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RESEARCH ARTICLE
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The Impact of Logistics Performance on Economic Complexity in PIIGS Countries

PİİGS Ülkelerinde Lojistik Performansın Ekonomik Karmaşıklığa Etkisi

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ABSTRACT

In this study, the effect of logistics performances of the PIIGS (Portugal, Ireland, Italy, Greece, Spain) countries on economic complexity is examined. The logistics performance index (LPI) is used as an indicator of the logistics performance of the countries, and the economic complexity index (ECI) is used as an indicator of economic complexity. Hovewer the LPI does not have observation data in some years, the unbalanced panel data method was used. In order to find the most suitable unbalanced panel data model, Breusch-Pagan Lagrange Multiplier (LM test) is performed and according to the analysis results, one of the random effects regression method is preferred. In this context, the analysis is carried out using the "Maximum Likelihood Regression (MLE) estimation method. According to the results of the analysis, the effect of the LPI on the economic complexity index is positive and significant. In other words, each unit increase in the LPI in the PIIGS countries increases the ECI by 1.28 units.

Keywords: Logistics, Economic complexity, PIIGS countries

ÖZET

Çalışmada PİİGS (Portekiz, İrlanda, İtalya, Yunanistan ve İspanya) ülkelerinin lojistik performanslarının ekonomik karmaşıklık üzerindeki etkisi incelenmiştir. Ülkelerin lojistik performanslarının göstergesi olarak lojistik performans endeksi, ekonomik karmaşıklık göstergesi olarak da karmaşıklık endeksi kullanılmıştır. Lojistik performans endeksinin bazı yıllardaki gözlem verileri olmadığı için dengesiz panel veri yöntemi kullanılmıştır. En uygun dengesiz panel veri modelini bulabilmek için Breusch-Pagan Lagrange Çarpanı (LM) testi yapılmış ve analiz sonucuna göre tesadüfi etkiler regresyon yöntemlerinden biri tercih edilmiştir. Bu bağlamda, En Çok Olabilirlik Regresyonu (MLE) tahmin yöntemi ile analiz yapılmıştır. Analiz sonuçlarına göre, lojistik performans endeksinin ekonomik karmaşıklık endeksi üzerindeki etkisi pozitif ve anlamlıdır. Diğer bir deyişle, PİİGS ülkelerinde lojistik performans endeksindeki her bir birimlik artış ekonomik karmaşıklık endeksini 1.28 birim artırmaktadır.

Anahtar Kelimeler: Lojistik, Ekonomik karmaşıklık, PİİGS ülkeleri

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INTRODUCTION

There are many macroeconomic indicators regarding the economic development of countries. The most popular of these indicators are GDP, GDP per capita, export, foreign trade deficit, current deficit, inflation, unemployment and human development index. However, although not as much as the macroeconomic indicators expressed in the economic literature and popular economic debates, the two indicators that are at least as important as these indicators are the economic complexity index and logistics performance index.

The ECI developed by Hidalgo and Hausmann (2009) expresses the economic development levels of countries more clearly (Hidalgo, 2009). The index also allows the foreign trade structures of countries to be revealed and compared more clearly. The ECI refers to both the foreign trade competitiveness of countries and the concentration of foreign trade. Using the LPI, many macro- and socio-economic variables such as countries' per capita incomes, human development indices and economic growth rates have begun to be estimated more clearly and accurately (Hausmann & Hidalgo, 2011). The ECI is a very important concept that shows the concentrations and competitiveness of the countries in exports. Especially in recent years, this index has been used when comparative analyzes of the foreign trade of countries.

However, the other important index that should be considered when analyzing the competitiveness of countries is the LPI. Calculated by the World Bank, the LPI considers the development of the logistics sector of countries in terms of six sub-headings. These sub-headings are customs, infrastructure, international shipments, services quality, tracking and tracing and timeliness (Arvis et al., 2018). Because, no matter how high the added value and technological structure of the product produced by the countries, the logistics power is not high enough, the global competition is experienced. In particular, the global logistics problem of the Covid-19 pandemic and the subsequent Ukrainian-Russia war is the most important indicator of this.

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In this perspective, in the study, the relationship between the LPI and the ECI in the PIIGS countries is discussed. The reason for analyzing the PIIGS countries is that these countries are the most affected by the euro zone debt crisis that emerged after the 2009 global economic crisis. In this context, the relationship between economic complexity and logistics performance in these countries is empirically examined.

LITERATURE REVIEW

When the literature is examined, it is seen that there are many publications on the logistics performance indices of the countries. Although not as much as LPI, the studies on ECI are also included in the literature. However, no scientific studies have been found on the relationship between the LPI and ECI scores of countries in the international literatüre. Some of these studies are presented below:

Lorente et al. (2022) examined the dynamic relationship between economic complexity, foreign direct investment, renewable energy, urbanization process and carbon emissions in the PIIGS countries with the smallest ordinary smallest frames (DOLS). The results of the analysis revealed a bidirectional relationship between economic complexity and CO2 emissions.

Osinubi and Ajide (2022) used the panel cointegration method to investigate the effect of foreign direct investment on economic complexity in the MINT and the BRICS countries. While the findings positively affected economic complexity in foreign direct investment countries, the effect of the BRICS showed that it was negative.

Basile and Cicerone (2022) analyzed the relationship between the ECI and regional labor productivity in Italy by using the panel cointegration method. According to the results obtained, changes in ECI had an effect on long -term labor productivity.

Molele and Ncanywa (2022) examined the relationship between the ECI and the current account in the selected Sub-Saharan Africa and the BRICS countries. In the study, which was analyzed in the 1994-2018 period, panel Autoregrcessive distribution DystribuTed Lag (Pardl) model was used. According to the results obtained, ECI was effective on the current account account in the long term.

Jayathilaka et al. (2022) examined the impact of GDP and the LPI on international trade on every continent and worldwide. Specification tests were performed for panel regression method on the country. According to the results of the Hausman tests and the Breusch - Pagan LM test, the random effect (RE) model was selected. The findings showed that LPI had a positive relationship with net exports globally and especially in the continents of Asia, European and Oceania.

Sergi et al. (2021) examined the relationship between the global competitiveness index (GCI) and the LPI in The European Union (EU), Asia and African countries. The results of the analysis revealed that human factor, infrastructure in Asia and all elements in Africa were important for the gradual improvement of the LPI in the EU.

Alnıpak et al. (2021) used various static panel data models to evaluate their logistics performances for 32 countries in the European region and to understand the factors that direct LPI scores. The results showed that the per capita per capita, the percentage of commercial service imports and the line of line transport connection index had significant effects by leaving behind other factors on the LPI at the country level.

Coul and Huarng (2021) analyzed the relationship between human development and economic complexity for 117 countries with international migration and logistics performance. The results showed that international migration and logistics performance were decisive mediators in changing the relationship between economic complexity and human development.

Chakraborty et al. (2020) examined the relationship between economic complexity in the Japanese provinces and per capita income. In the study where the Bipartite Network Projecting method was used, a high rate of correlation was found between ECI and GDP per capita.

Britto et al. (2019) examined the relationship between the ECI and economic development in Brazil and Korean Republic and compared the 1960s to 2000. In 1960, economic complexity and development scores are similar in two countries. However, in 2000, both indexes were at a higher level of the scores of the Republic of Korea.

In the international literature, it is thought that this study may be an original publication because there is no scientific study on the relationship between the LPI and the ECI. In this context, it is thought that the study can contribute to the economic literature.

METHODOLOGY

Maximum likelihood estimator (MLE) was first introduced by Magnus (1982), applied for linear and non -linear balanced panel data sets. Biorn (2004) developed this model and integrated this approach to unstable panel data models for random effective situations. As a start to the ML problem, the generalized least squares (GLS) problem is discussed and time effects are ignored in this model (Biorn, 2004). According to Pfaffermayr (2009), MLE performs well under random effects for unstable panels in Monte Carlo simulations. In addition, the T-tests applied for hypotheses related to the slope parameters reveal reliable results, just like balanced models (Pfaffermayr, 2009).

MLE method is found by taking partial derivatives of the likelihood function under the assumption of the normality of random error terms. In this model, estimators are variances of regression model coefficients and error term coefficients. MLE estimators are formulated as follows. (Güriş & Kızılarslan, 2018; Tatoğlu, 2018):

$$\text{Log L} = -(n/2)\log(2\pi) - (n/2)\log\sigma^2{}_v - \frac{1}{2}\log|\sum| - (y-Z\delta)'\sum^{-1}(y-Z\delta)/2\sigma^2{}_v \quad (1)$$

In addition, the Breusch-Pagan Lagrange multiplier (LM) test was applied in order to test the presence of the unit effect in the model and to select the correct model accordingly. Because the existence of unit and time effects is directly related to the meaningfulness of the model. LM test statistics is formulated as follows (Breusch & Pagan, 1980):

$$LM = b\,(m-1) \quad (2)$$

$$b = n\,[\,2\,(\sum Ti^2 - n\,)]^{-1/2} \quad (3)$$

$$m = \hat{u}\,Z'_{\mu}\,Z \quad (4)$$

EMPIRICAL RESULTS

In this study, the impact of logistics performance on economic complexity was investigated in the PIIGS countries. The LPI from the World Bank Data database was used to determine the logistics performances of these countries. Since the LPI data were present between 2007 and 2018, the scope of the study was limited to these dates. ECI data were taken from the Economic Completion Observatory (OEC) database. The data were on an annual basis and regression methods that could be applied for unbalanced panel data models had been preferred because of the lack of the LPI data in some years. Analysis was made using the STATA 14 package program. The model created is as follows:

$$ECO_{it} = \beta_0 + \beta_1\,LPI_{it} + u_{it} \quad (5)$$

In the model, ECO refers to the economic complexity, β0 refers to the fixed coefficient, LPI refers to the Logistics Performance Index variable and β1 refers to the coefficient of the LPI variable and the u error term.

The LM test is calculated by the remains of the least squares predicted. The hypotheses created to determine whether the variance of the unit effect is zero is as follows (Güriş & Kızılarslan, 2018):

$$H0: \sigma^2{}_{\mu} = 0$$

$$H1: \sigma^2{}_{\mu} > 0$$

While the Ho hypothesis is formed as the unit effect is equal if the variant is equal, the alternative hypothesis is created as unit effect is not equal if the variety is not equal. In the event that the Ho hypothesis is accepted, it is more accurate to use the smallest pooled squares (POLS), which is a classic regression method, assuming that there is no unit effect. However, if the unit effect will have an effect if the alternative hypothesis is accepted, POLS analysis should not be used. If used, the effectiveness of the model will be lost (Tatoğlu, 2018). In the study, the LM test was used to make choice among the pool and random effective panel data.

Table 1: Breusch-Pagan Lagrange Multiplier (LM) Test

	Var	sd = sqrt(Var)
eco	0.21016	0.4584282
e	0.00186	0.0430729
u	0.08669	0.2944271
chibar2(01) = 29.75		
Prob > chibar2 = 0.0000*		

Note: (*) It shows 1 %significance level.

Table 1 also shows variance and standard errors of the dependent variable and error components. According to the results of the LM test, the zero hypothesis indicating that the unit effect variance is equal to zero was rejected at 1 %significance level. In other words, the unit effects are significant and the POLS method should not be used. Instead, any of the randomly effective models should be selected.

It can be used for the smallest generalized squares (GLS) method or the most likelihood estimator (MLE) in unstable panel data models in random effective panel data models. The MLE regression model was preferred in the study. Because, MLE is an effective estimation consistent and asimptotic and does not take into account the loss of freedom that may occur in variance components (Tatoğlu, 2018).

Table 2: MLE Regression Results

Dependent variable: eco					
lpi	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]
	1.2822	0.03555	36.07	0.00000*	1.21253 1.351877
LR chi2(1) = 42.82					
Prob > chi2 = 0.0000*					
sigma_u	0.24614	0.09265			.1177066 .5147246
sigma_e	0.17761	0.02559			.1339112 .2355783
LR test of sigma_u=0: chibar2(01) = 18.04					
Prob >= chibar2 = 0.0000*					

Note: (*) It shows 1 %significance level.

According to the MLE Regression method, the logistics performance in the PIIGS countries explains the level of economic complexity of these countries. The MLE predictive results are significant and positive at 1 %in explaining the dependent variable (ECO). In other words, one unit increase in the logistics performance in the PIIGS countries increases the economic complexity of 1.28 units (Table 2).

The LR test, which tests the general meaning of the model, also shows a level of significance. The model is meaningful as a whole. It is the result of the LR ratio test in the lowest line of Table 2 and testing the significance of the unit effects. The test result shows that unit effects are significant at 1 %.

CONCLUSION

It is very important to have a high level of economic complexity in order to create a competitive advantage in foreign trade of countries. In addition to producing and exporting products with high added value, the logistics quality of the countries is a factor that increases foreign trade. Therefore, it was investigated whether logistics performance of the countries affects economic complexity. In the study, the most affected by the Euro Zone Debt Crisis (the PIIGS countries) were analyzed.

In the study, MLE Regression Method was used to analyze the relationship between the LPI and the ECI scores of these countries. According to the results obtained, there is a significant relationship between the LPI and the ECI of countries. The increase in the LPI of the countries has a positive effect on the ECI. In other words, the higher the logistics performance, the higher the level of economic complexity. In other words, the development of the logistics performances of the countries means that the exported product can reach wider markets in a better quality.

As a result, in order to increase the global competitiveness of the PIIGS countries, it is necessary to increase logistics performance. It is obvious that today's pandemia and increasing risk environment, in which global trade is subject to restrictions and that a product produced can be delivered to another geography of the world is difficult in terms of physical and cost, logistics performance is increasing day by day. For this reason, it has not been fully escaped from the economic crisis, and in addition to the effect of the global pandemi crisis, the economy should be able to get rid of the crisis environment and increase the export of foreign trade and increase the investments related to the logistics sector. In this perspective, policy makers should prioritize the logistics sector while implementing tax and various incentive policies and attach importance to projects and investments that improve the technological infrastructure of the sector.

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