

## Money Supply in Bahrain, 1974 – 2007

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### Abstract

*Bahrain is a very small oil-exporting country in the Middle East with a fixed exchange rate against the US dollar and has no restriction capital flows. Because its economy evolves around the oil sector, its economy is thought to be vulnerable to oil price movements. It is feared that the recent oil price hike would feed from foreign assets to monetary base and money supply to inflation. Empirical results show that the central Bank of Bahrain since 1990 had neutralized successfully the effect of foreign assets on monetary base and money supply. There was no exception for the recent shocks either. Only the domestic policy variables have had an impact on the monetary base. Except some exceptional years, money supply growth had been remarkably low and steady which helped to maintain stable price level. Empirical results show that the steady growth rates of money were achieved through the maneuvering of both monetary base and money multiplier.*

### 1. Introduction

Bahrain is a very small oil-exporting country in the Middle East with a fixed exchange rate against the US dollar from the early nineteen seventies. The primary objective of this study is to shed some perspective on the money supply process of Bahrain which is interesting in several ways. First, Bahrain is a tiny nation with a very open economy and has no restriction on capital flows. Second, the operation of the Central Bank of Bahrain (CBB) has been branded by some IMF (2006) and World Bank reports as quasi-currency board regime. To understand and make one's own judgment whether such a branding is appropriate, the paper compares the operation of the CBB with the workings of a traditional central bank and a currency board. Third, though the share of oil sector to its GDP is not as high as its other neighboring Gulf Cooperation Council (GCC) countries<sup>1</sup>, its economy very much evolves around the oil sector. That is, the mainstay of Bahrain economy is provided by the oil and gas sector. Oil accounts for over 65 percent of both export receipts and government revenues. The financial position of Bahrain is thus supposed to be vulnerable to oil price movements. The rise in oil price is always feared to create inflationary pressure. For example, Kamar and Naceur (2007) have argued for the GCC countries that the recent oil price was expected to increase the stock of net foreign assets that would increase monetary base and money supply and ultimately would put pressure on inflation. These propositions are serious and important enough to examine in details. This paper examines these propositions in details for Bahrain, a member country of the GCC. Empirical results show that such fears are unwarranted.

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<sup>1</sup> The Gulf Cooperation Council (GCC) countries include six Gulf oil-exporting countries: Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates.

The rest of the paper is organized as follows. Section 2 provides a brief currency and central banking history of Bahrain. Section 3 compares the operations of the Central Bank of Bahrain with a currency board and other conventional central banking. Determinants of nominal currency in circulation are discussed and empirically tested in section 4. In section 5, the money supply process is analyzed and empirical results are presented. Section 6 provides summary and some conclusions.

## 2. Brief History of Currency and the Central Bank of Bahrain

Before the formation of Bahrain Currency Board in 1964, Bahrain used various types of currencies as the means of exchange. The long used Austrian Schilling “Maria Theresa” was replaced by the Indian Rupee in 1880 (Alyousha 1995). Being a part of the British Protectorate, the British administration in 1959 for administrative convenience decided to refer the Indian Rupee used in the Gulf as the Persian Gulf Rupee. Both the Indian Rupee and the Persian Gulf Rupee were in the scheduled territory of the Sterling Area.<sup>2</sup>

In the mid nineteen sixties, Bahrain felt that the time had come to have its own currency which led to the formation of Bahrain Currency Board with the responsibility of issuing a new currency. The Bahrain Dinar (BD) was created in October 1965 with the official rate of US\$2.10 per BD and replaced the Persian Gulf Rupee. Following the US dollar devaluation of August 15, 1971, the BD through its link to the pound sterling of  $BD1.00 = \text{£}0.875$ , began to float upward and realigned the BD’s official rate from US\$2.10 to US\$2.28 two days after when it becomes a fully independent nation from British Protectorate on December 16, 1971. With the floating of the pound sterling and dissolution of the Sterling Area on 23 June 1972, Bahrain severed all ties that linked the BD to the British unit. Since Bahrain’s domestic activities were dominated by oil and gas sectors, the link to the US dollar was considered more important than pound sterling (Alyousha 1995). When the US dollar depreciated on 13 February 1973, the official rate of the BD was realigned to US\$2.53 per unit based on the currency’s unchanged gold content. The Bahrain Monetary Agency (BMA) was created on 5 December 1973 to *replace* the Bahrain Currency Board and assumed the functions of a central bank.

On January 28, 1978, approximately five years after its creation, the BMA announced the pegging of the BD to the SDR at the rate of SDR2.10 per BD. Bahrain agreed to confine the BD exchange rate to be within the narrow margin of 2.5 percent of the central rate. However, on 15 August 1978, the fluctuations for the effective rate were widened from 2.25 percent to 7.25 percent.

From December 1980 to December 2001, Bahrain maintained dual exchange rates against the SDR and the US dollar. The Bahrain Monetary Agency (BMA) officially pegged the Bahrain Dinar to the SDR and maintained an *effective* fixed rate with the US dollar at the rate of  $BD1 = \text{US}\$2.65$  and this rate never changed. Thus, the BD was unofficially but *effectively* fixed to the US dollar ( $BD1 = \text{US}\$2.65$ ). The BMA *formally* pegged the BD to the US dollar effective from 25 December 2001. The official exchange rate remains at  $BD1 = \text{US}\$2.65$  and the dollar is sold by the agency to all commercial banks in the archipelago at that rate. Karam (2001, p.12) has pointed out that, “while making no change to the current exchange rate, the move is likely to be viewed as adding transparency to the agency’s actual exchange rate arrangement.”

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<sup>2</sup> Most of the historical dates and developments referred in this section are taken from 1986/1987 *World Currency Yearbook*.

As per Amiri Decree No. 64 of 2006 with respect to promulgating the Central Bank of Bahrain and Financial Institutions Law, the BMA was renamed as the Central Bank of Bahrain in September 2006. Its main responsibilities remain the implementation of monetary policy, act as the government's fiscal agent and manage the foreign currency cash reserves for the Kingdom of Bahrain.

### 3. Operational Mode of the Central Bank of Bahrain

It is suggested (Fasano 2003, IMF 2006) that the Monetary Agency or the Central Bank of Bahrain that uses instruments to manage domestic liquidity would qualify to be a quasi-currency board regime. As mentioned above, Bahrain abandoned its currency board at the end of 1973. A traditional currency board is a monetary authority that issues notes and coins convertible into a foreign anchor currency called the reserve currency at a truly fixed rate. It usually supplies currency on the basis of 100 percent foreign reserves, at least at the margin. A typical central bank, on the other hand, is a wholly government-owned body that has a monopoly of issuing notes and coins with a high degree of discretionary power: it is constrained by no monetary rule, such as a binding commitment to a particular exchange rate or inflation rate.

A currency board has no discretionary powers. Its operations are completely passive and automatic. The sole function of a currency board is to exchange its notes and coins for the anchor currency at a fixed rate. Unlike a central bank, a traditional currency board does not lend to the domestic government, to domestic companies, or to domestic banks. That is, it does not act as a lender of last resort. A typical balance sheet of a currency board and a central bank is presented below in Table 1 (adapted from Humpage and McIntire, 1995) and compared with the balance sheet of the BMA and later the Central Bank of Bahrain (CBB).

Unlike a central bank, a currency board's only asset is its foreign exchange reserves. Comparing the balance sheet of the BMA, later the Central Bank of Bahrain (CBB), with that of a currency board or a central bank (Table 1), like a currency board the majority of the assets of the CBB comes from the foreign exchange reserves. However, that does not make the CBB as a currency board. Like a currency board, Bahrain's currency is 100 percent backed by foreign exchange reserve. The Article 19(b) and 19(c) of the Preamble of the Central Bank of Bahrain and Financial Institution law states that "the amount of foreign exchange reserve permanently maintained by the Central Bank shall not be less than 100% of the value of the currency in circulation. In exceptional circumstances, the minimum amount of the foreign exchange reserve may be changed by a resolution issued by the Board, provided that such minimum shall not be less than 75% of the value of the currency in circulation."

However, the other aspects of the CBB are similar to a traditional central bank. It has the same monetary base as measured from a balance sheet of a traditional central bank. Like other central banks, unlike a currency board, the CBB enforces monetary policy by using indirect instruments especially using repos and acts as a lender of last resort.<sup>3</sup> However, the BMA/CBA introduced these instruments gradually and progressively starting in the late nineteen eighties.

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<sup>3</sup> A summary view of monetary policy instruments and operations are found in the CBB's website <http://www.cbb.gov.bh/>. See also its annual reports and Fasano (2003).

Table 1 shows that the monetary base of a currency board is the sum of the commercial banks' holding of the currency board's currency ( $C_B$ ) in reserve against domestic assets plus the non-bank public holdings of the currency board's currency ( $C_P$ ). Thus, the money stock of a currency board country at time  $t$ ,  $M_t$ , can be written as:

$$M_t = m(C_P + C_B)_t \quad (1)$$

where  $m$  is the multiplier. The money stock of a currency board country is related to its overall balance of payments position; this is because a currency board issues only domestic currency against foreign exchange at a fixed exchange rate. Thus, the equation (1) can be written as

$$M_t = mBP_t \quad (2)$$

where  $BP$  is the balance-of-payments surplus. Equation (2) shows that the money stock of a currency board country will increase as long as that country runs a balance-of-payments surplus. The adjustment process from the balance-of-payments to money stock is automatic (Humpage and McIntire, 1995).

Under the fixed exchange rate rates, the CBB would face similar automatic adjustments, but *unlike* a currency board, the CBB can offset or sterilize the expansionary (contractionary) monetary effects of the capital inflows (outflows) on its monetary base and money supply. Monetary base (MB), defined as  $MB = CU + R$ , can be written from table 1 (ignoring the net items) as  $MB = FA + DC$ , where  $DC$  is domestic assets (also popularly known as domestic credit). In a fully sterilized intervention changes in monetary base would be zero making  $\Delta DC = -\Delta FA$ . As shown below the CBB fully sterilizes the capital flows and thereby enjoys a limited control of its monetary policy.<sup>4</sup>

#### 4. Determinants of Currency in Circulation

As mentioned above, like a currency board, currency in circulation (CU) of Bahrain is backed by 100 percent of foreign exchange. This may suggest that there is a co-movement between CU and foreign assets (FA). However, this may not be true because there is empirical evidence (shown below) that the CBB sterilizes the capital flows. On the other hand, being an oil exporting country, there is a strong presumption that CU of Bahrain would be influenced by the world oil price movement. Figure 1 plots the trend of (nominal) CU and (nominal) world oil price (OP) for the period 1974 – 2007.<sup>5</sup> Figure 1 shows that CU and OP drifted remarkably well together except few years of early nineteen eighties.

Being an oil-exporting country, economic activities in Bahrain, especially all sorts of construction activities, move with the oil price movement. Dhonte, Bhattacharya and Yousef (2001) suggest that construction would be the engine of growth in the Middle East. This view is probably shared by the people in the GCC countries for which Bahrain

<sup>4</sup> This is in contrast to the claim that a regime with fixed exchange rates and free capital movements loses the control over its monetary policy which is variously known as the impossibility trinity/trilemma (Obstfeld and Taylor, 1998)

<sup>5</sup> As mentioned above, the BMA was created on December 5, 1973. Thus the starting period of the data was 1974.

is a member and it is more evident in the recent surge in oil price. Almost all construction (unskilled) workers are expatriates with a very low wage. Low wages of these workers are received in cash and remain outside the banking system of Bahrain. The currency in circulation increases with the increase in construction works due to oil price increase. Thus, currency in circulation can be modeled as:

$$CU_t = f(OP_t, DR_t, FA_t, \dots) + \varepsilon_t \quad (3)$$

where  $DR_t$  is the bank deposit rate considered as the opportunity cost of holding currency,<sup>6</sup> dots indicate other factors that may influence CU and  $\varepsilon_t$  is the error term.

Table 2 presents the unit root test results using the augmented Dickey-Fuller (ADF), Kwiatkowski, Phillips, Schmidt, Shin (KPSS) and Phillips-Perron (PP) procedures. The results of the ADF and KPSS unit root tests indicate that the variables in equation (3), except  $DR_t$ , are non-stationary. However, the Phillips-Perron test indicates that all variables in equation (3) are non-stationary.

Cointegration test results are presented in Table 3 in panels A and B. Estimates of the three variables CU, OP and DR system are presented in Panel A, while the estimates of the four variables CU, OP, DR and FA system are presented in Panel B. A constant and a deterministic trend are allowed in the cointegrating equation in both panels. Both trace and max-eigenvalue tests in Panel A indicate there exists one cointegrating vector at the 5 percent level of significance for the three- variable system.

For Panel B when foreign assets (FA) are also included in the system, only trace test indicate that there exists one cointegrating relationship. The  $\lambda_{\max}(0,1)$  statistic of 26.433 is clearly less than the 5 percent critical value of 27.584. Thus, according to the max-eigenvalue test indicates no cointegration at the 5 percent level. Enders (2004) suggests that when  $\lambda_{\text{trace}}$  and  $\lambda_{\max}$  tests conflict, the  $\lambda_{\max}$  test has the sharper alternative hypothesis and “it is usually preferred for trying to pin down the number of cointegrating vectors” (p.354). This confirms that foreign assets have no long run relationship with currency in circulation as suggested earlier. In other words, currency in circulation in Bahrain is only backed by foreign exchange as in the case of a currency board.

To determine the short run response of the oil price to CU, a form of error correction model is estimated and result are as follows:

$$\begin{aligned} \Delta CU_t = 5.12 + 1.13\Delta OP_t - 0.68\Delta DR_t - 0.29\hat{\varepsilon}_{t-1} \\ (3.39) \quad (3.80) \quad (0.49) \quad (1.95) \\ R^2 = 0.41 \quad D - W = 1.36 \end{aligned}$$

where  $\hat{\varepsilon}_{t-1}$  is the one-period lagged residual from the cointegrating equation of Panel A of table 3 and absolute t-statistics are in parentheses. There is a one to one short run response of changes in oil price to changes in currency. The estimate of the equilibrium error term indicates that the 71 percent of the adjustment would happen within a year.

<sup>6</sup> Other interest rates, such as money market rate and treasury bills rate are only available from the end of 1980s.

## 5. Analysis of the Money Supply in Bahrain

The M2 definition of money will be referred as the money stock. The M2 definition of money in Bahrain consists of currency outside banks (CU), private demand deposits (D) and private time and saving deposits (T). Thus money stock (M) is defined here as:  $M = CU + D + T$ . The money supply mechanism is expressed as:

$$M = mMB \quad (4)$$

where  $m$  is the money multiplier and  $MB$  is the monetary base or high-powered money defined as  $MB = CU + R$ , where  $R$  is the commercial banks' reserves (liabilities of the central bank). Money supply ( $M$ ) is sufficiently determined by the two factors  $m$  and  $MB$  in equation (4).<sup>7</sup>

Figure 2 (left hand scale) shows the movements of the nominal money stock ( $M_2$ ),  $MB$ , and net foreign assets of the central bank (NFA) while the right hand scale shows the multiplier ( $m$ ) for the period 1974 – 2007. Both NFA and  $MB$ , only for the last period of the sample, exceeded BD1,000 million. The nominal money stock shows huge upward trend, specially after 1990. Money stock reached more than BD5,000 million, about five times of the  $MB$ . The fluctuation of the multiplier (right hand scale) is remarkable with a minimum value of 3.5 to the maximum value of 10.3 times.

### 5.1 Growth Rates of Money Stock and its Components

From the point of view of the monetary policy, it is important to consider the growth rates of these variables. From equation (4), empirical growth rates are calculated as:

$$\% \Delta M = \% \Delta m + \% \Delta MB + (\Delta m / m)(\Delta MB / MB) \quad (5)$$

where the last term  $(\Delta m / m)(\Delta MB / MB)$  is the interdependence or interaction term. Cagan (1965) emphasized that the money stock and their determinants might be related "either through some economic or political effect of one on the others or through the common effects of other factors" (p. 15). The interdependence term in equation (5) captures these effects.

Figure 3 shows the growth rates of these variables. After 1984 when money stock grew about 94 percent, the annual growth rates of money stock were quite secular (with no particular trend, though at the end of the sample period shows some upward trend). One of the objectives of the Central Bank of Bahrain is to ensure price level stability and it seems that the CBB is quite successful in achieving that goal. As shown in Figure 4, the average annual CPI inflation rates were less than 1 percent for the period 1985 to 2002 and inflation rates followed remarkably well with the growth rates of the money stock.<sup>8</sup>

Though the growth rates of money stock showed no particular trend, it experienced some wild swings, especially between 1974 and 1984, as shown in Figures 3 and 4 and reported in Table 4. The period 1974 to 1984 had been a wild ride for the growth rates of money supply. The period started with the formation of Bahrain's central

<sup>7</sup> See Cagan (1965) for elaborated discussion of the expression (4).

<sup>8</sup> However, annual inflation rates since 2002 have been more than 2 percent each year mainly due to BD depreciation with dollar. More discussions follow.

bank (BMA) after the abandonment of the currency board. It had also weathered the aftereffect of the Arab-Israeli war and oil price hike. Money supply grew about 65 percent in 1976 from about 26 percent in the previous year. Then it experienced its first recession in 1979 as an independent state that probably led to 26.66 and 35.48 percent growth rates of money stock in the following two years. The three years swing in the growth rates following 1981 is remarkable. From 1981 to 1982, money supply fell by almost 42 percent, and then increased by almost 94 percent in the following year followed by a decrease of three and half percent next year. These types of swings did not definitely help the cause for the second recession in the mid-eighties. The next big drop was in 1990 that corresponded to the Gulf War when many off-shore banks and financial institutions were closed down and slowed down the economic activities. After the war, economic and financial activities started to pick up and money supply grew more than 23 percent in 1991. The high growth rate of 2007 (the last year of the sample) seemed to be linked to the recent unprecedented world oil price hike.

It is also clear, especially from table 4, that huge growth rates of money were either contributed by huge increase in MB or increase in money multiplier  $m$ . There were few staggering growth rates of MB about 50 percent or more in some years and more than 100 percent in other years. The growth rate of about 58 percent for the period 1990 – 1991 was due to the Gulf War when there was a huge surge in bank reserves. The recent growth rate of 106.9 percent in 2007 was due to unprecedented oil price hike in that year and again saw a huge surge in bank reserves. It is important to note that a time to time surge in oil price might have contributed to the abnormal growth of MB for some periods. However, there is no long run relationship between fluctuations in the oil price and change in the MB.<sup>9</sup>

The percentage changes in multiplier also show huge abnormality of ups and downs during the recession in the mid-eighties, the Gulf War, and in those years of abnormal oil price increase. If one excludes those earlier years when the operations of the central bank, one may say, gone through some trials and errors and consider the developments from the beginning of the nineties when the monetary policy was conducted with indirect instruments, a remarkably stable growth rates of money emerges as shown in figure 5. It seems the CBB has been following Milton Friedman's arguments for a maintaining a low and steady growth rate of money. One can from figure 5 that the MB and  $m$  changed in opposite direction to keep the change in money stock steady.

## 5.2 Analysis of MB

Figure 2 shows that there is almost a parallel movement of NFA and MB, especially from the end of 1980s. As noted above, the central bank of Bahrain (CBB) has started to use indirect monetary instruments to conduct monetary policy only after the end of 1980s. With the changes in world oil price, the NFA of the CBB changes which may feed to the money stock. However, figure 3 shows that the changes in MB, except a big swing during the Gulf War, hovered around zero indicating that the effect of foreign exchange on MB has been neutralized (sterilized). In an unsterilized intervention, when foreign exchange of a monetary authority increases, MB increases which is the same as the domestic open market purchase of domestic securities. In case of Bahrain, the effect

<sup>9</sup> The oil price variable is non-stationary (table 2). The ADF, KPSS and PP unit root tests indicate MB is stationary, so that the cointegration test between oil price and MB is avoided. However, the simple correlation between change in two variables is 0.18 with the p-value of 0.31:  $\text{Corr}(\Delta\text{OP}, \Delta\text{MB}) = 0.18$  (0.31). This means there is no significant relationship between changes in oil price and changes in MB.

of foreign exchange seems to be sterilized; that is, it may have reversed the effect of the foreign exchange operation on the domestic MB by buying or selling of domestic securities. From table 1 the change (first difference) in MB can be written as:

$$\Delta MB \equiv \Delta NFA + \Delta DC \quad (6)$$

This mean, in a fully sterilized situation ( $\Delta MB = 0$ ), the changes in net foreign asset (NFA) should not have any effect on the changes of MB. We tested this proposition using the quarterly data for the period 1990:1 to 2007:3. The flow identity (6) can be translated into the reaction function of the source side of the MB as follows:

$$\Delta MB_t = \alpha \Delta NFA_t + X_t \beta + u_t \quad (7)$$

where  $X$  is a vector of other variables that may have had influence on MB,  $u$  is the error term. If the CBB neutralizes *fully* the effect of NFA on MB, the coefficient of NFA ( $\alpha$ ) should not be statistically different from zero. If NFA does not affect MB, what other factors could have influenced MB so that the observed fluctuations in changes in MB (as can be seen in figure 3) can be explained? Two important policy variables inflation rate and interest rate, besides seasonal fluctuations, may have had influence on the MB.

Thus, inflation rate and interest rate are included in the vector  $X$ . Price stability is one of the main stated objectives of the CBB. Actual inflation rate ( $\pi_t$ ) and the inflation rate differential  $(\pi - \pi^*)_t$ , where  $\pi_t^*$  is the targeted inflation rate, are used to estimate equation (7). Many central banks around the world have recently adopted inflation targeting as their monetary policy strategy to achieve price stability.<sup>10</sup> Under inflation targeting a central bank makes a public announcement of medium term numerical targets of inflation rate and commits its policies to achieve the targeted inflation rate. Given its success around the world in achieving price stability, many other central banks may have been practicing it without announcing it formally. Figure 4 indicates that there was a recent (after 2000) upward trend in the inflation rate in Bahrain. This may have influenced the monetary authorities of Bahrain to follow an implicit inflation targeting policy without announcing it. One way to test this is to include an inflation differential variable  $(\pi - \pi^*)_t$ . Thus, if the central bank is concerned about stabilizing inflation around the targeted inflation, one would expect the coefficient of  $(\pi - \pi^*)_t$  to be negative. The HP (Hodrick-Prescott, 1997) filter is used to calculate the targeted inflation rate  $\pi_t^*$ .<sup>11</sup> The interest rate used is the money market rate ( $MMR$ ), commonly known as the call money rate (federal fund rate in the US) which is a measure of the stance of monetary policy. The MMR is the opportunity cost of holding reserves which is a component of the MB. Thus, one would expect the coefficient of  $MMR$  to be negative.

Equation (7) was estimated using the Zellner's seemingly unrelated regression (SUR) method. The foreign component of the monetary base (NFA) cannot safely be

<sup>10</sup> New Zealand was the first country to formally adopt inflation targeting in 1990 followed by Canada, the U.K., Sweden, Finland, Australia, Spain, among other countries, have also adopted a form of inflation targeting. See, for example, Mishkin (2007) and Svensson (2007).

<sup>11</sup> Results, using the linear trend inflation as a measure of targeted inflation rate, did not differ significantly.

considered as an exogenous variable. The changes in domestic credit are liable to affect domestic interest rates and, through this channel, international capital flows and MB. This means, the NFA variable is correlated with the error term  $u$ , implying inconsistency of OLS estimates. In this case the most efficient estimator would be the Zellner's SUR method, rather than the 2SLS (two-stage least squares), that will also take full account of the correlations between residuals of the estimated reaction function specified for  $\Delta MB$  and  $\Delta NFA$ .<sup>12</sup> Because of the possibility of simultaneity bias as well as lags in implementing policy and following the usual practice, interest rate and inflation variables were lagged by one period. The estimated results are presented in table 5. In Table 5  $S_1 - S_3$  are the first three seasonal dummies and numbers in the parentheses are absolute t-statistic. It is very clear from Table 5 that the estimated coefficient of  $\Delta NFA$  is close to zero and more importantly it is statistically insignificant for the whole sample period 1991:1 – 2007:3 and for the sub-period 2000:1 – 2007:3. This means that there was a complete sterilization. In other words, a change in the net foreign asset (a source component of MB) has not been allowed to affect the overall MB. The coefficient of lagged inflation rate for the whole sample period has a correct negative sign but statistically insignificant. The coefficient of the lagged interest rate has a correct negative sign and it is statistically significant at 7 percent level. The third quarter seasonal dummy is also highly statistically significant. The third quarter is the hottest months in Bahrain when most of the outside activities including construction are substantially reduced that lead to a reduction of domestic credit (another source component of MB) and as a result MB decreases. Results in Table 5 show that the interest rate, seasonal factors, and some other unspecified factors (not NFA) are responsible for the fluctuations of the MB of Bahrain.

The recent (especially after 2000) observed growth rates of money supply must be explained. Figure 3 suggests that growth rates of money supply had come from the growth rates of the MB which was not influenced by NFA as many had believed. The growth rates of multiplier had been declining. Thus, the recent observed fluctuations in the growth rates of the MB need to be explained. Two factors might have contributed to the fluctuations. These are the imported inflation and the changes in the US federal fund rate that make a change in the money market rate of Bahrain. Bahrain inflation is quite controlled and it is quite surprising that the estimated coefficient is statistically insignificant for the entire sample period. Through out nineties price level was quite stable. However, after 2000, as figure 4 shows, inflation has a significant upward trend. This corresponds to the prolonged period of US dollar (and with it Bahrain dinar) depreciation. Because of its currency is fixed with the US dollar, Bahrain is affected by the dollar depreciation against major currencies. About 80 percent of goods consumed in Bahrain are imported goods. Thus, Bahrain has been experiencing a substantial imported inflation. The increase in oil price is another important development happened during this period. One would expect an increase in the stock of NFA with the increase in capital flows resulting from the increase in oil price. This has a consequence of increase in monetary base (if not sterilized) and money supply, which could be higher than the increase in money demand, leading to an inflationary pressure. The CBB, without making it public, may have a change in monetary policy stance during this period to account

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<sup>12</sup> The following variables were used as instruments: constant, three quarterly dummies, lagged values of the changes in the US net foreign assets, lagged MB, lagged and all lagged variables in the equation. If suspected, the equations were re-estimated with first order serial correlation correction.

these external shocks. To test it the reaction function was re-estimated for the sub period 2000:1 – 2007:3.

Results presented in table 5 for the sub period 2000:1 – 2007:3 show that the inflation variable either measured by  $\pi_{t-1}$  or  $(\pi - \pi^*)_{t-1}$  is now, as expected, statistically significant at the 1 percent level. The inflation variable measured by  $(\pi - \pi^*)_{t-1}$  as a domestic objective variable performs better than the actual inflation. Thus, as expected, inflation, interest rate (also significant at the 10 percent level) and seasonal factors are some of the recent sources of change in MB and money supply in Bahrain.

### 5.3 Analysis of Money Multiplier

Money multiplier ( $m$ ) is the other determinants of money supply. Figure 2 shows money multiplier fluctuated a lot during 1974 to 2007. It reached the maximum value of 10.3 in 1999 and since then shows a negative trend when money supply showed positive trend. This means multiplier played an important containing role in the money supply growth which could have been explosive given the recent international development. First, we identify the factors that determine the multiplier and then we evaluate the contribution of each factor to the growth rate of the multiplier. From equation (4) multiplier  $m$  can be written as:

$$m = \frac{M}{MB} = \frac{CU + D + T}{CU + R} = \frac{\frac{CU}{D} + 1 + \frac{T}{D}}{\frac{CU}{D} + \frac{R}{D+T} \left(1 + \frac{T}{D}\right)} \quad (8)$$

Denoting the currency ratio ( $c$ ), time and saving deposit ratio ( $t$ ), and reserve ratio ( $r$ ) as:  $c \equiv CU/D$ ,  $t \equiv T/D$ , and  $r \equiv R/(D+T)$  we can express  $m$  from equation (8) as:

$$m = \frac{1+c+t}{c+r(1+t)} \quad (9)$$

Here the reserve ratio  $r$  is defined in relation to total deposit consists of demand deposit and time and saving deposit rather than only demand deposit because required reserves in Bahrain is required out of total deposits. The partial derivatives of  $m$  with respect to  $c$ ,  $t$ , and  $r$  can be given as:

$$\frac{\delta m}{\delta c} = -\frac{(1+t)(1-r)}{[c+r(1+t)]^2} < 0, \quad \frac{\delta m}{\delta t} = \frac{c(1-r)}{[c+r(1+t)]^2} > 0, \quad \frac{\delta m}{\delta r} = -\frac{(1+t)(1+c+t)}{[c+r(1+t)]^2} < 0 \quad (10)$$

Thus,  $m$  and  $c$  are negatively related,  $m$  and  $t$  moves in the same direction and  $m$  decreases when  $r$  increases. The movements of multiplier and those ratios are shown in figure 6. The reserve ratio ( $r < 1$ ) remained almost the same for the entire sample period.

All commercial banks operating in Bahrain are required to maintain reserves deposited at the central bank amounting to 5 percent of total deposits till the end of 2006 when the BMA was renamed as the CBB. Then the reserve requirement was increased to 7 percent. The reserve requirement was never used as a tool of monetary policy. Thus, it

is not surprising that reserve ratio did not play an active role in the long run movements of the multiplier. The observed increase in  $r$  in 1990 was due to the Gulf War when the excess reserves of banks increased substantially because of the uncertainty related to the war.

The currency ratio ( $c < 1$ ) increased steadily from 1981 to 1990. In 1991 currency ratio took a dive and since then steadily decreased. As shown in equation (10),  $c$  and  $m$  should be negatively related, but Figure 6 does not support it suggesting that for Bahrain  $c$  did not play much of a role to the long run fluctuations of  $m$  either.<sup>13</sup> On the other hand time deposit ratio  $t$ , which is greater than 1 ( $t > 1$ ), is positively related to  $m$ . The time-deposit ratio follows quite closely to the long-run movement of the multiplier (Figure 5). It shows clearly that the recent decrease in the multiplier is due to the decrease in the time-deposit ratio.

To see the recent trend, the quarterly series for multiplier and its components are plotted in figure 7 for the period 1990:1 to 2007:3. The currency ratio shows a clear negative trend from the beginning of the nineties. Though the nominal currency in circulation over the time increased (Figure 1), the currency ratio decreased substantially over the time. The decrease in the currency ratio is a reflection of Bahrain as a technologically advanced country where electronic means of payments are widely accepted. The co-movements of  $m$  and  $c$  again suggest that  $c$  is not the long run determinants of  $m$ .<sup>14</sup> Reserve ratio, never used as a tool of monetary policy, remained stable. The co-movements of  $m$  and time-deposit ratio suggest that the  $t$  is the main long run determinants of the multiplier.

The time-deposit ratio ( $t$ ) is considered as the main determinant of the money multiplier of Bahrain. This ratio is expected to move directly to the market interest rate, for example, with the money market rate (MMR). Given the fixed exchange rate against the US dollar and free capital flows, money market rate of Bahrain follows directly with the US federal fund rate (FFR). Thus, it is hypothesized that whenever the FFR increases (decreases), money market rate of Bahrain would increase (or decrease) and that will move the multiplier in the same direction. In other words, money multiplier of Bahrain and FFR would be cointegrated. This proposition is now tested.

First to establish that FFR is a true proxy for the MMR, the following equation is estimated and reported in Table 6. The autoregressive conditional heteroscedasticity (ARCH) LM test from the initial estimation suggested that the equation was to be estimated with the ARCH and first-order serial correlation correction. z-statistics are in parentheses. It shows that there is one to one relationship between FFR and MMR and the estimated coefficient is statistically significant at zero percent level.<sup>15</sup>

The long run relationship between  $m$  and its components are now analyzed. First, test results for their order of integration are presented in Table 7. The unit root test contains a constant and time trend when variables are in level form and only constant when they are in first difference form. Results show both  $c$  and  $r$  are stationary is both in

<sup>13</sup> Both  $c$  and  $r$  could have important role in the short-run fluctuations of  $m$  which could be calculated as  $(\delta m / \delta c) \Delta c$  and  $(\delta m / \delta r) \Delta r$  for  $c$  and  $r$  respectively.

<sup>14</sup> It is interesting to note that this is indeed a contrast to the US for which the recent decrease in multiplier is due to the recent increase in the US currency ratio (Mishkin, 2007).

<sup>15</sup> This means one basis point increase in FFR would lead to a one basis point increase in MMR of Bahrain. However, it does not mean that MMR is equal to FFR which one may expect because fixed exchange rate and free capital movements; that is, interest parity condition would hold. This is not the case. There are differences between the US and Bahrain interest rates because of country risk. In other words, BD denominated assets are not perfect substitutes for the US dollar denominated assets.

level and first difference forms. On the other hand  $m$ ,  $t$  and FFR are nonstationary in the level form but are stationary in first difference form.

Because  $m$ ,  $c$  and  $r$  have different order of integration and what is already revealed from Figure 7, the cointegration test between  $m$  and  $c$  and between  $m$  and  $r$  are altogether avoided. Since there are two variables given that the FFR is truly exogenous, the Engle-Granger methodology is used to test whether the variables  $m$  and  $t$  are cointegrated. Results are presented in Table 8. Results more or less support the view that  $m$  and  $t$  are cointegrated at the level of significance between 5 to 10 percent level and  $m$ ,  $t$  and FFR are cointegrated at about 10 percent level.<sup>16</sup> Thus, there is a long run comovements between multiplier and the time-deposit ratio, which is the main determinant of the money multiplier of Bahrain.

Finally, results of the error-correction model are presented using the cointegrating regression in the first row of Table 8. The error correction models for  $m$  and  $t$  during the period 1990:2 – 2007:3 were estimated to be:

$$\Delta m_t = -0.44 - 3.75 \hat{\mu}_{t-1} \quad (0.37) \quad (3.18)$$

$$\Delta t_t = -0.03 + 0.023 \hat{\mu}_{t-1} \quad (0.57) \quad (0.43)$$

where  $\hat{\mu}_{t-1}$  is the lagged residual; that is  $\hat{\mu}_{t-1}$  is the estimated value of  $m_{t-1} - \alpha - \beta t_{t-1}$ . Absolute t-statistics are in parentheses. Lag length tests based on  $\chi^2$  and F-tests indicate that no lagged values of  $\Delta m_{t-1}$  or  $\Delta t_{t-1}$  would enter in the estimated equations presented above. These results indicate that the causation runs, as expected, from the deposit ratio to the multiplier. In the case of one unit deviation of  $m$  from  $t$ , the multiplier falls by 3.75 units and it happens, as expected, without changing (rising) the deposit ratio because the estimate 0.023 is close to zero and is insignificant.

## 6. Summary and Conclusions

After independence at the end of 1971, Bahrain abandoned its currency board and formed its central bank, named as the Bahrain Monetary Agency (BMA), at the end of 1973. The BMA is recently (at the end of 2006) renamed as the Central Bank of Bahrain (CBB). The BMA only at the end of nineteen eighties started to use indirect monetary instruments to conduct monetary policy. Before that it only concentrated on keeping the exchange rate fixed that left the growth rates of its money stock to fluctuate abruptly following any external shocks because there were no instruments available to direct the short run regulation of domestic liquidity. The other feature is that its currency in circulation is 100 percent backed by foreign exchange that led some to brand it as a quasi currency board regime. This branding seems to be questionable given the way it has operated especially after 1990.

<sup>16</sup> Johanson cointegration test consisting variables  $m$ ,  $t$  and FFR also indicates 1 cointegrating equation at the 0.05 level.

The mainstay of Bahrain economy is provided by the oil and gas sector. The rise in oil price is always feared to create inflationary pressure. Some researchers have argued that the recent oil price was expected to increase the stock of net foreign assets thereby would increase monetary base and money supply and ultimately would put pressure on inflation. This paper took these arguments very seriously and tested quite rigorously for Bahrain, a member country of the GCC. Data and empirical results for Bahrain show that MB was not influenced by the changes in the NFA even during the recent surges in oil prices. Though, oil price increase caused nominal currency in circulation to increase, such increase had no consequences on growth rates of money supply, MB or multiplier.

Bahrain in nineties experienced the lowest inflation among the GCC countries; annual average inflation rates were less than 1 percent. However, with the US dollar depreciation since 2002, Bahrain experienced a substantial imported inflation. Empirical results for recent period show that the changes in MB are negatively related to inflation indicating that the CBB is quite aware and sensitive to inflation. Domestic interest rate (measured by the money market rate), other than seasonal fluctuations, also had influence on the MB.

Following a decade of wild swings, the growth rates of money stock remained quite steady except few episodes such as Gulf War in 1990 and a huge spike in oil price in 2007 for which data is still preliminary. The growth rates of MB and multiplier moved in opposite direction to keep the growth rates of money steady. Out of the three ratios that determine the money multiplier, the reserve ratio remained steady. Currency does not go through the multiple deposit creation and not totally under the control of the central bank. Currency ratio seemed to have followed the same direction of the multiplier, rather than expected opposite direction; this indicates that it had no important role in the log-run movement of the multiplier. This leaves to the last determinants of the multiplier which is time-deposit ratio. As expected, time-deposit ratio and multiplier moved together for the entire sample period suggesting that time-deposit ratio remained the main determinants of the money multiplier. Results show that time-deposit ratio and multiplier are cointegrated. The time-deposit ratio is ultimately affected by the US federal fund rate. Idea is that the interest rate influenced the time-deposit ratio which in turn affected the multiplier.

The opposite movements of the growth rates of monetary base and multiplier that kept growth rates of money steady has important implications for the contentious issue of keeping the exchange rate fixed. Analysis shows that the monetary authority in Bahrain was able control both MB and multiplier to keep the growth rate of money supply steady. The monetary authority has remarkably weathered the recent external shocks.

7. Tables and Figures

Table 1

<b>Currency Board</b>	
<b>Assets</b>	<b>Liabilities</b>
Foreign Currency Reserves (FA) Liquid reserve account Investment reserve account Surplus reserve account	Non-bank public holding of Currency Board notes and coins (C <sub>p</sub> ) Commercial banks holding of currency board notes and coins (C <sub>B</sub> )
	Net worth
<b>Central Bank</b>	
<b>Assets</b>	<b>Liabilities</b>
Foreign exchange (FA)  Domestic Assets (DC) Government securities Loans to commercial banks	Reserve to commercial banks (R) Currency held by public (CU)  Net worth
<b>Bahrain Monetary Agency/Central Bank of Bahrain</b>	
<b>Assets</b>	<b>Liabilities</b>
Foreign Currency Reserves (FA) Bond portfolios (investment) in foreign currency Bank deposits and balances	Reserve to commercial banks (R) Currency held by public (CU)
Domestic Assets (DC) Claims on government Claims on banks	Net worth

**Table 2 Unit root test statistics with a constant and trend, 1974 – 2007**

Variables	ADF	KPSS	PP
CU	2.36	.129	1.33
OP	-.04	.132	-.43
FA	1.09	.115	0.02
DR	-4.43**	.153*	-2.56

**Note:** The null hypothesis is that the time series are I(1) against the alternative that they are I(0). Superscripts \*\* and \* signify the statistics are significant at the 1% and 5% level.

**Table 3 Results of cointegration analysis**

<b>Panel A: Included Variables: CU, OP, and DR</b>							
$\lambda_{\text{trace}}$ tests				$\lambda_{\text{max}}$ tests			
H <sub>0</sub>	H <sub>1</sub>	$\lambda_{\text{trace}}$ Value	0.05 Critical Value	H <sub>0</sub>	H <sub>1</sub>	$\lambda_{\text{max}}$ Value	0.05 Critical Value
r = 0	r > 0	36.819	29.797	r = 0	r = 1	21.368	21.132
r ≤ 1	r > 1	15.450	15.495	r = 1	r = 2	12.218	14.265
r ≤ 2	r > 2	3.233	3.841	r = 2	r = 3	3.233	3.841
<b>Panel B: Included Variables: CU, OP, DR, and FA</b>							
r = 0	r > 0	48.263	47.856	r = 0	r = 1	26.433	27.584
r ≤ 1	r > 1	21.830	29.797	r = 1	r = 2	11.229	21.132
r ≤ 2	r > 2	10.601	15.495	r = 2	r = 3	7.558	14.265
r ≤ 3	r > 3	3.043	3.841	r = 3	r = 4	3.043	3.841

**Note:** Critical values from MacKinnon, Haug, and Michelis (1999).

**Table 4 Unusual growth rates of money stock and its components**

Period	% $\Delta M$	% $\Delta m$	% $\Delta MB$	Interaction
1974 – 1975	26.34	– 50.44	154.92	– 78.14
1975 – 1976	64.93	11.46	47.97	5.50
1976 – 1977	19.09	24.39	– 4.26	– 1.04
1977 – 1978	19.46	9.56	9.04	0.86
1978 – 1979	2.57	– 16.72	23.15	– 3.87
1979 – 1980	26.66	30.00	– 2.56	– 0.77
1980 – 1981	35.48	17.67	15.13	2.67
1981 – 1982	– 41.76	– 51.39	19.81	– 10.18
1982 – 1983	93.68	95.86	– 1.11	– 1.07
1983 – 1984	– 3.52	2.76	– 6.11	– 0.17
1989 – 1990	– 11.56	– 19.17	9.41	– 1.80
1990 – 1991	23.22	– 21.84	57.65	– 12.59
2006 – 2007	40.80	– 31.95	106.90	– 34.15

**Table 5 Seemingly Unrelated Regression (SUR) estimates of the reaction function**

**Sample Period: 1991:1 – 2007:3**

$$\Delta MB_t = 41.61 + 0.12\Delta NFA_t - 7.91\pi_{t-1} - 4.04MMR_{t-1} - 5.96S_1 - 3.34S_2 - 48.73S_3$$

(2.96) (0.98) (1.16) (1.84) (0.41) (0.24) (3.28)

$$R^2 = 0.28 \quad D - W = 1.95$$

**Sample Period 2000:1 – 2007:3**

$$\Delta MB_t = 55.42 + 0.05\Delta NFA_t - 77.54(\pi - \pi^*)_{t-1} - 6.57MMR_{t-1} - 6.62S_1$$

(2.45) (0.24) (3.69) (1.73) (0.24)

$$- 25.12S_2 - 73.56S_3$$

(1.02) (2.69)

$$R^2 = 0.57 \quad D - W = 1.85$$

**Table 6 ARCH estimates for the period 1990:1 – 2007:3**

$$MMR_t = 0.34 + 1.04FFR_t$$

(1.28) (21.65)

$$R^2 = 0.98 \quad D - W = 1.93$$

**Table 7 Unit root test statistics, 1990:1 – 2007:3**

Variable	ADF		Phillips-Perron	
	Level	First difference	Level	First difference
<b>m</b>	-2.59	-9.84**	-2.55	-10.36**
<b>c</b>	-5.04**	-9.84**	-4.99**	-17.089**
<b>r</b>	-3.53*	-10.92**	-3.51*	-18.46**
<b>t</b>	-2.70	-8.65**	-2.59	-9.69**
<b>FFR</b>	-3.23	-3.24*	-2.06	-3.37*

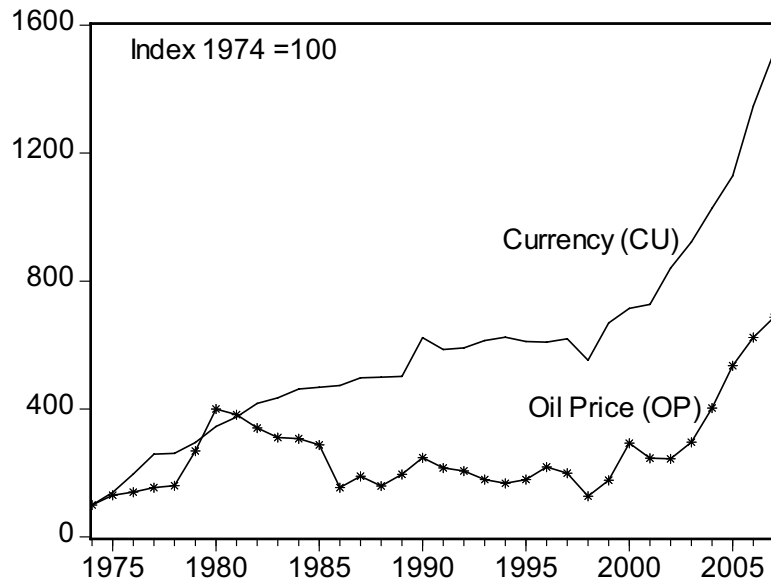
**Note:** \*\* and \*, signify the rejection of the presence of unit root at 1% and 5% level based on MacKinnon (1996).

**Table 8 Results of cointegration tests**

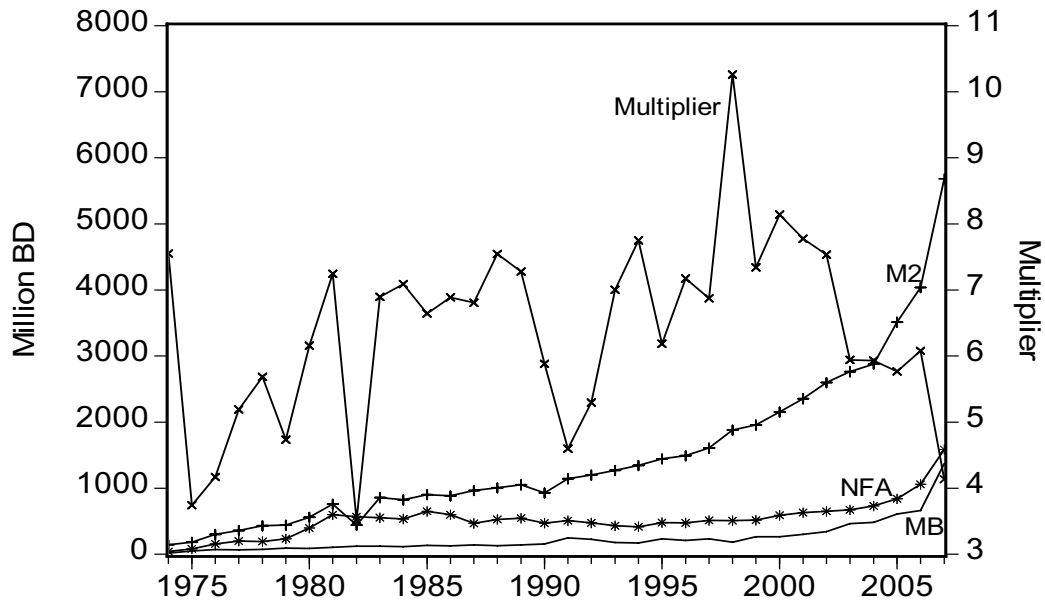
$y_t$	$x_{1t}, x_{2t}$	$\alpha$	$\beta$	$\gamma$	$\rho$	n	LM
$m_t$	$t_t$	3.96(7.77)	0.75(6.25)		-0.28(3.36)	0	1.63
$m_t$	$t_t, FFR_t$	4.03(7.85)	0.82(6.05)	0.08(1.06)	-0.30(3.64)	0	0.44

**Note:** Each row reports coefficients from two regressions. The first regression is the cointegrating regression of the form  $y_t = \alpha + \beta x_{1t} + \gamma x_{2t} + \mu_t$ , where  $\mu_t$  is the residual. The second regression tests for unit root in the residual of the relevant cointegrating regression and is of the form  $\Delta\mu_t = \rho\mu_{t-1} + \sum_{i=1}^n a_i \Delta\mu_{t-i}$ . Absolute t-statistics are in parentheses. The 5 percent and 10 percent critical values are -3.461 (or -3.915) and -3.130 (or -3.578), respectively for 2 (or 3) variables cointegrating regression (Enders, 2004, table C, p.441 based on MacKinnon). Breusch-Godfrey statistics (LM) do not show the presence serial correlation in the residuals of the second regression.

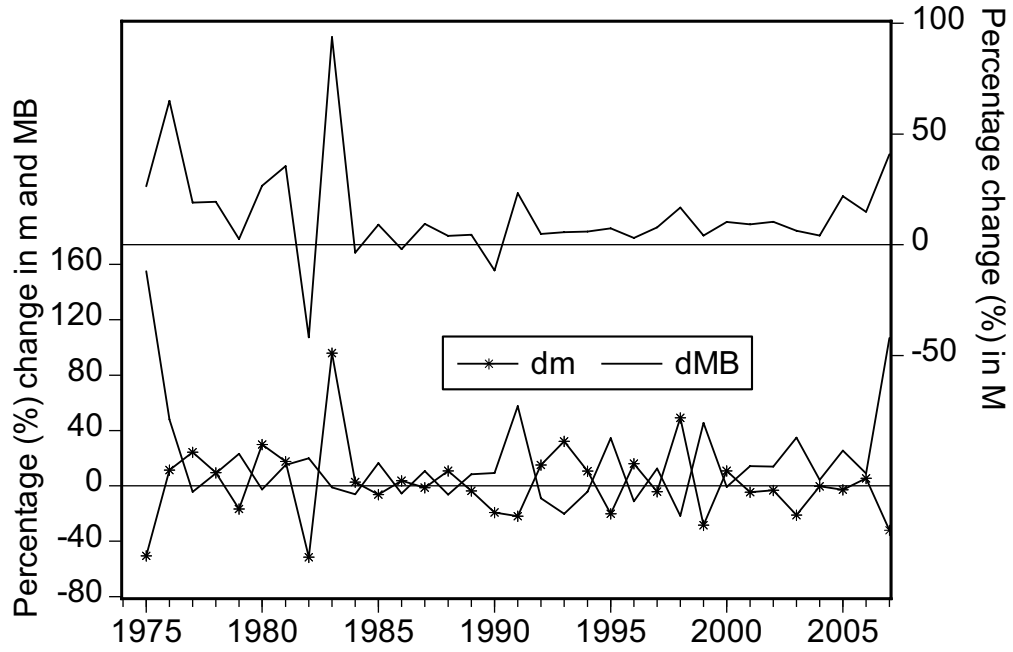
**Figure 1 Trend of CU and the world oil price (OP)**



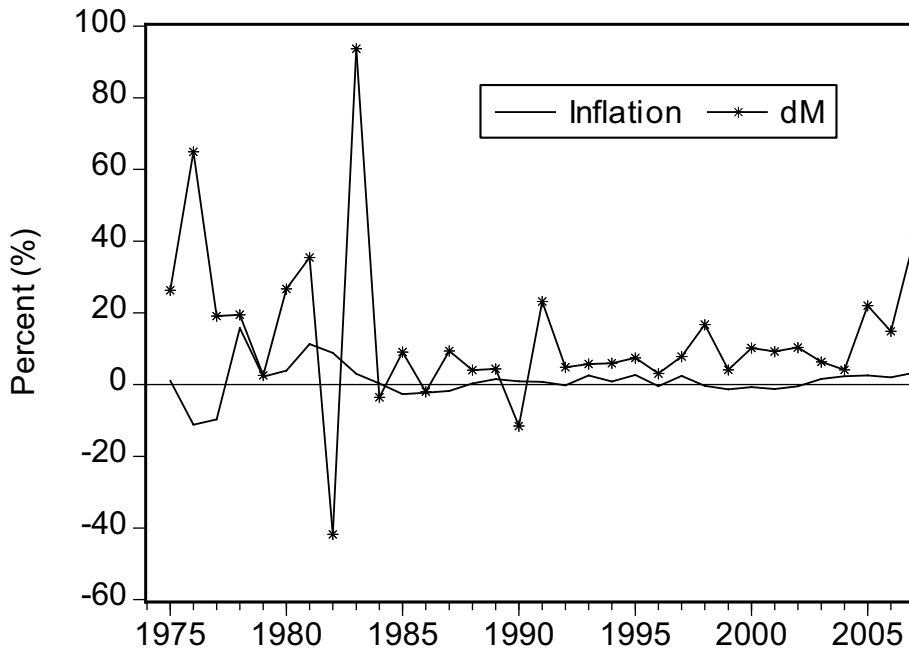
**Figure 2 Trends of money stock and its components in Bahrain**



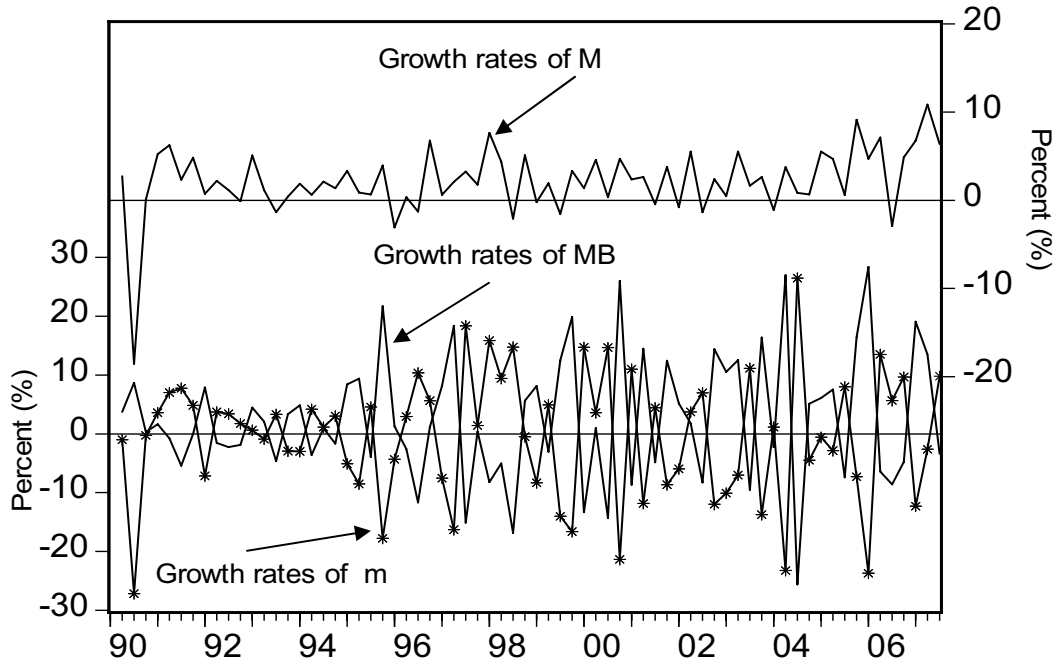
**Figure 3 Growth rates of money stock and its components**



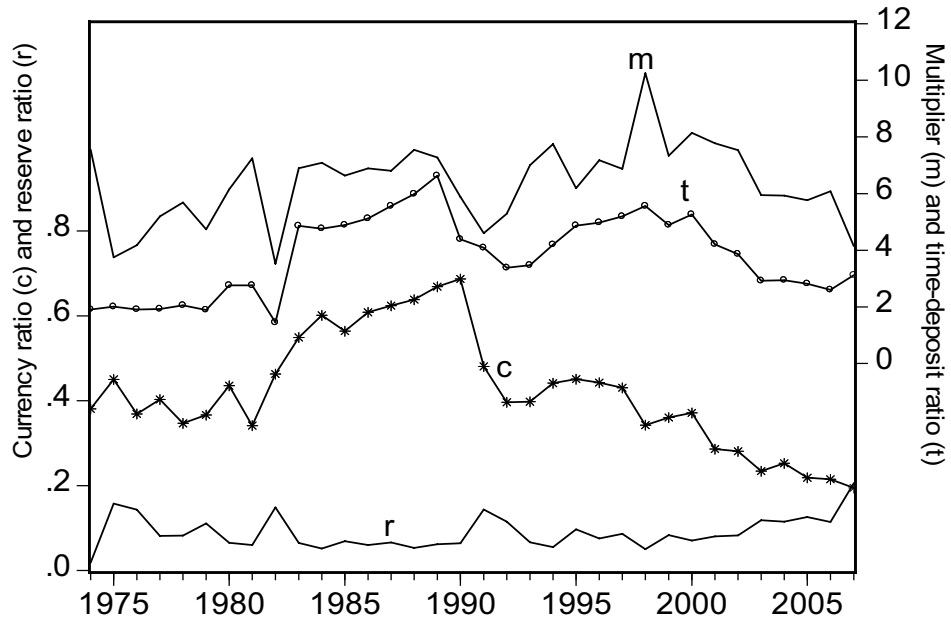
**Figure 4 Inflation and growth rates of money (dM) in Bahrain**



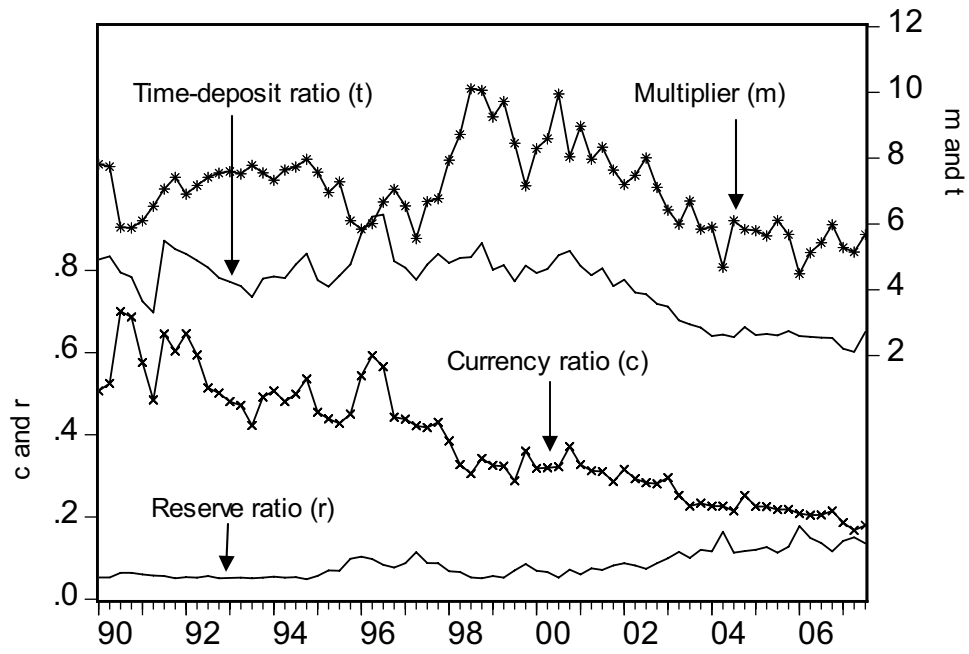
**Figure 5 Quarterly growth rates of Money and its components, 1990:1 – 2007:3**



**Figure 6 Multiplier and its components, 1974 – 2007**



**Figure 7 Multiplier and its components, 1990:1 – 2007:3**



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