"Measuring the stability of the demand for money function in Egypt"

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Measuring the stability of the demand for money function in Egypt

Abstract

This paper intends to answer the following question: Can the CBE achieve the goal of price stability under the currently applied monetary targeting regime? The answer depends on whether or not the demand for money function is stable in Egypt. Using quarterly data for the period of 1995-2007, the study estimated the long-run demand for money function in Egypt. By testing its stability for structural change, the demand for money function was found unstable. Thus, the study concludes that the central bank of Egypt cannot achieve price stability under the currently applied monetary targeting regime.

Introduction

In the late 70s, many countries, motivated by the monetarists' model, applied monetary targeting (MT) regime to fight inflation. The MT regime is established on the assumption that controlling the rate of growth of money gives control of inflation. This assumption finds its origin in the quantity equation by Irving Fisher and recently in Friedman (1968). According to Friedman (1968), monetary policy can affect real economy only during the short run. In the long run, inflation is a monetary phenomenon and real output is driven by real factors, i.e. money is neutral in the long run.

Mishkin (2000) determines three key elements for the MT: (i) announcing targets for monetary aggregates, (ii) reliance on information conveyed by monetary aggregates to conduct monetary policy, and (iii) some accountability mechanisms to prevent the deviations from the monetary targets.

In practice, no central bank applied the MT in the form of Friedman's rule of constant money growth. Moreover, not all monetary targeting-CBs disclose numeric money targets (Batini et al., 2005)[1].

The success of the MT regime in achieving the goal of price stability hinges on two basic assumptions; (i) the relationship between the goal variable and the monetary targets must be strong enough, i.e. money velocity is predictable, (ii) monetary aggregates must be under the control of CB, i.e. the money multiplier is predictable.

One lesson from the experience of the emerging market economies is that countries like Czech Republic, Poland and Brazil (CPB) were forced to float their currencies on the aftermath of economic crises during the second half of the nineties decade in order not to lose an influential part of their foreign reserves. The decision of floatation came on the backdrop of speculative attacks on domestic currency triggered by both the Asian crisis and external imbalances of current accounts. The imbalances of current accounts emerged because of pegging the foreign exchange (FX) rate in conjunction with high domestic inflation, thereby real appreciation occurred. After floating their currencies, CPB found that the inflation targeting (IT) regime is the only available option to achieve the goal of price stability upon forward-looking bases. The MT regime was not an appropriate alternative to achieve price stability especially after liberalizing capital flows and financial markets, which undermined the relationship between money supply and price level (Awad, 2009).

Although Egypt underwent similar circumstances to these countries during the second half of the nineties decade, the reaction of the central bank of Egypt (CBE) to economic shocks was different. After managing successive devaluations in domestic currency during the period of 2001-2002, the CBE announced free floating of FX rate at the beginning of 2003. Although the CBE has on several occasions announced its intention to adopt IT as a framework for its monetary policy, it has not matched words with deeds (IMF, 2007; CBE, 2005).

However, a fundamental question that has to be tackled before adopting IT is: Can the CBE achieve the goal of price stability under the currently applied MT regime? The answer depends on whether or not the demand for money function is stable in Egypt. Under a stable demand for money function, the CBE can accurately predict the demand for money and hence, control money supply in such a way as to achieve price stability. Conversely, if the demand for money function is not stable, the CBE does not have another option other than adopting IT, especially after floating the FX rate.

The rest of this paper is organized as follows. Section 1 discusses variables of the demand for money function. Section 2 highlights both data

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[1]Although the CBE is formally targeting the rate of growth of M2, it rarely discloses numeric money targets. During the fiscal year 2002-2003, the CBE targeted growth of domestic liquidity at a rate of 10%, irrespective of changes in the exchange rate (CBE, 2002-2003, p. 30).

sources and estimating procedures. Section 3 summarizes estimation results. The final Section concludes.

1. Variables of the demand for money function

The instability of the demand for money can be explained by the instability of the velocity of circulation. More frequently, the instability of the demand for money is illustrated in terms of the factors included in the demand for money function. Anderson (1985) identified three sources of instability of the demand for money: (i) Change in the velocity of circulation in response to fluctuations in interest rates as well as to movements in other arguments of the money demand function rather than real income, (ii) The demand for money function itself may shift. For instance, financial innovations and deregulation of interest rates may shift the demand for money at the prevailing levels of nominal interest rates, and (iii) Over shorter periods the money stocks actually held may not correspond to the money balances desired. If the speed of adjustment is low then such discrepancies will induce large and unexpected changes in the velocity of circulation.

Hetzel (1984) used a typical equation expressing the public's demand for real money balances (M^*) in the following form:

$$M^* = F(X) = e^k \, e^{-at} \, R^{-b} \, Y^c, \qquad (1)$$

where M^*, desired real money balances, is a function of nominal interest rate (R) and real income (Y), k is constant and at is the trend rate of growth in the income velocity of money.

Hetzel (1984) and Mehra (1993) measured the stability of the demand for money function by testing the following regression:

$$Ln \, (M/P)_t = \beta_1 + \beta_2 \, LnY_t + \beta_3 \, Ln \, R_t + \varepsilon_t. \qquad (2)$$

Wagner (1981) indicated that once the interest rate appears in the demand for money function, a stable demand for money function no longer implies a stable monetary multiplier. Bichaka and Deme (1995) estimated the demand for money function for Egypt, Morocco and Tunisia using quarterly data from 1964 to 1990. They specified the rate of growth of real demand for money as a function of real income, domestic interest rate, expected inflation rate (EP_t), nominal exchange rate ($E_{t,}$), foreign interest rates and imported inflation.

Following Bichaka and Deme (1995), real income, domestic interest rate, expected inflation rate and nominal exchange rate will be included in the demand for money function. The exclusion of both imported inflation and foreign interest rate from the specification of the demand for money function in

Egypt is for two reasons: (i) The rise in domestic price in Egypt during the second half of the seventies decade was partly induced by external factors. The FX rate was pegged to the USD during this period and, at the same time, this period witnessed a growth of inflation rates in the worldwide economy. Thus, domestic prices were negatively affected by imported inflation during that time. Although the FX rate was also pegged during the nineties decade, the rate of inflation improved in most countries including Egypt. In addition, after floating the FX rate at the beginning of 2003, movements in nominal exchange rate in the long run should reflect changes in domestic prices. (ii) The exclusion of foreign interest rate is explained by the high correlation between domestic interest rate, deposits rate, and foreign interest rates, federal fund rate (66%). Consequently, the real demand for money in Egypt can be specified as a function of the following variables;

$$(M/P)_t = f(Y_t, E_t, R_t, EP_t). \qquad (3)$$

The expected signs of explanatory variables are f_1 and $f_2 > 0$ and f_3 and $f_4 < 0$. That is, real income, Y_t, is positively related with the real demand for money. An increase in real income raises the number of transactions that people make, resulting in a rise in the real demand of money. FX rate, E_t (the price of foreign currency, USD, in terms of domestic currency, i.e. Egyptian pound), is positively related with demand for money. A decrease in FX rate appreciates domestic currency and dampens the demand for domestic cash balances. Domestic nominal interest rate (three-month deposit rates, R_t) is inversely related with the real demand of money. An increase in nominal interest rate raises the opportunity cost of holding money, resulting in a decrease in the real demand for money. The expected rate of inflation is inversely related with the demand for cash balances because of expecting higher prices of assets.

Following Bichaka and Deme (1995) and Al-Sowaidi and Darrat (2006), the lagged value of inflation, $(\pi)_{t-1}$, is included in the demand for money function to mirror the expected rate of inflation[1].

Using quarterly data covering the period of 1995Q1-2007Q4, we can check the stability of the following demand for money function:

$$(RM2)_t = \beta_1 + \beta_2 \, Y_t + \beta_3 \, E_t + \beta_4 \, R_t + \beta_5 \, \pi_{t-1} + \varepsilon_t. \qquad (4)$$

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[1] Under adaptive expectation hypothesis, expected inflation (π^*_t) takes the following form: $\pi^*_t = \pi^*_{t-1} + \gamma \, (\pi_{t-1} - \pi^*_{t-1})$ or, $\pi^*_t = \gamma \, \pi_{t-1} + (1-\gamma) \, \pi^*_{t-1}$. Under the assumption that the expectations factor (γ) = 1, or equivalently the expectations are instantaneous, the lagged value of inflation, π_{t-1}, can be used as measurement of expected inflation.

2. Data and estimation procedures

The source of the data is IFS, CD-R, 2009. As quarterly data about real GDP for the period of 1995Q1-2007Q4 are not available for Egypt either in this source or any other source, we used statistical methods to extrapolate quarterly data from the annual data for the period of 1995-2007. Lagged inflation series, π_{t-1}, is calculated from the CPI. M2 and CPI were used to calculate real money balances, *RM2*, since quarterly data are available for the two variables in the above source.

We can check the stability of the demand for money function in the Egyptian economy in two steps. The first step is to estimate the long-run demand for money function. The second step is to consider whether the long-run relationship is stable or not.

All variables included in equation (4) are introduced in the logarithm form except for the nominal interest rate and expected inflation rate. The unit root tests were performed on real money balances, (ln_RM2_t), real GDP (ln_Y_t), FX rate (ln_E_t), three-month deposit rates (R_t) and lagged CPI-inflation rate ($EP_t \equiv \pi_{t-1}$). While ln_RM2_t, ln_Y_t and ln_E_t are integrated of order one, i.e. I~ (1), both R_t and EP_t are integrated of order zero, i.e., I~ (0).

To estimate equation (4) whereas integrated variables with different orders are included, a cointegrated relationship has to exist. That is, ε_t has to be stationary[1]. According to the Johansen cointegration test, the variables ln_RM2_t, ln_Y_t, ln_E_t, R_t and EP_t are cointegrated (available upon request). In the light of this, we will check the stationarity of ε_t from the following regression:

$$ln\_RM2_t = \beta_1 + \beta_2 \, ln\_Y_t + \beta_3 \, ln\_E_t + \beta_4 \, R_t + \beta_5 \, EP_t + \varepsilon_t. \quad (5)$$

3. Estimation results

The estimation results of equation (5), as shown in Table 1, indicate that all explanatory variables came with proper signs and all of them are strongly significant at 5% level of significance, except for the expected inflation rate (EP_t). According to F-statistic, the regression relationship is significant.

Table 1. Estimation results of equation (5)

Dependent variable: LN_RM2			
Method: Least squares			
Sample (adjusted): 1995Q2 2007Q4			
Included observations: 51 after adjustments			
Variable	Coefficient	t-statistic	Prob.
C	2.999192	3.116211	0.0032
LN_Y	0.721576	9.903468	0.0000
LN_E	0.449419	13.81152	0.0000
R	-0.034212	-4.540960	0.0000
EP	-0.003646	-1.097930	0.2779
Adjusted R-squared	0.990066	Akaike info criterion	-4.219712
Durbin-Watson stat.	1.265010	Schwarz criterion	-4.030318
F-statistic	1246.769	Prob (F-statistic)	0.000000

According to Adjusted R-squared, the variables included in equation (5) explain 99% of the changes in ln_RM2_t. Unfortunately, the low value of the Durbin-Watson statistic is an indicator of the presence of serial correlation in the residuals. The Breusch-Godfrey serial correlation LM test detected first order serial correlation in the residuals of equation (5).

The LM test result suggests that we need to modify equation (5) to take account of the serial correlation. One common method to do that is to include autoregressive and/or a moving average term in equation (5).

By including an autoregressive term and re-estimating equation (5), results, as shown in Table 2, indicate that all explanatory variables are significant with proper signs and the regression relationship is strongly significant. There is no serial correlation and the regression equation captures 99% of the changes in Ln_RM2_t. According to the AIC and SIC, the later regression with AR term is better than the previous one.

Table 2. Estimation results of equation (5) with AR term

Dependent variable: LN_RM2			
Method: Least squares			
Sample (adjusted): 1995Q3 2007Q4			
Included observations: 50 after adjustments			
Convergence achieved after 8 iterations			
Variable	Coefficient	t-statistic	Prob.
C	3.306511	2.940130	0.0052
LN_Y	0.702352	8.230419	0.0000
LN_E	0.447089	11.20919	0.0000
R	-0.040070	-4.490517	0.0001
EP	-0.010566	-2.376997	0.0219
AR(1)	0.276300	1.902085	0.0637
Adjusted R-squared	0.991511	Akaike info criterion	-4.376875
Durbin-Watson stat.	2.031932	Schwarz criterion	-4.147432
F-statistic	1145.690	Prob (F-statistic)	0.000000

As previously mentioned, the stationary residuals of equation (5) with AR term, are an indicator that the

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[1] The econometric use of the term 'equilibrium' indicates any long-run relationship. Any equilibrium relationship within a set of nonstationary variables implies that their stochastic trends must be linked, i.e. the variables cannot move independently of each other. This linkage among stochastic trends necessitates that the variables have to be cointegrated. Although Engle and Granger's original definition of cointegration refers to variables that are integrated of the same order, it is possible to find equilibrium relationships within the group of variables that are integrated of different orders. This case is known as 'multicointegration' (Enders, 2004, pp. 319-323).

above regression represents the long-run, cointegration, relationship of the real demand for money. By estimating the residuals from the above regression and using the ADF unit root test, the residuals are stationary. Figure 1 shows the stationary behavior of the residuals of equation (5) with AR term.

The second step is to check whether the long-run demand for money function is stable or not. Different tests of stability can be used. Specifically, to check the stability of the above long-run demand for money function both the Chow breakpoint test and Chow forecast test will be used.
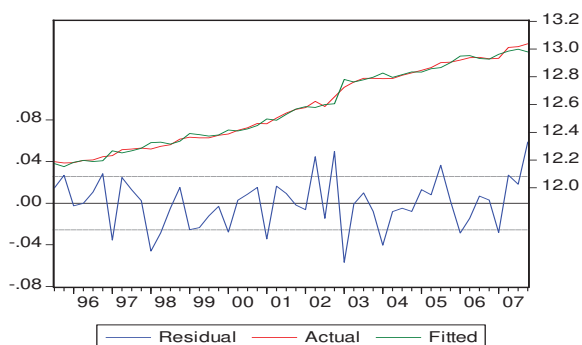

Fig. 1. The residuals of equation (5) with AR term

According to the Chow breakpoint test, the entire sample is divided into two or more sub-samples. Equation (5) with AR term is estimated separately for each sub-sample, and we test whether there are significant differences among the residuals of the estimated equations. A significant difference indicates a structural change in the relationship. Two test statistics for the Chow's breakpoint test are used: the F-statistic, based on the comparison between the restricted and unrestricted sum of squared residuals, and the log-likelihood ratio statistic, based on the comparison between the restricted and unrestricted maximum of the log-likelihood function. The test is performed under the null hypothesis that there is no structural change among the sub-samples.

According to the Chow forecast test, two models are estimated, i.e. one uses the full set of data and the other uses the sub-periods. A significant difference between the residuals of the two models is an indicator of a structural change. Two test statistics for Chow's forecast test are used: the F-statistic, based on the comparison between the restricted and unrestricted sum of squared residuals, and the log-likelihood ratio statistic, based on the comparison between the restricted and unrestricted maximum of the log-likelihood function. Both restricted and unrestricted log-likelihoods are obtained by estimating the regression using the whole sample. While the restricted regression uses the original set of regressors, the unrestricted regression adds a

dummy variable for each forecast point. The test is performed under the null hypothesis that there is no structural change between the two models.

Using different points to check whether there is a structural change in the long-run demand for money function or not, both the Chow breakpoint test and Chow forecast test, as shown in Tables 3 and 4, indicated a structural change. Both of these two tests rejected the null hypothesis, of no structural change.

Table 3. Chow breakpoint test

Test points	2001Q1	2003Q1	2005Q2
F-statistic	3.05	4.6	4.66
Prob. $F_{(6,38)}$	0.015	0.001	0.001
Log likelihood ratio	19.7	27.26	27.57
Prob. Chi-Square(6)	0.003	0.0001	0.0001

Table 4. Chow forecast test

Test points	2001Q4	2004Q1	2005Q1
F-statistic	2.24	2.18	2.17
Prob. F	0.037	0.034	0.006
Log likelihood ratio	68.65	40.47	37.43
Prob. Chi-Square	0.000	0.000	0.00

For more robust analysis, equation (5) is estimated using the real FX rate rather than a nominal FX rate. After treating autocorrelation, all variables, with proper signs, are significant except for a lagged CPI-inflation rate (EP_t). By testing its stability at the same points as in Tables 3 and 4, both the Chow breakpoint test and Chow forecast test indicate that the long-run demand for money function in Egypt is not stable (available upon request).

Conclusions

This paper intended to answer the following question: Can the CBE achieve the goal of price stability under the currently applied monetary policy regime? As the CBE is currently applying the monetary targeting regime, the answer depends on whether or not the demand for money function in Egypt is stable. Under a stable demand for money function, the CBE can accurately predict the demand for money and, hence, control money supply in such a way as to achieve the goal of price stability. Conversely, if the demand for money function is not stable, the CBE does not have any option other than adopting IT, especially after floating the FX rate.

Using quarterly data for the period of 1995-2007, the study estimated the long-run demand for money function in Egypt. By testing its stability for structural change, the demand for money function was found unstable.

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