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EMPIRICAL EVIDENCE ON DYNAMICS OF CREDIT GROWTH AND FOREIGN RESERVE

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Abstract

The paper presents a model for looking into the nature of change in foreign reserve from movements in domestic credit. This model is relevant to foreign reserve targeting, small and open economies. The model denotes that measures undertaken by central banks to constraint domestic credit growth with the view of controlling capital outflows will also be detrimental to foreign reserves level. The empirical studies with application of Fourier Transformation technique have been used to build a model, which shows that growth in domestic credit is more biased towards positive swings in foreign reserves, rather than being unfavorable. The small and open economies, particularly, the Pacific Island nations, have the right set up for application of this model to safeguard foreign reserves level.

Keywords: Fourier, Domestic Credit, Foreign Reserve, Monetary Policy

1. Introduction

This paper looks into the dynamics of credit growth and its impact on foreign reserves. This study is applicable to foreign reserve targeting countries with non-flexible exchange rate regime. Excessive credit growth is seen as exerting pressure on maintenance of adequate level of foreign reserves. However, the countries in South Pacific share very common characteristics in terms of monetary policy operation. These nations target maintaining an adequate level of foreign reserves and amongst other factors, credit growth has been seen as one of the variables affecting maintenance of adequate level of reserves.

International Monetary Fund (2013) defines international reserves as those external assets that are readily available to and controlled by monetary authorities for meeting balance of payments financing needs, for intervention in exchange markets to affect the currency exchange rate, and for other related purposes (such as maintaining confidence in the currency and the economy and serving as a basis for foreign borrowing).

Maintenance of adequate level of foreign reserve is one of the monetary policy objectives of countries with fixed exchange rate system. For instance, the twin objectives of Reserve Bank of Fiji (RBF) is maintenance of adequate level of foreign reserve and controlling inflation. The goal of maintaining adequate amount of foreign reserve takes priority over latter objective, in midst of fixed exchange rate regime in Fiji. Similarly, the Central Bank of Samoa's monetary policy objective is to achieve and maintain price stability as well as fostering and maintaining a stable financial system in order to achieve sustainable real economic growth and sound levels of international reserves (Central Bank of Samoa, 2016). Moreover, the Reserve Bank of Vanuatu's

main twin objectives of monetary policy are maintaining low and stable inflation rate and a sufficient level of official foreign exchange reserves (Reserve Bank of Vanuatu, 2017).

These Pacific Island nations need to have enough stock of foreign currency not only for the purpose of maintaining the exchange rate fixed (Anton and Serven, 2010), or allowing it to float within a band but also for the purpose of economic stability and growth (Caballero *et al.* 2008). Economic stability through this objective is achieved as businesses will have confidence in the economy with enough foreign currency available for import of their stock, thus will invest and also promote growth. More investment and growth will also create employment, increase in income and will lead to improvements in standard of living. Moreover, these may not be the only reason for accumulation of foreign reserves but may have others which cannot be summarized to indicator discussed here (Ghosh *et al.* 2012).

It is important that adequate level of foreign currency is kept in times of need. Adequate level is defined as foreign currency being able to cover three months of imports of goods and services; however, this may need to be adjusted with change in circumstances (Ghosh *et al.* 2012). Jeanne and Sandri (2016) studied a sample of 21 countries from 1960 - 2014 and found that these countries keep an average cover of 3.3 months of import, close to 3 months defined as adequate level of reserves. This would mean that in times of crisis, should there be factors hindering inflow of foreign currency, a nation should still be able to import goods for at least next three months. Some of these items can be goods which may be used in hospitals and are neither manufactured in Fiji nor other neighboring Pacific Island countries. Such drugs and medicine need to be imported for human survival, let alone import of petroleum products which are also not produced by Pacific Island nations.

Benigno and Fornaro (2012) explain that governments promote real effective exchange rate depreciation and diversion of production towards trade sector by accumulating foreign reserves. According to Bianchi *et al.* (2013), reserves are used as a buffer against rollover risk. Also, in an economy where private agents are able to borrow from abroad, piling up of foreign reserves will help these private agents to have access to funds when domestic market conditions will be imperfect (Bacchetta *et al.* 2013).

In considering the importance of foreign reserves discussed above, this paper aims to explain relationship between foreign reserves and domestic credit growth with empirical evidence from Fiji. A better understanding on mechanics of this will allow policy makers to formulate even better policies when it comes to safeguarding monetary policy objective by affecting domestic credit line.

Section 2 of this paper presents literature on credit growth and foreign reserves, while Section 3 looks at data used with discussion of empirical testing method. Section 4 presents results and insight into how the findings could be used by policy makers in Pacific Island nations. Section 5 will conclude the paper with findings from empirical studies and literature review.

2. Literature Review

The economies in Pacific Island share very common characteristics. Pacific Island countries are small open economies with a relatively dominant primary industry. These Island nations have a smaller manufacturing base, thus import of key commodities, including crude oil is vital, not only for operation but also for growth and development of other sectors. The management of foreign reserve for purpose of importing these key commodities is the overarching goal of monetary policy in these nations.

The inflow of foreign reserves increases the amount of money available in a country for borrowing and this also leads to a decline in interest rate. However, a central bank may intervene in the market to sterilize growth in money supply via open market operations and will aim to bring the overnight banking rates closer to policy indicator rate, though this may still show deviation. A higher interest rate is a signal for tighter monetary policy, thus discourages borrowings and any uncontrolled growth in money supply.

Moreover, credit growth has also been seen by central banks to be detrimental to foreign reserves level. Studies by Jorda *et al.* (2011), Schularick and Taylor (2012), Gourinchas and Obstfeld (2012) conclude that excessive credit growth leads to financial crisis. In June 2006, the

RBF announced that it aims to dampen credit growth following concerns over descending levels of foreign reserves (Reserve Bank of Fiji, 2006). In same month of 2006, foreign reserves in Fiji was \$US260 million, low when compared with \$US431 million in June 2005 (International Monetary Fund, 2016). Additionally, Barba and Pivetti (2009), Buyukkarabacak and Valev (2010), Sutherland *et al.* (2012), and Jappelli *et al.* (2013) report that expansion of household credit increases the probability of crisis and recession. Mohanty and Turner (2006) mentioned that credit to private sector has been increasing and this has been building large reserve holdings. The countries studied for this included Argentina, Brazil, China, the Czech Republic, Hong Kong SAR, Hungary, India, Korea, Malaysia, Mexico, Poland, Saudi Arabia, Singapore, Thailand, Russia and Venezuela.

Prior work on determining relationship between domestic credit and foreign reserve undertaken by Jordan and Branch (n.d) on Caribbean economies (The Bahamas, Barbados, Jamaica and Trinidad & Tobago) found that domestic credit growth and foreign reserves are positively related. The authors used VAR method to model data from 1982 to 2003 for four nations in Caribbean and concluded that measures undertaken by central bank to restrain credit growth is detrimental to foreign reserves growth. The approach undertaken for measurement of foreign reserves by Jordan and Branch (n.d) included Special Drawings Right (SDR) and also IMF Position components in foreign reserve to model this relationship. However, the approach undertaken in this paper excludes such components with the understanding that movements in domestic credit growth does not directly lead to changes in components of SDR allocation and IMF position in foreign reserves. These things are rather determined by IMF, based on a number of different factors in economy and not solely or directly by changes in domestic credit.

Moreover, Cheng (2015) applied Ramsey Problem method to study relationship between average growth rate of real GDP per capita and foreign reserves. A study of 24 emerging economies from 1980 to 2010 revealed a clear positive relationship between growth in real GDP per capita and foreign reserves. It is argued that foreign reserve accumulation is a consequence of a growth strategy induced by strong capital investment in a financially constrained economy. As such, this implies that restraining growth in domestic credit would undermine funds available to selected growth oriented sectors as well.

Lane and McQuade (2013) from the study of European countries concluded that domestic credit growth is strongly related to net debt inflows. A two-way causality effect was also found between domestic credit growth and international capital flows. The OLS regression model was extended to 54 advanced and emerging economies, which upheld this findings. Moreover, it is striking that net debt flows appear to be the relevant measure, with no apparent gain to splitting net debt flows between gross debt inflows and gross debt outflows. The authors used five-year interval data from 1993 to 2008 and measured domestic credit as a change in five-year intervals in ratio of private credit to GDP. Adding to this, Polat (2015) found that EU and USA real GDP growth and global financial crisis are powerful determinants of foreign direct investment in Central and Eastern European countries.

However, an empirical paper by Ghosh *et al.* (2012) found foreign reserve growth is achieved in open economy when domestic credit is more constrained. This is when higher savings eventually lead to current account surplus. The application of this finding was noted in action taken by RBF in 2006. In midst of declining foreign reserves, the RBF not only tightened capital control measures but also implemented policies to dampen domestic credit growth in 2006. Such action was taken by the bank to maintain macroeconomic stability. However, the pressure on foreign reserves was not eased and eventually the RBF had to devalue Fiji dollar by 20 percent in April 2009. Nevertheless, it would be worth acknowledging that during this phase, Fiji was also affected by Global Financial Crisis and domestic political event.

Moreover, South Pacific Island countries are characterized as small and open economies, which all have shallow financial market. However, in other advanced nations with more developed financial markets, transmission of monetary policy would operate differently, when compared with small Pacific Island nations. Shallow financial market and weak institutional framework will make transmission to take more time than in advanced nations (Pinter *et al.* 2013). A recent study by Slahor *et al.* (2015) found that in more advanced nations, such as EU, the changes in monetary aggregates can impact price relatively fast, which is with a delay of only one month.

Horne and Nahm (n.d) highlighted the rising levels of foreign exchange and decline in gold and SDR proportion in international reserve kept by countries. Data from International Monetary Fund (1998) shows that the share of gold was down to 2.4 percent in 1997, when compared with 63.2 percent recorded in 1960s. Similarly, SDR proportion fell from 3.4 percent in 1970 to only 1.6 percent in 1997. The data used in Horne and Nahm (n.d) complements views expressed in this paper, whereby, foreign reserve data used in modelling excludes SDR position in IMF. Given the declining proportion of Gold and SDR in international reserve basket, exclusion of these items allows derivation of model which not only includes domestic factors but is also more forward looking.

Carvalho and Castro (2015) used Bayesian estimation and concluded that higher interest rates would lead to a decline in exports, as such conditions contribute to appreciation of domestic currency. The Pacific Island nations are heavily dependent on foreign inflows to finance imports of selected key products and commodities. Decline in exports would mean fall in foreign reserves, which would put pressure on monetary policy objective of central bank. Trade openness has been seen as a factor of economic growth (Uslu, 2016); however, excessive imports should always be carefully studied by policy makers. Therefore, not only via domestic credit that foreign reserve will get affected but a number of other factors in monetary policy framework also affects foreign reserve. However, this paper aims to rather explain the relationship between one of the factors, being domestic credit to foreign reserve. This is done with the view that this method has recently been explored by the RBF, thus an estimation based on domestic credit would allow policy makers and other interested readers to gauge the effectiveness of such approach in safeguarding foreign reserves level.

3. Data

Foreign reserves and domestic credit are two key variables of focus in this research. The foreign reserves data used in this paper excludes SDR holdings and IMF Position. SDR allocation is determined by IMF based on country's GDP as a whole (quota) rather than domestic variables individually. Moreover, the IMF may also decide to allocate additional SDR to countries in times of need or following amendments in allocation policies. This was evident in 2009, when the IMF allocated an additional SDR to Fiji, which increased Fiji's SDR holdings to FJD202.8 million from FJD18.6 million a year ago (Fiji Island Bureau of Statistics, 2016). The IMF position in foreign reserve component is also based on quota and will not be changed by movements in domestic credit growth.

The other variable, domestic credit consists of credit to private sector, official entities and credit to government. In case of Fiji, private sector credit proportion is dominant, when compared with credit extended to official entities and the government. Private sector credit includes elements of credit given by commercial banks and non-bank financial institutions to individuals and businesses.

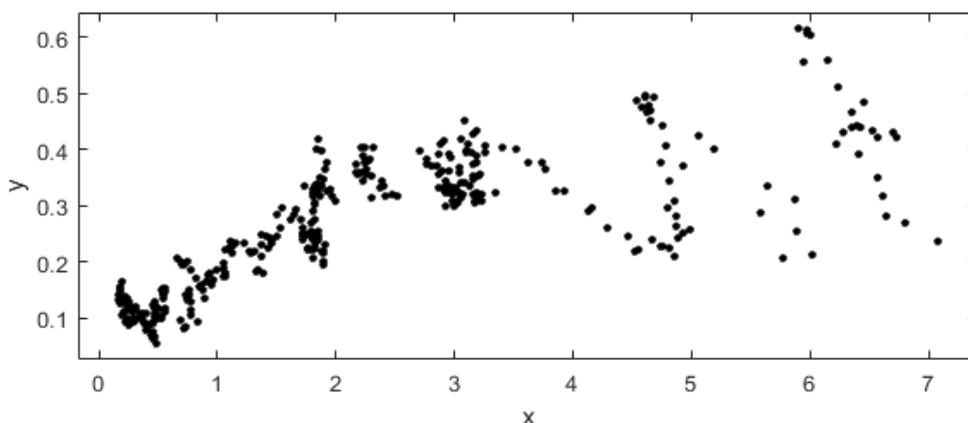


Figure 1. Foreign Reserve (y) & Domestic Credit (x) from 1980-2015 (\$US billion)

As such to explore the nature of change in foreign reserve from movements in domestic credit, data obtained from International Monetary Fund was first plotted to study the pattern of movement between the two variables, foreign reserves (y) and domestic credit (x) (Figure 1). After removing the outliers found in data, the plot revealed a periodic pattern between two variables. Fourier transformation techniques have been known to work well in explaining relationship in phenomena with periodic pattern.

Fourier Transformation has lately been gaining more popularity in finance and economics, following its evolvement from engineering field. Debnath (2012) mentions that Fourier is used widely in physics and engineering, including modern day mathematical analysis. Also, the new discipline of financial engineering is anticipated to expose the areas of finance and engineering more to each other for benefit of society as a whole.

Fourier transformation technique has been used in finance and economics discipline dating back to 1960s (Cunnyngham, 1963; Granger, 1966). This technique has also been applied in derivatives. Granger and Morgenstern (1964) used Fourier Transformation to examine stock market prices on New York Stock Exchange price series. Granger and Morgenstern (1964) found that stock prices followed the random-walk hypothesis in short term, but long run components exerted greater influence than the random-walk hypothesis suggested (a non-parametric test of this was demonstrated by a flat spectrum of share price changes).

More lately, Omekara *et al.* (2014) studied inflation data in Nigeria from 2003 to 2011 using Fourier Transformation techniques. Fourier techniques were used to analyze short-term data (20 months) and long-term data (51 months). The model derived was fitted in data to make accurate short-term monthly inflation rate forecasts from an out-of-sample period from September 2011 to September 2012.

A Fourier series is explained as infinite sum of sines and cosines. Hence, to solve this periodic phenomenon of movements in foreign reserves from growth in domestic credit, a generalized Fourier function is first expressed as:

$$f(t) = \partial_0 + \sum_{n=1}^{\infty} \partial_n \cos(nwt) + b_n \sin(nwt) \quad (1)$$

The coefficients of this function would be derived by integrating as follows:

$$\partial_0 = \frac{1}{T} \int_{-T/2}^{T/2} f(t) dt \quad (2)$$

$$\partial_n = \frac{2}{T} \int_{-T/2}^{T/2} f(t) \cos(nwt) dt \quad (3)$$

$$b_n = \frac{2}{T} \int_{-T/2}^{T/2} f(t) \sin(nwt) dt \quad (4)$$

$$W = \frac{2\pi}{T} \quad (5)$$

The value of T is worked out by looking at length of time it takes for a signal to complete a pattern. T will be the value from where the periodic graph begins to a point where first pattern shown starts to repeat itself.

Also t in this equation will be values on x axis representing time. The area of interest here is to see what will be the amplitude, which is $f(t)$ on y axis at a given point in time (t). Hence, given the periodic pattern of the phenomena studied in this paper, Fourier Transformation approach is applied to study nature of change in foreign reserves from movements in domestic credit line. The foreign reserves and domestic credit data studied here is times series data for 420 months. Such periodic data can be expressed using Fourier analysis as a series of waves (Brown and Churchill, 1993). The form of Fourier Transformation technique to be adopted in context of data presented needs to give consideration to length of frequency. In Fourier, the shorter the

frequency, the higher the value of n would be. For instance, $f(x) = \sin 2\pi t$ will have a shorter frequency than equation, $f(x) = \sin 3\pi t$ and $f(x) = \sin 4\pi t$ (Figure 2). However, all these would equate to same amount of period.

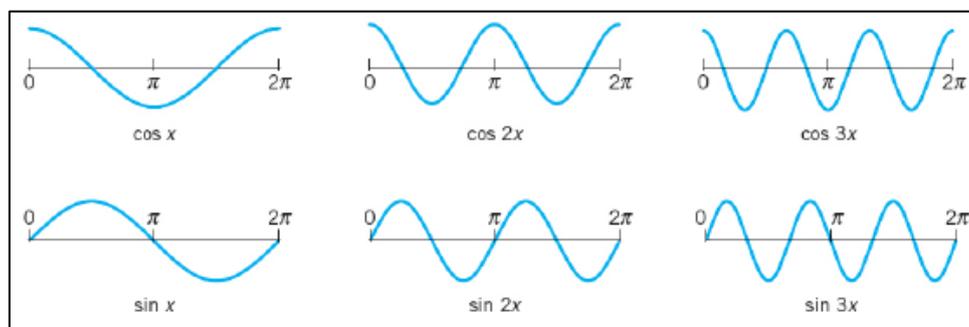


Figure 2. Fourier Curves

The above graphs are derived based on following generalized equations:

$$f(x) = \cos nx \quad (6)$$

$$f(x) = \sin nx \quad (7)$$

However, to reflect increased frequency, the value of n in cos graph is raised to 2 and then to 3. The graphs plotted based on below equation with greater value of n has a higher frequency:

$$f(x) = \cos 2x \quad (8)$$

$$f(x) = \cos 3x \quad (9)$$

Similarly, the value of n in sine graph is raised from 2 to 3 as the frequency increases within given time period of 2π .

$$f(x) = \sin 2x \quad (10)$$

$$f(x) = \sin 3x \quad (11)$$

In order to use Fourier Transformation to explain movements in foreign reserve from changes in domestic credit, we first need to clearly define the amplitude, $f(t)$ and the time period (t) in context of variables studied.

Thus, let foreign reserves be $f(t)$ and domestic credit be t . Also as explained earlier, the higher the frequency, the higher the value of n will be. The monthly foreign reserve and domestic credit data from 1980 to 2015 plotted above revealed a periodic pattern with relatively higher frequency. Thus, to derive an equation to explain this pattern, the coefficient n was substituted with values from 1 to 10 in Fourier equation and as would be expected, each of these resulted in different values for adjusted R square. Notably, after removing the outliers, adjusted R Square was maximized with $n=8$ to 0.9646 at 95% confidence bound (Figure 3).

Hence, the Fourier equation derived in this instance is:

$$f(t) = \partial_0 + \sum_{n=1}^{\infty} \partial_n \cos(8wt) + b_n \sin(8wt) \quad (12)$$

The value of T is given as 3, which is calculated by applying the same logic as how long it takes for first known pattern to complete a cycle.

The other coefficients are calculated as follows:

$$\partial_0 = \frac{1}{3} \int_0^{3/2} f(t) dt \quad (13)$$

$$\partial_n = \frac{2}{3} \int_0^{3/2} f(t) \cos(8wt) dt \quad (14)$$

$$b_n = \frac{2}{3} \int_0^{3/2} f(t) \sin(8wt) dt \quad (15)$$

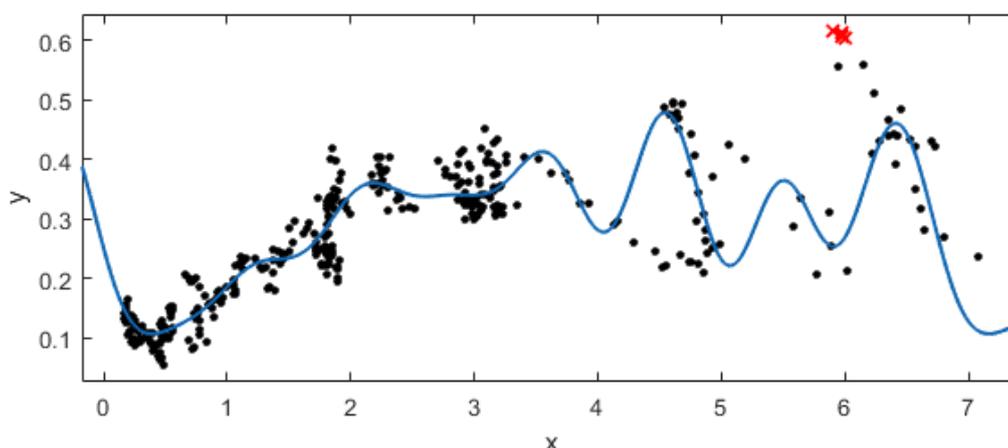


Figure 3. Fourier Curve Model for Foreign Reserve (y) & Domestic Credit (x) (\$US billion)

This model can be used to understand the nature of change in foreign reserves ($f(x)$) from movements in domestic credit (x). With a relatively higher value for Adjusted R Square at 95% confidence, this model can be relied on when extrapolating foreign reserves data at any x value. In process of extrapolating foreign reserves data for selected x values, the model revealed a more biased upswing pattern, whereby with increase in domestic credit (x), foreign reserves (y) also increase. This is even though the periodic pattern repeats itself with changes in x variable, a more favorable pattern towards increase in y variable is generally evident from this study.

4. Result Analysis and Implication

This model should be applied cautiously by policy makers in determining the nature of change in foreign reserves from growth in domestic credit. While the model depicts that increase in domestic credit growth is more biased towards increase in foreign reserve; however, depending on other shocks in the economy, an increase in credit growth can also be detrimental to foreign currency stock.

In June 2006, it was noted that the Reserve Bank of Fiji was putting in policies to dampen credit growth, which was envisaged to drain out foreign reserves level. The empirical research along with literature evidence presented holds that the movements in foreign reserve can be

explained by changes in domestic credit. This means that policy makers can achieve desirable levels of foreign reserves by impacting domestic credit growth rate.

However, as suggested by this model, any dampening in domestic credit growth should be analyzed thoroughly prior to encapsulating such decisions in monetary policy framework. The model shows that increase in domestic credit line would lead to increase in foreign reserves level. On the other hand, it is modelled that decrease in domestic credit, on instances would also lead to decline in foreign reserves. Thus, the policy makers need to be very strategic when putting in measures to cut down domestic credit growth. The application of this was evident in monetary policy tool used by RBF while reigning in domestic credit growth in June 2006. Though the RBF placed in even more direct measures such as credit ceiling on loans given by commercial banks, the regulator kept the gate open for loans given to any priority sector. The commercial banks were allowed to give loans above credit ceiling limit imposed by RBF, if purpose of the loan was towards priority sector listed by RBF. This ideally ensured that decline in domestic credit did not get suppressed to a stage whereby it becomes detrimental to foreign reserves level.

Moreover, as mentioned earlier, the small open economies in South Pacific share common characteristics in terms of monetary policy objectives and operation. The similarity between these nations and Fiji, certainly makes this model adoptable by other Pacific Island nations.

Also, the shocks in the economy, which may either be internally generated or imported, are not expected to affect this model. This is because the model was developed based on periodic pattern, which depicted such behavior after considering any such shocks affecting the variables studied. Moreover, due to geographic location of Pacific Islands, the nations in this territory are prone to cyclone every year, which also leads to destructive flooding. Such internal shock is anticipated to impact export industry and a consequent decline in reserve inflows. Also during such shocks, individuals will have to depend more on imported goods and this would exert more pressure on foreign reserves. However, in short term, though foreign aids received assists in keeping macroeconomic balance, full recovery from such natural disaster generally takes much longer.

The external shocks, which affect foreign currency basket of Pacific Island nations, would creep in from trading partner currencies. The major trading partners for Fiji are Australia, New Zealand, Japan, UK and USA. Most recent example of this would be contagion impact the Pacific Island nations went through post Global Financial Crisis.

5. Conclusion

Based on results of Fourier Transformation, it is accepted that the nature of change in foreign reserve can be explained by movements in domestic credit. The policy makers need to apply this model with the understanding that suppressing domestic credit below certain level would have detrimental impact on accumulation of foreign reserves. Prior to engaging into measures to cut domestic credit growth, various domestic credit scenarios should be evaluated in context of this model, following which credit growth should only be reined in to level extrapolated by Fourier Transformation for maintaining foreign reserves at adequate level.

Moreover, the operation of monetary policy in traditional approach is getting more challenging with changing parameters (Schularick and Taylor, 2012). Hence, it is suggested that a further research could be carried out by including new payment methods, derivatives and mechanism which may disrupt operation of monetary policy to control credit growth and impact on foreign reserve.

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