Exchange Market Pressure and Monetary Policy in Ethiopia

Deksios Bezabih Male

A study submitted to the department of Management in partial fulfillment of the requirements for the Degree of Master of Business Administration in Financial Service-specialization in Banking

ADDIS ABABA UNIVERSITY

COLLEGE OF BUSINESS AND ECONOMICS

MASTER OF BUSINESS ADMINISTRATION PROGRAM

Addis Ababa, Ethiopia

May, 2018

ADDIS ABABA UNIVERSITY
COLLEGE OF BUSINESS AND ECONOMICS
MASTER OF BUSINESS ADMINISTARTION PROGRAM

STATEMENT OF DECLARATION

I, Deksios Bezabih, declare that this thesis titled: *"Exchange Market Pressure and Monetary Policy in Ethiopia"* and submitted in partial fulfillment of the requirements for the Degree of Master of Business Administration in financial service, is outcome of my own effort and study and that all sources of materials used for the study have duly acknowledged. I have produced it independently with the only guidance and suggestion of the thesis Advisor. The study complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

Student: Deksios Bezabih

ID. No: GSE/1254/08

Signature: ----------

ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES

STATEMENT OF CERTIFICATION

This is to certify that the thesis prepared by Deksios Bezabih entitled: *"Exchange Market Pressure and Monetary Policy in Ethiopia"* and submitted in partial fulfillment of the requirements for the degree of Master of Business Administration in financial service, complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

Signed by the Examining Committee's

Internal examiner: Alem Hagos (PhD) Signature _____Date _____

External examiner: Zinegnaw Abiy(PhD) Signature_____Date _____

Advisor: Yitbarek Tekle (PhD)Signature _____Date _____

_____ _____ _____

Chair of Department or Graduate Program Coordinator

ACKNOWLEDGEMENTS

I praise the name of Almighty GOD who gave me power and patience in every endeavor of my life. I also extend my special acknowledgement to the following individuals for their unreserved support without that this work would not become reality. My first sincere and deepest gratitude goes to my advisor Dr Yitbarek Tekle for his absolute assistance in giving me relevant comments and guidance throughout the study.

I am also very gratefully indebted to Mr. Bekele Abebe helping me to get data for the study. My sincere gratitude also goes to Mr. Fitsum Tsehaye and Wro. Zemzem, staff of National Bank of Ethiopia, for providing me macroeconomic data and Ato Abebe Deresa staff of Awash Bank who helped me in giving direction. I would also like to thank my friends Tadesse Yirgu and Kahsay for their kind advice and support during the study period.

Finally, I would like to thank many other people who have been part of this journey with me and each have carried me along my path in some way and all my families for their unconditional support.

DeksiosBezabih

May, 2018

LIST OF FIGURES

LIST OF TABLES

ACRONYMS ANDABBRIVATIONS

- 2SLS Two Stage Least Square
- BLS Bureau of Labor Statistics
- GDP Gross Domestic Product
- IFS International Financial Statistics
- IMF International Monetary Fund
- NBE National Bank of Ethiopia
- NPC-NAS National Planning Commission-National Account Section
- RGDP Real Gross Domestic Product

ABSTRACT

In this paper, the study examined the foreign exchange market and try to extract an exchange market pressure and an intervention index for Ethiopia by following the Weymark (1995) approach to evaluate the National Bank of Ethiopia exchange rate policy during 2006:Q1 to2017:Q4 using the data obtained from NBE, BLS, IMF and IFS. To address the problem of endogenity, the study employed the popular Two-Stage Least Squares (2SLS) to measure the exchange market pressure and developing intervention index. The exchange market pressure's mean value of 0.002 provides evidence that depreciating pressure remained dominant over the entire sample period. However the minimum mean value suggest that NBE should further depreciate the exchange rate or increase the foreign currency reserve. Also, the mean value of the intervention index is 0.31, indicating that the foreign exchange reserve and exchange rate changes absorbed thirty one and sixty nine percent of the pressure, respectively. Comparing with other countries, NBE's policy towards the pressure is more dependent on exchange rate. Otherwise the results of the paper show that on an average there was a downward pressure on Ethiopia's currency and the National Bank of Ethiopia pursued an active intervention policy. Specifically, as the intervention index shows, the National Bank of Ethiopia used both exchange rate and foreign exchange reserve interventions for restoring the foreign exchange market to equilibrium levels, a policy known as the managed float exchange rate regime which is consistent with the existing policy of the National Bank of Ethiopia.

Keywords: Exchange Market Pressure; Intervention Index; Exchange Rate; Foreign Reserve; 2 SLS

Table of Contents

CHAPTER ONE: INTRODUCTION

1.1 Background of the Study

The collapse of the Bretton Wood fixed exchange rate system ushered in a substantial change in the international financial architecture. Alternative systems introduced included hard pegs, and floating and intermediate exchange rate arrangements. Hard pegs are also known as currency union, referring to one country adopting another country's currency, either as part of wider currency union or dollarizing by formally entering into currency union. A floating exchange rate can refer to either a free float or a managed float.

In this system, although a Central Bank freely intervenes in a foreign exchange market to avoid undesirable exchange rate fluctuations, it does not commit itself to any particular exchange rate level. An intermediate system consists of fixed exchange rate, crawling peg, exchange rate band, and crawling band. All these exchange rate arrangements involve Central Bank foreign exchange intervention to reduce pressure on the domestic currency. Fischer (2001) shows that the number of countries with an intermediate exchange rate declined from 98 in 1992 to 63 in 1999. Despite the falling number in the 1990s, there remain a considerable number of countries with an intermediate exchange rate system.

Two important concepts in this thesis are Exchange Market Pressure and Intervention. Exchange Market Pressure refers to foreign exchange market disequilibrium that arises due to non-zero excess demand for domestic currency in the foreign exchange market. It is reflected in exchange rate changes in the absence of Central Bank intervention; for example through changes in foreign exchange reserves or interest rate. In this study, the definition of Exchange Market Pressure is the exchange rate change that would have occurred in the absence of Central Bank intervention given the expectation generated by the actual exchange rate policy implemented.

Frequently, a Central Bank intervenes in the foreign exchange market to avoid the undesirable influence of exchange rate changes on domestic macroeconomic variables. In such a case, actual exchange rate movements do not fully reflect the extent of foreign exchange market pressure.

The sum of exchange rate and foreign exchange reserve changes can better measure the prevailing pressure in the foreign exchange market when the Central Bank uses only foreign exchange reserves changes for relieving pressure on the currency. However, when a Central Bank intervenes indirectly by changing interest rate with the sole objective of influencing market pressure, then exchange rate, foreign exchange reserve and interest rate changes better reflect the extent of foreign exchange market pressure. An intervention index based on given exchange market pressure definition can be defined as the fraction of pressure that the Central Bank relieves either by selling or purchasing foreign exchange reserves or changing the interest rate or any combination of these.

Exchange Market Pressure measurement has remained an important part of the empirical literature on speculative attacks and currency crises. Blanco and Garber (1986) constructed a macroeconomic model that consists of real money demand, purchasing power parity and uncovered interest rate parity and applied this to the Mexican experience under a fixed exchange rate regime. They showed that devaluation occurs when foreign exchange reserves reach critical level and the shadow exchange rate exceeds the fixed exchange rate level.

The empirical Exchange Market Pressure and intervention index literature uses excess demand for domestic currency in examining the role that Central Bank allows market forces to play in determining the domestic currency value in the foreign exchange market. These studies include Girton and Roper (1977), Roper and Turnovsky (1980) and Weymark (1995). All these approaches are model-dependent because the components of Exchange Market Pressure are derived using a macroeconomic model. These have the advantage of setting out a clear analytic framework that is based upon existing theory.

In contrast, Eichengreen et al. (1996) Exchange Market Pressure is a model independent because neither the components of Exchange Market Pressure nor the weights assigned to them are derived from any macroeconomic model. So, for example, it is an entirely empirical matter whether foreign exchange reserves or the interest rate are important in calculating Exchange Market Pressure.

Girton and Roper (1977) use the monetary approach to the balance of payments and derived exchange market pressure index which is simple sum of exchange rate and foreign exchange reserves changes. Since both exchange rate and foreign exchange reserve changes are equally weighted; therefore, the construction of Exchange Market Pressure is only dependent upon the index's components and does not require the estimation of the macro model.

Roper and Turnovsky (1980), on the other hand, used an *IS-LM* framework and derived an optimum trade-off that monetary authorities face between domestic credit and exchange rate when stabilizing domestic output. The weights assigned to the components are based upon the estimated parameters. Weymark (1995) made a notable contribution to the theory of Exchange Market Pressure. Although Weymark's (1995) Exchange Market Pressure is dependent upon actual exchange rate and foreign exchange reserve changes, the weights assigned to foreign exchange reserve changes are derived from an estimated macro model. Thus, to produce an exchange market pressure index, estimation of a model needed and hence derive weights assigned to components of the index. This converts foreign exchange reserve changes into equivalent exchange rate units. Thus, using equivalent weights ensures that the exchange market pressure index is not dominated by the most volatile component.

Exchange market pressure is not directly observable. It can be measured through the channels that are used for restoring foreign exchange market equilibrium. In Girton and Roper's (1977), Roper and Turnovsky's (1980) and Weymark's (1995) studies, it is assumed that a Central Bank uses either the exchange rate or foreign exchange reserves or both for restoring foreign exchange market equilibrium. Thus, these studies assume direct intervention which takes place through the sale or purchase of foreign exchange reserves.

However, interest rate is another policy instrument that the Central Bank may use for restoring foreign exchange market equilibrium (see for example Edison, 1993 and Dominguez and Kenen, 1992 for the interest rate policies pursued by the European Monetary System member countries to keep their exchange rates within the bands prescribed by the Exchange Rate Mechanism). Therefore, the studies that do not include the interest rate as a component of exchange market pressure may not fully reflect the extent of foreign exchange market disequilibrium. Since the Central Bank changes the interest rate to fend off the pressure, Eichengreen et al. (1996) use interest rate as an additional component of exchange market pressure index. Contrary to Girton and Roper (1977), Roper and Turnovsky (1980) and Weymark (1995), Eichengreen et al. (1996) use the inverse of variance approach for assigning weights to the components of exchange market pressure.

An important element of this thesis is the behavior of macroeconomic policy in Ethiopia. Ethiopia's exchange rate regime has evolved through different phases. As the central bank of the country, the National Bank of Ethiopia (NBE) is obviously entrusted with the responsibility of maintaining the stability of the exchange rate of the Birr, the country's legal tender currency against other currencies.

Accordingly, during 1970s and 1980s, when the Ethiopian Birr was pegged to the US dollar at a fixed rate, the NBE used to maintain exchange rate stability of the Birr by making available foreign currency to the market at the fixed rate.

Following the introduction of the auction system on May 1, 1993 and the subsequent replacement of the auction system by the daily inter-bank foreign exchange market in October, 2001, demand and supply factors were given more latitude in the determination of the exchange rate. As a result, the NBE acts as a buffer between forces of demand and supply through intervention. Indeed, the NBE has attempted to stabilize the exchange rate through official interventions mainly by varying the amount of foreign exchange it supplied to the market. In effect, pressures in the foreign exchange market are reflected by changes in both exchange rate and reserve holdings of the NBE.

A study that estimated an index of the EMP for Ethiopia over the period November, 2001 to December, 2005 reveals that in majority of the cases (in 42 months out of 49 months considered) the Ethiopian foreign exchange market was characterized by depreciation pressures (Abebe, 2006). A critical issue under such circumstances is the policy measures to be undertaken by Monetary Authority (central bank) when the economy faces such external strains.

One of the elements of this thesis is to adopt Weymark's (1995) approach for constructing exchange market pressure and intervention index for Ethiopia. This approach is adopted because it enables us to verify what fraction of pressure Central Bank relieves through the purchase and sale of foreign exchange reserves. Furthermore, Weymark (1995) argues that Girton and Roper's (1977) and Roper and Turnovsky's (1980) exchange Market Pressure indices measure foreign exchange market disequilibrium by the simple sum of exchange rate and foreign exchange reserve changes under fixed and float systems. On the other hand, foreign exchange reserve changes and exchange rate changes fully reflect the extent of foreign exchange market disequilibrium in a managed float or an intermediate exchange rate arrangement. Thus, under a managed float or intermediate exchange rate system, measurement of foreign exchange market disequilibrium involves converting foreign exchange reserve changes into equivalent exchange rate units and then combining them with observed exchange rate units.

Weymark (1998) further argues that model-independent approaches to exchange market pressure are difficult to interpret in terms of their general usefulness. This is because neither

the components of exchange market pressure nor the weights assigned to them are derived from a stochastic macroeconomic model. Furthermore, the volatilities of the exchange rate, foreign exchange reserve and interest changes not only depend on the structure of the economy but also on the intervention activity of the Central Bank. In such a case, volatility smoothing approaches cannot be expected to assign equal weights to all components of exchange market pressure index. Weymark (1998) further argues that a poor understanding of market participant's expectation formation process and failure to model this process correctly is the primary cause of poor performance of exchange rate models linking macrocosmic variables with exchange rate determination at short and intermediate horizon.

1.2 Statement of the Problems

Currently, the Ethiopian exchange rate is characterized by a managed floating regime. Under this regime, exchange rate is determined by demand and supply force. However, central bank can intervene through setting floor rate and reserve requirement as deemed necessary. Since the introduction of a managed floating exchange rate regime, the Ethiopian currency has been continuously depreciating against major hard currencies. In a free floating exchange rate regime, the total pressure in the foreign exchange market is reflected in observed changes in exchange rate. At the other extreme, in a fixed exchange rate regime, foreign exchange market conditions are completely captured by changes in reserves. But, in mixed exchange rate regimes such as in a managed floating, a part of the pressure is absorbed by a change in exchange rate and a part by changes in reserves. Under such circumstances, neither the reserve changes nor the exchange rate movements capture the extent or nature of the exchange market disequilibrium. This calls for the precise measurement of pressures in the foreign exchange market. The pressure in the foreign exchange market is measured by an exchange market pressure (EMP).

A recent study that estimated an index of the EMP for Ethiopia over the period November, 2001 to December, 2005 reveals that in majority of the cases (in 42 months out of 49 months considered) the Ethiopian foreign exchange market was characterized by depreciation pressures (Abebe, 2006). A critical issue under such circumstances is the policy measures to be undertaken by Monetary Authority (central bank) when the economy faces such external strains.

For a country adopting a managed floating exchange rate regime and faced with exchange rate pressures, policy options in the short run are only limited to monetary policy as certain

fundamental domestic remedies, like fiscal adjustment and financial sector reform, may require time to implement (often under political stress).To assuage the pressures and reduce EMP, the central bank should react by embracing contractionary monetary policy. Interest rate defense is recently emphasized by the literature as possible venue to defend the currency and contend the attack. A more traditional way is via controlling domestic credit (Kamaly and Erbil, 2000, Tanner, 2001).

The policy response to an exchange market pressure to a large extent depends on the stance of monetary policy as well as the degree of monetary autonomy. When EMP builds up, the central bank decides whether to use domestic credit or interest rate or a combination of both to contend such pressures. A simple monetary model of exchange market pressure states that for a given rate of growth of world prices, real income and the money multiplier, an increase in domestic credit (expansionary monetary policy) will result in an equi-proportionate loss in foreign reserves, or an equi-proportionate depreciation of the exchange rate, or some combination of the two (Kim, 1985).

Abebe (2006), on his Paper presented to the 9th In-house Presentation Forum of the Economic Research and Monetary Policy Directorate, National Bank of Ethiopia, January 2006 has performed the analysis on the interaction between monetary policy and exchange market pressure in Ethiopia. However he used Griton and roper model in which equal proportion is given to exchange rate and reserves. Moreover he used the data from year1993/94 to 2005/2006. But according to Weymark's(1995) model using the exchange market intervention index, we can estimate the proportion of the exchange rate and reserves applied to properly intervene in adjusting the exchange market pressure.

This is therefore, in this thesis, based on Weymark's (1995) model, the researcher examine the exchange market pressure on Ethiopian Birr in post 2005 period whether it is upward or downward pressure that has remained dominant over the entire sample period. Based on exchange market pressure index, the monetary authority response function has evaluated by constructing intervention index. The intervention index values reflect the extent that Central Bank allows to market forces in the determination of domestic currency value in the foreign exchange market. This has important policy implication. The Central Banks that target exchange rate stability loose monetary independence.

As the exchange rate regime of Ethiopia is characterized as managed floating (the simultaneous adjustment of both exchange rates and reserves), EMP is the appropriate concept for analysis. To the best of my knowledge, there has been no study conducted so far analyzing the interaction between EMP and monetary policy in Ethiopia using Weymark (1995) model. As a result, this study differs from previous studies in that it investigates the relationship between EMP and monetary policy using exchange market intervention index.

1.3 Research Questions

The research have the following research questions

I. What is the direction of EMP in Ethiopia?
II. What are the monetary authority's response towards EMP?

1.4 Objectives of the study

1.4.1 General Objective

The main objective of this study is to examine empirically the impact of monetary policy on Exchange Market Pressure (EMP) in Ethiopia using time series data.

1.4.2 Specific Objectives

I. To examine the direction of EMP in Ethiopia.
II. To examine the monetary authority's response on EMP of Ethiopia.

1.5 Scope and limitation of the study

The scope of the study is confined to the role of NBE in responding to macro shocks, and evaluates its objectives by using specification estimation and analysis of policy reaction function. The study covers for the period from year 2006Q1 to 2017Q4. It was difficult to get quarterly real GDP in Ethiopia, the researcher has tried to get from NBE, NPC-NAS, Ethiopian Economic Association and others related organization however no one has produced quarterly data to be utilized by the general public and this is therefore, the researcher is forced to disaggregate the annual data obtained from NBE using quadratic match sum method in e-view software. The assessment of the method is annexed in this paper.

1.6 Significance of the study

In this thesis, the study evaluated the exchange market pressure on Ethiopian Birr in post 2005 period and examine whether it is upward or downward pressure that has remained dominant over the entire sample period. Based on exchange market pressure index, the study evaluate monetary authority response function by constructing intervention index. The intervention index values reflect the extent that Central Bank allows to market forces in the determination of domestic currency value in the foreign exchange market. This has important policy implication. The Central Banks that target exchange rate stability loose monetary independence. Based on the findings, I recommend which variables Central Banks should keep in check if they want to avoid pressure on their currencies.

1.7 Organization of the paper

This paper consists of five chapters with different sections and sub-sections. Chapter one presents the introduction for the main part of the paper, and chapter two set out and contrast empirical exchange market pressure and discusses the empirical exchange market pressure literature and see whether the determinants of exchange market pressure confirm their theoretical predictions. Chapter three discusses the research design and methodology while chapter four present the data analysis part. Finally chapter five summarize, concludes and pinpoint policy implication.

CHAPTER TWO: MODELS AND LITRATURE REVIEW

2.1 Theory of Exchange Market Pressure Models and Central Bank Foreign Intervention

2.1.1 Theory of Exchange Market Pressure Models

In the literature, there are two main approaches to exchange market pressure, namely the model-dependent and model-independent. The difference between the two is that the model-dependent approach uses a stochastic macro model for either deriving the components of exchange market pressure or weights assigned to them or both. On the other hand, the model-independent approach does not use a macro model for deriving the components of exchange market pressure or weights assigned to them. In this thesis, the study discusses model dependent theoretical models of Exchange Market Pressure and determine how they differ from each other in deriving either the components of pressure index or weights assigned to them or both.

The models are called model-dependent models because either the components of exchange market pressure or weights assigned to them or both are derived from a stochastic macro model. The objective was to check how they differ from each other in terms of their components or weights assigned to them or both.

Girton and Roper (1977) used a monetary model of exchange rate determination and derived exchange market pressure index that is a simple sum of exchange rate and foreign exchange reserve changes. It assigns equal weights to both exchange rate changes and foreign exchange reserve changes. Hence the construction of Girton and Roper's (1977) exchange market pressure index does not require estimating any stochastic macro model for deriving weights to be assigned to components of pressure index.

Roper and Turnovsky (1980) on the other hand, used an *IS-LM* framework for deriving the tradeoff that monetary authorities face between exchange rate and foreign exchange reserves when they stabilize domestic output. The exchange market pressure that they derive is the sum of exchange rate and foreign exchange reserve changes. However, both components are not equally weighted. The construction of Roper and Turnovsky (1980) requires estimating six parameters for weighting foreign exchange reserve changes. Contrary to Girton and Roper (1977) and Roper and Turnovsky (1980), Weymark (1995) constructed an exchange

market pressure and intervention index. The intervention index is defined as the fraction of pressure that the Central Bank relieves through the purchase and sale of foreign exchange reserves. Similar to Roper and Turnovsky (1980), Weymark (1995) also used a macro model for deriving the weights assigned to foreign exchange reserve changes. Contrary to Roper and Turnovsky (1980), Weymark (1995) requires the estimation of two parameters for assigning weights to foreign exchange reserve changes.

Girton and Roper's (1977), Roper and Turnovsky's (1980) and Weymark's (1995) exchange market pressure indices are simple sums of exchange rate and foreign exchange reserve changes. However, they differ in weighting schemes. Pentecost et al. (2001), on the other hand used a wealth-augmented monetary model and derived an exchange market pressure index that is a simple sum of exchange rate, foreign exchange reserve and relative interest rate differential changes. The construction of Pentecost et al.'s (2001) exchange market pressure index requires the estimation of one parameter for assigning weight to the relative interest rate differential component in the exchange market pressure index.

2.1.2 Theory of Central Bank Foreign Exchange Intervention

The Central Bank can influence Exchange Market Pressure by intervening in the foreign exchange market. This could be direct or indirect intervention. Direct intervention refers to the purchase and sale of foreign exchange reserves with the sole objective of influencing exchange market pressure. On the other hand, the use of interest rate to influence the prevailing pressure is called the Central Bank's indirect foreign exchange market intervention. In this thesis, the study has particularly focused on the Central Bank's direct intervention.

Direct intervention can be sterilized and unsterilized. Sterilized intervention refers to Central Bank's offsetting the effect of purchase and sale of foreign exchange reserve on domestic monetary base. In other words, under sterilized intervention, domestic monetary base remains unaffected by the Central Bank's actions in the foreign exchange market. In contrast, under sterilized intervention, the Central Bank does not offset the effects of its foreign exchange intervention on domestic monetary base. Thus domestic monetary base changes by the extent of changes in foreign exchange reserves. Since it changes domestic monetary base therefore, it is assumed that unsterilized intervention has a significant effect on exchange market pressure. On the other hand, the effect of sterilized intervention on

exchange market pressure is uncertain. Since it leaves the domestic monetary base unaffected its effect on market pressure is still to be fully investigated.

In this thesis, intervention index values has been used for evaluating the conduct of the Central Bank monetary policy over the given sample period. The objective was to check the extent that Central Bank allows to market forces in the determination of exchange rate level. The study have not paid attention to whether the intervention policy pursued by the Central Bank is sterilized or unsterilized.

2.2 Empirical Exchange Market Pressure Literature

In this section, the paper discusses, the studies that have used Girton and Roper (1977), Weymark (1995) and Eichengreen et al. (1996) for evaluating pressure on different countries' currencies and monetary authorities' response function in time series framework. The objective of constructing Exchange Market Pressure and an intervention index is to check the direction of pressure and see what fraction of pressure Central Banks relieve through the purchase and sale of foreign exchange reserves. Furthermore, the objective of evaluating the determinants of Exchange Market Pressure is to determine whether they confirm their theoretical predictions.

2.2.1 Empirical Studies of variants of the Girton and Roper (1977) Model.

The first model that the paper discusses is Girton and Roper's (1977) theoretical model. They applied their model to post-war Canada. Its objective was to construct Exchange Market pressure index and measure the degree of autonomy that the Canadian Central Bank has in pursuing an independent monetary policy in an open economy. They equated monetary autonomy with monetary authorities' ability in diverging domestic prices and interest rates from their foreign counterparts by the use of monetary policy. Girton and Roper (1977) measured the monetary independence with the domestic credit parameter in their estimated regression equation. A lower domestic credit estimated coefficient suggests that monetary authorities can use domestic credit as instrument of monetary policy for influencing domestic macroeconomic conditions. On the other hand, higher domestic credit shows that an increase in the domestic component of money supply would increase pressure on domestic currency.

Such a case implies the loss of monetary independence. They regressed EMP_t on Canadian dollar on changes in domestic credit (Δd_t), growth of US money supply (Δm_t^*), domestic

output growth (Δy_t) and US output growth (Δy_t^*) respectively and estimated the following equation:

$$EMP_t = \alpha - \beta_1 \Delta d_t + \beta_2 \Delta m_t^* + \beta_3 \Delta y_t - \beta_4 \Delta y_t^* + v_t \quad (2.2.1.1)$$

Where EMP_t consists of Canadian exchange rate defined as number of units of Canadian per US dollar changes (Δs_t) and foreign exchange reserve changes (Δf_t) respectively. A random error term v_t is included in the equation to capture the effects of omitted variables from the equation and deviations from equilibrium. Similarly, α is an intercept that measures the extent of pressure in case all regressors included in the equation are equal to zero. Girton and Roper (1977) estimated equation 2.2.1.1 for Canada using annualized data for the period 1952 through 1974. The estimated coefficient of domestic credit in equation 2.2.1.1 was quite high, suggesting that Canadian monetary authorities when under a fixed exchange rate, had little scope for pursuing independent monetary policy. In other words, an increase in domestic credit reflected in either exchange rate changes (Δs_t) or foreign exchange reserve changes (Δf_t) or any combination of both under managed float. Other variables included in the regression equation (2.2.1.1) confirmed their theoretical predictions.

Girton and Roper (1977) tested the sensitivity of exchange market pressure index to its components (whether the authorities absorb pressure in international reserve changes or exchange rate changes) by including a new variable $\vartheta = s_t / f_t$ in (2.2.1.1) and re-estimated it. The newly introduced variable was insignificant and the estimates of the rest of the variables remained unchanged. This suggests that the constructed exchange market pressure is insensitive to its components. This has the policy implication that the components of Exchange Market Pressure can be used for the foreign exchange market intervention necessary for attaining certain exchange rate targets (Girton and Roper, 1977).

A modified version of Girton and Roper's (1977) model was applied to Brazil by Connolly and da Silveira (1979). This modified version depends on four essential ingredients: (a) stable money demand function, (b) money supply (c) purchasing power parity, and (d) monetary equilibrium. Unlike Girton and Roper (1977), Connolly and da Silveira assume that purchasing power parity holds continuously.[1] Based on these assumptions, they derived a single country exchange market pressure regression equation given as:

1 Purchasing power parity states that domestic prices reflect foreign prices via exchange rate changes.

$$EMP_t = -\beta_1 \Delta d_t + \beta_2 \Delta p_t^* + \beta_3 \Delta y_t \qquad (2.2.1.2)$$

Connolly and da Silveira estimated equation (2.2.1.2) for two period: one for 1955-1975 and then for a shorter sub-period of fourteen years, 1962-1975 for Brazil. The sign of the estimated coefficient on the growth of domestic credit was consistent with a monetary model of exchange market pressure and was significant in both periods. This can be interpreted as given a stable money demand function; an increase in domestic credit is associated with an outflow of foreign exchange reserve or depreciation of exchange rate or any combination of these under a managed float.

Thus the domestic credit coefficient worked as an offsetting coefficient, and reflected changes in domestic credit being offset by either exchange rate changes or foreign exchange reserve changes or any combination of these. The estimates of both foreign price, β_2 and income β_3, were not significant from 1955 to 1975, but were from 1962 to 1975. This shows that an increase in these variables appreciated domestic currency, encourages capital inflow or a combination of both, and thus reduced pressure on domestic currency.

It is argued that the regression equation that uses the exchange rate or foreign exchange reserves changes as the sole dependent variable assumes a fixed and flexible exchange rate regime. Connoly and da Silveira (1979) verified the performance of the model that uses simultaneous changes in exchange rate and foreign exchange reserve changes by comparing its results with those that are obtained using exchange rate and foreign exchange reserve changes as the sole dependent variable.

The results of the regression equation that used exchange rate and foreign exchange reserve changes compared to those obtained using the sum of exchange rate and foreign exchange reserve changes were poor for the entire sample period and worst for the sub-sample. This confirmed the opinion that under a managed float, simultaneous changes in exchange rate and foreign exchange reserve changes better explain exchange market pressure then exchange rate or foreign exchange reserve changes alone. They also tested the sensitivity of exchange market pressure to its components by including $\vartheta_t = (s_t - 1)/(f_t - 1)$ exchange rate to foreign exchange reserve ratio.[2] The basic objective of including this ratio as an additional variable was to check what fraction of pressure the monetary authorities relieve by exchange

[2]Girton and Roper (1977) used $\square = s_t / f_t$ for testing the sensitivity of Exchange Market Pressure to its components. It is discontinuous for values of f_t equals to zero.

rate and foreign exchange reserve changes respectively. The higher value of the estimated coefficient of ϑ_t implied that monetary authorities preferred exchange rate changes in relieving pressure. On the other hand, lower value is associated with foreign exchange reserve absorbing a major portion of exchange market pressure. The estimated coefficient of ϑ_t was insignificant and other coefficients remained unchanged. The insignificant estimate of ϑ_t implied that the monetary authorities did not distinguish between exchange rate and foreign exchange reserves in relieving exchange market pressure.

The modified version of Girton and Roper (1977) given in equation 2.2.1.2 is further applied by Modeste (1981) for evaluating the Argentinean monetary experience during the 1970s. All variables except foreign price confirmed their theoretical predictions. However, the estimated coefficient of foreign price was insignificant and yet the F – statistic of 9.41 indicate that the three variables together explained substantial variation in exchange market pressure.[3]Modeste (1981) further tested the sensitivity of exchange market pressure to its components by including $\vartheta_t = (s_t - 1)/(f_t - 1)$ as an additional regressor. The estimated coefficient of ϑ_t was insignificant and the estimated parameters for the remaining variables remained unchanged. This supports the view that monetary authorities did not distinguish between exchange rate and foreign exchange reserve changes in restoring foreign exchange market equilibrium.

Modeste (1981) further tested the efficacy of monetary model of exchange market pressure using exchange rate and foreign exchange reserves as the sole dependent variables. The use of exchange rate and foreign exchange reserves as the sole dependent variable implies flexible and fixed exchange rate system. The estimates of exchange market pressure using either exchange rate or foreign exchange reserve changes as sole dependent variable were inferior to those obtained from the regression equation that used the sum of exchange rate and foreign exchange reserve changes as the dependent variables. This confirm the view that under managed float, both exchange rate and foreign exchange reserves instead of exchange rate and foreign exchange reserves alone better explain market pressure for Argentina in 1970s. These finding confirm the superiority of monetary model in explaining market pressure under a managed float.

The studies discussed above focused on the relationship between exchange market pressure and its determinants. It is important for the parameters to be stable over time for the

[3] The F-test is used to test the null that all estimated parameters in the regression equation are zero. Its rejection implies that one of these estimates is non-zero and thus explains some variation in the dependent variable.

formulation of effective policy. Hodgson and Schneck (1981) addressed this issue and tested the stability of Exchange Market Pressure and its monetary determinants for Canada, France, West Germany, Belgium, the Netherlands and Switzerland. They used quarterly data from 1959:02 to 1976:01 and two stage least square approach for carrying out their analysis. For the United Kingdom, the sample period was 1964:02 to 1976:01, due to the absence of some data before 1964.

Hodgson and Schneck tested the stability of the relationship between Exchange Market Pressure and its determinants using the following equation:

$$EMP_t = \alpha + \beta_1 \Delta s_{t+1} + \beta_2 \Delta y_t + \beta_3 \Delta p_t + \beta_4 \Delta a_t + \beta_5 \Delta d_t + \beta_6 \Delta y^*_t + \beta_7 \Delta p^*_t + \beta_8 \Delta a^*_t + \beta_9 \Delta d^*_t + \beta_{10} \Delta f^*_t + v_t \qquad (2.2.1.3)$$

The new variables introduced in equation 2.2.1.3 are Δs_{t+1} and Δa_t. The former denote future spot rate of the same maturity as domestic and foreign interest rate and the latter is the deposit expansion multiplier. The future spot rate reflects the linkage between domestic and foreign economies through the asset market. It reflects the effects of interest rate differential between domestic and foreign countries on exchange market pressure. The deposit expansion multiplier is the inverse of reserve requirements.

It reflects the influence of an increase in checkable deposits resulting from the changes in the reserves of the commercial banks on exchange rate and reserve changes. The world counterparts of the domestic variables are denoted by *. The world variables are weighted average of the corresponding variables for the individual countries. The weights are the ratio of individual money stocks to world money stocks. The world is defined as the sample countries plus United States, Japan and Italy.

Expected signs of the coefficients are:

$$\beta_2, \beta_7, \beta_8, \beta_9, \beta_{10} > 0 \text{ and } \beta_4, \beta_5, \beta_6, \beta_7 < 0$$

The sign of β_1 is uncertain. It reflects the effect of interest rate differential between domestic and foreign country on exchange market pressure through uncovered interest rate parity. This could be either positive or negative. The positive effect of future spot exchange rate is in conformity with the Chicago theory that assumes flexible prices. As a consequence, changes in nominal interest rate reflect changes in expected inflation rate. Therefore, an increase in

domestic interest rate relative to foreign interest rate reflect an increase in domestic inflation and hence an increase in pressure on domestic currency to depreciate.

On the other hand, negative future spot rate is in accord with Keynes theory which assumes sticky prices, at least in the short run. Thus the assumption of sticky prices suggests a rise in interest rate as a consequence of contraction in domestic money supply without matching fall in domestic prices.

A domestic interest rate higher than the foreign interest rate attracts capital inflows and thus puts pressure on domestic currency to appreciate. Thus Keynes theory suggests a negative relationship between future spot rate and exchange market pressure. The results indicate that money demand variables were generally insignificant. On the other hand, money supply variables like domestic credit and home money multiplier were significant with signs as predicted by theory. The stability test however, suggested a weak relationship between exchange market pressure and its monetary determinants.[4]

The estimated parameters of domestic income (Δy_t), foreign price (Δp_t^*), foreign deposit expansion multiplier (Δa_t^*) and expansion in the domestic credit of foreign country (Δd_t^*) results either an increase in foreign exchange reserve or appreciation of domestic currency or both and thus reduce pressure on domestic currency. On the other hand, the estimated coefficients of changes in domestic price (Δp_t), domestic deposit expansion multiplier (Δa_t), domestic credit (Δd_t) and foreign income (Δy_t^*) exert pressure on domestic currency to depreciate and that an increase in these variables either reduces domestic countries holding of foreign exchange reserves, depreciates the value of domestic currency or both.

A slightly altered formulation of Connolly and da Silveira's (1979) version of Girton and Roper's (1977) model was adopted by Kim (1985) for examining Korean foreign exchange market conditions for the period March 1980 to July 1983. He estimated the following equation:

$$EMP_t = -\beta_1 \Delta d_t + \beta_2 \Delta p_t^* + \beta_3 \Delta y_t - \beta_4 \Delta mm_t \qquad (2.2.1.4)$$

[4]Zettelmeyer (2004) evaluated the impact of monetary policy shocks on exchange rate in Australia, Canada and New Zealand during the 1990s. They identified monetary shocks with the reaction of three months market interest rate to policy announcements that were not themselves endogenous to economic news on the same day and found a negative association between interest rate hike and exchange market pressure.

In addition to standard variables, Kim includes Δmm_t in the equation for capturing the effects of money multiplier changes on Exchange Market Pressure.[5] The negative estimates of domestic credit and money multiplier confirmed theoretical predictions that an increase in these variables increased pressure on domestic currency to depreciate. This can be interpreted as, when the nominal cash balances of the domestic residents increase, they swap them for foreign currency. This increases pressure on domestic currency to depreciate. On the other hand, positive estimates of foreign price and domestic income support the view that an increase in both these variables attracts either an inflow of foreign exchange reserves or exchange rate appreciation or any combination of both. Kim re-estimated equation 2.2.1.4 by including $\vartheta_t = (s_t - 1)/(f_t - 1)$ as an additional regressor. The objective was to test the sensitivity of exchange market pressure to its components.

The estimate of coefficient on this variable was insignificant and other variables remained unaffected. This suggests that monetary authorities did not distinguish between exchange rate and foreign exchange reserve in relieving pressure. Finally, Kim estimated equation 2.2.1.4 using foreign exchange reserves as the sole dependent variable. The estimated coefficient of variation and significance of foreign price increased substantially while that of domestic income and domestic credit reduced slightly. Kim interprets this finding as the Korean monetary authorities preferring to utilize foreign exchange reserves in relieving pressure. This may reflect the Korean monetary authorities' fear that exchange rate movements may unduly influence domestic prices and the debt burden of the country.

The monetary models that used exchange rate changes as the sole dependent variable failed to explain short-term movements of Canadian-US dollar exchange rate in the 1970s (Backus, 1984; Lafrance and Racette, 1985). This cast doubt on the validity of the monetary approach as an explanation of the short run movements of Canadian-US exchange rate after the breakdown of Bretton Wood system.

Burdekin and Burkett (1990) argued that the studies that use exchange rate as the sole dependent variable implicitly assume a fully flexible exchange rate which seems inconsistent with the actual post-Bretton Wood experience of dirty float. They therefore used simultaneous changes in exchange rate and foreign exchange reserve as the dependent variable and re-examined the performance of the Girton and Roper's (1977) monetary model for explaining short-term movements of the Canadian-US exchange rate for the period

[5] The money multiplier reflects the total change in the money supply that results from an increase of one unit of money in the economy.

1963:01 to 1988:01. The objective was to test whether the monetary model adequately explains short-term movements of the Canadian-US exchange rate since its floating in June 1970.

The proposed dynamic specification of the Girton and Roper (1977) model included lagged dependent and independent variables. Other variables included in the model are the Canadian and US gross national product deflators and the Canadian and US three-month Treasury bill rates. The results indicate that all variables have signs consistent with the literature and were generally significantly different from zero. However, some variables were insignificant, particularly the Canadian Treasury Bill Rate.

A modified version of Girton and Roper's (1977) monetary model of Exchange Market Pressure as given in equation 2.2.1.4 was further applied by Thornton (1995) to Costa Rica. Costa Rica is a small economy in which foreign prices and monetary conditions are taken as given. In addition, Costa Rica's domestic currency and foreign exchange reserves witnessed significant changes over the given sample period. This made Costa Rica a suitable country for testing the validity of Girton and Roper's (1977) monetary model of Exchange Market Pressure.

The estimated parameters were in conformity with their theoretical predictions. The negative estimate of domestic credit and money multiplier implied that an increase in domestic credit increased pressure on domestic currency to depreciate. On the other hand, positive signs of foreign price and domestic income suggest that an increase in these parameters is associated with decrease in pressure on domestic currency. Thornton (1995) further tested the sensitivity of exchange market pressure to its components by including the ratio of the exchange rate to foreign exchange reserves $\vartheta_t = (s_t - 1)/(f_t - 1)$. The estimated coefficient on this variable was insignificant and other estimates remained unchanged. This suggests that monetary authorities did not distinguish between exchange rate and foreign exchange reserve changes in relieving pressure.

Finally, Thornton (1995) re-estimated the model using foreign exchange reserves as the sole dependent variable. The overall estimates of the model improved substantially, which the author interprets as the Central Bank of Costa Rica preferring foreign exchange reserve in relieving pressure. This may reflect the monetary authorities' fear that exchange rate changes might influence domestic price levels.

All the studies discussed above, except Burdekin and Burkett (1990), estimated Girton and Roper (1977) and its modified version without allowing for a dynamic response. Mah (1998) on the other hand, adopted a dynamic approach and re-examined Connolly and da Silveira's (1979) version of Girton and Roper's model as given in equation 2.2.1.4 for Korea. The dynamic equation that Mah proposed included lagged values of the independent variables. The estimated coefficients showed signs consistent with their theoretical predictions.

Furthermore, the estimated parameters were significantly different from zero suggesting that dynamic specification of equation 2.2.1.4 explained exchange market pressure for Korea adequately.

All the studies discussed above use Girton and Roper's (1977) model to examine individual country Exchange Market Pressure. Bahmani-Oskooee and Bernstein (1999) on the other hand, employed Girton and Roper's (1977) model for investigating EMP_t for Canada, France, Germany, Italy, Japan, UK and the US. They estimated three different specifications of this equation. In addition to the benchmark model as given in equation 2.2.1.4, they estimated it using exchange rate foreign exchange reserve ratio $\vartheta_t = (s_t - 1)/(f_t - 1)$ as an additional independent variable.

The basic objective of including this ratio was to test the sensitivity of exchange market pressure to its component. The third specification used foreign exchange reserve changes instead of composite index that includes exchange rate and foreign exchange reserves as the dependent variable. The estimates of benchmark equation were poor. The domestic credit coefficient was insignificant for all countries except Canada and the UK. However, when the same equation is estimated using ϑ_t as an additional regressor, results were substantially improved. The estimate of ϑ_t is significant and of negative sign, suggesting that most of the pressure in these countries is absorbed by changes in foreign exchange reserves rather than exchange rate changes.

Finally, the specification of equation 2.2.1.4 that used foreign exchange reserves instead of composite variables, including exchange rate and foreign exchange reserve changes yield the estimates of variables of interest in accord with literature. One implication of these findings is that the exchange rate regime of these countries was close to fixed instead of freely floating.

Contrary to the studies discussed above, Pollard (1999), tested Wohar and Lee's (1992) formulations of the Girton–Roper (1977) model using data from Barbados (1968 - 1991), Guyana (1964 - 1985), Jamaica (1964 - 1993), and Trinidad and Tobago (1967 - 1993). The basic objective of the paper was to identify the international variables that develop pressure on Caribbean countries' currencies.

Wohar and Lee's (1992) formulation of the Girton and Roper model is given as:

$$EMP_t = -\beta_1 \Delta mm_t - \beta_2 \Delta d_t + \beta_3 \Delta m_t^* + \beta_4 \Delta q_t + \beta_5 \Delta y_t - \beta_6 \Delta y_t^* - \beta_7 \Delta er_t + v_t \quad (2.2.1.5)$$

$q_t$and er_tdenotes deviation from the purchasing power parity and interest rate differential between domestic and foreign country. Wohar and Lee (1992) proposed an alternative to this model which is given as:

$$EMP_t = -\beta_1 \Delta mm_t - \beta_2 \Delta d_t + \beta_3 \Delta p_t^* - \beta_4 \Delta i_t^* + \beta_5 \Delta q_t + \beta_6 \Delta y_t - \beta_7 \Delta er_t + v_t \quad (2.2.1.6)$$

The difference between the two equations is the way foreign disturbance enters into the economy. In equation 2.2.1.5, foreign money supply and income are the sources of foreign disturbance. On the other, foreign price and interest rate are the important sources of foreign disturbances in equation 2.2.1.6.

The estimates of both domestic credit and money multiplier are significant and are negatively signed, which is in conformity with the literature. Similarly, the estimate of differential between domestic and foreign price is positive and is significant, suggesting that purchasing power parity does not hold for Caribbean countries. Similarly, the coefficient of domestic income, although of positive sign, is not significantly different from zero.

The results further showed that growth in US money supply significantly increased pressure for Barbados and Guyana and was therefore identified as a major source of foreign disturbance for these countries.

On the other hand, US inflation significantly increased pressure for Jamaica and Trinidad and was therefore identified as an important source of foreign disturbance for these countries. For Jamaica, the US interest rate was identified as a source that contributed to the buildup of pressure on its currency. Finally, Pollard tested the composition of Exchange Market Pressure to its components by including another variable $\vartheta_t = (s_t - 1)/(f_t - 1)$ in the

regression equation. The estimated coefficient on this ratio was insignificant for Jamaica and Trinidad & Tobago. However, for Barbados and Guyana the estimate was significant and of positive and negative sign.

This suggests that in Barbados, the monetary authorities preferred exchange rate changes for relieving pressure. On the other hand, the negative estimate of this ratio implies that monetary authorities in Guyana intervened in foreign exchange market and relieved most of the pressure by selling and purchasing foreign exchange reserves.

Contrary to above studies, Taslim (2003) applied Girton and Roper's (1977) framework to study Australian exchange market pressure and reserve transactions during 1975-1997. The results indicate substantial reserve transactions even after the switch to a floating exchange rate in December, 1983. This shows that Australian monetary authorities permitted little flexibility to exchange rate in adjusting towards its underlying market equilibrium rate. An implication of the continued intervention is that monetary policy is unlikely to be fully independent of balance of payments adjustments.

Most of the studies that have discussed have used domestic and foreign macroeconomic variables as Exchange Market Pressure determinants. Conversely, Hallwood and Marsh (2004) used expected exchange rate changes within the bands $E\Delta x_{t+1}$ and expected exchange rate depreciation from the central parity Ec_{t+1} along with macroeconomic variables as the determinants of Exchange Market Pressure. They evaluated Exchange Market Pressure against pound during the inter-war period when it operated a peg to gold and consequently to the US dollar and estimated an Exchange Market Pressure model in the following form:[6]

$$EMP_t = \alpha - \beta_1 d_t + \beta_2 d_t^* + \beta_3(\Delta y_t - \Delta y_t^*) - \beta_4 \Delta q_t - \beta_5 E\Delta x_{t+1} - \beta_6 E(\Delta c_t) + v_t \qquad (2.2.1.7)$$

EMP_t refers to Girton and Roper's (1977) measure of Exchange Market Pressure index. Its lower value implies greater pressure against pound because there is some reduction in the domestic reserves relative to foreign reserves and exchange rate depreciation. $E\Delta x_{t+1}$ and Ec_{t+1} has included as additional regressors.

The rationale for including the real exchange rate is to evaluate the effect of deviation from purchasing power parity on the level of exchange market pressure. An over-valued real

[6]Hallwood and Marsh (2004) used monthly data between May 1925 and August 1931 and McCallum-Wicken's instrumental variable technique, which uses instruments for endogenous variables.

exchange rate reduces domestic exporters' competitiveness in the international market and hence puts downward pressure on domestic currency. The deviations from central parity (c_t) and movements of exchange rate within the band (x_t) reflect the effect of expected exchange rate change on the level of exchange market pressure. Uncovered interest rate parity suggests that expected exchange rate reflects the differential between domestic and foreign interest rate therefore, deviations from central parity (c_t) and movements of exchange rate within the band (x_t) are included to evaluate the effect of interest rate differential on exchange market pressure. The asterisk denotes foreign counterparts of domestic variables.

The main finding of the paper is that devaluation expectation as denoted by deviations from central parity (c_t) and movements of exchange rate within band (x_t) and UK macroeconomic fundamentals have significant power in explaining pressure. This has important implications in that disciplined management of macroeconomic fundamentals may not be enough to maintain a currency peg over a time. A foreign disturbance can put pressure on domestic currency and results in the collapse of a fixed exchange rate regime.

Foreign debt is an important factor that determines pressure on domestic currency. However, its effect on market pressure has not been evaluated in the empirical studies discussed above. There are two channels through which an increase in foreign debt increases pressure. It is argued that the debt burden contributes to market pressure in the form of increased debt and debt servicing payments.

This is a direct effect of debt burden on market pressure. Indirectly, debt burden reduces productivity in the economy. With unchanged demand, a drop in the production increases prices of domestic goods and services. With unchanged world price level, increase in domestic prices increases pressure on domestic currency to depreciate. This makes it necessary to evaluate the effects of debt burden on the buildup of exchange market pressure. Guyana's debt showed great fluctuations for the period 1968 to 2000. In 1968, it constituted approximately 30 percent of Guyana's domestic income and had increased to more than 800 percent of domestic income by 1991. It fell to 180.5 percent of domestic income in 2000 due to debt relief given by the donor community.

This makes it necessary to consider the impact of foreign debt burden on the buildup of foreign exchange market pressure for Guyana. Modeste (2005) evaluated the impact of the foreign debt burden on Guyana market pressure using following equation:

$$EMP_t = \alpha - \beta_1 d_t - \beta_2 B_t^* + \beta_3 p_t^* - \beta_4 rpo_t - \beta_5 uncer_t + \beta_5 X_{t-1} \quad (2.2.1.8)$$

It includes the foreign debt burden (B_t^*), relative price of crude oil (rpo_t), macroeconomic uncertainty ($uncer_t$) and lagged real exports (X_{t-1}). Lagged real exports are used to allow for a delay in the response of productivity changes to growth in real exports. It is assumed that productivity growth is influenced by foreign debt burden, relative price of crude oil, macroeconomic uncertainty, and lagged growth in real exports and is therefore replaced by these variables in equation 2.2.1.8. The results confirm theoretical predictions. Empirical evidence shows that domestic credit, foreign debt burden, relative crude oil price and macroeconomic uncertainty are positively correlated with exchange market pressure. On the other hand, growth in foreign price (p_t^*) and lagged real exports ($\exp_{t-1}$) reduce pressure on Guyanian dollar to depreciate.[7]

The studies discussed above confirm monetary approach to Exchange Market Pressure which argues that a rise in the domestic component of a monetary base would reduce either the foreign exchange reserve or the depreciation of currency.

The results obtained in these studies further support this interpretation. Particularly, domestic credit is consistently negatively related to Exchange Market Pressure, and is significant, apart from in Bahmani Oskooee and Bernstein (1999). This suggests that a rise in domestic credit results either in exchange rate depreciation or depletion of foreign exchange reserves or any combination of these. This has the important policy implication for the Central Bank having to give up its monetary independence of attaining domestic objectives when it targets exchange rate stability. The estimate of money multiplier has also the same interpretation. Furthermore, the estimates of foreign price and domestic income are consistent with their prediction. An increase in domestic income and foreign price reduce pressure on domestic currency. All these findings are consistent with the monetary model of exchange market pressure.

[7]Burket and Richard (1993) evaluated the impact of global and regional developments and found that the shocks emanating in the region had greater power in explaining Paraguayan pressure.

2.2.2 Exchange Market Pressure Studies Based on VAR approach

In economics, it is common to have variables that not only explain some dependent variables but are also explained by the dependent variables. Such a situation is characterized as simultaneous equation bias. This issue is generally dealt with by the use of the instrumental variables technique which uses instrumental variables for endogenous variables. Furthermore, it splits variables between exogenous and endogenous variables. Sims (1980) criticized this approach and advocated equal treatment of all variables in the presence of simultaneous equation bias. That all variables should be treated as endogenous. It was in this spirit that Sims (1980) developed the Vector Auto Regression (VAR) Approach. Since its development, the VAR approach has been frequently used in empirical international finance literature.

The theoretical literature on currency crises emphasizes macroeconomic variables and shifts in market expectations about the macroeconomic fundamentals as important determinants. Karfakis and Moschos (1999) used the VAR framework to examine the macroeconomic fundamentals that explain Exchange Market Pressure for Greece, using quarterly data from 1975Q1 to 1995Q4. The Granger causality results thus obtained show that real overvaluation of the drachma, the reserve adequacy ratio, the current account balance and the net capital movements have predictive power in explaining Greece exchange market pressure for the given period. On the other hand, variance and historical decomposition results show that shocks associated with real over valuation, reserve adequacy ratio, and net capital movements were the most important sources of foreign exchange market pressure in Greece. These findings have the implication that monetary authorities should monitor the signals given by these variables if they want to avoid pressure on the Greek drachma.

The independence of monetary authorities in formulating effective monetary policy depends on the exchange rate regime. In a fixed exchange rate regime, monetary authorities target the domestic currency value and market determines its quantity. Thus under a fixed exchange rate, monetary authorities lose monetary independence as they cannot use monetary instruments for attaining domestic objectives. On the other hand, a floating exchange rate buys monetary independence but monetary authorities have to give up the freedom of fixing the value of domestic currency in the foreign exchange market.

In a managed float system, monetary authorities can simultaneously target the exchange rate stability and domestic objectives. Kamaly and Erbil (2000) used Exchange Market Pressure and a VAR approach for gauging the monetary independence for Middle East and North African (MENA) region countries (Egypt, Tunisia and Turkey) that maintained a managed

float.[8] The authors were primarily interested in gauging the degree of monetary independence and the monetary authorities' response to exchange market pressure for MENA region.

The small estimates of domestic credit and interest rate differential may imply a higher degree of monetary independence for Turkey. This is also evident from exchange rate changes that dominate foreign exchange reserve changes. This provides support that the Turkish economy is more open and Turkish monetary authorities can use monetary policy for targeting domestic objectives. On the other hand, the large estimates of domestic credit and interest rate for Egypt and Tunisia suggest a low degree of monetary independence. The authors' interpretation of this finding is that in an environment of low monetary independence, monetary authorities have to vigorously change its monetary instruments for them to have a desirable effect on exchange market pressure.

Contrary to Kamaly and Erbil (2000) who tested the independence of monetary authorities, Tanner (2001) examined the responses of monetary authorities to Exchange Market Pressure for Brazil, Chile, Mexico, Indonesia, Korea and Thailand in VAR framework.

Particularly, Tanner was interested in identifying whether monetary authorities sterilized their foreign exchange market intervention. The results indicate that contractionary monetary policy reduced pressure. However, Mexican and East Asian countries' monetary authorities sterilized their foreign exchange market intervention and thus increased domestic credit in the event of a speculative attack on their currencies.

Tanner (2002) further extended his previous work (Tanner, 2001) and reexamined the relationship between exchange market pressure and monetary variables for 32 emerging markets in Western Hemisphere, Asia and Europe. Vector Auto regression Approach has the advantage of examining the relationship between exchange market pressure and monetary policy in both directions. In this study, Tanner (2002) used a modified exchange market pressure index that consisted of three elements, namely a real money demand, money supply and real exchange rate, as its components. The VAR estimates of exchange market pressure indicate a positive association between domestic credit and exchange market pressure, a finding consistent with traditional monetary theory. The negative estimate of interest rate differential for the majority of the countries also confirms their theoretical predictions. This

[8] The authors provide two reasons to justify the use of VAR: (a) it circumvents the endogeneity problem, and (b) it provides an effective tool to analyze how a system reacts to shocks in one of its components through Impulse Response Function.

suggests that an increase in interest rate differential reduces pressure on domestic currency. Shocks to exchange market pressure increase domestic credit and thus confirmed the view that domestic monetary authorities sterilized their foreign exchange market intervention.

Pooled estimates further support individual country vector auto regression estimates. They show a positive association between domestic credit and exchange market pressure. However, pooled estimates of interest rate differential provide inconclusive evidence. The augmented model that includes fiscal policy variable estimated for the subset of the countries further provides evidence of the positive association between domestic credit and Exchange Market Pressure.[9]

The East Asian financial crises affected the countries of region to varying degrees and the Philippine was no exception to this. The standard International Monetary Fund prescription was the same as that embodied in monetary model of Exchange Market Pressure - to reduce domestic credit instead of targeting any exchange rate level (Boorman et al. 2000). Gochoco-Bautista and Bautista (2005) examined whether the prescription suggested by the International Monetary Fund contributed to strengthening the Philippine peso during the period. Particularly they focused on whether the monetary authorities' response of contracting domestic credit reduced pressure on the Philippine peso.

They used Tanner's (2000, 2001) VAR method and obtained results that supported the traditional view of a positive association between domestic credit and Exchange Market Pressure. This supports the view that increase in domestic credit expansion either depreciates domestic currency or depletes the foreign exchange reserves of Central Bank or both. The results provide further evidence that in the non-crisis period, monetary authorities sterilized reserve outflow, fearing that unsterilized foreign exchange intervention would cause bankruptcy of the domestic financial system. However, in the crisis period, monetary authorities abstained from sterilizing foreign reserve outflow and followed a tight monetary policy in the face of exchange market pressure.

Furthermore, in a non-crisis period, an increase in interest rate differential reduced pressure. Conversely to that, in a crisis period, an increase in interest rate differential increased pressure, suggesting a perverse effect. This has an important policy implication in that in the crisis

[9] Younus (2005) used Engel and Granger's (1987) two-step procedure and Vector Error Correction Model for evaluating the impact of domestic credit on exchange market pressure for Bangladesh. They found that an increase in domestic credit increases exchange market pressure, which is reflected either in exchange rate depreciation or foreign exchange reserves depletions or any combination these.

period, the use of interest rate as an instrument of monetary policy will not yield the desired results.

The empirical studies on Exchange Market Pressure that use a VAR approach tends to omit the output growth variable. However, the domestic output growth is considered to be an important determinant of Exchange Market Pressure. In the Girton and Roper (1977) model, growth in domestic output reduces pressure on the domestic currency. Furthermore, the second generation currency crises models argue that output growth might inversely affect the devaluation expectation and hence reduce pressure on the domestic currency. Due to its enormous importance, Garcia and Malet (2007) used a VAR framework and included domestic output as an additional determinant in examining Exchange Market Pressure for Argentina from 1993-2004.

The results indicate a positive relationship between domestic credit and market pressure – a finding consistent with the monetary approach to balance of payments. Shocks to Exchange Market Pressure indicate that Argentinean monetary authorities sterilized reserve outflow with a view to providing enough liquidity to the domestic financial system. Second, this study finds a positive association between interest rate and Exchange Market Pressure. This suggests that interest rate rather than reducing pressure alerted domestic investors to the eventual need for depreciation and thus increased pressure. Third, the study provides evidence that increase in output reduced pressure on Argentinean currency. This finding confirms the second generation currency crises model's theoretical prediction that worsening fundamentals increase pressure on a fixed exchange rate regime to collapse.[10]

The empirical literature that analyzed exchange market pressure in a VAR framework delivers consistent results. It indicates that an increase in domestic credit increases pressure on domestic currency. This has an important policy implication for countries that target the exchange rate stability, in that they would have to give up the independence of using monetary policy instruments for attaining domestic objectives such as output growth and stable prices. The interest rate effect in some studies is contrary to what the theoretical literature suggests and seems to be insignificant. A positive interest rate coefficient implies that monetary authorities cannot use the interest rate as a policy instrument for reducing pressure. On the other hand, a negative relationship between exchange market pressure and domestic output is confirmed in Garcia and Malet (2007). All these studies suggest that monetary authorities cannot use the

[10]Kumah (2007) examined exchange market pressure and its dynamics for the Kyrgz Republic using the Markov Regime switching approach and found that contractionary monetary policy helps reduce pressure.

interest rate as a policy instrument in a crisis period. However, if the policy authorities wish to reduce pressure, they have to control domestic credit growth and formulate policies conducive to domestic output growth.

2.2.3 Empirical Studies of the Weymark (1995) Model

Prior to Weymark (1995), Frenkel and Aizenman (1982) derived an index that measures the extent of foreign exchange market intervention. It takes the value of zero and one for two extreme exchange rate regimes, flexible and fixed. Based on Frenkel and Aizenman's (1982) index, Weymark (1995) proposed an index of exchange market pressure which she later used for developing a quantitative measure of the degree of exchange market intervention. It indicates the fraction of pressure that a Central Bank relieves through the purchase and sale of foreign exchange reserves. Weymark (1995) argues that the intervention index values can be used as a tool for analyzing the monetary policy being implemented.

Using a simple macroeconomic model with rational expectations, Weymark (1995) constructed a quarterly measure of exchange market pressure and intervention index for Canada between 1975 and 1991. A subset of these calculated values was then used to analyze the Bank of Canada's conduct of exchange rate policy over the period 1981–1984. The Exchange Market Pressure indicated upward pressure on Canadian dollar between 1975Q2 to 1984Q4. In the post-1984 period there was downward pressure. The intervention index mean value indicated that on average, the intervention activities of the Central Bank of Canada removed approximately 96% of the pressure by purchasing and selling foreign exchange reserves. Exchange rate changes relieved the remaining market pressure.

Poso and Spolander (1997) used the Weymark (1995) model for analyzing the Bank of Finland's conduct of monetary policy during the markka's recent float from September 1992 to October (1996). The average exchange market pressure was more often negative than positive. The intervention index mean value of 0.99 indicated that the Bank of Finland removed almost all the pressure by purchasing and selling foreign exchange reserves and permitted limited flexibility for the exchange rate to adjust towards its underlying free float equilibrium value. A Weymark-type model was also applied to Chile and Greece by Kohlschen (2000) and Apergis and Eleftheriou (2002), respectively. Kohlschen (2000) modified Weymark's (1995) model slightly and applied exchange market pressure and intervention index to analyze pressure on

the Chilean peso from 1990 to 1998.[11] He slightly modified the index with reserve requirement and gathered the evidence that supported the Chilean peso's experiencing upward pressure.

Furthermore, the intervention index values suggest that the Central Bank of Chile substantially intervened in the foreign exchange market and prevented the Chilean peso from appreciation for most of the time.An approach slightly modified from Weymark's (1995) model was also applied by Apergis and Eleftheriou (2002) to analyze Greek monetary authorities' response to Exchange Market Pressure from 1975 to 1998. They assumed the absence of a well-developed financial system and therefore, the absence of perfect substitutability between domestic and foreign assets. In other words, they assumed that uncovered interest parity condition does not hold.

The mean of the exchange market pressure was positive from 1975Q4 to 1989Q4. On the other hand, in the post-1990 period, exchange market pressure was negative, indicating appreciating pressure on Greek drachma. In the pre- and post-1989 period, the intervention index means were 0.89 and 0.97 respectively. This indicates that in the pre-1989 period, policy makers let the exchange rate to depreciate to boost the exports. However, in the post- 1989 period, particularly after 1992, the Bank of Greece frequently intervened in the foreign exchange market to stabilize the value of domestic currency as part of the Maastricht criteria regarding the limitations of inflationary pressures.

Some studies use both model-dependent and model-independent approaches when considering exchange rate arrangements. Jeisman (2005) used the model-dependent approach proposed by Weymark (1995) and the model-independent approach of Eichengreen et al. (1996) for measuring exchange market pressure and intervention index for Australia over the post-float period. The resulting exchange market pressure and intervention indices thus enabled the author to determine how well the two methodologies explained the conduct of the Australian Reserve Bank momentary policy over the given period. The empirical evidence shows that the Central Bank assisted pressure on the Australian dollar to depreciate and reversed appreciating pressure.

Contrary to Jeisman (2005), Leu (2009) found that in the post float period, the monetary authority followed a leaning against the wind policy – that is, the Australian Reserve Bank sold

[11] In the early 1990s, Chile witnessed a surge in capital inflows equivalent to 10% of GDP, due to lax US monetary policy. In order to avoid a conflict between capital inflows and domestic objectives, the Chilean Central Bank initially imposed a one-year non-interest bearing reserve requirement on selected capital inflows. Initially, it was set up to 10% and was increased to 30% in May 1992.

(purchased) foreign exchange reserves when the Australian dollar was under pressure to depreciate (appreciate). The difference in the results could be due to the use of different econometric approach. Jeisman (2005) uses the two-stage least square approach, while Leu (2009) used Johansen's co- integration approach for constructing Exchange Market Pressure and intervention index for Australia. Since its development, Weymark's (1995) approach has been applied by a number of researchers for evaluating the external position and conduct of monetary policy for a number of countries. All these studies indicate that the countries thus evaluated were either faced with downward or upward pressure.

However, almost all studies confirm some form of Central Bank leaning against the wind in that the Central Bank frequently intervened in the foreign exchange market and relieved depreciating pressure by selling foreign exchange reserves and vice versa. This confirms the view that the Central Banks of the countries thus evaluated allowed a limited role to market forces in determining the value of domestic currency in the foreign exchange market, a finding consistent with the fear of floating.

2.2.4 Empirical Studies of Eichengreen et al's (1996) model

Before Eichengreen et al. (1996), Girton and Roper (1977), Roper and Turnovsky (1980) and Weymark (1995) derived Exchange Market Pressure indices that are simple sum of exchange rate and foreign exchange reserve changes. However, all these studies differ in assigning the weights attached to Exchange Market Pressure components. Girton and Roper (1977) assigns equal weight to both exchange rate and foreign exchange reserve changes. On the other hand, Roper and Turnovsky (1980) and Weymark (1995) derived the weight using a stochastic macro model. All these studies assumed direct foreign exchange market intervention that the Central Bank relieves pressure by purchasing and selling foreign exchange reserves. However, it may be the case that Central Bank relieves pressure by changing interest rate. In such a case, interest rate constitutes another monetary instrument that Central Bank may use for restoring foreign exchange market equilibrium. In such a case, the studies that ignore interest rate do not fully reflect the extent of foreign exchange market disequilibrium.

Eichengreen et al. (1996) used a statistical approach and constructed an exchange market pressure index consisting of percentage change in exchange rate, relative interest rate differential and percentage change in relative foreign exchange reserves. They used the inverse of the variance approach for assigning weights to the components of exchange market pressure. This approach assigns low weight to more volatile component and thus ensures that all

variables are equally weighted. First generation currency crisis models argue that inconsistency between domestic macroeconomic policies and the exchange rate regime often results in the collapse of the fixed exchange rate regime. Particularly they argue that increased monetizing of budget deficit results in speculative attacks and thus the collapse of the fixed exchange rate regime (Krugman, 1979).

Bird and Mandilaras (2006) examined the relationship between fiscal deficit and Exchange Market Pressure for Latin America & Caribbean (LAC) and East Asia & Pacific (EAP) regions in a panel framework. The results indicate significant effect of fiscal deficit on exchange market pressure for Latin America & Caribbean (LAC) countries but not for East Asia & Pacific (EAP) countries. The difference in the results is due to low savings, lack of investor's confidence and high and volatile inflation rate in LAC compare to EAP countries. These findings have the implication that the same policy prescription cannot be followed in both regions to avoid currency crises.

Moreover, foreign debt is an important factor in causing exchange market pressure. There are two channels through which an increase in foreign debt increases pressure. Ricardian equivalence points towards a strong association between an increase in taxes and an increase in debt. It argues that current higher debt suggest a future increase in taxes. Given a future rise in taxes, rational agents would save the amount equal to foreign debt to offset the effects of expansionary macroeconomic policies in future. This will not affect investors' confidence and thus cause pressure on a highly indebted country to rise.

On the other hand, Keynes argues that domestic economic agents are myopic. They base their consumption on disposable instead of permanent income. In such a case they do not save the amount required for financing future expansionary macroeconomic policies. In such a situation a rise in foreign debt will increase pressure on domestic currency. Mandilaras and Bird (2008) tested which of the above effects of debt burden on exchange market pressure held true for Latin American countries from 1970 to 2000. They used Eichengreen et al's (1996) approach for constructing exchange market pressure.

However, they assigned weights to the components of exchange market pressure by the ratio of inverse of variance of each component to the sum of inverse of variance of all components. They used four proxies of Exchange Market Pressure for checking the robustness of their results. The first proxy used exchange rate changes, relative interest rate differential and relative foreign exchange reserve changes. The second specification used exchange rate and

foreign exchange reserve as components of exchange market pressure. The third specification uses exchange rate changes to denote market pressure.

In the fourth specification, the authors assumed that purchasing power parity holds and used inflation differential to denote devaluation expectations. The results indicate that an increase in foreign debt increases pressure on currency to depreciate in foreign exchange market. This finding appears to be robust across different proxies used for denoting Exchange Market Pressure.

Finally, Turkey experienced currency crises in 1994 and 2000-2001 as well as unsuccessful speculative attacks that were fended off by the monetary authorities. This makes Turkey a suitable country to examine the relationship between exchange market pressure and macroeconomic fundamentals. Katircioglu and Feridun (2011) evaluated this relationship and found the relevancy of fiscal and current account balance, domestic credit and excess real money balances to be important macroeconomic determinants of exchange market pressure in Turkey. These findings suggest that the monetary authorities in Turkey should constantly monitor the growth of these variables if they want to avoid pressure on Turkish currency.

2.3 Conclusion

In this chapter, we reviewed the empirical studies that have applied Girton and Roper (1977), Weymark (1995) and Eichengreen et al. (1995) to the experience of different countries. The empirical studies that use Girton and Roper (1977) and Eichengreen et al. (1995) are primarily interested in evaluating the determinants of Exchange Market Pressure both in time series and panel frameworks. On the other hand, the studies that have used Weymark's approach to different countries were primarily concerned with determining the direction of the pressure and monetary authorities' response function.

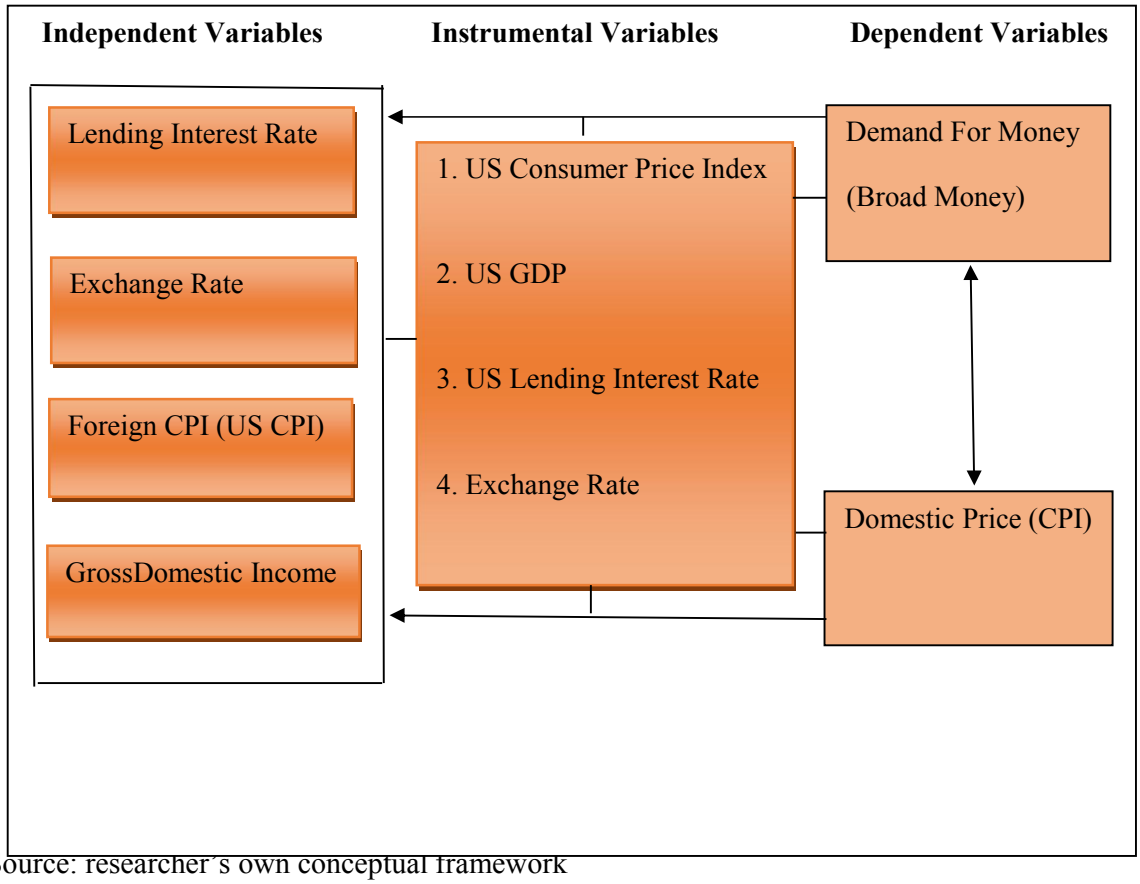
They focused on whether downward or upward pressure was dominant over the given sample period and what fraction of the pressure a Central Bank relieves through the purchase and sale of foreign exchange reserves. The empirical studies that use Girton and Roper's (1977) model provide evidence that confirms the predictions implied by the monetary approach to Exchange Market Pressure. This indicates that in a fixed exchange rate regime, an increase in domestic credit increases pressure on domestic currency to depreciate.

This has an important policy implication in that when a Central Bank targets exchange rate stability, it has to relinquish its independence in using monetary policy instruments for stabilizing domestic output or prices or both. The empirical evidence further shows that an increase in domestic prices further increases pressure on domestic currency to depreciate. However, an increase in domestic output and foreign prices are associated with downward pressure on domestic currency. All these findings are consistent with the predictions of the monetary model of exchange market pressure. Similarly, the studies that use Eichengreen et al. (1995) indicates that fiscal deficit, foreign debt burden, current account deficit are important determinants of exchange market pressure in a panel framework. The studies that applied Weymark's (1995) approach to different countries provide evidence that it is either upward or downward pressure that has remained dominant over the entire sample period. Furthermore, they indicate that the Central Bank actively intervened in the foreign exchange market and allowed limited flexibility to exchange rate to adjust to the equilibrium value as suggested by the market forces. For this chapter, the researcher has gone through different articles and papers written on this topic. However since there is limited articles in this regard, most of them are identical in literature part and the researcher has used some of the imperial works which are written by Gilal, Muhammed Akram (2011). In the chapters that follow, the study uses Weymark's (1995) approach and determine whether it is downward or upward pressure that has remained dominant on the Ethiopian Birr over the given sample period. Furthermore, based on the exchange market pressure index, an intervention index is constructed and use its value for analyzing monetary authorities' responses to foreign exchange market disequilibrium.

2.4 Conceptual Framework of the Research

Based on theoretical and empirical researches that have discussed so far the researchers developed the following conceptual framework that eases understanding on the subject matter.

Figure 1.1: Conceptual Framework



Source: researcher's own conceptual framework

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Research Design

Since the research objective is to analyze the Exchange Market Pressure and Monetary Policy in Ethiopia, a well-designed quantitative approach has been followed.

3.2 Data Source

In order to construct an exchange market pressure and intervention index for Ethiopia, the researcher has used logged quarterly data for the period 2006:Q1 to 2017:Q4. The secondary data on interest rate, domestic, Quarterly money supply data, real GDP, foreign price and spot exchange rate were taken from IMF, IFS, BLS and the NBE. The real GDP figure couldn't be obtained in quarter report from NBE, Ministry of Economic Development, Ethiopian Economic association, statistics bureau and other relevant government organs. And simply as it is used by other researchers also, disaggregation of the annual data in to quarterly data is using quadratic match sum method in line with the assessment annexed.

3.3 The Model specification

In order to measure exchange market pressure upon the Ethiopian currency and also the foreign exchange intervention policy of the National Bank of Ethiopia, the approach of Weymark (1995) has been adopted. Weymark's simple model is based on money demand, price, interest rate, money supply and monetary authorities' response function and is given as:

$$m_t^d = p_t + b_1 y_t - b_2 i_t + v_t \qquad b_1 > 0 \text{ and } b_2 > 0 \qquad (3.1)$$

$$p_t = a_0 + a_1 p_t^* + a_2 s_t \qquad a_1, a_2 > 0 \qquad (3.2)$$

$$i_t = i_{t*} + E_t s_{t+1} - s_t \qquad (3.3)$$

$$m_{ts} = m_{t-1s} + \Delta d_t + \Delta f_t \qquad (3.4)$$

$$\Delta f_t = -\overline{p}_t \Delta s_t \qquad (3.5)$$

Asterisks denote foreign counterparts of domestic variables and in this study even though the foreign counterpart should be of the major trading partner which is EU in our case, the researcher preferred US because the data can be obtained easily. Moreover most of the foreign transaction in Ethiopia is conducted using US dollar rather than EURO. The notation

Es_{t+1}represents the rational agents' expected value of exchange rate at time $t+1$, conditional on the information available in period t. All variables are logged.

Equation 3.1 describes domestic real money demand function. It states that the demand for nominal monetary aggregates (m_t^d) is a positive function of domestic prices (p_t) and real income (y_t) and a negative function of interest rate(i_t). The positive relation between income (y_t) and nominal money demand (m_t^d) is based on the assumption that as income increases, people demand more money for financing their transactions. The interest rate represents an opportunity cost of holding money.

As the opportunity cost of holding money increases, people prefer to hold their cash balances in assets that earn interest rate. This reduces demand for domestic money balances. Equation 3.1 also has a stochastic money demand disturbance (v_t). Equation 3.2 is the Purchasing Power Parity (PPP) condition. It states that the domestic prices (p_t) are an increasing function of both exchange rate (s_t) and foreign price level (p_t).

The spot exchange rate is defined as the number of units of domestic currency per unit of foreign currency. Hence an increase in exchange rate suggests that the domestic currency depreciates. Parameter a_0 denotes deviations from purchasing power parity. If $a_0 = 0$ and $a_1 = a_2 = 1$ simultaneously, the price equation breaks down in absolute PPP, suggesting that exchange rate and foreign price changes are reflected equally in domestic prices.

Equation 3.3 is Uncovered Interest Parity and suggests that returns on both domestic and foreign assets are set equal. In case of difference between the domestic and foreign interest rate, exchange rate changes to bring equality on asset returns. Equation 3.4 defines the evolution of the money supply process. It states that money supply depends on inherited money stock m_{t-1}^s, changes in domestic credit (Δd_t) and foreign exchange reserves (Δf_t). Equation (3.5) shows that the Central Bank responds to exchange rate fluctuation. For example, as the domestic currency depreciates ($\Delta s_t>0$), the Central Bank sells foreign exchange reserves ($\Delta f_t<0$). Similarly, when a country has an appreciating currency, the reserves of the Central Bank rise ($\Delta f_t>0$).

In order to use the simple model to obtain exchange market pressure and intervention indices. Substitution of equation (3.2) and (3.3) into (3.1), taking the difference of the

resulting equation, combining it with the central bank's response function and re-arranging the resulting equation yields an equation for the changes in the exchange rate:

$$\Delta s_t = \frac{-\{(a_1 \Delta p_t^* + b_1 \Delta y_t - b_2 \Delta i_t^* + v_t - \Delta d_t - b_2 \Delta ES_{t+1}) + \Delta f_t\}}{a_2 + b_2} \quad (3.6)$$

Taking the partial derivative of exchange rate change with respect to foreign exchange reserve changes is given by equation 3.7:

$$\eta = -\frac{\partial \Delta s_t}{\partial \Delta f_t} = \frac{-1}{a_2 + b_2} \quad (3.7)$$

The exchange rate elasticity with respect to foreign exchange reserves (η) is of negative sign. It shows that both foreign exchange reserves and exchange rate changes move in the opposite direction. An increase in foreign exchange reserve causes the exchange rate to appreciate, and vice versa.

The log linear small open economy model given above allows us to construct exchange market pressure (EMP_t) index given as:

$$\boldsymbol{EMP_t} = \Delta s_t + \eta \Delta f_t \quad (3.8)$$

The EMP_t index measures the extent of exchange rate changes required for removing exchange market pressure in the absence of Central Bank intervention. It takes a negative or a positive sign. A negative sign implies strengthening pressure and vice versa. A zero value of exchange market pressure suggests the absence of market pressure. This index contrasts with the Girton and Roper (1977) approach that assigns equal weights to Δs_t and Δf_t hence $\eta = 1$. Equation 3.8 further shows that as a_2 and b_2 rises, less EMP_t is relieved by Δf_t (i.e. $\eta \rightarrow 0$).

That is, as the semi-elasticity of real money demand to interest rate rises and the response of domestic prices to exchange rate increases, η approaches to zero and the Central Bank either

allows exchange rate changes or the interest rate to restore foreign exchange market equilibrium. Based on exchange market pressure index, Weymark (1995) constructed foreign exchange market intervention index. It measures the fraction of total pressure on the currency that Central Bank relieves through the purchase of foreign exchange reserves. Hence, the intervention index is the ratio of reserve changes to pressure, adjusted for parameter η.

When monetary authorities engage only in direct exchange market intervention, the intervention index (ω_t) is given as:

$$\omega_t = \frac{\eta \Delta f_t}{EMP_t} = \frac{\eta \Delta f_t}{\Delta s_t + \eta \Delta f_t} \quad (3.9)$$

Dividing the numerator and denominator of the right hand side of the equation 3.9 by $1/\eta$ gives:

$$\omega_t = \frac{\Delta f_t}{(1/\eta)\Delta s_t + \Delta f_t)} \quad (3.10)$$

The intervention index takes values between $-\infty < \omega_t < \infty$. Its values can be interpreted as follows: when $\omega_t = 0$, the Central Bank abstained from intervening in the foreign exchange market and exchange rate changes absorbed the entire pressure. This is consistent with a flexible exchange rate regime. On the other hand, $\omega_t = 1$ suggests that foreign exchange reserve changes absorbed the entire pressure and exchange rate remained unchanged. This suggests fixed exchange rate arrangements. When the intervention index takes values between $0 < \omega_t < 1$, we call it a managed float. This is because both the exchange rate and foreign exchange reserve absorb the prevailing pressure. $\omega_t < 0$ indicates the Central Bank's leans with the wind. That is for example, the Central Bank purchases foreign exchange reserves when there is a pressure on the domestic currency to depreciate.

Typically a Central Bank will only engage in leaning with the wind to attain an exchange rate level rather than to resist exchange rate volatility. Adjustment of the exchange market pressure and intervention index is made with η. It converts foreign exchange reserve

changes into equivalent exchange rate changes. The underlying intuition of adjusting foreign exchange reserve changes with η is to avoid exchange market pressure and intervention index being dominated by more volatile component.

3.4 Method of Data Analysis

Before the analysis, the collected data has been processed in order to identify whether it needs special or unusual treatments, and then regression analysis has been made based on the popular Two Stage Ordinary Least Square estimator using time series data collected for the period 2006Q1 to 2017Q4. The analysis has been done using statistical software package, Eviews8.

3.4.1 Unit Root Tests (Stationarity Test)

The empirical work based on time series data assumes that the underlying stochastic process is stationary. This implies that its mean, variance and auto covariance (at various lags) remains time-invariant no matter at what point we measure them. When this assumption is violated, we say that the time series is non-stationary.

A non-stationarity test that has been widely used in empirical work on time series process is based on the following Augmented Dicky Fuller regression:

$$\Delta x_t = \alpha_0 + \beta_1 x_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta x_{t-i} + \varepsilon_t \qquad (3.11)$$

Here x_t and ε_t denote stochastic time series process and white noise error term respectively.

The unit root test implies that $\beta_1 = 0$. If calculated t–values are greater than the critical values from McKinnon (1996), we do not reject the null of data non-stationarity.

Alternatively, if the calculated t–values are less than the critical ones, the null of non-stationarity of the data is rejected. Due to quarterly data, we use four lags as the maximum number of lag length (ρ).

Alternatively, the lag length can be chosen so that the Information Criterion (AIC) value is minimized. After selecting the optimal lag length, we use the Augmented Dicky Fuller test for testing the presence of unit root.

3.5 Operational Definitions of Variables

The operational definitions of variables used in the research are explained as follow:

i. Real Money Demand: the total amount of demand deposit and money out of the bank. Which is called M_2 in NBE.
ii. Domestic Price: is the general price level in Ethiopia and proxies by CPI
iii. Gross Domestic Product: is a monetary measure of the market value of all final goods and services produced in a period of time.
iv. Foreign Price: is a hypothetical daily measure of overall **prices** for some set of goods and services (the consumer basket), in an economy or monetary union during a given interval (generally one day), normalized relative to some base set. Since the study takes us price as a foreign price, it is proxies by US CPI.
v. Lending Interest Rate: is the average amount charged, expressed as a **percentage** of principal, by all lenders to a borrower for the use of assets. Since the analysis uses US as a foreign counterpart, it denotes for both countries average lending interest rate.
vi. Exchange Rate: is the price of a *US dollar* in terms of another *birr.*

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 Descriptive Statistics

Before diving into the econometric analysis, it is worth discussing the descriptive statistics of the variables used in the research. Thus, table 4.1 below present summary of descriptive statistics of two dependent variables (i.e., Money Demand (broad Money) and Price (CPI)), four independent variables (i.e., Gross Domestic Product (Income), Interest, Foreign price (US CPI) and exchange rate). The descriptive statistics includes the mean, median, maximum, minimum, standard deviation of variables quarterly data included in the research for the period 2006 to 2017.

Table 4.1: Summary of Descriptive Statistics

Variables	Mean	Median	Maximum	Minimum	Std. Dev.	Obs.
Money Demand	5.161773	5.170465	5.758470	4.621520	0.353010	48
CPI	4.395455	4.518418	5.109356	3.464489	0.53048	48
GDP	11.70841	11.72949	12.28135	11.10327	0.346363	48
Lending Interest rate	11.70841	11.8800	12.7500	10.50000	0.696771	48
Foreign Price(us CPI)	2.013358	2.017805	2.053460	1.960140	0.026281	48
Exchange Rate	1.161431	1.161431	1.360260	0.938030	0.152858	48

Source: Author's computation using Eviews-8

As it can be seen from the above table, there is no big variation between the maximum and minimum value of the dependent and independent variables. In this instance the mean, median, minimum, standard deviation value of the dependent variables money demand and purchasing power parity and independent variables of lending interest rate, real gross domestic product, price (consumer price index), us price (us price index) and exchange rate have exhibited no data instability for the forty eight observations.

From the above figure it is evident that there is no significant dispersion between the data of each variables for the total forty eight observations and it is true that, performing regression analysis using highly disbursed data leads to spurious result due to the highly disbursed single observation from the total. The above mentioned facts remind us that the data used in this research paper has good arrangement to perform the regression analysis without worrying about the dummy variables.

4.2 Stationary and Non-Stationary Test

4.2.1 Graphical Method

To check the stationarity of the data, first the researcher has simply graph the time serious line graph using the Variable on the y- axis and time on the x-axis. In the first annexed figure, it shows the data in level and the difference data in the second figure but after checking the non stationarity of the data by looking from the level graphs.

Figure 4.1 contains the graphs of data in log levels. Following the approach of Weymark (1995), the graphs reveal that all variables display an increasing trend over the entire sample period. The data are apparently non-stationary in levels.

Figure 4.2 contains graphs of first difference data on all these variables. The plots do not display any systematic pattern which is in conformity with the non-stationarity of the stochastic process.

This finding is further supported by the values obtained for both Augmented Dicky-Fuller unit root test values using log level and differenced data and are given in section 4.2.2.

4.2.2 Unit Root Test

Table 4.2 shows the results of ADF unit root test both in log levels and log first difference for random walk model with drift and with drift and trend.

Table 4.2: Unit Root Test

ADF Test in Levels		
Variables	Constant	Constant and trend
i_t	-1.568 (1)	-1.905(1)
M_t	1.177(1)	-2.608(1)
P_t	-1.797(1)	-1.117(1)
p^*_t	-1.524(1)	-2.050(1)
S_t	-0.702(1)	-0.668(1)
Y_t	-1.803(1)	-2.526(1)
5% critical values	-2.925	-3.508
ADF Unit Root Test in First Difference		
Variables	Constant	Constant and trend
Δi_t	-6.952 ^{a}(1)	-6.915 ^{a}(1)
Δm_t	-6.345 ^{a}(1)	-6.505 ^{a}(1)
Δp_t	-4.913 ^{a}(1)	-5.254 ^{a}(1)
Δp_{t*}	-8.097 ^{a}(1)	-8.220 ^{a} (1)
Δs_t	-5.062 ^{a}(1)	-5.062 ^{a}(1)
Δy_t	-4.453 ^{a}(1)	-4.841 ^{a}(1)
5% critical values	-2.925	-3.508

Note: superscript a indicates the significance of the variables at 5% critical values. * denotes the foreign counterparts of the domestic variables. Lag lengths are determined by the Schwarz Information Criterion. Variables used are defined as: i_t= Lending interest rate, m_t= M2 in Ethiopia, p_t= CPI in Ethiopia, p_{t^*}= US CPI, s_t= spot exchange rate, and y_t=gross domestic product. 5% one-sided critical values are taken from McKinnon (1996). Quarterly data for the period 2006:Q1 to 2017:Q4 is used. Δ denotes first difference operator.

It is evident from the table that log level data yield the t-values that are far greater than 5% critical ones for all variables in model with constant and deterministic trend. Therefore, we are unable to reject the null of unit root in levels for all variables, with drift and deterministic trend. Following Weymark's (1995) empirical strategy, we first difference the data to overcome the non-stationarity issues. The difference data ADF unit root test results are, as expected, entirely different from those obtained in levels. The lower part of table 4.2 shows that the calculated t-values are lower than the critical ones at 5% significance levels for all variables with constant and deterministic trend. This shows that first difference for all variables are more appropriate specification for the estimation. All this shows that we can reject the null of non-stationarity for all variables in at least one specification.

4.3 Estimation of the Model

In order to estimate the parameters of the model, we first need to estimate η which requires estimates of the parameters $_{a2}$ and $_{b2}$ from equation 1 and 2:

The basic objective of constructing an exchange market pressure and intervention index is to determine the direction of pressure and evaluate the monetary authorities' response function over the sample period. The study have used the data and a Two-Stage Least Square procedure for obtaining interest sensitivity of money demand ($_{b2}$) and price sensitivity of exchange rate ($_{a2}$) from the estimated real money demand (eq.1) and price equation (eq. 2). This approach is adopted to overcome the endogenity Problem that arises due to simultaneous determination of the dependent variable and one or more of the independent variables. In such a situation, ordinary least square approach yields inconsistent estimates of behavioral parameters in the regression equations. The Two Stage Least Square (2SLS) uses instrument variables for obtaining unbiased estimates of the endogenous variables[12]. Instrumental variable is assumed to be uncorrelated with the model's error term but correlated with the endogenous variables. It is argued that the instruments used may be strongly correlated with the endogenous variable but may be uncorrelated with the dependent variable. This may give insignificant estimate of endogenous variable(s) in the estimated regression equation. Furthermore, the study don't take in to account R^2 and $\overline{R}^2$ values due to lack of consensus on unique definition of the coefficient of variation if the model is estimated by the method other than ordinary least square. The objective of using instrumental variables is to obtain consistent estimate of the causal effects of endogenous variables on regressand and the use of instruments instead of endogenous variables fulfil this task (Verbeck 2008, P.150)

Table 4.3 shows our estimates of the real money demand function, using a Two-Stage Least Square (2SLS) method.

Table 4.3. Real Money Demand Estimation (DD for Money=f(GDP,i)

At first difference	**Coefficient**	**Std.Error**	**t-Statistic**	**Prob**
Gdp(Y)	1.054529	0.159762	6.6000621	0.0000
I	-0.050197	0.065630	-0.764844	0.4484

Source: Research findings

[12] . We used the US, CPI, GDP, interest rate, and exchange rate as the first stage instruments.

It is evident from Table 4.3 that interest rate and real domestic income estimates are of negative and positive signs respectively. The positive domestic real income estimate suggests that as incomes increase, people demand more money to finance their transactions. On the other hand, a negative interest rate estimate suggests that with the rise in opportunity cost of holding money, people prefer to hold their cash balances in terms of assets that earn interest rate instead of holding them in cash balances. This behavior of individuals and firms suggests a negative sign of interest rate in real money demand equation. The insignificant estimate of interest rate in two stage least square approach could be due to the use of differenced data. In addition, the use of instruments instead of interest rate may account for its insignificant estimate in two stage least square approach. This occurs when instruments although strongly correlated with the endogenous variable have weak correlation with the dependent variable. This gives increased values of standard errors which results in insignificant t–values. Insignificant interest rate coefficient in 2SLS approach implies that the short term interest rate does not have any significant impact on nominal money holdings (Khan, 1980). Its insignificancy doesn't prohibit to take the coefficient of interest in calculation of the interest sensitivity of money demand as per the Weymark Model (1995)

Table 4.4. Purchasing Power Parity Equation (Domestic Price=f(up,s)

At first difference	Coefficient	Std.Error	t-Statistic	Prob
Cpi-usa (UP)	3.341401	2.346235	1.424154	0.1613
S(exchange rate)	0.855120	0.483661	1.768014	0.0038

Source: Research findings

In table 4.4, the positive estimates of exchange rate and foreign price are consistent with purchasing power parity. Purchasing Power Parity suggests that exchange rate and foreign price changes are positively associated with domestic prices. However, the estimates of foreign price is insignificant. This indicates that changes in foreign prices do not have any influence on Exchange Market Pressure. This can be interpreted in terms of independence of domestic monetary authorities in pursuing an independent monetary policy

4.4 Estimation of Exchange Market Pressure and Intervention Index

4.4.1 Estimation of EMP Index

Following Weymark (1995), the study uses interest rate and exchange rate estimates obtained from two-stage least square approach for constructing exchange market pressure and intervention index for Ethiopia

. The study have adopted this approach to overcome the endogenity problem that arises due to simultaneous determination of dependent and one or more of the independent variables. This requires using instrumental instead of endogenous variables in the estimation of the regression equation. The instrumental variables must be correlated with endogenous variables but uncorrelated with the model's error term. Exchange market pressure and intervention index are constructed to check the direction of pressure and evaluate the monetary authority's response.

The intervention index estimates are then used to characterize the exchange rate regime of the Ethiopia from 2006 to 2017.

Exchange market pressure index is given as:

$$EMP_t = \Delta s_t + \eta \Delta f_t$$

estimation of bilateral elasticity η to construct a model consistent exchange market pressure and intervention index is needed. It is obtained by adding the estimated parameter of interest sensitivity of money demand (b_2) from money demand equation and (a_2) exchange rate estimate from price equation. The parameter a_2 reflects the sensitivity of domestic prices to exchange rate changes. Similarly, b_2 is interest rate sensitivity of the demand for money. The estimates of both these variables obtained from our regression equation using two-stage least square approach following Weymark (1995) are: a_2 =0.855 And b_2 =0.050

Based on these estimates of interest rate and exchange rate, the model consistent elasticity η is:

$$\eta = \frac{-1}{a_2 + b_2} = \frac{-1}{0.855+0.050} = -1.105$$

η denotes exchange rate elasticity with respect to foreign exchange reserve changes and is used to convert foreign exchange reserve changes into equivalent exchange rate units. The sign of η is negative, which implies that exchange rate and foreign exchange reserve changes move in the opposite direction. An increase in foreign exchange reserves is

associated with the appreciation of domestic currency against the US dollar in the foreign exchange market.

Figure 4.3 shows quarterly estimates of exchange market pressure. It is evident from the figure that depreciation pressure has remained dominant over the entire sample period. This is further supported by exchange market pressure mean value of 0.00208. This can be interpreted as if the Central Bank had abstained from intervening in the foreign exchange market, the domestic currency would have depreciated by 0.2 percent.

However, a positive Exchange Market Pressure mean value does not imply that in each quarter there was downward pressure on domestic currency's value. There are eighteen quarters for which appreciation pressure has exhibited. For the remaining thirty quarters, depreciating pressure was dominant on the domestic currency.

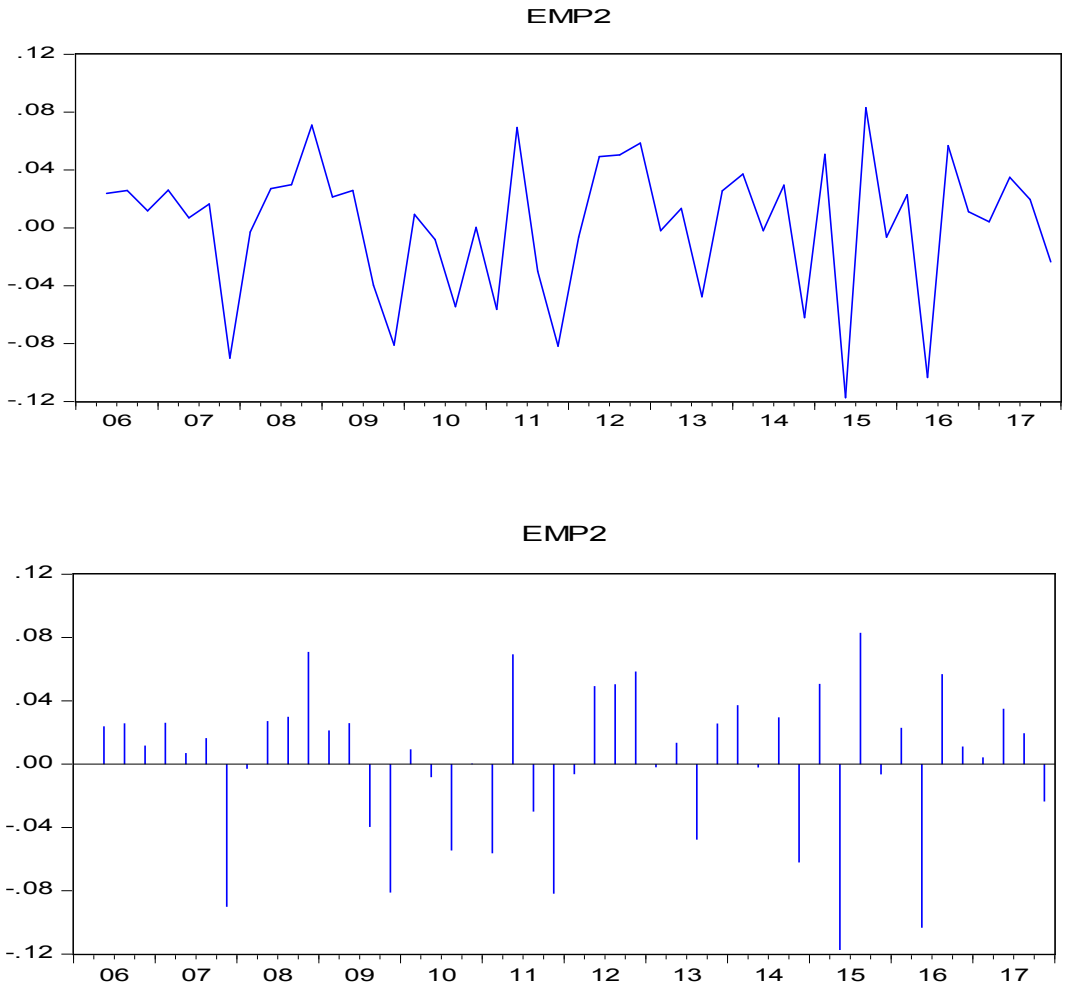


Figure 4.3: EMP index

4.4.2 Exchange Market Intervention Index

Figure 4.4 shows intervention index values. Intervention index is the fraction of pressure that the Central Bank relieves through purchase and sale of foreign exchange reserves and is given as:

$$\omega_t = \frac{\eta(\Delta f_t)}{EMP_t} = \frac{\Delta f_t}{(1/\eta)\Delta s_t + \Delta f_t}$$

Its values range between $-\infty$ till $+\infty$ .A value of $\omega_t = 0$ implies the absence of Central Bank intervention and exchange rate changes relieving the entire exchange market pressure. This is consistent with flexible exchange rate arrangements. $0<\omega<1$ with implications that exchange market pressure is relieved by exchange rate and foreign exchange reserve changes. Such a monetary policy characterizes the exchange rate regime as managed float.

$\omega_t \prec 0$ reveals the monetary authority's leaning with the wind in that the central bank purchased foreign exchange reserves when there was already a downward pressure on domestic currency. $\omega_t \succ 1$ can be interpreted as foreign exchange reserve changes being more than that warranted by the pressure. This leads the exchange rate to move in the direction opposite to that which would have prevailed in the absence of Central Bank intervention.

Figure 4.4 reveals that there are no quarters for which $\omega_\tau = 1$.This can be interpreted as foreign exchange reserves changes having relieved the entire pressure Index (ω_τ) in no quarters. And hence there were no fixed exchange rate regime during the sample periods. Similarly for twenty seven quarters ω_τ were $\prec 1$ but greater than zero .This reveals that in these quarters both exchange rate and foreign exchange reserves changes absorbed exchange market pressure, which is consistent with a managed float. For eighteen quarters $\omega_\tau \succ 1$ suggesting that relative changes in foreign exchange reserves were more than those warranted by the pressure.

This caused the exchange rate to move in the direction opposite to that warranted by the pressure. For the remaining three quarters, ω_t were $\prec 0$. This implies the Central Bank's leaning with the wind policy in that the Central Bank purchased foreign exchange reserves when there was already downward pressure on domestic currency and sold reserves with a strengthening domestic currency.

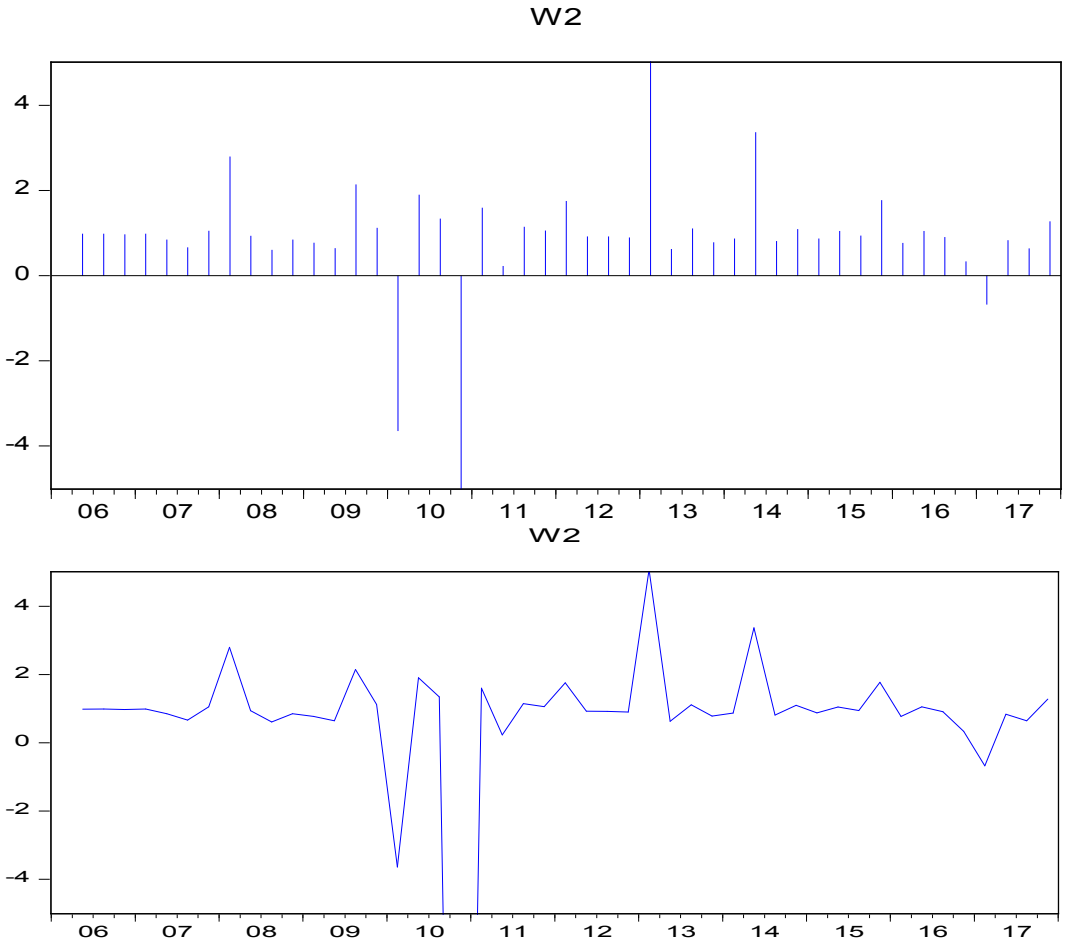


Figure 4.4. Intervention (EMP)

The intervention index mean value 0.31 is substantially different from that obtained by Weymark (1995) for Canada ω_t = 0.946, Gilal, Muhammad Akram (2011) for Pakistan ω_t =

0.61 and Apergis and Eleftheriou (2002) for Greece $\omega_t = 0.971$.[13] This shows that foreign exchange reserves and exchange rate changes absorbed thirty one and sixty nine percent of the pressure respectively. Since both exchange rate and foreign exchange reserve changes absorbed the pressure, we can safely characterize Ethiopia's exchange rate regime as managed float for the given sample period.

[13] Kohlschen (2000) made Weymark (1995) approach consistent with Chilean monetary experience and obtained intervention index mean value of 0.196. Similarly Spolander (1997) analysed Finland central bank intervention policy using Weymark (1995) approach and obtained intervention index mean value of 0.99

CHAPTER FIVE: SUMMARY, CONCLUSION AND POLICY IMPLECATION

5.1 Summary

In this thesis, the study have examined Exchange Market Pressure and monetary authorities' response to market pressure on Ethiopia. Exchange market pressure refers to money market disequilibrium that arises due to non-zero excess demand of money. It is therefore not directly observable; the channels that restore money market equilibrium are used for measuring the extent of foreign exchange market disequilibrium. In a fixed exchange rate system, money market operations denoted as Central Bank's buying and selling of foreign exchange reserves are used for measuring foreign exchange market disequilibrium. On the other hand, exchange rate changes reflect foreign exchange market disequilibrium under a flexible exchange rate system. Simultaneous changes in exchange rate and foreign exchange reserves characterize foreign exchange market disequilibrium under a managed float. Ethiopia's exchange rate regime has evolved in different phases.

The Ethiopia's exchange rate system were fixed during the derge regime and used to control the EMP by foreign currency reserve only. Following the introduction of the auction system on May 1, 1993 and the subsequent replacement of the auction system by the daily inter-bank foreign exchange market in October, 2001, demand and supply factors were given more latitude in the determination of the exchange rate. As a result, the NBE acts as a buffer between forces of demand and supply through intervention. Indeed, the NBE has attempted to stabilize the exchange rate through official interventions mainly by varying the amount of foreign exchange it supplied to the market. In effect, pressures in the foreign exchange market are reflected by changes in both exchange rate and reserve holdings of the NBE.

Astudy that estimated an index of the EMP for Ethiopia over the period November, 2001 to December, 2005 reveals that in majority of the cases (in 42 months out of 49 months considered) the Ethiopian foreign exchange market was characterized by depreciation pressures (Abebe, 2006). A critical issue under such circumstances is the policy measures to be undertaken by Monetary Authority (central bank) when the economy faces such external strains. These facts necessitates to evaluate whether it is upward or downward pressure that has remained dominant over the entire sample period and evaluate the

monetary authority's response by constructing exchange market pressure and the intervention index over the given sample period. The study has adopted Weymark's (1995) approach to evaluate the pressure on Ethiopia's domestic currency and the monetary authority's response to exchange rate fluctuations. This approach has the advantage of enabling us to examine what fraction of pressure the Central Bank relieves through the purchase and sale of foreign exchange reserves. The intervention index values are then used to identify the extent that the Central Bank allows the exchange rate to adjust to its market determined value. It is therefore ideally suited to single country analysis.

In data analysis, the study has incorporated difference data and the two-stage least square approach. Difference data is used to overcome a non-stationary problem that yields spurious regression when used with the ordinary least square technique and the two-stage least square approach to address the endogenity problem. The endogenity problem arises when the dependent and one or more independent variables are simultaneously determined. This does not yield unbiased parameter estimates. The study have used the instrumental variable technique to overcome the endogenity problem. It is argued that the instruments used must be correlated with endogenous variables but not correlated with the model's error term. The results indicate weakening pressure and active Central Bank intervention. The intervention index mean value of 0.31 suggests that Central Bank relieved thirty one percent of the pressure by the sale and purchase of foreign exchange reserves. Exchange rate changes absorbed the remaining sixty nine percent of the pressure.

The use of difference data, although overcomes the non-stationary issue, results in the loss of vital information about a long-term relationship if one exists. It is argued that the linear combination of non-stationary variables yields a non-stationary outcome. It may be the case that a linear combination of non-stationary variables may result in stationary variables. Such an outcome provides evidence for the presence of a long-term relationship.

The intervention index mean value suggests that the Central Bank relieved thirty one percent of the pressure by the purchase and sale of foreign exchange reserve. Exchange rate changes absorbed rest of the pressure. This provide evidence of weakening pressure and active Central Bank intervention.

5.2 Conclusion

To conclude, this thesis has found that downward pressure has remained dominant over the entire sample period for Ethiopia and active Central Bank intervention. It further shows that the Central Bank allowed limited flexibility for reserves to adjust to its equilibrium value. This may be due to lack of adequate foreign currency reserves.

Further, the study has found there is active Central Bank intervention. It shows the extent that Ethiopia's Central Bank allows to market forces in the determination of domestic currency's value in the foreign exchange market.

5.3 Policy Implication

In this thesis, the study have used Weymark's (1995) approach to identify the direction of pressure and evaluate monetary authorities' response function. The results indicate downward pressure and active Central Bank intervention. Moreover, the intervention index is lower compared to most countries. This has policy implications, in that the countries that want to avoid pressure on their currencies have to monitor the developments of these variables. They should keep their trade and capital account open with the rest of the world. At the same time, they have to monitor the growth of domestic real income. Due attention should be given by the Government to accumulate adequate reserves by all means so that role of the reserve will be increase in managing the pressure as per other countries This will enable them to avoid pressure on their currencies in the foreign exchange market and .

Reference

Abebe, Deressa, (2006). "*Measuring Exchange Market Pressure and the Degree of NBE's Intervention in the Foreign Exchange Market*," A Paper presented to the 9thIn House Presentation Forum of the Economic Research and Monetary Policy Directorate, National Bank of Ethiopia, January 2006.

Apergis, N. and Eleftheriou, S. (2002) *Measuring exchange market pressure and the degree of exchange market intervention for the Greek Drachma*, International Economic Journal, Vol. 16, pp. 135–145.

Backus, S. (1984) *Empirical models of the exchange rate: separating wheat from the chaff*. Canadian Journal of Economics, Vol. 17, pp. 824-846. 237

Bahmani-Oskooee, M. and Berstein, D.J. (1999) *Exchange market pressure during the current managed float.* Applied Economic Letters, Vol. 6, pp. 585-588.

Bird, G., and Mandilalaras, A., (2006) "*Regional Heterogeneity in the relationship between fiscal imbalances and foreign exchange market pressure*" World Development Economics,Vol. 34(7), pp. 1171-1181. 238

Blanco, H. and Garber, P. M. (1986) *recurrent devaluation and speculative attacks on the Mexican Peso.* Journal of Political Economy, Vol. 94, pp. 148–166.

Boorman J.L. Lane, T. Schulze-Ghattas, M. Bulir, A. Ghosh, A.R. Hamann, J. Mourmouras, A. and Phillips, S. (2000) Managing financial crises: The experience in East Asia. IMF Working Paper WP/00/107(June).

Burdekin, R.C.K. and Burkett, P. (1990) *A re-examination of the monetary model of exchange market pressure:* Canada 1963-1988. The Review of Economics and Statistics,Vol. 72, pp. 677-681.

Connolly, M. and Da Silveira, J.D. (1979) *Exchange market pressure in postwar Brazil: an application of the Girton-Roper monetary model*. The American Economic Review, Vol.69, pp. 448–454.

Edison, H.J. (1993) *The effectiveness of Central-Bank intervention: a survey of the literature after 1982.*Princeton University, International Finance Section, Special Papers in International Economics No. 18, July.

Eichengreen, B. Rose, A.K. and Wyplosz, C. (1994) *Speculative attacks on pegged exchange rates: an empirical exploration with special reference to the European Monetary System*. Centre for Economic Policy research, Discussion Paper No. 1060.

Eichengreen, B. Rose, A. and Wyplosz, C. (1996) *Contagious Currency Crises: First Tests*. The Scandinavian Journal of Economics, Vol. 98, pp. 463–484.

Fischer, S. (2001) *Distinguished lectures on economics in government: exchange rate regimes: is the bipolar view correct?* The Journal of Economic Perspectives, Vol. 15, pp. 3-24.

Frenkel, J.A. and Aizenman, J. (1982) *Aspects of the optimal exchange rate management.* Journal of International Economics, Vol. 13, pp. 231–256.

Garcia, C. and Malet, N. (2007) *Exchange market pressure, monetary policy, and economic growth:* Argentina, 1993-2004. The Developing Economies, Vol. 45, pp. 253-282.

Gilal, Muhammad Akram (2011) *Exchange Market Pressure and Monetary Policy*: the case of Pakistan, Glasgow theses service.

Girton, L. and Roper, D. (1977) *A monetary model of exchange market pressure applied to the post war Canadian experience*. The American Economic Review, Vol. 67, pp. 537-48.

Gochoco-Bautista and Bautista (2005) *Monetary policy and exchange market pressure: The case of the Philippines*. Journal of Macroeconomics, Vol. 27, pp. 15 –168.

Hallwood, C.P. and Marsh, I.W. (2003) *Exchange market pressure on the Pound-Dollar exchange rate: 1925-1931.* Department of Economics, University of Connecticut Working Paper No: 2003-23.

Hodgson, J.S. Schneck, R.G. (1981) *Stability of the relationship between monetary variables and exchange market pressure: empirical evidence*. Southern Economic Journal, Vol. 47, pp. 941–958.

Jeisman, S. (2005) *Exchange Market Pressure in Australia*. Quarterly Journal of Business and Economics, Vol. 44, pp. 13-27.

Kamaly, A. and Erbil, N. (2000) *A VAR analysis of exchange market pressure: A case study for the MENA region.* University of Maryland College Park and George Washington University, Working Paper No 2025

Karfakis, C. and Moschos, D. (1999) *Searching for indicators of foreign exchange market pressure: Evidence from Greece*. International Journal of Finance and Economics, Vol. 4, pp. 63-73.

Katircioglu, S.T. and Feridun, M. (2011), *Do macroeconomic fundamentals affect exchange market pressure? Evidence from bounds testing approach for Turkey*. Applied Economic Letters, Vol. 18, pp. 295–300.

Kohlscheen, Emanuel-Werner (2000) *Estimating exchange market pressure and intervention activity.* Banco Central Da Brasil Working Paper No. 9.

Krugman, P. (1979) *A model of balance of payments Crises.* Journal of Money, Credit and Banking, Vol. 11, pp. 311–325.

Lafrance, R. and Racette, D. (1985) *The Canadian-US dollar exchange rate: a test of alternative models for the seventies.* Journal of International Money and Finance, Vol. 4, pp. 237-252.

Leu, S. Chen-Yu. (2009) *Managed floating in Australia*. Economic Papers, Vol. 28, pp. 310-322.

Mah, J.S. (1998) *Exchange market pressure in Korea: dynamic specifications*. Applied Economic Letters, Vol. 5, pp. 765-768.

Mandilaras, A. and Bird, G. (2008) *Foreign exchange pressures in Latin America: Does debt matter?* Journal of International Development, Vol. 20, pp. 613–627.

Modeste, N. (2005), *The impact of the foreign debt burden on exchange market pressure in Guyana, 1968-2000: An application of the error correction methodology*. The Journal of Development Areas, Vol. 38, pp. 25-39.

Pentecost, E.J. Hooydonk, C.V. and Poeck, A.V. (2001) *Measuring and estimating exchange market pressure in the EU.* Journal of International Money and Finance, Vol.20, pp. 401– 418.

Pollard, S.K. (1999) *Foreign exchange market pressure and transmission of international disturbances: the case of Barbados, Guyana, Jamaica and Trinidad & Tobago.* Applied Economic Letters, Vol. 6(1), pp. 1–14.

Poso, M. and Spolander, M. (1997) *Estimating exchange market pressure and the degree of exchange market intervention for Finland during the floating exchange rate regime.* Bank of Finland Discussion Paper 4/97. 250

Roper, D.E. and Turnovsky, S.J. (1980). *Optimal exchange market intervention in a simple stochastic macro model.* The Canadian Journal of Economics, Vol.13, pp. 296–309.

Sims, C.A. (1980) *Macroeconomics and reality*. Econometrica, Vol. 48, pp. 1-48.

Tanner, E. (2001) *Exchange market pressure and monetary policy: Asia and Latin America in the 1990s.* International Monetary Policy Fund Staff Papers, Vol. 47, pp. 311–333.

Tanner, E. (2002) *Exchange market pressure, currency crises, and monetary policy: Additional evidence from emerging markets.* International Monetary Fund, Working Paper No Wp/02/14.

Taslim, M.A. (2003) "*A monetary approach to exchange market Disequilibrium in Australia: 1975-197*" Australian Economic Papers, Vol. 42(2), pp. 183-196.

Thornton, J. (1995) *Exchange market pressure in Costa Rica, 1986-92: An application of the Girton-Roper model*. International Economic Journal, Vol. 9(1), pp. 67-72. 252

Verbeek, M. (2008) *A Guide to Modern econometrics*. 3rd Edition, John Wiley & Sons, Ltd.

Weymark, D.N. (1995) *Estimating exchange market pressure and the degree of exchange market intervention for Canada*. Journal of International EconomicsVol. 39, pp. 273–295.

Weymark, D.N. (1998) *A general approach to measuring exchange market pressure.* Oxford Economic Papers, Vol. 50, pp. 106–121.

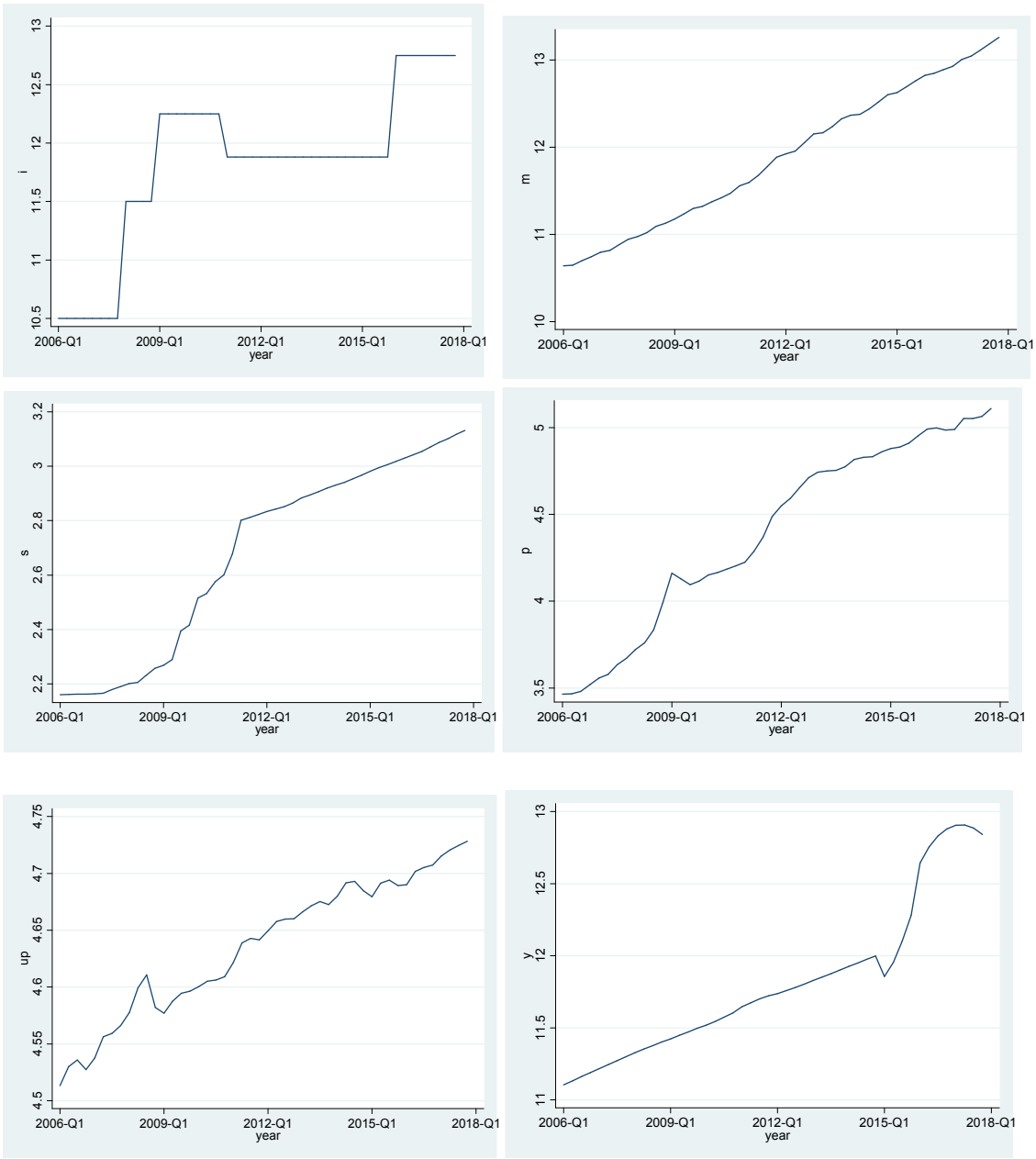
Wohar, M. and Lee, B.S. (1992) *An application of the Girton-Roper monetary model of exchange market pressure: The Japanese experience*, 1959 – 1991. Rivisita Internazionale di Scienze e Economiche e Commerciali, Vol. 39, pp 993–1013.

Wolf, C.C.P. (1987) *Time-varying parameters and out-of-sample forecasting performance of structural exchange rate models*. Journal of Business & Economic Statistics, Vol. 5, pp. 87-97.

Younus, S. (2005) *Exchange market pressure and monetary policy*. Policy Analysis Unit, Research Department, Bangladesh Bank, Working Paper No 0603.

Appendix A: stationary test graphs

Fig 4.1 Data in Level



Notes: These graphs represent data for Ethiopia's interest rate, money supply, prices, US prices, bilateral nominal exchange rate with the US dollar and real income. Sample period is from 2006 to 2017. The exchange rate (s_t) refers to number of units of domestic currency in terms of US dollars. Consumer price indices for both Ethiopia (p_t) and the US

(P_t^*) reflect the cost of acquiring a fixed basket of goods and services by the average consumer. Money (mt) refers broad money. Foreign exchange reserves (f_t) refer to total reserves minus gold. Real income is y_t.

Figure 4.2 Data in first difference

Notes: These graphs represent data for Ethiopia's interest rate, money supply, prices, US prices, bilateral nominal exchange rate with US dollar and real income. Sample period is from 2006 to 2017.

Appendix B. An Assessment of the Quadratic-Match Method for Interpolation

There are multiple interpolation methods (Quadratic-match, Cubic-spline and Partial-sum cubic-spline) which can be used for temporal disaggregation, but there is not necessarily one single method that is superior to the others. We generally do not have access to quarterly indicators that can be used with the available data for temporal disaggregation of the series in the RGDP. We employ a local quadratic method where the average (or the sum) is matched to the sourced low frequency data. The quadratic-match interpolation fits a local parabola to three points for each low frequency observation, then uses this polynomial to fill in all observations of the high frequency (quarterly) series associated with the data for the observed period. One point before and one point after the period being interpolated are used to provide the set of three points needed for the quadratic polynomial. For end points, both points must be taken from the side where data is available. Our preferred choice for interpolation is to use the quadratic-match average (or the quadratic match sum) method to interpolate the data to a quarterly frequency (annually frequency for real GDP only) in the following perspectives:

Local/global behavior: An important distinction between interpolation methods is that some are global (e.g., the cubic-spline and the partial-sum cubic-spline methods) while others are local (e.g., the quadratic-match method). Global methods take into consideration all low frequency observations so that changes in any one data point (or the addition of new data) to the observed series affect all interpolated data points. Global methods generally—but not always—create smooth surfaces, but can be very sensitive to the presence of outliers or breaks in the data. The influence of outliers on the fitted interpolating function will be felt on the entire surface. Local methods, in turn, only use a fixed number of observations within the neighborhood of the interpolated data point. Local methods usually yield less smooth surfaces, but are not as sensitive to outliers, breaks in the series, and preliminary data (or data subject to significant revisions) because their effects only affect localized regions of the interpolated curve. For those reasons, preference is given to local interpolation methods.

Smoothness/ruggedness: Excessive undulations caused by large curvature changes should be avoided—since the fitting curve changes its curvature at inflection points, these should be kept to a minimum as well. Using quadratic match sum method helps to keep this minimum better than the other method.

Shape-preservation/monotonicity/natural-shape features: A trade-off arises between the degree of smoothness and the property of local monotonicity (or shape-preservation). The piecewise linear interpolating function is at one extreme of the possibilities because it is continuous—with jumps in its first derivatives—and there is hardly any smoothness in the interpolation, but piecewise linear interpolation preserves the monotonicity of the data locally. It also preserves the shape of the data better because it avoids overshooting in the approximation, and the interpolated data is increasing, decreasing, or constant on the same intervals as the actual observed data. The infinite-order polynomial interpolating function is at the other extreme of the realm of possibilities. It is infinitely differentiable, but it generally fails to preserve the shape of the observed data. By using the quadratic-match method, therefore, we favor the shape preservation property over greater smoothness relative to the standard cubic-spline method.

Accuracy-of-fit/parsimony: Another one of our major goals is to strike a balance between accuracy and parsimony, which depends on the desired properties for the interpolated data (see,e.g., Baxter (1998) and Chamberlin (2010)). Our preferred method—the quadratic-match method—requires only the accuracy of a second-order polynomial. The method is not only fairly accurate for our purposes but also that the goodness-of-fit attained is largely robust to subsequent data revisions.

ANNEX c: Exchange Rate Regime of Ethiopia

The exchange rate regime is the way a country manages its currency in respect to foreign currencies and the foreign exchange market. It is closely related to monetary policy and the two are generally dependent on many of the same factors.

There are various types of exchange rate regimes being practiced by countries. The main types include floating, pegged floating and fixed.

Floating Exchange Rate: They are the most common exchange rate regimes today. For example, the dollar, euro, yen, and British pound all float. However, since central banks frequently intervene to avoid excessive appreciation/depreciation, these regimes are often called *managed float* or a *dirty float*.

Pegged Floating Exchange Rate: Here, the currency is pegged to some band or value, either fixed or periodically adjusted. Pegged floats are:

- *Crawling bands*: the rate is allowed to fluctuate in a band around a central value, which is adjusted periodically. This is done at a preannounced rate or in a controlled way following economic indicators.
- *Crawling pegs*: Here, the rate itself is fixed, and adjusted as above.

Pegged with horizontal bands: The currency is allowed to fluctuate in a fixed band (bigger than 1%) around a central rate.

Fixed Exchange Rate: Fixed rates are those that have direct convertibility towards another currency. In case of a separate currency, also known as a currency board arrangement, the domestic currency is backed one to one by foreign reserves. A pegged currency with very small bands (<1%) and countries that have adopted another country's currency and abandoned its own also fall under this category.

The choice of exchange rate regime is determined by various factors, such as the objectives pursued by the policy makers, the sources of shocks hitting the economy and the structural characteristics of the economy. But once the choice is made, the authorities are presumed to adjust their macroeconomic policies (especially fiscal and monetary policies) to fit the chosen exchange rate policy. Considering the underlying economic situation of the country, **managed floating exchange rate regime** is being practiced in Ethiopia since 1992. This exchange rate regime will continue to be adopted in the years to come.