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## ANALYSIS OF TWIN DEFICIT PROBLEM AND FELDSTEIN-HORIOKA HYPOTHESIS: AN EMPIRICAL INVESTIGATION FOR OECD COUNTRIES

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### ABSTRACT

The twin deficit hypothesis suggests that there is a relationship between the budget deficit and the current account deficit. The traditional Keynesian Approach emphasizes that budget deficits resulted in the current account deficit. On the other hand, the Ricardian Equivalence Approach argues that there is no relationship between budget deficits and current account deficit. In this study, the validity of the twin deficit hypothesis and Feldstein Horioka (1980) hypothesis is analyzed using both the Breaking Periods of the Westerlund-Edgerton Breaking Cointegration Test (2008) and the Dumitrescu & Hurlin (2012) Panel Causality Test. According to the cointegration and causality analyzes, it is concluded that there is a long-term relationship between budget deficits and current account deficits. This result supports the Traditional Keynesian Approach. Furthermore, it is seen that there is a two-way relationship between budget deficits and current account deficits. Long term coefficients were obtained by using the AMG test. When the panel coefficient results are considered, it is seen that the twin deficit hypothesis is valid, but the results are obtained contrary to the analysis found by Feldstein Horioka (1980). However, when the individual countries are examined, it is seen that the twin deficit hypothesis applies to some countries, and the twin divergence hypothesis applies to some other countries. Besides, it is understood that the study results do not support the Feldstein-Horioka (1980) hypothesis.

**Keywords:** Twin Deficit Hypothesis, Feldstein Horioka Hypothesis, Budget Deficits, Dumitrescu and Hurlin Panel Causality Test, Westerlund-Edgerton Breaking Cointegration Test.

## İKİZ AÇIK SORUNU VE FELDSTEİN-HORİOKA HİPOTEZİNİN ANALİZİ: OECD ÜLKELERİ ÜZERİNE AMPİRİK BİR ARAŞTIRMA

### ÖZET

İkiz açık hipotezi, bütçe açığı ile cari açık arasında bir ilişki olduğunu ifade etmektedir. Geleneksel Keynesyen Yaklaşım, bütçe açıklarının cari işlemler açığına neden olduğunu vurgulamaktadır. Diğer taraftan, Ricardocu Eşdeğerlik Yaklaşımı ise bütçe açıkları ile cari açık arasında bir ilişki olmadığını kabul etmektedir. Bu çalışmada, ikiz açık hipotezi ve Feldstein Horioka (1980) hipotezinin geçerliliği, hem Westerlund-Edgerton Yapısal Kırılmalı Eşbütünleşme Testi (2008) hem de Dumitrescu & Hurlin (2012) Panel Nedensellik Testi kullanılarak analiz edilmiştir. Eşbütünleşme ve nedensellik analizi sonuçlarına göre bütçe açıkları ile cari işlemler açıkları arasında uzun vadeli bir ilişki olduğu görülmektedir. Bu sonuç Geleneksel Keynesyen Yaklaşımı desteklemektedir. Ayrıca, bütçe açıkları ile cari işlemler açıkları arasında iki taraflı bir ilişki olduğu görülmektedir. AMG testi ile uzun dönem katsayıları elde edilmiş ve panel katsayı sonuçları dikkate alındığında, ikiz açık hipotezinin geçerli olduğu görülmüştür. Ancak, ayrı ayrı ülkeler incelendiğinde, bazı ülkeler için ikiz açık hipotezinin, bazı ülkeler için ise ikiz ayrışma hipotezinin geçerli olduğu görülmektedir. Bunun yanı sıra çalışma sonuçları ile Feldstein-Horioka (1980) tarafından ifade edilen sonuçların desteklenmediği görülmektedir.

**Anahtar Kelimeler:** İkiz Açık Hipotezi, Feldstein Horioka (1980) Hipotezi, Bütçe Açığı, Dumitrescu ve Hurlin Panel Nedensellik Testi, Westerlund-Edgerton Breaking Eşbütünleşme Testi.

## **1. Introduction**

Since the 1980s, in many developed and developing countries, particularly in the United States, the twin deficits hypothesis has been put forward. The hypothesis suggests that there may be a relationship between the two deficits, resulting from the fact that the budget deficits have reached significant levels and the high deficits in the current account balance follow the budget deficits. Determining whether there is an interaction between the budget and the current account deficits, determining the direction and effect level in the case of interaction, as well as revealing the other variables that are determinant on the said interaction, are essential in terms of the economic policies to be implemented to overcome the twin deficit problem (Frankel, 2006; Erdinç, 2008; Emirkadı, 2017).

The twin deficits hypothesis is one of the most controversial economic issues in the world's developed and developing countries over the past 20 years. According to this hypothesis, the internal and external deficits of the government are kept in balance by reducing the budget deficit (by reducing state expenditures or increasing taxes) (Zamanzadeh & Mehrar, 2011).

Numerous studies have been conducted in the literature to determine whether the twin deficit hypothesis is valid. In these studies, the budget deficit and current account deficit data of different countries and regions were tested with different econometric methods. Different results were obtained in the mentioned studies, and there was no consensus on the validity of the subject. It is essential to determine whether there is a relationship between the current account deficit and the budget deficit. If any link is identified, it will be possible to implement an appropriate policy to prevent the problem in question (Oktar & Yüksel, 2016).

Indeed, a causal or systematic relationship between the budget balance and the current account balance has significant implications for the economic policies to be implemented. If the twin deficits hypothesis is valid, when a country with a high current account deficit wants to reduce this deficit for various reasons, it will be effective to take measures to correct the budget balance. However, if there is no positive relationship between these two variables as predicted by the twin deficits hypothesis, it will be necessary to focus on other policies rather than budget balance to reduce the current account deficit. Similarly, if the current account deficit has a positive effect on the budget deficit, it can be argued that taking measures to reduce or control the budget deficit will help improve the budget balance. If there is no causal relationship between these two variables, the current account deficit and budget deficit problems should be solved by considering this fact. (Turan & Karakaş, 2017).

The study follows the following order. After the introduction, the second part of the study deals with the theoretical explanations of the concept of twin deficit. The third part of the study continues with the Literature Review. In the fourth part of the study, after performing data analysis, econometric analysis is completed and the results are obtained. The last part of the study includes results and evaluation.

## **2. Theoretical Background**

According to the results of the research conducted by Feldstein and Horioka in 1980, there is a high correlation between national saving and investment rates among OECD countries

and this is one of the most critical hypotheses in international economics. Feldstein & Horioka (1980) interpreted this result as evidence against capital mobility (Caporale et al., 2005).

The twin deficits hypothesis explains that when any tax reduction in a country increases its fiscal deficit, domestic residents use some of their unexpected income to increase their spending, resulting in a fall in total national (private and public) savings. The reduction in savings rates requires the country to borrow from abroad or reduce its foreign debt, as long as domestic investments do not sufficiently decrease to offset the savings deficit. A larger budget deficit should, therefore, usually match with a larger current account deficit. (Bartolini & Lahiri, 2006).

With the argument of twin deficits, the Ricardian equivalence hypothesis provides an alternative explanation for the history of twin deficits. The Ricardian equivalence hypothesis claims that deficits have no real impact on an economy. Private households adjust their savings to offset the expected future tax liabilities associated with deficits. Therefore, interest rates remain unchanged, and budget deficits have no adverse economic impact. However, the traditional Keynesian open economy hypothesis states that high budget deficits can raise interest rates and attract foreign capital. This will lead to an appreciation of the national currency against other currencies. In the hypothesis, an increase in the budget deficit could crowd out funds that should go into investment. This leads to a rise in real interest rates. Given all these factors, rising budget deficits increase actual interest rates as government coffers for domestic funds to finance budget deficits. To the extent that high-interest rates attract foreign short-term capital and lead to a revaluation of the national currency. In other words, continuing budget deficits have raised interest rates and revalued the national currency, displacing investment and exports. In addition, reserve money reacted positively and significantly to an increase in short-term capital inflows. This result, combined with persistent fiscal deficits, could boost inflation expectations. Domestic currency owners, therefore, demand higher returns to hedge against inflation risk (Bolat et al., 2014).

Bolat et al. (2011) examined the short- and long-term relationship between budget deficit and current account deficit by using the boundary test method. It was used quarterly data for the period of 1998-2010. According to the findings of Bolat et al. (2011), it is seen that the budget deficit has no effect on the current account deficit in the long run. But in the short term, there is a relationship between the budget deficit and the current account deficit. It was found that the 1% increase in the budget deficit in the short term increases the current account deficit by 0.18%. This is because the real exchange rate and interest rate have an impact on the current account deficit both in the short and long term. However, the fact that the coefficients of these two variables are quite low indicates that the relationship is not economically meaningful. According to the results of the research, the short-run relationship between the budget deficit and the current account deficit is stronger than in the long-run situation. The results support that the Keynesian approach is valid in the short run, and the Ricardian equivalence hypothesis is valid in the long run.

The twin deficits hypothesis is also closely related to the FHH (Feldstein-Horioka Hypothesis) since external deficits are associated with the financing source. The domestic investments can not only be limited to domestic savings but can be financed from the international

savings pool in globalized financial markets. Thus, the validity of the twin deficit hypothesis is also related to the degree of international capital mobility. If the Ricardian Equivalence hypothesis<sup>1</sup> It does not apply to an economy; increases in budget deficits will reduce national savings. According to Keynesian Theory, budgetary deficits, which cause the decline of nationwide savings, increase domestic interest rates. If the domestic interest rates exceed the international interest rates, the amount of foreign capital entering the country increases under the assumption of full capital mobility. Increases in foreign capital inflows in a rise in economy current account deficits by overestimating the national currency (reverse dollarization) so that imports are cheaper (Koçbulut & Altuntaş, 2016).

According to the Keynesian approach, there is a positive relationship between the budget deficit and the current account deficit. At the same time, there is a one-way causality from the budget deficit to the current deficit (Lau & Baharumshah, 2006). It is also possible to evaluate the concept in terms of savings and investments. The deterioration in the budgetary balance due to the increase in public expenditures leads to a decline in national savings. However, the government may seek to attract foreign investment (capital) by offering higher interest rates to finance the budget deficit. This reduces the competitiveness of the country's foreign trade by making national currency valuable. As a result, budget deficits, interest rates, and exchange rates caused by government expenditures would cause deterioration in the current account balance (Bakarr, 2014). According to the Feldstein Chain Approach, which is based on the Mundell-Fleming model, the budget deficit created by expansionary fiscal policies has a real interest-raising effect. As a result, the inflow of foreign capital is encouraged, thereby widening the foreign trade deficit and thus the current account deficit as a result of the appreciation of the national currency (Feldstein, 1986; İpek & Kizilgöl, 2016)

Depending on the Keynesian fiscal policy, which takes into account the effects of fiscal deficits on private savings and investments, a tax reduction or financial expansion financed by the public sector borrowing reduces private saving by increasing disposable income and thus private consumption. The effects of savings shortfall on investments and current depend on the level of openness of the capital movements of the country. In closed countries relative to capital flows, declining domestic savings are matched by declining investments because residents cannot borrow from abroad to keep their investments high. For this reason, fiscal expansion generally "crowd outs" domestic investment by raising domestic interest rates. Compared to this, more open economies can keep their domestic investments stable through external loans. The increase in the deficit is accompanied by twin deficits (Bartolini & Lahiri, 2006).

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<sup>1</sup> The Ricardian Equivalence term was first used by Buchanan (1976). This concept has been used to indicate the approach of Barro (1974), which is parallel to Ricardo theory in its work, that budget deficit financing or borrowing is fundamentally equivalent to the economy. Because the Ricardian viewpoint is again attributed to Barro (1974), the theory is also described as the Ricardo-Barro Equivalence (Özdamar, 2015).

The basic economic identity defines income  $Y$  as the sum of private and public consumption,  $C$  and  $G$ , investment  $I$  and net exports (which for convenience are identified with the following current account),  $X - M$ ,

$$Y = C + I + G + (X - M) \quad (1)$$

$$(X - M) = Y - (C + G) - I = S - I \quad (2)$$

According to the above equation, the trade balance is equal to the difference between national savings and investments. This can be interpreted as the relationship between external balance and savings and investments. Thus, an increase in investments has a negative impact on the foreign trade balance, while other conditions are constant. On the other hand, decreases in public or private consumption will positively affect the current account balance as they will increase national savings (Fidrmuc, 2003:136).

In an economy, private savings represent the unconsumed portion of post-tax revenue, while public savings show the difference between public tax revenues ( $T$ ) and public expenditures. When we rearrange by adding or subtracting taxes to the right of equation (2), we can obtain equation (3). In equality (4),  $SP$  represents private savings and shows public savings.

$$(X - M) = (Y - C - T) + (T - G) - I = SP + SG - I \quad (3)$$

According to equation (3), if private savings are equal to investment ( $SP = I$ ), there will be a direct relationship between current account balance and budget balance. This implies that the increase in budget deficit increases the current account deficit and this situation implies the twin deficit situation.

In his study, Fidrmuc (2003) revised the equation (3), which shows the relationship between the current account balance and the budget balance and investments, and obtained the equation (4).

$$X_t - M_t = \beta_1 + \beta_2 (T_t - G_t) - \beta_3 I_t \quad (4)$$

In this model,  $(X - M)$  represents the current account balance,  $(T - G)$  represents the public budget balance and  $I$  represent the gross capital formation as a share of GDP. In the model, under the assumption of *ceteris paribus* based on the national income identity, the increase in investments disrupts the current account balance and the investment coefficient ( $\beta_3$ ) is expected to be negative. On the other hand, the budget balance coefficient ( $\beta_2$ ) is expected to have a positive value. The positive value of the budget balance coefficient indicates the existence of the twin deficit and that the Ricardian balance is not valid. The fact that the coefficient  $\beta_3$  is significantly lower than 1 is interpreted as the Feldstein-Horioka hypothesis (Fidrmuc, 2003)

### 3. Literature Review

Utkulu (2003) analyzes the nexus between budget deficits and current account deficits using annual time series covering the 1950-2000 period for Turkey. The study aims to test the Keynesian view and Ricardo's equivalence hypothesis empirically. The econometric method

used is based on cointegration analysis and is supported by the error-correction model and causality findings. The research results support the Keynesian twin deficit theory, but the long-term causal link is twofold.

The purpose of the article conducted by Acaravci & Öztürk (2008) is to examine the validity of the twin deficit hypothesis for Turkey for the period of 1987: 1 to 2005: 4. In this study, autoregressive distributed (ARDL) model and bound tests for cointegration are used for the analysis of twin deficits in Turkey. According to the investigation, the Ricardian Equivalence Hypothesis is rejected, and the Keynesian view is supported. Therefore, there is a long-term relationship between the budget deficit and current account imbalances. Empirical results also show that the causality aspect is from the budget deficit to the current deficit.

In the study conducted by Erdinç (2008), the traditional Keynesian approach, which emphasizes that budget deficits cause the current account deficit, and the Ricardian Equivalence Approaches, which accepts that there is no relationship between the budget deficits and the current account deficit, is analyzed. In this study, the relationship between the budget deficit and the current account deficit were analyzed by using cointegration analysis and Granger causality test for Turkey's economy for 1950-2005 period. In the cointegration analysis, it is concluded that there is a long-term relationship between budget deficits and current account deficits. This result supports the Traditional Keynesian Approach. In addition, it is concluded that the relationship between the budget deficits and the current account deficit is from the budget deficits to the current account deficits.

The purpose of the study by Uğurlu & Düzgün (2009), is to test whether the Ricardian Equivalence Hypothesis (REH) is valid in Turkey. According to Keynesian macroeconomics, public debt has a significant impact on the economy. On the other hand, according to the Ricardo equation, the increase in public debt will not encourage private consumption. Therefore, the increase in debt will not have any real effect. In the study, the validity of REH was tested using the time series method. The results obtained in this context show that in Turkey, REH is rejected.

Karanfil & Kılıç (2015) analyzed the validity of the triplet deficit hypothesis for Turkey. It was used variables such as savings deficit, budget deficit, and current account deficit, which represent the presence of the triplet deficit hypothesis. For the purpose of the study, yearly data covering the period 1980-2013 was used with the help of cointegration analysis and Granger Causality Test. According to the results of the analysis, the current account deficit affects the savings deficit and budget deficit in one direction in the period in Turkey's economy. In this study, savings deficit, budget deficit, and current account deficit representing the presence of triplets simultaneously open the validity of the hypothesis being tested for Turkey. Covering the period 1980-2013 using data from the study in Turkey's economy triplet deficit hypothesis of cointegration analysis and analyzed by Granger Causality Test. According to the results of the analysis, the current account deficit affects the savings deficit and budget deficit in one direction. Also, a bi-directional interaction between the savings deficit and the budget deficit was determined, and the triplet hypothesis was accepted.

The relationship between the current account deficit and the budget deficit was also analyzed with the threshold cointegration approach advocated by Hansen & Seo (2002),

Holmes (2011), Ahmad et al. (2015). In the article published by Holmes (2011), the relationship between the current account and budget balances is examined with the threshold cointegration approach proposed by Hansen & Seo (2002). Using US data covering 1947-2009, a long-term positive cointegration relationship was concluded. This result supports the concept of Keynesian twin deficits. Short-term dynamics were investigated using an estimated threshold vector error correction model. According to the results of the study, the use of fiscal policy to control the external balance has significant effects. Ahmad et al. (2015) examine the relationship between fiscal deficit and current account deficit using the threshold cointegration approach of Hansen & Seo (2002). For the period of 1980-2009, quarterly data were used for nine African countries, and six of the nine countries examined had a long-term positive cointegration relationship, and no such relationship was found for the other three countries (Ahmad et al., 2015).

Bolat et al. (2014) have tested the relationship between budget deficit, current account deficit, and net savings to identify the problem of “triple deficit” in 15 European countries. To measure the causality between net savings, budget, and current account deficit, Hacker and Hatemi-j (2006) bootstrap causality test were applied for the period of 2002: Q1-2013: Q3. According to test results, there is a twin deficit relationship for some countries and a triple deficit relationship for some countries. In addition, some critical test results were found by the authors, indicating that none of these two theories were valid.

Herwartz & Siedenburg (2007) tested the data of 16 OECD countries in the period 1980-2004 with panel regression and dynamic panel method. According to the findings, the effects of the variables of public sector budget balance, national output deficit and terms of trade on the current account balance are essential.

The aim of the research carried out by Sevinç (2016) is to analyze the relationship between current account deficit and budget deficits to investigate whether there is a relationship between deficits in Turkey by using the Granger causality test for 2006: 01 -2015:01. It is concluded that there is a long term relationship between budget deficits and current account deficits in both directions. That is, the Ricardian theory is valid for Turkey.

Altintas & Taban (2011) use time series data for the period of 1974-2010 for Turkey. It was tested the relations with the budget deficit and current account deficit and the hypothesis of Felstein-Horioka (1980) puzzle. Empirical results show that there is a long-term relationship between variables. The study also demonstrates that the Feldstein-Horioka hypothesis is valid.

In the study conducted by Erdinç (2008), cointegration analysis and Granger Causality test were used to analyze the twin tests for the period of 1950-2005. In the cointegration analysis, it is concluded that there is a long-term relationship between budget deficits and current account deficits. This result supports the Traditional Keynesian Approach. In addition, it is found that the relationship between the budget deficits and the current account deficit is from the budget deficits to the current account deficits.

Zamanzadeh & Mehrara (2011) use statistical data for the period 1959-2007 and apply the cointegration technique and Granger causality test to examine the impact of the current government budget deficit on Iran’s non-oil current account deficit. According to the results of this study, the twin deficit hypothesis is valid, and therefore the Ricardian equivalence hypothesis is rejected.

Wirasti & Widodo (2017) empirically examine the twin deficit hypothesis and Feldstein-Horioka Hypothesis in the case of Indonesian. According to the results of the cointegration analysis, there is a long-term relationship between financial imbalances, investment, and current account imbalance. Autoregressive Distributed Lag (ARDL) and Autoregressive Distributed Lag-Error Correction Model (ARDL-ECM) approaches are used to estimate the long-term and short-term relationships, respectively. According to the estimation results, financial imbalances have a positive effect on current account imbalances in Indonesia. On the other hand, investments have a positive effect on the current account. According to these results, the twin deficit hypothesis and Feldstein-Horioka Hypothesis are valid in Indonesia.

Akbostancı & Tuncer (2001) analyzed the relationship between the budget deficit and trade deficit for the 1987-2001 period using the cointegration methodology for Turkey. Thus, the relationship between internal and external deficits was investigated both in the short run and in the long run. According to the analysis, there is a long-run relationship between the two variables. Furthermore, the short-run model revealed that the deterioration in the budget balance worsened the trade balance. Therefore, it is concluded that the twin deficit hypothesis is valid for Turkey's economy. Accordingly, the Ricardian equivalence hypothesis is not valid for the specified period for Turkey.

In addition, Evans (1988), Winner (1993), Enders & Lee (1990), Kim (1995), Miller & Russek (1989), Kaufmann et al. (2002), Aristovnik & Djurić (2010)'s work supports the results obtained REH.

In the studies of Kaufmann et al. (2002), the twin deficit hypothesis for the Austrian economy is analyzed from 1976 to 1997. As a result of the analysis, according to the analysis of variance decomposition of the current account error, the interest rate does not have a significant share in the current account estimate. This result shows that the Keynesian approach, which is the traditional approach, is not valid in Austria for the period mentioned.

Aristovnik & Djurić (2010) analyze the twin deficit phenomenon for the EU economy. According to this study, empirical results generally reject the twin deficit hypothesis. However, the results of the study show high capital mobility and thus, contrary to the results of Feldstein & Horioka (1980) study.

Evans (1988) uses quarterly data for the US economy for the period 1947-1985 and the twin deficit hypothesis is tested with the consumer behavior model. The results of the analysis show that the Ricardian equivalence hypothesis is valid.

The analysis by Winner (1993) shows that the budget deficit does not have a significant effect on the current account deficit. But according to Winner (1993), Australian data seems to show that the Ricardian Equivalence Theorem explains better economic movements.

Enders & Lee (1990) used quarterly data for the US economy and the validity of the Ricardian theory is tested with the VAR model. According to the results of the analysis, increasing taxes to cover government debts does not affect private sector expenditures. So the Ricardian equivalent hypothesis is valid. However, the increase in public expenditures affects the current account deficit. For this reason, the Ricardian equivalence hypothesis is rejected.



Miller & Russek (1989), in the survey conducted by the US economy after World War II cointegration analysis using data for the relationship between budget deficit and financial output was analyzed. According to the results of the analysis, there is no long-term relationship between the variables and the Ricardian equivalence hypothesis is valid.

#### 4. Data and Method

##### 4.1. Data

In this study, the validity of twin deficit and Feldstein Horioka hypothesis in the OECD country group between 1995 and 2017 was examined by using the panel data analysis method. For the purpose of this study, theoretical and empirical explanations were taken into consideration. The variables used in the study are given in Table 1 and the data used in the study were obtained from the World Bank’s World Development Indicators dataset and from the OECD online database. All variables are expressed in US dollars.

**Table 1: Variables and Definitions Used in Analysis**

Variables	Symbol
Foreign Trade Deficit	FTD
Budget Deficit	BD
Fixed Capital Formation/GDP	FCF

##### 4.2. Analysis

This section includes a cross-section dependence test, unit root test, cointegration tests and panel AMG test.

##### 4.2.1. Cross-Sectional Dependence and Homogeneity Test

In studies using econometric analysis, controlling the cross-sectional dependence among variables significantly affects the results of the study (Pesaran, 2004). Therefore, firstly, the cross-sectional dependence between the variables will be tested.

When the time interval is greater than the cross-sectional unit, the cross-sectional dependence test is performed by Breusch & Pagan (1980) LM test. When the cross-sectional unit is greater than the time interval, Pesaran (2004) CDLM test is applied (Equation 2). On the other hand, when the cross-sectional unit and time interval are equal, Pesaran (2004) CDLM2 test is applied. Also, Pesaran et al. (2008) developed a bias-adjusted LM test.

$$CD_{tm} = \sqrt{\frac{1}{n(n-1)} \sum_{i=1}^{n-1} \sum_{j=i+1}^n (T\check{\rho}_{ij}^2 = \pi r^2 - 1)} \tag{2}$$

When the probability value obtained in the cross-sectional dependence test is less than 0.05, the null hypothesis is rejected and a cross-sectional dependence is determined between the series (Pesaran et al., 2008). The hypotheses of the cross-sectional dependence test are given below;

H0: “No cross-section dependency.”

H1: “There is cross-sectional dependency.”

The Cross-section dependency test results are given in Table 2.

**Table 2: Cross-Sectional Dependency Test Results**

Cross-sectional Dependency of Variables	FTD		BD		FCF		MODEL	
	St.	Prob.	St.	Prob.	St.	Prob.	St.	Prob.
CDLM1 (BP, 1980)	1427.041	0.000	2778.088	0.000	1672.928	0.000	3772.514	0.000
CDLM2 (Pesaran, 2004)	33.633	0.000	79.438	0.000	41.970	0.000	113.152	0.000
CD <sub>LM</sub> (Pesaran, 2004)	-1.608	0.054	2.065	0.019	-2.499	0.006	52.183	0.000
Bias-Adjusted CD Test	26.613	0.000	68.553	0.000	30.364	0.000	107.909	0.000

The result of the cross-sectional dependency test is less than 0.05; the null hypothesis of “no cross-sectional dependency” is rejected at a 5% significance level (Pesaran et al., 2008). According to the results of the test, the null hypothesis was rejected and it was concluded that there was a cross-sectional dependence between the series. Therefore, the second generation unit root test, which takes into account the cross-sectional dependency, was applied.

Pesaran & Yamagata (2008) homogeneity test were used to test whether the slope coefficients of the variables were homogeneous or not. The null hypothesis of the homogeneity test indicates that the slope coefficients are homogeneous and the alternative hypothesis states that the slope coefficients are heterogeneous. If the probability value obtained from the test is greater than 0,10, the null hypothesis is accepted at a 10% significance level (Pesaran & Yamagata, 2008). Table 3 shows the homogeneity test results.

**Table 3: Homogeneity Test Results**

	Test Stat.	Prob. Value
Delta_tilde	-2.129	0.983
Delta_tilde_adj	-2.275	0.989

When the homogeneity test results in Table 3 are considered, the hypothesis of zero is accepted as the probability values are greater than 0.10, in other words, it is concluded that the constant term and slope coefficients are homogeneous.

**4.2.2. CADF Unit Root Test**

The CADF unit root test (Cross-Sectionally Augmented Dickey-Fuller), an extended Dickey-Fuller test in cross-sectional terms, was developed by Pesaran (2007). For the analysis results to be meaningful, unit root tests (second generation unit root tests) that take into account the cross-sectional dependency should be used (Pesaran, 2007).

With the CADF test, the unit root test can be applied to each cross-section of the series in the panel. In this case, it is possible to calculate the stability of the series in the panel separately for the overall panel and for each cross-section. The CADF unit root test pays attention to spatial autocorrelation with the assumption that each cross-section is affected differently from the time effect (Pesaran, 2007).

Pesaran (2007) ‘s CADF regression equation is given in equation 3;

$$y_{it} = (1 - \phi_i) \mu_i + \phi_i y_{i,t-1} + u_{it}, i = 1, \dots, N; t = 1, \dots, T \quad u_{it} = Y_i f_t + \varepsilon_{it} \quad (3)$$

The CADF unit root test can be used when the time dimension is greater than the section dimension and the section dimension is greater than the time dimension. CADF unit root test hypotheses are given in Equations 4 and 5 (Pesaran, 2007: 268).

$$H_0 : \beta_1 = 0 \quad (\text{The series is not stationary}) \quad (4)$$

$$H_1 : \beta_1 < 0, i = 1, 2, \dots, N_1, \beta_1 = 0, i = N_1 + 1 \quad (\text{The series is stationary}) \quad (5)$$

The CIPS value (Equation 6) obtained from CADF unit root test is obtained by taking the average of t value calculated for each cross- section (Pesaran, 2007: 276).

$$CIPS(N, T) = t - bar = N^{-1} \sum_{i=1}^N t_i(N, T) \quad (6)$$

CADF Unit root test results are given in Table 4.

**Table 4: CADF Unit Root Test Results**

<b>LEVEL</b>	<b>FTD</b>	<b>BD</b>	<b>FCF</b>
Constant	-2.856	-2.94	-2.758
<b>FIRST DIFFERENCE</b>	<b>FTD</b>	<b>BD</b>	<b>FCF</b>
Constant	-4.366***	-4.708***	-4.652***

\*, \*\*, \*\*\* indicate that the null hypothesis was rejected at the significance level of 10%, 5%, and 1%, respectively. The test was performed using a fixed model. Critical values for the intercept model are -4.35 (1%), -3.43 (5%), -3.01 (10%). For critical value calculations, Pesaran (2007) article was used.

When the CIPS values are examined according to CADF unit root test results, the “unit root exists” hypothesis cannot be rejected because they are not stationary at the series level throughout the panel. When the first differences of the series were taken, they became stationary; in other words, they were I (1).

### 4.2.3. Westerlund-Edgerton Fracture Cointegration Test

The cointegration test by Westerlund & Edgerton (2008) takes into account both cross-sectional dependency and heterogeneity together with structural breakage, heteroscedasticity and autocorrelation. The statistics of the co-integration test are determined using the following equations (Bayar & Sasmaz):

$$y_{it} = \alpha_i + \psi_{it} + \delta_i D_{it} + \beta_i x_{it} + (D_{it} x_{it}) \gamma_i + u_{it} \quad (7)$$

$$x_{it} = x_{it-1} + w_{it} \quad (8)$$

Table 5 shows the results of the Westerlund-Edgerton Break Cointegration Test. According to the test results, there is a long-run relationship between the variables.

**Table 5: Westerlund-Edgerton Break Cointegration Test Results**

Break Type	Test	Statistics	Prob.
Break-in Level	tau_n	-0.02679	0.08931
	phi_n	-0.14318	0.04307

estimated no of factors = 2.00000

Therefore, Westerlund Edgerton refractive cointegration test, which takes into account the structural breaks between the series, was re-analyzed and the results are given in Table 5. According to the results of this test, a cointegration relationship was found between the variables. On the other hand, the breaking years of the countries are given in Table 6.

**Table 6: Breaking Periods of the Countries with Westerlund-Edgerton Breaking Cointegration Test**

Countries	Breaking Years at Level
Australia	2006
Austria	1998
Belgium	2007
Canada	2007
Chile	2007
Denmark	2008
Finland	2008
France	2008
Germany	2008
Greece	2015
Hungary	2008

**Table 6 continued**

Iceland	2001
Ireland	2001
Israel	2001
Italy	2001
Japan	2008
Korea	2010
Mexico	2000
Netherlands	2010
New Zealand	2009
Norway	2005
Poland	2000
Portugal	2000
Slovak Rep.	2000
Spain	2000
Sweden	2000
Switzerland	2014
Turkey	2010
UK	2003
US	1998

According to the results of the Westerlund-Edgerton Breaking Cointegration Test analysis, breakage dates are mainly in 2000/2001 and 2007/2008. One of the main developments during these dates came into effect in 1999 as the currency of the euro (in cash since 2002) (ECB, 2007). In addition, the Dot-com bubble was experienced in 2000 mainly as a result of excessive speculation in the USA (Kraay & Ventura, 2005) and this continued until 2004. In addition, the economic systems of Eastern European countries were transformed in the early 2000s. The dates 2007/2008 can be explained by the economic crisis that emerged in 2007 and became widespread in 2008 (Helleiner, 2011).

#### **4.2.4. Dumitrescu and Hurlin (2012) Panel Causality Test Results**

In the study, the causality relationship between variables was tested using Dumitrescu & Hurlin (2012) causality test. There is a condition that the variables are stationary for the causality test. Therefore, the first-order difference of the variables was used. The causality test results between the variables are given in Table 7. According to the results obtained, a two-way causality relationship was determined in all lag lengths between foreign trade deficit, fixed capital formation and budget deficit.

**Table 7: Dumitrescu and Hurlin (2012) Panel Causality Test Results**

**Model :**  $FTD_{2it} = \alpha_{it} + \beta_1 FCF_{it} + \beta_2 BD_{it} + u_{it}$

Variables	K=1		K=2		K=3	
	$Z_N^{HNC}$	Possibility	$Z_N^{HNC}$	Possibility	$Z_N^{HNC}$	Possibility
FCF- FTD	4.33023	<b>1.E-05***</b>	1.78842	<b>0.0737***</b>	2.73556	<b>0.0062***</b>
FTD- FCF	5.99940	<b>2.E-09***</b>	7.61366	<b>3.E-14***</b>	5.66004	<b>2.E-08***</b>
BD- FTD	8.15790	<b>4.E-16***</b>	6.78357	<b>1.E-11***</b>	3.71788	<b>0.0002***</b>
FTD- BD	9.06149	<b>0.0000***</b>	4.59815	<b>4.E-06***</b>	4.05931	<b>5.E-05***</b>
BD -FCF	6.88316	<b>6.E-12***</b>	4.30351	<b>2.E-05***</b>	4.06972	<b>5.E-05***</b>
FCF- BD	13.2363	<b>0.0000***</b>	5.84924	<b>5.E-09***</b>	4.72971	<b>2.E-06***</b>

Note: \*, \*\*, \*\*\* indicate significance at 10%, 5% and 1%, respectively.

#### 4.2.5. Estimation of Long-Term Cointegrating Coefficients

In order to estimate long term coefficients of the models, AMG (Augmented Mean Group Estimator) method was used. In this method, there is no requirement that the integration degree of the variables in the model is the same, the cross-sectional dependence is taken into account and different coefficients can be estimated for the cross-sectional equations (Eberhardt & Bond, 2009; Eberhardt & Teal, 2010, 2011). AMG test results are given in Table 8.

**Table 8: AMG Test Results**

Countries	BD		FCF	
	Coefficients	Prob.	Coefficients	Prob.
Australia	.073	0.195	- 0.177	0.578
<b>Austria</b>	<b>0.36*</b>	<b>0.003</b>	<b>- 0.810*</b>	<b>0.000</b>
Belgium	0.06	0.243	-0.116	0.950
<b>Canada</b>	<b>-0.35**</b>	<b>0.027</b>	0.114	0.313
<b>Chile</b>	<b>0.46*</b>	<b>0.002</b>	<b>-0.294*</b>	<b>0.000</b>
Denmark	-0.029	0.669	0.984	0.294
<b>Finland</b>	<b>0.575*</b>	<b>0.000</b>	<b>0.450*</b>	<b>0.000</b>
<b>France</b>	<b>0.208*</b>	<b>0.000</b>	-0.325	0.345
<b>Germany</b>	<b>-0.485*</b>	<b>0.000</b>	<b>-0.243*</b>	<b>0.000</b>
<b>Greece</b>	<b>0.526*</b>	<b>0.000</b>	<b>-0.538*</b>	<b>0.005</b>
Hungary	-0.031	0.806	-0.183	0.754
<b>Iceland</b>	<b>0.300*</b>	<b>0.001</b>	<b>0.359***</b>	<b>0.082</b>

Table 8 continued

<b>Ireland</b>	<b>-0.798*</b>	<b>0.003</b>	-0.234	0.760
<b>Israel</b>	<b>0.223*</b>	<b>0.000</b>	<b>-0.262*</b>	<b>0.000</b>
<b>Italy</b>	<b>0.178*</b>	<b>0.000</b>	<b>-0.126*</b>	<b>0.000</b>
<b>Japan</b>	<b>0.330*</b>	<b>0.005</b>	-0.764	0.302
<b>Korea</b>	<b>-0.209*</b>	<b>0.003</b>	<b>-0.484*</b>	<b>0.007</b>
<b>Mexico</b>	<b>0.151*</b>	<b>0.002</b>	<b>-0.325*</b>	<b>0.009</b>
<b>Netherlands</b>	<b>-0.324*</b>	<b>0.000</b>	-0.229	0.134
<b>New Zealand</b>	<b>0.434*</b>	<b>0.000</b>	-0.539	0.510
<b>Norway</b>	<b>-0.481</b>	<b>0.001</b>	<b>-0.767*</b>	<b>0.000</b>
<b>Poland</b>	<b>0.067***</b>	<b>0.087</b>	<b>-0.274*</b>	<b>0.000</b>
<b>Portugal</b>	<b>0.419*</b>	<b>0.000</b>	<b>-0.641*</b>	<b>0.023</b>
<b>Slovak Rep.</b>	<b>0.997*</b>	<b>0.000</b>	<b>-0.723***</b>	<b>0.067</b>
<b>Spain</b>	<b>0.102*</b>	<b>0.003</b>	<b>-0.799*</b>	<b>0.000</b>
Sweden	0.049	0.569	0.114	0.568
<b>Switzerland</b>	<b>-1.027*</b>	<b>0.000</b>	-0.182	0.961
<b>Turkey</b>	<b>0.300*</b>	<b>0.000</b>	<b>-0.287*</b>	<b>0.000</b>
<b>UK</b>	<b>0.186*</b>	<b>0.000</b>	<b>-0.746**</b>	<b>0.044</b>
<b>US</b>	<b>0.434*</b>	<b>0.000</b>	<b>-0.994*</b>	<b>0.000</b>
<b>Panel</b>	<b>0.148**</b>	<b>0.043</b>	<b>-0.647*</b>	<b>0.001</b>

Note: \*, \*\*, \*\*\* indicate significance at 10%, 5% and 1%, respectively.

According to the AMG test results, the panel results of the variables of the budget deficit and fixed capital investments are both statistically significant and the signs of coefficients are as expected. This means rejection of the Ricardian approach and the acceptance of the Feldstein Horioka (1980) hypothesis.

In addition, when the countries are examined separately, the presence of the twin deficit hypothesis is seen in Austria, Chile, Finland, France, Greece, Iceland, Israel, Italy, Japan, Mexico, Poland, Portugal, Slovak Republic, Spain, Turkey, UK and US. This means that the Keynesian approach applies to these countries.

In addition, in Canada, Germany, Ireland, Korea, the Netherlands, Norway and Switzerland, the twin divergence approach applies because there is an inverse relationship between the budget deficit and the current account deficit. The twin divergence approach was developed by Kim & Roubini (2008). In economic recessions (or booms), production decreases (or rises) and financial balance deteriorates (or increases). At the same time, the current account balance may improve if the decline in production leads to a decline in investments and consequently, the decline in investments is greater than the decrease in savings. In addition,

the explosions in the economy caused by technological shocks, for example, may lead to a worsening of the current account due to the increase in investments. At the same time, this economic boom will also improve the fiscal balance. Consequently, current transactions may recover in the event of a deterioration in the fiscal balance or may worsen in the event of an improvement. In this case, it is concluded that twin divergence is observed instead of twin deficits. In only four countries, Australia, Belgium, Denmark, Hungary and Sweden, there is no relationship between the budget deficit and the current account deficit.

When the panel coefficient results are considered, the results are obtained contrary to the analysis found by Feldstein Horioka (1980). According to the results of the analysis, a 1% increase in investments increases the current account deficit by 0.64 and this shows that international capital movements are high as indicated by Fidrmuc (2003).

## **5. Conclusion**

The study analyzes the validity of the twin deficit hypothesis and Feldstein Horioka (1980) hypothesis for 30 OECD member countries. Both the panel causality test, Dumitrescu Hurlin Test (2012) and the Westerlund-Edgerton Breaking Cointegration Test, which is a panel break cointegration analysis, were performed. AMG test was also used to obtain long-term coefficients. According to the panel coefficient results, the twin deficit hypothesis is valid for OECD countries, but the results are obtained contrary to the analysis found by Feldstein Horioka (1980). The results of the Dumitrescu Hurlin Test (2012) shows that there is a reciprocal relationship between both budget deficit, current account deficit, and fixed capital formation variables.

According to the results of AMG test, the twin divergence hypothesis is valid for some OECD countries, while the twin deficit hypothesis is valid for some OECD countries. For the countries of Austria, Chile, Finland, France, Greece, Iceland, Israel, Italy, Japan, Mexico, Poland, Portugal, the Slovak Republic, Spain, Turkey, UK and the US, the twin deficit hypothesis is valid. When the coefficient sizes are analyzed, for the Slovak Republic, which has a twin deficit hypothesis, the coefficient is highest with 0.997. In addition, coefficients are high for Greece, Finland, Chile, New Zealand and USA. In addition, considering the countries where the twin divergence hypothesis is valid, the highest coefficient is obtained for Switzerland and Ireland.

It can be said that it is necessary to achieve internal balances based on the budget balance in the fight against twin deficits and that the improvement of internal balances will, directly and indirectly, positively affect external balances. In some assessments, the release of short-term capital inflows and outflows also has negative effects on macro-balances. Particularly emphasized in this context is that increasing interest rates due to the high borrowing requirement easily add value to the national currency due to the free capital inflows and create pressure on the foreign trade balance (Sever & Demir, 2007).

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