# International Capital Flows and the 'Feldstein Horioka Puzzle' Evidence from Emerging Asian Economies

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**Abstract**

This paper revisits the Feldstein and Horioka (FH) (1980) hypothesis for a panel of 8 emerging Asian economies. The saving-investment relationship is estimated over the period 1965-2013 (full sample period) as well as for the sub-period 1965-1994. The later period is assumed to be an era when the Asian economies were not as open to the global capital markets compared to the current times. The study uses Fully Modified OLS (FMOLS), Dynamic OLS (DOLS) and the panel cointegration techniques to estimate the FH $\beta$ coefficient for these countries. It finds that the savings and investment are cointegrated for both the sample periods. Further, the FMOLS and the DOLS results show that the value of $\beta$ is significantly higher for the full sample period as compared to the sub-sample period. This indicates that during the post liberalisation period capital flows have significantly increased in these countries. Hence, the study confirms the claim of FH that a high correlation between the savings and investment shows a lower capital mobility.

*JEL classification:* F32; E2

*Key Words:* Capital mobility, Saving-investment correlation

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## 1. Introduction

Modelling the relationship between aggregate savings and investments, and their linkage with other macro-economic variables such as capital flows have long been a challenge in open economy macroeconomics. Theoretically, in an open economy, savings and investments are mostly influenced by capital flows and world interest rate. Hence, the relationship between these two variables is not expected to be strong in an economy which is open to capital flows. This contradicts the results of Feldstein and Horioka (FH) (1980). The results of FH (1980) indicates that there exists a strong correlation between domestic saving rate and investment rate in 16 OECD countries for the period 1960-74. As it is well known the OECD economies are 'advanced' economies and more capital flows are expected in these economies, so the finding of FH (1980) is a 'puzzle'. Most importantly, after this result found to be contradictory to many of the existing studies indicating the evidence of capital mobility (e.g. Obstfeld 1986, 1995), a number of studies have attempted to test this issue for single country cases as well as for a cross section of countries. Obstfeld and Rogoff (2000) have regarded FH puzzle as one of the six major puzzle in the international monetary economics.

During last decade there have been several attempts to examine this issue both in the case of the developed countries as well as emerging economies[4]. Two extreme results can be found in the existing literature. While one set of studies found that there exists high correlation between the domestic savings and investment and thereby validated the existence of the puzzle (Penati and Dooley, 1984; Feldstein and Bachetta, 1991), the other set of studies obtained the $\beta$ coefficient value close to zero, and hence contradicted the claim of Feldstein and Horioka (1980) (Sinn, 1992; Coakley et al. 2004). Further, some studies accepted the existence of high correlation between the savings and investments but not the fact that the high $\beta$ coefficient indicates low capital mobility (Petreska & Mojsoska-Blazevski, 2013). They argued that, high correlation between saving and investment in the presence of perfect capital mobility can be due to various other factors such as the size of the country (Harberger, 1980; Murphy, 1984), the degree of development of the country (Dooley et al., 1987; Sinn, 1992; Sinha and Sinha, 2004), degree of openness of the economy (Bahmani-Oskooee and Chakrabarti, 2005, 2005) and the effect of the European Union (Feldstein and Bachetta, 1991).

[4] Recent studies include (Johnson & Lamdin, 2014; Chang & Smith, 2014; Barros & Gil-Alana, 2015)

Given this back ground, the objective of this paper is to examine the link between openness and capital flows through the saving-investment relationship for eight emerging Asian economies. These economies were having restricted capital flows during 1960s and 1970s. Further, during 1990s, most of these countries introduced exchange rate reforms and implemented measures for the liberalisation of capital account. For example, in 1994 the People's Bank of China devalued the RMB against the US dollar, and thereby the exchange rate system officially changed to a managed float. Therefore, in this study, we use two sample periods, i.e. 1965 to 1994 (sub sample) and 1965 to 2013 (full sample). The former one is assumed to be the period when the Asian economies were relatively less open to world capital markets.

Kim et al. (2005) and Eslamloueyan & Jafari (2010)[5] have examined the same issue for the Asian economies. Our paper differs from the existing literatures in several ways. First, the study uses data for an extended period of time, from 1965 to 2013. This, in our view, is a more appropriate sample period, since it consists of longer data from the post liberalisation periods. Secondly, the study uses a battery of advanced panel unit root and cointegration tests, which can overcome the problems of low power associated with the traditional unit root and cointegration tests. Further, we also use the fully modified ordinary least squares (FMOLS) estimator of Phillips and Hansen (1990) and the dynamic ordinary least squares (DOLS) estimator of Stock and Watson (1993) to estimate the long run equilibrium parameters. The use of more than one estimator is crucial if there is concern about the robustness about the results (Narayan, 2005).

The rest of the paper is organised as follows. Section 2 briefly reviews the literature. Section 3 discusses the methodology. Section 4 the presents data and analysis the empirical results. Section 5 provides conclusion and policy implications.

## 2. Literature Survey

This section briefly provides a brief overview of the theoretical and empirical literature on the FH puzzle. First, we start with the basic equation of Feldstein and Horioka to explain the saving-investment relationship. The equation can be written as follows:

[5] Detailed discussions of these studies are given in the next section.

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

Where $(I/Y)_i$ is the ratio of gross domestic investment to gross domestic product in country $i$ and $(S/Y)_i$ is the corresponding ratio of gross domestic savings to gross domestic product. $\varepsilon_i$ is the error term. Feldstein and Horioka postulated that if the value of $\beta$ is close to one, then it indicates that capital is internationally immobile. On the other hand, if the value of $\beta$ is close to zero, we can say that capital is internationally mobile. In their study, for the period from 1960-1974, the estimated value of $\beta$ was varying between 0.87 to 0.91. This result was contrary to the supposed belief that capital is mostly mobile in the developed countries and hence became considered as a puzzle. Feeney (1994), accords importance to trade to explain the international capital mobility and argues that trade in goods and the international factor mobility are substitute to each other and claim that higher capital mobility is associated with increased trade openness. Narayan (2005) examine the saving-investment nexus for China for the period of 1952 to 1994. He found that the saving and investment are correlated for both the period of the fixed exchange rate (1952-1994) and the entire sample period (1952-1998), and the correlation found to be high for the period of fixed exchange rate. Hence, the study confirms the validity of the FH hypothesis for China.

Among the cross sectional studies, Bahmani-Oskooee and Chakrabarti (2005) studied the saving investment relationship for a panel of 126 countries for the period 1960 to 2000. The authors claimed that the correlation between the saving and the investment varies with the degree of openness. They also found that the correlation is much stronger in the less open economies as compared to the more open economies. Payne and Kumazawa (2005) investigating the same issue for a panel of 29 sub-Saharan African countries for the period 1980 to 2001, found that there is a positive and significant impact of openness on investment.

Further, Dar and Amirkhalkhali (2006) and Amirkhalkhali and Dar (2007) investigated the relationship between capital mobility and openness for a panel of G-7 countries and 23 OECD countries, respectively. The authors do not find evidence in favour of the argument that more openness leads to increasing capital flows in these countries. It can also be seen that bulk of the cross sectional studies are based on the OECD countries, while a very few of them focus on the Asian economies. Kim et al. (2005) examined the FH hypothesis for 11 Asian economies for the period of 1960 to 1998. They found that after the capital account

liberalisation in most of the Asian countries in 1980s, capital became more mobile. In contrast, for the period prior to 1980s, the FH coefficients are found to be very small, showing high correlation between saving and investment, and hence the existence of less capital mobility. Eslamloueyan and Jafari (2010), investigated the relationship between openness to trade and saving-investment behaviour for a panel of 21 Asian countries for the period from 1990 to 2006. The authors found that more openness to trade implies greater capital mobility in Asia. Further, the results also showed that trade in goods and capital mobility are complimentary to each other.

However, these studies have some limitations. First, both the studies[6] considered a very short time period for the post liberalisation era. Since most of the Asian countries liberalized after 1990s, considering a longer duration post liberalization can better explain the openness and capital flow relationship. Second, the studies have used unit root tests which are less powerful than Maddala and Wu (1999) and Pesaran (2007) unit root tests. This is because these earlier tests assume that the cross-sections are independent. Third, unlike the panel used in this work i.e. emerging Asian economies, the panel used in the earlier studies are not unique, as the sample are mostly the random sample. Hence, there is the possibility that the result may not effectively explain the saving-investment relationship in those studies.

To fill these gaps, our study tries to examine the link between openness and capital flows in the context of eight emerging Asian economies on the basis of saving-investment relationship as postulated by FH (1980).

## 3. Methodology[7]

### *3.1. Panel unit root test*

As it is important to test whether the variables are integrated of the same order for applying the cointegration test, we applied a battery of first generation and second generation panel unit root tests. The tests proposed by Im et al. (2003) (IPS) and Maddala and Wu (1999) (MW) are called as the first generation panel unit root test, and the unit root test of Pesaran (2007) called as the second generation unit root test. These tests are less restrictive and more powerful than the tests of Levin and Lin (1993) and Levin et al. (2002), which do not allow for heterogeneity in the autoregressive coefficient (Bangake and Eggoh, 2011). Further, Im et al. (2003) test permits to solve Levin and Lin's serial correlation problem by assuming

[6] Kim et al., (2005) and Eslamloueyan and Jafari (2010).
[7] The methodologies are mostly followed from the Bangake and Eggoh (2011) paper.

heterogeneity between units in a dynamic panel framework. The basic equation for the panel unit root test for IPS can be explained as follows:

$$\Delta y_{it} = z_{it}'\gamma + \rho_i y_{it-1} + \sum_{j=1}^{k_i} \varphi_{ij} \Delta y_{it-j} + \varepsilon_{it},\ i = 1, \dots, N; t = 1, \dots, T \quad (2)$$

Where $k_i$ shows the lag order and $z_{it}$ represents the deterministic terms (such as a constant and a trend). The unit root null hypothesis can be given as $H_0$: $\rho_i = 0$, $\forall_i$= 1,…, N, against the alternative hypothesis that is $H_1$: $\rho_i < 0$ for some $i$=1,…, $N_1$ and $\rho_i = 0$ for $i$= $N_1$+1,….,N. The IPS proposed a standardised t-bar test statistic based on the (augmented) Dickey-Fuller statistics averaged across group can be written as:

$$\bar{t} = \frac{1}{N} \sum_{i=1}^{N} t_{iT}, \quad (3)$$

Where $t_{iT}$ is the ADF statistic for country $i$ based on the country specific ADF regression, as in Eq. (2). The $\bar{t}$ statistic follows the standard normal distribution asymptotically. The standardised statistic $t_{IPS}$ can be expressed as:

$$t_{IPS} = \frac{\sqrt{n}\left(\bar{t} - \frac{1}{N}\sum_{i=1}^{N} E(t_{iT}|\rho_i = 0)\right)}{\sqrt{\frac{1}{N}\sum_{i=1}^{N} Var(t_{iT}|\rho_i = 0)}} \quad (4)$$

Maddala and Wu (1999) find that the IPS test, while relax the assumption of homogeneity of the root across the units, still have several difficulties. Rather, they suggest the Fisher type test, which is based on combining the p-values, $\pi_i$ of the test statistic for the unit root in each cross sectional unit. The MW test statistic $\lambda$ is given by

$$\lambda = -2 \sum_{i=1}^{N} ln\pi_i, \quad (5)$$

The MW is distributed as Chi-squared with 2N degrees of freedom under the hypothesis of cross sectional interdependence.

However, the standard IPS and the MW tests assume that cross-sections are independent. Therefore, both the tests can lead to spurious inferences if the errors, $\varepsilon_{it}$, are not independent across $i$. All the first generation panel unit root tests face the same problems. Recently, some new techniques emerged which address the issue of dependence and correlation which are called as the second generation panel unit root tests. A well-known second generation test is used in this paper that is Pesaran's (2007) Cross-Sectionally Augmented IPS (CIPS) test. This test is designed to filter out the cross section averages of lagged levels and first differences of the individual series. The Cross-Sectionally Augmented Dickey-Fuller (CADF) regression is given by

$$\Delta y_{it} = z'_{it}\gamma + \rho_i y_{it-1} + \sum_{j=1}^{k_i} \varphi_{ij} \Delta y_{it-j} + \alpha_i \bar{y}_{t-1} + \sum_{j=0}^{ki} \eta_{ij} \Delta \bar{y}_{t-j} + v_{it} \quad (6)$$

where $\bar{y}_t$ is the cross section mean of $y_{it}$, $\bar{y}_t = N^{-1} \sum_{i=1}^{N} x_{it}$. The CIPS statistic is the simple average of the individual CADF statistics and defined as

$$\text{CIPS = t-bar} = N^{-1} \sum_{i=1}^{N} t_i\,(N, T). \quad (7)$$

where $t_i$ is the OLS t-ratio of $\rho_i$ in Eq. (6). Further, the critical values for CIPS are tabulated by Pesaran (2007).

*3.2. Panel cointegration test*

After the order of stationarity is defined, we applied the Pedroni's (1999 & 2004) cointegration test methodology. Indeed, like the IPS and MW panel unit root, the panel cointegration tests proposed by Pedroni (1999 & 2004) also take into account heterogeneity by using specific parameters that are allowed to vary across individual members of the sample (Bangake and Eggoh, 2011). Pedroni's tests of cointegration are derived from Engle and Granger (1987) cointegration test.

Pedroni's cointegration test can be implemented by estimating the following long run relationship:

$$(I/Y)_{it} = \alpha_i + \delta_i t + \beta_i (S/Y)_{it} + \varepsilon_{it}, \qquad \text{for } i = 1,\ldots, N;\ t = 1,\ldots, T. \tag{8}$$

The structure of the estimated residuals is as follows:

$$\hat{\varepsilon}_{it} = \hat{\rho}_i \hat{\varepsilon}_{it-1} + \hat{u}_{it}, \tag{9}$$

There are seven different statistics proposed by Pedroni to test the cointegration in the panel data analysis. Out of them, four are the called as the "Within" dimension, and the other three are called as the "Between" dimensions. In both the cases the null hypothesis are same (i.e. $H_0$: No cointegration) whereas the difference comes from the specification of the alternative hypothesis. For the tests based on "Within" dimension, the alternative hypothesis is $\rho_i = \rho < 1$ for all $i$, while for the tests based on "Between" dimension, the alternative hypothesis is $\rho_i < 1$, for all $i$.

Pedroni has tabulated the finite distribution for the seven statistics through Monte Carlo simulations. The calculated statistic tests must be smaller than the tabulated critical value to reject the null hypothesis of the absence of cointegration.

## 4. Data and empirical results

### *4.1. Data*

The data used in this paper are obtained from the World Development Indicators (WDI) database of the World Bank for 8 emerging Asian economies namely, China, India, Malaysia, Philippines, Korea, Singapore, Sri Lanka and Thailand.[8] Due to the non-availability of data we do not include the three other countries such as Taiwan province of China, Hong Kong SRC and Indonesia in our sample. The data set consists of the annual data from 1965 to 2013. Following Feldstein and Horioka (1980), the saving is measured as the gross domestic savings as ratio to gross domestic product (GDP), and the investment is measured as the gross fixed capital formation as ratio to GDP, for the respective countries.

[8] We have used the selected countries as the emerging Asian economies on the basis of Bluedorn et al. (2011) .

The descriptive statics are provided in Table 1. Here, invgdp and savgdp represent investment as ratio to GDP and saving as ratio to GDP, respectively. As expected, Table 1 shows that for the full sample period i.e. 1965 to 2013, there exist a relatively low correlation between the savings and investment (both the variables are expressed as ratio to GDP) than the period from 1965 to 1994. In other words, this indicates that the saving-investment correlation has reduced significantly after the addition of the post liberalisation periods into the sample. This supports the Feldstein-Horioka (1980) argument that a weak correlation between domestic saving and investment reflects the opening up of the economy to the capital flows. As the increasing capital mobility across countries have important macroeconomic implications, we examine the saving investment relationship more extensively.

Table 1 Descriptive Statistics

| **Variables** | **Mean** | **Max.** | **Min.** | **S.D.** | **Skewness** | **Kurtosis** | **J.B. Test** |
|---|---|---|---|---|---|---|---|
| *Full Sample: 1965-2013* | | | | | | | |
| invgdp | 0.265 | 0.462 | 0.125026 | 0.071134 | 0.528635 | 3.006751 | 18.25848 |
| savgdp | 0.282 | 0.54384 | 0.080203 | 0.111615 | 0.406412 | 2.262330 | 19.67904 |
| *Correlations* | | | | | | | |
| | invgdp | savgdp | | | | | |
| invgdp | 1 | 0.660 | | | | | |
| savgdp | 0.660 | 1 | | | | | |
| *Sub-Sample: 1965-1994* | | | | | | | |
| invgdp | 0.254 | 0.462 | 0.125 | 0.072 | 0.474 | 2.850 | 9.213 |
| savgdp | 0.251 | 0.490 | 0.080 | 0.092 | 0.433 | 2.478 | 10.236 |
| *Correlations* | | | | | | | |
| | invgdp | savgdp | | | | | |
| invgdp | 1 | 0.738 | | | | | |
| savgdp | 0.738 | 1 | | | | | |

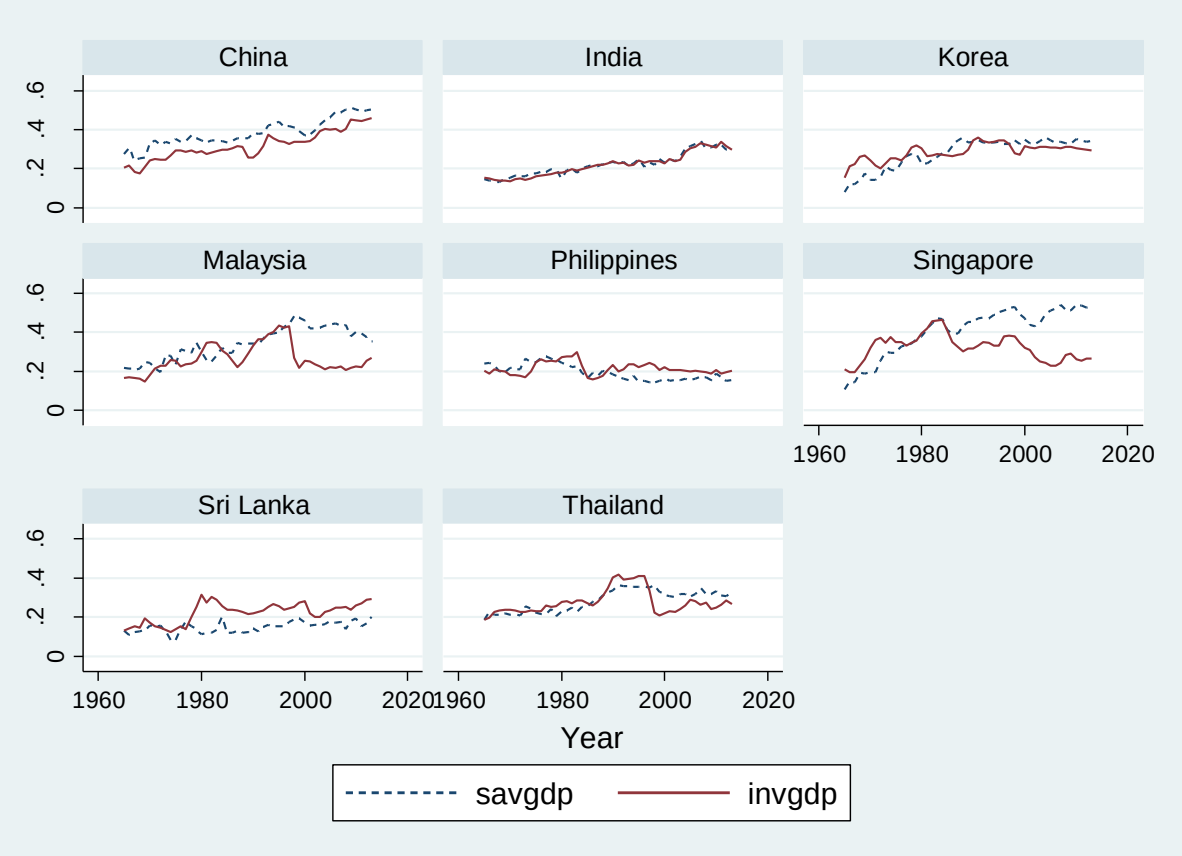
Note: "invgdp" is the gross domestic investment to GDP ratio and "savgdp" is gross domestic saving to GDP ratio.

In figure 1 we present the basic trend in saving and investment for the eight emerging Asian economies for the period 1965 to 2013. This shows that there is a significant change in the movement of both saving and investment after 1990s (i.e. post globalisation period) for most of the countries. In case of Malaysia, Singapore, Korea and Thailand, the gross domestic

saving has increased to a larger extent than the gross domestic investment, thereby, the saving investment gap has increased significantly during the post reform period. On the other hand, in case of Philippines and Sri Lanka, the investment has remained higher than the saving. Further, for China, both the savings and investment have increased over time and the savings remained higher than the investment. However, in Indian context, both the variables have increased over time and moved together for whole period of the study.

Similar kind of trends in saving-investment have been observed by some of the earlier studies (Chinn and Ito, 2007; Chinn and Ito, 2008). Clarida (2005a, b) argued that the existence of the less sophisticated financial market is considered as one of the major factor for higher saving and lower investment rate in the emerging Asian economies. Further, Bernanke (2005) found that the saving glut of the Asian emerging market economies, mostly driven by rising savings and collapsing investment in the aftermath of the financial crisis, is the direct cause of the US current account deficit.

Fig. 1. Trend in savings and investments (as ratio to GDP)



*4.2. Panel unit root test*

As it is necessary to test the order of integration of the variables for applying the panel cointegration test, we use three panel unit root tests such as Im et al. (2003), Maddala and Wu (1999), and Pesaran (2007). The results of the unit root tests are reported in Table 2. This shows that the null hypothesis of unit roots for the panel data for savings and investment (both for full sample: 1965 to 2013, and sub-sample: 1965 to 1994) cannot be rejected at levels, rather both the variables are integrated of order one. In other words, the variables are non-stationary at levels but stationary at first difference. This provides justification for applying panel cointegration test.

Table 2 Panel unit root tests

| | **Im et al. (2003)** | | **Maddala and Wu (1999)** | | **Pesaran (2007)** | |
|---|---|---|---|---|---|---|
| | Statistic | P-values | Statistic | P-values | Statistic | P-values |
| **Full Sample: 1965 to 2013** | | | | | | |
| $(I/Y)_{it}$ | 0.544 | 0.707 | 31.342 | 0.012 | -1.251 | 0.106 |
| $\Delta(I/Y)_{it}$ | -7.796 | 0.000 | 165.154 | 0.000 | -9.545 | 0.000 |
| $(S/Y)_{it}$ | -1.108 | 0.134 | 18.520 | 0.294 | -0.943 | 0.173 |
| $\Delta(S/Y)_{it}$ | -18.869 | 0.000 | 237.483 | 0.000 | -10.064 | 0.000 |
| **Sub-Sample: 1965 to 1994** | | | | | | |
| $(I/Y)_{it}$ | 0.544 | 0.707 | 17.520 | 0.353 | -1.846 | 0.032 |
| $\Delta(I/Y)_{it}$ | -7.796 | 0.000 | 84.693 | 0.000 | -5.937 | 0.000 |
| $(S/Y)_{it}$ | -0.932 | 0.175 | 20.779 | 0.187 | -1.834 | 0.033 |
| $\Delta(S/Y)_{it}$ | -13.316 | 0.000 | 174.835 | 0.000 | -6.843 | 0.000 |

*4.3. Panel cointegration test*

The results of the Pedroni's (1999) panel cointegration tests are presented in Table 3 and 4. While Table 3 shows the cointegration results for the full sample (1965 to 2013), the sub-

sample (1965 to 1994) cointegration results are explained in Table 4. We report both the within and between panel cointegration test statistics for our panel data set. These statistics are based on averages of the individual autoregressive coefficients associated with the unit root tests of the residuals for each country in the panel. The results from the Table 3 shows that all the statistic values are significant at least at 5 percent level. That means the null of no cointegration between the savings and investment is rejected at 5 percent significance level which implies that both the savings and investment are cointegrated in the long run.

Further, Table 4 which reports the results of cointegration between savings and investment for the sub-sample periods, 1965 to 1994, show that all the test statistics except Panel $\boldsymbol{\rho}$-Stat (both in Within and Between dimensions) reject the null of no cointegration at least at 10 percent level of significance. That means before 1994 (assuming prior to globalisation periods), both saving and the investment are also cointegrated, showing the long run relation between the variables.

The existence of cointegrating relationship between investment and saving in both the panels shows that these countries meet the long run solvency condition in both the periods. After getting the cointegrating link between both the variables, it is convenient to estimate the saving retention coefficients using the panel cointegrating estimators such as the Fully Modified OLS (FMOLS) and the Dynamic OLS (DOLS).

Table 3 Pedroni panel cointegration test results, 1965 to 2013.

| **Methods** | **Within dimension (Panel statistics)** | | | **Between dimension (Group statistics)** | | |
|---|---|---|---|---|---|---|
| | Test | Statistics | Prob. | Test | Statistic | Prob. |
| **SAVGDP INVGDP** | | | | | | |
| **Pedroni(1999)** | Panel $\boldsymbol{v}$-Stat | 2.077 | 0.019 | Panel $\boldsymbol{\rho}$-Stat | -2.693 | 0.003 |
| | Panel $\boldsymbol{\rho}$-Stat | -1.758 | 0.039 | Panel PP-Stat | -3.049 | 0.001 |
| | Panel PP-Stat | -1.764 | 0.039 | Panel ADF-Stat | -4.794 | 0.000 |
| | Panel ADF-Stat | -2.888 | 0.000 | | | |
| **Pedroni (2004) (Weighted statistic)** | Panel $\boldsymbol{v}$-Stat | 2.312 | 0.01 | | | |
| | Panel $\boldsymbol{\rho}$-Stat | -3.848 | 0.000 | | | |

| | | | |
|---|---|---|---|
| | Panel PP-Stat | -3.412 | 0.000 |
| | Panel ADF-Stat | -4.764 | 0.000 |

Table 4 Pedroni panel cointegration test results, 1965 to 1994.

| **Methods** | **Within dimension (Panel statistics)** | | | **Between dimension (Group statistics)** | | |
|---|---|---|---|---|---|---|
| | Test | Statistics | Prob. | Test | Statistic | Prob. |
| **SAVGDP INVGDP** | | | | | | |
| **Pedroni(1999)** | Panel $\boldsymbol{v}$-Stat | 1.564 | 0.059 | Panel $\boldsymbol{\rho}$-Stat | -0.98 | 0.163 |
| | Panel $\boldsymbol{\rho}$-Stat | -1.236 | 0.108 | Panel PP-Stat | -1.794 | 0.036 |
| | Panel PP-Stat | -1.357 | 0.087 | Panel ADF-Stat | -3.128 | 0.000 |
| | Panel ADF-Stat | -2.055 | 0.02 | | | |
| **Pedroni (2004) (Weighted statistic)** | | | | | | |
| | Panel $\boldsymbol{v}$-Stat | 1.486 | 0.069 | | | |
| | Panel $\boldsymbol{\rho}$-Stat | -2.318 | 0.01 | | | |
| | Panel PP-Stat | -2.416 | 0.008 | | | |
| | Panel ADF-Stat | -3.104 | 0.001 | | | |

*4.4. Results of FOLS and DOLS*

Although Pedroni's cointegration test shows that whether the variables are cointegrated in the long run or not, it does not provide the estimation of such long run relationships. There are various estimators such Fully Modified OLS (FMOLS), Dynamic OLS (DOLS) and Pooled Mean Group (PMG) which are used to estimate the coefficient values of the long run relationship in the presence of cointegration among the variables. In this paper we have considered two estimators i.e. FMOLS and the DOLS to examine the validity of the Feldstein-Horioka Puzzle in the emerging Asian countries.

Both the tests (FMOLS and DOLS) are proposed by Kao and Chiang (2000) to estimate the long run cointegration vector for non-stationary panels. These estimators correct the standard pooled OLS for serial correlation and endogeneity of regressors that are normally present in a long-run relationship (Bangake and Eggoh, 2011). The results of FMOLS and the DOLS are presented in the Table 5.

Table 5 Results of FMOLS and DOLS for 8 emerging Asian countries

| **Sample Periods** | **FMOLS** | **DOLS** |
|---|---|---|
| **Full Sample: 1965 to 2013** | $0.5969^{***}$ (0.0694) | $0.5974^{***}$ (0.0905) |
| **Sub-Sample: 1965 to 1994** | $0.7703^{***}$ (0.1079) | $0.9070^{***}$ (0.2178) |

Notes: 1. The values in the parenthesis denote standard errors.
2. $^{***}$ shows significance at 1% level.

The results of both FMOLS and DOLS give interesting insights about the existence of Feldstein-Horioka puzzle for the eight emerging Asian economies. The results show that, before 1994, when these economies were not as open as it is now (i.e. the capital flows were less in magnitude), the savings retention coefficients are very high i.e. 0.77 and 0.90, as estimated by the FMOLS and DOLS, respectively. On the other hand, for the full sample period of 1965 to 2013, when the economies opened up to the world economy (and hence the capital flows increased), the saving retention ratio came down to a low level of 0.596 and 0.597, respectively.

Hence, our result supports the argument of Feldstein and Horioka (1980) that an economy having high correlation between its domestic saving and investment is relatively less open to capital flow than the economy having less correlation between its domestic saving and investment.

Further, this study conducted the panel granger causality test to examine the direction of causality between the saving as ratio to GDP and investment as ratio to GDP for both the sample periods. As panel Granger Causality test shows the short run relation between the variables therefore, this study capture the speed of adjustment or $ECM_{t-1}$ term through

Arellano-Bond (1991) dynamic panel generalized method of moment (GMM) (Narayan et al. 2012 and Narayan and Smyth ,2008). We report the result in Table 6.

Table 6: Panel Granger Causality Result

| | **Full Sample (1965-2013)** | | | **Sub-Sample (1965-1994)** | | |
|---|---|---|---|---|---|---|
| | dsavgdp | dinvgdp | $ECM_{t-1}$ | dsavgdp | dinvgdp | $ECM_{t-1}$ |
| **dsavgdp** | --------- | 7.52 (0.00) | -0.37 (0.00) | ---------- | 7.78 (0.00) | -0.42 (0.00) |
| **dinvgdp** | 3.92 (0.02) | ---------- | 0.07 (0.13) | 2.12 (1.12) | --------- | 0.08 (0.23) |

Note: The null hypothesis is no Granger causality, and the probability values are given in the parenthesis.

The result of short run Granger causality is derived from the difference of the variables and the long run causality between the variables is observed from one period lag of error correction term (Narayan et al. 2012 and Bal and Rath, 2015). From the Table 6, we can find that, both in the short run as well as in the long run, there is unidirectional causality running from saving as ratio to GDP to investment as ratio to GDP.

## 5. Conclusions

Feldstein and Horioka examined the relationship between the domestic saving and the domestic investment for 16 OECD countries for the period from 1960 to 1974 and found a very high correlation between the two variables despite the OECD having more open and integrated market. This remains as a puzzle. Feldstein and Horioka (1980) argued that in a closed economy where the capital flows are restricted, the saving investment correlation will be high. In this study, we have revisited this for 8 emerging Asian economies for the period of 1965 to 2013. The study has used panel cointegration technique to test the long run equilibrium relationship between the savings and investment in these economies. Further, three classes of panel unit root tests such as Im et al (2003), Maddala and Wu (1999) and Pesaran (2007), and also the panel cointegration estimations like FMOLS and DOLS, are used to deal with the heterogeneity problems.

The empirical results of this study reveal that the savings and the investment are nonstationary (integrated of first order) and coinegrated for both the sample periods. The saving retention ratio which is significantly higher i.e. 0.7 (FMOLS) and 0.9 (DOLS) for the period of 1965-1994 than 0.56 (FMOLS) and 0.56 (DOLS) for 1965 to 2013. This shows that

during the period prior to 1994, the capital flows in these economies were very low and domestic investments were mainly being financed by the domestic savings. This results suggest that the emerging Asian economies are in conformity with the Feldstein-Horioka hypothesis, which is not surprising given that over the 1965-1994 period the capital mobility has been fairly restricted in these economies.

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