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# The Impact of Monetary Policy on Foreign Reserves: MABP Approach

*Ala'a Abdul-Hafeez Al-Basheer [1]*, Ahmad Ibrahim Malawi [2]*

## ABSTRACT

This paper aims to investigate the short and long-run impacts of monetary policy on Jordanian foreign reserves for the period (1980-2012) in the context of the monetary approach to the balance of payments (MABP) and the reserve-flow equation. In doing so, the autoregressive distributed lag (ARDL) bounds testing approach of cointegration is employed.

The empirical results of the bounds testing approach have revealed the existence of a long-run relationship among foreign reserves, determinants of money demand, and the broad definition of money, M2. Moreover, the long-run parameters of the model came in line with the theoretical propositions of the monetary approach since money supply has a negative and statistically significant impact on foreign reserves, while domestic income and domestic price have positive and statistically significant impacts on foreign reserves. Domestic interest rate has a negative and statistically significant impact on foreign reserves, which is consistent with the MABP approach.

**Keywords**: Foreign Reserves, Monetary Policy, MABP, ARDL Cointegration Approach, Jordan.

## INTRODUCTION

One of the main macroeconomic objectives that any country pursues is to have a favorable balance of payments, and this happens when payments made by the country are less than payments received by the country, which is a case that results in foreign reserves accumulation. Such a favorable economic state, of an unequal flow of currency, will have implications for the supply of money, exchange rate, interest rate, inflation rate, unemployment rate, production, and other aspects of the domestic economy.

Countries frequently employ different policies to generate efficient external and internal effects on the national economy. Among these policies is the monetary policy. For most economies, monetary policy aims at controlling money supply so as to counteract all undesirable trends in the economy (Imoisi et al., 2013) such as high inflation rate, low economic growth rates, and distortions in the balance of payments.

In Jordan, the balance of payments suffers from the problem of a chronic trade balance deficit .The deficit in the current account of the balance of payments can be financed using three different sources (Dornbusch et al., 2008); (i) selling assets (ii) borrowing abroad (iii) using foreign reserves. However, in the case of Jordan, the chronic deficit in the trade balance and the current account is often financed by using foreign reserves. In 2012, the trade balance deficit in Jordan was estimated to be around Jordanian Dinar (JD) 7448.8 million, compared with around JD 543.3 million in 1980.

### 2. Research problem and Importance

Since Jordan has a chronic trade deficit (exports

*This paper is drawn from a Master's thesis of the first Author at Yarmouk University.

[1] Economic Researcher, Jordan.

[2] Department of Economics, Yarmouk University, Irbid, Jordan.

✉ ahmad.malawi@yahoo.com

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represent one third of imports) which is continuously financed by using foreign reserves held by the Central Bank of Jordan (CBJ), it is obvious how important is the task that foreign reserves have as means of international payments. Besides, foreign reserves have other important tasks in measuring the financial solvency enjoyed by the national economy, limiting the proportion of economic exposure of the national economy to external threats, protecting the exchange rate of the JD, and increasing the confidence of investors and lenders in the economy and its ability to fulfill the obligations and debts.

It can be concluded from the above discussion that one of the most important macroeconomic objectives in Jordan is to have a free of distortions balance of payments, which automatically implies holding sufficient foreign reserves on a permanent basis, and in pursuit of such an objective, different economic policies should be employed.

To the best of our knowledge, the impact of economic policies on the state of the Jordanian balance of payments, which automatically implies the amount and movements of foreign reserves, was not heavily carried out in research projects, thus this study has come to empirically investigate the impact of monetary policy, carried by the CBJ, on the status of the balance of payments represented by foreign reserves movements in the context of the Monetary Approach to the Balance of Payments (MABP) using yearly data for the period of study.

So, the main hypothesis of this paper is: there is a negative relationship between monetary policy represented by money supply and foreign reserves in Jordan during the period (1980-2012).

The rest of the paper is organized as follows: the next section reviews the theoretical and empirical literature. Section 4 provides definitions of the variables. The descriptive analysis is introduced in section 5. Section 6 discusses the econometric analysis, while section 7 reports the empirical results. Finally, the conclusions are presented in the last section.

## 3. Theoretical and Empirical Literature Review

Pursuing a favorable balance of payments, which automatically implies increasing the amount of foreign reserves and decreasing the current account deficit, is the responsibility of the Central Bank at the first place and should be one of its primary objectives. In an attempt to reach such a macroeconomic target, understanding the exact sources of the balance of payments' distortions becomes a necessary starting point.

This section deals with the theoretical part of the MABP approach which forms the focus of this study. This approach emerged in the early 70's trying to explain and understand the primary sources of the balance of payments distortions. Besides, this section carries out a brief presentation for two of the conventional theories of the balance of payments. Also, some previous studies will be presented.

### 3.1 Theoretical Literature Review

In economic literature, there are many theories explain international adjustment mechanism (or balance of payments adjustment mechanism). At least, there are three well-known competing theories of disequilibrium and adjustment of the balance of payments: the elasticity approach, the income-absorption approach, and the MABP approach. However, the relatively new theory of the MABP approach has taken a great attention worldwide in an attempt to explain such a complex phenomenon.

As previously mentioned, in this paper, the monetary approach is taken where foreign reserves flows in Jordan are assumed to be determined by factors determining the demand for money and by policy actions taken by the CBJ to contribute to the stock of money in the economy. Before going through a detailed discussion of the theoretical propositions of the monetary approach, a

brief theoretical presentation of the conventional theories to the balance of payments; the elasticity and the absorption approaches, will be given in this section.

### 3.1.1 The Elasticity Approach

The elasticity approach is based on the work of John M. Keynes during the twentieth century. This approach provides an analysis of how the devaluation of the domestic currency can improve the balance of trade or, in other words, it considers the responsiveness of imports and exports demand to a change in the value of a nation's currency. For instance, if demand for imports is considered to be highly elastic, a depreciation of the domestic currency will cause an unequal reduction in the country's imports. The greater the elasticity of the country's demand for the other country's goods, the greater the improvement in the balance of trade after currency devaluation. This approach is based on the assumption that the Marshall-Lerner condition holds; that is in a two-country, two-goods world, a devaluation of the currency in the deficit country will be beneficial if the sum of the two countries elasticities of demand for imports exceeds unity (Shamia, 1989). The analysis under the elasticity approach leads to the J-Curve which is an often but not always observed phenomenon. What is observed is that, following depreciation, trade balance initially worsens before it improves (Duasa, 2004).

### 3.1.2 The Absorption Approach

This approach was originally introduced by Sidney Alexander in 1968 (Shamia, 1989). It is based on the income-expenditure identity and simply hypothesizes that a country's trade balance is determined by the difference between what the economy produces and what it takes for domestic use or what it absorbs (Duasa, 2004). The domestic absorption or spending is given below:

$$A= C+ I+G +M \quad (1)$$

and the country's income ($Y$) is given below:

$$Y= C+ I+G +X \quad (2)$$

Where $C$ stands for consumption, $I$ stands for investment, $G$ stands for government expenditures, $M$ stands for imports, and $X$ stands for exports.

The current account ($CA$) is then:

$$CA=Y-A= (C+I+G+X)-(C+I+G+M) =X-M \quad (3)$$

Equation (3) implies that in the case that the economic production ($Y$) is less than its potential level of output ($Y<Y^*$), any policy would improve the trade balance of any economy if it causes an increase in production ($Y$) relative to expenditures ($A$). However, If the economy is at its potential level ($Y^*$), any economic policy that would decrease domestic spending ($A$) will result in a balance of trade improvements. As a result, this approach hypothesizes that devaluation of the domestic currency would improve the trade balance of the country if domestic output is less than its potential level. But in the case that the domestic production is at the potential level, the effect of devaluation depends on the inflation it causes, which in turn reduces the value of real money balances and reduces expenditures (Shamia, 1989).

As a conclusion remark, it should be noticed at this stage of the theoretical discussion that the above two theories; the elasticity and the absorption theories, can only be viewed as theories of the balance of payments in a world without capital flows (Duasa, 2004). In other words both of them suffer from a serious shortcoming that they ignore the capital account of the balance of payments and mainly focus on the trade balance. Based on this fact, a new approach to the balance of payments emerged. This particular approach is called the MABP approach.

### 3.1.3 The Monetary Approach to the Balance of Payments (MABP)

The MABP approach was developed by (Mundell,

1968), (Johnson, 1972), (Zecher, 1974), (Wilford & Zecher, 1979), and others. This approach states that the balance of payments is essentially a monetary phenomenon. That is; the balance of payments distortions reflect a disequilibrium situation in the domestic money market (excess supply of or excess demand for money). This approach is basically dependent upon on the work of David Hume and particularly his contribution of the analysis of the price-specie-flow mechanism (Johnson, 1972).

According to Hume, pre-assuming that the world is gold-standard with perfect capital mobility, when a country has a positive balance of trade ($X>M$), more money will flow into the country and thus money supply would increase, which raises the inflation rate. The higher prices of goods and services would cause exports to decrease and imports to increase (domestic demand for goods and services diverts abroad) which in turn causes monetary outflows, leading to a decline in the money stock and the price level until the balance of trade goes back to a neutral balance ($X=M$). On the other hand, when the country has a negative balance of trade ($X<M$) the opposite will exactly take place until the balance of trade goes back again to its neutral balance. Therefore, in the case that the Central Bank does not intervene to offset the quantity of money in circulation, the amount of money in the country would be adjusted automatically to the demand for it through surpluses or deficits in the balance of trade induced by the effects on relative price levels (Hamdan, 1997). It can be noticed from the above discussion that Hume presented the relative price level as a key determinant of the adjustment mechanism. Johnson (1972) asserted in his article that "The monetary approach to the balance of payments (MABP), while basically Humean in spirit, places the emphasis not on relative price changes but on the direct influence of excess demand for or excess supply of money on the overall balance of payments and not on the trade balance only" (p.1556). Therefore, this approach presents the international adjustment process not as an automatic process but as a reflection of government policies and actions (Hamdan, 1997).

The core concept of the MABP approach is basically dependent on Walras' Law which suggests that an excess supply in one market must be matched by excess demand in another market. Zecher (1974) asserted in his article that "When monetary authorities in an open economy are willing to buy or sell foreign reserves at fixed prices, private citizens and businesses play an essential role in determining the amount of money " (p.1523). Therefore, under the monetary approach, if the domestic money supply increases in excess of demand for it, citizens must readjust their portfolios and they will attempt to get rid of the excess money supply by purchasing foreign goods or services or by investing abroad. For this purpose, citizens can purchase foreign reserves from the Central Bank to settle their payments to foreigners which implies an outflow of foreign reserves and then causes a distortion in the balance of payments. While in the case of an excess demand for money, the opposite will take place, meaning that the excess demand for money can be eliminated by net sales of domestic goods and services or by disinvestment in the foreign market resulting in an increase in foreign reserves. In this sense, the balance of payments is a monetary phenomenon (Hamdan, 1997; Bilquees, 1989; Howard & Mamingi, 2002; Jager, 1978; Chaudhary & Shabbir, 2004).

The proposition of the MABP approach could be tested by the reserve-flow equation (Zecher, 1974). The reserve-flow equation is an equation in which the dependent variable is either the level of the country's foreign reserves, changes in foreign reserves, or the rate of change in foreign reserves (Chaudhary & Shabbir, 2004). The explanatory variables of the equation are the basic determinants of the demand for money; domestic interest rate, domestic price level, and domestic income, along with the key explanatory variable of the equation

which represents the domestic monetary policy. This monetary model states that the determinants of the demand for money in the reserve-flow equation represents the economy' ability to absorb the increased money supply and that variations in the economic activities of the country will determine changes in the demand for and supply of money. Therefore, it can be concluded that the monetary approach is concerned with the relationship among the main determinants of the demand for money, money supply, and foreign reserves movements. According to the monetary approach, the estimated coefficients of the reserve-flow equation are expected to generate positive signs for the price level and the income level, while it is expected for the interest rate and the proxy variable of the monetary policy to have a negative sign.

Hence, in the context of the monetary approach and the reserve-flow equation, the coefficients of the price level, interest rate, and income are expected to generate the same signs as in the demand for money function. While the coefficient of the money supply is expected to generate a negative sign based on the belief that extensive credit is a common observed phenomenon in small-open economies. The extensive credit expansion by Central Banks in small-open economies takes place because government budget deficit occurs most often in such countries and this, in turn, causes money supply to increase relative to money demand resulting in a disequilibrium money market and then foreign reserves outflows ( Zecher, 1974; Borts & Hanson, 1979; Chaudhary & Shabbir, 2004). It should be mentioned at this stage of discussion that, given a generally accepted characteristics of the monetary approach, a focus on the long-run relationship among the dependent and the explanatory variables of the reserve-flow equation is given pride. In the short-run, money can still function as a kind of buffer stock serving to absorb changes in other variables. Therefore, in this view, essentially non-monetary variables (other than the determinants of the demand for money and money supply) can determine the behavior of the foreign reserves and the balance of payments in the short-run (Jager, 1978).

The monetary approach depends on the following assumptions. Firstly; a fixed exchange rate regime (Shamia, 1989). Secondly; the country's demand for money is assumed to be a stable function of income (Howard & Mamingi, 2002). Thirdly; financial assets and goods are assumed to be perfectly mobile in the international market (Hamdan, 1997). Fourthly; the country's price level is determined in the world market according to the law of one price (Bilquees, 1989). This is a small country assumption. Fifthly; domestic interest rate is assumed to converge to the world level with the requirement that, the international capital mobility, rates on return on assets dominated in different countries must be equalized (Bilquees, 1989). This is also a small country assumption. Domestic interest rate is viewed as a proxy of for the world interest rate (Zecher, 1974). Sixthly; domestic output is determined by forces independent of the monetary factors or the balance of payments (Bilquees, 1989). Seventhly; the domestic money supply is backed by only two components; foreign reserves and domestic credit (Bilquees, 1989). Eighthly; the monetary approach states that an increase in the level of domestic income and the level of domestic prices will result in improvements in the balance of payments and foreign reserves. While in the Keynesian approach these increases will cause the balance of payments to deteriorate because of increasing imports relative to exports (Dabbagh & Al-Nagdawi, 1994). And finally; foreign exchange reserves changes are not sterilized by the monetary authorities implying that international payment adjustment is self-correcting and no need to correct the balance of payments distortions through policy actions (Howard & Mamingi, 2002).

The MABP approach has been subjected to a number of criticisms. Firstly, many critics argue that this approach focuses heavily on the state that domestic

money market is the primary source of the balance of payments distortions and pays little attention to fiscal and economic variables that might cause distortions to the balance of payments (Howard & Mamingi, 2002). Secondly, the developers and supporters of this approach, as previously mentioned above, uses what is called the "reserve-flow equation" to test for the prediction power of the theory. This general equation regularly employs the domestic credit to represent monetary policy actions conducted by the monetary authorities. However, Currie (1976) argues that the monetary approach, represented by the standard reserve-flow equation with the domestic credit variable included in it, ignores the various ways by which the money supply can be expanded. This particular criticism is made against the seventh assumption above. Thirdly, the coefficient of domestic credit variable in the standard reserve-flow equation of the monetary approach is expected by the developers and supporters of the theory to generate the value of -1 (that is the offset coefficient). However, some researchers argued that if there is a missing variable in the reserve-flow equation of those which determine the demand for money, then the value of the offset coefficient is not -1. Other researchers contend that there is no one-to-one relation between domestic credit and foreign reserves because the level of income and interest rate might vary significantly making it impossible to predict movements in the balance of payments arising from changes in the money supply (Howard & Mamingi, 2002). And finally; there is some concern among arguing parties regarding the sterilization role played by the central bank. The conventional theories of the balance of payments tell that the balance of payments distortions can be sterilized (Hamdan, 1997). However, the monetary approach suggests that the distortions in the balance of payments will be self-correcting through the mechanism mentioned above if the central bank does not resort to the sterilization operation.

Sterilization refers to a monetary action in which the Central Bank attempts to isolate itself from the foreign exchange market to counteract the effects of a changing monetary base. Dornbusch et al. (2008) pointed out that with sterilization; persistent external deficit is possible because the link, under the monetary approach, between the external imbalance and the equilibrating changes in the money stock is broken. To illustrate, according to the monetary approach, whenever there is an excess money supply, outlays rise above receipts, and part of the increased outlays is directed to foreign goods, services, and assets. In this particular case, citizens and private businesses will resort to the Central Bank and buy foreign currencies at fixed prices to pay for their increased purchases abroad resulting in a decline in the domestic money stock. At this stage of the process, the monetary approach suggests that, if the Central Bank tries to sterilize this effect of the reduction in the domestic money supply through buying bonds in open market operations to bring back the money supply to its original level, the external imbalance will persist. However, in many developing countries, Jordan inclusive, external deficit may persist not only because of sterilization but also because the government often resort to use extensive credit policies and expenditure policies to maintain some levels of output and employment which implies that the Central Bank is forced to expand the domestic credit to government thus increasing the level of domestic money supply relative to a given money demand within the country. This particular criticism is made against the ninth assumption above.

**3.2 Empirical Literature Review**

The balance of payments is considered to be one of the major indicators of a country's performance in international economics and thus it expresses a country's relative value in the world economy. Based on this fact, many researchers around the world, especially in

developing countries, attempted to examine the influence of monetary and domestic credit policies on the foreign reserves flows in the context of the MABP approach proceeding their beliefs that distortions in the balance of payment are essentially a reflection of a disequilibrium status in the domestic money market.

Zecher (1974) evaluated the impact of monetary policy on foreign reserves movements in Australia in the context of the MABP approach for the period 1950-1971 and he estimated two equations; the reserve flow equation and the demand for money equation. His findings revealed that the reserve flows were consistent with the propositions of the monetary approach since the growth in the income level and the price level is associated with foreign reserves inflows and the growth in interest rate and the supply of money is associated with foreign reserves losses. Also, he found that when the demand for money grows faster than money supply, foreign reserves inflows will take place. Finally, the results showed a weak effect of interest rate on the foreign reserves but it confirmed the negative relation implied by the theory. He concluded that the reserve inflow could have been reversed by a more expansionary monetary policy.

Wilford and Wilford (1978) examined the MABP approach in Honduras. The study was conducted in two stages; in the first stage they used annual data from 1950 to 1974, and in the second stage they used quarterly data from the fourth quarter of 1966 through the fourth quarter of 1974. The results in the first stage conformed closely to the expectations of the theory. The reserve flow equation showed that a 1% increase in domestically created money, *ceteris paribus*, will generate approximately 1% loss in foreign reserves. In the second stage, the results also supported the expectations of the theory. Based on their empirical results, they suggested that if the Central Bank of Honduras desires to maintain a favorable balance of payment position, it should keep the rate of growth in domestic credit and the money multiplier at a rate equal to, or slightly less than, the internal demand for money.

Wilford and Zecher (1979) examined the balance of payments and the monetary policies in Mexico during the fixed exchange rate period 1955-1975. Their empirical results of testing the reserve-flow equation showed that the monetary approach can be used in analyzing policies since the estimated coefficient came as expected. They pointed out that increasing fiscal deficits, partially due to an income inelastic revenue structure, led to an excessive expansion of domestic credit and finally foreign reserves losses. The results also revealed how the consistency of Mexican monetary policy with world economic performance during the fifties and sixties led to a stable growth in foreign reserves and in turn the maintenance of a fixed exchange rate.

Leon (1988) employed annual Jamaican data for the period 1950-1972 to estimate the relationship between domestic credit and foreign reserves flows using both the reserve-flow equation and sterilization formulations in both single equation and simultaneous equation contexts. The results confirmed the priori predictions of the monetary approach. Most importantly, the broad definition of money indicated that an increase in the money supply will lead to an outflow of foreign reserves. Besides, changes in foreign reserves were sterilized by the monetary authorities.

Dabbagh & Al-Nagdawi (1994) evaluated the suggestion made by the monetary approach that sources of monetary expansion and influences on domestic demand for money exert a significant impact on the external balance in Israel for the period 1960-1990. Using the standard reserve-flow equation, the empirical results revealed that the estimated coefficients of the domestic price level, domestic interest rate, domestic income, and the domestic credit, came in consonance with the theory. These results implied that when domestic credit expansion is taken as independent of the

quantity of money demanded; this will certainly lead to foreign reserves losses.

Hamdan (1997) tried to empirically test whether foreign reserve movements in the case of Oman could be explained by the long-run model of MABP approach and the reserve flow equation. The empirical results showed that the long-run model of monetary approach explains very well the movement of foreign assets of the banking system in Oman. The results also revealed that excessive domestic credit is undesirable.

Howard & Mamingi (2002) examined the MABP approach in Barbados, a small-developed country with fixed exchange rate regime, for the period 1973-1998. They used the standard reserve-flow equation and the ECM. Their empirical results revealed implications for monetary policy since all the explanatory variables confirmed the expectations of the monetary approach. The results showed that extensive credit expansion leads to foreign reserves outflows and balance of payments' distortions.

Chaudhary & Shabbir (2004) examined the impact of monetary variables on the balance of payments of Pakistan in the context of the monetary approach for the period 1965-1999. They estimated the standard reserve-flow equation and used the broad definition of money supply ($M_2$) as a proxy for domestic monetary policy. Their empirical results showed that the Pakistani balance of payments is a monetary phenomenon since the estimated coefficients generated the expected signs; where an increase in the price level and income generates foreign reserves inflows, and on the other hand an increase in the money supply and interest rate generates foreign reserves outflows. Based on these results, they concluded that more control over the money supply and domestic credit is needed to stabilize foreign reserves.

Ali (2011) examined the monetary approach to the Pakistani balance of payments for the period 1990-2008. However, Ali used a modified version of the reserve flow equation which took the following form:

$$BOP=a_1 + a_2 M + a_3 NFA + a_4 INF + a_5 EXGRATE + a_6 INT + a_7 DCRE$$

Where *BOP* is the balance of payment; *M* is the money supply; *NFA* is the net foreign assets; *INF* is the rate of inflation; *EXGRATE* is the exchange rate, *INT* is the rate of interest, and *DCRE* is the domestic credit. The empirical results showed the existence of significant relationships among net foreign assets, exchange rate, inflation, and the balance of payments, which reflected a strong positive relationship, while reflected a strong negative relationship among money supply, domestic credit and the balance of payments as posited by the monetary approach to the balance of payments. However, the results revealed an insignificant relationship between interest rate and Pakistani balance of payments. The results also showed that the Pakistani balance of payments is not purely a monetary phenomenon as the monetary approach suggests. Therefore, distortions in the balance of payments cannot be corrected only through monetary actions by the Central Bank.

Regarding Jordan, only one study is found and conducted by Shamia (1989). He analyzed the Jordanian balance of payments within the monetary approach during the period 1968-1986. He employed the reserve flow equation. The empirical results confirmed that the behavior of foreign reserve flow was in line with the propositions of the monetary approach. Using annual data, he found that a rise in the domestic component of money supply by 1% will generate a 0.57% decline in foreign reserves. Besides, an increase in domestic price level and domestic income by 1% will generate 0.31% and 0.76% increase in foreign reserves respectively, while an increase in domestic interest rate by 1% will generate a decline in foreign reserves by 0.66%. The study concluded that, in order to correct for balance of

payments, the CBJ should control domestic credit expansion.

**4. Variables' Definitions**

This paper employs the MABP approach and the reserve-flow equation to explain and estimate the long-run relationship between the monetary policy and foreign reserves in Jordan during the period (1980-2012). As will be seen later, the balance of payments equation under the monetary approach (the reserve-flow equation) is derived given a closed system assumption where money demand equals supply of money. As a result of the mathematical derivation process, the dependent variable will be the level of foreign reserves as a proxy of the balance of payments and the explanatory variables will be the basic determinants of the money demand plus a proxy variable for domestic monetary policy. According to the monetary approach, the demand for money is essentially influenced by the interest rate, GDP, and the price level (Jager, 1978). Hence, one could enter other explanatory variables into the reserve-flow equation as determinants of the demand for money in consonance with any theory regarding the demand for money (Chaudhary & Shabbir, 2004). This study follows the standard reserve flow equation of the monetary approach in its choice of the variables that determine the demand for money. Therefore, interest rate, price level, and GDP are used in this study as the basic determinants of the demand for money along with the broad definition of money, $M_2$, as a proxy of the domestic monetary policy and foreign reserves as a proxy of the balance of payments status. These variables can be explained as follows:

**4.1 The balance of payments and foreign reserves**

The balance of payments consists of two major head accounts; the current account and the capital account. Under the monetary approach, the amount of foreign reserves is used as a proxy for the balance of payments since the official reserve transactions are equal to the balance of payments (Dornbusch et al., 2008). Any increase in official foreign exchange reserves holdings causes an improvement in balance of payments.

**4.2 Monetary policy**

Monetary policy refers to a combination of measures designed to regulate the value, supply and cost of money in an economy in consonance with the expected level of economic activity (Imoisi et al., 2013). The monetary policy could be expansionary or contractionary. An expansionary monetary policy takes place when the central bank buys bonds in exchange for money, lowers the discount rate, or lowers the required reserve ratio, as a result, the amount of money in the domestic market will expand. On the other hand, a contractionary monetary policy attempts to restrict the amount of money in the economy through selling bonds, increasing the discount rate, or increasing the required reserve ratio. This study uses the broad definition of money, $M_2$, as a proxy for the domestic money supply.

**4.3 Determinants of the demand for money**

The major factors that might affect money demand are: firstly; domestic price level represented by the consumer price index (CPI). Secondly; Gross Domestic Product (GDP) (Dornbusch et al., 2008). And finally; domestic interest rate expressed in terms of an annual percentage rate (APR) (Jhingan, 2004).

**5. Descriptive Analysis**

Jordan's economy is a small-open economy with scarce natural resources. Exports of phosphate, potash, fertilizers, along with tourism income, foreign grants, and workers' remittances, constitute the primary and most important resources for obtaining foreign reserves.

The Jordanian balance of payments clarifies the general characteristics of the national economy and its performance level. The Jordanian balance of payments is

distinguished by the feature of a chronic trade balance deficit which is normally a measure of foreign reserves outflow and balance of payments fluctuations. This deficit had an upward trend over the targeted period, where the trade balance was estimated to be around JD (-543.3) million in 1980, and ended up to be around JD (-7448.8) million in 2012. This increasing trend in trade deficit might be due to the increasing gap between exports and imports, especially after Jordan's accession to the World Trade Organization (WTO) in 2000. On the other hand, the Jordanian foreign reserves had witnessed a fluctuating trend over the same period, where these reserves started to be around JD 342.5 million in 1980 and ended up to be around JD 4690.8 million in 2012. In 1988, these reserves sharply jumped down to reach the lowest level (JD 152.5 million) since 1980, which led to the exchange rate devaluation of the JD against the U.S. dollar. Also, these reserves decreased during the period 1993-1996 due to the decline in foreign grants along with an increase in external payments to settle imports' payments and to serve foreign debt payments. In general, these reserves had a gradually increasing trend over the period 1988-2011. In year 2012, these reserves jumped down by an around 37% compared to year 2011 as a result of some political and technical setbacks, Egypt gas supplies decreased which puts Jordan on the track towards an "energy crisis", which in turns led to an increase in the Jordan's payments for energy imports.

Regarding the monetary policy, which is undertaken by the CBJ aims to provide the proper volume of domestic liquidity in consonance with the real economic activities in the country. Once the proper volume of domestic liquidity is effectively reached, monetary stability is achieved and economic growth is promoted.

Monetary policy management in Jordan can be divided into two stages; the first stage, which has the feature of direct intervention, extended since the establishment of the CBJ in 1964 until the financial and economic crisis in the late 1980s. The second stage started from 1990 and has the feature of indirect intervention. In the first stage, the CBJ resorted to use the traditional monetary policy tools by changing the discount rate and the required reserve ratio in an attempt to affect domestic liquidity and it also resorted to the direct intervention techniques to determine the size, cost, and direction of credit. In addition to that, the CBJ played an important role in financing government budget deficit. Despite the success of monetary policy in achieving many of its objectives in that stage, it produced several negative effects such as some distortions in the banking system and inefficient resources allocation. However, the economic and financial crisis in the late 1980s has deepened these distortions. And in the second stage and as a result of the economic and financial crisis previously mentioned, the government began, in collaboration with World Bank and International Monetary Fund (IMF), to apply a comprehensive economic reform program which included all economic sectors in the Kingdom. One of the most distinct features of the economic reform program in the monetary and banking sector is the shift toward market sources in managing the monetary policy through interest rate liberalization.

The expansionary monetary policy as measured by the broad definition of money, $M_2$, continued to rise during the period of study at varying growth rates. Over this period, the average growth rate of money supply ($M_2$) is estimated to be around (10%).

**6. Econometric Analysis**

This part follows a certain sequence, starting from specifying the economic model to be tested, presenting a brief theoretical framework of the statistical and econometric techniques to be used, followed by introducing the data sources and the functional form, and finally explaining the empirical results of the estimation procedure.

**6.1 Model Specification**

According to the MABP approach, which states that the balance-of-payments is essentially a monetary phenomenon, and under fixed exchange rate regime, changes in foreign reserves (which is considered by the theory as a proxy of the status of the balance of payment) are seen as a result of excess supply of or excess demand for money. Therefore, the monetary approach to the balance of payments can be presented in the following general form: $BOP = f(S, M_S)$ ……(4)

Where BOP denotes the balance-of-payments; S represents the vector of variables that determine the demand for money, and $M_S$ stands for the money supply.

Leon (1988) asserted in his article that "tests of the predictive power of the monetary approach (MABP) tend to consider the predictions of the effects of the money supply and the determinants of the money demand on the balance of payments" (p.5).

It should be mentioned here that different forms of equations were adopted by different empirical studies around the world to test for the predictions of the monetary approach to the balance of payments. Following (Howard & Maningi, 2002), the standard and most common form of the monetary approach is simply developed as follows:

$$M_d = P.L(Y, r) \quad (5)$$

$$M_s = m.H \quad (6)$$

$$M_s = m\,(R+D) \quad (7)$$

$$M_d = M_s \quad (8)$$

$$P.L(Y, r) = m\,(R+D) \quad (9)$$

Where *P* is the price level; *Y* is the domestic income; *r* is the domestic interest rate; *m* is the money multiplier, *R* stands for foreign reserves; *D* is the domestic credit; $M_s$ is the money supply, *H* is the monetary base which equals *(D+R)*, and $M_d$ is the money demand.

Differentiation of equation (9) gives [1]:

$$\frac{R}{R+D}\dot{R} = a_1\dot{P} + a_2\dot{Y} + a_3\dot{r} + a_4\dot{m} + a_5\frac{R}{R+D}\dot{D} + U \quad (10)$$

Equation (10) is called the "reserve-flow" equation and it represents the standard form to test for the predictions of the monetary approach theory. This form was adopted in several empirical studies such as (Zecher, 1974); (Wilford & Wilford, 1978); (Wilford & Zecher, 1979); (Leon, 1988); (Bilquees, 1989); (Shamia, 1989); (Dabbagh & Al-Ngdawi, 1994); (Hamdan, 1997); (Howard & Mamingi, 2002). However, many researchers used a number of alternative forms to test for the predictions of the monetary approach as they are indicated below (Howard & Mamingi, 2002):

$$\Delta\log R = a_1\Delta\log P + a_2\Delta\log Y + a_3\Delta\log r + a_4\Delta\log m + a_5\Delta\log D \quad (11)$$

$$\frac{\Delta R}{R+D} = a_1\frac{\Delta P}{P} + a_2\frac{\Delta Y}{Y} + a_3\frac{\Delta r}{r} + a_4\frac{\Delta m}{m} + a_5\frac{\Delta D}{R+D} \quad (12)$$

Among the other forms, (Borts & Hanson, 1979) developed an extended version of the monetary approach (MABP) is the linear form of the estimated model written as follows:

$$R = a_1P_y + a_2P_x + a_3M + a_4d \quad (13)$$

Where *R* stands for foreign reserves; $P_y$ stands for the price of home goods; $P_x$ stands for the price of exports, *M* is the money supply, and *d* stands for government deficit.

Ali (2011) used an alternative formulation to test for the predictions of the monetary approach as follows:

$$BOP = a_1+a_2M+a_3NFA+a_4INF+a_5EXGRATE+a_6INT+a_7DCRE \quad (14)$$

Where *BOP* is the balance of payment; *M* is the money supply; *NFA* is the net foreign assets; *INF* is the

rate of inflation; *EXGRATE* is the exchange rate; *INT* is the rate of interest and *DCRE* is the domestic credit.

In this paper, since the purpose is to investigate the direct impact of monetary policy on foreign reserves, the model will be constructed in the context of MABP approach and in the context of the reserve-flow equation. Since the dependent and explanatory variables of the reserve-flow equation could be presented in levels, changes, or rates of growth (Leon, 1988), the model that is adopted in this study will take the following form:

$$R = f(P, GDP, r, M_2) \quad (15)$$

Where;

R: is the amount of foreign reserves held by the CBJ, which is used as a proxy for the balance of payments.

P, GDP and r represent the determinants for the money demand, where:

P: is the ratio of domestic consumer price index to foreign, (USA), consumer price index: $P=CPI^{JOR}/CPI^{US}$ (base year is 2006=100).

GDP: is the gross domestic product.

r: is the weighted average interest rate on saving deposits as a proxy for domestic nominal interest rate.

$M_2$: is the broad definition of the money supply as a proxy variable for monetary policy.

More specifically:

$$R_t = \alpha_0 + \alpha_1 P_t + \alpha_2 r_t + \alpha_3 GDP_t + \alpha_4 M_{2t} + Ut \quad (16)$$

The parameters are expected to have the following signs: $\alpha_1>0$, $\alpha_2<0$, $\alpha_3>0$, $\alpha_4<0$

$\alpha_1$: is expected to have a positive sign, i.e. $\alpha_1>0$, implying that the increase in the domestic price level reduce the real value of money and cause people to hoard in order to restore their actual real money. This rise in money demand relative to money supply will ultimately improve foreign reserves and the balance of payments (Shamia, 1989).

Chaudhary & Shabbir (2004) have also pointed out that the increase in the domestic price level, relative to foreign price level, will improve the international reserve position because of devaluation. Devaluation is treated as a monetary phenomenon, since devaluation raises the domestic price level leading to a reduction in domestic expenditures on goods and services via reduction in residents' purchasing power. This leads to an increase in the production of exportable goods. As a result, the level of income and employment improves leading to an increase in demand for nominal money balances over money supply. If the domestic money supply is constant, the increased money demand generates foreign exchange reserves inflows.

$\alpha_2$: interest rate is supposed to have a negative impact on foreign reserves, i.e. $\alpha_2<0$. An increase in the interest rate is associated with foreign reserves outflows. Other things being the same, an increase in the interest rate increases the cost of holding money and thus depresses the demand for money, leading to an excess supply of money which will result in foreign reserves losses (Shamia, 1989; Chaudhary & Shabbir, 2004). The MABP views domestic interest rate as a proxy for the world interest rates since it is expected for both interest rates, domestic and foreign, to move in the same direction (Zecher, 1974).

$\alpha_3$: is expected to generate a positive value, i.e. $\alpha_3>0$. In particular, a 1% increase in income brings $\alpha_3$% increase in money demand and consequently an increase in foreign reserves inflow. The rise in the level of real income might lead to an increase in the exportable goods (Shamia, 1989; Chaudhary& Shabbir, 2004).

$\alpha_4$: is the most important parameter in the model since it captures the essence of the MABP and it is expected to have a negative sign, i.e. $\alpha_4<0$. When money supply rises above money demand, the result will be disequilibrium in money market. This increase in the money supply over the money demand will improve economy through stimulation of aggregate demand (AD). In this particular case, people will get rid of the excess money supply by importing more foreign goods and services or investing abroad and this will ultimately

worsen the balance of payments through losses in foreign reserves (Zecher, 1974).

## 6.2 Methodology

A brief presentation of the theoretical framework of the statistical and econometric techniques to be used in the empirical estimation part of this study is presented below:

### 6.2.1 Time series and data properties

Granger and Newbold (1974) showed that if a regression equation relating economic variables that behave as random walks (non-stationary variables) is found to have strongly auto-correlated errors, which is represented by a non significant Durbin-Watson value, it can be concluded that the equation is miss-specified (or the results of the regression are spurious), whatever the value of $R^2$ observed.

Nelson and Plosser (1982) showed that running an OLS regression method on equations with variables that are not stationary at level, i.e. I(0), is not adequate since it can generate high values of *F* and *t* tests as well as a high value of $R^2$.

To avoid getting spurious results when using different econometric models that work under the assumption of stationarity, and since choosing the appropriate econometric model must be built, in the first place, on knowing the order of integration of the variables, testing for the existence of unit root problem becomes a necessity and should be done before going through the estimation process.

Among the most common tests used to investigate the stationarity of the series are: Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests.

### 6.2.2 Cointegration test

The ARDL approach to cointegration has been introduced in several papers by Pesaran et al. (1996), Pesaran and Pesaran (1997), and Pesaran et al. (2001) trying to test for the existence of a long-run relationship between variables irrespective of whether the regressors are purely I(0), purely I(1), or mixed. Amongst the other advantages, the ARDL estimates the short-run and the long-run coefficients of the model simultaneously using a single reduced form equation. Another advantage is that this model takes sufficient number of lags to capture the data generating process (Shrestha & Chowdhury, 2005). Finally, the ARDL approach is more appropriate for estimation in small samples studies (Trivedi & Behera, 2012).

This study employs the ARDL approach to cointegration to test for the impact of monetary policy on foreign reserves in Jordan during the period (1980-2012). The ARDL approach will be conducted in three stages. In the first stage, the test of co-integration will be conducted for the model of this study in the context of unrestricted error correction model (UECM) using the following formula (Pesaran et al., 2001):

$$\Delta y_t = \alpha + \sum_{i=1}^{m} \beta_i \, \Delta y_{t-i} + \sum_{j=0}^{n} \mu_j \Delta x_{t-j} + \emptyset y_{t-1} + þ x_{t-1} + u_t \qquad (17)$$

where $\Delta y_t$ is the dependent variable; $\Delta x_t$ is a vector of independent variables; α, β, μ, Ø, þ are parameters; Δ is the first difference operator; m, n are lagged values for the first differenced variables; and $u_t$ is the error term.

The null hypothesis in the last equation is:

$H_0$: Ø=þ=0 no cointegration among the variables against the alternative hypothesis:

$H_1$: Ø≠þ≠0variables are cointegrated

Equation (17) is estimated first in a restricted form by excluding the level form of the lagged variables and then tested for the significance of the level-form of the lagged variables through a variable addition test (F-test) (Hossain, 2011). Once the last equation has been estimated, the estimated *F*-statistic can then be used to decide whether the underlying variables are

cointegrated. The F-statistic is compared with the critical bounds proposed by Pesaran, et al. (2001) where two critical bounds are given:

- Lower Critical Bounds (LCB) which assume that the variables are I (0).
- Upper Critical Bounds (UCB) which assume that the variables are I (1).

If F-statistic falls above the (UCB), then the null hypothesis is rejected, meaning that the variables are cointegrated, but if F-statistic falls below the (LCB), then the null hypothesis is accepted, meaning that the variables are not cointegrated; and if F-statistic falls between the (UCB) and the (LCB), then the results are inconclusive.

In the case that the variables are co-integrated, the next step will be the estimation of the long-run equation which takes the following form (Trivedi & Behera, 2012):

$$y_t = \Omega + \sum_{i=1}^{p} £_i y_{t-i} + \sum_{j=0}^{q} k_j x_{t-j} + v_t \quad (18)$$

Where Ω, £, k are parameters; *p,q* are lagged values; and *v* is the error term.

The ARDL method estimates $(c+1)^n$ number of regressions in order to obtain the optimal lag length for each variable, where *c* is the maximum number of lag to be used and *n* is the number of variables in the equation. The model can be selected using the model selection criteria like Schwartz-Bayesian Criteria (SBC) (Alam, 2012).

The final step will be getting the short-run dynamics that can be derived by constructing an error correction model (ECM) which takes the form (Duasa, 2007):

$$\Delta y_t = \mu + \sum_{i=1}^{r} \alpha_i \Delta y_{t-i} + \sum_{j=0}^{s} þ_j \Delta x_{t-j} + \beta ECM_{t-1} + u_t \quad (19)$$

Where ECM is the error correction term, defined as:

$$ECM_t = y_t - \alpha_1 - \sum_{i=1}^{p} \beta_i y_{t-i} - \sum_{j=0}^{q} þ_j x_{t-j} \quad (20)$$

All coefficients of the short-run equation are coefficients relating to the short-run dynamics of the model's convergence to equilibrium and β represents the speed of adjustment (Duasa, 2007).

**6.2.3 Diagnostic Tests**

Since time series data might suffer from structural changes due to changes in governmental policy and critical social events and since model stability is an important assumption for prediction and for making economic inferences, testing for the stability of the regression relationship (parameters stability) becomes a necessary step that must be done in every research project. The most popular test of parameters stability is the Cumulative Sum of Squares of Recursive Residuals (CUSUMQ).

**6.2.4 Data sources and functional form**

This paper uses time series data of Jordan covering the period 1980-2012 to investigate the impact of monetary policy on foreign reserves. The secondary data on the official foreign reserves (FR), domestic consumer price index ($CPI^{JO}$), the weighted average interest rate on saving deposits (r), gross domestic product (GDP), and the broad definition of money ($M_2$) were obtained from the bulletins of the CBJ, an online database. The data on the U.S. consumer price index ($CPI^{US}$) were obtained from the U.S. Bureau of Labor Statistic, an online database.

**6.2.5 Functional Form**

The functional form that will be used in the estimation process in this paper takes the following semi-log form:

$$\ln FR_t = \alpha_0 + \alpha_1 P_t + \alpha_2 r_t + \alpha_3 \ln GDP_t + \alpha_4 \ln M_{2t} + u_t \quad (21)$$

Where all the variables, except the ratio of domestic to foreign consumer price index, P, and domestic interest

rate, are in natural logarithmic form.

## 7. Empirical Results

### 7.1 Unit root test

This study employs two tests of stationarity of a time series; ADF and PP. The results of these tests are given in appendices 1 and 2.

According to the results of the ADF test presented in appendix 1, all the variables are not stationary at their levels since the absolute values of the ADF statistic were less the tabulated values at 5% or 10% significance level. However, after taking the first difference, the results shows that each variable becomes stationary at 5% or 10% significance level. The results of the PP test in appendix 2 are completely consistent with the results of the (ADF) test. Based on that, all the variables of this study are said to be integrated of degree one; I(1) at 5% and 10% levels of significance.

### 7.2 Cointegration test

After determining the order of integration of each variable and in an attempt to investigate the existence of a long-run equilibrium relationship among these variables, this study employs the autoregressive distributed lag (ARDL) bounds testing approach proposed by Pesaran et al. (2001).

The ARDL model estimation procedure goes through three steps; the first step will be to investigate the existence of a long-run relationship among the variables in equation 21 above. Given that a long-run relationship exists, the next two steps will be to estimate the long-run and the short-run coefficients.

As mentioned above, the estimation procedure using ARDL starts with investigating the existence of a long-run relationship among the variables of equation 25, and for this purpose the full ARDL model for bounds testing of cointegration can be formulated in the context of the unrestricted error correction model (UECM) as follows:

$$\Delta \ln FR_t = \beta_0 + \sum_{i=1}^{p} \alpha_{1i} \Delta \ln FR_{t-i} + \sum_{j=0}^{q} \alpha_{2j} \Delta P_{t-j} + \sum_{k=0}^{z} \alpha_{3k} \Delta r_{t-k} + \sum_{l=0}^{s} \alpha_{4l} \Delta \ln GDP_{t-l} + \sum_{h=0}^{w} \alpha_{5h} \Delta \ln M_{2_{t-h}} + \beta_1 \ln FR_{t-1} + \beta_2 P_{t-1} + \beta_3 r_{t-1} + \beta_4 \ln GDP_{t-1} + \beta_5 \ln M_{2_{t-1}} + u_t \quad (22)$$

$$\Delta \ln P_t = \beta_0 + \sum_{i=1}^{p} \alpha_{1i} \Delta \ln P_{t-i} + \sum_{j=0}^{q} \alpha_{2j} \Delta FR_{t-j} + \sum_{k=0}^{z} \alpha_{3k} \Delta r_{t-k} + \sum_{l=0}^{s} \alpha_{4l} \Delta \ln GDP_{t-l} + \sum_{h=0}^{w} \alpha_{5h} \Delta \ln M_{2_{t-h}} + \beta_1 \ln P_{t-1} + \beta_2 FR_{t-1} + \beta_3 r_{t-1} + \beta_4 \ln GDP_{t-1} + \beta_5 \ln M^2{}_{t-1} + u_t \quad (23)$$

$$\Delta \ln r_t = \beta_0 + \sum_{i=1}^{p} \alpha_{1i} \Delta \ln r_{t-i} + \sum_{j=0}^{q} \alpha_{2j} \Delta P_{t-j} + \sum_{k=0}^{z} \alpha_{3k} \Delta FR_{t-k} + \sum_{l=0}^{s} \alpha_{4l} \Delta \ln GDP_{t-l} + \sum_{h=0}^{w} \alpha_{5h} \Delta \ln M_{2_{t-h}} + \beta_1 \ln r_{t-1} + \beta_2 P_{t-1} + \beta_3 FR_{t-1} + \beta_4 \ln GDP_{t-1} + \beta_5 \ln M_{2_{t-1}} + u_t \quad (24)$$

$$\Delta \ln GDP_t = \beta_0 + \sum_{i=1}^{p} \alpha_{1i} \Delta \ln GDP_{t-i} + \sum_{j=0}^{q} \alpha_{2j} \Delta P_{t-j} + \sum_{k=0}^{z} \alpha_{3k} \Delta r_{t-k} + \sum_{l=0}^{s} \alpha_{4l} \Delta \ln FR_{t-l} + \sum_{h=0}^{w} \alpha_{5h} \Delta \ln M_{2_{t-h}} + \beta_1 \ln GDP_{t-1} + \beta_2 P_{t-1} + \beta_3 r_{t-1} + \beta_4 \ln FR_{t-1} + \beta_5 \ln M_{2_{t-1}} + u_t \quad (25)$$

$$\Delta \ln M_{2_t} = \beta_0 + \sum_{i=1}^{p} \alpha_{1i} \Delta \ln M_{2_{t-i}} + \sum_{j=0}^{q} \alpha_{2j} \Delta P_{t-j} + \sum_{k=0}^{z} \alpha_{3k} \Delta r_{t-k} + \sum_{l=0}^{s} \alpha_{4l} \Delta \ln GDP_{t-l} + \sum_{h=0}^{w} \alpha_{5h} \Delta \ln FR_{t-h} + \beta_1 \ln M_{2t-1} + \beta_2 P_{t-1} + \beta_3 r_{t-1} + \beta_4 \ln GDP_{t-1} + \beta_5 \ln FR_{t-1} + u_t \quad (26)$$

Where $\alpha_1$, $\alpha_2$, $\alpha_3$, $\alpha_4$, $\alpha_5$ are the coefficients of the short-run relationship; $\beta_1$, $\beta_2$, $\beta_3$, $\beta_4$, $\beta_5$ are the

coefficients of the long-run relationship; Δ: is the first difference operator; $\beta_0$ is constant; *p,q, z, s, w* are lagged values for the variables in the first difference form; and $u_t$ is the error term.

The null hypothesis is: $H_0$: $\beta_1=\beta_2=\beta_3=\beta_4=\beta_5=0$ the variables are not cointegrated against the alternative hypothesis: $H_1$: $\beta_1\neq\beta_2\neq\beta_3\neq\beta_4\neq\beta_5\neq0$ the variables are cointegrated.

Equations (22) through (26) above, are estimated first in a restricted form by excluding the level-form of the lagged variables and then tested for the significance of the level-form of the lagged variables through a variable addition test (F-test) (Hossain, 2011). The F-statistic obtained from the variable addition test is then compared to two set of critical values introduced by Pesaran et al. (2001); values of LCB and UCB and the decision of whether the underlying variables are cointegrated is made based on the above-mentioned strategy. The results of estimating equations (22) through (26) are given in appendix 3.

Appendix 3 shows the results of the bound test of the long-run relationship among LNFR, P, r, LNGDP, and $LNM_2$ in one particular scenario suggested by Pesaran et al. (2001); that is with constant and without time trend. In the model where LNFR is the dependent variable, the F-statistic obtained from the variable addition test was 5.6637, which is greater than the UCB at all levels of significance, meaning that the null hypothesis of no cointegration among the variables is rejected and the alternative hypothesis cannot be rejected; that is the variables of the model are co-integrated. In addition to that, in models where P, LNGDP, and $LNM_2$ are the dependent variables, the F-statistics obtained from the variable addition test were 11.1101, 9.9056, and 7.0460 respectively and they were greater than the upper critical bound at all level of significant meaning that they are cointegrated. These results confirm that the variables of this study have a long-run relationship. However, in the model were the interest rate, r, is the dependent variable, the F-statistic was 1.2702, which is below the lower bound at all levels of significance, meaning that the variables in this particular model are not cointegrated.

In the second step, after providing the evidence that the variables are cointegrated, the conditional ARDL (*p, q, z, s, w*) long-run model for $LNFR_t$, the basic model in this study, can be estimated as follows:

$$\ln FR_t = \beta_0 + \sum_{i=1}^{p} \alpha_{1i} \ln FR_{t-i} + \sum_{j=0}^{q} \alpha_{2j} P_{t-j} + \sum_{k=0}^{z} \alpha_{3k} r_{t-k} + \sum_{l=0}^{s} \alpha_{4l} \ln GDP_{t-l} + \sum_{h=0}^{w} \alpha_{5h} \ln M_{2_{t-h}} + u_t \quad (27)$$

This involves selecting the optimal orders of lags for ARDL (*p, q, z, s, w*) model using Schwarz Bayesian Criterion (SBC) (Trivedi & Behera, 2012).

Appendix 4 reports the estimated coefficients of the long-run relationships when $LNFR_t$ is the dependent variable. To capture more variations in the data, 4 lags are selected as the maximum lag length. The total number of regressions estimated following the ARDL method is $(4+1)^5=3125$. Based on Schwarz Bayesian Criterion (SBC), the optimal ARDL model selected by MICROFIT is ARDL (4, 4, 2, 4, 4).

The results reported in appendix 4 shows that all signs of the variables came as expected and confirm the proposition of the MABP approach. The estimated coefficient of the broad definition of money supply ($LNM_2$) has a statistically significant negative impact on foreign reserves, which is in line with theoretical argument of the MABP approach. This would imply that expansionary monetary policies, conducted by the CBJ, would lead to losses in foreign reserves, i.e. worsen the balance of payments, if the increase in the money supply is not met by an equal increase in the demand for money

(Zecher, 1974). One of the most important real-world cases that might explain such a finding is: in a country like Jordan, the government often fails to collect enough revenues to meet its requirement and ends up with government budget deficit. In this particular case, the government might resort to the Central Bank to finance such a deficit by enforcing the Central Bank to expand domestic credit, which in turn represents an important determinant of the broad definition of money $M_2$ (Chaudhary & Shabbir, 2004 ).

Similarly, the signs of the long-run coefficients of the determinants of the money demand came as expected and in line with the theoretical argument of the MABP approach. The ratio of the domestic price index to foreign price index, P, generated a statistically significant positive sign (at 10%) implying that an increase in this ratio reduces real money balances and, other things equal, this leads to a foreign reserve inflow just sufficient to restore real money balances to their previous level (Zecher, 1974). Also, the nominal domestic income, LNGDP, generated a statistically significant positive sign and implying a positive impact on foreign reserves since increases in income leads to an increase in the production of goods available for exportation which improves the external balance (Dabbagh & Al-Nagdawi, 1994; Chaudhary & Shabbir, 2004). Finally, the domestic interest rate, r, generated a statistically significant sign implying a negative impact on foreign reserves since the increase in the domestic interest rate depresses the demand for money. To sum up, the correct and statistically significant signs of the ratio of price levels, nominal domestic income, and domestic interest rate indicate that if it happens and the increase in the money demand is not met by an equal increase in the money supply by the CBJ, this disequilibrium situation in the domestic money market will be eliminated by net sales of domestic goods and services or by disinvestment abroad resulting in foreign reserves inflows (Hamdan, 1997).

From the summary statistics of the R-Squared, R-Bar-Squared, and the F-statistic, it is concluded that the selected ARDL model has a good fit. Therefore, appendix 4 can be summarized in the following long-run equation:

$$LNFR = -3.7216 + 2.6819\,P - 0.23376\,r + 4.6338\,LNGDP - 3.6652\,LNM_2 \quad (28)$$
$$(0.049)\quad (0.078)\quad (0.005)\quad (0.001)\quad (0.005)$$

Finally, the short-run dynamic parameters, by estimating an error correction model (ECM) associated with the long-run estimates, can be estimated using the following specification (Trivedi & Behera, 2012) and (Duasa, 2007):

$$\Delta \ln FR_t = \alpha_0 + \sum_{i=1}^{p} \alpha_{1i}\, \Delta \ln FR_{t-i} + \sum_{j=0}^{q} \alpha_{2j} \Delta P_{t-j} + \sum_{k=0}^{z} \alpha_{3k}\, \Delta r_{t-k} + \sum_{l=0}^{s} \alpha_{4l} \Delta \ln GDP_{t-l} + \sum_{h=0}^{w} \alpha_{5h} \Delta \ln {M^2}_{t-h} + \Omega ECM_{t-1} + u_t \quad (29)$$

Appendix 5 reports the short-run dynamics. It can be noticed that the error correction model is robust, since most of the short-run coefficients are statistically significant except for: lag two of the first difference of foreign reserves, lag one of the first difference of P, lag three of the first difference of P, and lag zero of the interest rate, which all seem to have no impact on foreign reserves in the short-run. Not much interpretation could be attached to the short-run coefficients since they show the dynamic adjustment of all variables (Dritsakis, 2011). However, the most important coefficient in short-run results of the ARDL model is the coefficient of the error correction term, $ECM_{t-1}$. The highly significance of this term, with a correct negative sign, -3.0299, further confirms the existence of a stable long-run relationship between foreign reserves and its determinants in the model (Alam, 2012). In addition to that, the absolute value of the coefficient of the error correction term, which is equal to 3.0299, implies a very quick adjustment of

foreign reserves back to its long-run equilibrium value following a shock. Therefore, the discrepancy between the long-run equilibrium value and the current value of the foreign reserves is corrected within a fraction of a year (Gharana & Kishor, 2012).

**7.3 Diagnostic Tests**

It can be seen from figure 1 that the plot of CUSUMQ stays within the 5% critical bounds which means that the parameters of the model are stable during the selected period of the study and therefore there is no need to split the period (1980-2012) into sub-periods.

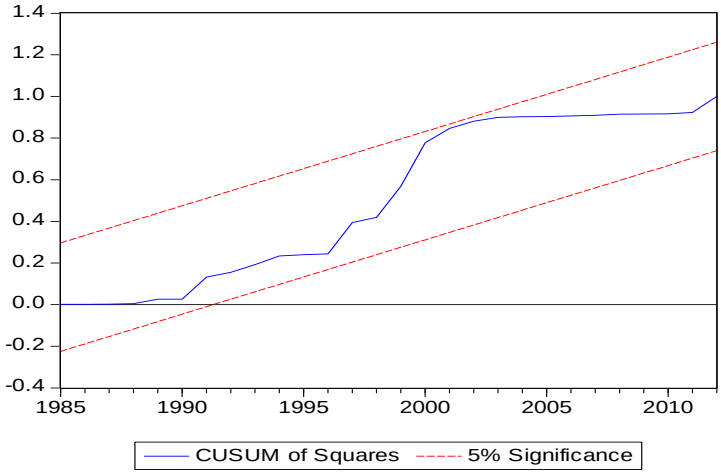


**Figure 1: CUSUM of Squares stability test**

**8. Conclusions and Policy Implications**

The empirical results of investigating the impact of monetary policy on foreign reserves using the ARDL bounds testing approach showed that when foreign reserves is the dependent variable and the broad definition of the money supply along with the determinants of the money demand are the independent variables, the outcome is an evidence of a long-run relationship among these variables at all levels of significance.

The estimated long-run coefficients of the ARDL model came as expected and in line with the theoretical proposition of the MABP approach. The coefficient of the broad definition of money generated a highly significant negative sign implying that expansionary monetary policies would worsen the balance of payments if the Central

Bank carries out such policies irrespective of its adverse effects on the economy. Therefore, this indicates that extensive domestic credit expansion, mainly due to government budget deficit, will ultimately lead to foreign reserves outflows. Similarly, the determinants of the demand for money generated statistically significant effects on foreign reserves in Jordan and the signs came as expected and proposed by the monetary approach. However, the impact of interest rate on foreign reserves was the weakest among the explanatory variables of the model. In addition to that, the results showed that a rise in domestic nominal income and in the ratio of domestic price level to foreign price level, *ceteris paribus*, would generate foreign reserves inflows. As a result, the increase in the domestic price level, the increase in the domestic income, and the decrease in the domestic interest rate will lead to an increase in the demand for money. However, if the increase in the demand for money is not met by an equal increase in money supply

by monetary authorities in Jordan, an inflow of money from abroad will take place to make up the difference. Thus, controlling domestic credit and keeping its growth at a rate equal to, or relatively less than, the domestic demand for money will ultimately result in stable foreign reserves in Jordan.

The short-run dynamics i.e. the error correction model estimated by the ARDL approach showed that the coefficient of the $ECM_{t-1}$ was highly significant with a correct negative sign, which confirms the existence of a stable long-run relationship between foreign reserves and its determinants. In addition to that, the absolute value of the coefficient of the error correction term, which is equal to (-3.0299), implied a very quick adjustment of foreign reserves back to its long-run equilibrium value following a shock. Therefore, the discrepancy between the long-run equilibrium value and the current value of the foreign reserves is corrected within a fraction of a year.

The major policy implication that should be addressed here is that: if the Jordanian Government target is to improve the status of its balance of payments in the long-run, the negative impact of expansionary monetary policy should not be neglected.

**Appendix 1: ADF unit root test results.**

| **Augmented Dickey-Fuller test** | | | | | | |
|---|---|---|---|---|---|---|
| **Variable** | **Tests** | **Level** | | **First difference** | | **Order of integration** |
| | | **Intercept** | **Intercept & trend** | **Intercept** | **Intercept & trend** | |
| LNFR | ADF statistic | -0.665716 | -2.688217 | -5.047884 | -4.952692 | I (1) at 1% level of significance |
| | Critical values | | | | | |
| | 1% | -3.653730 | -4.273277 | -3.661661 | -4.284580 | |
| | 5% | -2.957110 | -3.557759 | -2.960411 | -3.562882 | |
| | 10% | -2.617434 | -3.212361 | -2.619160 | -3.215267 | |
| P | ADF statistic | -0.079156 | -2.524066 | -3.905245 | -3.845175 | I (1) at 5% level of significance |
| r | ADF statistic | -0.210223 | -1.729972 | -3.651421 | -3.632739 | I (1) at 5% level of significance |
| LNGDP | ADF statistic | 0.315002 | -2.659454 | -2.717466 | -3.032115 | I (1) at 10% level of significance |
| $LNM^2$ | ADF statistic | -1.488728 | -2.529023 | -3.803708 | -3.781485 | I (1) at 5% level of significance |

**Appendix 2: PP unit root test results**

| Phillips-Perron test | | | | | | |
|---|---|---|---|---|---|---|
| **Variables** | **Tests** | **Level** | | **First difference** | | **Order of integration** |
| | | **Intercept** | **Intercept & trend** | **Intercept** | **Intercept & trend** | |
| LNFR | PP statistic | -0.494487 | -2.425559 | -5.327972 | -5.449386 | I(1) at 1% level of significance |
| | Critical values | | | | | |
| | 1% | -3.653730 | -4.273277 | -3.661661 | -4.284580 | |
| | 5% | -2.957110 | -3.557759 | -2.960411 | -3.562882 | |
| | 10% | -2.617434 | -3.212361 | -2.619160 | -3.215267 | |
| P | PP statistic | -0.079156 | -1.808746 | -3.785017 | -3.774162 | I (1) at 5% level of significance |
| r | PP statistic | -0.210223 | -2.363932 | -3.579456 | -3.560657 | I (1) at 10% level of significance |
| LNGDP | PP statistic | 0.187922 | -1.701417 | -4.883178 | -5.003346 | I (1) at 1% level of significance |
| $LNM_2$ | PP statistic | -1.261436 | -2.688148 | -3.803708 | -3.781485 | I (1) at 5% level of significance |

**Appendix 3: Results of Bounds Test for Cointegration**

| **K=4** | **Variable Addition test F-statistic** | |
|---|---|---|
| $LNFR_t=f(P_t, r_t, LNGDP_t, LNM_{2t})$ | 5.6637 [0.040 ] | |
| Significance level | Critical values bounds* | |
| | Lower Critical Bounds (LCB) I(0) | Upper Critical Bounds (UCB) I(1) |
| 1% | 3.74 | 5.06 |
| 5% | 2.86 | 4.01 |
| 10% | 2.45 | 3.52 |
| $P_t=f(FR_t,r_t,LNGDP_t,LNM_{2t})$ | 11.1101 [0.010 ] | |
| $r_t=f(P_t,FR_t,LNGDP_t,LNM_{2t})$ | 1.2702 [0.400 ] | |
| $LNGDP_t=f(P_t,r_t,LNFR_t,LNM_{2t})$ | 9.9056 [0.012 ] | |
| $LNM_{2t}=f(P_t,r_t,LNGDP_t,LNFR_t)$ | 7.0460 [0.026 ] | |

*Source: Pesaran et al. (2001)

## Appendix 4: Estimated Long-Run Coefficients using ARDL Model ARDL (4, 4, 2, 4, 4) selected based on Schwarz Bayesian Criterion

| Regressor | Coefficient | Standard Error | T-Ratio | Probability |
|---|---|---|---|---|
| P | 2.6819 | 1.2640 | 2.1217 | 0.078* |
| r | -0.23376 | 0.053819 | -4.3434 | 0.005 |
| LNGDP | 4.6338 | 0.73166 | 6.3333 | 0.001 |
| $LNM_2$ | -3.6652 | 0.86463 | -4.2390 | 0.005 |
| INTERCEPT | -3.7216 | 1.5140 | -2.4581 | 0.049 |
| R-Squared: 0.99410 | | | R-Bar-Squared: 0.97246 | |
| S.E. of Regression: 0.20880 | | | F-stat.: 45.9438 [ 0.000 ] | |
| Diagnostic Tests | | | | |
| Test Statistics | LM Version | | F Version | |
| Serial Correlation | CHSQ (1)=10.1246 [0.001] | | F (1,5)=2.6819 [0.162] | |
| Functional Form | CHSQ (1)=8.9286 [0.003] | | F (1,5)=2.2242 [0.196] | |
| Normality | CHSQ (1)=10.8992 [0.004] | | Not applicable | |
| Heteroscedasticity | CHSQ (1)=2.0103 [0.156] | | F (1,27)=2.0111 [0.162] | |

*At 10% level of significance.

## Appendix 5: Error Correction Representation for the Selected ARDL Model ARDL (4, 4, 2, 4, 4) selected based on Schwarz Bayesian Criterion

| Dependent variable is ΔLNFR | | | | |
|---|---|---|---|---|
| **Regressor** | **Coefficient** | **Standard Error** | **T-Ratio** | **Probability** |
| ΔLNFR1 | 1.9916 | 0.56119 | 3.5489 | [ 0.005 ] |
| ΔLNFR2 | 0.58412 | 0.38100 | 1.5331 | [*0.156* ] |
| ΔLNFR3 | -0.54650 | 0.29275 | -1.8668 | [ 0.091 ] |
| ΔP | -18.8593 | 4.7237 | -3.9925 | [ 0.003 ] |
| ΔP1 | -3.9341 | 3.4349 | -1.1453 | [*0.279* ] |
| ΔP2 | -8.3762 | 2.7808 | -3.0121 | [ 0.013 ] |
| ΔP3 | 2.1655 | 2.1224 | 1.0203 | [*0.332* ] |
| Δr | 0.18384 | 0.21597 | 0.85122 | [ *0.415* ] |
| Δr1 | -0.95796 | 0.23174 | -4.1338 | [ 0.002 ] |
| ΔLNGDP | 8.8533 | 3.2761 | 2.7024 | [ 0.022 ] |
| ΔLNGDP1 | -3.1078 | 1.4970 | -2.0761 | [ 0.065 ] |
| ΔLNGDP2 | -6.8305 | 2.4931 | -2.7398 | [ 0.021 ] |
| ΔLNGDP3 | -13.1842 | 2.3852 | -5.5275 | [ 0.000 ] |
| $\Delta LNM_2$ | 9.9519 | 2.3347 | 4.2626 | [ 0.002 ] |
| $\Delta LNM_2 1$ | 7.3492 | 2.8183 | 2.6076 | [ 0.026 ] |
| $\Delta LNM_2 2$ | 22.1392 | 4.5756 | 4.8386 | [ 0.001 ] |
| $\Delta LNM_2 3$ | 14.3546 | 2.9842 | 4.8102 | [ 0.001 ] |
| ΔINTERCEPT | -11.2760 | 4.2974 | -2.6239 | [ 0.025 ] |
| $ECM_{t-1}$ | -3.0299 | 0.79097 | -3.8306 | [ 0.003 ] |
| R-Squared: 0.94415 | | | R-Bar-Squared: 0.73938 | |
| S.E. of Regression: 0.20880 | | | F-stat.: 5.6354 [ 0.004 ] | |

## NOTES

1 Following Bilquees (1989) & Johnson (1972), the reserve-flow equation can be constructed as follows:

$P.L(Y,r) = m(R+D)$. Taking the natural logarithm of both sides, we get:

$\ln P + \ln Y + \ln r = \ln m + \ln(R+D)$. Taking the derivative with respect to time, using dots to denote rates of growth, and solving for the reserve flow equation, we can get:

$\frac{R}{R+D}\dot{R} = a_1\dot{P} + a_2\dot{Y} + a_3\dot{r} + a_4\dot{m} + a_5\frac{R}{R+D}\dot{D} + U$,

Where $\dot{X} = \frac{dlnX}{dt}$ is the growth rate of *X*. Note that the growth rate of (A+B) is (Johnson, 1972): $(\dot{A+B}) = \frac{A}{A+B}\dot{A} + \frac{B}{A+B}\dot{B}$

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# أثر السياسة النقدية على الاحتياطيات الأجنبية: المنهج النقدي لميزان المدفوعات

***علاء عبد الحفيظ البشير [1]*، أحمد إبراهيم ملاوي [2]***

## ملخص

تهدف الدراسة إلى استقصاء آثار السياسة النقدية في المديين القصير والطويل على الاحتياطيات الأجنبية في الأردن خلال الفترة (2012 -1980) وذلك ضمن إطار النظرية النقدية لميزان المدفوعات ومعادلة تدفق الاحتياطيات النقدية الأجنبية. ولتحقيق ذلك، تم استخدام طريقة الانحدار الذاتي لفترات الإبطاء الموزعة بأسلوب اختبار الحدود للتكامل المشترك.

كشفت النتائج التطبيقية للدراسة عن وجود علاقة في المدى الطويل بين الاحتياطيات الأجنبية، ومحددات الطلب على النقود، وعرض النقد بالمفهوم الواسع (*M2*). إضافة إلى ذلك، بينت النتائج أن معاملات المتغيرات في المدى البعيد جاءت متوافقة مع توقعات النظرية النقدية لميزان المدفوعات، إذ إن زيادة عرض النقد بالمفهوم الواسع له تأثيرا سلبيا ومقبولا احصائيا على الاحتياطيات الاجنبية، في حين أن زيادة كل من الدخل المحلي ومستوى الأسعار المحلي له تأثيرا إيجابيا ومقبولا احصائيا على الاحتياطيات الأجنبية. أما أسعار الفائدة المحلية فلها تأثيرا سلبيا ومقبولا إحصائيا على الاحتياطيات الأجنبية، وهو ما يتفق مع المنهج النقدي لميزان المدفوعات.

**الكلمات الدالة:** الاحتياطيات الأجنبية، السياسة النقدية، النظرية النقدية لميزان المدفوعات، طريقة الانحدار الذاتي لفترات الإبطاء الموزعة، الأردن.

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[1] باحث اقتصادي، الأردن.

[2] قسم الاقتصاد، جامعة اليرموك، الأردن.

✉ ahmad.malawi@yahoo.com

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