Asian Economic and Financial Review, 2014, 4(11): 1485-1501

Asian Economic and Financial Review

journal homepage: http://www.aessweb.com/journals/5002

CROSS SECTIONAL DEPENDENCE AND COINTEGRATION ANALYSIS AMONG THE GDP-FOREIGN DIRECT INVESTMENT AND AGGREGATE CREDITS: EVIDENCE FROM SELECTED DEVELOPING COUNTRIES

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ABSTRACT

In this study; it is investigated that gross domestic product (GDP), foreign direct investment (FDI) and aggregate credits (CR) relationship of seven developing countries over the period of 1982-2010. Firstly, CD_{LM} tests were applied to detect the cross-sectional dependency. Then, SURADF and CADF tests were applied. According to cross-sectional augmented panel unit root test (CIPS) result that detect if the entire panel carries a unit root, is consistent with SURADF and CADF test results. Finally, cointegration is determined among GDP, FDI and CR in all cases via Westerlund (2007)) Error Correction and Westerlund and Edgerton (2007) Lagrange Multiplier (LM) Bootstrap panel cointegration tests.

Keywords: GDP, FDI, Aggregate credits, Cross-sectional dependency, Panel cointegration analysis, Non-stationary panels.

JEL Classification: C22, C33, E22, F41, F43.

1. INTRODUCTION

The contribution and the employment capacity increase in the country have positive effects on economic growth in terms of financing current account deficit by foreign direct investments (FDI). Capital inflow increases the supply of exchange and facilitates the position of Central Bank. That increases the effectiveness of other monetary policy tools. By this means, the economic sustainability is maintained, also price stability, which is main aim, is facilitated and helps to put economy under control. All these positive progresses bringing stability to the country that hosts direct capital flows, make foreign direct investments (short and long term) continue by increasing. That loop also strengths the performance of economic growth and accelerates the development of the country. The increasing demand of investment in the economy which both domestic and foreign investors are active in, affects the total demand of credits. Foreign direct investment, interaction between economic growth and total credits can be explained in this way.

The purpose of this study is to identify if there is a long term relation between foreign direct investment, economic growth and total credits in seven developing countries. This study is a cross-sectional dependency and cointegration analysis. It is thought that this study will contribute significantly to the literature due to the lack of studies examining these three variables for these countries. Unlike the previous empirical studies, the use of recent methods such as both unit root test and cointegration test increases the importance of the study. About the sections of the study, it is planned in this order: Second section forms the theoretical substructure. The data and econometric methodology are explained in third section. Empirical findings are mentioned in fourth section while the result and political suggestions are in the last section.

2. THEORETICAL SUBSTRUCTURE

The first step of economic liberalization process occurs at the globalization point of production: at this point, among the economies involving to this process – except major force situations or obligatory reasons such as protecting the producer – the amount limitations and prohibitions for import are removed and import and export procedures are done freely. The main reasons for this are the lack of natural resources in the country and price differentiation between international markets, which means that a country is able to import a product or a service cheaper than its own country. On other hand, the other part of the process of economic liberalization is the fact of international capital activity. The free-activity ability of international capital is dependent only if there are not any limitations (McKinnon, 1973; Shaw, 1973). This means that economies integrate completely to the process of financial liberalization. The free activity of the capital in international areas is possible in two ways. The first one is mobility of capital in short term, which also means hot money. The other one is foreign direct investments may affect the economic growth, employment and competitiveness among the firms. Clearly, these effects are more positive and permanent than short term capital flows (Bumann *et al.*, 2012).

In the liberalization process that is experienced in global markets, trade of products and services crossing the country borders also means internationalizing the production. The liberalization process occurring in foreign direct investment and international product and service mobility has strong effects on competition in markets. Amount limitations are able to cause national monopoly and oligopolies. The removal of amount limitations increases the number of companies in the market and makes them more competitive. Planning the amount limitations create also same effects. In many countries, it is seen that the number of companies are increased in order to make the sector more competitive. In this way, a lot for companies gain an international characteristic and show a better performance than expectations on growth (Giulietti and Sicca, 1999).

Foreign direct capital mobility internationalizes the competition as it gives the chance to the firms to cross the country. This makes companies have a better institutional structure in order to survive and move depending consumer choices as adaptation to innovation process. The liberalization of financial markets gives production competition a global identity and also moves the consumers to transnational areas. This means that the producers need to set their productions not only for the choices of consumers in their countries, but also consumers in other countries. In this way, total consumption increases with globalization (Garcia *et al.*, 2013). Total consumption could be met by more productions with increasing the level of income and also it could be met by credits. But in both situations, a rise in credits could be seen. The companies need bank credits except the owner's equity for production. In this respect, with the increase of foreign direct investments, the number of companies in the related country and strength of competition are increased and thus boosts growth rate and total credits (Fry, 1980; Keller, 1980; Blinder and Stiglitz, 1983).

Thereby, it is expected to be a relation between activities of direct capital inflow, economic growth and total credits in long term. Econometric results related to this topic are examined detailed in the section of empirical findings of the study.

3. LITERATURE REVIEW

While studies examining FDI, economic growth (GDP) and total credits all together are not seen in the literature, various studies examining the relations between FDI and GDP, FDI and credits and GDP and credits have been done.

In the result of panel data analyze which was applied in order to examine the relation between economic independence, direct capital investment and economic growth in 18 Latin American countries in the period of 1970–1999, Bengoa and Blanca (2003) concluded economic independence is positive for foreign direct investment in host countries and is in positive correlation with economic growth. Li and Liu (2005) also had the same result with Bengoa and Blanca (2003) with their study including 84 developed and developing countries in the period of 1970–1999. Beside these researches, (Eller *et al.*, 2006) found positive relation between foreign direct investments and economic growth after the study researching the effects of foreign direct investments on economic growth in 11 Central and South European countries for the period of 1996–2003. Adams (2009) reached the same result with Eller *et al.* (2006) in his study including 42 African countries in the period of 1990-2003. Kottaridi and Stengos (2010) used GMM method in order to examine 25 OECD countries and 20 non-member countries of OECD in the period of 1970–2004 and found that foreign direct investments have positive effects on economic growth in developed countries but they have nonlinear effects on economic growth in developing countries. And the last, Rodriguez and Bustillo (2011) concluded that there is a positive and significant relation between economic growth and foreign direct investment by applying panel data method to find factors affecting activities of foreign direct capital outflow for China and 36 host countries in the period of 1995–2009. As it could be understood from the literature, there is a strong relation between FDI and GDP. Beside FDI and GDP, there are also studies examining the relation between FDI and credits. Hegerty (2009) used VAR analyze for four countries that became members of EU later (Bulgaria, Lithuania, Latvia and Estonia) for the period of 1995–2008 and reached the result that the effects of foreign direct investments on credits differ between these four countries. Furceri *et al.* (2011) found the same result with Hegerty (2009) in his study for developed and developing countries. Furthermore, they found that capital flows affect credits positively in the first two years of capital inflow, but the effect became reversed in the midterm. It was also concluded that depending on the type of capital flows (portfolio investments, FDI or other investments), their effects distinguish.

4. DATA AND METHODOLOGY

In this study, the mutual relationships of GDP, FDI and Total Credits of 7 countries for their in the long term period of 1982-2010 is analyzed. This study covers these countries: Brazil, India, Indonesia, Mexico, Pakistan, Turkey and Argentina. GDP was percentage of growth rate in gross ddomestic product. FDI represented the ratio of net direct investment to GDP, CR was the ratio of total credit to GDP, and Nominal value and annual data related to these three variables were used in the study. Moreover, data were evaluated as a percentage of GDP. The series related to these countries were obtained from the electronic database of the World Bank, and the data of these countries were preferred according to their availability in the database. The data used in the study were as follows:

Table-1. Data Set

Variables	Explanations	Source
FDI	Foreign Direct Investment (%GDP)	World Bank
GDP	Growth Rate of Gross Domestic Product (%)	World Bank
CR	Total Credits (%GDP)	World Bank

4.1. Cross Sectional Dependence and Panel Unit Root Tests

In order to use panel unit root tests such as Levin *et al.* (2002), Breitung (2000), Im *et al.* (2003), Hadri (2000), Maddala and Wu (1999) and Choi (2001) which are also first generation unit root tests, cross-sectional dependency must not exist. If there is cross-sectional dependency in panel data, first generation unit root tests cannot be used. In this case, the second generation unit root tests like SURADF, CADF and CIPS which consider cross-sectional dependency are needed to use. Cross-sectional dependency could be explained in terms of econometric as units forming panel are related to error terms in panel data model which is given in the equation (1). In terms of economic, it could be explained that in a situation that units forming panel are affected by a shock, then the other units of panel are affected as well.

$$y_{it} = \alpha_i + \beta_i x_{it} + \varepsilon_{it} \tag{1}$$

$$Cov(\varepsilon_{it}, \varepsilon_{ij}) \neq 0$$

There are various tests in order to analyze cross-sectional dependency in panel data. In this study, tests which are developed by Breusch and Pagan (1980) CD_{LM1}, (Pesaran, 2004) CD_{LM2}, Pesaran (2004) CD_{LM} and Pesaran *et al.* (2008) are used.

CD_{LM1} test which is developed by Breusch and Pagan (1980) are calculated as below.

$$CD_{LM1} = T\sum_{i=1}^{N-1}\sum_{j=i-1}^{N}\hat{\rho}_{ij}^{2} \tag{2}$$

This test is based on the sum of correlation coefficient squares among cross section residuals which are obtained from OLS. This test which has N(N-1)/2 degree of freedom, is used when N is constant and T→∞. Null hypothesis and alternate hypothesis are mentioned below.

H_0 : No relations between cross sections.

H_1 : Relations exist between cross sections.

CD_{LM2} test which is another test to examine cross-sectional dependency is calculated as below.

$$CD_{LM2} = \sqrt{\frac{1}{N(N-1)}}\left[\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}T\hat{\rho}_{ij}\right] \sim N(0,1) \tag{3}$$

In this equation, $\hat{p}_{ij}^{2}$ shows the estimation of the sum of cross section residuals. The test which is used when N and T are great (T→∞ and N→∞) is asymptotically normal distribution.

CD_{LM} test which is also another test to examine cross-sectional dependency is calculated with the formula mentioned below.

$$CD_{LM} = \sqrt{\frac{2T}{N(N-1)}}\left[\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}\right] \sim N(0,1) \tag{4}$$

This test is based on the sum of correlation coefficient squares among cross section residuals. This test which is asymptotically standard normal distribution is used when T>N and N>T. The null and alternative hypothesis of this test is similar with CD_{LM1} and CD_{LM2} tests.

Lastly, CD_{LM1}adj test is modified version of CD_{LM1} test which is developed by Pesaran *et al.* (2008). This test is formulated as below.

$$CD_{LM1adj} = \frac{1}{CD_{LM1}}\left[\frac{(T-k)\rho_{ij}^{2}\mu T_{ij}}{\sqrt{v_{ij}^{2}}}\right] \sim N(0,1) \tag{5}$$

SURADF test which is developed by Breuer *et al.* (2002) is actually a regression of ADF. SURADF test whose critical values are found by bootstrap method, could be used when T>N. In this test which allows heterogeneity, the existence of unit root in units forming panel is tested. Thereby, there is no common effect in this test and a deduction about panel cannot be created. SURADF test under the null hypothesis expressing the existence of unit root could be calculated as below:

$$\Delta Y_{it} = \alpha_i + \beta_i Y_{i,t-1} + \delta_i t + \sum_{j=1}^{\rho_j} \phi_{ij} \Delta Y_{i,t-j} + u_{it} \qquad i = 1,2,...T \qquad (6)$$

where, ADF regression for every unit is taken. Later, the means of time are added to these regressions. After adding means of time, the general average is calculated. And the last, unit root for every root forming panel is tested.

CADF test is another test which considers cross-sectional dependency, except SURADF. This test which could be used when N>T also gives strong results when T>N. In CADF test which is developed by Pesaran (2006), bootstrap method is not used to calculate critical values. Instead of bootstrap, Monte Carlo simulation is applied. Because of this, the critical values for CADF test is obtained from table values of Pesaran. Another difference of this test from SURADF is that it is able to apply unit root test for every unit forming panel and for panel itself. In order to create a deduction from CADF test for panel, CIPS test is examined. The critical values in CIPS test are also taken from table values of Pesaran (2006). CADF test could be calculated as below:

$$\Delta Y_{it} = \alpha_i + b_i Y_{i,t-1} + \sum_{j=1}^{\rho i} c_{ij} \Delta Y_{i,t-j} + d_i t + h_i \bar{Y}_{t-1} + \sum_{j=0}^{\rho i} \eta \Delta \bar{Y}_{t-1} + \varepsilon_{i,t} \qquad i = 1,2,...,t \qquad (7)$$

In this equation, α_i is constant, t is trend, $\Delta \bar{Y}_{t-1}$ is lags of differences and $\bar{Y}_{t-1}$ is the value of one term lag of $\bar{Y}_t$, respectively. Null and alternative hypotheses for CADF testing are as follows:

$H_0 = \beta_1 = \beta_2 = ...\beta_n$ (Series include unit root)

$H_A =$ At least one is different than zero (Series are stationary)

4.2. Panel Cointegration Tests

In this study, Westerlund (2007) Panel Error Correction cointegration tests and Westerlund and Edgerton (2007) LM Bootstrap Panel Cointegration tests are applied.

4.2.1. Error Correction in Panel Cointegration Test

This test provides an error term based on cointegration test for panel data. This test of Westerlund (2007) gives strong results in small samples. This test could be used both in existence and non-existence of cross-sectional dependency. Bootstrap distribution is used when cross-sectional dependency exists while standard asymptotically normal distribution is used when it does not exist. In addition to that, this test could be used when series are;

$y \rightarrow I(1)$ and $\forall X' \rightarrow I(1)$.

There are 4 test types in error correction panel cointegration test. Two of them are panel statistics and the other two are group statistics. Panel statistics give an option to create deduction for panel itself while group statistics make deduction for individual forming panel possible. According to this, panel and group hypotheses are as follows:

Panel statistics;

$H_0 : \alpha_i = 0$ Cointegration does not exist for $\forall i'$

$H_A : \alpha_i = \alpha < 0$ Cointegration exist for $\forall i'$

Group statistics;

$H_0 : \alpha_i = 0$ Cointegration does not exist for $\forall i'$

$H_A : \alpha_i < 0$ Cointegration exists for some units, but for some it does not exist.

Panel error correction cointegration test is parametric in two of these four tests and non-parametric for other two of them. Lag length of series in parametric tests is needed. In addition, when sample in parametric tests are small and a lot of parameters are estimated, deviation in results could be obtained. Error correction panel cointegration model could be created as follows:

$$\Delta y_{it} = \delta'_i d_t + \alpha_i (y_{i,t-1} - \beta_i ' x_{i,t-1}) + \sum_{j=1}^{\rho i} \alpha_{ij} \Delta y_{i,t-j} + \sum_{j=0}^{\rho i} \theta_{ij} \Delta x_{it-j} + e_{it} \qquad (8)$$

In this equation, d_t, δ', α_i show deterministic composition, vector parameters and error correction parameter, respectively. They could be estimated with error correction model $\left(y_{i,t-1} - \beta_i ' X_{i,t-1}\right)$.

Equation (8) could be parameterized again and explained as follows:

$$\Delta y_{it} = \delta'_i d_t + \alpha_i y_{i,t-1} + \lambda'_i x_{i,t-1} + \sum_{j=1}^{\rho i} \alpha_{ij} \Delta y_{i,t-j} + \sum_{j=0}^{\rho i} \theta_{ij} \Delta x_{it-j} + e_{it} \qquad (9)$$

Group Statistics;

Group mean statistic is formed by three stages. At the first stage, equation (9) is estimated with OLS for every unit in the panel:

$$\Delta y_{it} = \hat{\delta}'_i d_t + \hat{\alpha}_i y_{it-1} + \hat{\lambda}'_i x_{it-1} + \sum_{j=1}^{pi} \hat{\alpha}_{ij} \Delta y_{it-j} + \sum_{j=0}^{pi} \hat{\gamma}_{ij} \Delta x_{it-j} + \hat{e}_{it} \qquad (10)$$

In equation (10), ρ_i which shows lag length, is allowed to differ from unit to unit.

At the second stage in group statistic, ρ_i which is error correction parameter is estimated:

$$\alpha_i(1) = 1 - \sum_{j=1}^{\rho t} \alpha_{ij} \tag{11}$$

The natural way to do this calculation is to use parametric method and parametric method is estimated by the formula mentioned below:

$$\tilde{\alpha}_i(1) = 1 - \sum_{j=1}^{\rho t} \hat{\alpha}_{ij} \tag{12}$$

Due to parametric method which leads deviation in results in small samples, an ambiguity occurs while estimating parameters that are affected by its own deferred values (Autoregressive). Thereby, an alternative way is needed. This alternative approach is called Kernel approach. It is formulated as follows:

$$(\hat{\omega})^2_{yi} = \frac{1}{T-1} \sum_{j=-M_i}^{M_i} \left(1 - \frac{j}{M_i+1}\right) \sum_{t=j+1}^{T} \Delta y_{it} \Delta y_{it-j} \tag{13}$$

In equation (13), M_i shows band with parameter expressing covariance number in Kernel approach $(\hat{\omega})^2_{yi}$ shows long term variance of Δy_{it}. Δy_{it} is expressed as $(\hat{\omega})^2_{ui} / (1)^2$. $(\hat{\omega})^2_{ui}$ shows long term variance of error term. In this way, alpha (1) could be estimated easily by using $\alpha_i(1)\hat{\omega}_{ui} / \hat{\omega}_{yi}$. Equation (14) is obtained by applying $\hat{\omega}_{ui}$ together with Δy_{it}.

$$\hat{u}_{it} = \sum_{j=0}^{\rho t} \hat{\gamma}_{ij} \Delta x_{it-j} + \hat{e}_{it} \tag{14}$$

In this equation $\hat{\gamma}_{ij}$ and $\hat{e}_{it}$ are obtained from Equation (9) $\alpha_i(1)$ which is semi-parametric Kernel estimator becomes $\hat{\alpha}_i(1)$.

At the last stage in group statistic, test statistic is calculated by the formula mentioned below:

$$G_t = \frac{1}{N} \sum_{i=1}^{N} \frac{\hat{\alpha}_i}{SE(\hat{\alpha}_i)} \qquad G_\alpha = \frac{1}{N} \sum_{i=1}^{N} \frac{T\hat{\alpha}_i}{\hat{\alpha}_i(1)} \tag{15}$$

In the equation (15), SE shows conventional standard error of $\hat{\alpha}_i$.

Panel Statistics:

There are three stages in panel statistics.

First stage is the same with group statistics.

$$\Delta\tilde{y}_{it-1} = \Delta y_{it} - \hat{\delta}' d_t + \hat{\lambda}_i' x_{i,t-1} + \sum_{j=1}^{\rho i} \hat{\alpha}_{ij} \Delta y_{i,t-j} + \sum_{j=0}^{\rho i} \hat{\gamma}_{ij} \Delta x_{it-j} \quad (16)$$

$$\Delta\tilde{y}_{it-1} = \Delta y_{it-1} - \hat{\delta}'_i d_t + \hat{\lambda}_i' x_{i,t-1} + \sum_{j=1}^{\rho i} \hat{\alpha}_{ij} \Delta y_{i,t-j} + \sum_{j=0}^{\rho i} \hat{\gamma}_{ij} \Delta x_{it-j} \quad (17)$$

Second stage includes common error term parameter (α) and $\Delta\tilde{y}_{it}$ and $\Delta\tilde{y}_{it-1}$ which estimates standard error:

$$\hat{\alpha} = \left(\sum_{i=1}^{N} \sum_{t=1}^{T} \tilde{y}_{it}^2 \right)^{-1} \sum_{i=1}^{N} \sum_{t=2}^{T} \frac{1}{\hat{\alpha}_i(1)} \tilde{y}_{it-1} \Delta\tilde{y}_{it} \quad (18)$$

Calculation of standard error of $\hat{\alpha}$ is expressed below:

$$SE(\hat{\alpha}) = ((\hat{S}_N^2)^{-1} \sum_{i=1}^{N} \sum_{t=2}^{T} \tilde{y}_{it-1}^2)^{-1/2} \quad (19)$$

$\hat{S}_N^2$ is calculated as follows:

$$\hat{S}_N^2 = \frac{1}{N} \sum_{i=1}^{N} \hat{S}_i^2 \quad (20)$$

The third stage in panel statistics is calculation of panel statistics. This calculation is made by the formula given below.

$$p_t = \frac{\hat{\alpha}}{SE(\hat{\alpha})} \text{ and } p_\alpha = T\hat{\alpha} \quad (21)$$

4.2.2. LM Bootstrap Panel Cointegration Test

Similar to Westerlund error correction panel cointegration test Westerlund and Edgerton (2007) test could be used both in existence and non-existence of cross-sectional dependency. This test allows autocorrelation differ from cross section to another cross section. In addition, it assumes the matrix of variance – covariance as omega. In this test, bootstrap method is used in existence of cross-sectional independency while McCoskey and Kao (1998) are used in non-existence of it. Unlike Westerlund error correction test, it tests cointegration under null hypothesis.

If it is assumed that there is a panel data model as follows:

$$y_{it} = \alpha_i + x'_{it} \beta_i + Z_{it} \quad (22)$$

$$Z_{it} = u_{it} + v_{it}$$

$$v_{it} = \sum_{j=1}^{t} \eta_{ij}$$

$$w_{it} = \sum_{j=0}^{\infty} \alpha_{ij} e_{it-j} \qquad (23)$$

After explaining the model above, in case of non-existence of cross-sectional dependency, hypothesis test could be done by LM test as below:

$$LM^{+}_{NT^2} = \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{\omega}_{it}^{-2} S_{it} \qquad (24)$$

S_{it} is part of Z_{it} process which is an full modified estimation of Z_{it}, while $\hat{\omega}_{it}^{2}$ is an estimation of long term variance (u_{it}).

In case of existence of cross-sectional dependency, LM test gives deviations in results. It is also detected that asymptotically standard normal distribution is very sensitive to serial correlation. To overcome this problem, bootstrap method is used instead of asymptotically standard normal distribution.

Bootstrap method follows autoregressive process as follows:

$$\sum_{j=0}^{\infty} \phi_{ij} w_{it-j} = e_{it} \qquad (25)$$

The first stage in our bootstrap scheme is to estimate ϕ_{ij} in equation (25) using $\hat{w}_{it} = (\hat{z}_{it}, \Delta x'_{it})'$ instead of w_{it} and ρ_i lags. We can then to compute the residuals:

$$\hat{e}_{it} = \sum_{j=0}^{\infty} \hat{\phi}_{ij} w_{it-j} \qquad (26)$$

At the second stage, e_t^* is obtained from empirical distribution on residuals $\hat{e}_t - \frac{1}{T}\sum_{j=1}^{T} \hat{e}_j$.

After that, instead of $\hat{w}_{it}$ and $\hat{e}_{it}$ in the equation (26), e_{it}^* and w_{it}^* are used in order to obtain e_t^* and w_{it}^*. And at the last stage, w_{it}^* is separated as $w_{it}^* = (z_{it}^*, \Delta x_{it}^*{}')'$ and bootstrap samples which are x_{it}^* and y_{it}^* formed by following the process mentioned below:

$$y_{it}^{*} = \hat{\alpha}_i + x_{it}^{*}{}'\hat{\beta}_i + z_{it}^{*} \text{ and } x_{it}^{*} = \sum_{j=1}^{1} \Delta x_{ij}^{*} \quad (27)$$

5. EMPIRICAL FINDINGS

The CD_{LM} tests were applied prior to panel unit root test, in order to detect cross-sectional dependency among variables. Test results are shown in Table 2.

Table-2. Cross Section Dependence Test Results of the Variables

Variables	CD_{LM1}		CD_{LM2}		CD_{LM}		CD_{LM1adj}	
	t-stat	**p-value**	**t-stat**	**p-value**	**t-stat**	**p-value**	**t-stat**	**p-value**
GDP	32.426	0.053	1.763	0.039	-3.022	0.001	1.798	0.036
CR	33.546	0.041	1.936	0.026	-1.893	0.029	4.251	0.000
FDI	51.004	0.000	4.630	0.000	-2.717	0.003	6.321	0.000

The p-values of GDP, Credits and FDI are statistically significant in these 4 test results as shown in Table-2. Therefore, the null hypothesis of these 3 series which claims the absence of cross section dependence is rejected.

Levin *et al.* (2002), Breitung (2000), Im *et al.* (2003), Hadri (2000), Maddala and Wu (1999) and Choi (2001) claim that cross section independence should be in place in order to apply the panel unit root tests. On the other hand, SURADF, CADF and CIPS panel unit root tests can be used in case of cross section dependence. Hence, SURADF, CADF and CIPS test were used in order to analyze the stationary characteristics of GDP, Credits and FDI series.

Table-3. SURADF and CADF Test Results for CR

Countries	SURADF	0.01	0.05	0.1	*p*	Countries	CADF	*p*
Brazil	-2.981	-6.297	-5.055	-4.553	1	Brazil	-2.207	1
India	-1.562	-6.357	-5.245	-4.764	3	India	-0.458	3
Indonesia	-4.300	-7.052	-5.600	-4.961	1	Indonesia	-2.832	1
Mexico	-2.501	-5.265	-4.281	-3.826	2	Mexico	-2.646	2
Pakistan	-2.414	-6.283	-5.196	-4.734	1	Pakistan	-1.129	1
Turkey	-2.390	-6.369	-5.333	-4.844	1	Turkey	-0.3908	1
Argentina	-3.004	-4.855	-3.395	-2.498	4	Argentina	-1.601	4

Notes: ***, ** and * stand for significance at 1, 5 and 10% levels, respectively. The critical values for the SURADF test were generated using Monte Carlo simulations with 10 000 replications. The lag lengths (p) are selected according to Schwarz information criterion. The critical values for the CADF test were obtained from Pesaran (2006), Case III Intercept and Trend. CIPS statistic for all countries is-1.609, critical values of CIPS test at 1, 5 and 10% significance levels are -3.12, -2.87 and -2.73.

Since t-statistics values of all units that form the panel are lower than the critical values according to SURADF and CADF test results for Total Credit Series, the null hypothesis suggesting the existence of unit root cannot be rejected. Therefore, there is no stationary structure in any of the countries forming the panel according to the test result.

SURADF and CADF tests apply unit root test for every individual country that forms the panel whereas the CIPS test applies the unit root test for the entire panel combining the countries. The CIPS test results for Total Credit Series is depicted at Table 3's footnote. Since the CIPS statistics value is smaller than Pesaran (2006) table value, the null hypothesis which suggests that the series contain a unit root cannot be rejected. Thus, total credit series formed by all seven countries, does carry a unit root. The tests applied to total credit series also applied to FDI series as well.

Table-4. SURADF and CADF Test Results for FDI

Countries	**SURADF**	**0.01**	**0.05**	**0.1**	***p***	**Countries**	**CADF**	***p***
Brazil	-2.948	-6.402	-5.094	-4.542	3	Brazil	-1.220	3
India	-3.191	-6.669	-5.373	-4.797	1	India	-1.628	1
Indonesia	-2.830	-6.459	-5.207	-4.656	1	Indonesia	-2.347	1
Mexico	-0.6897	-7.172	-5.687	-5.107	3	Mexico	-0.648	3
Pakistan	-3.928***	-0.967	-0.678	-0.487	5	Pakistan	-0.670	5
Turkey	-4.793	-7.187	-5.742	-5.114	1	Turkey	-2.532	1
Argentina	-3.957	--6.637	-5.615	-5.018	2	Argentina	-2.054	2

Notes: ***, ** and * stand for significance at 1, 5 and 10% levels, respectively.

The critical values for the SURADF test were generated using Monte Carlo simulations with 10000 replications.

The lag lengths (p) are selected according to Schwarz information criterion.

The critical values for the CADF test were obtained from Pesaran (2006), Case III Intercept and Trend.

CIPS statistic for all countries is -1.586, critical values of CIPS test at 1, 5 and 10% significance levels are -3.12, -2.87 and -2.73.

FDI series is 1% significant in Pakistan according to SURADF test. The series is statistically insignificant for the rest of the countries that form the panel. Besides, the same series is statistically insignificant for all the countries based on CADF test results. Therefore, FDI series only stationary for Pakistan and contain a unit root for the rest of the countries. According to the results of CIPS test that is shown at Table 4, CIPS statistics value is smaller than the critical value which means that the null hypothesis cannot be rejected and FDI series contain unit root for the countries that forms the panel. Finally, the GDP unit root test results are depicted at Table-5.

Table-5. SURADF and CADF Test Results for GDP

Countries	**SURADF**	**0.01**	**0.05**	**0.1**	***p***	**Countries**	**CADF**	***p***
Brazil	-3.745	-6.210	-5.219	-4.724	2	Brazil	-3.116	2
India	-4.089	-5.913	-4.889	-4.432	1	India	-3.910**	1
Indonesia	-3.753	-5.597	-4.539	-4.069	1	Indonesia	-2.904	1
Mexico	-3.963	-6.157	-5.126	-4.672	1	Mexico	-2.578	1
Pakistan	-4.165	-6.658	-5.644	-5.107	1	Pakistan	-2.793	1
Turkey	-3.902	-6.592	-5.601	-5.022	2	Turkey	-2.132	2
Argentina	-4.030	-5.747	-4.719	-4.254	1	Argentina	-3.957**	1

Notes: ***, ** and * stand for significance at 1, 5 and 10% levels, respectively. The critical values for the SURADF test were generated using Monte Carlo simulations with 10000 replications. The lag lengths (p) are selected according to Schwarz information criterion. The critical values for the CADF test were obtained from Pesaran (2006), Case III Intercept and Trend. CIPS statistic for all countries is -2.056 critical values of CIPS test at 1, 5 and 10% significance levels are -3.20, -2.87 and -2.73.

The GDP series is statistically insignificant for all the countries based on SURADF test applied to the panel that is shown at Table-5. However, GDP series is 5% significant for India and Argentina according to CADF test results, but insignificant for the remaining. It is insignificant based on CIPS test results which is shown at the footnote of Table-5. Therefore, the null hypothesis which suggests the existence of unit root cannot be rejected.

After applying the unit root test of the variables studied in the article, the cointegration relationship of the model is analyzed. Before applying the cointegration test, one has to analyze the cross section dependence of the model. Table 6 depicts the cross-sectional dependency test results of the model in which GDP is dependent variable, total credits and FDI are the explanatory variables.

Table-6. Cross Sectional Dependency Test Results of the Model

	t-statistics	**p-value**
CD_{LM1}	4.281	0.507
CD_{LM2}	0.839	0.452
CD_{LM}	3.602	0.006
CD_{LM1adj}	1.840	0.101

According to Table 6, p-values are statistically insignificant for all the test results except for CD_{LM} test. CD_{LM} could be used when N>T. The other 3 tests could be used when T>N. Since T>N in our study, CD_{LM} should be neglected. Therefore, it is safe to claim that there is cross section dependence in our model.

In order to use Pedroni (1995;1999), Kao (1999), Westerlund (2005) Panel CUSUM cointegration tests, there shouldn't be a cross-sectional dependency in a model. Although there is no cross-sectional dependency, following panel cointegration tests designed by Westerlund (2007) and LM Bootstrap panel cointegration test designed by Westerlund and Edgerton (2007) was used in our study. These two tests can be used in both cases of cross-sectional dependency and independence. Besides, these tests allow heterogeneity among the units forming the panel. Therefore, they are more comprehensive than Pedroni (1995;1997;1999), Kao (1999), Westerlund (2005) Panel CUSUM tests.

Table-7. Error-Correction Panel Cointegration Test Results

Test	*t-stat.*	$p\ value^a$	$p\ value^b$
G_τ	-74.125	0.000	*0.650*
G_α	-0.549	0.000	*0.610*
p_τ	-12.112	*0.046*	*0.560*
p_α	-4.410	*0.024*	*0.290*

Note: All tests are applied constant and with trend. a indicates the tests where p-values are asymptotic normal distribution. b indicates the tests that has a p-value based on bootstrap method. In this study, 10.000 bootstrap repeats are used.

As mentioned in the previous sections, bootstrap method can be used when there occurs cross section dependence in a model. In its absence, asymptotic standard distribution is valid. According to bootstrap method, both the groups and the panel are statistically insignificant. According to the asymptotic standard distribution, both the groups and the panel statistics are statistically significant. Thus, the null hypothesis of no-cointegration is rejected in asymptotic distribution although it is not rejected in bootstrap method. In our model, the result of the asymptotic standard distribution is taken into consideration since there is no cross-sectional dependency in the model. In this context, one can draw a conclusion that there is a cointegration in our model and the GDP, FDI and total credit series are related in the long run.

Table-8. LM Bootstrap Cointegration Test Results

LM statistic	Asymptotic p-value	Bootstrap p-value
0.889	0.187	0.540

The bootstrap p-value was generated with 10.000 replications. This model was arranged as a constant and trend mod.

LM Bootstrap panel cointegration test results are consistent with the results of Error Correction panel cointegration test. Therefore, it can be stated that the GDP, FDI and total credit relationship is significant in the countries that were used in this study.

6. CONCLUSION

Develop a new understanding the role played by total credits on FDI is important for policy makers on the purpose of calculate intense monetary policies concerning the interest rate into the country. This paper investigates the relationship between GDP, FDI and total credits in Brazil, India, Indonesia, Mexico, Pakistan, Turkey and Argentina countries by employing yearly data from 1982 to 2010. In order to determine the stationary characteristics the variables in question, we employ CADF, SURADF and CIPS tests approaches. We also employ panel cointegration methodology developed by Westerlund (2007), to distinguish long run impacts of variables on each other to get more appropriate results. Test empirical results imply a number of key findings: (*i*) According to cross-sectional dependency test results the absence of cross-sectional dependency is rejected (*ii*) CADF and SURADF tests there is no stationary structure in any of countries (*iii*) CIPS test results imply total credit, FDI and GDP series include unit root (*iv*) Panel cointegration test results imply GDP, FDI and total credit series are related in the long run. First of all findings of this study supports total credits are an important indicator for GDP growth and determinant of FDI in each country. And also social and economics similarities, economists use acronym BRIC-T to refer Brazil, China, India and Turkey. Because of its economic structure as well as the period of transition to global economy like such as Indonesia, Mexico and Pakistan. The panel cointegration analyses imply that a change in total credits affects FDI and so GDP growth and aggregate supply. In other words, long run stable relationships between the variables exist. The existence of cointegration in these countries supports New Growth Theory's foreign trade arguments implying short run effectiveness of policy actions on real activity henceforth total credits in this case and long run effectiveness of policy actions on GDP growth.

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