IJCEAS

International Journal of Contemporary Economics and Administrative Sciences
ISSN: 1925 – 4423
Volume: XIII, Issue: 1, Year: 2023, pp. 263-295

Comparative Analysis of Fragile Fives with Panel VAR Models

Esin DEMİREL [1]
Şevket Işıl AKGÜL [2]

Received: 20.09.2022, Accepted: 05.12.2022
DOI Number: 10.5281/zenodo.8335600

Abstract

This study aims to show the similarities and differences between the *fragile five classifications*, which include countries that are quite different from each other, and to show whether there is a need for a different classification of fragile five, econometrically. In this context, the data set consists of *old fragile five* and *new fragile five* classifications. Seven independent variables that are thought to affect the gross domestic product of the countries have been determined. The data are annual for the period 2001-2018. Panel data analysis and Panel vector autoregression are used as a methodology in this paper, respectively. As a result of the analysis, the effects of the independent variables used in the analysis on the dependent differ in the countries included in *fragile fives*. Also, a change in one of the countries included in *fragile fives* will affect other countries. Therefore, it concluded that the variables in the models of *fragile fives* generally have different coefficients from each other. Based on this, it is understood that the revision of *old fragile five* does not conform to *new fragile five*, econometrically. It can be suggested as a policy implication that a different classification of fragile five is necessary.

Key words: Fragile Five, Panel Data Analysis, Panel Vector Autoregression, Comparative Analysis.

JEL Code: E1, E2, C10, C18

[1] Research Assistant, Işık University, Turkiye, esin.demirel@isikun.edu.tr, http://orcid.org/ 0000-0003-4257-6780

[2] Prof. PhD, Marmara University, Turkiye, iakgul@marmara.edu.tr, http://orcid.org/ 0000-0003-4133-1378

1. Introduction

In August 2013, Morgan Stanley published an economic report. In this report, the US Federal Reserve stated that the FED will reduce its bond purchases and enter a monetary squeeze, therefore the currencies will lose value and the need for external financing will increase. In the report, these countries are named "the fragile five". Brazil, India, Indonesia, South Africa, and Turkey are included in the fragile five country classification defined by Morgan Stanley.

In 2017, Standard & Poor's changed the fragile five classification announced by Morgan Stanley in 2013 and made a new fragile five classification. S&P listed new fragile five countries: Turkey, Argentina, Pakistan, Egypt, and Qatar. Namely, only Turkey is included in new fragile five classification.

From this point of view, this study aims to make an econometric analysis of old and new fragile five countries, which are like each other in terms of their formation reasons and only Turkey is a partner country. Econometric analyzes of these country classifications will be made comparatively and all analysis results will be evaluated by comparing them according to country classifications.

Previous studies have addressed either only old fragile or only new fragile classifications as the subject of study. In other words, before this study, there is no study that addresses both old fragile and the new fragile classifications at the same time. And, previous studies have used either panel data analysis or Panel VAR when working with fragile fives. Therefore, it can be claimed that this is the only study that models both country classifications simultaneously, and the only study that deals with fragile five classifications comparatively. In addition, this study has used both Panel data analysis and Panel vector autoregression (Panel VAR) when working with fragile fives. In this context, the theoretical framework of the study includes analyzes and tests compatible with its purpose. In accordance with the purpose of the study, to compare the country classifications and show the similarities and differences between them, the tests used in the analysis in the scope of Panel data analysis and Panel VAR have made comparatively.

Table 1. Country Classifications

Country Classification	Country	Abbreviation
Fragile Five announced in 2013: Old Fragile Five	Brazil, India, Indonesia, South Africa and Turkiye	BIIST
Fragile Five announced in 2017: New Fragile Five	Argentina, Qatar, Egypt, Pakistan and Turkiye	AQEPT

Source: Authors

The table below shows the country classifications included in the analysis, the countries included in these country classifications and the abbreviations of these country classifications. These abbreviations will be used in the study. Abbreviations are formed according to the initials of the countries.

2. Literature Review

When the literature is examined, it is seen that there are analyzes in different time periods and with different methods.

Myszczyszyn and Supron (2021)'s main objective is to determine the long-term and short-term correlation between CO_2 emissions per capita, energy consumption per capita, and the level of economic growth of GDP per capita in the V4 countries. The results of the research are varied, but the authors confirmed, especially in the case of Poland, the long-term correlations between the studied variables. In the short term, such interdependencies also occurred, especially between the level of energy consumption per capita and the level of CO_2 emissions.

Pejovic et al. (2021) examines the association between gross domestic product per capita, CO_2 emissions and energy consumption from renewable sources for the 27 countries of the European Union and the Western Balkans for the period 2008–2018. The panel vector autoregressive approach (PVAR) is used in the analysis, and the panel VAR model with three variables is evaluated based on the generalized method of moments (GMM). The results indicate that most of the variations in CO_2 emissions are determined by variations in GDP, so reducing CO_2 emissions in the long run can be achieved by continuously increasing GDP.

Sabra (2021) aims to investigate the impact of inward Foreign Direct Investment FDI on both exports and national output, i.e. whether inward FDI led-exports and led-output growth or not, in seven middle income MENA countries, which are (Algeria, Egypt, Jordan, Lebanon, Morocco, Palestine, and Tunisia), for the period from 2000 to 2019, using four equations and two different econometric techniques, which are simultaneous equations and Dynamic Panel Data estimators. It is found that a positive limited FDI impact on both GDP and exports. Positive association with exports indicates complex type of FDI, which services the local market and re-export to home or third country, in the area. This indicates an important result that complex vertical, Knowledge Capital model and platform exports "third country effect" types may stand, and FDI complement exports in the area and during the mentioned period.

Baghirov et al. (2022) is used the long-term Pedroni cointegration test to analysis the relationship between overall turnover, the share of individuals using the Internet in the population, Human Development Index (life expectancy index, education index & GNI index), Population and GDP per capita on based annual panel data set of 12 European countries in the context of the GDP per Capita model over the period from 1998 to 2020. According to the DOLSMG results, the t statistics of turnover, human development index and population variables at the 1% significance level are found to be significant in the long run for the entire panel and turnover, human development index and variables, expect for the share of individuals using the internet in the population affect GDP per capita. Although it was insignificant in the long run for the entire panel in terms of the share of individuals using the internet in the population, except for Austria, it was significant Belgium at the 5% significance level and all other countries at the 1% significance level.

Batrancea et al. (2022) examines the determinants of economic growth in seven countries that are not members of the Basel Committee of Banking Supervision, namely Bolivia, Czech Republic, Estonia, Malaysia, Peru, Poland, and Thailand, for the decades 1990–2019. The study's set of predictors included bank capital to assets ratio, bank liquid reserves to bank assets ratio, inflation, interest rate spread, bank nonperforming loans to total gross loans ratio. By means of panel data analysis and a random effects econometric model, the results show that economic growth proxied by gross domestic product growth rate was mainly driven by bank capital to assets ratio across the three decades. The implications of this study's empirical results could assist national authorities interested in elevating the level of economic growth for the benefit of the overall society.

Benali (2022) aims to empirically analyze the relationship between natural disaster, health spending, urban population, gross fixed capital formation, and gross domestic product (GDP) per capita for lower middle-income countries. The data cover the period 2000–2019. The methodological approach used is based on Granger causality and Vector Error Correction Model (VECM) procedures. Empirical result reveals that GDP per capita and health spending are correlated positively with urban population. The results also indicate that there is a one-way relationship running from natural disaster to GDP per capita and from natural disaster to health spending in short and long run, while two-way relationship between health spending and urban population in short term. In long run, there is two-way relationship between GDP per capita and health spending.

Gezer (2022) deals with the relationship between per capita real GDP, per capita real military expenditure, and per capita real capital in 12 NATO member countries from 1995-2020. The country group is chosen from Central and Eastern European countries depending on their common properties.

Bai and Ng (2004) PANIC, Westerlund and Edgerton (2008) structural break co-integration, and Konya (2006) bootstrap panel causality tests are applied to consider cross-sectional dependence, respectively. Meanwhile, the convergence of the 12 countries' military expenditure in Russia is discussed. It was seen that there is weak evidence for this convergence. According to bootstrap panel causality findings, there is strong evidence in 5 countries based on the non-existence of causality. Therefore, Neutrality Hypothesis was valid in Croatia, Estonia, Latvia, Lithuania, and Turkey.

International Journal of Contemporary Economics and Administrative Sciences
ISSN: 1925 – 4423
Volume: XIII, Issue: 1, Year: 2023, pp. 263-295

Harnphattananusorn and Puttitanun (2022) investigates whether generation diversity in workforce can influence economic growth. Using a panel data of 37 OECD countries over the years 1979–2019, it is found that the effect of generation diversity on economic growth depends on the development level of a country. Essentially, the generation diversity has a positive impact on economic growth in developed countries, but a negative impact on economic growth in developing countries.

Semmerling et al. (2022) extrapolated data from 36 Organization for Economic Cooperation and Development (OECD) countries and analyzed whether decentralization of the state assists in economic growth and development. Administrative decentralization is explored through defining a precedence from the literature. A systematic literature review was conducted and macroeconomic OECD data using nominal gross domestic product was analyzed for the period of 1995–2018. The results confirm that decentralization does not positively correlate with the level of tax independence of local government and, in effect, is not an advantage. Territorial administration is highlighted throughout the paper as a key factor behind tax autonomy in relation to fiscal decentralization levels.

Williams et al. (2022) is carried out to analyze the impact of ecological footprint (EFP), exchange rate (EXC) and bio-capacity (BC) on foreign direct investment (FDI) in South Africa. The study is based on monthly time series data from 1996 to 2017. Asymmetric dynamic multiplier, Linear and Nonlinear Autoregressive distributed lag models were used to establish the relationship between the selected variables. Linear ARDL reveals significant symmetric relationship between FDI, ecological footprint, biocapacity and exchange rate in the short run. Nonlinear Autoregressive distributed lag (NARDL) bounds test confirmed the existence of cointegration between the variables. The non-linear short-run results reveal that positive shock of EXC affect FDI negatively. While positive shock from EFP has a significant and positive effect on FDI. Interestingly, in the long run the negative shock of EXC on FDI is negative while the positive shock of EXC affects FDI positively. Furthermore, the long-run asymmetric dynamic multiplier shows that the cumulative positive and negative effect of EFP and BC on FDI is positive.

3. Data and Methodology

In this study, analyzes will be made to provide information about the validity of these groupings, taking into account the criteria used in the formation of old fragile five and new fragile five countries between 2001-2018. The effects of the variables that are thought to affect the change in the GDP growth rate, which is taken as the main variable, in this grouping will be discussed comparatively. China, as well as old and new fragile five countries, participated in the analysis. In terms of accessibility of all country data, the study started in 2001 and the period of the study is terminated in 2018, since the Covid-19 pandemic, which started in China in 2019, affected all data.

7 series are used to reveal the effects of the variables that are thought to affect the changes in the GDP growth rate of the country classifications (BIIST and AQEPT) included in the analysis between 2001-2018 periods. The data used in the study are annual for the period 2001-2018; Gross Domestic Product (GDP), External Debt Stock (DEBT), Gross Savings (SAVING), Consumer Price Index (CPI), Unemployment Rate (UNEMP), Current Account Balance (BALANCE), Exchange Rate in Dollars (USD) and Central Bank Reserves (RESERVE) series. These data are obtained from The World Bank Data (data.worldbank.org) and Federal Reserve Economic Data (fred.stlouisfed.org).

Since all series in the analysis have a curvilinear trend and/or do not show stationarity in variance. For this reason, logarithmic transformations of all variables are performed except BALANCE.

In its most general representation, the Panel model can be defined as in the following equation (1):

$$LGDP_{it} = \alpha_{it} + \beta_{it}LDEBT_{it} + \gamma_{it}LSAVING_{it} + \delta_{it}LCPI_{it} + \theta_{it}LUNEMP_{it} + \rho_{it}BALANCE_{it} + \sigma_{it}LUSD_{it} + \varphi_{it}LRESERVE_{it} + e_{it} \quad (1)$$

Here, i indicates the country, t indicates the year, α_{it} indicates the constant variable and e_{it} indicates the error term of the model.

4. Empirical Analysis

In the study, homogeneity test, cross-section independence test, Panel unit root test, pooled regression, fixed effects and random effects model, Hausman test, Arellano, Froot and Rogers resistant standard error estimator and Panel VAR tests are performed, respectively.

These methods have also been used in some studies when testing the factors affecting economic growth. Exchange rate fluctuations play a vital role in influencing macroeconomic variables including economic growth. Week currency hurts economic growth, while strong currency adds to growth (Hussain et al., (2019)). Cahyadin and Ratwianingsih, (2020) found a causal between external debt, exchange rate, and unemployment. Moreover, the linkages between external debt, exchange rate, and unemployment were comovement. Vu et al., (2019) showed that an increase in the government external debt ratio creates an increase in GDP and there is a positive relationship between economic growth and external debt. Zerarka et al, (2022) showed that, in addition to the negative impact of public debt and inflation on economic growth, their interaction has negative effects on economic growth, which means that debt can affect economic growth through its impact on inflation.

The countries with the large economy, inflation uncertainty shocks diminish GDP growth only in conditions when output growth is very low or negative (Živkov et al., (2020)). Uddin and Rahman, (2020) revealed that corruption, unemployment

International Journal of Contemporary Economics and Administrative Sciences
ISSN: 1925 – 4423
Volume: XIII, Issue: 1, Year: 2023, pp. 263-295

and political stability have negative effect on GDP per capita, while Inflation, governance effectiveness and rule of law have positive effect on GDP per capita. Panigrahi et al., (2020) showed a strong dynamic long-run linkage between interest and inflation rates and economic growth, but the linkage between unemployment rate and economic growth is insignificant. And it indicated that interest, unemployment and inflation rates and economic growth are related. Nazari and Dalari, (2019) found that there exists a statistically significant negative relationship between inflation and growth for the inflation rates above the threshold level of 3. 3%, above which inflation starts impeding economic growth. Yang and Shafiq, (2020) revealed that the predictors such as FDI, capital formation, money supply, and trade openness have a positive association with economic growth, while inflation has a negative association with the economic growth.

Also, countries should focus on promoting policies to boost productivity growth and thereby achieve higher savings instead of focusing on savings-induced policies alone (Kumar et al.,(2020)).

Homogeneity Test

The homogeneity test in Panel Data analysis aims to understand whether other countries are affected in the same way by a change in any of the countries participating in the analysis. This test is especially meaningful with the cross-section independence/dependency in terms of the model and tests to be selected. For example, in terms of unit root tests to be applied to determine whether the variables are stationary, it may be possible to conduct a unit root test that defends heterogeneity under cross-sectional dependence. For this, a homogeneity test should be applied.

In this study, whether the slope coefficients are homogeneous or not is investigated with the help of Delta test. Delta test is calculated with the help of equations (2) and (3) (Pesaran & Yamagata, 2008);

$$\tilde{\Delta} = \sqrt{N}\frac{N^{-1}\check{S} - k}{\sqrt{2k}} \tag{2}$$

$$\tilde{\Delta}_{adj} = \frac{\sqrt{N}N^{-1}\check{S} - k}{\sqrt{Var(t,K)}} \tag{3}$$

In the above equation; $\tilde{\Delta}$ is the delta test statistic for small samples, $\tilde{\Delta}_{adj}$ is the corrected Delta test statistic for large samples, N is the number of observations, S is the Swamy test statistic, k is the number of explanatory variables and Var(t,K) is the variance.

Table 2. Delta Homogeneity Test Results

	BIIST	
Test		**Test Statistics**
$\tilde{\Delta}$		2.829***
$\tilde{\Delta}_{adj}$		4.243***
	AQEPT	
Test		**Test Statistics**
$\tilde{\Delta}$		2.314***
$\tilde{\Delta}_{adj}$		3.471***

Source: Authors' calculations

*, ** and ** indicate rejection of the null hypothesis at the 90%, 95% and 99% significance level, respectively.

If the economic structures of the countries participating in the analysis are similar, the coefficients are expected to be homogeneous and if they differ from each other, the coefficients are expected to be heterogeneous in the model. When the table is examined, it is seen that the variables that make up the Panel Dataset of the countries for the BIIST and AQEPT country classifications are not homogeneous at the 99% significance level but are heterogeneous. This reveals that the effects of the independent variables used in the analysis on the dependent differ in the countries included in BIIST and AQEPT.

Cross-Section Independence Test

When starting the analysis, it is necessary to consider whether there is a cross-sectional dependence between the series. Regardless of this situation, the results to be obtained as a result of the analysis are greatly affected (Breusch & Pagan, 1980). The LM test is used when the time dimension is greater than the cross-section dimension (T>N); The CD_{LM} test has both cross-sectional and time dimensions large (T>N and N>T); The CD test, on the other hand, is used when the cross-section dimension is greater than the time dimension (N>T). In this study, since the time dimension is larger than the unit dimension (T>N), LM and CD_{LM} tests are used to test the assumption of cross-section independence between the series. The test statistics of these tests can be shown as follows.

$$LM = T\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}^{2} \tag{4}$$

International Journal of Contemporary Economics and Administrative Sciences
ISSN: 1925 – 4423
Volume: XIII, Issue: 1, Year: 2023, pp. 263-295

$$CD_{LM} = \sqrt{\frac{1}{N(N-1)}\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}(T\hat{\rho}_{ij}^{2} - 1)} \qquad (5)$$

$\hat{\rho}$ in the LM test statistic shows the sample estimate of the binary correlation of residuals (Pesaran, 2004).

Table 3. LM and CD_{LM} Tests Results

	BIIST	
Test		**Test Statistics**
LM		30.27***
CD_{LM}		3.623***
	AQEPT	
Test		**Test Statistics**
LM		21.81**
CD_{LM}		1.774*

Source: Authors' calculations

*, ** and ** indicate rejection of the null hypothesis at the 90%, 95% and 99% significance level, respectively.

When the table is examined, it is seen that there is a cross-section dependence between the series at 99% confidence level according to the LM and CD_{LM} tests for BIIST country classification. For the AQEPT country classification, it is seen that there is a cross-section dependency between the series at the 95% confidence level according to the LM test and at the 90% confidence level according to the CD_{LM} test. In other words, It is concluded that a change in one of the countries included in BIIST and AQEPT will affect other countries. Since there is a cross-section dependency between the series, in this study, Pesaran's (2007) CADF Unit Root Test, which is one of the second-generation Panel unit root tests that takes the cross-section dependence into account, is used while investigating the stationarity levels of the variables.

Pesaran (2007) CADF Unit Root Test

The unit root test used in this study is the Pesaran (2007) CADF (Cross-Sectional Augmented Dickey-Fuller) test due to the presence of cross-section dependence in the series. In this test, the CADF test statistics value is calculated for all the variables in the Panel. The arithmetic average of these calculated values is taken. Then, with the help of this value obtained, a CIPS (Cross-Sectionally Augmented IPS) test values are calculated, and two values (CADF and CIPS) are compared with the critical values. These benchmarks are generated via Monte

Carlo. The basic hypothesis of the CADF test is "there is a unit root in the series" and it is rejected when the CADF and CIPS values are more negative than the critical value. The CADF test equation is as shown in equation (6) (Pesaran, 2007);

$$\Delta Y_{it} = \alpha_i + \beta_i Y_{i,t-1} + \gamma_i \bar{Y}_{t-1} + \theta_i \Delta \bar{Y}_t + \varepsilon_{it} \tag{6}$$

In the above equation; ΔY_{it} is the dependent variable and can be defined as "Y_{it}-$Y_{i,t-1}$", $Y_{i,t-1}$ is the unconstant value, $\bar{Y}_{t-1}$ is the constant and $\Delta \bar{Y}_t$ is the fixed and trending value. As mentioned above, it is calculated separately for each case. CIPS statistics are calculated using the formula in (7) (Pesaran, 2007);

$$CIPS(N,T) = N^{-1} \sum_{i=1}^{N} CADF_i \tag{7}$$

Table 4. Pesaran (2007) CADF Unit Root Test Results

		BIIST		**AQEPT**	
Variable	**Lag Length**	**Level**	**First Difference**	**Level**	**First Difference**
		Constant+Trend	**Constant**	**Constant+Trend**	**Constant**
LGDP	**0**	0.191	0.000***	0.000***	0.000***
	1	0.004***	0.011**	0.059*	0.000***
	2	0.082*	0.012*	0.300	0.072*
LDEBT	**0**	0.156	0.000***	1.000	0.030**
	1	0.942	0.161	0.989	0.092*
	2	0.691	0.551	1.000	0.716
LSAVING	**0**	0.508	0.000***	0.086*	0.000***
	1	0.275	0.021**	0.303	0.021**
	2	0.923	0.183	0.421	0.183
LUNEMP	**0**	0.210	0.000***	0.670	0.000***
	1	0.112	0.017**	0.182	0.013**
	2	0.902	0.052*	0.444	0.033**
LCPI	**0**	0.954	0.506	0.064*	0.000***
	1	0.437	0.000***	0.097*	0.000***
	2	0.902	0.052*	0.793	0.170
BALANCE	**0**	0.025**	0.000***	0.006***	0.000***
	1	0.513	0.004***	0.116	0.000***
	2	0.241	0.002***	0.788	0.015**
LUSD	**0**	0.283	0.000***	0.100	0.000***
	1	0.156	0.000***	0.933	0.149
	2	0.209	0.040**	0.971	0.756
LRESERVE	**0**	0.686	0.000***	0.939	0.001***
	1	0.254	0.005***	0.631	0.024**
	2	0.081*	0.025**	0.886	0.569

Source: Authors' calculations

International Journal of Contemporary Economics and Administrative Sciences
ISSN: 1925 – 4423
Volume: XIII, Issue: 1, Year: 2023, pp. 263-295

*, ** and ** indicate rejection of the null hypothesis at the 90%, 95% and 99% significance level, respectively.

When looking at the table showing the results of the Pesaran (2007) CADF Panel unit root test all variables are stationary at the first difference.

Thereupon, the first differences of all variables are taken, all analyzes are made with the stationary states of the series and the Panel models are defined with their stationary states. The following notations show the differentiated series. After taking the first difference of the variables, 1-lagged logarithmic CPI is defined as INFLATION (INF) and 1-lagged logarithmic GDP is defined as GROWTH RATE (GROWTH). Equation (8) shows the general Panel model specified with the stationary variables.

$$GROWTH_{it} = \alpha_{it} + \beta_{it}\Delta LDEBT_{it} + \gamma_{it}\Delta LSAVING_{it} + \delta_{it}INF + \theta_{it}\Delta LUNEMP_{it} + \rho_{it}\Delta BALANCE_{it} + \sigma_{it}\Delta LUSD_{it} + \varphi_{it}\Delta LRESERVE_{it} + u_{it} \tag{8}$$

Panel Data Regression Analysis

While applying Panel Data analysis, there are different estimation methods due to the differences in the constant term. These estimation methods are listed as classical model, fixed effects, and random effects models. Panel Data models where constant and slope parameters do not change according to units and time, that is, constant, are called "classical models". Panel Data models in which unobservable unit and time effects are included in the model within the fixed parameter and therefore the fixed parameter changes according to the units or time are called "fixed effects model". Panel Data models in which the differences of the units are determined within the error term are called “random effects model”.

Pooled Regression, Fixed Effects and Random Effects Model

In the pooled regression model, all units are pooled and the effects of the independent variables on the dependent variable are analyzed. The Pooled Least Squares definition can be seen in Equation (9) (Yaffee, 2003).

$$y_{it} = \alpha + b'x_{it} + e_{it} \qquad \alpha_{it} = \alpha \qquad b_{it} = b \tag{9}$$

It is a feature of the fixed effects model that the slope coefficients are not the same for time and cross-section units and the constant coefficient differs according to the cross-section units (Greene, 1993). In the random effects model, since the unit effect is not fixed, it is not included in the fixed parameter. Since it is random, it is within the margin of error.

The fixed effects model explains its general formulation on the view that "differences between units can be explained by the difference experienced in the fixed term". In such models, only the constant term changes and differs with units, not time. In other words, the time dimension differs according to the behaviors among individuals. In Panel Data models, there may sometimes be differentiation by both time and unit. In this case, this model is called the "bidirectional fixed effects model" (Hsiao, 2014).

Equation (10) contains the equation of the one-way fixed effects model.

$$Y_{it} = (\alpha_{it} + \mu_{it}) + \beta_{1it}X_{1t} + \cdots + \beta_{kit}X_{kit} + \varepsilon_{it} \qquad \varepsilon_{it} \cong IID(0, \sigma_\varepsilon^2) \tag{10}$$

Equation (11) contains the equation of the bidirectional fixed effects model;

$$Y_{it} = (\alpha_{it} + \mu_{it} + \gamma_{it}) + \beta_{1it}X_{1t} + \cdots + \beta_{kit}X_{kit} + \varepsilon_{it} \qquad \varepsilon_{it} \cong IID(0, \sigma_\varepsilon^2) \tag{11}$$

The validity of these equations is based on the assumption of $\varepsilon_{it} \sim IID(0, \sigma_\varepsilon^2)$.

This assumption states that the error terms are independently and identically distributed such that the variance is equal to zero (Baltagi, 2005).

In the random effects model, variables that occur depending on units or time are included in the model as a component of the error term to prevent the loss of degrees of freedom encountered in fixed effect models (Baltagi, 2005). Because, instead of finding the coefficients depending on the unit or time, it is important to find the unit or time specific error components in the random effects model.

In the random effects model, the unit effect is not fixed and is not included in the constant parameter, it is included in the error term. Equation (12) includes linear Panel Data regression and Equation (13) includes random effects model. In Equation (14), the error term in Equation (13) is expressed.

$$Y_{it} = \beta_0 + \beta_{1it}X_{1it} + \cdots + \beta_{kit}X_{kit} + \varepsilon_{it} \tag{12}$$

$$v_{it} = \varepsilon_{it} + \mu_{it} \tag{13}$$

$$Y_{it} = \beta_0 + \beta_{1it}X_{1it} + \cdots + \beta_{kit}X_{kit} + v_{it} \tag{14}$$

International Journal of Contemporary Economics and Administrative Sciences
ISSN: 1925 – 4423
Volume: XIII, Issue: 1, Year: 2023, pp. 263-295

In the above equations, ε_{it} is the error term, μ_i is the unit differences and the change between units with time.

Hausman Test

The Hausman test mainly tests whether there is a significant difference between the model coefficients. The basic hypothesis of the Hausman test is expressed as "the coefficients of the random and fixed effect model are equal to each other; the random effects model is effective". This indicates that the random effects model is valid. Equation (15) includes Hausman test statistics (Hausman, 1978).

$$H = (\hat{\beta}\hat{\beta}_{FE} - \hat{\beta}\hat{\beta}_{RE}\left[Var(\hat{\beta}\hat{\beta}_{FE})Var(\hat{\beta}\hat{\beta}_{RE})\right]^{-1} = (\hat{\beta}\hat{\beta}_{FE} - \hat{\beta}\hat{\beta}_{RE}) \tag{15}$$

Here, FE (fixed effect) shows the estimators of the fixed effects model, RE (random effect) shows the estimators of the random effects model, $Var(\hat{\beta}\hat{\beta}_{FE})$ shows the asymptotic variance-covariance matrix obtained from the fixed effects model and $Var(\hat{\beta}\hat{\beta}_{RE})$ shows the asymptotic variance-covariance matrix obtained from the random effects model.

Table 5. LR, LM, F and Score Tests Results for Unit and/or Time Effects

BIIST	**H_0: Unit effect is not included in the model. The classic model is suitable.**	**H_0: Time effect is not included in the model. The classic model is suitable.**
F Test	0.5867	0.008***
LM (Lagrange Multiplier) Test	1.000	0.078*
LR (Likelihood Ratio) Test	1.000	0.005***
Score Test	1.000	0.088*
AQEPT	**H_0: Unit effect is not included in the model. The classic model is suitable.**	**H_0: Time effect is not included in the model. The classic model is suitable.**
F Test	0.8856	0.000***
LM (Lagrange Multiplier) Test	1.000	0.067*
LR (Likelihood Ratio) Test	1.000	0.000***
Score Test	1.000	0.1369*

Source: Authors' calculations

*, ** and ** indicate rejection of the null hypothesis at the 90%, 95% and 99% significance level, respectively.

Looking at the table; Since the probability values of the LM, LR and Score tests are close to 1, it is seen that the null hypothesis, which states that the unit effect is not included in the model and therefore the classical model is appropriate, is not rejected. However, it is seen that the H_0 hypothesis, which states that the time effect is not included in the model, so the classical model is appropriate, is rejected at the 99% significance level for the F and LR tests. This shows that there is a time effect in the model created for BIIST and AQEPT countries.

Table 6. Panel Data Regression Analysis Results

		BIIST			AQEPT	
Independent Variables	**Pooled OLS**	**Fixed Effects**	**Random Effects**	**Pooled OLS**	**Fixed Effects**	**Random Effects**
DLDEBT	1.91* [0.0425]	2.02** [0.0433]	1.91* [0.0425]	3.17*** [0.0712]	3.13*** [0.0745]	3.17*** [0.0712]
DLSAVING	14.31*** [0.0511]	14.01*** [0.0520]	14.31*** [0.0511]	10.43*** [0.0638]	10.24*** [0.0654]	10.43*** [0.0638]
DLUNEMP	3.53*** [0.0578]	3.47*** [0.0591]	3.53*** [0.0578]	1.64 [0.0392]	1.62 [0.0410]	1.64 [0.0392]
INF	-3.06*** [0.0016]	-3.25*** [0.0016]	-3.06*** [0.0016]	-2.85*** [0.0017]	-2.92*** [0.0018]	-2.85*** [0.0017]
DBALANCE	0.02 [0.004]	-0.01 [0.004]	0.02 [0.0004]	0.38 [0.058]	0.24 [0.0060]	0.38 [0.0058]
DLUSD	-3.77*** [0.0142]	-3.92*** [0.0144]	-3.77*** [0.0142]	0.39 [0.0387]	0.21 [0.0411]	0.39 [0.0387]
DLRESERVE	5.38*** [0.0347]	4.98*** [0.0361]	5.38*** [0.0347]	1.33 [0.0390]	1.18 [0.0408]	1.33 [0.0390]
R^2 Within	0.9839	0.9839	0.9839	0.9291	0.9292	0.9291
R^2 Between	0.9842	0.9801	0.9842	0.9113	0.8912	0.9113
R^2 Overall	0.9835	0.9835	0.9835	0.9286	0.9285	0.9286
X^2 (POLS, RE) / F (FE)	4780.44*** (8)	580.85*** (8. 76)	4780.44*** (8)	1041.17*** (8)	124.62*** (8. 76)	1041.17*** (8)
Hausman			2.46 (8)			0.83 (8)

Source: Authors' calculations

International Journal of Contemporary Economics and Administrative Sciences
ISSN: 1925 – 4423
Volume: XIII, Issue: 1, Year: 2023, pp. 263-295

*, ** and ** indicate rejection of the null hypothesis at the 90%, 95% and 99% significance level, respectively. ( ) indicates degrees of freedom and [ ] indicates standard errors.

According to the table, It is seen that the pooled OLS, fixed effects and random effects estimation methods give similar results in the calculations related to the independent variables in the model. According to the models obtained with three estimation methods.

According to the results of the F and X^2 tests, all of the models are found to be statistically significant. As a result of the Hausman test, it is concluded that the models are random effects models.

1. For BIIST: On GROWTH, the variable DLDEBT is significant at the 90% significance level. The variables DLSAVING, DLUNEMP, INF, DLUSD and DLRESERV are significant at the 99% significance level. The DBALANCE variable is insignificant. The explanation rate of the change in the GROWTH variable of the BIIST countries by the independent variables in the model is calculated as 98%.
2. For AQEPT: On GROWTH, the variables DLSAVING, DLDEBT and INF are significant at the 99% significance level. The DLUNEMP, DLUSD, DLRESERVE and DBALANCE are insignificant. The explanation rate of the change in the GROWTH variable of the AQEPT countries by the independent variables in the model is calculated as 92%.

Table 7. Assumption Test Results

	Random Effects	
Tests	**BIIST**	**AQEPT**
Levene, Brown, Forsythe Heteroskedasticity Test	W0: 0.6663 (4.84) W10: 0.2865 (4.84) W50: 0.2852 (4.84)	W0: 1.7052 (4.8) W10: 0.8633 (4.84) W50: 0.8677 (4.84)
Baltagi-Wu LBI Autocorelation Test	DW: 1.8571 Baltagi-Wu LBI: 1.9797	DW: 1.4110 Baltagi-Wu LBI: 1.8015
Pesaran Cross-Sectional Independence Test	1.701*	1.439
Friedman	28.031***	21.522***

Cross-Sectional Independence Test		
Frees Cross-Sectional Independence Test	0.316	0.124

Source: Authors' calculations

*, ** and ** indicate rejection of the null hypothesis at the 90%, 95% and 99% significance level, respectively.

Considering the result of Levene, Brown and Forsythe test, which is performed to test the existence of varying variance in the random effects model, both models are positive according to the Baltagi-Wu local best invariant (LBI) test, which is used to test whether there is a constant variance assumption and whether there is an autocorrelation problem. There appears to be an autocorrelation problem. In addition, according to Friedman, one of the tests performed to test whether the assumption of cross-section independence is valid in the model, it is seen that the assumption of cross-section independence is not valid in both models.

Arellano, Froot and Rogers Robust Standard Error Estimator

Arellano, Froot and Rogers robust standard errors models allow efficient estimation in the presence of at least one of the cross-section dependence, varying variance, and autocorrelation problems. This model makes use of robust standard errors methods to make the standard errors resistant to these assumption deviations. In this case, while the parameters in the predicted models do not change, the standard error and thus the coefficient significance values remain effective and consistent despite the assumption's deviations (Gujarati, 1995).

Robust standard errors developed by Arellano, Froot and Rogers, in which the assumption of independent distribution of residues is made flexible, can be expressed as in Equation (16);

$$Vst(\widehat{\beta}) = \frac{N-1}{N-k}\frac{M}{M-1}(X'X)^{-1}(\sum\nolimits_{i=1}^{N} X_i'\hat{\mu}_i\hat{\mu}_i'X_i)(X'X)^{-1} \quad (16)$$

Here, M is number of clusters N is number of units in the cluster (Arellano, 1987; Froot, 1989; Rogers, 1993).

International Journal of Contemporary Economics and Administrative Sciences
ISSN: 1925 – 4423
Volume: XIII, Issue: 1, Year: 2023, pp. 263-295

Table 8. Arellano, Froot and Rogers Robust Standard Error Results

DEPENDENT VARIABLE: GROWTH				
INDEPENDENT VARIABLES	**BIIST**		**AQEPT**	
	Test Statistics	**Coefficient**	**Test Statistics**	**Coefficient**
DLDEBT	1.48 [0.0729]	0.1081	9.25*** [0.0731]	0.6761
DLSAVING	12.12*** [0.0457]	0.5544	8.55*** [0.0747]	0.6394
DLUNEMP	3.58*** [0.0258]	0.0924	-0.90 [0.1068]	-0.0962
INF	-2.82*** [0.0027]	-0.0077	-1.43 [0.0033]	-0.0048
DBALANCE	-1.02 [0.0003]	-0.0003	-0.58 [0.0049]	-0.0028
DLUSD	-4.92*** [0.0195]	-0.0964	-1.08 [0.1431]	-0.1541
DLRESERVE	6.04*** [0.0382]	0.2314	-1.78* [0.0886]	-0.1580
R^2	0.9798		0.80	
Wald X^2	0.000*** (4)		0.000*** (4)	

Source: Authors' calculations

*, ** and ** indicate rejection of the null hypothesis at the 90%, 95% and 99% significance level, respectively. ( ) indicates degrees of freedom and [ ] indicates Arellano, Froot and Rogers standard errors.

FOR BIIST:

According to the table.

1. According to the X^2 tests, the model is found to be statistically significant.
2. On GROWTH, the variables DLSAVING, DLUNEMP and DLRESERVE are positive and significant at the 99% significance level; DLUSD and INF are negative and significant at 99% significance level. The DLDEBT and DBALANCE are insignificant.
3. The explanation rate of the change in the GROWTH variable of the BIIST countries by the independent variables in the model is calculated as 98%.

Looking at the coefficients.

1. A 1% increase in the DLSAVING variable will cause a 0.55% increase on the GROWTH variable.
2. A 1% increase in the DLUNEMP variable will cause a 0.09% increase on the GROWTH variable.
3. A 1% increase in the INF variable will cause a 0.01% decrease on the GROWTH variable.
4. A 1% increase in the DLUSD variable will cause a 0.09% decrease on the GROWTH variable.
5. A 1% increase in the DLRESERVE variable will cause a 0.23% increase on the GROWTH variable.

FOR AQEPT:

According to the table.

1. According to the X^2 tests, the model is found to be statistically significant.
2. On GROWTH, the variables DLSAVING and DLDEBT are positive and significant at the 99% significance level: DLRESERVE negative and significant at 90% significance level. The DLUNEMP, INF, DBALANCE and DLUSD are insignificant.
3. The explanation rate of the change in the GROWTH variable of the AQEPT countries by the independent variables in the model is calculated as 80%.

Looking at the coefficients.

1. A 1% increase in the DLDEBT variable will cause a 0.67% increase on the GROWTH variable.
2. A 1% increase in the DLSAVING variable will cause a 0.63% increase on the GROWTH variable.
3. A 1% increase in the DLRESERVE variable will cause a 0.15% decrease on the GROWTH variable.

Panel Vector Autoregression: Panel VAR

The adaptation of traditional vector autoregressive models to the Panel dataset is called Panel Vector Autoregression (Canova & Ciccarelli, 2013). The Panel VAR model is a model that internally assumes the variables that are related to each other, is explained by the delays of each of the variables that

International Journal of Contemporary Economics and Administrative Sciences
ISSN: 1925 – 4423
Volume: XIII, Issue: 1, Year: 2023, pp. 263-295

belong to it and all the other internal variables in the model until a certain time. It is the system of equations that allows us to see the method and how these internal variables move (Sims, 1980). In its general form, our model can be written as follows (Grossman, Love & Orlov, 2014):

$$Z_{it} = \Gamma_0 + \Gamma_1 Z_{it-1} + f_i + d_i + e_{it} \tag{17}$$

Here, Z_{it} is a vector of the key variables, Γ_0 is the matrix of the constant variable, Γ_1 is the coefficients matrices of the lags of the vector of the key variable, f_i is all unobdervable time-invariabt factors at a country level (fixed effects), d_t is the common time effects and e_{it} is the error term.

The procedure applied to determine the causality relationship between the variables in the Panel VAR approach is based on the work of Granger 1969 and can be expressed as in Equation (18):

$$y_{it} = \delta_i + \sum_{n=1}^{N} \gamma_i^{(n)} y_{it-n} + \sum_{n=1}^{N} \beta_i^{(n)} X_{it-n} + \varepsilon_{it} \tag{18}$$

In the above equation, x and y represent stationary variables for t period and i unit. In this test, it is assumed that the individual effects are constant and the lag length (N) is common. In addition, $\gamma_i^{(n)}$ is defined as autoregressive parameters and $\beta_i^{(n)}$ as slope coefficients.

The coefficients obtained from the estimation of the VAR model are difficult to interpret directly. For this, impulse-response function and variance decomposition are used to help understand the relationships between the variables in the model (Lütkepohl & Saikkonen, 1997).

Impulse-response functions characterize the dynamic behavior of each variable in the model's response to shocks and all other endogenous variables. The fact that the impulse-response functions can change depending on the order of the variables is an important problem in VAR models (Awokuse & Bessler, 2003).

The variance decomposition obtained from the moving averages section of the VAR model expresses the sources of shocks occurring in the variables themselves and in other variables as a percentage. It shows how many percent of a change that will occur in the variables used is due to itself and what percent is due to other variables. If most of the changes in a variable are due to its own shocks, it indicates that the variable acts exogenously (Enders, 1995).

Table 9. Lag Length – Information Criteria Table

			BIIST			
Lag	**CD**	**J**	**J pvalue**	**MBIC**	**MAIC**	**MQIC**
1	0.9999	43.4364	0.3271*	-126.5034*	-48.8616*	-72.2887*
2	0.9988*	1.1383*	0.9999	-105.0741	-36.5635	-71.1899
			AQEPT			
Lag	**CD**	**J**	**J pvalue**	**MBIC**	**MAIC**	**MQIC**
1	0.9999	44.4170	0.4540*	-141.5829*	-43.5829*	-82.5821*
2	0.9998*	14.9915*	0.7231	-65.4564	-23.0084	-39.8489

Source: Authors' calculations

When the table showing the Panel VAR lag length selection results is examined; for the model of BIIST and AQEPT countries, MBIC, MAIC and MQIC have minimum values at the first delay. Although the appropriate lag length appears to be 1 according to this table, it should be tested whether this lag length satisfies the stability condition of the model. After selecting the appropriate lag length, stability analysis should be done in Panel VAR models. In the stability analysis, it is checked whether the characteristic roots of the Panel VAR model are within the unit circle. If the characteristic roots are in the unit circle, that is, if the eigenvalues are less than one, the stability condition is satisfied.

The Panel VAR model with 1 lag:

$$y_{it} = A_{1,i}y_{t-1} + \varepsilon_{it} \quad (19)$$

Here, y_{it} is a vector of the key variables, $A_{1,i}$ is the coefficient of autoregressive variable and ε_{it} is the error term of the model.

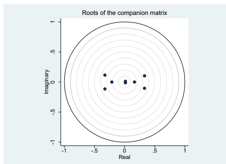
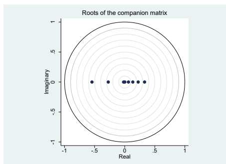
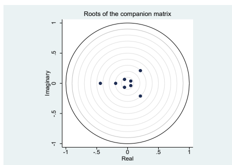
International Journal of Contemporary Economics and Administrative Sciences
ISSN: 1925 – 4423
Volume: XIII, Issue: 1, Year: 2023, pp. 263-295

Table 10. Inverse Roots of the AR Characteristic Polynomial

BIIST		AQEPT		BRICS	
EIGENVALUE	MODULUS	EIGENENVALUE	MODULUS	EIGENVALUE	MODULUS
0.3461	0.3653	-0.5439	0.5439	-0.4392	0.4392
0.3461	0.3653	0.3300	0.3300	0.4185	0.4185
-0.2857	0.3225	-0.2732	0.2732	0.0461	0.3161
-0.2857	0.3225	0.2241	0.2241	0.0461	0.3161
-0.2758	0.2758	0.1348	0.1348	-0.1904	0.1904
0.1853	0.1853	0.0622	0.0048	-0.0103	0.0923
0.0553	0.0553	-0.0185	0.0185	-0.0103	0.0923
0.0141	0.0141	0.0021	0.0021	0.2514	0.0251

Source: Authors' calculations

Table 11. Inverse Roots of the AR Characteristic Polynomial in the Unit Circle

BIIST	
AQEPT	
BRICS	

When the Table 10 and Table 11 showing the values of the Inverse Roots of the AR Characteristic Polynomial are examined, it is seen that the stability condition is met for the models belonging to the two-country classification.

Table 12. Granger Causality Wald Test Results – BIIST

EQUATION	**EXCLUDED**	X^2	**DECISION**	**EQUATION**	**EXCLUDED**	X^2	**DECISION**	**EQUATION**	**EXCLUDED**	X^2	**DECISION**
GROWTH	ΔLDEBT	0.32	No Causality	ΔLSAVING	ΔLDEBT	0.15	No Causality	ΔBALANCE	ΔLDEBT	0.40	No Causality
	ΔLSAVING	19.22***	There is Causality		GROWTH	20.48***	There is Causality		ΔLSAVING	0.00	No Causality
	ΔLUNEMP	3.27*	There is Causality		ΔLUNEMP	4.91**	There is Causality		ΔLUNEMP	2.77*	There is Causality
	INF	4.46**	There is Causality		INF	2.47	No Causality		INF	2.23	No Causality
	ΔBALANCE	2.79*	There is Causality		ΔBALANCE	3.06*	There is Causality		ΔBALANCE	1.91	No Causality
	ΔLUSD	0.64	No Causality		ΔLUSD	2.38	No Causality		ΔLUSD	3.19*	There is Causality
	ΔLRESERVE	0.76	No Causality		ΔLRESERVE	4.72**	There is Causality		ΔLRESERVE	3.49*	There is Causality
ΔLRESERVE	ΔLDEBT	4.86**	There is Causality	ΔLUNEMP	ΔLDEBT	2.94*	There is Causality	ΔLUSD	ΔLDEBT	2.65	No Causality
	ΔLSAVING	6.53**	There is Causality		ΔLSAVING	0.56	No Causality		ΔLSAVING	2.50	No Causality
	ΔLUNEMP	0.44	No Causality		GROWTH	0.00	No Causality		ΔLUNEMP	0.19	No Causality
	INF	0.22	No Causality		INF	0.41	No Causality		INF	0.02	No Causality
	ΔBALANCE	8.08***	There is Causality		ΔBALANCE	0.08	No Causality		ΔBALANCE	4.90**	There is Causality
	ΔLUSD	0.00	No Causality		ΔLUSD	0.00	No Causality		GROWTH	2.77*	There is Causality
	GROWTH	1.20	No Causality		ΔLRESERVE	2.42	No Causality		ΔLRESERVE	2.67	No Causality

ΔLDEBT	GROWTH	0.05	No Causality	INF	ΔLDEBT	0.83	No Causality				
	ΔLSAVING	0.51	No Causality		ΔLSAVING	1.49	No Causality				
	ΔLUNEMP	0.37	No Causality		ΔLUNEMP	1.41	No Causality				
	INF	0.27	No Causality		GROWTH	0.25	No Causality				
	ΔBALANCE	0.11	No Causality		ΔBALANCE	1.86	No Causality				
	ΔLUSD	1.87	No Causality		ΔLUSD	1.33	No Causality				
	ΔLRESERVE	2.18	No Causality		ΔLRESERVE	5.78 **	There is Causality				

Source: Authors' calculations

*. ** and ** indicate rejection of the null hypothesis at the 90%, 95% and 99% significance level, respectively.

According to the Table 12, there are one-way causality relationships between the following variables; from DLDEBT to DLRESERVE at 95% significance level; to UNEMP at 90% significance level; from DLUNEMP to DLSAVING at 95% significance level; to GROWTH and DBALANCE at 90% significance level; from INF to GROWTH at 95% significance level; from DBALANCE to GROWTH and DLSAVING at 90% significance level; from DLRESERVE to INF at 95% significance level; from GROWTH to DLUSD at 90% significance level.

And there are bidirectional causality relationships between the variables DLSAVING-DLRESERVE, DLSAVING-GROWTH, DLRESERVE-DBALANCE and DBALANCE-DLUSD.

Table 13. Granger Causality Wald Test Results – AQEPT

EQUATION	**EXCLUDED**	X^2	**DECISION**	**EQUATION**	**EXCLUDED**	X^2	**DECISION**	**EQUATION**	**EXCLUDED**	X^2	**DECISION**
GROWTH	ΔLDEBT	1.24	No Causality	ΔLSAVING	ΔLDEBT	1.23	No Causality	ΔBALANCE	ΔLDEBT	0.70	No Causality
	ΔLSAVING	6.11 **	There is		GROWTH	0.00	No Causality		ΔLSAVING	0.54	No Causality

			Causality								
	ΔLUNEMP	2.16	No Causality		ΔLUNEMP	3.16*	There is Causality		ΔLUNEMP	4.99**	There is Causality
	INF	0.25	No Causality		INF	1.12	No Causality		INF	0.02	No Causality
	ΔBALANCE	0.26	No Causality		ΔBALANCE	0.08	No Causality		ΔBALANCE	0.06	No Causality
	ΔLUSD	1.18	No Causality		ΔLUSD	1.60	No Causality		ΔLUSD	15.66***	No Causality
	ΔLRESERVE	1.77	No Causality		ΔLRESERVE	1.91	No Causality		ΔLRESERVE	0,62	No Causality
ΔLRESERVE	ΔLDEBT	0,38	No Causality	ΔLUNEMP	ΔLDEBT	1.16	No Causality	ΔLUSD	ΔLDEBT	4.45**	There is Causality
	ΔLSAVING	0,87	No Causality		ΔLSAVING	0.23	No Causality		ΔLSAVING	0.25	No Causality
	ΔLUNEMP	0,00	No Causality		GROWTH	0.02	No Causality		ΔLUNEMP	1.40	No Causality
	INF	0,43	No Causality		INF	1.22	No Causality		INF	0.49	No Causality
	ΔBALANCE	0,63	No Causality		ΔBALANCE	0.09	No Causality		ΔBALANCE	0.00	No Causality
	ΔLUSD	0,25	No Causality		ΔLUSD	0.32	No Causality		GROWTH	0.06	No Causality
	GROWTH	0,36	No Causality		ΔLRESERVE	1.80	No Causality		ΔLRESERVE	1.17	No Causality
ΔLDEBT	GROWTH	1,54	No Causality	INF	ΔLDEBT	0.45	No Causality				
	ΔLSAVING	0,03	No Causality		ΔLSAVING	0.38	No Causality				
	ΔLUNEMP	4.82**	There is Causality		ΔLUNEMP	1.01	No Causality				
	INF	1.43	No Causality		GROWTH	0.29	No Causality				
	ΔBALANCE	3.42*	There is Causality		ΔBALANCE	0.08	No Causality				
	ΔLUSD	11.61***	There is		ΔLUSD	3.93**	There is				

			Causality				Causality				
	ΔLRESERVE	3.70 *	There is Causality		ΔLRESERVE	0.00	No Causality				

Source: Authors' calculations

*, ** and ** indicate rejection of the null hypothesis at the 90%, 95% and 99% significance level, respectively.

According to the Table 13;

There are one-way causality relationships between the following variables; from DLSAVING to GROWTH at 95% significance level; from DLUNEMP to DLDEBT at 95% significance level; from DLUSD to DBALANCE at 99% significance level; to INF at 95% significance level; from DLRESERVE to DLDEBT at 90% significance level.

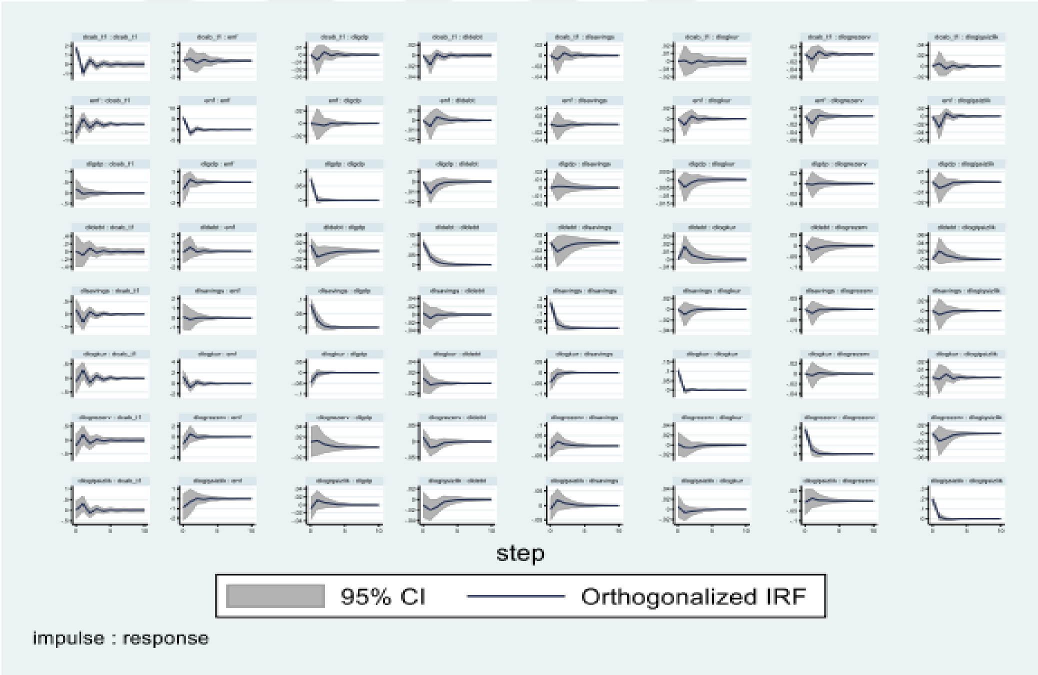
And, there are bidirectional causality relationships between DLUSD-DLDEBT variables.

When the tables showing the causality relationships between the variables in the model of BIIST and AQEPT countries are examined, the variables are listed as follows from external to internal and the analyzes are continued in this order.

1. BIIST: DLDEBT, INF, DLUNEMP, DBALANCE, DLUSD, DLRESERVE, DLSAVING, GROWTH

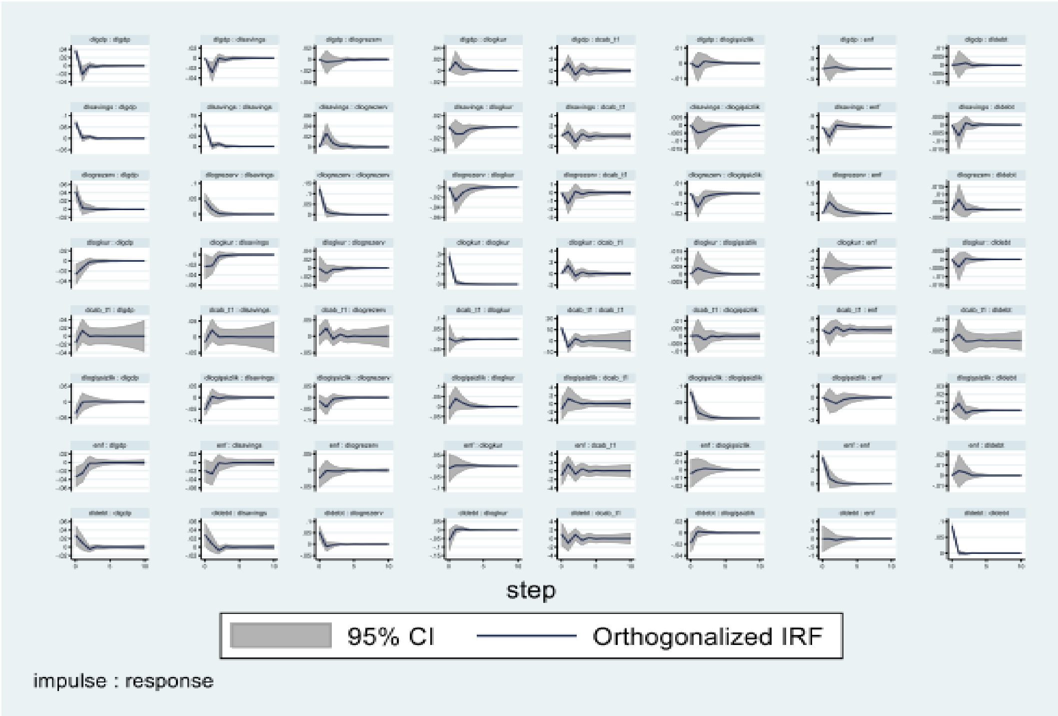
2. AQEPT: DLUNEMP, DLRESERVE, DLUSD, DLSAVING, DLDEBT, GROWTH, INF, DBALANCE, DLRESERVVE, DLUSD, DLSAVING, DLDEBT, GROWTH

Figure 1. Panel VAR Impulse-Response Functions – BIIST



Source: Authors' calculations

Figure 2. Panel VAR Impulse-Response Functions – AQEPT



Source: Authors' calculations

Table 14. Variance Decomposition Analysis Results – BIIST

	ΔLDEBT	**INF**	**ΔLUNEMP**	**ΔBALANCE**	**ΔLUSD**	**ΔLRESERVE**	**ΔLSAVING**	**GROWTH**
ΔLDEBT	100	0	0	0	0	0	0	0
INF	0.01	99.99	0	0	0	0	0	0
ΔLUNEMP	4.4	0.30	95.28	0	0	0	0	0
ΔBALANCE	0.81	0.83	1.35	96.99	0	0	0	0
ΔLUSD	4.53	0.11	0.11	0.02	95.20	0	0	0
ΔLRESERVE	14.82	3.27	1.17	0.03	0.01	80.67	0	0
ΔLSAVING	4.89	2.25	17.09	1.67	3.16	11.13	59.78	0
GROWTH	6.25	9.52	10.92	2.15	5.92	14.82	39.22	11.16

Source: Authors' calculations

According to the Figure 1 showing the impulse-response functions results for BIIST, the reaction of the other variables generally ends in the second or third period against the shock of 1 standard deviation in the GROWTH variable; It is seen that the response of the GROWTH variable generally ends in the third or fourth period, against a 1 standard deviation shock occurring in other variables. According the Figure 2 showing the impulse-response functions results for AQEPT, the reaction of the other variables to the 1 standard deviation shock that occurred in the GROWTH variable generally lasted until the fifth period and then ended; It is seen that the response of the GROWTH variable generally ends in the third period against the 1 standard deviation shock occurring in other variables.

In the first period, 11% of the change in the variance of the GROWTH variable is with the changes in itself, 39% with the changes in the DLSAVING variable, 14% with the changes in the DLRESERVE variable, 10% with the changes in the DLUNEMP variable, 9.5% with the changes in the INF variable, 6%, It is seen that 2 of them are explained by the changes in the DLDEBT variable, 5.9% by the changes in the DLUSD variable and 2.1% by the changes in the DBALANCE variable.

Table 15. Variance Decomposition Analysis Results – AQEPT

	ΔLUNEMP	**ΔLRESERVE**	**ΔLUSD**	**ΔLSAVING**	**ΔLDEBT**	**GROWTH**	**INF**	**ΔBALANCE**
ΔLUNP	100	0	0	0	0	0	0	0
ΔLRESERVE	0.05	99.94	0	0	0	0	0	0
ΔLUSD	0.34	0.05	99.60	0	0	0	0	0
ΔLSAVING	0.46	0.61	6.10	92.81	0	0	0	0
ΔLDEBT	0.75	1.51	0.73	0.15	96.83	0	0	0
GROWTH	0.62	0.80	14.41	45.61	1.59	36.94	0	0
INF	2.08	5.01	4.32	0.04	0.06	13.3	87.13	0
ΔBALANCE	0.01	1.10	0.41	0.90	0.01	10.6	7.69	88.81

Source: Authors' calculations

The first period of the change in the variance of the GROWTH variable is 36% with the changes, 45% with the changes in the DLSAVING variable, 14% with the changes in the DLUSD variable, 1.5% with the changes in the DLDEBT variable, 0.8% with the changes in the DLRESERVE variable, 0.6% are explained by changes in the DLUNEMP variable.

5. Conclusion

This study aims to make an econometric analysis of old and new fragile five countries, which are like each other in terms of their formation reasons and only Turkey is a partner country. Econometric analyzes of these country classifications will be made comparatively and all analysis results will be evaluated by comparing them according to country classifications. With this econometric comparison, the similarities, and differences of the aforementioned fragile five classifications will be seen econometrically.

When looking at the result of analyzes, the effects of the independent variables used in the analysis on the dependent differ in the countries included in BIIST and AQEPT. A change in one of the countries included in BIIST and AQEPT will affect other countries. All variables are stationary at the first difference. There is a time effect in the model created for BIIST and AQEPT countries. Considering the result of Levene, Brown and Forsythe test, both models are positive according to the Baltagi-Wu local best invariant (LBI) test, there is an autocorrelation problem. In addition, according to Friedman, the assumption of cross-section independence is not valid in both models. Due to Arellano, Froot and Rogers models, for BIIST: The variables DLSAVING, DLUNEMP and DLRESERVE are positive and significant, DLUSD and INF are negative and significant, but the DLDEBT and DBALANCE are insignificant on GROWTH. And also, the explanation rate of the change in the GROWTH variable of the BIIST countries by the independent variables in the model is calculated as 98%. For AQEPT: The variables DLSAVING and DLDEBT are positive and significant, DLRESERVE negative and significant. The DLUNEMP, INF, DBALANCE and DLUSD are insignificant on GROWTH. The explanation rate of the change in the GROWTH variable of the AQEPT countries by the independent variables in the model is calculated as 80%. Looking at the coefficients for BIIST, the variable DLSAVING causes the highest increase on GROWTH with 0.55%. The variable DLUSD causes the highest decrease on GROWTH with 0.09%. For AQEPT, the variable DLDEBT causes the highest increase on GROWTH with 0.67%.

This study cannot be compared with previous studies in this respect, as there has not been a study comparing the classifications of both countries before. In terms of the effects of variables on economic growth, this study can be compared with previous studies. The results found in the study are consistent with the results of previous studies.Sharaf, (2021) study results show a robust statistically significant negative long-run impact on economic growth stemming from both positive and negative external-debt-induced shocks. Gidigbi and Donga, (2020) study concluded that saving is relevant to economic growth and revealed that savings contribute positive effects to economic outputs when increased by a percentage. Ramzan, (2021) study results indicate that inflation and unemployment are statistically insignificant. Chugunov et al., (2021) study revealed that the inflation level has no significant influence on economic growth in the long run. Ameziane and Benyacoub, (2022) study results demonstrate that exchange rate volatility costs both directly and indirectly in terms of growth. Han, (2020) study results shows that exchange rate fluctuation has different effects on economic growth in different countries. Mohammadi, (2020) study results indicate that the exchange rate volatility has a negative and significant effect on the economic growth of countries.

Overall, the variables in the models of the BIIST and AQEPT country classifications generally have different coefficients from each other. In other words, although these two country classifications are created for "similar reasons", they do not yield results that are close to each other in terms of econometrics. And it is concluded that the fact that only "Turkey" is included in the revised fragile five classification as the 'economy that remain fragile" and all other countries is changed has caused the two fragile country classifications showed different results. Based on this, it is concluded that the revision of the fragile economies classification in 2017 does not conform to the classification in 2013, econometrically. A new classification of fragile economies is necessary. It is a suggestion of this study that future studies should work on "a different classification of fragile five". This *different* fragile five classification can be specified in several ways. The first fragile five classification was revised 4 years later. However, it is seen that this revision has countries with quite different characteristics from the previous classification. In other words, these country classifications do not resemble each other even at this stage. The econometric results of this study also prove this situation. It is a suggestion of this study that policy providers make a fragile five classification with countries with similar characteristics to the first classification.

REFERENCES

Aizenman, J., Binici, M., & Hutchison, M. M. (2014). *The transmission of Federal Reserve tapering news to emerging financial markets* (No. w19980). National Bureau of Economic Research.

Akel, V., Kandır, S., & Yavuz, Ö. S. (2016). Dynamic relationship between stock prices and exchange rates in emerging markets: Evidence from fragile five economies. In *International Business: Concepts, Methodologies, Tools and Applications* (pp. 2257-2273). IGI global.

Ameziane, K., & Benyacoub, B. (2022). Exchange Rate Volatility Effect on Economic Growth under Different Exchange Rate Regimes: New Evidence from Emerging Countries Using Panel CS-ARDL Model. *Journal of Risk and Financial Management*, *15*(11), 499.

Arellano, M. (1987). Computing robust standard errors for within-groups estimators. *Oxford bulletin of Economics and Statistics*, *49*(4), 431-434.

Awokuse, T. O., & Bessler, D. A. (2003). Vector autoregressions, policy analysis and directed acyclic graphs: an application to the US economy. *Journal of Applied Economics*, *6*(1), 1-24.

Baltagi, B. H. (2005). Econometric analysis of Panel data 3rd Edition England JW &Sons. *Vol., No., hlm*.

Batrancea, L., Rathnaswamy, M. K., & Batrancea, I. (2022). A panel data analysis on determinants of economic growth in seven non-BCBS Countries. *Journal of the Knowledge Economy*, *13*(2), 1651-1665.

Bhattarai, S., Chatterjee, A., & Park, W. Y. (2021). Effects of US quantitative easing on emerging market economies. *Journal of Economic Dynamics and Control*, *122*, 104031.

Breusch, T. S., & Pagan, A. R. (1980). The Lagrange multiplier test and its applications to model specification in econometrics. *The review of economic studies*, *47*(1), 239-253.

Cahyadin, M., & Ratwianingsih, L. (2020). External debt, exchange rate, and unemployment in selected ASEAN countries. *Jurnal Ekonomi & Studi Pembangunan*, *21*(1), 16-36.

Canova, F., & Ciccarelli, M. (2013). Panel Vector Autoregressive Models: A Survey☆ The views expressed in this article are those of the authors and do not necessarily reflect those of the ECB or the Eurosystem. In *VAR models in macroeconomics–new developments and applications: Essays in honor of Christopher A. Sims*. Emerald Group Publishing Limited.

Chugunov, I., Pasichnyi, M., Kaneva, T., Nepytaliuk, A., & Koroviy, V. (2021). The Influence of Inflation Targeting on Economic Growth in the OECD and Developing Countries. *Montenegrin Journal of Economics*, *17*(2), 173-186.

Enders, W. (2008). *Applied econometric time series*. John Wiley & Sons.

Froot, K. A. (1989). Consistent covariance matrix estimation with cross-sectional dependence and heteroskedasticity in financial data. *The Journal of Financial and Quantitative Analysis. 24*(3), 333-355.

Gidigbi, M. O., & Donga, M. (2020). Impact of savings on economic growth in Africa. *The Economics and Finance Letters*, *7*(2), 136-147.

Granger, C. W. (1969). Investigating causal relations by econometric models and cross-spectral methods. *Econometrica: journal of the Econometric Society*, 424-438.

Greene, W. H. (1993). Econometric Analysis 2nd Edition Macmillan. *New York*.

Grossmann, A., Love, I., & Orlov, A. G. (2014). The dynamics of exchange rate volatility: A Panel VAR approach. *Journal of International Financial Market. Institutions and Money. 33*, 1-27.

Gujarati, D. N. (1995). Basic econometrics, New York: MacGraw-Hill. *Inc. 838p*.

Han, Y. (2020, July). The Impact of Exchange Rate Fluctuation on Economic Growth–Empirical Studies Based on Different Countries. In *4th International Symposium on Business Corporation and Development in South-East and South Asia under B&R Initiative (ISBCD 2019)* (pp. 29-33). Atlantis Press.

Hayaloğlu, P. (2015). The relationship between financial development and economic growth in fragile five countries: dynamic Panel data analysis. *Journal of Economic and Social Research. 11*(1), 131-144.

Helhel, Y. (2019). Stock market development and economic growth nexus in fragile five countries. *Journal of Business and Economic Studies. 7*(1), 19-29.

Hsiao, C. (2022). *Analysis of Panel data*. Cambridge university press.

Hussain, I., Hussain, J., Ali Khan, A., & Khan, Y. (2019). An analysis of the asymmetric impact of exchange rate changes on GDP in Pakistan: application of non-linear ARDL. *Economic research-Ekonomska istraživanja*, *32*(1), 3094-3111.

Javidiar, A., & Ekaputra, I. A. (2019). The dynamics of exchange rate and stock return before and after the FED policy normalization: Evidence from fragile five countries. *International Journal of Business Studies. 3*(2), 54-63.

Kamacı, A. (2019). The effects of income inquality on economic growth in new fragile five countries. *Fiscaoeconomia. 3*(3), 58-71.

Kumar, A., Mallick, S. K., & Sen, K. (2020). *Effects of productivity growth on domestic savings across countries: Disentangling the roles of trend and cycle* (No. 2020/155). WIDER Working Paper.

Lütkepohl, H., & Saikkonen, P. (1997). Impulse response analysis in infinite order cointegrated vector otoregressive processes. *Journal of Econometrics. 81*, 127-57.

Mohammadi, E., Kazerooni, A., & Asgharpur, H. (2020). The impact of exchange rate on economic growth under different exchange rate regimes (in selected countries developed and developing). *Quarterly Journal of Fiscal and Economic Policies*, *8*(29), 111-134.

Nazarı, A., & Dalırı, H. (2019). Threshold Effects Of Inflation On Growth İn D8 Countries: A Panel Smooth Transition Regression Approach. *Journal Of Quantıtatıve Economıcs (Quarterly Journal Of Economıcs Revıew)*, *15*(4), 1-20.

Öner, H. (2018). The causuality relationship between the fragile five countries stock markets indexes: An empirical analysis. *Journal of Economic Policy Researches. 5*(2), 152-166.

Panigrahi, S., Azizan, N., Sorooshian, S., & Thoudam, P. (2020). Effects of Inflation, Interest, and Unemployment Rates on Economic Growth: Evidence from ASEAN Countries. *ABAC Journal*, *40*(2).

Pesaran, M. (2004). General diagnostic test for cross sectional independence in Panel. *Journal of Econometrics*, *68*(1), 79-113.

Pesaran, M. H. (2007). Simple Panel unit root test in the presence of cross section dependence. *Journal of Applied Econometrics. 22*, 265-312.

Pesaran, M. H., & Yamagata, T. (2008). Testing slope homogeneity in large Panels. *Journal of Econometrics. 142*(1), 50-93.

Ramzan, M. (2021). Impact of Inflation and Unemployment on Economic Growth of Pakistan. *European Journal of Business and Management Research*, *6*(4), 282-288.

Rogers, W. (1994). Regression standard errors in clustered samples. *Stata technical bulletin*, *3*(13).

Sharaf, M. F. (2021). The asymmetric and threshold impact of external debt on economic growth: new evidence from Egypt. *Journal of Business and Socio-economic Development*.

Sims, C. A. (1980). Macroeconomics and reality. *Econometrica: journal of the Econometric Society*, 1-48.

Uddin, I., & Rahman, K. U. (2022). Impact of corruption, unemployment and inflation on economic growth evidence from developing countries. *Quality & Quantity*, 1-21.

Vu, Y. H., Nguyen, N. T., Nguyen, T. T., & Pham, A. T. (2019, January). The threshold effect of government's external debt on economic growth in emerging countries. In *International Econometric Conference of Vietnam* (pp. 440-451). Springer, Cham.

Yaffee, R. (2003). A primer for Panel data analysis. *Connect: Information Technology at NYU*, *8*(3), 1-11.

Yang, X., & Shafiq, M. N. (2020). The Impact of Foreign Direct Investment, Capital Formation, Inflation, Money Supply and Trade Openness on Economic Growth of Asian Countries. *iRASD Journal of Economics*, *2*(1), 25-34.

Zerarka, R., Belarbi, Y., & Bouchouk, S. (2022). public debt, inflation and their interaction effects on economic growth (case of middle income countries). *Revue Finance & marchés*, *9*(2), 31-50.

Živkov, D., Kovačević, J., & Papić-Blagojević, N. (2020). Measuring the effects of inflation and inflation uncertainty on output growth in the central and eastern European countries. *Baltic journal of economics*, *20*(2), 218-242.