Time Varying Sterilisation Coefficient For India

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Abstract

This study is aimed at understanding time varying sterilization coefficient for India from a developing country perspective using monthly data from April 1994 to March 2013. The empirical results show, there is a positive relationship between interest rate and sterilization coefficient. The positive relation was experienced more during periods of financial strain. This study has also found a negative relationship between exchange rate and the sterilization coefficient.
Key Words: Exchange rate, Interest rate, Sterilization. ,JEL Classification: F410, F450

1. Introduction

The late 1980s and 1990s India embraced financial openness and liberalisation. Over the years   there has been an accumulation of foreign exchange reserve. The years 2003 -2004 has shown an accumulation of 4901.29 billion foreign exchange reserve, 2008-2009 foreign exchange reserve amounted to 12838.65.By 2013 - 2014 the foreign exchange reserve has increased to 18283.80 billion. 2014 was indeed a big blow for the country in terms of investment.There has been an increase in the foreign exchange reserves to the country.The announcement of various schemes and special programmes has increased the expectations of investors to fix their roots in the Indian soil.

In order to prevent the harmful effects of this surge in capital inflows a number of market and nonmarket based approach has been followed. Market based approach involves the actions of the central bank to inject or withdraw liquidity in the market. Non-market based approach involves the quantitative restrictions in which injection of liquidity is kept outside the financial system. The market based approach aims at neutralizing the effect of forex inflows is called sterilisation.

 The instruments used for sterilization are Cash reserve ratio, Liquidity adjusted facility, market stabilization scheme, foreign exchange swaps etc. New instruments have been introduced by the central bank like the interest-bearing deposit by commercial bank. There can be friendly and non-friendly approaches to sterilization. The friendly approach involves for example the central bank voluntarily purchasing the bonds. The non-friendly approach includes forced bond sales at low interest rates compulsory lending from commercial banks to central banks. Sterilization policy should be an amalgam of friendly and market friendly approach

 The degree of sterilization is called the sterilization coefficient. It lies between -1 and 0 (if it is -1, it means that the change in net foreign exchange assets arising out of the intervention in the foreign exchange market has been exactly offset by an opposite change in net domestic assets, thus implying full sterilization. And if the value of the sterilization coefficient is equal to 0 then no sterilization has taken place). If the sterilization coefficient is greater than -1 as in the case of Korea then we are sterilizing the expected capital inflows. Sterilization policy is highly effective when the capital inflows are temporary in nature. If the capital inflows are continuous in nature it leads to highly ineffective sterilization policy as there are further capital inflows. Sterilization policy is a short-term measure until the macroeconomic policy sets in to absorb all the capital inflows.

2. Literature Review

Following Kouri and Porter (1974), the ability of a central bank to carry out sterilisation operations effectively can be examined by analysing the relationship between a central bank's net domestic assets (NDA) and its net foreign assets (NFA).Ghosh (2004)the impact on the monetary base can, however, be neutralised by offsetting transactions in domestic assets having the same magnitude as the trans-action in foreign assets.

Lavinge(2008) estimated the sterilization coefficient as a ratio of

(ΔRD - ΔNDA) / ΔNFA

Δ refers to change.Where RD is the reserve deposits. NDA is the net domestic asset and NFA is the net foreign asset.

Sheefeni (2013) estimated a sterilisation coefficient for Namibia using OLS(ordinary least square method). Namibia shows a sterilisation coefficient of 0.21, $\Delta NDA_t = \gamma_1 \Delta NFA + \mu_t$

Jan et al. (2005) as noted in earlier studies have OLS (Ordinary least squares has been used) .The above model used only NFA as the dependant variable whereas here a number of variables have been included which are said to affect the net domestic asset Pakistan sterilization coefficient is around -.87%

$$\Delta NDA_t = \gamma_1 \Delta NFA_t + \eta_1 \Delta IPIsa_{t-1} + \delta_1 \Delta CPI_{t-i} + \beta \Delta ER_{t-i} + \alpha Diff_{t-i} + \mu_3$$

Cavoli andRajan(2013) in there paper have analysed the extent to which south East Asian countries engage in sterilization activity. The sterilization coefficient has been found for time in varying form using simultaneous equation and the time in varying form has been found using Kalman filter approach. Since sterilization is a very dynamic concept the use of Kalman filter has been recommended by researchers. Kalman filter uses past value and noise in order to predict present value.

Another study on the same subject is by Celasun and Denizer (1999) who computed the sterilisation coefficients based on the methodology of Cumby and Obstfeld (1983). They estimated NDA by using 2SLS for the period February 1990 to June 1996. The sterilisation coefficient was found as –0.37, which indicated partial sterilisation of 37 percent of reserve inflows

Cavoli and Rajan(2005) have used a VAR model in estimating sterilization coefficient. The same authors have used simultaneous equations in th eir works..

Prabheesh andMalathy like earlier studies used VAR.They have calculated the sterilization coefficient for two decades for India. The calculated sterilization coefficient accounts to around 90 percent. There results disprove that of Cavoli and Rajan(2013)there exist a positive relationship between interest rate and sterilization coefficient they have extended the model to include cash reserve ratio, exchange rate, index of industrial production as a proxy for output. This method has been widely used in developing countries.

$$\Delta NDA = \gamma_1 + \gamma_2 \Delta NFA + \gamma_3 \Delta IIP + \gamma_4 \Delta CRR + \gamma_5 ER + \varepsilon_t$$

In the Indian context so far the empirical studies have done time invarying analysis using Ordinary Least Square method,Vector Auto Regression, Simultaneous equations. If it is time varying then the inference drawn from existing literature may give misleading conclusion. In order to capture the time varying aspect I have used Kalman Filter Smoothening. With this the main objective of the study is to estimate a time varying sterilisation coefficient for the country

3. Data and Methodology

Monthly data has been taken from April 1994 to March 2013. Data has been collected from the handbook of statistics on the Indian economy of Reserve Bank of India. A total of 228 observations are being used. The variables used are NDA (Net Domestic Asset) and NFA (Net Foreign Asset). The variables are being explained in detail below.

3.1 NFA (Net foreign Asset)

A definition for Net Foreign Asset from world bank is that it is the sum of foreign asset held by monetary authorities and deposit money bank less there foreign liabilities. In India the reserve bank measures the Net Foreign Asset by subtracting the reserve tranche position and SDR (Special Drawing Right) from the total foreign exchange reserve of the country. Here Δd is taken as ΔNDA/$RESERVE\ MONEY_{t-1}$

3.2 NDA (Net Domestic Asset)

Which includes the net claims on government central bank plus loans to public entities and private entities and other items net. It is obtained by deducting Net Foreign Asset from reserve mon. It was found from the series that NDA cannot be seasonally adjusted because of the presence of negative values in the series. So reserve money and NFA was seasonally adjusted separately and then NFA was deducted from reserve money. Δf is represented as ΔNFA/$RESERVE\ MONEY_{t-1}$

3.3 Reserve money

Reserve money is a sum of Currency in circulation, other deposits with RBI, Bankers deposits with RBI. Reserve money is also known as high powered money, monetary base, base money and is represented as M_0. It is a liability component of the central bank. RBI prints the domestic currency by buying gold, foreign currency

3.4 Call money rate

Call money is rate of interest paid by banks for financing their short-term requirements.

3.4 Exchange rate

Exchange rateis the rate at which one currency is exchanged for another. It is also regarded as the value of one country's currency in terms of another currency. Depreciation of a currency refers to the fall in the value of the currency with respect to the other currency. Appreciation on the other hand currency refers to rise in the value of the currency with respect to the other currency

3.5 Methodology

Here we discuss the model to be used. Stationarity of a series has to be ensured before analysis otherwise the estimated results will give a spurious result. The first thing to do with time series data is to plot the data and check whether there is any seasonal component. The seasonality can be removed by using census x13 method. We have to then observe the data and check for stationarity using unit root test. The unit root test has been performed using Augmented Dickey Fuller Test.

$$\Delta y_t = \delta + \lambda y_{t-1} + \sum_{i=1}^{n} \Delta y_{t-1} + u_t \dots\dots\dots\dots\dots (1)$$

So far whatever studies have been conducted have used VAR (vector auto regressive model) to estimate the sterilization coefficient. VAR has the limitation of the number of lags to be included and it is a time invariant form to measure sterilisatiion coefficient.

In order to measure this time varying aspect we have used Kalman filter approach. Kalman (1960) published his paper a recursive solution to the discrete –data linear filtering problem. Kalman filter helps to predict present values using past value and past noises. Sterilization is a very dynamic concept and in order to capture the time varying aspect of sterilization coefficient the Kalman filter has been used

3.5.1 Estimation Model

In the next section we go for the estimation of the model using Kalman filter approach. NDA is the dependent variable. The independent variables are NFA and the first lag of NDA and NFA.

The model has been written as below

$$\Delta d = \lambda_0 + \lambda_t \Delta f + \gamma_1 \Delta d_{t-1} + \gamma_2 \Delta f_{t-1} + u_1$$

$$\ldots\ldots\ldots(2)$$

$$\lambda_t = \theta_0 + \theta_1 \lambda_{t-1} + u_2 \ldots\ldots\ldots(3)$$

λ_0 = Intercept coefficient

$\gamma_1 \; \gamma_2$ = Slope coefficient

λ_t = sterilisation coefficient and slope coefficient

Eq. (2) and (3) is a state space representation   where Eq. (2) is the signal equation, featuring a time varying version of the sterilisation coefficient, state equation that depicts how the state is updated. The evolution of λt is determined by the standard Kalman Filter algorithm as given in Hamilton (1994). The specification of the lag structure of the signal equation are determined by Akaike Information Criteria (AIC)

4. Empirical Analysis

4.1 *Unit Root Results*

The stationarity property of NDA and NFA are tested using Augmented Dickey Fuller (ADF) and Phillips Perron (1998). The optimum lag length for ADF is determined by Schwartz Criterion. By accepting and rejecting null hypotheses their respective t-statistic,the test results confirms that both NDA and NFA are stationary at first difference (Table 1)

Figure 1 show the estimated sterilization coefficient for the time period April 1994 to April 2013. Prior to 1990's the Indian economy was stagnant. The new economic reforms did elevate the economy to greater heights; the stock of FDI to the country had increased from 2 billion in 1991 to 35 billion in 2004. This explains why the sterilization coefficient has been increasing. The year 1996 and 1997 the sterilization coefficient was greater than -1. Thus, implies we are sterilizing the expected capital inflows. The years 1999 India had gone through the Asian financial crises as a result of which we can see a fall in sterilization coefficient. Over the years the sterilization coefficient has increased. 2004 again witnessed a transfer of power to the United Progressive Alliance government. It witnessed high sterilization rates greater than -1. The2008 financial crises did bring a slowdown in the accumulation of foreign exchange reserve. The end of 2009 we can see an increase in the sterilization coefficient because more than ½ of the global capital inflows have been concentrated in a group of large countries including India. Because the interest rates in USA was kept low when compared to the other emerging economies. We have observed traces of partial sterilization during this time.2010,2011.2012 maintained their sterilisation coefficient at around -.98.any fluctuations between them is because the credibility of India has reduced because of the multicore scams like the 2G scam, common wealth games scam, Coalgate scam etc. SEBI has bought forward easier delisting rules and tighter regulations to prevent insider trading. All these measures are taken to safeguard investor interest and boost investor confidence (2014).

Table 2 shows the correlation coefficient that has been calculated. It shows the association between sterilisation and interest rate and the association between sterilisation and exchange rate. .29 shows that there exists a positive relationship between interest rate and sterilisation. Whereas -0.57 shows that there exists a negative relationship between exchange rate and sterilisation.

Figure 2 shows the relationship between interest rate and sterilisation coefficient. The 2008 crises or the housing bubble did have its impact on the Indian economy. Foreign institutional investment to the country fell as a result of Indian capital market and FOREX market suffered loses. Indian economy experienced a slowdown in employment and output growth. Domestic interest rate fell as there was a withdrawal of funds by foreign investor. Imports to the country fell by 12.2% and employment fell by 20%. In order to boost the economy, the RBI reduced the rates used for controlling credit. There was a reduction in the repo rate from 9% in October 2008 to 4.75%. Reverse repo also experienced a fall from 6% to 3.25%. CRR was also reduced from 9% to 5%. Statutory liquidity ratio was also reduced from 25% to 24%. The rate of sterilization of capital inflows reduced during the

period. The graph shows a drop-in sterilization coefficient after 2008. Similarly, we can also see drop in the interest rate. As interest rate fall the rate of sterilization in the country reduces. I have observed a positive relationship between interest rate and time varying sterilisation coefficient.

Figure 3 shows the relationship between exchange rate and the time varying sterilisation coefficient. A negative relationship has been observed between exchange rate and sterilisation coefficient. The rise in foreign exchange reserve to the country have led to upward pressure on the currency. This leads to increased sterilization activity and brings about downward pressure on the rupee. The graph when closely observe gives us many reason for as to why there is a positive or a negative relationship. The year 1999 you can see that when the currency is depreciating the sterilization coefficient is decreasing. The Asian financial crises lost investor confidence and there was capital outflow. The decreased demand for Indian rupee made the rupee loose its value. In order to strengthen the Indian rupee, the sterilization rates were reduced.

The 2008 crises also had a similar impact. Repo, reverserepo, statutory liquidity ratio, cash reserve ratio fell drastically in order to expand the monetary base. A negative relationship has been observed between sterilisation coefficient and exchange rate.

5. Conclusion

The study has helped in calculating a time varying sterilization coefficient for the country. It has indeed helped in studying the dynamicity of the concept. Study has got results in support of existing theory that there is a positive relationship between interest rate and sterilization coefficient. The positive relation was experienced more during periods of financial strain. A negative relationship has been observed between exchange rate and the sterilization coefficient. In emerging markets, capital flows are often more relatively volatile and sentiment driven, not necessarily being related to fundamentals in these markets. Such volatility imposes substantial risks on the market agents which they may not be able to sustain and manage. It becomes imperative in these conditions to guard the economy against the harmful effects of forex flows so as to ensure proper conduct of monetary policy based on fundamentals In this line it is important to study the dynamicity of the concept by analysing the time varying sterilisation coefficient.

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Table: 1

Variable	PP	ADF
NDA	-1.11 (0.71)	-1.18 (0.68)
NFA	1.46 (0.99)	0.96 (0.99)
ΔNDA	-13.89 (0.00)	-7.82 (0.00)
ΔNFA	11.58 (0.00)	-6.67 (0.00)

Figures in parenthesis are p-values

Table: 2

Correlation	
Sterilisation and Interest Rate	0.29
Sterilisation and Exchange Rate	-0.57

Figure.1 Time Varying Sterilization Coefficient
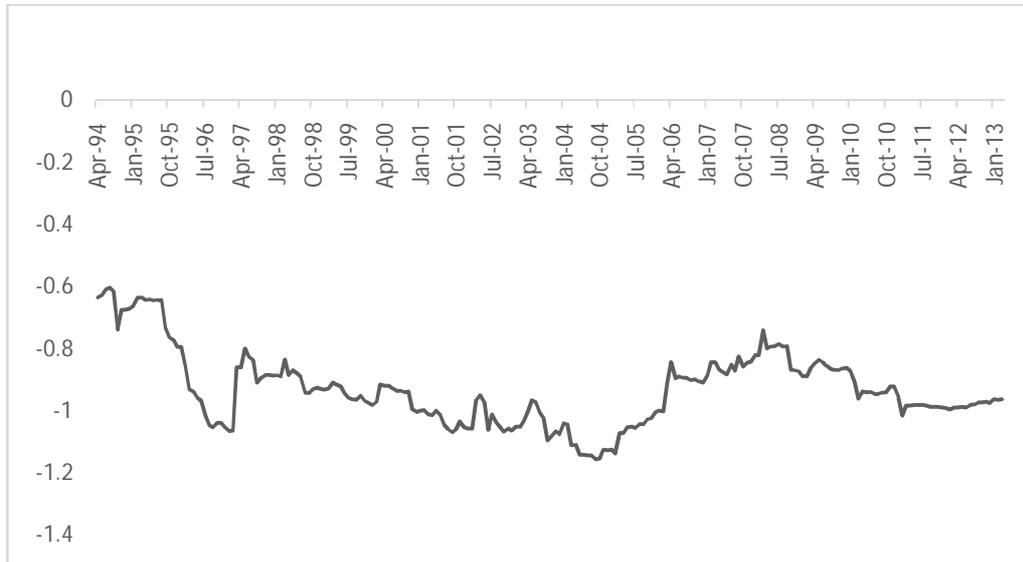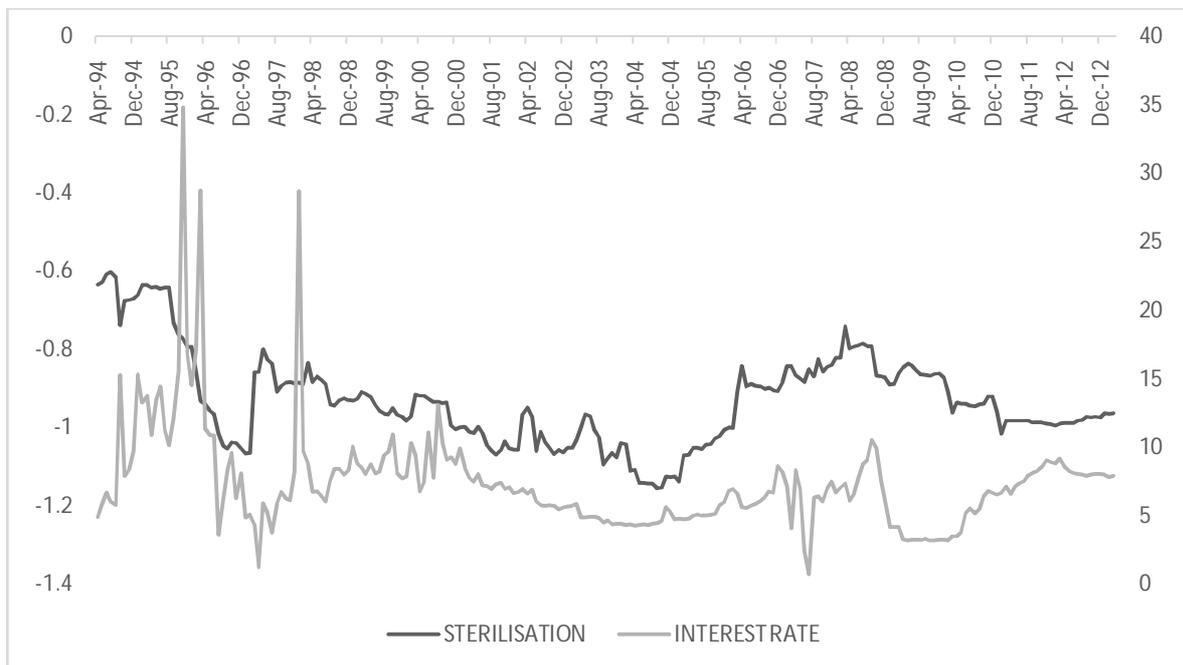

Figure 2: Sterilisation and interest rate

Figure 3: Sterilisation and Exchange rate