

The Connection Between Economic Complexity, Foreign Direct Investment and Economic Freedom: A Panel ARDL Approach for The Black Sea Economic Cooperation Organization (BSEC)

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Abstract

Geographically, the Black Sea Economic Cooperation Organization (BSEC) is of great strategic importance. Because the Black Sea is a crossing point between both Europe and Asia. Due to its geopolitical location, BSEC offers great opportunities in many aspects such as energy, trade volume, logistics, etc. This is important understanding the potential of BSEC countries. In the study, the connection between economic complexity (EC), foreign direct investment (FDI) and economic freedom (EF) and in 13 BSEC member countries was investigated. In this study, which covers the years 1998-2022, the existence of the long-run connection was analyzed through the PMG estimator, which is frequently used in the Panel ARDL method. The results reveal that EC and EF increase FDI in both short and long run. Accordingly results of error correction model, positive and significant connection was found in 10 BSEC member countries. In 3 countries, the error correction model is insignificant.

Keywords: Economic Complexity, Economic Freedom, Foreign Direct Investment, Black Sea Economic Cooperation Organization

Ekonomik Karmařıklık, Doğrudan Yabancı Yatırım ve Ekonomik Özgürlük Arasındaki İliřki: Karadeniz Ekonomik İşbirlięi Örgütü (KEİ) için Bir Panel ARDL Yaklařımı

Öz

Karadeniz Ekonomik İşbirlięi Örgütü (KEİ) coęrafî olarak çok stratejik bir öneme sahiptir. Çünkü Karadeniz hem Avrupa hem de Asya arasında bir geçiş noktasıdır. KEİ bulunduğu jeopolitik konumu itibarıyla enerji, ticaret hacmi, lojistik vb. birçok yönden büyük fırsatlar sunmaktadır. Bu da KEİ ülkelerinin potansiyelinin anlaşılması bağlamında önemlidir. Çalışmada KEİ üyesi olan 13 ülkede ekonomik karmařıklık (EC), ekonomik özgürlük (EF) ve doğrudan yabancı yatırım (FDI) ilişkisi araştırılmıştır. 1998-2022 yıllarını kapsayan bu çalışmada uzun dönemli ilişkinin varlığı Panel ARDL yönteminde sıkça kullanılan PMG tahmincisi yoluyla analiz edilmiştir. Sonuçlar hem kısa hem de uzun dönemde EC ve EF'nin FDI'yi artırdığını ortaya koymaktadır. Hata düzeltme modeli sonucunda KEİ üyesi 10 ülkede anlamlı ve pozitif bir ilişki bulunmuştur. 3 ülkede ise hata düzeltme modeli anlamsızdır.

Anahtar Kelimeler: Ekonomik Karmařıklık, Ekonomik Özgürlük, Doğrudan Yabancı Yatırım, Karadeniz Ekonomik İşbirlięi Örgütü

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Introduction

There is a strong, multifaceted and interconnected connection between foreign direct investment (FDI), economic complexity (EC), economic freedom (EF). EC is a concept that refers to the product diversity of an economy and the sophistication of production processes. High complexity in a country refers to economies with relatively high high-tech industries and trade chains. Of course, in order for a country to increase its complexity, its EF must be high. Because the high level of EF in a country will facilitate both individuals and businesses in areas such as decision-making, trade and investment, etc. This will increase not only domestic investments but also foreign investments.

High EF is often a factor that increases FDI. Foreign investors invest more in countries where they can do business freely and where regulations, tax rates and bureaucracy are low. This, in turn, encourages both EC and economic growth. Because complexity creates opportunities for the production of advanced technologies and high value-added products. More economically complex countries generally have more EF. This encourages increased market diversity and competitiveness, entrepreneurship and innovation. In a country with high EF, EC will increase, which will attract more foreign investors to the country. The effect of these three concepts on each other creates a cycle that increases economic growth and development.

In today's global context, countries endeavour to attract FDI in order to achieve sustainable and robust economic growth and to increase their competitiveness in the global market. FDI leads not only to capital flows but also to many positive effects such as technology transfer, employment, growth and production capacity enhancement. The ability of a country to attract FDI is determined not only by low production costs, but also by the level of economic freedom and the EC index (ECI), which indicates the diversity and technological depth of the country's production structure. In this context, it is important to analyse the impact of EF and EC on FDI. The aim of this study is to analyse the impact of EC and EF on FDI and to provide policy recommendations for the Black Sea Economic Cooperation Organization (BSEC) countries.

The BSEC has a great potential to attract FDI with its geopolitical position and existing cooperation issues. BSEC, which was established on June 25, 1992 with the signing of the Istanbul Summit Declaration and the Bosphorus Declaration by the countries in the region, gained a legal identity with its regulation that entered into force on May 1, 1999. There are 13 countries that are members of BSEC. These countries are; Albania, Armenia, Azerbaijan, Bulgaria, Georgia, Greece, Moldova, North Macedonia, Romania, Russia, Serbia, Turkey and Ukraine. BSEC countries, which have an area of approximately 20 million km², are located in a geography where more than 350 million people live, including the Balkans and the Caucasus. While the total trade turnover of BSEC countries for 2023 is approximately 2 trillion dollars, the trade volume within the organization has reached approximately 320 billion dollars. BSEC countries cooperate in many areas such as agriculture, industry, banking and finance, education, energy, environment, health and information and communication technologies (Black Sea Economic Cooperation, 2025).

The study focuses on the connection between the EC, FDI and EF in the BSEC countries. Firstly, EF and EC are discussed in the conceptual framework. Then, the correlation between the parameters was analyzed and a suitable unit root test was performed. Finally, it was investigated whether there was a long-term connection between the variables.

Theoretical Framework

In this part of the study, the concepts of EC and EF will be mentioned. The concepts of EC and EF are two inseparable concepts. The EF index deals with the concept of freedom in a multidimensional way and is calculated annually by The Heritage Foundation. The index, which determines the criteria of countries such as trade, business, labor, investment, financial and monetary freedom, covers the data of 184 countries. The index ranges from 0 to 100. As the index value approaches 100, the economic freedom of countries increases. It shows that countries with high EF are in a good position not only economically, but also in terms of human rights, democracy and the rule of law (The Heritage Foundation, 2025).

ECI is used to estimate and elucidate the complexity values of countries as well as the dynamics of their economic size. The ECI is a measurement method that links the capacity of an economy to its activities and can be inferred from the data derived from it. The index can predict a country's income level, economic growth, income inequality and even many different macroeconomic data, including

greenhouse gas emissions (Hidalgo C. A., 2023). The ECI uses a data-driven approach, utilising macroeconomic indicators to assess economic capacity in different geographical regions. Various data sources such as trade, employment, stock market and patent data are used to estimate the ECI (OECD, 2025). The calculation of ECI is typically performed in three main categories: trade, technology, and research. The Revealed Comparative Advantages (RCA) coefficient, introduced by Balassa (1965) and based on Ricardo's Theory of Comparative Advantage, is used in ECI calculations. RCA is formulated as follows (Balassa, 1965):

$$RCA_{cp} = \frac{\frac{X_{cp}}{\sum_p X_{cp}}}{\frac{\sum_c X_{cp}}{\sum_c \sum_p X_{cp}}} \quad (1)$$

Balassa's RCA index is a statistical tool used to analyze the comparative performance of a country's exports against the global export landscape. This index uses a country's export data to calculate a country's share of exports relative to its share of world exports. If the index value is greater than 1 ($RCA > 1$), there is a comparative advantage. The complexity index is calculated using a matrix created with the help of the RCA coefficient. This matrix is defined as the output of an activity at a given location being greater than that expected for an activity at the same size location and an activity with the same total output (Hidalgo & Hausmann, 2009).

$$M_{cp} = 1 \text{ ise } RCA > 1 \quad (2)$$

$$M_{cp} = \begin{bmatrix} 0 & 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 1 & 1 \\ 1 & 1 & 1 & 0 & 0 \\ 1 & 1 & 1 & 0 & 0 \end{bmatrix} \quad (3)$$

Hidalgo ve Stojkoski (2025), created the matrix $M_{cc'}$ that ($M_{cc'}$ defined as the product of 4 matrices) and $M_{cc'}$ to derive M_{cp} . Thus, using the ECI and product complexity index (PCI) to determine the complexity of economies and products, the ECI is formulated as (Hidalgo & Stojkoski, 2025):

$$ECI_{cp} = \frac{1}{M_c} \sum_p M_{cp} PCI_p \quad (4)$$

The use of the RCA coefficient in calculating ECI shows how much the increase of EC depends on export competitiveness. Of course, both production and exports of countries with high EF will increase relatively more, which will increase the EC of countries. As a matter of fact, the three countries with the highest EF (Singapore, Switzerland, Ireland) are also at the top of the EC rankings (Singapore 6th, Switzerland 3rd, Ireland 17th). This shows that there is an undeniably important link between EF and EC. In other words, the increase in freedom also increases complexity.

Literature Review

A overview of literature reveals that the majority of studies address connection between FDI and EF, with a focus on their impact on growth. However, numerous studies also examine connection between EC and EF, and between EC and FDI.

Zghidi et al. (2016) surveyed connection between EF, FDI and growth (GDP) in 4 North African countries using the Sistem GMM estimator. The findings of the analysis demonstrated a positive connection between growth and FDI, as well as between FDI and EF. Muslija (2018) discussed the connection between FDI and EF in OECD countries, finding that there was a positive link between FDI and EF. Ghazalian and Amponsem (2019) surveyed the effect of EF in institutions on FDI inflows, and findings demonstrate that as the EF in institutions increases, there is an inflow of foreign investment into

multinational companies. Kılıcı and Akıncı (2020) surveyed the effect of EF on GDP and FDI in Turkey with structural break cointegration test. The findings show that there is a cointegration relationship between EFI, GDP and FDI in Turkey. Özcan and Akar (2020) surveyed the relationship between EF and FDI in E7 countries through causality analysis. The findings show that there is a one-way causality relationship from FDI to EF. Çoban and Küsmen (2021) surveyed the causality relationship between FDI and EF, GDP, and labor force for OECD countries. The findings show that there is a one-way causality relationship between FDI and EF, labor force, GDP. Tag and Değirmen (2022) analyzed the connection between EF and FDI in 127 countries with the economic System GMM method. The results show that as EF increases, the inflow of FDI increases. Çiftçi ve Durusu-Çiftçi (2022), surveyed connection between EF, FDI and growth for the countries that attract the most FDI. Findings highlight that connection between these three parameters is weak in these countries. Şit (2023) surveyed the effect of EF on FDI for MINT countries with Pedroni and KAO cointegration tests. The findings show that in the long run, FDI has a cointegrated relationship with EF. Rafique et al. (2023) investigated impact of EF on FDI in Pakistan with Panel Autoregressive Distributed Lagged (ARDL) model. Findings reveal that EF affects FDI. Mitsi (2023) surveyed the connection between EF and FDI in 24 developing countries within the framework of fiscal rules. The results of the research show that monetary, financial and EF increase FDI. Upadhyaya and Barreto de Goes (2024) surveyed the connection between EF and FDI in Brazil with macroeconomic indicators. Analysis results; gross domestic product (GDP), current account balance, and economic freedom index (EFI) show that FDI in Brazil has increased. Kasap (2025) surveyed the relationship between economic freedom and specific macroeconomic variables (FDI, GDP, etc.) in five fragile countries. The findings show that the increase in EF increases FDI and GDP. Alidemaj et al. (2025) investigated the impact of EF's sub-components (business, trade, investment, etc.) and GDP on FDI in 6 EU countries and 6 Balkan countries. In particular, the findings suggest that EF and the subcomponents of GDP have positive effects on FDI.

There are also studies in the literature that deal with connection between EC and EF, growth and environment. Ratih et al. (2023) surveyed impact of EF and complexity on growth in low and middle-income countries. Findings show that freedom of work and investment has a positive effect on growth. Khaliq and Mamkhezri (2023) investigated the impact of EC and EF on environment in South Asian countries. Findings show that both EF and EC affect environmental pollution. Öztürk and Topçu (2024) surveyed the effect of the six components of economic freedom on export complexity with the Generalized Moments Method. The findings show that the rule of law, public sector size, and market access positively affect export complexity. Aydın et al. (2024) surveyed how the banking sector, human rights, EC and EF influence the green energy transition in China. The findings show that EF, Human Rights and EC are stepping up the transition to green energy in China. Sallam (2025) analyzed the determinants of EC using EF. Findings show that EF is not a determinant of EC in the short run, but in the long run. Christoforidis and Katrakilitis (2025) investigated the impact of EC and EF on carbon dioxide (CO₂) emissions for European Union (EU) countries. The findings reveal that there is an inverse relationship between EC and EF and CO₂.

Additionally EF, there are also studies involving connection between EC and FDI. Khan et al. (2020) surveyed the relationship between EC and FDI for China with ARDL and VECM approaches. The findings show a long-term two-way and short-term one way causality relationship between EC and FDI. Ovenseri-Ogbomo and Obasuyi (2022) surveyed impact of EC on FDI in NESK countries. Findings show that EC affects FDI inflows in the long run. Nguéda and Kelly (2022) surveyed the connection between FDI and EC in Sub-Saharan African countries. Findings show that EC positively affects FDI in these countries. Doru (2022) analysed the connection between EC and FDI for Turkey with causality analysis. Findings reveal that EC is the cause of FDI. Kouam et al. (2023) surveyed the effect of FDI on EC in 21 Sub-Saharan African countries. Findings show that FDI in these countries increases EC in the long run and decreases it in the short run. Saqib and Dinca (2024) surveyed the effects of EC, FDI, environmental technology, and renewable energy on carbon emissions in countries investing in clean energy. The findings show that positive shocks in EC, FDI, environmental technology and renewable energy reduce carbon emissions, while negative shocks increase carbon emissions in the long run. Ajide et al. (2025) surveyed the impact of FDI and trade in China on economic complexity in 34 countries in Africa. The findings show that the increase in China's FDI and trade increases the economic complexity in African countries. Ateş and Arslan (2025) surveyed the impact of EC on FDI in 127 countries determined by income level. The findings show that there is a positive and significant relationship between ECI and FDI.

There are numerous studies in the literature reviewing the connection between EC, EF, and FDI. However, there has not been any study investigating this connection in the BSEC countries. Hence, the study is believed to contribute to the literature with its originality.

Data and Methodology

The connection between EC, EF and FDI in 13 BSEC member countries was surveyed. The concept of EF encompasses various factors, including the safeguarding of property rights, the promotion of free trade, the implementation of low tax rates, and the efficacy of market regulations. The index comprises twelve indicators, which are divided into four primary categories: rule of law, government size, regulatory efficiency and market openness. The scoring system utilised for each indicator ranges from 0 to 100, with the total score of a given country being calculated by averaging these components. The EF index data was obtained from the Heritage Foundation website.

The ECI is calculated using the export data of individual countries. In the calculation process, firstly, the RCA value is calculated. This value indicates whether countries have a competitive advantage in certain products. A country-product matrix is created for products with an RCA value greater than 1 (see Theoretical Framework). Then, the economic complexity scores of the countries are determined by an iterative method, taking into account the prevalence of products and the product diversity of the countries. A high ECI value is indicative of a country's specialisation in technology and knowledge-intensive products, and a more complex production structure (Hausmann & Hidalgo, 2014). The ECI was obtained from the Economic Complexity Observatory (OEC), and the FDI net inflows (% GDP) data were received from The World Bank database. The reason for choosing EC and EF as independent variables in this study is that the factors affecting FDI are not limited to cost considerations but also include deeper factors such as the quality of the production structure and the institutional framework. The capacity of economic complexity to attract investment is based on its capacity to reflect high value-added production capacity. In contrast, economic freedom has a direct impact on investors' decision-making processes by ensuring the reliability and predictability of the investment climate. As a result, analysing the impact of both variables on FDI together provides a more holistic perspective.

The analysis covers the years 1998 to 2022. In order to analyze the connection between EF, EC and FDI, firstly, the stationarity of the variables was tested and it was identified that the variables were stationary at different levels in Findings. Therefore, Panel ARDL model was used to identify the long-run connection between variables. Hausman test, which is one of the specification tests, was applied to identify the model estimator, and Pooled Mean Group (PMG) estimator was applied for the long-run estimator.

LM Test

The LM test is a statistical estimation technique that is utilised to assess the correlation between units, otherwise known as cross-sectional dependence. Fundamental objective of this test is to ascertain whether there is link between residuals of the cointegration or error correction model established for each parameter (Tatoğlu, 2018). Cross-sectional dependence may arise when panel units, such as countries or firms, interact with each other due to common economic shocks or exogenous factors. The existence of this dependence is incompatible with the fundamental assumptions of classical panel data models and consequently leads to bias in standard error estimates, thereby reducing the reliability of the estimates. The LM Test is formulated as follows (Breusch & Pagan, 1980):

$$LM = T \sum_{i=1}^{N-1} \sum_{j=i+1}^N \hat{P}_{ij}^2 \quad (5)$$

$\hat{P}_{ij}^2$, i and j refer to the correlation between the remnants of its parameters. Null hypothesis of test denotes that there is no correlation between units and alternative hypothesis denotes that there is a correlation between units.

Unit Root Test

The cross-sectional extended Dickey Fuller (CADF) test, as developed by Pesaran (2007), is a methodology for calculating the stationarity of parameters in the context of correlation between units. In

addressing the issue of inter-unit correlation, Pesaran (2007) proposed an augmentation of unit root tests with lagged levels of predicted standard DF or extended Dickey Fuller (ADF) regressions with cross-sectional means and initial differences of the series. This approach led to the introduction of the CADF test. The CADF test is formulated as follows (Pesaran, 2007):

$$\Delta Y_{it} = a_i + b_i y_{i,t-1} + c_i \bar{y}_{t-1} + d_i \Delta \bar{y}_t + \varepsilon_{it} \quad (6)$$

CADF t statistic is;

$$t_i(N, T) = \frac{\Delta Y'_{it} \bar{M}_w y_{i,-1}}{\bar{\sigma}_i (y'_{i,-1} \bar{M}_w y_{i,-1})^{1/2}} \quad (7)$$

shown in the form. Null hypothesis of test is that series are not stationary, while alternative hypothesis is that series are stationary.

Hausman Test

Pesaran et al. (1999) observed that the Mean Group (MG) and PMG estimators provide accurate predictions of the mean of the long-run coefficients when the parameters are not at the same stationarity level. Furthermore, irrespective of whether the variables are I(0) or I(1), PMG estimates are consistent and asymptotically normal. Consequently, it is recommended to undertake a specification test, such as Hausman (1978) Test, to identify compatibility between MG and PMG estimators. Null hypothesis of this test, which serves to distinguish between MG and PMG estimators, posits that both estimators are consistent, but MG is inefficient. That is, if the null hypothesis is not rejected, PMG estimator will be deemed effective. Consequently, the rejection of the null hypothesis would indicate a preference for PMG estimator (Ben-Salha, Dachraoui, & Sebri, 2021).

PMG Estimator

The panel ARDL model demonstrates to be applicable irrespective of whether the series in question has level (I (0)) values or first difference (I (1)) values. Furthermore, model enables the generation of both long and short-run estimates. PMG estimator, which is utilised to forecast the ARDL model, permits the short-run coefficients to vary between groups of countries using the ARDL model. Concurrently, the PMG estimator ensures that long-run parameters remain constant across individual groups of countries, while concurrently permitting short-run forecasts, variances of error, and crossovers to vary (Mensah et al., 2019).

PMG estimator is a statistical estimation method that incorporates both pooling and averaging processes. It permits the short-run coefficients and error variances to vary independently across groups, while constraining the long-run coefficients to be homogeneous. The PMG estimator generates the results for the entire panel by calculating the mean of the unit-based estimates (Tatoğlu, 2018). Conversely, the Mean Group (MG) estimator operates under the assumption that long and short-run relationships vary for each panel unit. In the event that the Hausman test indicates a preference for the PMG, the PMG estimator is regarded as a particularly suitable option on account of its theoretical consistency and statistical efficiency. This estimator allows to estimate the long-run parameter without making an assumption that the same dynamics exist in every country. The PMG estimator used as an error correction model in the panel ARDL method is formulated as follows (Pesaran, Shin, & Smith, 1999):

$$y_{it} = \sum_{j=1}^p \lambda_{ij} y_{it} + \sum_{j=0}^p \delta'_{ij} x_{i,t-j} + \mu_i + \varepsilon_{it} \quad (8)$$

X_{it} ($k \times 1$) refers to the vector of explanatory variables for group i , μ_i fixed effects of lagged dependent variable coefficients, λ_{ij} skaler ve δ_{ij} ise ($k \times 1$) coefficient vectors. The time dimension needs to be large enough to predict for each group.

Empirical Results

The impact of EF and EC on FDI in BSEC countries between 1998 and 2022 was investigated. The model created in the study is as follows:

$$FDI_{it} = \beta_0 + \beta_1 ECI_{it} + \beta_2 EFI_{it} + \varepsilon_{it} \quad (9)$$

FDI_{it} foreign direct investments, ECI_{it} economic complexity index and EFI_{it} economic freedom index and ε_{it} refers to the term error.

Table 1: Results of LM Test

Test	Statistic	p-val.
LM	192.5	0.0000*
LM adj*	23.11	0.0000*
LM CD*	9.451	0.0000*

Note: (*) denotes significance level of 1%.

LM test demonstrate that null hypothesis of the absence of a cross-sectional dependence between parameters was rejected at the 1% significance level. Findings denote the presence of a cross-sectional dependency between variables. Consequently CADF test, a second-generation unit root test, was employed to account for the cross-sectional dependence.

Table 2: CADF Test I (0) Results

FDI					
t val.	%10	%5	%1	z (t)	p-val.
-2.280	-2.140	-2.250	-2.450	-1.897	0.029**
ECI					
t val.	%10	%5	%1	z (t)	p-val.
-1.272	-2.140	-2.250	-2.450	1.851	0.968
EFI					
t val.	%10	%5	%1	z (t)	p-val.
-2.146	-2.140	-2.250	-2.450	-1.399	0.081***

Note: (*), (**), and (***) denote significance level of 1%, 5%, and 10%, respectively.

Stationarity analyses of parameters were analyzed by CADF test. In I (0) values, it is seen that the FDI and EFI variables are not stationary, while the ECI variable is stationary. For this reason, I (1) values of all variables were taken and stationarity analysis was performed again.

Table 3: CADF Test I(1) Results

d.FDI					
t val.	%10	%5	%1	z (t)	p-val.
-3.617	-2.140	-2.250	-2.450	-6.866	0.000*
d.ECI					
t val.	%10	%5	%1	z (t)	p-val.
-3.297	-2.140	-2.250	-2.450	-5.677	0.000*
d.EFI					
t val.	%10	%5	%1	z (t)	p-val.
-3.065	-2.140	-2.250	-2.450	-4.815	0.000*

Note: (*) denotes significance level of 1%.

Stationarity analysis of the variables whose I (1) values were taken was performed and thus all of series were stationary at the I (1) level. P-values of the series were rejected at the 1% significance level. Since one of the parameters is stationary at the (ECI) level and the others (EFI and FDI) are stationary at the first difference, Panel ARDL model was preferred for estimation of the long-run connection.

MG and PMG models are among the most used methods in the panel ARDL model. Hausman test was performed to identify which of these two methods was more effective. According to the results of

Hausman test (see Table 4), null hypothesis stating that PMG model is effective could not be rejected. Therefore, using the PMG estimator in the model will give more effective and consistent results.

Table 4: Hausman Test Results

	MG	PMG	Diff.	S.E.
ECI	13.74512	6.367135	7.37799	11.68187
EFI	-.4354178	.0268978	-.4623156	.2809803
$\chi^2(2) = (b-B)'[(V_b - V_B)^{-1}](b-B)$				
= 2.75				
Prob> χ^2 = 0.2522				

PMG estimators (see Table 5) demonstrate the short and long-run connection between the variables. The error correction coefficient (ec) is indicative of short-run deviations, which are a consequence of the series being non-stationary. It also expresses the equilibrium of these imbalances in the subsequent period. Concurrently, ec also reveals the short-run connection between the parameters.

According to Table 5, error correction parameter, ec, is positive and significant. There is both a short and long-run connection between ECI, EFI and FDI variables. Accordingly, the short-run analysis states that 44% of imbalances that occur in one period will be corrected in the next period.

Table 5: PMG Estimator Results (Long and Short Run)

Dependent variable: FDI (Long Run)	Coef.	Std. Err.	z	P> z	[95% Conf. Inter.]	
ECI	6.367135	1.226763	5.19	0.000 *	3.962724	8.771545
EFI	.0268978	.014535	1.85	0.064***	-.0015903	.055386
Dependent variable: FDI (Short Run)	Coef.	Std. Err.	z	P> z	[95% Conf. Inter.]	
ec	.4400412	.0894728	4.92	0.0000*	.2646776	.6154047
d.ECI	1.675164	2.049157	0.82	0.414	-2.34111	5.691439
d.EFI	.0404102	.0598991	0.67	0.500	-.0769899	.1578104

Note: (*), and (***) denote significance level of 1% and 10%, respectively.

In the long-run analysis, both ECI and EFI are positive and significant in explaining FDI variable. Accordingly, in the long run, a one-unit increase in ECI variable increases FDI variable by 6.36 units, and a one-unit increase in EFI variable increases FDI variable by 0.02 units. According to the results, there is a long-run connection between the three variables.

Table 6: PMG Error Correction Model Results (by Countries)

	Coef.	Std. Err.	z	P> z	[95% Conf. Inter.]	
Albenia	.0479154	.0844293	0.57	0.570	-.117563	.2133937
Azerbaijan	.1989883	.1192697	1.67	0.095***	-.034776	.4327526
Bulgaria	.211414	.1239221	1.71	0.088***	-.0314689	.4542968
Armenia	.1601228	.1752697	0.91	0.361	-.1833995	.503645
Georgia	.4321026	.1609532	2.68	0.007*	.1166401	.7475651
Moldova	.4848428	.1563706	3.10	0.002*	.1783619	.7913236
North Macedonia	.6719926	.1420452	4.73	0.000*	.3935892	.950396
Romania	.1292206	.0963788	1.34	0.180	-.0596783	.3181195
Russian Federation	.8333156	.1926015	4.33	0.000*	.4558236	1.210808
Serbia	1.046444	.2243757	4.66	0.000*	.6066761	1.486213
Turkiye	.1612697	.0894596	1.80	0.071***	-.0140679	.3366073
Ukraine	.824194	.1700919	4.85	0.000*	.4908201	1.157568
Greece	.5187124	.1481938	3.50	0.000*	.2282578	.809167

Note: (*), and (***) denote significance level of 1% and 10%, respectively.

By-country findings of PMG estimator (see Table 6) show that the error correction parameter was positive and significant in 10 of the 13 BSEC countries. In other words, in these 10 countries (Azerbaijan, Bulgaria, Georgia, Moldova, North Macedonia, Russia, Serbia, Turkey, Ukraine and Greece) there is a long-run connection between FDI, ECI and EFI. Within the BSEC countries, only in Albania, Armenia

and Romania, the error correction parameter is insignificant. In other words, there is no long-run connection between FDI, ECI and EFI in these 3 countries.

Conclusion and Recommendation

The study, connection between FDI, EC and EF in BSEC countries was surveyed. First, LM Test was performed to identify correlation between variables. LM test reveals the correlation connection between the parameters; therefore, the CADF test was selected as a preferred option. Of the variables, ECI was found to be stable at the level, while EFI and FDI were stable at the first difference. Consequently, the Panel ARDL test was performed to conducting a long-run analysis between these parameters. Hausman test was then employed to ascertain the most suitable MG and PMG estimators for panel ARDL test. This test identified that PMG estimator would yield more effective and consistent results. Forecasts were thus made for both the short and long run using PMG estimator.

Findings revealed that there is a connection between these three variables in both the short and long run. The results of short-run overall analysis reveal that ECI and EFI affect FDI positively and significantly. Because a one-unit increase in EFI increases FDI by 0.02 units, and a one-unit increase in ECI increases FDI by 6.36 units. In this case, it is possible to say that EC affects FDI more than EF. Long-run analysis was carried out on a unit basis, and it was tried to identify in which countries there was a long-run connection. The long-run error correction model is positive and significant in all countries except Albania, Armenia and Romania. Only in these three countries is it insignificant.

The findings of the study are consistent with many studies in the literature. Especially in the context of the connection between EF and FDI, results consistent with Tag and Değirmen (2022), Rafique et al. (2023), Kasap (2025) and Alidemaj et al. (2025). In other words, the results of the studies in the literature and the findings align with each other. Similarly, in terms of the connection between EC and FDI, Ovenseri-Ogbomo and Obasuyi (2022), Nguéda and Kelly (2022), Ateş and Arslan (2025) provide similar results. Finally, in terms of the connection between EF and EC, the findings of the study are similar to Khaliq and Mamkhezri (2023), Öztürk and Topçu (2024) and Sallam (2025). In conclusion, the analysis findings of the study are consistent and similar with most of the studies in the literature.

Increasing EC and strengthening EF in the BSEC countries is of vital importance in terms of increasing FDI inflows. In this context, policies that will support regional development should be implemented. In the BSEC countries, joint incentive programs should be developed in high value-added sectors. Infrastructure investments, especially in the fields of technology and digital economy, should be prioritized. In addition, the rule of law and the protection of property rights will increase investor confidence. These steps will contribute to the increase in regional EC and increase the competitiveness of the BSEC countries. In conclusion, these policy proposals in the areas of investment incentives, institutional reforms and digital transformation will contribute to sustainable economic growth by increasing FDI inflows in the BSEC region. A series of regulations will have a positive impact on FDI inflows so that countries can increase their EC and EF.

Consequently, countries should strengthen the infrastructure of information and communication technologies, increase R&D expenditures, and simplify economic regulations. On the other hand, policies such as ensuring the rule of law and facilitating free foreign trade will increase the inflow of foreign direct investment and enable countries to achieve their economic growth and development goals. In addition, tax incentives, etc., will reduce the cost of foreign investors, making the country attractive to invest. Likewise, with the creation of an investor-friendly environment, the BSEC countries will become the center of global investments.

Ethical Declaration

The Connection Between Economic Complexity, Foreign Direct Investment and Economic Freedom: A Panel ARDL Approach for The Black Sea Economic Cooperation Organization (BSEC), the scientific, ethical and citation rules have been followed during the writing process; no tampering has been made on the collected data and this study has not been sent to any other academic publication environment for evaluation.

Etik Beyan

“Ekonomik Karmaşıklık, Doğrudan Yabancı Yatırım ve Ekonomik Özgürlük Arasındaki İlişki: Karadeniz Ekonomik İşbirliği Örgütü (KEİ) için Bir Panel ARDL Yaklaşımı” başlıklı çalışmanın yazım sürecinde bilimsel kurallara,

etik ve alıntı kurallarına uyulmuř; toplanan veriler üzerinde herhangi bir tahrifat yapılmamıř ve bu alıřma herhangi bařka bir akademik yayın ortamına deęerlendirme iin gnderilmemiřtir.

Declaration of Conflict

There is no potential conflict of interest in the study.

atıřma Beyanı

alıřmada herhangi bir potansiyel ıkar atıřması sz konusu deęildir.

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EXTENDED ABSTRACT

Doğrudan yabancı yatırım, ekonomik karmaşıklık ve ekonomik özgürlük arasında güçlü bir ilişki vardır. Ekonomik karmaşıklık, ürün çeşitliliği ve üretim süreçlerinin karmaşıklığı ile ilgili bir kavramdır. Karmaşık ekonomiler genellikle yüksek teknolojiye endüstrilere ve ticaret zincirlerine sahiptir. Kısacası karmaşıklık ne kadar yüksek olursa ülkelerin yüksek teknolojiye ürün üretme potansiyeli o kadar fazla olacaktır. Karmaşıklığı artırmak için ise ülkelerin ekonomik anlamda özgürlüğünün yüksek olması gerekmektedir. Yüksek ekonomik özgürlük, bireylere ve işletmelere karar alma, üretim, yatırım ve ticaret gibi konularda kolaylık sağlamaktadır. Elbette bu da yerli ve yabancı yatırımları teşvik ederek ve yatırımları artıracaktır. Bu nedenle, ülkelerin yabancı yatırımcıları çekebilmeleri için daha az bürokratik düzenlemelere ve düşük vergi oranlarına sahip olmaları gerekmektedir. Çünkü ülkelerin bürokratik yapısı yabancı yatırımları etkileyen bir unsur olarak karşımıza çıkmaktadır. Yatırımın artırması için sadece karmaşıklığın artışı değil aynı zamanda ekonomi özgürlüğünün de artması gerekmektedir. Yatırımların artışı üretim ve dış ticaret kapasitesini genişletmekte bu da ekonomik büyümeyi artırmaktadır. Üretim kapasitesi artan ülkelerin ekonomi karmaşıklığı artacak, böylece o ülkedeki üreticilerin ileri teknoloji ve yüksek katma değerli ürünleri üretebilmesi için bir fırsatlar sunacaktır. Keza, yüksek özgürlük ve karmaşıklığa sahip ülkeler, genellikle rekabet gücü yüksek ve inovatif olmaktadır. Bu üç faktör birbirini güçlendirerek ekonomik büyümeyi ve kalkınmayı teşvik etmektedir. Karadeniz Ekonomik İşbirliği Örgütü (KEİ) de gerek bölge ülkeleri arasında jeopolitik konumu gerekse işbirliği potansiyeli nedeniyle yabancı yatırımları çekme potansiyeline sahiptir. Karadeniz bulunduğu konum itibarıyla transit geçiş, lojistik ve tedarik zinciri gibi konularda büyük bir

öneme sahiptir. Bu nedenle, bu alanda bir ekonomik işbirliği örgütü kurulmuş 1992 yılında İstanbul Zirvesi ve Boğaziçi Deklarasyonu ile örgüt resmîyet kazanmıştır. KEİ örgütünün 13 üyesi bulunmaktadır. Bu ülkeler; Arnavutluk, Ermenistan, Azerbaycan, Bulgaristan, Gürcistan, Yunanistan, Moldova, Kuzey Makedonya, Romanya, Rusya, Sırbistan, Türkiye ve Ukrayna'dır. KEİ ülkeleri coğrafik olarak 20 milyon km²'lik bir alana yayılmış ve 350 milyondan fazla insan bu bölgede bulunmaktadır. Toplam ticaret hacmi 2 trilyon dolar olan KEİ ülkeleri, örgüt içi ticaret hacmini de 320 milyar dolara ulaştırmayı başarmıştır. KEİ ülkeleri birçok alanda, işbirliği yapmaktadır. Bu alanlardan bazıları; tarım, sanayi, finans, eğitim, enerji, çevre, sağlık ve bilgi teknolojileri gibi alanlardır. Bu bağlamda, bu çalışmada KEİ ülkelerindeki, doğrudan yabancı yatırım, ekonomik karmaşıklık ve ekonomik özgürlük arasındaki bağlantı analiz edilmektedir. Çalışmada, ekonomik özgürlük endeksi, doğrudan yabancı yatırım girişlerinin GSYH içindeki yüzdelik payı ve ekonomik karmaşıklık endeksi değişkenleri kullanılmıştır. Oluşturulan modelde ekonomik karmaşıklık ve ekonomik özgürlük endeksleri bağımsız değişken, doğrudan yabancı yatırım girişleri ise bağımlı değişken olarak yer almıştır. Söz konusu değişkenler arasındaki ilişkiyi belirlemek için korelasyon analizi ve CADF testi kullanılmıştır. Birim kök testi sonucunda ECI'nin düzeyde, EFI ve FDI'nın ise birinci farkta durağan olduğu bulunmuştur. Panel ARDL testi kullanılarak uzun dönem analizi yapılmış ve Hausman testi ile MG ve PMG tahmincisi arasında seçim yapılarak PMG tahmincisinin daha etkin olduğu belirlenmiştir. Bulgular, ECI ve EFI'nin kısa dönemde FDI'yı pozitif ve anlamlı bir şekilde etkilediğini göstermektedir. Uzun dönem analizi ise Arnavutluk, Ermenistan ve Romanya dışındaki ülkelerde pozitif ve anlamlı bir ilişkinin olduğunu ortaya koymaktadır. Sadece bu üç ülkede ise sonuçlar anlamsızdır. Bu sonuçlar, KEİ ülkelerinde doğrudan yabancı yatırım, karmaşıklık ve ekonomik özgürlük arasında hem kısa hem de uzun vadede bir ilişki olduğunu göstermektedir. Ülkelerin ekonomik karmaşıklık ve ekonomik özgürlüklerini artırabilmeleri için yapılacak bir dizi düzenleme, yabancı yatırım girişleri üzerinde olumlu etki yaratacaktır. Özellikle, KEİ ülkelerindeki ekonomik karmaşıklığın ve ekonomik özgürlüğün artışı, sadece üretim kapasitesindeki bir artışı desteklemeyecek aynı zamanda yerli ve yabancı yatırımların da önünü açacaktır. Dolayısıyla hem karmaşıklık hem özgürlük kavramı üretim artışının ötesine geçen bir değişimin göstergesidir. Daha çeşitli, yenilikçi, dijital dünyaya uyum sağlayan ve sürdürülebilir bir ekonomik yapı inşa etmek için karmaşıklığın artırılması gerekir. Bu nedenle, bu ülkelerin ekonomik yapılarını çeşitlendirip daha karmaşık bir hale getirmesi bölgenin ekonomik potansiyelini en üst düzeye çıkaracaktır. Bu bağlamda, ülkeler bilgi ve iletişim teknolojileri altyapısını güçlendirmeli, Ar-Ge harcamalarını artırmalı ve ekonomik düzenlemeleri basitleştirerek bürokratik engelleri kaldırmalıdır. Öte yandan, ülkelerin hukukun üstünlüğü gibi gerekli şartları sağlamalı ve serbest dış ticaretin kolaylaştırılması gibi politikalar uygulamalıdır. Böylece doğrudan yabancı yatırım girişi artacak ve bu durum da ülkelerin ekonomik büyüme ve kalkınma hedeflerine ulaşmalarını hızlandırıcı bir etki yapacaktır. Ayrıca, vergi muafiyetleri veya vergi teşvikleri gibi yabancı yatırımcıların maliyetini azaltmak ülkeleri yatırım için cazip hale getirecektir. Benzer şekilde yatırımcı dostu bir ortamın yaratılması da ülkeleri küresel yatırımların merkezi haline getirecektir. Böylece KEİ üye devletleri, küresel ölçekte diğer ekonomik işbirliği örgütleriyle üretim, yatırım ve ticari ilişkilerini güçlendirerek yabancı yatırımcıları etkin bir şekilde çekebileceklerdir.