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International Capital Mobility and Saving-Investment Relationship in India

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Abstract

This paper examines the Saving-Investment (S-I) relationship and the extent of capital mobility in India during the period 1970-2010. We find that S-I are cointegrated, but the error correction model exhibits structural instability on the onset of balance of payment crisis in the 1990s and currency devaluation period after 2000. The interactive dummy variables reveal that the current period-pass through of savings to investment is negative and statistically significant in the post-2000 period, indicating huge capital mobility and currency depreciation. Furthermore, the speed of adjustment is quite low to restore to its steady state point due to structural shift of the parameters.

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1. Introduction

In a seminal study, Feldstein and Horioka (1980) examined the correlation between saving and investment rates and the extent of capital mobility across 16 OECD countries. They obtained that saving and investment were highly correlated and concluded that the degree of capital mobility in the industrialized countries was low. Murphy (1984), Obstfeld (1986), and Dooley *et al.* (1987) found the evidence of an association between saving and investment for the less industrialized and developing countries, although, the estimated correlation coefficients are lower on the average. The regularity of the result has made the saving-investment correlation of Feldstein and Horioka (1980) as one of the most important puzzles in international macroeconomics (Obstfeld and Rogoff, 2000).[1]

Following this controversial finding of Feldstein-Horioka puzzle, the relationship between saving and investment has been the subject of intense research over the past two decades. In brief, there are two strands of literature that attempt to shed more light on the Feldstein-Horioka puzzle. The first strand of literature, which is in line with the Feldstein-Horioka interpretation, argues that a closer relationship between saving and investment implies greater international capital immobility. Furthermore, the argument related to the endogenous nature of saving suggests that other factors could have induced the correlation between saving and investment rates, even if in the presence of capital mobility (Murphy, 1986; Obstfeld, 1986; Summers, 1988; Wong, 1990). Moreover, in many instances, the effect of country size has played an important role for the determination of international capital mobility and saving-investment relationship across OECD and other industrial countries (Murphy, 1984; Harberger, 1980).

The second strand of literature focuses on offering of alternative explanations for the saving-investment correlations. For instance, Bayoumi (1990) argues that the S-I relationship may be due to the implementation of government policies with the objective of achieving a balanced current account. Afterwards, the group of studies then raised the question of S-I correlation, which is an indicator of capital mobility. Since countries cannot run the current account deficits indefinitely, nevertheless, the intertemporal budget constraints suggest that there must be a long-run relationship between saving and investment (Coakley *et al*. 1996; Jansen, 1996; Jansen and Schulze, 1996). Another part of literature then agree that the interpretation of the estimated coefficient needs to be modified in view of the results derived from the intertemporal macroeconomic models, and consider that the analytically relevant correlation is a short-term one, defined as that between changes in saving and investment. The long-run correlation, in turn, captures the coefficients implied by the solvency restriction (Rocha, 2009, p. 612).

The purpose of this paper is to estimate the S-I relationship and the extent of capital mobility in India. This paper uses an error-correction model proposed by Jansen and Schulze (1996); Jansen (1996); Coakley *et al*. (1996, 1998) and Pelgrin and Schich (2004) to examine the S-I correlation and the extent of capital mobility in case of India, a country which has

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[1]Feldstein and Horioka (1980) found the high correlation between saving and investment rates by using the cross-section data for OECD countries, and the high correlation between saving and investment was interpreted as capital being immobile even among the developed countries. This came to be known as the "Feldstein-Horioka puzzle" because the evidence of capital immobility flies in the face of financial liberalization that seems to have already taken place. For its importance, Obstfeld and Rogof (2000, p. 175) have called it "the mother of all puzzles".

experienced a great deal of economic turmoil ranging from the balance of payment crisis in 1990s to the currency devaluation crisis after 2000s. Specifically, the following questions are examined: (1) has better domestic saving shocks in the current period pass through to investment? (2) Are saving and investment cointegrated and what is magnitude of adjustment? (3) What impact did the balance of payment crisis in 1990s and currency devaluation crisis after 2000s have on current period pass-through and the adjustment of the current account to long-run equilibrium?

The article is structured as follows. Section 2 provides a brief overview of the Indian experience. Section 3 discusses the econometric procedures and data sets. Section 4 interprets the estimated results. Section 5 concludes the analysis with a set of policy implications.

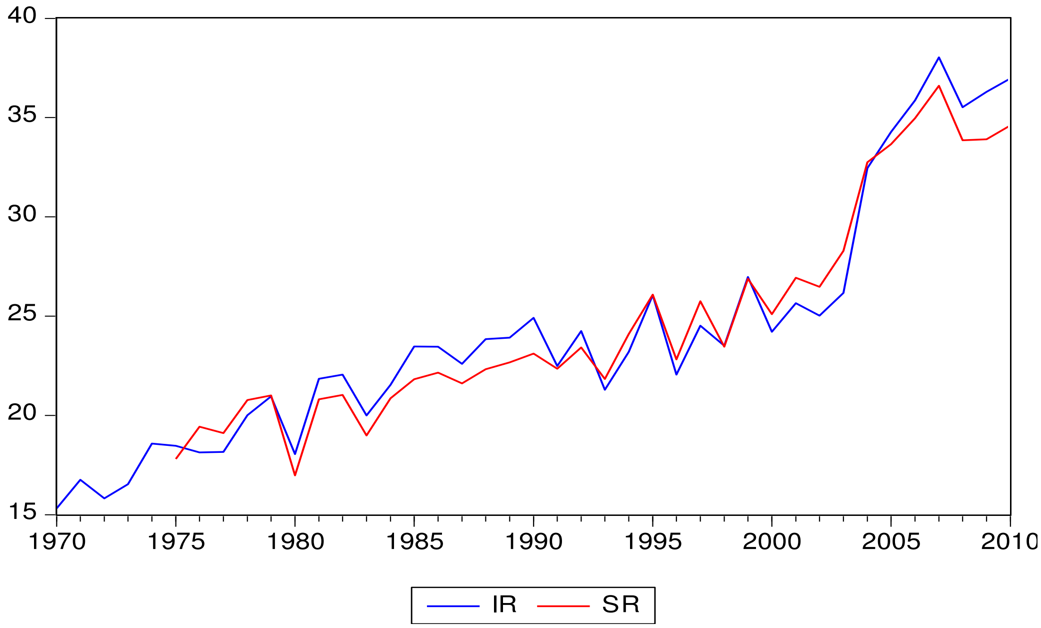
2. Brief Overview of the Indian Experience

Fig-1 presents the saving-investment trends of India during the period 1970-2010. The S-I trends have been clustered in between 15% to 38% and a reasonably low gap prevails between saving and investment in India. The investment rate (as % of GDP) exceeds the saving rate during the period 1978-2005. This indicates that India is one of the major recipients of foreign capital from abroad. India has received huge amount of foreign direct investment (FDI) of 4, 029 US million dollars in 2000-01 to 34,847 US million dollars in 2010-11. This is almost 9 times higher inflows of FDI in 2010 as compared to 2000, but despite that the percentage growth of FDI inflows over the years is negative. Corruptions, political instability, huge fiscal deficit, volatility in the capital market, and high inflation rates over the years are the key factors to trigger the risk premiums on assets and greater capital outflows. Over the years, the Indian rupee has been depreciated against the US dollars from 35.44 in 1996 to almost 68.30 in 2013. This is considered to be a very high risk currency in the world as compared to other developing countries like China, Brazil, South Africa, and Mexico.

By 1985, India had started suffering balance of payment problems. By the end of 1990s, India faced a serious economic crisis and, the crisis was caused by the currency overvaluation, the current account deficit, and the investor confidence played a significant role in the sharp exchange rate depreciation. The economic crisis was primarily due to the large and growing fiscal imbalances over the 1980s. The Gulf war swelled Indian import oil bills, export slumped, credit dried up, and investors took their money out. Large fiscal deficits over time had a spillover effect on trade deficit cumulating into an external payment crisis.

In mid-1991, the rupee exchange rate was subjected to a severe adjustment. The Reserve Bank of India took certain partial measures, defending the currency by expending international reserves and slowing the decline in value. However, in mid-1991, with foreign reserves nearly depleted, the Indian government permitted a sharp depreciation of currencies against major currencies. By the intervention of IMF, India adopted the liberalization policy in 1991 to overcome the economic crisis. India opened the door to foreign investment, reduced red tape that often cripples initiative and streamline industrial policy. The foreign exchange reserves started picking up with the onset of the liberalization policies.

Fig 1: Trends of Saving-Investment Rates in India during the Period 1970-2010.



Source: Own Compilation from World Development Indicator Tables, World Bank.

Note. Gross savings are calculated as gross national income less total consumption, plus net transfers. Gross fixed capital formation (formerly gross fixed domestic investment) consists of outlays on additions to the fixed assets of the economy plus net changes in the level of inventories. *SR* and *IR* represent the saving and investment as a percentage of GDP.

3. The Econometric Procedures and Data Sets

The objective of our empirical analysis is to evaluate the international capital mobility and estimate the long-and short-run dynamics of the saving-investment relationship in India. Furthermore, in order to check the stationarity of the variables, we follow the standard practice by applying the various unit root tests and cointegration tests. Then after, we follow the vector error-correction modeling to capture the speed of adjustment between the saving and investment rates in the model. The cointegration technique has been widely applied in empirical work to estimate the long-run relationship between the variables (when nonstationary time series are violated). According to this technique, if two variables are cointegrated, then the finding of non-causality in either direction is ruled out. Nevertheless, as long as the two variables have a common trend, causality in the Granger sense must exist at least in one direction. The cointegration indicates the presence or absence of Granger-causality; it does not indicate the direction of causality between the variables. The direction can be detected though the vector error-correction models (VECM), which is derived from the long-run cointegrating vectors (Baharumshah *et al.* 2002).

In the intertemporal macroeconomic models in the steady state, the saving and investment rates are cointegrated and exhibit a one-to-one relationship. Within this theoretical framework, the long-run saving-investment correlation represents the intertemporal budget constraint. However, in the short-run, shocks may initiate the movements between the saving and investment rates and could away from their steady state values. Given that the saving and investment rates are cointegrated in the steady state, the following error-correction model has been estimated to find out the basis of our inquiry.

$$\Delta IR_t = \alpha + \beta \Delta SR_t + \hat{\gamma}\left(IR_{t-1} - \hat{\phi}_i - \hat{\delta}_i SR_{t-1}\right) + \varepsilon_t \quad (1)$$

$$\forall t = 1,2,................T.$$

where *IR* is the gross fixed capital formation to GDP ratio, and *SR* is the gross domestic saving to GDP ratio of India over the different time period *t*.[2] The error-correction term (ECT) could be obtained by taking $\left(IR_{t-1} - \hat{\phi} - \hat{\delta}\, SR_{t-1}\right)$, to formulate an error-correction model. The estimate β, reflects the average contemporaneous co-movement between the saving and investment rates in response to shocks affecting the economy (i.e. current period pass through). The sign and significance of β estimate depends on the size and nature of shocks as well as structure of the economy. The high saving-investment correlation could represent either low capital mobility or the response of saving and investment to shocks stemming from the economy (Jansen and Schulze, 1996). Furthermore, small, positive, zero, or negative correlations are indicative of capital mobility in the countries. The estimate γ, could represent the adjustment parameter associated with error-correction term, and if γ # 0, then the saving and investment rates are cointegrated (Payne, 2005, p. 528).

Eq. (1) is estimated using the annual data obtained for India from the World Bank Indicators during the period 1970-2010. Gross savings are calculated as gross national income less total consumption, plus net transfers. Gross domestic investment consists of outlays on additions to the fixed assets of the economy plus net changes in the level of inventories. Domestic investment corresponds to the gross investment of the private and public sectors and saving corresponds to the sum of private and public sector savings. Both are divided by the gross domestic product (GDP) for conversion into rates.

4. Estimation Results

We begin the analysis by examining the unit root properties of the underlying variables. Following the standard practice, all variables are measured in natural logarithms. The stationarity and the order of integration of the variables are examined by using three standard unit root tests-the Augmented Dickey-Fuller (ADF); Dickey-Fuller GLS (DF-GLS); and Phillips-Perron (PP) tests. The unit root test results are reported in Table 1 unanimously suggest that the investment (*IR*) and saving rates (*SR*) are non-stationary at levels and *I*(1) variables.[3] This leads to the checking whether the cointegration exist between the saving and *IR* in India.

[2] Bayoumi (1990), and Shinha and Sinha (2004) suggest to use the gross fixed capital formation in place of gross capital formation to avoid the spurious correlation between the saving and investment rates.

[3] The variables are non-stationary at levels and follow the *I*(1) process. But when we include the trend, then in most of the cases, the variables are stationary at levels and integrated of order zero. But, despite this outcome, we could proceed to check the cointegration between the saving and *IR*. Wu (1996) examined that in the long-run the trend would be consistent in the time series variable like, exchange rate in the case of long-run PPP.

Table 1: Test Results for Unit Roots

	Without Trend			With Trend		
Variables	ADF	DF-GLS	PP	ADF	DF-GLS	PP
IR	-0.345 (0.908)	0.7118 (0.481)	-0.814 (0.804)	-3.300 (0.080)	-3.328 (0.001)	-3.332 (0.075)
ΔIR	-9.613 (0.000)	-8.474 (0.000)	-10.325 (0.000)	-9.508 (0.000)	-9.289 (0.000)	-10.390 (0.000)
SR	0.317 (0.976)	0.505 (0.616)	-0.561 (0.867)	-3.803 (0.026)	-3.908 (0.000)	-3.944 (0.019)
ΔSR	-9.951 (0.000)	-9.335 (0.000)	-11.950 (0.000)	-9.863 (0.000)	-9.844 (0.000)	-13.179 (0.000)

Note. Automatic selection of maximum lags is based on SIC: 0 to 2. Newey-West bandwidth selection using Bartlett and Kernel.

Tables 2 and 3 summarize the results of the cointegration analysis by using the Johansen maximum likelihood approach employing the Eigen-value and trace statistics. Initially, to determine the appropriate lag length for the VAR system, we estimate an unrestricted VAR model in level of the series and use Akaike Information Criteria (AIC), Schwarz Bayesian Criteria (SBC) and Hanann-Quinn (HQC) Criteria to choose the appropriate lag length in the model. The results suggest to taking 4 lags to get uncorrelated and homoskedastic residual for the VAR system. The cointegration test carried out by including an intercept and a trend in the cointegrating equation.

The results reported in Table 2 suggest that there is at least one stochastic trend present between the variables in the model. By the maximum likelihood ratio tests, one significant cointegrating vector is identified between the saving and *IR* in India. The null hypothesis indicates, no cointegration, $r = 0$, is rejected at the 5% level since the Eigen-value statistics (26.003) exceeds the critical values (18.330). However, we fail to reject the null hypothesis of at most one cointegrating equation. Similarly, Table 3 shows that the trace statistics (λ_{trace}) point to the existence of one significant cointegrating vector between the saving and *IR* in India. Furthermore, the result suggests that there could be a long-run relationship between the saving and *IR* in India.

The Johansen cointegration test shows that there exists one significant cointegrating vector between the saving and *IR*, which suggests that both variables are causally related at least in one direction. We can further use an error-correction model to investigate the short-and long-run dynamics between the saving and *IR* in India.

Table 2: Cointegration Test Based on Maximal Eigen value of the Stochastic Matrix, (VAR Lag = 4)

Null	Alternative	Max-Eigen Statistic	5% critical values
r = 0	r = 1	26.003*	18.330
r<= 1	r = 2	3.685	11.540

Note. * Denote rejection of the null hypothesis at the 5% level, maximal Eigen value statistics indicates 1 cointegrating equation at 5% levels; r indicates the number of cointegration relationship.

Table 3: Cointegration Test Based on Trace of the Stochastic Matrix

Null	Alternative	Trace Statistic	5% critical values
r = 0	r>= 1	29.688*	23.830
r<= 1	r = 2	3.685	11.540

Note.* Denote rejection of the null hypothesis at the 5% level, trace statistics indicates 1 cointegrating equation at 5% levels; r indicates the number of cointegration relationship.

The results of the error correction model specified in Eq. (1) are reported in Table 4. The estimated coefficient β, is statistically significant at the 1% level, suggests that the saving and *IR* are cointegrated with a binding intertemporal budget constraint and an adjustment parameter of -0.251. This further suggests that the speed of adjustment back to equilibrium following a disturbance is fairly slow at 25% rate. Furthermore, $\gamma \neq 0$ suggests a long-run relationship between the saving and *IR* in India.

Furthermore, the short-run estimated coefficient β, if it is not significantly different from zero, there is capital mobility; if β is not significantly different from one, capital is immobile, and β is significantly different from zero and one, there is an intermediate degree of capital mobility. Since β is significantly different from zero and one, we conclude that there is some degree of capital mobility. Furthermore, a lower value of coefficient estimate β, can be obtained if capital is sufficiently mobile (Rocha, 2009, p. 616). Nevertheless, we found that the estimated coefficient estimate β, is nearly equal to one (see Table 4), indicating an intermediate degree of capital mobility in India.

Table 4: Error Correction Model Results Saving-Investment Dynamics in India (1970-2010)

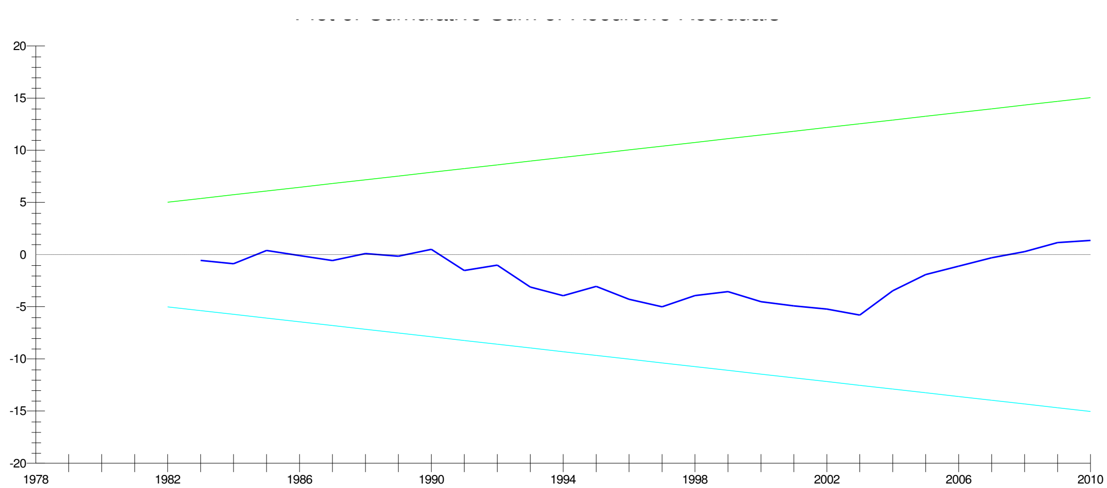
(Error Correction Model without Regime Shift)

α	β	γ	R^2	$\bar{R}^2$	*F-stat.*	*AIC*	*SBC*
-0.026 (-0.303	0.995* (5.762)	-0.251** (-2.189)	0.900	0.890	36.142*	68.919	65.866

Note: *t*-statistics are reported in parenthesis. ***, ** and * indicate 10%, 5% and 1% level of significance, respectively.

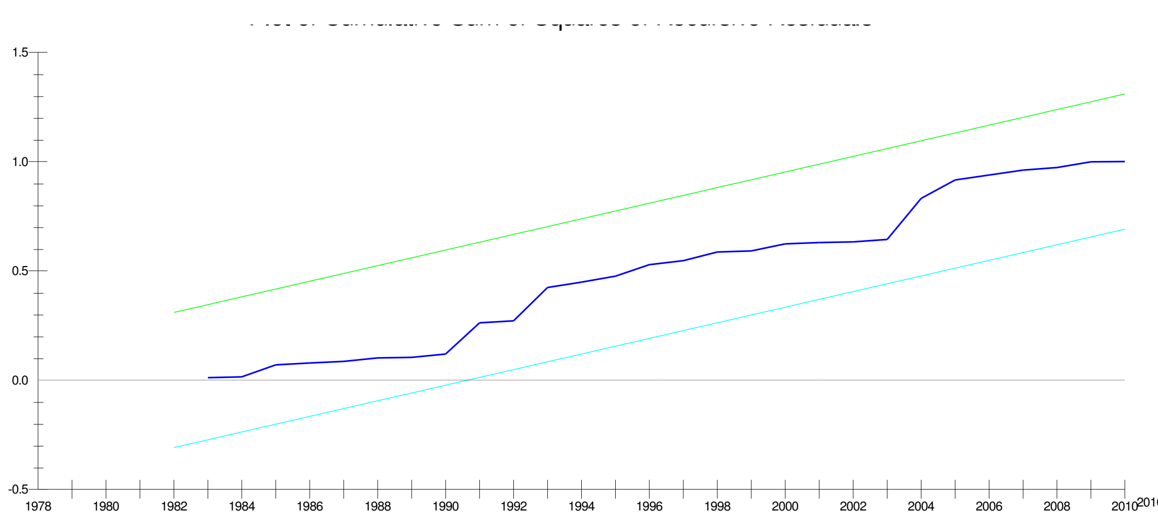
The structural stability of the error correction model is examined by employing the cumulative sum and cumulative sum of squares tests on the recursive residuals. The cumulative sum test is able to detect the systematic changes in the regression coefficients whereas the cumulative sum of squares test detects abrupt and sudden changes from the constancy of the regression coefficients (Brown *et al*. 1975; Payne, 2005, p. 530). Figs. 2 and 3 display the cumulative sum and cumulative sum of squares results, respectively. The cumulative sum statistics appears to be trending downward beyond 1990 in Fig 1, while the cumulative sum statistics lies within 5% critical bounds. On the other hand, the cumulative sum of squares statistics in Fig 3 are within the 5% critical bound, but the statistics shows that it goes upwards suddenly after 1990 and rapidly changes after 2000. Upon closer inspection of the recursive coefficient estimates for the changes in the saving parameter β, in Fig 4A and the adjustment parameter γ, in Fig 4B, reveals a structural shift before 1990s, corresponding to the balance of payment crisis, and after 2000s, corresponding to the currency devaluation crisis in India.

Fig 2: Plot of Cumulative Sum of Recursive Residuals



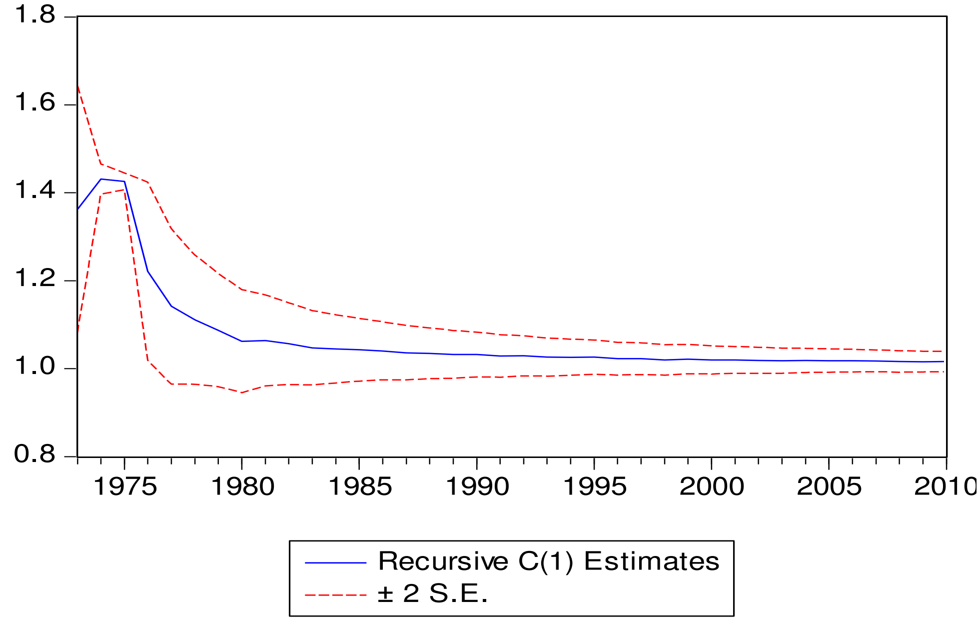
The straight lines represent critical bounds at 5% significance level

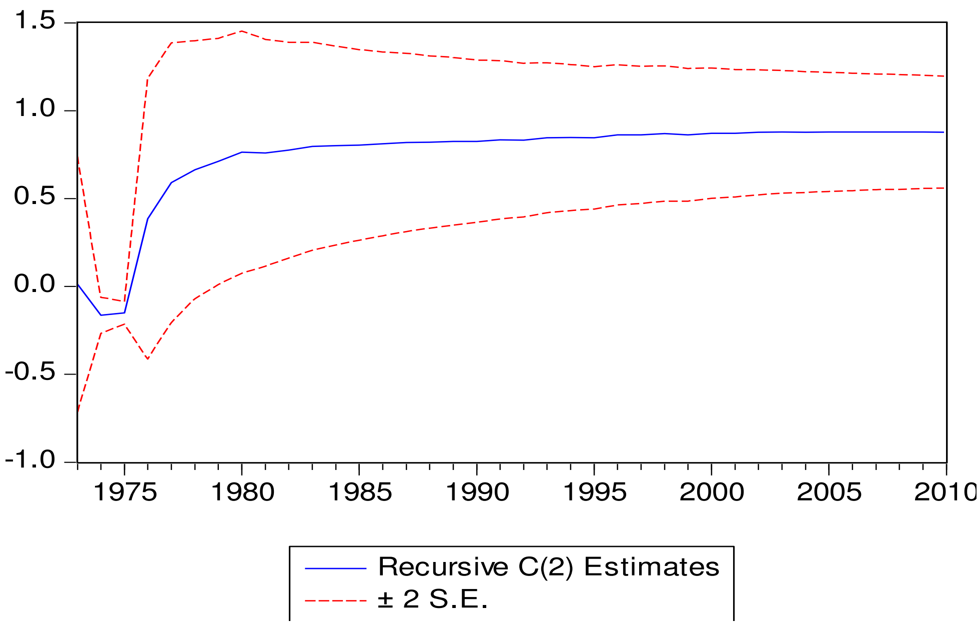
Fig 3: Plot of Cumulative Sum of Squares of Recursive Residuals



The straight lines represent critical bounds at 5% significance level

Fig 4: (A) Recursive Coefficient Estimates for Changes in Saving, C (1) and (B) Recursive Coefficient Estimates for Adjustment Parameter, C (2)





To find out the reflection of the 1990 balance of payment crisis and the currency devaluation crisis after 2000, the entire sample is divided into two sub-periods as follows: D_1 (1.0 for 1970-1989 and 0.0 otherwise) represent the period prior to the 1990 balance of payment crisis, D_2 (1.0 for 2000-2010 and 0.0 otherwise) represent the high currency devaluation period after 2000. The interactive dummy variables with ΔSR are included in the model as follows:

$$\Delta IR_t = \alpha + \beta_1 \Delta SR_t + \beta_2 (D_1 \Delta SR_t) + \beta_3 (D_2 \Delta SR_t) + \hat{\gamma} (IR_{t-1} - \hat{\phi}_i - \hat{\delta}_i SR_{t-1}) + \varepsilon_t \quad (2)$$

Table 5: Error Correction Model Results Saving-Investment Dynamics in India (1970-2010)

(Error Correction Model with Regime Shifts)

α	β_1	β_2	β_3	γ	R^2	$\bar{R}^2$	*F-stat.*	*AIC*	*SBC*
-0.936* (-2.909)	0.912* (8.660)	-0.004 (-0.274)	-0.016*** (-1.659)	-0.549* (-4.247)	0.783	0.735	22.489*	61.889	55.235

Note: *t*-statistics are reported in parenthesis. ***, ** and * indicate 10%, 5% and 1% level of significance, respectively.

Table 5 reports the empirical results of the estimating error correction model specified in Eq. (2). The estimated coefficient β_2, represents the impact of ΔSR prior to 1990 is negative but statistically insignificant. The negative coefficient estimate indicates the foreign capital fled out from the Indian market during the period of balance of payment crisis.[4] But the results are not statistically robust because of the insignificant *t*-ratio. Whereas the estimated coefficient β_3, for the impact of ΔSR after 2000 is negative and statistically significant at the 10% level, indicative of capital mobility and reduction of ability to adjust its current account deviation in the short-run. Furthermore, higher the gap between the saving and *IR*, then lesser will be the adjustment in current account deviation in the short-run. The estimated speed of adjustment parameter γ, remains negative and statistically significant at 1% level suggesting that the saving and *IR* are cointegrated during the different crisis period in India. In addition, the empirical result suggests that the speed of adjustment is reasonably better to retain at the steady state but still more time will be needed to adjust the current account deviation in the short-run during the crisis period of the Indian economy.

5. Conclusions and Policy Implications

The estimation results of this study find that the saving (*SR*) and investment rates (*IR*) are indeed cointegrated during the period 1970-2010. Furthermore, we also examined that the saving and *IR* are cointegrated during the different economic crisis period in India. The Johansen cointegration test further suggests that there is at-least one cointegration vector between the saving and *IR*. The error correction model exhibits structural instability before 1990s and after 2000s, because of the balance of payment crisis arise over the period 1990, and currency devaluation starts after 2000 in India. The speed of adjustment back to its equilibrium following a disturbance is quite low, suggesting a huge balance of payment problem and difficult to adjust its current account deviation in the short-run prior to 1990s and after 2000 in India. In addition, we found that the coefficient of current period pass-through of saving to investment is negative for the prior-1990 period, indicative of capital outflow from the Indian market. Similarly, the coefficient for current period-pass through of saving to investment is negative and statistically significant for the post-2000 period, indicative of huge capital flows and currency depreciation.

Presently, the international capital flows is an important source for the allocation of resources and to their best use of unutilized recourses in the recipient countries. However, there are the possibilities of structural instability due to the political and economic events, which

[4] Dooley *et al*. (1987), Jansen and Schulze (1996), and Payne (2005) provide the evidence of a negative coefficient estimate for the changes in saving rate (*SR*) in the short-run.

further facilitate to capital mobility in the countries. The positive side is that international capital mobility can assist to enhance the productivity of the host country industries, the typical evidence in the case of India and other emerging countries like China, South Africa, Brazil, and other industrialized countries, etc. The negative side is that capital mobility may also increase the risk of financial turmoil, instances like the East Asian financial crisis in 1997-98. In the case of India, number of policy implications can be raised because of the balance of payment crisis in 1990s and the devaluation currency crisis after 2000. Furthermore, due to huge capital flows volatility, the Indian currency has been highly depreciated after 2000. In fact, except China, other industrialized countries currencies are highly depreciated to dollar during the post-2000 period. Policy makers need to restore the confidence in the domestic currency, the rupee. Individual country may follow the International Monetary Fund (IMF) guidelines to overcome the currency depreciation and reinstate the foreign investor confidence in the short-and long-run. The risk associated with a currency can be reduced by means of keeping low and stable inflation rates, sustainability of fiscal deficits, movements towards the flexible exchange rates, political stability and transparent and corruption free in the system.

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