Demand for International Reserves in Turkey

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Having an important place in the international monetary system, international reserves held by central bank usually reflect country's economic strength in terms of international finance and trade. There are many reasons for holding international reserves by central banks such as financing the deficit in the balance of payment, managing the monetary and exchange rate policies, minimizing the negative effects of external shocks and reducing the cost of borrowing. Continuously changing and diversifying characteristics of these reasons affect the demand for reserves depending to the economic conditions of the country. Over the last ten years, there has been a tremendous increase in international reserves held by Turkish Central Bank. From 2002 to 2012, the reserves of the bank have risen from 20 billion dollars to 96 billion dollars, showing an increase more than four times. This sudden and huge increase in the foreign reserves drove us to determine and investigate the factors which induce the Turkish Central Bank to hold high level of reserves. Thus, the purpose of this study is to estimate and analyze the demand for international reserves held by central banks using the buffer stock model in the case of Turkey. The data used in the study is monthly and cover the period of 1990:03-2012:10. The buffer stock model was econometrically estimated by using the OLS method for three different models. Our findings indicate that the opportunity cost affected reserve demand much stronger than the reserve volatility in Turkish case.

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1. INTRODUCTION

The theory of demand for international reserves had been established through important contribution of Heller (1966). In a few years the theory has been extended by some studies (for instance Hamada and Ueda (1977), Frenkel and Jovanovic (1981)). Since then, the demand for international reserves has become one of the most remarkable interests in policy and academic circle. This recent interest causes to rapid increase in international reserves held by developing countries such as Turkey. Over the past few decades, there has been a tremendous increase in international reserves held by Turkish Central Bank. For example, starting from a low level of U.S. $4.7 billion at the end of March 1990, the stock of international reserves have increased continuously to U.S. $18.8 billion by the end of December 2001 and have reached U.S. $99.2 billion in end October 2012 (see Figure 1). In other words, in twenty two years the growth rate of reserves has been increased nearly 2010%.

Globally international reserves have grown very quickly especially in the last decade. These growths of international reserves have been even faster for developing economies than developed ones. There are many reasons to hold international reserves by central banks. Those reasons might be ordered as fixing the value of the national currency change, supporting monetary and exchange rate policies, meeting foreign debt, providing emergency protection and financing imports respectively.

Despite being much benefits of holding reserves, if reserves hold greater than a certain value, the country have more harm than good. The optimal level of reserve which is determined by countries is important to decide of the demanded amount of reserve. So, research

on optimal international reserves is important for sustainable development.

Until present, there have been a great number of studies on the demand for international reserves for developed and developing countries. Generally Turkey was excluded for in panel data analysis those developing countries dealing with the demand for international reserves since there are still lack of studies on Turkey. In this paper we intend to fill up this gap in the literature.

In fact, we analyze the demand for international reserves in the Turkey context through using the buffer stock model of reserves. In their recent cross-sectional time series analysis, Flood and Marion (2002) asserted that the buffer stock model is so successful to define international reserve holding for developing economies. The model is based on the balance of two costs which are; the opportunity cost and the adjustment cost. The opportunity cost of holding reserves is the difference between return on alternative investment and on reserves. The adjustment cost is generally related to policy action lead to welfare lost.

The rest of the paper is organized as the review of empirical literature about the particular issue in section 2, trends in international reserves in Turkey in section 3, the model of the demand for reserves in section 4, the results of the empirical research in section 5, and conclusion remarks of the study in the last section.

2. REVIEW OF THE EMPIRICAL LITERATURE

This section has reviewed some empirical studies on the demand for international reserves from the period 1981 to 2009. Empirical studies can be separated broadly into two groups. The first group has determined the demand for international reserve for cross countries (see Table 1). Most of cross country studies group countries into developed and developing countries. The second group has investigated the demand for international reserve under the time series data for an individual country (see Table 2).

Result of Frankel's (1981) study is consistent with the predictions of the buffer stock model. Moreover Flood and Marion (2002) have indicated that the buffer stock model worked well in the era of high capital mobility and country characteristics could affect the cost of adjustment. On the other hand, Aizenman and Marion (2002) have found that sovereign risk and costly tax collection led to hold high level of reserves to cover fiscal liabilities for developing countries. Cheung and Ito (2009) have concluded that developing economies tend to hold higher level of reserves than developed ones.

Table1

Cross-Country Studies on the Demand for International Reserve

Author	Country	Period and data frequency	Dependent variable	Explanatory variable	Methodology
Frankel (1981)	For 22 developing countries	1971-1975 annual data	R (Level of reserves)	Opportunity cost, adjustment cost, import	OLS
Aizenman and Marion (2002)	For 122 developing countries	1980-2002 annual data	R/P (deflated by U.S GDP deflator)	GDP, Population, Volatility of real export receipts, volatility of nominal effective exchange rate, share of imports of goods and services in GDP	Panel Regression
Flood and Marion (2002)	For 35 countries	1988-1999 annual data	R, R/M, R/P, R/GNP or R/M2	Volatility of Reserves, opportunity cost, Nominal effect exchange rate volatility,	GMM

				ratio of export plus import to GDP, ratio of gross capital flows to GDP	
Cheung and Ito (2009)	For 119 countries	1975-2004 annual data	R/GDP	Traditional macroeconomic variables, financial variables, institutional variables, dummy variables	Panel Regression

Elbadawi (1988) has concluded that the variability measure was positive and significant in Sudan to accumulate reserves. Ford and Huang (1994) have indicated that domestic monetary disequilibrium significantly affected reserve demand in China. Ramachandran (2004) has found that the opportunity cost played a greater role than reserve volatility to determine the level of reserves in India. Parallel with Ramachandran's (2004) framework for Pakistan, Jalil and Bokhari (2008) have found similar results through using the same method. However Prabheesh, Malathy and Madhumathi's findings (2007) have showed that capital account vulnerability is more sensitive than its opportunity cost for reserve accumulation in India. Similarly Ra (2007) has showed that after crises the Korean reserve demands have becomed more sensitive to the adjustment cost and the openness than opportunity cost. Sehgal and Sharma (2008) have found that risky capital flows and exchange rate volatility have positive impact on international reserve demand. And export growth is found to be significant. Nor, Azali and Law (2008) have concluded that the current account balance and short term external debt have significant impacts on the demand for international reserves in Malaysia.

Table 2
Individual Country Studies on the Demand for International Reserve

Author	Country	Period and data frequency	Dependent variable	Explanatory variable	Methodology
Elbadawi (1988)	Sudan	1971-1982 quarterly data	First difference of reserves	import to GDP ratio, variability of reserves, uncertainty of reserves, scale variables, remittances	ECM
Ford and Huang (1994)	China	1956-1989 annual data	First difference of reserves	Sum of the industrial and agricaltural output, uncertainty of reserves, import to GDP ratio	ECM
Ramachandran (2004)	India	1999-2003 weekly data	Level of reserves	Adjustment cost, opportunity cost	ARCH/GARCH
Prabheesh, Malathy and Madhumathi (2007)	India	1983-2005 monthly data	Level of reserves	Economic size, current account vulnerability, capital account vulnerability, exchange rate flexibility, opportunity cost	VECM

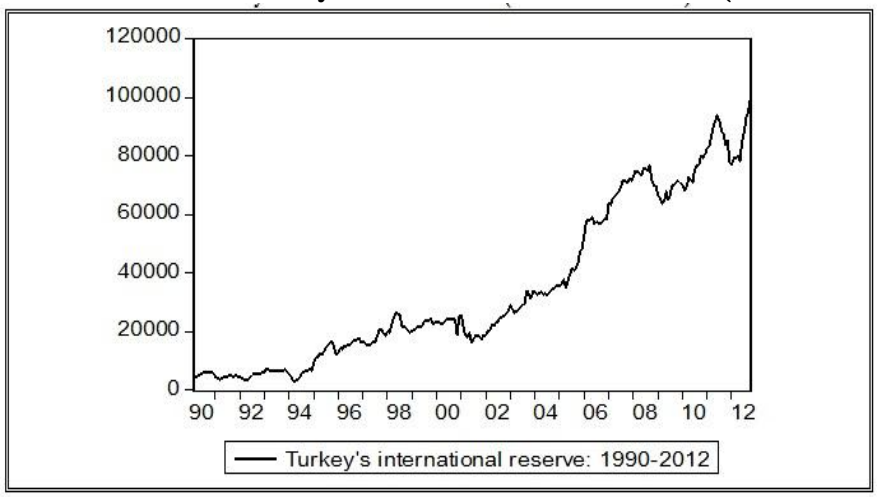
Ra (2007)	Korea	1973-2005 1990-1997 1998-2005 monthly data	Level of reserves	Adjustment cost, opportunity cost, openness, scale variables	Johansen and Juselius (1992) cointegration, ECM
Sehgal and Sharma (2008)	India	1990-2006 monthly data	Level of reserves	GDP, import to GDP ratio, short run external debt to GDP ratio, portfolio investment to GDP ratio, opportunity cost, export growths	VECM
Jalil and Bokhari (2008)	Pakistan	1995-2005 monthly data	Level of reserves	Adjustment cost, opportunity cost, dummy for regime change	ARCH/GARCH
Nor, Azali and Law (2008)	Malaysia	1970-2004 annual data	Level of reserves	Scale variables, variability measurements, propensity to import, current account balance, real short term external debt	ARDL

3. TRENDS IN INTERNATIONAL RESERVES IN TURKEY

The level of Turkey's international reserves has showed massive growth in the period from 1990 to 2010. Figure 1 exhibits significant increasing trend in international reserves. Especially, over the last ten years, there has been a tremendous increase in international reserves

held by Turkish Central Bank. From 2002 to 2012, the reserves of the bank have risen from 20 billion dollars to 96 billion dollars, showing an increase more than four times. The highest growth rate of reserves in Turkey has become in January 1995 (35%).
Also Turkish Central Bank reserves have been continuously increasing since 1987s. In October 1990 the reserves increased from U.S. $6 billion to U.S. $26 billion in November 2002. In October 2008 the amount climbed to U.S. $72 billion and finally they reached U.S. $99 billion in October 2012.

Figure 1
Turkey's International Reserve (Million US Dollar)



Source: Central Bank of the Republic of Turkey (CBRT).

4. THE MODEL OF THE DEMAND FOR INTERNATIONAL RESERVES

In this section we used the buffer stock model to explain optimal international reserve movements. Heller (1966) determined the optimal stock of reserves in terms of a rational optimising decision that including equating the marginal cost and benefit of holding reserves. To determine the optimal stock for reserves, Frenkel and Jovanovic (1981) expanded Heller's framework and developed a theoretical model which is based on the principles of inventory management.

The buffer stock of Frenkel and Jovanovic (1981) characterized reserve movements in continuous time period as a Wiener process[2], by the following stochastic equation:

$$dR(t) = -\mu dt + \acute{o} dW(t) \quad (1)$$

where R (t) is reserve held in time t and W (t) is the standard Wiener process with mean zero and variance t. In variably the distribution of reserve holdings R (t) can be defined as:

$$R(t) = R^* - \mu t + \acute{o} W(t) \quad (2)$$

where R* is the optimal stock of reserves, μ is deterministic part of sudden change in reserves and ó is the standard deviation of the Wiener increment in reserves. The estimating reserve demand equation can be written as:

$$\text{Log } R_t = b_0 + b_1 \ln \acute{o}_t + b_2 \ln r_t + u_t \quad (3)$$

where b_0,ó and r are fixed, adjustment and opportunity cost of holding reserves respectively and u_t is white noise error. The theoretical prediction of the model for the parameters are that $b_1 = 0{,}5$ and $b_2 =$ -

[2] The Wiener Process is a continuous time of a simple random walk with independent increments (Jalil and Bokhari (2008), 40).

0,25. Substantially equation (3) identifies two macroeconomic costs for determining the optimal stock of reserves. The first is the adjustment cost ($ó_t$), which is based on the frequency of adjustment. The second is the opportunity cost (r_t), which is incurred the forgone earnings on reserve accumulation.

5. EMPRICAL ANALYSIS

We estimate equation (3) using monthly data for the period from 1990:03 to 2012:10. The data on reserves and one month forward interest rate are obtained from the Central Bank of the Republic of Turkey. To be consistent with the literature on reserves for measuring the adjustment cost we is defined rolling standard deviation of change in reserves and opportunity cost which is defined by using one month forward interest rate.

Firstly we estimate equation (3) for three different adjustment costs which are defined as 4 month, 6 month and 8 month rolling standard deviation of change in reserves. The results are shown in Table 3 respectively.

Table 3
Results of Buffer Stock Models for Three Different Adjustment Cost

Indicators	Model 1	Model 2	Model 3
b_o	9.7575*** (0.5979)	8.4879*** (0.6533)	7.7133*** (0.7765)
b_1	0.5204*** (0.0673)	0.6609*** (0.0760)	0.7461*** (0.0885)
b_2	-0.8950*** (0.0806)	-0.8314*** (0.0759)	-0.7916*** (0.0769)

R^2	0.7392	0.7700	0.7906
F- statistic	375.7310	440.415	429.9950
D-W	0.3218	0.2613	0.2412
Parenthesis indicates Newey-West standard errors. ***, indicates that coefficients are significant at 1% level.			

As seen in Table 3 the buffer stock model explains averagely 76,66% of the reserve demand. All the variables signs in all regression are consistent with the theoretical predictions. Furthermore, for three models the volatility coefficients are found to be higher than the theoretical prediction. All types coefficient of volatility are positive and significant at 1% level. This means that volatility increases by 1% the reserves increases by 0.5204%, 0.6609% and 0.7461% for three models respectively. However, model 1 is the closest model to the theory among all three models [3].

Further Figure 2 shows that the behavior of observed and estimated values of reserves gained from equation (3). During March 1990 to March 1996, the CBRT hold reserves less than optimal level averagely

[3] Additionally we measure the volatility by modelling the variance of reserve changes using ARCH specification. However the results of ARCH model worse than all three models because of the coefficients similarity with theoretical prediction.

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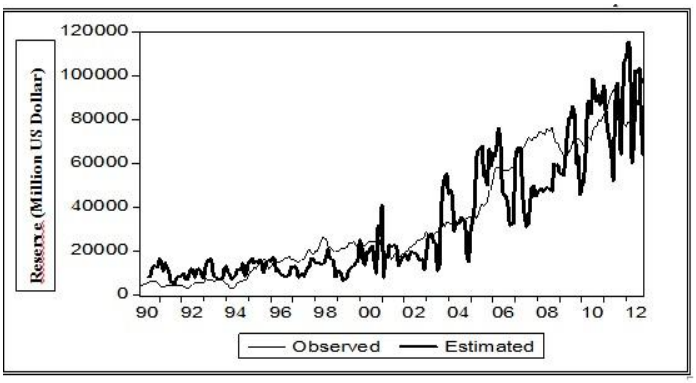
U.S. $7 billion. When we compare to results of 2012 year, CBRT hold averagely U.S. $93 billion of optimal reserves. But last two months estimation results show that the level of optimal reserves has reduced U.S. $77 and U.S. $64 respectively. Looking at these conclusions, we can say that recent two months reserve movements express the optimal behavior more than the buffer stock model.

Figure 2
Observed and Estimated Values of International Reserve Demand Equation



6. CONCLUSION

The current paper has estimated the buffer stock model using an analysis of time series for Turkey from 1990 to 2012 using monthly data. All of the estimates of buffer stock models indicate that the opportunity cost affected determining the level of reserves much stronger than the reserve volatility but not to the significant effect for

model 3. This result is consistent with Ramachandran (2004) and Jalil and Bokhari (2008). As said by Ramachandran (2004) this can perhaps be attributed to the fact that capital outflow in Turkey as in India and Pakistan is less free than capital inflow. Furthermore, in the second quarter of 2012 Turkey's total foreign debt stocks have declared U.S. $323 million by CBRT. Maybe to say that a large part of reserve accumulation is derived from the level of foreign debt would not be wrong.

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