9. INTERNATIONAL FINANCIAL MARKET INTEGRATION AND THE FELDSTEIN–HORIOKA PUZZLE: EVIDENCE FROM EMERGING MARKET ECONOMIES

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Abstract

Financial liberalization and globalization gained speed as of late 1970s with collapse of Bretton Woods system and the global integration raised considerably, especially during the past four decades. Foreign capital flows in terms of foreign direct investments and portfolio investments increased, especially in the emerging markets experiencing high growth rates, with relatively cheap, but qualified labor. This study tests the validity of the Feldstein-Horioka puzzle in 21 emerging markets during the 1994-2016 period with the panel cointegration test of Westerlund's (2008) Durbin-Hausman panel cointegration test and the panel causality test of Dumitrescu and Hurlin (2012). The findings revealed that domestic investments were mostly financed through external capital inflows; therefore, the findings contradicted the results of Feldstein-Horioka (1980) in the sample of emerging market economies.

Keywords: domestic savings, domestic investments, Feldstein-Horioka puzzle, international financial market integration, emerging market economies, panel data analysis

JEL Classification: F37, C33, E21, E22

1. Introduction

Economic growth is one of the principal dimensions of economic wellbeing. The related literature has documented the major determinants of economic growth as human and physical capital, savings, technological progress, institutional development, and many other non-economic factors (Arvanitidis *et al.,* 2007; Boldeanu and Constantinescu, 2015). Regarding savings, the developing and emerging countries in particular have faced serious savings gaps, while pursuing policies which enhance economic growth. However, following

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the rapid acceleration of the liberalization and globalization process from the late 1970s onward, countries have generally addressed the problem of insufficient savings using foreign capital inflows, in terms of foreign direct investments, foreign debt, and portfolio investments.

Domestic savings are the sum of public and private sector savings in a closed economy and, in turn, are equal to total public and private sector investments. However, the equilibrium between domestic investments and domestic savings ends in an open economy. In this case, domestic investments may be higher or lower than domestic savings. Feldstein and Horioka (1980) suggested that the correlation between domestic savings and domestics investments should not be high in the case of perfect capital mobility; however, when the authors tested the relationship for a sample of OECD countries with high capital mobility over the period 1960–1974, their findings suggested the opposite is true (there was a high correlation between domestic savings and domestic investors). This phenomenon is known in the relevant literature as the Feldstein–Horioka Puzzle (FHP). Obstfeld and Rogoff (2000) listed the FHP as one of the six main puzzles in international economics.

The liberalization of capital account and the global integration of financial markets increased the flow of transnational capital. Countries with higher financial openness can easily finance their current account deficits through the global financial markets, but in turn their current account deficits may reach very high levels (Özmen, 2007; Younas and Chakraborty, 2011; Drakos *et al*., 2018). However, the countries with high international capital mobility may be negatively affected by such rapid and considerable capital outflows (Dash, 2019; Eyüboğlu and Uzar, 2020). This is because the transnational capital flows can be stopped or significant cuts can be experienced in the international capital flows due to increase in the severity and frequency of crises. Therefore, such increases in foreign capital flows may be a destabilizing factor for the economies and current account sustainability, and sudden and significant capital withdrawals may cause financial crises (Dash, 2019; Eyüboğlu and Uzar, 2020; Younis and Dhannoon, 2020). Furthermore, the domestic savings levels may be weakened as a consequence of the access to global financial funds facilitated by financial liberalization. Therefore, market size and global risk aversion are significant factors in explaining international capital allocation (Camarero *et al*., 2019).

But and Morley (2016) revealed that the savings–investment correlation decreased to a low level immediately prior to the 2008 global crisis for the OECD economies and that the FHP did not apply to these countries. However, the correlation became stronger during the crisis, and FHP became a valid concern. In this context, a low savings–investment correlation might be considered as an early warning crisis indicator for the policy makers (But and Morley, 2016). Therefore, short-term capital controls can be employed by the economic authorities to avoid a possible sharp reversal in ß (the saving-retention coefficient) following sudden capital outflows if the ß coefficient continues to stay low. The increase in the savings–investment correlation after the 2008 economic crisis may be seen as an indicator of the decreasing confidence in transnational capital flows (Amirkhalkhali and Dar, 2020). Furthermore, the countries less dependent on capital mobility displayed superior economic performance during the 2008–2017 period (World Bank, 2020). Consequently, transnational capital flows may, in addition to their positive effects on national economies, have serious adverse effects, and the FHP is the result of such considerations.

In this study, the FHP was analyzed in a sample of emerging market economies. Emerging markets such as China, India, and South Korea have attained significant rates of economic growth since the 1990s, but the majority of these emerging market economies have also experienced serious negative saving gaps, mainly financed by external capital inflows (Åslund, 2013; Worrell *et al*., 2016). Furthermore, the emerging economies exhibit

heterogeneity in terms of financial openness, as represented by the Chinn–Ito index (KAOPEN) calculated by Chinn and Ito (2006), as shown in Table 1.

Table 1

Capital Account Openness of the Emerging Economies

Country	1994	2016
Brazil	-1.91043	-1.20236
Chile	-1.91043	1.07353
China	-1.20236	-1.20236
Czech Republic	-0.1355098	2.359998
Egypt	-0.70139	-1.20236
Greece	-0.13551	1.293152
Hungary	-1.20236	2.359998
India	-1.20236	-1.20236
Indonesia	2.359998	-0.13551
Korea, Rep.	-0.13551	2.359998
Malaysia	1.150958	-0.13551
Mexico	1.07353	1.07353
Pakistan	-1.20236	-1.20236
Peru	1.588117	2.359998
Philippines	0.006684	0.006684
Poland	-0.84358	1.07353
Russian Federation	-0.13551	0.893664
South Africa	-0.13551	-1.20236
Thailand	-0.13551	-1.20236
Turkey	-0.13551	0.006684

Source: Chinn-Ito Index, 2019, http://web.pdx.edu/~ito/Chinn-Ito_website.htm (05.01.2019).

Evidence of the FHP has remained inconclusive in the relevant literature, despite the increasing international financial integration. This study aims to contribute to the related literature in three ways. First, it investigates the validity of the puzzle for the emerging market economies experiencing significant growth rates regarding the unconventional monetary policy form of quantitative easing (QE). Secondly, employment of second-generation econometric tests leads us to obtain relatively robust more findings. Thirdly, it considers specific periods regarding transnational capital flows, testing the validity of the FHP in 21 emerging markets during the 1994–2016 period using Westerlund's (2008) Durbin–Hausman panel cointegration test and the Dumitrescu and Hurlin (2012) panel causality test. The remaining paper is structured as follows: Section 2 summarizes the relevant literature, the dataset and study method are described in Section 3, and Section 4 contains the empirical analysis and discusses the findings of the analysis. Finally, Section 5 concludes the study.

2. Literature Review

In a highly globalized world, a domestic savings gap can be financed with external savings. Feldstein and Horioka (1980) investigated the correlation of domestic savings and domestic investments in 16 OECD countries over the 1960–1974 period using horizontal cross-sectional data analysis assisted by Equation 1. Normally, it is expected that capital mobility

decreases/increases as the parameter (β) grows/decreases. In this respect, in a closed economy, a high β value is expected, because the domestic investments are financed only by domestic savings. Indeed, as capital mobility is liberalized, domestic investments can be financed from the world's capital pool, and domestic savings created in each country will be freely distributed globally to access new investment opportunities.

$$(I/Y)_i = \alpha + \beta(S/Y)_i + \mu_i \quad (1)$$

In equation (1), the i subscript represents the cross-sections of the dataset, I symbolizes domestic investments, S represents domestic savings, Y is gross domestic product, and μ is the error. In this model, the measure of international capital mobility is determined using the (β) parameter. Feldstein and Horioka (1980) revealed the β value to be 0.89 for the OECD countries with high capital mobility. In other words, a large part of the changes in domestic investments was explained by domestic savings for the sample with high capital mobility. This finding, which is contrary to the original hypothesis, is known as the FHP.

The FHP has begun to be questioned both theoretically and empirically, but strong evidence for its existence has remained inconclusive. In this regard, Fieleke (1982), Penati and Dooley (1984), Dooley *et al*. (1987), Bayoumi (1989), Feldstein and Bacchetta (1991), Petreska and Mojsoska-Blazevski (2013), Drakos *et al*. (2017), and Raheem (2017) discovered findings which support the FHP. However, Obstfeld (1986), Krol (1996), Sarno and Taylor (1998), Ang (2007), Mastroyiannis (2007), Marinheiro (2008), Kollias *et al*. (2008), Barros and Gil-Alana (2015), and Ay and Özmen (2017) reached the opposite conclusions to the FHP.

Many studies have attempted to explain the FHP in the related literature. Obstfeld (1986) theorized that investment and savings can be affected by the growth rate and the share of national labor input, based on the life cycle consumption model. In this respect, he adapted the data of 17 OECD countries according to the model, which assumes that the capital is fully mobile and that, given the re-estimate of equation (1), there is a value of 0.858 with Greece and 1.422 without Greece for the coefficient β. Consequently, the close proximity of the coefficient β does not contradict the capital flows. According to Obstfeld (1986), a rise in the savings rate due to a rise in the economic growth rate is theoretically linked to an increase in the domestic investment rate. However, it cannot be said that the rise in savings will be accompanied by a rise in investment. In fact, in that case any increase in savings will move abroad.

The literature also mentions the effects of certain variables not considered in the FHP and the assumption of savings endogeneity. For example, Roubini (1988) argued that the FHP could be explained by fiscal deficits in the current account determination as well as savings behavior. He considered the impact of the budget deficit and tested the FHP for 18 OECD countries with data from the 1960–1985 period, the results indicating that the capital is mobile. Feldstein and Horioka (1980) tested for the problem of endogeneity saving and added some variables to the model, such as growth rate, aged dependency ratio, social-security program, ratio of the number of dependent young population to the working age population, and labor force participation rate, and then re-estimated the "β" coefficient. However, it should be emphasized that the results obtained in this manner do not change the previously obtained results.

Some authors have argued that only the current account deficit and investment should be considered in studies analyzing the FHP and that the budget deficit should be excluded from the model. Roubini (1988) considered the impact of the budget deficit, testing the data of 18 countries for the 1960–1985 period and concluding that the capital moved. However, according to Feldstein and Bacchetta (1991), it is possible to see the effect of growth and

income distribution by including the two variables in question. Furthermore, in this case the data itself should be used instead of the modified ones. According to the assumption made by Obstfeld (1986), the value of β is therefore estimated as 0.88 when the two variables are not included, and 0.87 when they are included.

In this context, some scholars have suggested that the capital flows are not sufficiently high. For example, Feldstein (1983) contended that capital is far from full mobility and that the tendency towards risk aversion is limiting the capital movements (Feldstein, 1993). According to Feldstein (1994), despite the elimination of legal and institutional factors preventing capital from moving, the reason why domestic investment and savings are interrelated is that the risk aversion tendency remains high. This situation prevents capital from moving in reality, although it is movable. However, Frankel *et al*. (1987) pointed out that the FHP is "*the reason why the physical capital cannot be replaced internationally*."

Another important explanation for solving the FHP is the effect of public intervention on capital movements. According to Summers (1988), governments systematically implement policies targeting a level of current account deficit, which may lead to a relationship between internal savings and investment, even when the capital is fully mobile. Summers (1988) offered three explanations for the FHP: the immobility of capital, the impact of excluded variables such as population in the model, and government intervention.

Some studies in the related literature have suggested that some of the variables left out of the model may have affected the estimation results. In this context, Feldstein and Horioka (1980), Feldstein and Bacchetta (1991), Obstfeld (1986), Summers (1988), Roubini (1988), Tesar (1991) and Taylor (1994) considered variables not included in the model, as well as the endogeneity of saving. These authors investigated other variables which theoretically affect the two variables (domestic investments and domestic savings), and re-predicted the model by including these variables.

Kim (2001) addressed the argument that the relationship between domestic investment and saving may have been caused by periodic shocks (in the form of efficiency, both in the public and private sector commercial). In the study, the relationship between domestic investment and saving is re-estimated with panel data from 1960 to 1992 for 19 OECD countries, and the coefficient β is found to be "0.69." According to Kim (2001), when the effect of shocks is considered, the coefficient "β" falls, but the value is still non-zero and high.

At the same time, there were some studies on how the size of the country affects the capital movements and, thus, the domestic savings and investment relationship. Héricourt and Maurel (2005) highlighted how the FH coefficients are close to zero for Germany, France, Italy, Belgium, and the Netherlands, and statistically insignificant. However, the correlation between savings and investment is significantly different from zero for the European periphery countries, namely Portugal, Greece, and Sweden.

Many studies have explained the FHP by the economic size of the country. Fougau *et al*. (2008) found country-specific and time-specific saving retention coefficients belonging to 24 OECD states during the 1960–2000 period and concluded that openness, economic size, and current account have the largest effect on the savings–investment relationship. According to the studies, as the country economic size increases, the relationship between domestic savings and domestic investments increases and, therefore, the foreign financing needs of the countries decrease (Harberger, 1980; Murphy, 1984; Obstfeld, 1986).

Some studies on the FHP have questioned the use of data in Feldstein and Horioka's original study (Sinn, 1992; Krol, 1996). Such critics argue that, if the data used in the 1980 study are taken as annual data rather than long-term average data, them the β coefficient is low.

According to Özmen and Parmaksiz (2003a, 2003b) and Özmen (2007), the FH coefficient is estimated to be lower when the structural change resulting from the change in the policy regime is considered.

Numerous studies have shown that economic integration activities encourage capital movements, whereas crises have differentiated the risk premiums of countries and, thus, affected the capital movements. Katsimi and Zoega (2016) argued that, in the context of European integration, the single market could be expected to decrease the country-specific premium through the country's commitment to free capital flows, and that the single currency euro would eliminate the currency premium. However, the financial crisis raised the country-specific premium and even increased the currency premium as a result of certain states' threat of exiting the euro area. In other words, the European Single Market and the introduction of the euro raised the capital mobility through government budget surpluses and capital from countries with higher per capita output (Blanchard and Giavazzi, 2002; Katsimi and Zoega, 2016; Raza *et al*., 2017).

In this context, some researchers have argued that the β coefficient of the EU states should be low due to institutional and informational factors (Coakley *et al*., 1998). Feldstein and Bacchetta (1991), Artis and Bayoumi (1992), and Bayoumi *et al*. (1996) asserted that financial flows among the EU states should be higher than those among the OECD states. Therefore, the EU member states will have a relatively lower savings–investment correlation.

Coakley *et al*. (1996) focused on the impact of a country's ability to pay external debt. For the authors, the coefficient is a measure of the long-run cointegration relationship between investment and savings more than the degree of capital mobility. If the long-term current account solvency constraint is valid in the economy, then the economy's balance of payments (when taken as a share of gross national product) must be stationary. This implies that domestic investment and domestic savings need to be cointegrated with the unit coefficient in the long term regardless of the degree of capital mobility.

Frankel (1992, 2003) considered the effect of real interest rate differentials in terms of international capital mobility and identified the existence of different definitions of the perfect mobilization of capital: 1) The Feldstein–Horioka definition: changes in domestic savings have no impact on domestic investment; 2) Real interest parity: real interest rates across countries will equalize due to international capital flows; 3) Uncovered interest parity: the equalization of the expected returns of the countries' bonds despite currency risk; 4) Covered interest parity: equalization of capital gains in different countries over a common currency. Frankel (1992, 2003) conducted empirical studies with data from the 1980s of 25 countries across the world (according to different regions and development levels) and found that the currency risk still exists. This suggests that the real interest rate is not equal between countries. Theoretically, considering that investment and savings are affected by the real interest rate, the FHP does not occur under these circumstances.

Furthermore, some recent studies have explored the validity of FHP with endogenously determined structural breaks models (*e.g*., see Akkoyunlu, 2020; Patra and Mohanty, 2020). Akkoyunlu (2020) explored the validity of FHP in Turkey for the periods 1950–2017, 1950–1989, and 1990–2016 and found a positive savings–investment correlation for the period 1950–2017, with limited capital mobility, and a negative savings–investment correlation for the period 1990–2017, with high capital mobility. Meanwhile, Patra and Mohanty (2020) explored the FHP validity in six major South Asian countries for the period 1960–2017 using Markov-switching regression and discovered that the FHP is valid for some periods depending on regime changes.

3. Method

For the econometric analysis, cross-sectional dependence was firstly tested with the Breusch and Pagan (1980) LM test, Pesaran (2004) LM CD test, and Pesaran *et al*. (2008) $LM_{adj.}$ test, considering the dataset's characteristics. Meanwhile, the homogeneity was tested with the adjusted delta tilde test of Pesaran and Yamagata (2008), considering the selection of further econometric tests.

In the second step of the econometric analysis, the series' integration levels were researched using the Pesaran (2007) second generation unit root test regarding cross-sectional dependence. Subsequently, Westerlund's (2008) Durbin–Hausman cointegration test was employed with the aim of testing the cointegration relationship between the variables. The Durbin–Hausman cointegration test notes the cross-sectional dependence and heterogeneity of the slope coefficients. Furthermore, the test can be used in the event the dependent variable is I(1), but the independent variables may have different integration levels. The Durbin–Hausman cointegration test calculates two test statistics: the Durbin–Hausman panel statistic and group statistic (Westerlund, 2008). The panel statistic is calculated as follows, assuming the autoregressive parameters are homogenous:

$$DH_p = \hat{S}_n\left(\tilde{\emptyset}_i - \hat{\emptyset}_i\right)^2 \sum_{i=1}^{n}\sum_{t=2}^{T} \hat{e}_{it-1}^2 \qquad (2)$$

Meanwhile, the group statistic posits that the autoregressive parameters are heterogenous and is calculated as follows:

$$DH_g = \sum_{i=1}^{n} \tilde{S}_i\left(\tilde{\emptyset}_i - \hat{\emptyset}_i\right)^2 \sum_{t=2}^{T} \hat{e}_{it-1}^2 \qquad (3)$$

Lastly, the causal interaction between the variables was investigated with the Dumitrescu and Hurlin (2012) causality test. The major advantages of the test are that it considers heterogeneity and it can be used when T>N or T<N and yield robust results for unbalanced panels (Dumitrescu and Hurlin, 2012). Study calculates the individual Wald statistics $\left(W_{i,T}\right)$ and then the panel Wald statistic $\left(W_{N,T}^{HNC}\right)$ by taking the arithmetic mean of the Wald statistics. Dumitrescu and Hurlin (2012) suggest that $Z_{N,T}^{HNC}$ test statistic having asymptotic distribution should be used when T>N and Z_N^{HNC} test statistic having semi-asymptotic distribution should be used when T<N.

$$Z_{N,T}^{HNC} = \sqrt{\frac{N}{2K}}\left(W_{N,T}^{HNC} - K\right) \qquad (4)$$

$$Z_N^{HNC} = \frac{\sqrt{N}\left(W_{N,T}^{HNC} - N^{-1}\sum_{i=1}^{N} E\left(W_{i,T}\right)\right)}{\sqrt{N^{-1}\sum_{i=1}^{N} Var\left(W_{i,T}\right)}} \qquad (5)$$

4. Data and Empirical Analysis

In this study, panel data analysis was used to test the validity of the FHP for 21 emerging market economies during the 1994–2016 period[3].

4.1. Data

In the econometric analysis of the study, the gross domestic savings were included in the model as the dependent variable, whereas the gross fixed capital formation was taken as the independent variable representing the domestic investments (see Table 2). The selection of countries was made considering MSCI (2018) and the data availability. Furthermore, the dummy 2002–2007 variable was used to observe the impact of high capital inflows during the 2002–2007 period. Therefore, its value was one for the period 2002–2007 and zero for the other years. In addition, the dummy 1998–2002 variable was employed to observe the significant decreases during the period, and it was taken as one for the period 1998–2002 and zero for the other periods. Lastly, then Federal Reserve Chairman Ben Bernanke announced on May 22nd, 2013, that the Fed would end monetary expansion in the coming period. Therefore, it was taken as one for the 2013–2016 period and zero for other periods. Therefore, the dummy 2013–2016 was used considering Bernanke's announcement. The variables were annual and the study duration was determined as 1994–2016. First, the analyses were conducted for the whole period; subsequently, the study period was divided into the 1994–2001 and 2002–2016 sub-periods, as global external capital inflows have considerably changed since 2002, considering Suchanek and Vasishtha (2009) and Collyns (2015).

Table 2

Data Definitions

Variables	Definitions	Data Source
SAVING	Gross domestic savings (% of GDP)	World Bank (2018a)
INV	Gross fixed capital formation (% of GDP)	World Bank (2018b)

The descriptive characteristics and the correlation matrix with level values are displayed in Table 3. As obvious from the table, there was a positive correlation between gross fixed capital formations and savings (as a % of GDP).

Table 3

Descriptive Statistics and Correlation Matrix

Variables	Mean	Std.Dev.	Min	Max
INV	22.96048	6.701308	11.12117	45.51477
SAVING	2417167	9.86547	7.063782	60.78199
	LGDP		EF	
INV	1.0000		0.665193	
SAVING	0.665193		1.0000	

[3] *Eviews 10.0, Gauss 10.0 and Stata 14.0 statistical software programs were used for the econometric analysis.*

4.2. Empirical Analysis

In this study, the validity of the FHP was investigated in 21 emerging economies during the 1994–2016 period using panel data econometric analysis. Furthermore, the interaction between domestic savings and domestic investments was researched for the 1994–2001 and 2002–2016 sub-periods.

The presence of cross-sectional dependence between domestic savings and domestic investments was tested with the Breusch and Pagan (1980) LM test, Pesaran (2004) LM CD test, and Pesaran *et al.* (2008) $LM_{adj.}$ test; the test results are displayed in Table 4. The cross-sectional independence was denied at 1% significance level and a cross-sectional dependence between cross-sections was determined. Furthermore, the homogeneity of the cointegrating coefficients was tested with the adjusted delta tilde test; the test results are also shown in Table 4. The homogeneity was denied at 1% significance level and, in turn, the cointegrating coefficients were found to be heterogeneous.

Table 4

Results of Cross-sectional Dependence and Homogeneity Tests

Cross-sectional dependency tests		
Test	Test Statistic	p-value
LM	505.8	0.0000
$LM_{adj.}$	35.97	0.0000
LM CD*	3.574	0.0004
Homogeneity tests		
Test	Test Statistic	p-value
Delta tilde	16.763	0.0000
Delta tilde adjusted	17.976	0.0000

*Note: *two-sided test.*

The integration levels of both series of domestic savings and domestic investments were explored with the Pesaran (2007) second generation unit root test and cross-sectionally augmented Im–Pesaran–Shin (IPS; 2003) test considering cross-sectional dependence. The results indicated that SAVING was I(0) and INV was I(1).

The long-term interaction between domestic savings and domestic investments was examined with Westerlund's (2008) Durbin–Hausman test, because both variables had different integration levels; the results are shown in Table 5. A cointegration relationship between the two series was revealed in the light of the Durbin–Hausman group statistic p-value. The Durbin-Hausman group statistic was considered due to the existence of cross-sectional dependence and heterogeneity. Therefore, at 1% significance level the null hypothesis was denied and a cointegrating relationship between domestic savings and domestic investments was disclosed.

Table 5

Results of Westerlund's (2008) Durbin-Hausman Cointegrating Test

	Test statistic	P values
Durbin-Hausman Group Statistic	5.109	0.000
Durbin-Hausman Panel Statistic	4.744	0.000

H_0: There is no cointegrating relationship.

The cointegrating coefficients were assessed with the augmented mean group (AMG) estimator, considering the heterogeneity and cross-sectional dependence presented in Bond and Eberhardt (2009) after determination of the significant cointegration relationship over the 1994–2016 period; the estimated coefficients are displayed in Table 6.

Table 6

Long-term Cointegrating Coefficients (1994-2016)

Country	SAVING		DUMY20022007=1		DUMY19982002-20132016=1	
	Cointegrating Coefficients	P values	Cointegrating Coefficients	P values	Cointegrating Coefficients	P values
Brazil	**0.4827575**	**0.000***	-2.298989	0.000*	-0.2249457	0.629
Chile	-0.2082417	0.445	-3.219901	0.000*	-2.255815	0.014**
China	-0.0192012	0.938	0.2379778	0.814	-2.944987	0.067***
Colombia	**0.8089021**	**0.000***	-1.432017	0.067***	-1.604927	0.096***
Czech Republic	0.0929308	0.637	0.2891456	0.635	-1.154703	0.060***
Egypt	**0.7236908**	**0.000***	-1.421474	0.165	0.2751291	0.777
Greece	0.9568153	0.185	2.347011	0.444	-1.300262	0.480
Hungary	**-0.5610471**	**0.002***	0.7798839	0.342	2.265293	0.001*
India	**0.7133373**	**0.000***	-0.7347557	0.201	-1.575444	0.020*
Indonesia	**0.3092902**	**0.024***	-5.010954	0.000*	-2.834556	0.023*
Malaysia	**-1.142645**	**0.001***	-5.125417	0.009*	-6.277371	0.001*
Mexico	**0.6235413**	**0.010***	1.236994	0.119	0.3581717	0.671
Peru	0.1969083	0.225	-4.95493	0.000*	-1.469649	0.016**
Philippines	-0.0149607	0.592	-0.2320794	0.658	-0.2805611	0.488
Poland	0.2153778	0.611	-0.153473	0.912	.1092132	0.928
Pakistan	0.000923	0.996	1.305717	0.133	-1.866235	0.002*
Russia	0.1023458	0.160	-1.525724	0.026**	-2.877473	0.000*
South Africa	0.0665578	0.770	0.4967292	0.288	-1.543368	0.000*
South Korea	0.0601753	0.830	-.0361471	0.953	-2.900204	0.000
Thailand	**0.8571931**	**0.029****	-1.839676	0.380	-6.241411	0.000*
Turkey	0.33251	0.413	-1.141501	0.295	-3.355221	0.003*
Panel	**0.2830679**	**0.007***	-0.8234487	0.093***	-1.683205	0.000*

*Note: ***, **, *: significance at 1,5 and 10 % level.*

Table 6 shows the estimation results for the entire period of 1994–2016. The panel coefficient was found to be statistically significant and close to 0, contradicting the findings of Feldstein and Horioka (1980). Consequently, the considerable part of the domestic investments in the sample was financed from the international markets. The panel coefficients of the two dummy variables representing the 1998–2002 period, 2013–2016 (decreasing period) and 2002–2007 (increasing period) of decreasing/increasing capital flows to the emerging markets in the model were found to be statistically significant. During the 2002–2007 period, the impact of the 2002–2007 dummy on domestic investments was found to be negative, although the global capital flows increased. However, the negative impacts of the dummy variables for 1998–2002 and 2013– 2016 were found to be relatively higher as compared to the 2002–2007 dummy impact. When the country-specific

cointegrating coefficients are considered, the results do not support the FHP, except for Brazil, Colombia, India, Mexico, and Thailand.

As analyzed by Ghosh and Qureshi (2012), the capital flows to emerging markets increased more in the 2000s as compared to the previous periods. Bhattarai and Chatterjee (2015) analyzed the international spillover effect of the US QE policy and found that it leads to an increase in capital inflows to these countries. For this reason, when compared to these two periods, it is estimated that the domestic savings–domestic investment relationship will be even lower in the 2000s.

The same estimations were conducted for the 1994–2001 and 2002–2016 sub-periods; the results are shown in Tables 7 and 8.

Table 7

Long-term Cointegrating Coefficients (1994-2001)

Country	SAVING	
	Long-term Coefficients	P values
Brazil	**0.656011***	**0.000**
Chile	0.5003345	0.497
China	0.9028841	0.210
Colombia	0.0239183	0.949
Czech Republic	**0.7991213****	**0.049**
Egypt	**1.034302*****	**0.098**
Greece	0.5614487	0.676
Hungary	**-0.4132289*****	**0.099**
India	**0.4162154*****	**0.084**
Indonesia	0.098976	0.493
Malaysia	-0.7762725	0.297
Mexico	-0.5725706	0.391
Peru	**1.458086****	**0.030**
Philippines	0.024226	0.819
Poland	**1.655215***	**0.008**
Pakistan	**.3779553*****	**0.091**
Russia	**.2109595****	**0.025**
South Africa	0.4064026	0.517
South Korea	-0.0304852	0.971
Thailand	-0.6530303	0.801
Turkey	-0.2882839	0.571
Panel	**0.2866082*****	**0.064**

*Note: ***, **, *: significance at 1,5 and 10 % level*

As Table 7 (the results for the 1994–2001 sub-period) shows, the panel coefficient is significant at the level of 10%. When the countries are examined separately, the coefficients for Brazil, Czech Republic, Egypt, Hungary, India, Peru, Poland, Pakistan, and Russia are significant. The coefficients are negative for Hungary. The coefficients are high for Peru, Egypt, Czech Republic, and Brazil, which shows the similarity to the results of Feldstein and Horioka (1980). In the cases of Russia, Pakistan, and India, the coefficients are close to 0, and for other countries, the coefficients are not significant. This result shows that capital flows to these countries are at a high level.

Table 8

Long-term Cointegrating Coefficients (2002-2016)

Country	SAVING	
	Long-term Coefficients	P value
Brazil	0.1950789	0.273
Chile	**-0.7304394***	**0.000**
China	0.4025152	0.147
Colombia	0.1913298	0.480
Czech Republic	**0.2364949****	**0.011**
Egypt	0.0789334	0.702
Greece	**0.5353163****	**0.019**
Hungary	0.2304516	0.510
India	**0.5663741***	**0.000**
Indonesia	0.1260932	0.301
Malaysia	-0.2690039	0.172
Mexico	**0.4214577**	**0.003**
Peru	0.0526301	0.844
Philippines	0.009236	0.814
Poland	**0.25432*****	**0.072**
Pakistan	0.3016205	0.321
Russia	-0.1385728	0.248
South Africa	-0.206386	0.157
South Korea	0.1772238	0.193
Thailand	-0.0240138	0.936
Turkey	0.5920761	0.296
Panel	**0.1742661**	**0.006**

*Note: ***, **, *: significance at 1,5 and 10 % level*

As Table 8 (the results for the 2002–2016 sub-period) shows, the panel coefficient is significant at the level of 1%. When the period of 2002–2016 is examined, the panel coefficient showing the whole country is lower as compared to the previous sub-period, and the β coefficient is 0.17. These results do not align with those of Feldstein and Horioka (1980). This is because capital movements to emerging market countries increased during this period, which reduced the coefficient of the domestic capital and domestic savings relationship for the concerned countries.

When the countries are analyzed separately, for all the countries the β coefficient is below 0.50, whereas in all other countries, this coefficient is not significant. That is, according to the estimations results, no significant relationships were identified in any of the countries in Table 8, excluding Chile, Czech Republic, Greece, India, Mexico, and Poland.

The capital inflows to the emerging markets have increased as of late 2009 and institutional quality, country risk, and macroeconomic fundamentals have been documented as the main factors underlying foreign capital attraction (Fratzscher, 2012). Phiri (2019) explored the impact of the 2008 global financial crisis on the FH coefficient in South Africa for the periods 1960–2008 and 2008–2016 and found that it became insignificant after the crisis. Therefore, capital mobility increased after the 2008 crisis. Furthermore, capital inflows to the emerging economies have increased due to the United States (US)' QE policy (Ramírez and González, 2017). However, the heterogeneous distribution of the transnational capital flows in the

emerging market economies confirms that the risk aversion characteristic of the capital flows is an important factor for foreign capital attraction. Therefore, the high significant value of the saving retention coefficient for Greece when compared with the 1994–2001 period can be explained by the risk aversion characteristic of transnational capital flows, as suggested by Camarero et al. (2019).

The QE policy in the US after the global financial crisis led the significant changes in the financial variables of the developing and emerging economies. The considerable capital inflows, appreciation in their currencies, decreases in the returns of long-term bonds, and considerable increases in the stock markets were experienced in the aforementioned economies (Bhattari *et al*., 2015). Khatiwada (2007) also attributed the considerable capital inflows to the developing countries during the period of 2008-2014 to the QE policy of Fed (Federal Reserve). Therefore, the factor beyond the control of countries played a key role in the fluctuations and sudden stops in the transnational capital flows to the countries. However, the positive changes in industrial production and stock market performance of the countries were the important factors affecting the capital inflows to the developing and emerging economies (Khatiwada, 2017). Clark *et al*. (2020) also suggested that Fed monetary policy, loan spreads, economic growth, and commodity prices were the significant factors affecting the transnational capital inflows to the emerging and developing economies.

The global financial cycle exhibits importance for the emerging market economies. In this context, Fed monetary policy, the driving force of this cycle, significantly affects the emerging and developing economies. The Fed monetary policy affects the global portfolio investments and the financial conditions in the developing countries are structured through the global portfolio investments (Anaya *et al*., 2017). Therefore, the possible contractions in the international capital flows resulting from Fed monetary policy can negatively affect the economies of developing and emerging countries. As a result, the central banks in the developing and emerging markets cannot follow an independent monetary policy under the effect of global financial flows (Rey, 2015). In this case, the impossible dilemma hypothesis would be more accurate instead of impossible trinity hypothesis.

In such a situation, as shown in the studies of Dash (2019) and Eyüboğlu and Uzar (2020), the decrease in access to resources in international capital markets will have negative effects for the relevant countries. According to these results, if international capital mobility is high, the emergence of a more fragile world economy and a crisis that may emerge with the globalization process will limit capital movements to the relevant countries and reduce the borrowing opportunities.

The causal interplay between domestic savings and domestic investments was explored by the Dumitrescu and Hurlin (2012) panel causality test; the causality analysis results are shown in Table 9. The test results show causality from the domestic savings to the domestic investment.

Table 9

Dumitrescu and Hurlin (2012) Causality Test Results

Null Hypothesis:	W-Stat.	Zbar-Stat.	Prob.
SAVING ↛DINV	3.81578	2.46064	0.0139
DINV ↛SAVING	2.07571	-0.42761	0.6689

*Note: ***, **, *: significance at 1,5 and 10 % level.*

5. Conclusion

In this study, the interaction between domestic savings and domestic investment was researched using a sample of emerging markets over the period 1994–2015 in the short and long run. First, Westerlund's (2008) Durbin–Hausman panel cointegration test was applied and showed that there is a cointegrating relationship between domestic savings and domestic investment over the 1994–2015 period.

In the 1994–2016 period, the β coefficient is very close to 0, namely 0.28. However, when sub-periods such as 1994–2001 and 2002–2016 are analyzed, it is obvious that the β coefficient is lower in the period of 2002–2016. This indicates that capital flows to the emerging markets have a positive effect on domestic investment. This result is not consistent with that of Feldstein and Horioka (1980) and is consistent with that of Rocha (2007), who used the data for the period 1960–1996 for 29 developing countries and found that the estimated effect of savings on investment is 0.40, which is extremely small. According to this result, there is a possibility that in the developing countries some degree of capital mobility exists.

When the period 1994-2016 is examined, the findings indicate that the β coefficients for countries are statistically significant in the cases of Brazil, Colombia, Egypt, Hungary, India, Indonesia, Malaysia, Mexico, and Thailand, whereas it is not significant in other countries. When this period is divided into the two sub periods of 1994-2001 and 2002-2016, respectively, both the statistically insignificant coefficients and the zero approaching coefficients increase in the latter. When the 1994–2001 period is examined, the β coefficients for Brazil, Czech Republic, Egypt, Hungary, India, Peru, Poland, Pakistan, and Russia are significant. The coefficients are negative for Hungary. In the 2002–2016 period, the coefficients, according to the estimations results, are not significant in Brazil, China, Colombia, Hungary, Indonesia, Malaysia, Peru, Philippines, Russia, South Africa, South Korea, Thailand, and Turkey.

Both the dummy variables used for the 1994–2016 period have a negative value. However, the dummy variable for 1998–2002 and 2013–2016 (a period of decreasing capital flows to the emerging markets) has more of a negative impact on investment than in the 2002–2007 period (a period of increasing capital flows to the emerging markets). This result means that, for the emerging markets, capital inflows have a significant effect on domestic investment. These results do not support those of Feldstein and Horioka (1980). They also indicate that if there is a decrease in capital inflows to the emerging market countries, this will have a negative effect on these countries. In this context, sudden capital outflows or significant cuts in foreign capital inflows will increase the problem of financing faced by a developing country and, in turn, economic growth and sustainability of the current account deficit will be adversely affected.

These results show that developing countries have experienced high capital inflows in the study period, thus providing a significant portion of the country's domestic investments from foreign markets. This result is not compatible with Feldstein and Horioka's (1980) prediction. Contrary to those authors, when the capital movements are high, the domestic savings and domestic investment relationship weakens and even disappears in some countries. The results also indicate that the capital inflows to the developing countries in the 2000s were negative for these countries, especially due to the increase in interest rates as a result of inflation and higher employment in the United States and the European Union. This may also be the result of these countries experiencing problems when financing their domestic investment.

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Appendix

Table 10

Literature Summary Related to the Feldstein and Horioka Hypothesis

Study	Sample/Study period	Method	Validity of Feldstein and Horioka's (1980) findings (β value)
Fieleke (1982)	18 industrial countries and 69 non-industrial countries/ 1968-1977	Regression analysis	Valid (β= 0.89 for industrial countries); (β= 0.65 for nonindustrial countries); (β= 0.66 for all 87countries);
Penati and Dooley (1984)	19 industrial OECD countries/ 1949-1981	Time-series cross-section analysis	Valid (β= 0.88 for 1949-1959; β= 0.88 for 1971-1981)
Dooley *et al*. (1987)	14 industrialized countries and 48 developing countries /1960-1984	Regression analysis	Valid (β= 0.75 for industrial countries in 1960-1973; β= 0.74 for industrial countries in 1974-1984); (β= 0.46 for developing countries in 1960-1973; β= 0.61 for developing countries in 1974-1984)
Golub (1990)	23 OECD countries/ 1970-1979 and 1980-1986	Regression Analysis	Valid (β= 0.85 for 1970-1979 and β= 0.85 for 1980-1986)
Sarno and Taylor (1998)	UK/ 1955-1995	Chow test/ Cointegration test/ Correlation test	Valid (The correlation coefficients are considerably lower in the duration after the UK exchange controls' abolition. In other words, UK is highly integrated with the global financial markets as of 1979.)
Blanchard and Giavazzi (2002)	OECD, EU, and Eurozone/ 1975 -2001	Regression Analysis	Valid for OECD and invalid for EU and the Eurozone (β= 0.58 for OECD; β= 0.47 for EU and β= 0.35 for Eurozone)
Narayan (2005)	Japan/ 1960-1999	Cointegration Test	Valid (β = 0.68)
Christopoulos (2007)	OECD countries/ 1885-1992	Dynamic ordinary least squares	Valid (β is around 0.5 for whole sample period (1885–1992); β = 0.79 for 1921-1992; β = 0.79 for 1950-1992)
Di Iorio and Fachin (2007)	EU-12/ 1960-2002	Panel bootstrap tests	Valid (except the UK) (β= 0.59 to 1.03 (for the UK = -0.25))
Mastroyiannis (2007)	Greek/ 1960-2004	Time series analysis	Valid for the period of 1960-2003, but FH (1980) did not hold after Greek's accession to the EU (1992), since the degree of integration of the Greek economy into the international capital market has increased

Study	Sample/Study period	Method	Validity of Feldstein and Horioka's (1980) findings (β value)
Marinheiro (2008)	Egypt/ 1977-2003	Cointegration test	Invalid
Fouquau *et al*. (2008)	24 OECD countries / 1960-2000	Panel smooth transition regression	Valid (β = 0.502 to 0.710)
İyidoğan and Balıkçıoğlu (2010)	Turkey/ 1968-2008	Cointegration Test (Bounds tests)	Invalid
Rao *et al*. (2010)	13 OECD countries/ 1960-2007	Dynamic regression analysis	Invalid (β = 0.963 for 1960-1974; β = 0.538 for 1975-2007; β = 0.528 for 1960-1994; β = 0.289 for 1995-2007 with the System Generalized Method of Moments); (β = 0.590 for 1960-1994; β = 0.414 for 1995-2007 with Generalized Method of Moments
Kumar and Bhaskara Rao (2011)	OECD/ 1960-2007	Panel cointegration test	Weakly valid (β = 0.30 for fixed effect model; β = 0.57 for random model)
Jošić and Jošić (2012)	Croatia/ 1994-2010	Johansen cointegration test and Granger causality	Invalid (β=0,88)
Adebola and Dahalan (2012)	Tunisisa/ 1970-2009	ARDL, FMOLS, DOLS	Invalid (β=1,407; 0,649 and 0,688)
Petreska and Mojsoska-Blazevski (2013)	Central and Eastern Europa; South-East Europe; Commonwealth of Independent States/ 1991-2010	Panel Cointegration	Valid (β = 0.86 for Central and Eastern Europe; β = 0.58 for South-East Europe; β = 0.47 for Commonwealth of Independent States)
Erataş *et al*. (2013)	G7/1990-2012	Westerlund ECM; Common Correlated Effect	Invalid (β = 0.42)
Tunçsiper and Biçen (2016)	E7 countries/ 1990-2014	SUR regression	Valid for China, India and Indonesia (βs were respectively 0,806, 1,360 and 1,268) Invalid for Brasil, Mexico, Russia and Turkey (βs were respectively 0.370, 0.492, 0.508 and 0.431)
But and Morley (2017)	27 OECD countries / 1980-2012	Regression analysis	FH puzzle weakened until global financial crisis, and then revived afther the crisis.
Ay and Özmen (2017)	12 emerging economies/ 1970-2015	FMOLS, DOLS, CCR and panel causality	Mixed (β coefficient in China, South Africa and India is one or near to one, and is relatively small for Argentina, Turkey and Egypt. On the other hand, the fact that the

Study	Sample/Study period	Method	Validity of Feldstein and Horioka's (1980) findings (β value)
			coefficients are close to zero for Peru, Chile and Brazil indicate the FHP)
Demir and Cergibozan (2017)	Turkey/ 1962-2015	Markov regime switching approach	Partially valid (β=0.53 for 1990-2015 period) Invalid (β=0.89 for 1962-1989 period)
Mosikari *et al*. (2017)	BRICS countries/ 2001-2014	Panel cointegration test, FMOLS, DOLS estimators	Invalid (β=0.85, 0.74 with two estimators)
Drakos *et al.* (2018)	14 European Union/ 1970-2015	Panel cointegration approach	Weakly valid
Çiftçi *et al.* (2018)	28 OECD states/ 1980-2015	Panel cointegration test	Invalid
Grubišić *et al.* (2018)	Czech Republic, Hungary, Poland, Serbia	Cointegration test	Invalid
Pata (2018)	E7 countries/ 1989-2015	Panel cointegration and causality analyses	Valid (β= 0.792 and 0.758 with different estimators)

Table 11

Panel Unit Root Test Results

Variables	Constant	Constant + Trend
INV	-0.001 (0.500)	-0.501 (0.308)
d(INV)	-7.195 (0.000)***	-4.409 (0.000)***
SAVING	-1.598 (0.055)*	-1.341 (0.090)*
d(SAVING)	-8.220 (0.000)***	-6.162 (0.000)***

*, *** significance at 10% and 1% level.