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# IMPACT OF STRUCTURAL BREAKS PRESENCE ON ECONOMIC DEVELOPMENT OF EMERGING COUNTRIES

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***Abstract***

*The panel group of 21 emerging countries is examined in the paper by employing the growth model. The impact of financial development and trade openness on economic development of emerging countries is estimated for the period 1995-2013 on the quarterly basis. The paper examines the presence of structural breaks in series and how the impact on financial development and trade openness on economic growth of emerging countries varies in the presence of structural shifts. Recent panel techniques are employed in this study, such as the Westerlund (2006) panel cointegration test and Im et al. (2005) unit root test that allow presence of structural shifts. Estimation results demonstrated that exposion of emerging countries to structural shifts significantly decrease the impact of financial development and trade openness on economic development.*

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***Key Words:*** *Economic growth, financial development, trade openness, emerging markets, cointegration test, structural shifts.*

## 1. Introduction

The neoclassical and endogenous growth theories aimed to explain the correlation between economic growth and financial development by analyzing financial liberalization and trade openness since the last decades. Solow (1956) indicated that the policy change did not influence long-run economic growth. As stated in the endogenous growth theory literature financial development may lead to long-run economic growth

(Romer (1986), Lucas (1988), Rebelo (1991), Grossman and Helpman (1991), Pagano (1993), Khan (2001)). Financial development increases economic growth (Bagehot (1873), Schumpeter (1934), Hicks (1969), McKinnon (1973), Shaw (1973), and Claessens and Laeven (2005)). Economic growth may be triggered by increasing the pace of financial liberalization (Bekaert and Harvey (2000), Bekaert et al. 2001, 2002, and 2005). According to Blackburn and Hung (1998) economic growth is not affected by financial development and trade liberalization.

The endogenous growth theory states that in the long run economic growth may be achieved through policy changes. Financial development may create capital accumulation, technological innovation, and efficient allocation of resources (Menyah, Nazlıoğlu, and Wolde-Rufael, 2014). Trade openness and policies utilize competition, economies of scale, increasing inputs and production, capacity utilization, and spillover effects to influence the economy. Higher human capital, increasing returns on investment and savings rate raise the aggregate output levels in financially developed economies (Kar, Peker, and Kaplan, 2008). Rajan and Zingales (2003) suggest that financial development stems from higher levels of capital flows and trade. Trade openness and financial development are positively correlated in the long-run (Kim et al., 2010). Financial development increases net exports (Wolde-Rufael, 2009).

Levine (2003) states that financial development may increase the returns to saving and decrease risk; thereby decreasing savings and in turn economic growth. Robinson (1952) indicated that financial development is led by economic growth. Lucas (1988) stated that the role of finance on economic growth is overemphasized. Schumpeter (1934) argued that financial development increases economic growth through efficient allocation of resources that leads to technological innovations. Patrick (1966) suggested the demand following hypothesis, and the supply leading hypothesis. The direction of causality has four categories: (i) supply leading hypothesis - unidirectional causality from financial development to economic growth, (ii) demand following hypothesis - unidirectional causality from economic growth to financial, (iii) bidirectional causality between economic growth and financial development, and (iv) neutral hypothesis - no causality between financial development and economic growth.

The relationship between economic growth and financial development is analyzed in studies that utilize Granger causality tests, cross-section analysis (Goldsmith (1969), Atje and Jovanovic (1993), King and Levine (1993a and 1993b), Levine and Zervos (1998)), panel time-series analysis (Levine, 2005), panel GMM estimation (Levine, Loayza, and Beck, 2000; Beck, Levine, and Loayza, 2000) with fixed and random effects estimators (Hsiao et al., 1989; Pesaran and Smith, 1995; Weinhold, 1999; Nair-Reichert and Weinhold, 2001), and panel cointegration analysis (Neusser and Kugler, 1998; Christopoulos and Tsionas, 2004). Trade and financial liberalizations lead to economic growth (Roubini and Sala-i-Martin, 1991). Higher economic growth rates are witnessed in well-functioning financial markets of the developed and developing countries (Hassan et al., 2011, Kar et al., 2011).

Panel data causality test assuming slope heterogeneity is applied by Hurlin (2008). Bai and Kao (2006) indicate that the assumption of cross-sectional independence may not be satisfied by panel data which may create biased and inconsistent results. Konya (2006) assumes cross-sectional dependency and coefficient heterogeneity using a panel Granger causality test for 24 OECD countries between 1960 and 1997 based on SUR systems and Wald tests for two models. The bivariate model analyzes the GDP and exports relationship and the trivariate model studies the relationship between GDP, exports, and openness. Authors find one-way causality: (i) test results for the export led growth hypothesis reflect the direction of causality to be from exports to GDP for Belgium, Denmark, Iceland, Ireland, Italy, New Zealand, Spain, and Sweden, and (ii) test results for the growth driven exports hypothesis state the direction of causality to be from GDP to exports for Austria, France, Greece, Japan, Mexico, Norway, and Portugal. Two-way causality between exports and economic growth is observed for Canada, Finland, and the Netherlands. No evidence of causality was found for Australia, Korea, Luxembourg, Switzerland, the UK, and the USA.

Authors such as King and Levine (1993a), Savvides (1995), Levine et al. (2000), Khan and Senhadji (2003), Hassan and Bashir (2003), Chuah and Thai (2004), Christopoulos and Tsionas (2004), Al-Awad and Harb

(2005), and Shahbaz (2009) indicate that financial development and economic growth are positively correlated. Many studies indicate that the causality is from financial development to economic growth and not vice versa (King and Levine, 1993a and 1993b; Levine, 1997 and 2005; Levine et al., 2000; Khan and Senhadji, 2003; Christopoulos and Tsionas, 2004; Habibullah and Eng, 2006). A negative relationship between financial development and economic growth is stated by Friedman and Schwartz (1963) and Lucas (1988).

The long-run relationship between financial development and economic growth is analyzed (Kyophilavong et al., 2014). Authors apply the ARDL bounds testing approach to cointegration and indicate that while unidirectional causation running from economic growth to financial development supports the demand following hypothesis, unidirectional causation running from financial development to economic growth supports the supply leading hypothesis. The supply leading hypothesis shows that the causality runs from financial development to economic growth (Shahbaz and Rahman, 2012).

The causal relationship between financial development and economic growth for a heterogenous panel dataset of 19 high income countries for the period 1974-2001 is analyzed by Kemal et al. (2004) who underline that under high inflation rates financial development may affect economic growth negatively. A causal relationship between finance and economic growth or vice versa is also not found. Authors state that finance and growth literature consists of different groups: (i) finance promotes growth (Schumpeter, 1934), (ii) finance hurts growth (Levine, 2003), (iii) finance follows growth (Robinson, 1952), and (iv) finance does not matter (Lucas, 1988).

Hassan et al. (2011) apply Granger causality tests to find the direction of causality and analyze the relationship between financial development and economic growth across geographic regions and income groups in low and middle income countries. They find a strong positive correlation between financial development and economic growth in developing countries in the long run. Two-way causality is reflected for all the regions except Sub-Saharan Africa, East Asia and Pacific in the short run (Demetriades and Hussein (1996), Blackburn and Hung (1998), Luintel and Khan (1999), Khan (2001), Shan et al. (2001), Calderon and Liu (2003)), contradicting with McKinnon (1973), King and Levine (1993a), Levine et al. (2000), Christopoulos and Tsionas (2004) who state unidirectional causality from finance to growth. Economic growth increases the demand for financial services and thereby financial development (Kemal et al. (2004); Gurley and Shaw (1967); Goldsmith (1969), and Jung (1986)). The causal relationship is unidirectional, from growth to finance for Sub-Saharan Africa, East Asia and Pacific regions.

The supply-leading hypothesis stating financial development increases economic growth is supported by Hsueh et al. (2013) in their study of Asian countries such as China. The correlation between financial development and economic growth is stronger for the 84 countries analyzed for the period 1960-2003 (Rousseau and Wachtel, 2005). The correlation between financial development and economic growth for the Middle Eastern and North African (MENA) countries is explained by Kar et al. (2011) who apply panel causality test controlling for cross-sectional dependence. Their results indicate that, while most of the cross-sectional and panel studies find a positive correlation between financial development and economic growth most of the literature employing time series states either unidirectional or bidirectional causality. Kar et al. (2011) suggest that economic reforms and efficient financial systems may enhance economic growth in the long-run, and trade openness may influence financial development.

Panel cointegration approach is analyzed for ten MENA countries for the period between 1969 and 2000 (Al-Avad and Harb, 2005). The causal relationship between financial development and economic growth may be stronger in the long-run. Achy (2004) analyzes five MENA countries between 1970 and 1997 by controlling human capital and private investment and taking trade openness into account, and finds that financial development may not explain economic growth. Schich and Pelgrin (2002) apply a panel error correction approach to data for 19 OECD countries between 1970-1997, and state that there is a strong correlation between financial development and investment levels in the long-run for low and middle income economies.

The analysis of human capital, trade liberalization and financial development on economic growth for the

period 1960-2004 shows that trade and financial liberalizations affect economic growth positively (Kar et al., 2008). Habibullah and Eng (2006) using a panel data set with GMM technique, support the supply leading hypothesis and suggest that financial development and economic growth are strongly correlated in the developing countries.

Christopoulos and Tsionas (2004) employ panel unit root tests and panel cointegration and find unidirectional causality from financial development to economic growth in the long-run. Menyah et al. (2014) find support for the demand-following hypothesis for three countries out of 21 by allocating a bootstrapped panel causality analysis in order to explain the causality between financial development, trade openness, and economic growth. Limited causal relationship is found between financial development and trade openness. Results found by Agbetsiafia (2004) support the supply-leading hypothesis for Sub-Saharan Africa. Odhiambo (2007) finds supply-leading hypothesis for Tanzania, but demand-following hypothesis for Kenya and South Africa. Bidirectional causality is found between financial development and economic growth for Kenya (Wolde-Rufael, 2009). Fowowe's (2011) results state homogeneous bidirectional causality for the so-called variables.

The growth model extended for financial development tand trade openness is estimated for the presence of the long-run relationships. The long-run relationships are examined fro 21 emerging countries[1] for the period 1995-2013 on quarterly basis. The novelty of this study is the analysis of the long-run relationships in growth model of emerging countries in the presence of structural breaks. The rest of the paper is organized as follows. In the next section, the applied methodological approach is presented. In section 3, the obtained empirical results are reported, and finally, the last section concludes.

## 2. Methodology

Level of the financial development and a degree of the trade openness in developing countries are considered in the literature as most important determinants of economic development in emerging countries (Halicioglu, 2007, Vo, 2010, Polat et al., 2014). In order to estimate impact of financial development and of trade openness on economic growth the following linear model is employed:

$$\ln EG_{\mathrm{j,t}} = \beta_0 + \beta_1 \ln FD_{j.t} + \beta_2 \ln TO_{j,t} + \varepsilon \quad (1)$$

where $EG_{j,t}$ is economic growth of the $j^{\mathrm{th}}$ country at period $t$, and is presented by the real income per capita. $FD_{j,t}$ is the ratio of Money Supply (M2) to the GDP of the $j^{\mathrm{th}}$ country, which represents the financial development of the estimated country. Finally, $TO_{j,t}$ is the ratio of sum of export and import to GDP at period t, and represents the trade openness of the $j^{\mathrm{th}}$ country. $\varepsilon_t$ is the error term associated with each observation at period $t$. It is expected that the improved level financial development and the higher degree of trade openness will increase economic growth of a country, therefore coefficients $\beta_1$ and $\beta_2$ are expected to have positive signs.

### *2.1 Unit root tests*[2]

This paper employs two types of the panel unit root tests, those that do not allow for structural changes in series, and those that do allow for structural shifts. The first type of the panel unit root tests are the Levin, Lin and Chu (LLC) test (Levin et al., 2002), the Im, Pesaran and Shin (IPS) test (Im et al. 2003), the Fisher-

1) Estimated 21 emerging countries are: Argentina, Brazil, Bulgaria, Chile, Colombia, Estonia, Hungary, India, Indonesia, Lithuania, Malaysia, Mexico, Peru, Philippines, Poland, Romania, Russia, South Africa, Thailand, Turkey and Ukraine.

2) Theoretical explanations in sections 2.1 Unit root tests, 2.2 Stability test and 2.3 Cointegration tests, are heavily relies on Ketenci (2013)

type tests using ADF and PP tests Maddala and Wu (1999) and the Choi (2001), and the Hadri (Hadri, 2000) test. The LLC test is based on orthogonalized residuals and on the correction by the ratio of the long-run to the short-run variance of each variable. One of disadvantages of the LLC test is that it allows for heterogeneity only in the constant term of the ADF regression. The IPS test is the superior test to the LLC test and was proposed by Im et al. (2003) as a solution to the homogeneity issue. This test allows for heterogeneity in both the constant and slope terms of the ADF regression. An alternative test is proposed by Maddala and Wu (1999) and Choi (2001) and employs the Fisher test, which is based on combining the P-values from the individual unit root test statistics such as ADF and PP. One of the advantages of the Fisher test is that it does not require a balanced panel. Finally, the Hadri test is a heterogenous panel unit root test that is an extension of the test of Kwiatkowski et al. (1992), the KPSS (Kwiatkowski–Phillips–Schmidt–Shin) test, to a panel with individual and time effects and deterministic trends, which has as its null the stationarity of the series.

The second type of tests that are employed in this study allow for structural shifts in series. Im et al. (2005) proposed the LM unit root test that is a panel extension of the Schmidt and Phillips (1992) test. The LM test allows for one and two structural shifts in the trend of a panel and of every individual time series. Im et al. (2005) illustrated that in the series where structural shifts do not exist the size of distortions and loss of power in the panel unit root tests remain insignificant when structural shifts are accommodated. However, size distortions and loss power in the tests were found to be significant when unit root tests were applied to the time series without taking into account the existing structural shifts. The break date in the Im et al. (2005) test is chosen using the minimum LM statistics of Lee and Strazicich (2003, 2013). In this method, the break date is selected when the t-statistic of possible break points is minimized.

### *2.2 Stability test*

The stability of series is the requirement for panel cointegration tests that allow for structural shifts. Estimation of parameter stability in cointegration relationships has been done by employing the Hansen's (1992) stability test. The test is based on the fully modified OLS residuals proposed by Phillips and Hansen (1990). The stability test produces three test statistics: *supF*, *meanF* and *Lc* and requires data to be non-stationary. The null hypothesis of the *supF* statistic tests is cointegration with no structural shift in the parameter vector versus the alternative hypothesis of cointegration in the presence of sudden structural shifts. The *meanF* and *Lc* statistics test for a cointegration with constant parameters against an alternative hypothesis of gradual variance in parameters, which is considered no cointegration. Particularly, the *meanF* statistic is used to capture the overall stability of the model.

### *2.3 Cointegration tests*

The long-run relationships in the growth model of emerging countries are examined by two different tests. First test does not allow for structural breaks and is proposed by Pedroni (1999). The second one is proposed by Westerlund (2006) and allows for multiple structural breaks in series. The following system of cointegrated regressors is considered for estimation in cointegration tests:

$$y_{it} = \alpha_i + \beta x_{it} + \varepsilon_{it} \quad (2)$$

Where $i$=1,…, $N$, and $t$=1,…., $T$, $\alpha_i$ are constant terms, $\beta$ is the slope, $y_{it}$ and $x_{it}$ are non-stationary regressors, and $\varepsilon_{it}$ are stationary disturbance terms.

Pedroni (1999) tests for the null hypothesis of no cointegration in dynamic panel series with multiple regressors proposing a panel and group cointegration test where seven residual-based tests (with four panel statistics and three group statistics) were introduced. The first four panel cointegration tests, which are defined as within-dimension-based statistics, use the following null and alternative hypotheses: $H_0 : \phi = 1, \quad H_1 : \phi < 1$ assuming the homogeneity of coefficients under the null hypothesis. The other three group statistics, which

are defined as between-dimension-based statistics, use $H_0 : \phi_i = 1,$ versus $H_1 : \phi_i < 1$ for all *i*. In this case for each *i*th unit it is necessary to calculate *N* coefficients, where slope heterogeneity across countries is now allowed under the alternative hypothesis.

In the long run, macroeconomic series such as economic growth, money supply and trade are exposed to structural shifts in emerging countries. Therefore, Westerlund (2006) methodology is employed in this study that allows for structural shifts. This is the panel cointegration test that allows for multiple structural breaks accommodation in the level as well as in the trend of cointegrated regression. This test is based on the panel cointegration residual-based LM test proposed by McCoskey and Kao (1998), which does not allow for structural shifts. The advantage of Westerlund's test is that it allows for the possibility of known a priori multiple structural breaks or it allows for breaks the locations of which are determined endogenously from the series. At the same time this test allows for a possibility of structural breaks that may be placed at different locations in different individual series. Westerlund (2006) showed in his work that the test is free of nuisance parameters under the null hypothesis and that the number and location points of structural shifts do not affect the limiting distribution. The null of the test is $H_0 : \phi_i = 0$ for all $i = 1,...., N,$ versus alternative hypothesis: $H_1 : \phi_i \neq 0$ for $i = 1,...., N_1,$ and $\phi_i = 0$ for $i = 1,...., N,$ One of important advantages of this test is that the alternative hypothesis is not just a general rejection of the null like in the commonly used LM panel cointegration test of McCoskey and Kao (1998), but allows $\phi_i$ to differ across individual series.

## 3. Empirical Results

### *3.1 Unit root tests*

The Hansen (1992) stability test requires series to be non-stationary, therefore firstly the integration order of panel series has to be examined. Five alternative unit root tests, the LLC, IPS, ADF, PP, and Hadri tests are employed in this study. The null hypothesis of the LLC test is the presence of the common unit root process in panel series, while the Hadri test has the opposite hypothesis of no unit root in the common unit root process. The presence of individual unit root in series is investigated by the IPS, the ADF, and the PP tests. The results of the unit root tests are presented in Table 1. The unit root presence was detected in levels and no unit root was found in the first differences of Economic Growth and Trade Openness series by all four tests. However, results for the Money Supply variable are mixed, where the unit root presence in levels was rejected by the LLC test. However, the presence of common sources of non-stationarity may lead to over-rejection the null of non-stationarity by the LLC test (Banerjee et al. 2004, 2005). Different reasons of the possible weak performance of the LLC test are discussed in the literature. Tests that do not require pooling in series may performer better relative to the LLC test, which is based on the pooled regressions (Banerjee et al. 2004, 2005). Serially correlated errors may lead the test to over-reject the null hypothesis (Im et al., 2003). Presence of individual specific trends in pooled series may lead the LLC test to loose a power (Breitung, 2000). Taking into consideration weaknesses of tests we conclude that all series are generated by a non-stationary stochastic process.

In order to acquire stronger evidence of the nonstationarity of series additional test Im et al. (2005) that allows for one and two structural shifts in series is applied to the series. Results for the LM unit root tests with structural shifts are reported in Table 2 for the case of one structural shift, and Table 3 for the case of two structural shifts. Both unit root tests provide strong evidence of the unit root presence in the panel series, irrespective of the presence of structural shifts. The LM unit root tests for two structural shifts demonstrated stronger power to reject the null hypothesis stationarity.

### *Stability test*

The non-stationarity of panel series allows us to employ the Hansen's (1992) stability test. The test consists of three different statistics, the *supF*, the *meanF* and the *Lc* statistics. Results of estimations are reported in

Table 4. The *supF* statistic rejects the stability of model parameters indicating the presence of structural shifts in parameters for Argentina, Brazil, Bulgaria, Chile, Hungary, India, Indonesia, Philippines, Poland, Thailand, Turkey, and Ukraine. Parameters of all other countries are estimated as stable. The *meanF* statistics of Colombia, Estonia, Mexico, South Africa, and Ukraine failed to reject the hypothesis of cointegration, and failed to reject the null hypothesis in favor of the instability of the overall model for the rest of countries. The null hypothesis of constant parameters is not rejected by the *Lc* statistic in cases of Estonia, Mexico, Peru, and South Africa. In all other countries, the statistic rejects the hypothesis of constant parameters. Basing on results of the stability test we divide estimated countries into two groups, stable – where the evidence of structural breaks was not detected, and unstable – where the presence of structural shifts was detected by the stability test. Group of stable countries include Estonia, Mexico, and South Africa. All other countries are included in the group of unstable countries.

*Cointegration test*

The Westerlund (2006) panel cointegration test in the presence of multiple structural breaks may be employed for the group of countries where structural breaks were detected, unstable group. Results of the Westerlund (2006) panel cointegration test estimations are reported in Table 5. Panel A illustrate the results of estimations with structural shifts allowed in constant. Panel B demonstrates results with structural shifts allowed for both constant and trend of the regression. The Westerlund (2006) test detected up to five breaks for estimated countries. Detected structural shifts are concentrated around specific dates. For example, there is a prevalence of breaks around periods 1997-1998 and 2003-2004. The 1997-1998 period is characterized by the Asian financial crisis, where many emerging countries were affected. The 2003-2004 period has experienced rapid growth of commodity prices such as nickel, copper, zinc and others. This may be one of reasons of considerable growth in emerging markets (Arbatli and Vasishtha, 2012).

The LM statistics of the Westerlund (2006) cointegration test reject the null hypothesis of cointegration in both cases where constant and constant with trend are allowed. The estimation results do not provide evidence of cointegration in the estimated model of economic growth. Therefore we conclude that there are no long-run relationships between economic growth, financial development and trade openness in emerging countries when their economies are exposed to structural shifts.

The Pedroni (1999) panel cointegration test is employed to test cointegration characteristics in countries where structural shifts were not detected, stable group. The Pedroni (1999) panel cointegration test may be applied only to non-stationary variables. After finding evidence of non-stationarity (Table 1) of series the test was employed. Table 6 reports the results of the Pedroni (1999) panel cointegration test for stable countries. All six statistics of the cointegration test rejected the null hypothesis of cointegration in both cases when only constant and constant with trend are included. However only the group ADF-statistics failed to reject the null hypothesis. Most of statistics of the Pedroni (1999) test provide strong evidence of stable long-run relationships among panel series.

Empirical results provide strong evidence for the existence of long-run relationships in the growth model of the estimated emerging countries, which are not exposed to structural shifts. However there is no evidence supporting the long-run relationships in the growth model in countries where structural shifts are detected. Therefore it can be concluded that financial development and trade openness do not determine economic growth in emerging countries that are exposed to structural breaks. At the same time stable emerging countries experience long-run relationships between economic growth, financial development and trade openness.

## 4. Conclusion

This paper investigated the long-run relationships in the growth model between economic growth, financial development, and trade openness in 21 emerging countries. In order to investigate long-run relationships in the growth model of emerging countries recently developed econometric methods were applied, such as the Im et al. (2005) unit root test in the presene of structural shifts and the Westerlund (2006) panel cointegration test in the presence of multiple structural shifts. Quarterly series for the period 1995-2013 are estimated. Additionally the Hansen's (1992) stability test is employed for investigation of series for the presence of structural shifts. As a result, only three countries out of 21 estimated emerging countries were determined by the stability test as stable countries without structural shifts. The Westerlund (2006) cointegration test was applied to the panel of unstable countries, allowing for maximum five breaks and the Pedroni (1999) panel cointegration test was applied to stable countries. There was no evidence found for the long-run relationships in the growth model of emerging countries, which are exposed to structural shifts. Opposite to the results of the Westerlund (2006) test, the Pedroni panel cointegration test provided strong evidence of cointegration for the group of stable emerging countries.

This study illustrates that the financial development and trade openness are making an economy to work only if this economy is not exposed to structural shifts. If an emerging country experiences instability, improvement in financial development and increasing degree of trade openness may not benefit the broken system, and other sources of economic growth have to be searched for.

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## 6. Appendix: Tables

Table 1. Unit root tests

| | GDP/capita | | Money Supply | | Openness | |
|---|---|---|---|---|---|---|
| | level | Δ | level | Δ | level | Δ |
| LLCa | 0.85 | 5.84 | -7.03** | -4.38** | 0.34 | -24.64** |
| | I(1) | I(1) | I(0) | I(0) | I(1) | I(0) |
| IPSb | 5.17 | -15.71** | -1.44 | -14.99** | 4.03 | -27.11** |
| | I(1) | I(0) | I(1) | I(0) | I(1) | I(0) |
| ADFb | 18.89 | 301.41** | 68.51** | 314.86** | 17.43 | 475.91** |
| | I(1) | I(0) | I(0) | I(0) | I(1) | I(0) |
| PPb | 53.20 | 439.20** | 115.39** | 502.57** | 25.31 | 517.62** |
| | I(1) | I(0) | I(0) | I(0) | I(1) | I(0) |
| Hadric | 28.35** | -0.91 | 28.74** | 8.02** | 27.73** | 0.47 |
| | I(1) | I(0) | I(1) | I(1) | I(1) | I(0) |

*Note*: Estimations are made with inclusion of constant and trend, estimations are made with 1 specified lag, with increase of lag length the power of tests increases in favor of unit root presence in level estimations. * denotes significance at the 5% significance level. a. tests the hypothesis of the presence of the common unit root process,

b. tests the hypothesis of the presence of the individual unit root process, c. tests the hypothesis of no unit root in the common unit root process.

Table 2. Panel unit root test with one structural break

| Country | GDP/capita | | | M2 | | | Openness | | |
|---|---|---|---|---|---|---|---|---|---|
| | LM | Break | Lag | LM | Break | Lag | LM | Break | Lag |
| Argentina | -5.77** | 2009Q1 | 5 | -4.33** | 1999Q2 | 7 | -4.47* | 2010Q2 | 7 |
| Brazil | -5.78** | 2010Q3 | 5 | -6.08** | 2009Q2 | 1 | -6.99** | 2011Q2 | 1 |
| Bulgaria | -6.27** | 2011Q1 | 5 | -4.65** | 2002Q3 | 7 | -6.76** | 2004Q2 | 1 |
| Chile | -5.62** | 2010Q4 | 5 | -4.17** | 1998Q2 | 7 | -3.91 | 2009Q3 | 7 |
| Colombia | -5.42** | 1999Q1 | 5 | -4.99** | 1998Q2 | 7 | -4.48* | 2009Q2 | 7 |
| Estonia | -5.51** | 2005Q1 | 5 | -8.54** | 1998Q3 | 1 | -4.45* | 2010Q1 | 7 |
| Hungary | -5.52** | 2010Q4 | 5 | -9.06** | 1998Q3 | 1 | -7.62** | 2003Q4 | 1 |
| India | -5.49** | 2009Q4 | 5 | -5.39** | 2006Q3 | 8 | -4.47* | 2005Q1 | 7 |
| Indonesia | -5.39** | 1998Q1 | 5 | -4.22** | 2010Q2 | 7 | -6.33** | 2005Q4 | 1 |
| Lithuania | -5.43** | 1998Q4 | 5 | -4.78** | 2011Q3 | 8 | -7.24** | 2006Q2 | 1 |
| Malaysia | -5.59** | 1998Q3 | 5 | -3.66** | 2005Q3 | 6 | -6.39** | 1999Q4 | 1 |
| Mexico | -5.55** | 1998Q2 | 5 | -5.32** | 2005Q3 | 8 | -4.01 | 1998Q4 | 7 |
| Peru | -5.50** | 1998Q1 | 5 | -5.56** | 2001Q4 | 8 | -5.61** | 2004Q1 | 0 |
| Philippines | -5.94** | 1998Q3 | 5 | -5.72** | 2005Q1 | 8 | -8.16** | 2000Q1 | 1 |
| Poland | -5.79** | 1998Q2 | 5 | -4.32** | 2000Q4 | 8 | -7.97** | 2002Q1 | 1 |
| Romania | -5.32** | 2000Q1 | 5 | -4.06** | 1998Q3 | 3 | -4.55* | 1999Q4 | 7 |
| Russia | -5.56** | 1997Q4 | 5 | -4.72** | 2004Q2 | 7 | -7.95** | 1997Q4 | 1 |
| South Africa | -5.44** | 2009Q3 | 5 | -4.92** | 1998Q4 | 7 | -8.52** | 2001Q1 | 1 |
| Thailand | -5.24** | 2009Q4 | 5 | -3.68** | 1998Q2 | 7 | -4.63** | 2004Q2 | 7 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Turkey | -5.78** | 2011Q2 | 5 | -6.55** | 1997Q3 | 1 | -7.03** | 2008Q2 | 1 |
| Ukraine | -6.11** | 2011Q1 | 5 | -4.00** | 2003Q2 | 7 | -7.77** | 2010Q4 | 1 |
| **MinLM** | -6.11** | 2011Q1 | 5 | -4.00 | 2003Q2 | 7 | -7.77** | 2010Q4 | 1 |
| **LM statistic** | -28.57** | | | -24.95** | | | -32.26** | | |

*Notes*: The critical values for the panel LM test with a break at the 1%, 5% and 10% are −2.326, −1.645 and −1.282, respectively. The 1%, 5% and 10% critical values for the minimum LM test with one break are −5.11, −4.50 and −4.21, respectively (Lee and Strazicich [2013]). **denotes significance at the 1% level.

Table 3. Panel unit root test with two structural breaks

| **Country** | **GDP/capita** | | | | **M2** | | | | **Openness** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | LM | Break | Lag | LM | Break | Lag | LM | Break | Lag | | | |
| | LM | Break1 | Break2 | Lag | LM | Break1 | Break2 | Lag | LM | Break1 | Break2 | Lag |
| Argentina | -6.42** | 2003Q3 | 2006Q2 | 5 | -8.06** | 2000Q1 | 2010Q2 | 1 | -7.85** | 2000Q1 | 2010Q3 | 1 |
| Brazil | -6.39** | 2001Q1 | 2005Q2 | 5 | -7.68** | 1998Q2 | 2001Q4 | 1 | -8.42** | 1999Q3 | 2010Q2 | 1 |
| Bulgaria | -7.04** | 2005Q4 | 2010Q2 | 5 | -7.29** | 1998Q1 | 2002Q3 | 1 | -8.49** | 1997Q4 | 2002Q4 | 1 |
| Chile | -6.45** | 2005Q3 | 2010Q1 | 5 | -8.72** | 1999Q2 | 2008Q1 | 1 | -8.66** | 1999Q2 | 2009Q4 | 1 |
| Colombia | -6.55** | 2000Q4 | 2010Q3 | 5 | -9.73** | 1999Q1 | 2004Q1 | 1 | -7.68** | 2004Q1 | 2004Q4 | 1 |
| Estonia | -6.28** | 2005Q1 | 2011Q1 | 5 | -9.68** | 1998Q4 | 2003Q4 | 1 | -8.08** | 1998Q4 | 2004Q1 | 1 |
| Hungary | -6.27** | 2005Q3 | 2010Q1 | 5 | -9.94** | 1998Q3 | 2003Q4 | 1 | -8.59** | 2002Q1 | 2005Q2 | 1 |
| India | -6.19** | 2004Q3 | 2010Q3 | 5 | -8.15** | 1998Q2 | 2000Q1 | 1 | -8.59** | 2007Q1 | 2009Q2 | 1 |
| Indonesia | -6.79** | 1999Q4 | 2009Q3 | 5 | -8.34** | 1998Q2 | 2003Q1 | 1 | -8.53** | 2001Q2 | 2004Q4 | 1 |
| Lithuania | -6.77** | 1999Q3 | 2009Q2 | 5 | -9.32** | 1998Q1 | 2002Q4 | 1 | -8.74** | 2001Q2 | 2006Q2 | 1 |
| Malaysia | -6.61** | 1999Q2 | 2009Q1 | 5 | -5.09** | 2000Q3 | 2011Q2 | 7 | -8.01** | 2001Q1 | 2004Q2 | 1 |
| Mexico | -6.86** | 1999Q1 | 2008Q4 | 5 | -5.71** | 2005Q3 | 2010Q4 | 7 | -8.15** | 1999Q3 | 2008Q1 | 1 |
| Peru | -6.85** | 1998Q4 | 2008Q3 | 5 | -5.92** | 2002Q4 | 2007Q2 | 7 | -8.53** | 2000Q2 | 2011Q1 | 1 |
| Philippines | -6.37** | 1997Q4 | 2003Q4 | 5 | -6.08** | 1999Q3 | 2005Q1 | 7 | -8.89** | 2000Q1 | 2010Q4 | 1 |
| Poland | -6.20** | 1997Q3 | 2003Q3 | 5 | -7.51** | 1998Q3 | 2008Q3 | 1 | -8.98** | 2000Q1 | 2003Q2 | 1 |
| Romania | -6.44** | 1998Q1 | 2007Q4 | 5 | -7.19** | 1998Q1 | 2003Q1 | 2 | -7.81** | 1998Q2 | 2004Q4 | 1 |
| Russia | -6.09** | 1999Q3 | 2003Q1 | 5 | -7.77** | 1999Q2 | 2004Q3 | 1 | -8.57** | 1998Q2 | 1999Q2 | 1 |
| South Africa | -6.61** | 1997Q3 | 2007Q2 | 5 | -5.36** | 1998Q3 | 2004Q1 | 7 | -9.81** | 1999Q2 | 2001Q3 | 1 |
| Thailand | -5.73** | 2004Q2 | 2007Q4 | 5 | -6.80** | 1997Q3 | 2009Q4 | 1 | -9.18** | 1999Q1 | 2004Q1 | 1 |
| Turkey | -6.39** | 2007Q1 | 2011Q2 | 5 | -7.34** | 1999Q1 | 2002Q3 | 1 | -9.56** | 1998Q4 | 2003Q4 | 1 |
| Ukraine | -6.67** | 2006Q4 | 2011Q1 | 5 | -7.15** | 1998Q4 | 2002Q2 | 1 | -8.87** | 1998Q3 | 2003Q3 | 1 |
| **MinLM** | -6.67** | 2006Q4 | 2011Q1 | 5 | -7.15** | 1998Q4 | 2002Q2 | 1 | -8.87** | 1998Q3 | 2003Q3 | 1 |
| **LM statistic** | -35.15** | | | | -42.99** | | | | -50.68** | | | |

*Notes*: The critical values for the panel LM test with a break at the 1%, 5% and 10% are −2.326, −1.645 and −1.282, respectively. The 1%, 5% and 10% critical values for the minimum LM test with two breaks are −5.823, −5.286 and −4.989, respectively (Lee and Strazicich [2003]). **denotes significance at the 1% level.

Table 4. The Hansen (1992) stability test in cointegrated relations

| Country | SupF | | MeanF | | Lc | |
|---|---|---|---|---|---|---|
| | test | p-value | Test | p-value | test | p-value |
| Argentina | 1.05 | 0.01 | 9.35 | 0.01 | 16.54 | 0.03 |
| Brazil | 1.36 | 0.01 | 12.12 | 0.01 | 17.59 | 0.02 |
| Bulgaria | 1.36 | 0.01 | 39.83 | 0.01 | 96.49 | 0.01 |
| Chile | 0.78 | 0.02 | 15.19 | 0.01 | 26.13 | 0.01 |
| Colombia | 0.12 | 0.20 | 2.46 | 0.20 | 27.04 | 0.01 |
| Estonia | 0.26 | 0.20 | 4.29 | 0.18 | 13.15 | 0.11 |
| Hungary | 1.09 | 0.01 | 20.65 | 0.01 | 75.24 | 0.01 |
| India | 1.59 | 0.01 | 75.57 | 0.01 | 469.85 | 0.01 |
| Indonesia | 1.17 | 0.01 | 28.00 | 0.01 | 84.90 | 0.01 |
| Lithuania | 0.58 | 0.06 | 73.59 | 0.01 | 666.74 | 0.01 |
| Malaysia | 0.35 | 0.20 | 9.02 | 0.01 | 41.48 | 0.01 |
| Mexico | 0.38 | 0.19 | 3.39 | 0.20 | 8.03 | 0.20 |
| Peru | 0.57 | 0.07 | 6.44 | 0.04 | 13.28 | 0.10 |
| Philippines | 0.96 | 0.01 | 13.21 | 0.01 | 76.66 | 0.01 |
| Poland | 1.48 | 0.01 | 34.82 | 0.01 | 246.96 | 0.01 |
| Romania | 0.57 | 0.07 | 19.53 | 0.01 | 219.26 | 0.01 |
| Russia | 0.48 | 0.11 | 8.62 | 0.01 | 17.46 | 0.02 |
| South Africa | 0.16 | 0.20 | 3.54 | 0.20 | 9.69 | 0.20 |
| Thailand | 1.61 | 0.01 | 29.78 | 0.01 | 80.72 | 0.01 |
| Turkey | 1.06 | 0.01 | 25.55 | 0.01 | 57.20 | 0.01 |
| Ukraine | 0.62 | 0.05 | 5.12 | 0.11 | 17.54 | 0.02 |

Table 5. Estimated structural breaks using the approach of Westerlund (2006).

| **Panel A breaks in constant** | | | | | | |
|---|---|---|---|---|---|---|
| Country | Breaks | Date | | | | |
| Argentina | | 1995Q2 | 2001Q3 | 2006Q1 | | |
| Brazil | | 1995Q2 | 2006Q1 | 2009Q2 | | |
| Bulgaria | | 1995Q4 | 1999Q2 | 2002Q2 | 2005Q2 | 2009Q2 |
| Chile | | 1995Q4 | 2000Q3 | 2003Q4 | 2006Q3 | 2010Q3 |
| Colombia | | 1995Q4 | 1998Q3 | 2003Q2 | 2006Q1 | 2010Q3 |
| Hungary | | 1995Q3 | 1998Q1 | 2001Q1 | 2004Q1 | |
| India | | 1995Q1 | 2005Q2 | | | |
| Indonesia | | 1995Q4 | 1997Q4 | 2003Q1 | 2006Q2 | 2009Q3 |
| Lithuania | | - | - | - | - | - |
| Malaysia | | 1995Q2 | 1997Q4 | 2002Q1 | | |
| Peru | | 1995Q2 | 2004Q1 | 2007Q1 | | |
| Philippines | | 1995Q4 | 1997Q4 | 2003Q3 | 2006Q4 | 2009Q4 |
| Poland | | 1995Q2 | 2003Q3 | 2006Q3 | | |
| Romania | | 1995Q3 | 1998Q2 | 2002Q2 | 2005Q2 | |
| Russia | | 1995Q3 | 1997Q4 | 2006Q1 | 2008Q4 | |
| Thailand | | 1996Q1 | 1997Q4 | 2000Q3 | 2003Q2 | 2006Q1 |
| Turkey | | 1995Q3 | 1998Q4 | 2004Q2 | 2010Q1 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Ukraine | | 1995Q3 | 1998Q3 | 2002Q1 | 2004Q4 | |
| Lm | 4.14 | | | | | |
| **Panel B breaks in constant and trend** | | | | | | |
| Country | Breaks | Date | | | | |
| Argentina | | 1995Q3 | 1998Q3 | 2003Q1 | 2008Q4 | |
| Brazil | | 1995Q3 | 1998Q4 | 2002Q4 | 2007Q3 | |
| Bulgaria | | 1995Q2 | 1997Q4 | 2008Q4 | | |
| Chile | | 1995Q3 | 1998Q2 | 2004Q3 | 2008Q4 | |
| Colombia | | 1995Q3 | 1998Q3 | 2002Q3 | 2008Q3 | |
| Hungary | | 1995Q4 | 1998Q3 | 2001Q3 | 2005Q3 | 2008Q3 |
| India | | 1995Q3 | 1998Q3 | 2004Q1 | 2008Q3 | |
| Indonesia | | 1995Q3 | 1997Q4 | 2000Q4 | 2004Q4 | |
| Lithuania | | 1995Q4 | 1997Q3 | 2000Q3 | 2005Q3 | 2008Q4 |
| Malaysia | | 1995Q4 | 1997Q4 | 2000Q4 | 2003Q3 | 2008Q3 |
| Peru | | 1995Q4 | 1997Q3 | 2000Q2 | 2004Q1 | 2007Q1 |
| Philippines | | 1995Q4 | 1997Q4 | 2000Q3 | 2006Q1 | 2010Q3 |
| Poland | | 1995Q4 | 1999Q1 | 2001Q4 | 2004Q3 | 2008Q3 |
| Romania | | 1995Q4 | 1998Q2 | 2001Q1 | 2004Q3 | 2007Q3 |
| Russia | | 1995Q3 | 1998Q2 | 2004Q3 | 2008Q4 | |
| Thailand | | 1995Q3 | 1997Q3 | 2003Q1 | 2009Q3 | |
| Turkey | | 1995Q3 | 1999Q2 | 2002Q1 | 2006Q1 | |
| Ukraine | | 1995Q4 | 1998Q2 | 2002Q3 | 2005Q2 | 2008Q4 |
| Lm | 10.86 | | | | | |

*Notes*: The CV at the 1 per cent level is 2.28.

Table 6. Panel cointegration tests

| | Stable countries | |
|---|---|---|
| | c | c&t |
| Pedroni | | |
| Panel v-Statistic | 6.52** | 4.04** |
| Panel rho-Statistic | -5.29** | -4.05** |
| Panel PP-Statistic | -3.82** | -3.69** |
| Panel ADF-Statistic | 0.56 | 1.62 |
| Group rho-Statistic | -2.696** | -2.04* |
| Group PP-Statistic | -2.67** | -2.61** |
| Group ADF-Statistic | -0.61 | 0.22 |

*Note*: The critical values are based on Pedroni (2004). Null hypothesis for cointegration tests: No cointegration. ** and * reject hypothesis of no cointegration at 1% and 5% level of significance. Lag selection is based on the SIC with automatic selection. c denotes constant, c&t – constant and trend, U – group of countries where structural breaks were detected, unstable countries, S – group of countries, where structural breaks were not detected, stable countries.

## 7. Appendix: Data

The quarterly data for the period between 1995 Q2 and 2013 Q2 for 21 emerging countries are employed in this study. Quarterly GDP data are acquired from the International Monetary Fund Financial Statistics (IFS). Current domestic prices are used, which are converted into current dollars by using the exchange rates obtained from the same source. Money Supply (M2) data are obtained from sources like the OECD, the World Bank, and Central Banks of estimated countries. Finally, quarterly data on import are obtained from the IFS and the FED Saint Louis database. In some cases, where values are provided on the annual basis, the transformation approach to quarterly data was employed. Estimations employ the logs of individual data.