Modeling International Trinity & Policy Choices for India

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This study is an attempt to test the validity of trinity hypothesis and to measure the cost of capital account convertibility which Indian economy has paid in the form of one of the cornerns of trinity triangle. The monthly data obtained from various publications of RBI and IMF over the period 1980:M1 to 2016:M12 have been utilized to construct three trinity indices of Monetary Independence (MI), Exchange Rate Stability (ERS), and Capital Account Openness (CO).Using the graphical and cointegration tools, the existence of trinity hypothesis has been confirmed in Indian context. It has been noticed that India has clearly chosen capital openness (CO) over exchange rate stability (ERS).

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Introduction

In this globalized world, most of the economies are advancing on the path of higher degree of capital account openness which implies free and unrestricted exchange of domestic currency for foreign currency to perform capital account transactions. Moreover, capital account convertibility is a process through which economies with surplus savings can transfer their excess funds to deficient nations. This transformation process acts as a golden opportunity for the developing economies to admit the additional capital to boost up their development process. Higher degree of capital account openness can affect the domestic macroeconomic performance by increasing the ability of the economy to finance larger current account deficit. However, capital mobility comes with its respective strings attached. On various occasions this has led to severe balance of payment crisis usually accompanied by financial crisis. To overcome the side effects of capital account openness, an economy can resort to unsterilized as well as sterilized solutions. However, unsterilized interventions always carry the risk of increase in inflationary pres-

sures while avoiding appreciation, whereas, sterilization imposes high interest cost on the budget. In addition, the choice of adopting higher degree of capital account openness is never an easy task as it depends upon other policy choices of the economy and at the same time, it consequently alters the effectiveness of other policies. This kind of choice making process of an open economy has been discussed by Markus Flemming (1962) and Robert Mundell (1963) in the form of international trinity hypothesis. This trilemma hypothesis states that an economy can achieve only two policy goals at a time out of the three, i.e. sovereign monetary policy, exchange rate stability and full capital account convertibility.

India has not been facing these tradeoffs of international trinity before 1990 because it has been following the policy of low capital account liberalization. However, with structural transformation of 1991, India has started opening up. As it has earlier been mentioned that increasing capital inflows many a times result in rapid real exchange rate appreciation which further can negatively hit export market. If the central bank tries to prevent this appreciation then it is likely to lead to an increase in money supply resulting in fueling inflationary pressure. Due to these challenges, India is following a calibrated and gradualist approach towards capital mobility. Indian economy is one of those special cases which are not opting the corner solution of international trinity because India is following the intermediate policies, i.e. partial capital mobility, flexible exchange rate only till the fixed level and partial independence of monetary policy. The Reserve Bank of India is increasingly facing the complex challenge of trying to pursue an open capital account, an independent monetary policy, and a managed exchange rate. Given that India has gradually opened up its capital account, the Central Bank is being forced to choose between the other two corners of the impossible trinity i.e., an independent monetary policy and a stable exchange rate. Therefore, the choice of fully convertible capital account is associated with the cost of loosing either the monetary independence or the exchange rate stability. As each one of the policy objectives has some costs along with benefits and policy makers should always be careful while exercising certain combinations of these policies.

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Literature Review

Aizenman et al. (2008) have made a major contribution by the construction of three indices for trinity analysis i.e. Monetary Policy Independence Index, Exchange Rate Stability Index and Capital Openness Index. Many other economists like Obstfeld et al. (2004), Hagen and Zhou (2005), etc. have also made empirical attempts to test the validity of trinity hypothesis but they have not consid-

ered all the three corners of trinity triangle but only two out of the three.

A little amount of empirical work has been done to test the validity of trinity hypothesis in Indian economy. However, few names can be mentioned for their contribution in this field like Kramer et al (2007), in their empirical work have proved that no strong relationship exists between degree of stability in monetary conditions and the choice of a particular exchange rate or monetary regime. Therefore, international trinity hypothesis is not valid for Indian economy. On the other hand, Gupta and Manjhi (2011) by using data for the period 1980-81 to 2009-10 concluded that international trinity is valid in India and India has adopted middle solutions. However, Joshi (2003) has found that the Indian economy has saved itself from the heat of East-Asian crisis by following the combination of exchange rate targeting with monetary independence. On the other hand, the empirical study by Hutchison et al. (2012) has accepted the existence of trinity in India and this study has also concluded that the monetary independence is helpful in improving the macroeconomic stability in the Indian economy.

Some studies are also available to know the pros and cons as well as necessary conditions of capital account convertibility. In this context, Seth and Verma (2009) have proved empirically that capital account openness affects positively the pace of growth of Indian economy. Therefore, India should go for higher degree of capital account convertibility. Moreover, authors like Patil (1999) and Amodua (2007) have suggested that every economy should adopt all the necessary reforms like development of stabilization policies, trade policies, domestic banking system and domestic capital market, etc. On the other hand, Padmanabhan (2015) has supported capital controls but at the same time said that it is impossible for India to adopt these controls as it has become part of globalized world and it is pertinent for India to open up its capital account.

Database, Methodology & Construction of Trinity Indices

The empirical analysis is based upon the monthly data over the period 1980M1 to 2016M12 retrieved from International Financial Statistics (IFS) database of International Monetary Fund (IMF). The variables extracted are Call Money Rate (CMR), Federal Rate, Exchange Rate of Indian Rupee in Dollars, Net Capital Inflow, and Gross Domestic Product (GDP) at factor cost. By using the monthly figures of these variables, the annual indices have been constructed for the above said time period. The method suggested by Aizenman et al. (2008) has been used to develop Trilemma Indices of Monetary Policy Independence (MI) and Exchange Rate Stability (ERS). However, for the construction of the index of capital openness (CO), the methodology of Gupta and Manjhi (2011) has been followed. The index of monetary independence has been constructed as follows:

$$MI_t = 1 - \frac{corr(i_{mt}^{India}, i_{mt}^{*}) - (-1)}{1 - (-1)} \Bigg\}; \begin{matrix} m = 1,2\ldots,12\ months \\ t = 1,2\ldots,T\ years \end{matrix}$$

Where i_{mt}^{India} implies call money rate of India and i_{mt}^{*} implies Federal market rate of United States in m^{th} month of t^{th} year. The *corr* refers to the annual correlation between i_{mt}^{India} and i_{mt}^{*}. The United States has been selected as a base country as during this period Indian economy is most closely associated with United States. The value of index can vary between zero and one; a value near to one will ensure high level of monetary policy independence and value near to zero will reflect lower degree of monetary policy independence.

Further, the monthly data on the Exchange Rate of Indian Rupee for USA Dollars has been used for the construction of ERS index. Thereafter, annual standard deviation of this monthly exchange rate has been calculated in order to construct an index of Exchange Rate Stability.

$$ERS_t = \left.\frac{0.01}{0.01+\sigma_{mt}\left(\Delta\varepsilon_{mt}\right)}\right\}; \begin{matrix} m=1,2\ldots,12\ months \\ t=1,2\ldots,T\ years \end{matrix}$$

Where Δ is the first order difference operator, ε_{mt} reflects the log of exchange of Indian rupee *vis*-α-*vis* United States dollar (USD), and σ_{mt} indicates monthly standard deviation in t^{th} year. The value of this index will also lie between 0 and 1.

The third trilemma index has been constructed by using the annual data on Net Capital Inflows and GDP at factor cost. For construction of this index methodology given by Gupta and Manjhi (2011) has been made use of. According to Gupta and Manjhi (2011) de facto measure is more suitable for Indian economy as against the de jure measure. This index has been normalized between zero and one in order to make it comparable to ERS and MI index.

$$CO_t = \frac{\left|NetFlows_t\right|}{GDP_t}; t=1,2\ldots,T\ years$$

Empirical Analysis

In order to apply econometric analysis, it is mandatory to know the functional form of the relationship between three indices but there is no satisfactory answer available in the economic theory. However, Aizenman et al. (2010) have used linear functional form. The justification for using linear form lies in the basic concept of trilemma hypothesis that when an economy tries to increase two trilemma variables then it has to sacrifice the third one because it is not possible to achieve all corner solutions simultaneously. Hence, this study is also considering a linear functional relationship, i.e. whether weighted sum of three trinity choices equals to a constant or not. In case of time series analysis, it is mandatory to conduct the preliminary analysis to check the stationary state of the series. Therefore, in the present study, before conducting the linear regression analysis, the unit root analysis has been done with ADF, PP, KPSS and DF-GLS

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test statistics. Majority of test statistics have revealed that all the series are integral of order one. The summary of results of unit root analysis as well as structural break analysis has been reported in Table 1. Moreover, application of unit root with structural break procedure has identified one structural break for each variable i.e. 2008, 1989, and 2009 for MI, ERS and CO, respectively.

Table 1 Summary of Unit Root Analysis

	Order of Integration of Trinity Indices		
	ER	*CO*	*MI*
ADF	I(0)	I(1)	I(1)
PP	I(1)	I(1)	I(1)
DF-GLS	I(1)	I(1)	I(1)
KPSS	I(1)	I(0)	I(1)

Note: I(0) and I(1) represent the order of integration at level and first difference, respectively.
Source: Authors' calculations.

The Johansen Co-integration test has been applied because all the three series are stationary at first difference. The Johansen's Co-integration approach has been criticized for being sensitive to the selection of lag length. Therefore, it is crucial to choose an appropriate lag length for both the Co-integration analysis as well as for the error correction model adopting a consistent procedure. In this reasoning the VAR system for various lag lengths has been applied assuming all selected variables as endogenous without any exogenous variable in the model. The estimation of VAR (p) process confirms the inclusion of two lags as three out of five criteria are favoring two lags. After selection of optimum lag length, Johnson Co-integration approach has been applied. The analysis reveals that trend in VAR (p=2) is statistically insignificant whereas, some of the seasonal dummies are significant along with significant intercept term. Hence, a model with intercept and three structural breaks have been used to identify the existence and rank of co-integration matrix which confirms the rejection of the null hypotheses of no Co-integration relationship and at most one relationship, and, the acceptance of the null of at most two vectors. Accordingly, two equations can be specified with two variables in each equation.

Since two Co-integration relationships have been noticed, thus, there is a need to apply some theoretical restrictions in such a way that it reflects the working of trinity hypothesis. As CO (Capital Openness) and ERS (Exchange Rate Stability are related to foreign market, ERS can be specified as a function of CO. It is hypothesized that if any economy opens up its capital account then it will have to loose on its exchange rate stability. It is so because a fully convertible capital account may cause capital flight in the time of recession. This sudden capital flight may further cause a fall in the market value of the domestic

currency and hence, causes exchange rate to increase. Therefore, more capital openness will enhance volatility in exchange rate and this enhanced volatility indicates low stability. The two Co-integration vectors with *ERS* and *MI* as target variables have been obtained as follows:

$$\left.\begin{aligned} MI_t &= 0.347 + \underset{(5.468)}{1.009}\, ERS_t + \varepsilon_t \\ ERS_t &= 1.111 - \underset{(-6.544)}{3.357}\, CO_t + \varepsilon_t \end{aligned}\right\} (1)$$

From two Co-integration vectors of model 1, it is evident that an increase in Capital Openness (CO) will adversely affect Exchange Rate Stability (ERS) and consequently, a positive coefficient of ERS will cause MI to fall. Hence, a trinity is confirmed because if Indian economy has to choose higher rate of Capital Openness then it has to sacrifice other two namely ERS and MI.

Further, CO can also be modeled as a target variable with ERS as an intermediate variable and MI as the policy shock variable. The rationale behind this is that the CO can be expressed as a function of ERS with the reasoning that if an economy want to introduce full convertibility in its capital account then it will have to adopt flexible exchange rate system to provide more freedom to the international investors. The other Co-integration vector can be modeled as the combination of MI and ERS because monetary policy stance will effect exchange rate fluctuations. In the Mundell- Flemming model, a balance of payment curve is derived as a locus of different combinations of rate of interest and level of output for a given exchange rate at which foreign market is in equilibrium. In simple terms, if money market, commodity market and foreign market are in disequilibrium the situation of BOP curve will affect the extent of monetary policy to be exercised. Since the situation of BOP curve depends upon exchange rate, it can be said that ERS plays an important role to determine the extent of monetary and fiscal policies to be exercised to restore the equilibrium in the economy. Hence, the independence of monetary authority/ policy got adversely affected in an open economy. On the basis of above two arguments, the two Co-integration vectors with restrictions have been obtained as follows:

ERS plays an important role to determine the extent of monetary and fiscal policies to be exercised to restore the equilibrium in the economy.

$$\left.\begin{aligned} CO_t &= 0.331 - \underset{(-6.931)}{0.297}\, ERS_t + \varepsilon_t \\ ERS_t &= -0.343 + \underset{(3.030)}{0.990}\, MI_t + \varepsilon_t \end{aligned}\right\} (2)$$

The two Co-integration equations of Model 2 represent that there is a positive relationship between MI and ERS, but, negative relationship between ERS and CO. Here in Model 2, ERS index has been considered as an intermediate variable because Indian economy has continuously sacrificed over the period of time in order to increase its capital openness. Therefore, CO and MI have been considered as the target variables as after 1990, Indian economy has targeted to increase its degree of capital account

Table 2 Vector Error Correction Model Results

Error Correction Term	D(MI)	D(CO)	D(ER)
Model 1: Co integration with two vectors *MI=f(ERS)* and *ERS=f(CO)*			
CointEq1MI=f(ERS)	-0.025**[-0.287]	-0.329**[-3.979]	**-0.335**[2.116]**
CointEq2*ERS=f(CO)*	0.330**[2.41]	**-0.436**[-3.305]**	-0.418**[-2.873]
Model 2: Co integration with two vectors *CO=f(ERS)* and *ERS=f(MI)*			
CointEq1*CO=f(ERS)*	1.302**[2.414]	-1.719**[-3.305]	**-1.649**[-1.974]**
CointEq2*ERS=f(MI)*	**-1.035**[3.288]**	0.464**[3.979]	-0.049[-0.116]

Note:i) Parenthesis of type [ ] are Z-values; and ii) ** represents significance at 5 per cent . Bold figures are used to make final conclusions.
Source: Authors' calculations.

convertibility in a gradual manner and at the same time it has maintained its MI by sacrificing its ERS at a very high speed. Both the models conclude that in the case of Indian economy trinity hypothesis is valid in the sense that two policy objectives (ERS and MI) are positively related with each other but negatively related with the third one (CO).

To prove the validity of above mentioned models, Vector Error Correction Model (VECM) has been applied and the results have been reported in Table 2. It is evident that the error correction terms of both the models are negative and statistically significant at 5 per cent level of significance. Therefore, it can be said with conformity that long run relationships provided by both the models are stable in nature and thus, the trinity hypothesis is valid in Indian economy.

In addition to the regression/ cointegration based analysis, the radar diagrams have been used to test the trinity hypothesis for the full period as well as for sub-period comparisons. To show the clear picture, arithmetic mean of three trinity indices along with geometric means of growth rates of the respective indices have been plotted on the three axes of the radar diagrams. It is evident from the Fig.1 that India has directly chosen one out of the three policy choices of trinity hypothesis and that choice is Capital Account Openness with a growth rate of 5 per cent. Moreover, India has opted the path of Exchange Rate Flexibility as the growth rate of *ERS* is negative and its value is quite high i.e. 34 per cent. The Indian economy has provided a clear indication towards this in 1993 by adopting the Managed Floating Exchange Rate System. Moreover, the growth rate of Monetary Independence Index is also negative but its value is as low as negligible i.e.-0.002. Therefore, it can be said that although India has given priority to the open capital account yet it is also true that among other two policy objectives, Indian policy makers have chosen monetary

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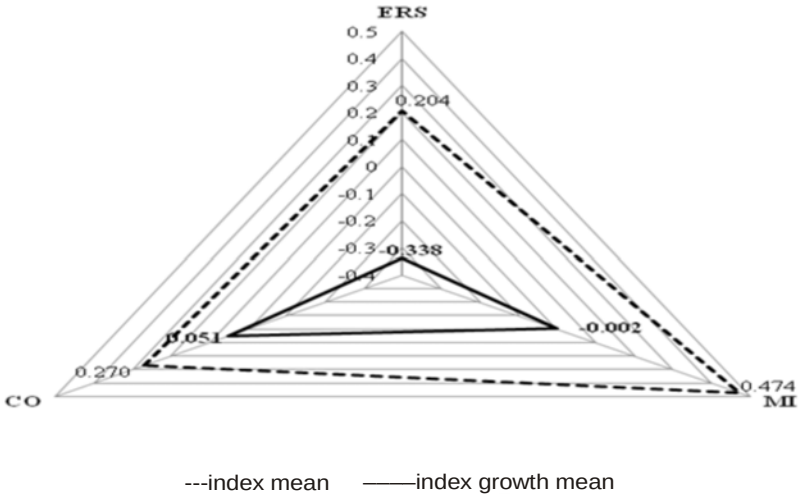
policy autonomy over the exchange rate stability. Even if India has not tried to increase the degree of monetary policy autonomy yet it has maintained its monetary independence without letting it decline over the period of time. Therefore, it is proved that the trinity hypothesis is valid in the Indian economy as India has chosen two policy objectives (*CO* and *MI*) by sacrificing the third one (*ERS*). However, the value of *ERS* is quite close to *CO* but India through its policy choices over the period of time has indicated that it is surely going to choose *CO* over *ERS*.

The Panel-(a) and Panel-(b) of Fig. 2 reveal that at the beginning of 1980s, there was a negligible amount of capital account convertibility as India was enjoying high levels of Exchange Rate Stability with a high degree of monetary policy autonomy. Moreover, it is clear from Panel-(c) and Panel-(d) that although India was giving priority to *ERS* and *MI* over *CO*, yet, towards the end of 80's growth rate of *MI* and *ERS* has started becoming negative which was basically due to deteriorating macroeconomic health of Indian economy.

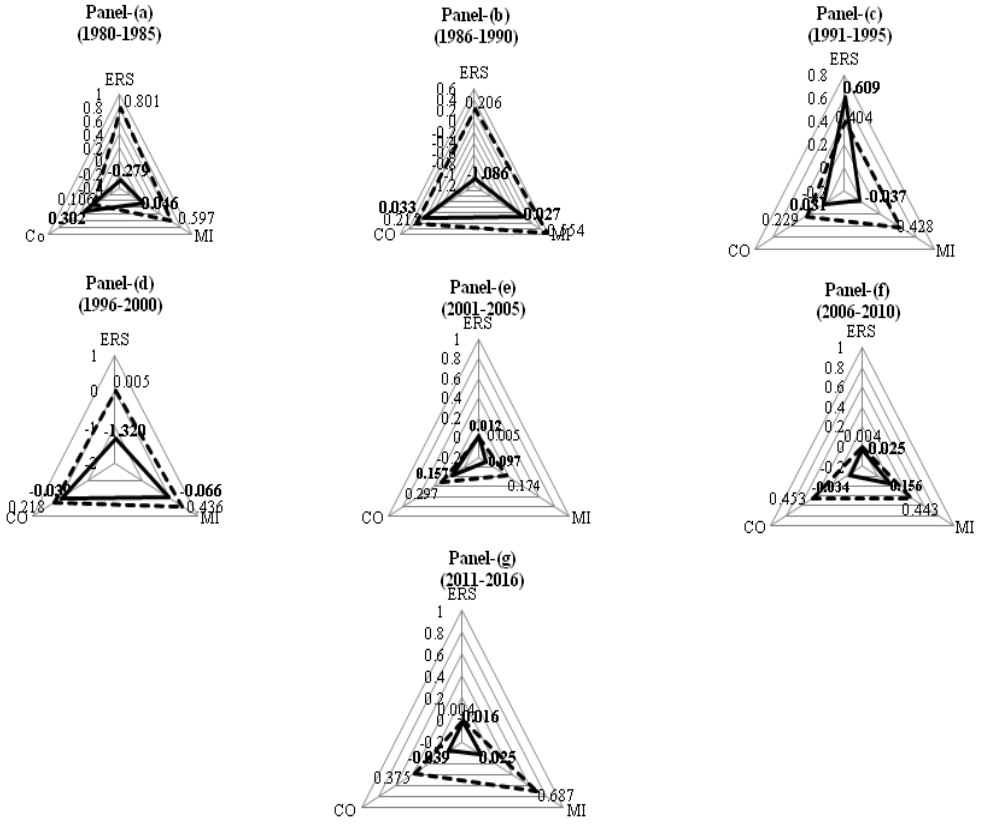
Fig.1 Trinity Choices of India during Full Period (1980-2016)



Source: Authors' Elaborations.

Panel-(c) and Panel-(d) of Fig. 2 show the Indian journey for the decade 1990-2000 which is the most interesting part of Indian economic story regarding trinity choices as India has completely changed its outlook towards its dealing with other countries. Therefore, India has adopted the policy of Liberalization, Privatization and Globalization in 1991 and fully opened up its current account but full capital account convertibility was not an easy job. It requires a pre cost-benefit analysis as there is a risk of sudden capital flight as well as it is very difficult and necessary to manage capital inflows in the most productive and effi-

Fig. 2 Sub-Period aAnalysis of Trinity Choice of Indian Economy



Note: Dotted line represents index mean and bold line represents index growth mean.
Source: Authors' elaborations.

cient manner. More degree of capital openness not only makes financial markets more efficient but also more fragile by making financial markets more prone to sudden shifts in capital inflows as well as capital outflows which are sometimes very difficult to manage to lead to the unstable financial system. However, it does not necessarily indicate the adoption of capital controls but warns the economies to take conscious steps while moving on the path of capital account convertibility. The Indian case of capital liberalization can be considered as a benchmark case as it opens up in the most systematic and timed manner.

In spite of the fact that the Indian economy was opening up, its capital account openness and its growth were still very low and exchange rate stability was quite high.

Fig. 2 shows the slow and steady journey of Indian economy towards financial integration. Moreover, monetary policy independence does not only depend upon the degree of capital account openness but also on the choice of exchange rate system. There is a positive relationship between monetary autonomy and flexible exchange rate system because exchange rate flexibility will itself deal with the balance of payment disequilibrium and will maintain monetary policy independence by making domestic interest rates less sensitive to international interest rate changes.

The Indian Exchange Rate System has taken shifts in a very systematic way and the similar kind of picture has been portrayed in Panel-(c) of fig. 2 that initially India has prepared itself for more capital account convertibility and accordingly it has introduced some major changes in its exchange rate management. Therefore, in spite of the fact that the Indian economy was opening up, its capital account openness and its growth were still very low and exchange rate stability was quite high. Accordingly in the next five year period Indian economy has shown its clear choice for more flexible exchange rate system and at the same time monetary policy autonomy with some amount of capital account openness.

During the decade of 1990-2000, the Indian economy has prepared itself and in the next five years it has introduced major changes in its capital account and achieved a high level of capital openness as compared to the earlier period. This situation has been shown in Panel-(e). Moreover, during this period India again has chosen some positive Exchange Rate Stability which was again a conscious step because Asian Crisis has led to the depreciation of Indian rupee and in order to avoid this kind of situation in future India has pegged its exchange rate with USA Dollar from 1998-2004. Further, Panel-(f) reveals that from 2006 to 2010 the Indian economy has clearly chosen *CO* and *MI* over *ERS*. The mean value of the *CO* index has increased and it has almost achieved the value of 0.5. However, the growth rate of the *CO* index during these five years is negative and it was purely due to the post impact of the world recession. During this period *ERS* index has achieved almost zero mean value with a negative growth rate of 2 per cent. Here, the growth rate of *MI* index is positive to the tune of 15 per cent and mean value is also satisfactory around 5 per cent. The next five year journey of the Indian economy has been explained in the Panel-g which shows that India has drastically focused upon independent monetary policy. Before this time period, India has maintained its monetary policy independence around the value of 50 per cent but after 2010 it is clear from the Panel-(g) of fig.2 that the *MI* index has touched the highest mean value with almost 3 per cent growth rate. Therefore, on the one hand India is going for systematic capital account convertibility and on the other hand it is focusing upon its autonomy in framing its monetary policy.

Conclusions & Policy Implications

This study has proved that the trinity hypothesis is valid in the Indian case especially after 1990, because earlier, trinity choices were not a binding for India as it was a closed economy at that time, but, after 1990, India has changed its policy perspective and has opened up itself for the rest of the world. The growth rate of *CO* index is increasing decade by decade as against the growth rate of *ERS* and *MI*.

Further, to check the relationship amongst all three trinity variables, the Johansen Co-integration technique has been applied as it is the most suitable in case all the variables are integrated at order one. Two Co-integration relationships have been derived by applying some theoretical restrictions. Two types of models have been executed with i) Monetary Independence as a target variable and capital openness as shock variable with the exchange rate as an intermediate variable; and ii) Capital Openness as a target variable and Monetary Independence as shock variable with the exchange rate as an intermediate variable. In both models, the *ERS* index has been considered as an intermediate variable because the Indian economy has continuously sacrificed it over the period of time in order to increase its capital openness. Both the models conclude that in case of Indian economy trinity hypothesis is valid in the sense that two policy objectives (*ERS* and *MI*) are positively related with each other but negatively related with the third one (*CO*).

Through the graphical analysis of Trinity hypothesis using 3-dimentional radar diagram, it has been observed that the economy of India has clearly chosen the corner of capital account openness over the other two corners of the trinity triangle, yet, it is still within the middle solution range of all the three corners of trinity triangle as the mean value of all is less than 50 per cent. However, it is crystal clear that capital account openness is beating the other two as the compound growth rate of *CO* index is the highest i.e. 4 per cent as against the growth rate of *MI* and *ERS* i.e. (-)0.002 per cent and (-)34 per cent, respectively. Therefore, Indian policy makers' need cautious drives at the path of capital openness without hitting further the boundaries of *ERS* and*MI*

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