stable I(1), 0.01
	LTJ	-4.626896	%1 → -4.394309	Stable I(1), 0.01	-22.13377	%1 → -4.356068	Stable I(1), 0.01
				Model 2			
	LFDI	-5.678304	%1 → -4.394309	Stable I(1), 0.01	-5.086767	%1 → -2.653401	Stable I(1), 0.01
	SDI	-8.455620	%1 → -4.374307	Stable I(1), 0.01	-8.778408	%1 → -3.711457	Stable I(1), 0.01

Note: If the ADF test and PP test results of the first-order differenced variables is greater than the table value, the hypothesis that the studied series is stationary [I(1)] is accepted.

It is a prerequisite for cointegration test that all series are stationary at the same level. The unit root test results of the variables used for Model 1 and Model 2 are given in Table 3. When the first differences of the variables are taken, it is seen that they are stationary at the significance level.

4.2. Testing for Structural Breaks: Zivot-Andrews

In studies with time series, there may be structural changes arising from changes such as economic and political crises that took place during the period. Failure to pay attention to the structural changes occurring within the series in unit root tests leads to biased results. In this direction, unit root tests have been developed in which the structural break is detected internally. In this study, Zivot and Andrews (1992) unit root test was used, which is one of the methods that enables the determination of structural break internally.

The results of the Zivot-Andrews unit root test are obtained using the following equation (Zivot and Andrews, 1992, p. 254):

$$Y_t = \mu + \beta t + \delta Y_{t-1} + \theta_1 DU(\lambda) + \sum_{i=1}^{k} \delta_i \Delta Y_{t-i} + \varepsilon_t \qquad \text{(Model A)} \qquad (5)$$

$$Y_t = \mu + \beta t + \delta Y_{t-1} + \theta_2 DT(\lambda) + \sum_{i=1}^{k} \delta_i \Delta Y_{t-i} + \varepsilon_t \quad \text{(Model B)} \quad (6)$$

$$Y_t = \mu + \beta t + \delta Y_{t-1} + \theta_1 DU(\lambda) + \theta_2 DT(\lambda) + \sum_{i=1}^{k} \delta_i \Delta Y_{t-i} + \varepsilon_t \quad \text{(Model C)} \quad (7)$$

Model A includes the structural change in the level, Model B in the slope, and Model C in both the slope and the level. $t = 1, 2, \ldots, T$ stands for time, T_B for break time and $\lambda = T_B/T$ for relative break point. In the models, DU is the mean and DT is the dummy variable that represents the break in the trend.

$$DU(\lambda) = \begin{cases} 1 & t > T_B \\ 0 & t \leq T_B \end{cases} \quad DT(\lambda) = \begin{cases} t - T\lambda & \mathrm{t} > \mathrm{T}\lambda \\ 0 & t \leq T_B \end{cases} \quad (8)$$

For the estimation of the breakpoint, t=2,…,(t-1) T-2 regressions are created using the Least Squares method. The date in the model where the t statistic of the coefficient of the variable $\gamma_{t-1}$is the smallest is accepted as the structural break point. If the absolute value of the t statistic is less than the Zivot-Andrews critical value after the appropriate break point has been determined, it is considered to be the unit root of the series without structural break.

Table 4. Zivot Andrews Fracture Test Results

Variable	Model	Break Point	t-statistics	Critical Value	
				%1	%5
		Model 1			
LFDI	Intercept	2001	-6.908051	-5.34	-4.93
	Trend	2007	-6.681107	-4.80	-4.42
	Trend and Intercept	2005	-6.896745	-5.57	-5.08
LGDP	Intercept	2011	-5.258100	-5.34	-4.93
	Trend	2008	-5.211274	-4.80	-4.42
	Trend and Intercept	2011	-5.258100	-5.34	-4.93
LTJ	Intercept	2012	-7.154622	-5.34	-4.93
	Trend	2007	-5.994133	-4.80	-4.42
	Trend and Intercept	2012	-6.943623	-5.57	-5.08
		Model 2			
LFDI	Intercept	2009	-6.278329	-5.34	-4.93
	Trend	2006	-4.443739	-4.80	-4.42
	Trend and Intercept	2009	-6.194166	-5.57	-5.08
LSDI	Intercept	2005	-3.983275	-5.34	-4.93
	Trend	2012	-2.579090	-4.80	-4.42
	Trend and Intercept	2004	-3.630207	-5.57	-5.08

Structural break was investigated by the Zivot-Andrews test and is presented in Table 4. According to the test results presented, the test statistics were greater than the critical value in Model 1 and Model 2 LGDP series is significant at the level of 5% in the stable (model A) and trend and stable (Model C) models, and at the level of 1% in the Trend (Model B) model. All other series show significance at the 1% level. H_0 hypothesis was rejected because the series did not contain unit root.

4.3. Johansen Cointegration Test

In econometric models, whether two or more non-stationary series move together in the long run is analysed using the cointegration test. After determining the stationarity of the variables, the appropriate lag lengths for the model should be determined by creating a VAR model for the series. When the relevant literature is examined, it is seen that many criteria are used to determine the lag length. Some of those; Akaike information criterion (AIC), Schwarz information criterion (SC), Hannan-Quinn information criterion (HQ) and Final Error Estimation (FPE) are the most preferred information criteria (Bulut and Özdemir, 2012, p. 218). In this analysis, considering the AIC, the lag length for model 1 was determined as 1, and the lag length for model 2 was determined as 4. The results of the Johansen cointegration test with appropriate lag lengths are presented in Table 5.

Table 5. Model 1-2 Johansen Cointegration Test Results

MODEL 1									
Variables: LFDI, LGDP, LTJ Lags interval: 1									
Unrestricted Cointegration Rank Test (Trace)					Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
H_0	**H_1**	**Trace Statistic**	**Critical Value %5**	**Prob.**	**H_0**	**H_1**	**Trace Statistic**	**Critical Value %5**	**Prob.**
r=0	r≥1	46.69608	42.91525	0.0200*	r=0	r≥1	25.88127	25.82321	0.0491*
r≤1	r≥2	20.81481	25.87211	0.1874	r≤1	r≥2	14.18603	19.38704	0.2419
r≤2	r=3	6.628785	12.51798	0.3848	r≤2	r=3	6.628785	12.51798	0.3848
MODEL 2									
Variables: FDI, SDI Lags interval: 4									
Unrestricted Cointegration Rank Test (Trace)					Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
H_0	**H_1**	**Trace Statistic**	**Critical Value %5**	**Prob.**	**H_0**	**H_1**	**Trace Statistic**	**Critical Value %5**	**Prob.**
r=0	r≥1	14.65880	15.49471	0.0666	r=0	r≥1	9.100892	14.26460	0.2778
r≤1	r=2	5.557903	3.841466	0.0184*	r≤1	r=2	5.557903	3.841466	0.0184*

Note: *According to the trace and max-eigenvalue tests, there is a cointegrating vector at the 5% significance level.

In the Johansen cointegration test, the H_0 hypothesis states that there is no cointegration relationship between the variables, while the H_1 hypothesis states that there is a cointegration relationship between the variables. If the probability values of trace and max-eigenvalue statistics are less than 0.05 significance level, H_0 is rejected and H_1 hypothesis is accepted. If the probability value is greater than 0.05, the H_0 hypothesis is accepted and the H_1 hypothesis is rejected.

When Table 5 was examined, it was observed that the probability value of the trace and maximum eigenvalue statistics is less than 0.05, and the H_0 hypothesis is rejected and the H_1 hypothesis is accepted. In other words, there is a cointegration relationship between the variables and they act together in the long run.

4.4. Vector Error Correction Model (VECM)

In models in which a cointegration relationship is detected, it is expected that there will be at least one causality relationship between the variables. In this case, Vector Error Correction Model is applied to determine the causality relationship. Vector Error Correction Model helps to prevent the losses in long-term information caused by the difference operation applied to ensure the stability of the variables (Erdil Şahin, 2019, p. 70).

Table 6. Granger Causality Test Based on VECM Result

MODEL 1				
Dependent variable: LGDP				
Excluded	Chi-sq	df	Prob.	Direction of causality
LFDI	5.855721	1	0.0155*	LFDI→LGDP
LTJ	5.176867	1	0.0229*	LTJ→LGDP
Dependent variable: LTJ				
Excluded	Chi-sq	df	Prob.	Direction of causality
LFDI	4.317279	1	0.0377*	LFDI→LTJ
LGDP	3.978020	1	0.0461*	LGDP→LTJ
Dependent variable: LFDI				
Excluded	Chi-sq	df	Prob.	Direction of causality
LGDP	0.966785	1	0.3255	No relationship
LTJ	0.691990	1	0.4055	
MODEL 2				
Dependent variable: FDI, SDI				
Excluded	Chi-sq	df	Prob.	Direction of causality
FDI	9.760642	4	0.0447*	FDI→SDI
SDI	3.102370	4	0.5408	

Note: If the probability value is 0.05 and less than 0.01, the relevant hypothesis is rejected at 5% and 1% significance levels.

According to the results of the Granger causality test based on the vector error correction model, when model 1 is examined, it has been determined that there is a one-way relationship from foreign direct investment to gross domestic product per capita and energy consumption per capita. It is also observed that there is bidirectional causality between the per capita gross domestic product variable and per capita energy consumption variables. In Model 2, on the other hand, a one-way relationship from foreign direct investment to SDI has been determined.

4.5. Testing the Suitability of the VAR Model

The VAR model is a work of Simms proposed in 1980. It is a multivariate time series model, which is an extension of the univariate autoregressive process. It describes the dynamic behavior of economic time series and shows the interdependence between the variables. It also predicts the potential paths that a selected variable will follow in the future (Erden and Turan Koyuncu, 2014, p. 17-18). An important point in establishing the VAR model is to determine the appropriate lag length. The lag lengths according to the LogL, FPE, AIC, SC and HQ criteria used to find the lag length are given in Table 7.

Table 7. Determination of VAR Lag Length

MODEL 1					
Lag	**LogL**	**FPE**	**AIC**	**SC**	**HQ**
1	-108.6340	4.704966*	10.05283*	10.64186	10.20910
2	-105.2504	7.842494	10.52087	11.55166	10.79434
3	-92.02528	6.153687	10.16877	11.64134	10.55945
4	-87.38638	11.10766	10.53220	12.44654	11.04007
MODEL 2					
Lag	**LogL**	**FPE**	**AIC**	**SC**	**HQ**
1	-49.76952	0.302950	4.480793	4.677136*	4.532883
2	-47.75075	0.359306	4.645896	5.038580	4.750075
3	-44.11317	0.376060	4.676097	5.265124	4.832366
4	-35.61018	0.266616*	4.300848*	5.086217	4.509207*

Note: *Appropriate lag length.

Since the number of observations was less than 60, in order to get more accurate results, FPE and AIC information criteria were preferred for the model, and the appropriate lag length was determined as 1 for model 1 and 4 for model 2. At the same time, in order to see if there is a structural problem in the VAR model, it was tested by applying the LM test for autocorrelation and the White test for heteroscedasticity. The results are presented in Table 8.

Table 8. Autocorrelation and Variance Testing

MODEL 1				
	Autocorrelation		**None Constant Variance**	
Lag	**LRE statistics**	**Prob.**	**Chi-sq**	**Prob.**
1	3.313277	0.9509	43.74620	0.1757
2	3.818673	0.9234		
MODEL 2				
	Autocorrelation		**None Constant Variance**	
Lag	**LRE statistics**	**Prob.**	**Chi-sq**	**Prob.**
1	5.911417	0.2069		
2	13.95491	0.3231		
3	20.06681	0.1773	65.20650	0.1412
4	18.84894	0.1915		
5	31.55056	0.2529		

In the autocorrelation test performed to determine the relationship between the error terms in the VAR model, no autocorrelation problems were encountered at 2 lag levels for model 1 and at 5 lag levels for model 2. In addition, the White test results for the heteroscedasticity problem show that there is no problem of varying variance in the Chi-square value, that is, the variance of the error terms is the same in all observations. Finally, the stationarity of the model was tested with the autoregressive unit root test of the model. All the inverse roots of the AR characteristic polynomial were found in the circle and it was determined that the VAR model satisfies the stability condition.

4.6. Action-Response Functions

The impulse-response functions reflect the effect of a standard deviation shock in one of the random error terms on the present and future values of the endogenous variables. In VAR

analysis, action-response functions have a great role in determining the dynamic interaction between the variables examined and detecting symmetrical relationships. Variance decomposition distinguishes the change in one of the endogenous variables as separate shocks affecting all the endogenous variables. In this sense, variance decomposition gives information about the dynamic structure of the system. The purpose of variance decomposition is to reveal the effect of each random shock on the error variance of the forecast for future periods. While the most effective variable on a macroeconomic size is determined by variance decomposition, whether this variable can be used as a policy tool is determined by the impact-response functions (Sarı, 2008, p. 4).

In this section, graphs showing the reactions of other variables against a standard error shock occurring in the variables used for model 1 and model 2 are given. The solid lines (blue) in the graphs show the response of other variables over time to a standard error shock occurring in the error terms of the model.

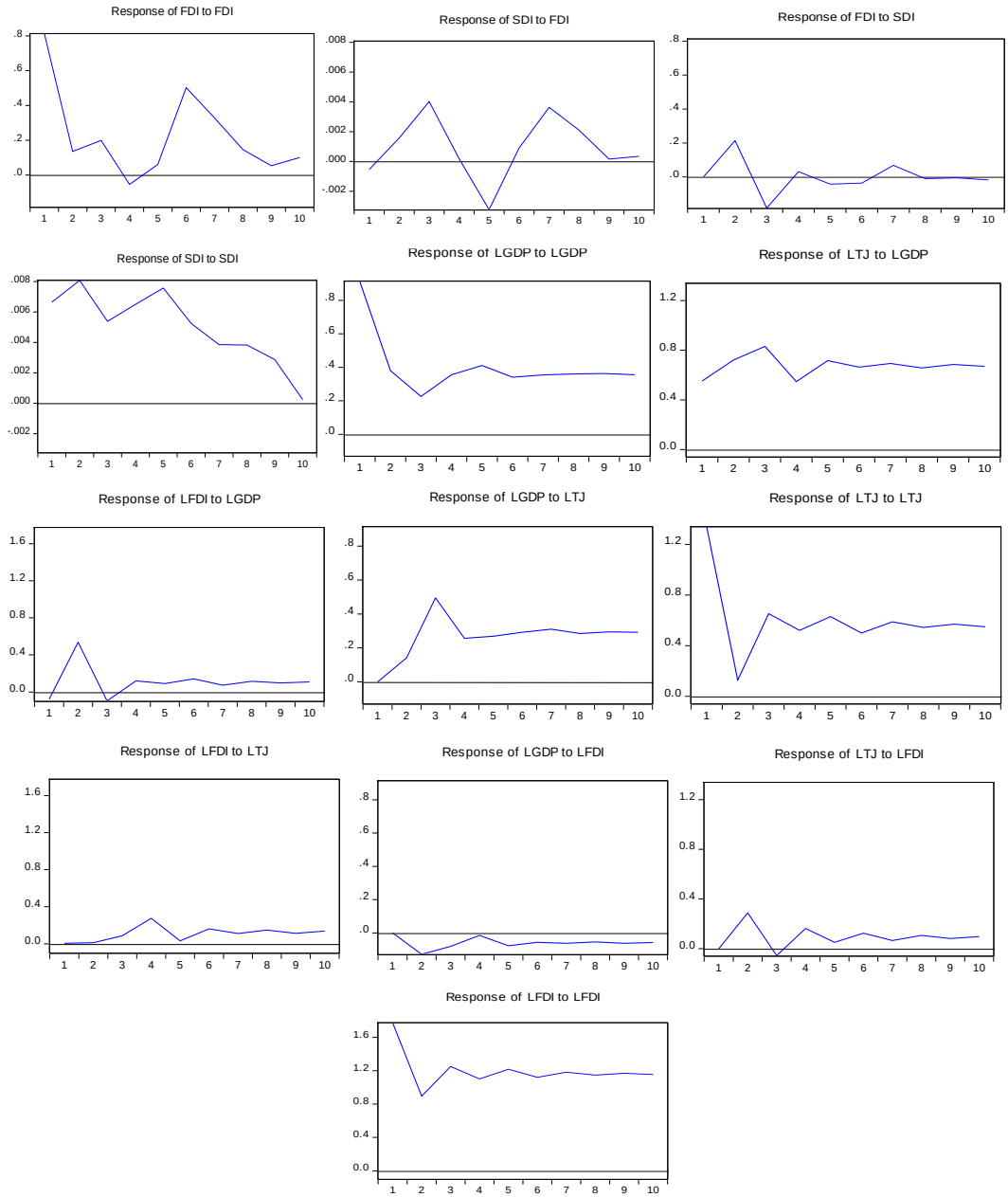

Figure 2. Model 1 and Model 2 Impulse Response Functions

4.7. Variance Decomposition

Variance decomposition shows how much of the changes in dependent variables are caused by their own shocks and how much is caused by the shocks of other variables (Barişik and Kesikoğlu, 2006, p. 77). In Table 9 and Table 10, variance decomposition of the variables used in the models is shown for 10 periods in order to examine the relationship between sustainable development and foreign direct investment.

Table 9. Variance Decomposition Results of Model 1 Variables (%)

MODEL 1			
Period	**Variance Decomposition of LFDI**		
	LFDI	**LGDP**	**LTJ**
1	100.0000	0.000000	0.000000
2	69.72845	25.78279	4.488756
3	70.23230	24.37610	5.391600
4	73.16929	22.07818	4.752534
5	72.11665	22.87412	5.009232
6	70.31176	24.32481	5.363433
7	71.11620	23.61268	5.271120
8	71.25807	23.52268	5.219256
9	70.79346	23.87560	5.330941
10	70.75103	23.89723	5.351740
Period	**Variance Decomposition of LGDP**		
	LGDP	**LFDI**	**LTJ**
1	91.14176	7.858240	0.000000
2	80.64365	17.23297	2.123384
3	67.39922	28.15573	4.445052
4	66.74641	25.43835	7.815246
5	67.26769	29.31085	8.421453
6	63.75865	32.80037	8.440983
7	62.52729	34.03401	9.438703
8	62.21758	34.53274	9.249674
9	61.38694	35.42360	9.189463
10	60.46343	36.37418	9.162399
Period	**Variance Decomposition of LTJ**		
	LTJ	**LFDI**	**LGDP**
1	81.52204	5.275329	13.20263
2	68.91288	4.163842	26.92328
3	60.48549	7.249025	32.26549
4	62.18867	6.281606	31.52972
5	60.55229	6.630937	32.81678
6	58.99214	6.155270	34.85259
7	58.82383	6.006016	35.17016
8	58.79005	5.688621	35.52133
9	58.19391	5.619391	36.18670
10	57.92248	5.455214	36.62230

While the variances of the variables are mostly explained by themselves in the first periods, this ratio decreases towards the 10th period. While the variance of the variable of foreign direct investment is explained by itself according to the average of 10 periods, 21.43% of the variance of the variance of foreign direct investment is explained by the per capita gross domestic product and 5.13% by the energy consumption per capita. While the LGDP variable was explained by itself by 91.14% in the first period, this rate decreased by 68% compared to the average of 10

periods, and 28.11% of the change in its variance was caused by the LFDI and 7% by the LTJ variable. In the LTJ variable, 81.52% originates from itself in the first period, 5.85% is caused by the LFDI variable compared to the average of 10 periods, and 31.50% is caused by the LGDP variable.

Table 10. Variance Decomposition Results of Model 2 Variables (%)

MODEL 2		
Period	**Variance Decomposition of FDI**	
	FDI	**SDI**
1	100.0000	0.000000
2	93.68670	6.313300
3	90.04189	9.958110
4	89.96824	10.03176
5	89.81853	10.18147
6	92.13630	7.863702
7	92.48989	7.510115
8	92.61794	7.382059
9	92.63345	7.366548
10	92.67339	7.326613
Period	**Variance Decomposition of SDI**	
	SDI	**FDI**
1	99.35164	0.648359
2	97.53864	2.461363
3	87.97667	12.02333
4	90.51056	9.489443
5	88.99797	11.00203
6	89.77505	10.22495
7	86.58058	13.41942
8	86.03519	13.96481
9	86.35541	13.64459
10	86.32882	13.67118

The variance decomposition results for Model 2 variables are presented in Table 10. It is seen that the variables are mostly explained by themselves in the first periods, as in model 1. Looking at the average of 10 periods, it was observed that 92.60% of the FDI variable was explained by itself, while 7.39% was explained by the SDI variable. While the SDI variable was explained by him at the rate of 99.35% in the first period, it is seen that 89.94% of it and 10.05% of it was caused by the FDI variable in the 10-term average.

5. Conclusion

The 17 sustainable development goals created by the United Nations on basic elements such as poverty, climate change, economic inequality, innovation, sustainable consumption, peace and justice also have social, economic and environmental dimensions. The adoption of 17 sustainable development goals also includes the need for investments for international communities. In terms of sustainable development goals, private sector and foreign direct investments are of great importance, besides public investments (Aust et al. 2020). Furthermore, the development priorities of developing countries include sustainable economic growth, increased investment, increasing export power in world markets, creating more and better employment opportunities, strengthening technological development and protecting the

environment for future generations. The liberalization and globalization trends in the world economy put pressure on developing countries to develop their own resources and capacities to achieve these goals.

Especially underdeveloped and developing countries may experience difficulties in reaching these targets due to their low socioeconomic development. For these countries, foreign direct investment can create an opportunity to achieve sustainable development goals (Gallagher, 2005). Since the early 1990s, foreign direct investment has been recognized as an 'engine of development' for developing countries, especially by organizations such as UNCTAD, and this acceptance has been confirmed in practice. Liberalization policies, liberalization in international capital movements, privatization practices, cross-border mergers and acquisitions, favourable international environment, developments in communication and transportation technologies, securing contracts, reducing nationalization risks increase foreign direct investments towards developing countries. Regional integrations are another factor supporting the increase in foreign investment flows. Thus, the acceleration of foreign direct investments has increased the effectiveness of countries' economies and improves conditions for sustainable development.

According to findings of the study, examining the relationship between foreign direct investment and sustainable development by using time series of Turkey's 1990-2018 periods, there is a co-integration relationship between the variables and they act together in the long run. In addition, the following conclusions are reached in the study that there is a one-way relationship from foreign direct investment to per capita gross domestic product and per capita energy consumption and there is bidirectional causality between per capita gross domestic product and per capita energy consumption the existence of a one-way relationship from foreign direct investment to the SDI. In this context, the findings support the idea that FDI increase creates significant direct economic effects such as increased income to the host country, higher employment and growth rate from an economic development perspective. In this respect, with the results obtained from the study, Turkey's legislative improvements to attract more FDI and taking measures to ensure macroeconomic stability will have favourable results for its sustainable development.

Researcher's Contribution Rate Statement

The authors declare that they have contributed equally to the article.

Researcher's Conflict of Interest Statement

There is no potential conflicts of interest in this study.

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