MODELING MONETARY POLICY RULES IN THE MENA COUNTRIES: ISSUES AND EVIDENCE

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─Abstract ─

This paper estimates the monetary policy reaction function for two sets of MENA countries: The inflation target countries, (Turkey and Israel) and the exchange rate target countries, (Jordan and Morocco). We motivate our empirical analysis by analyzing a simple Taylor rule. This model looks at the effects of inflation and output on setting the interest rate by the central bank. Furthermore, we extended our model by adding the exchange rate and the foreign interest rate using similar model used by Clarida et al (1998) with using GMM estimator.

Findings of this study yield some interesting results, all the central banks in the sample uses interest rate smoothing in managing their monetary policy. In addition, The Central bank in Turkey, Israel and Morocco focuses on achieving low level of inflation. On the other hand, the Monetary Authority in Jordan cares about stabilizing the output gap. Estimating the extended Taylor rule suggests the highly significant effect of foreign interest rate on setting the interest rate in Turkey. Taken all together, the results lend support to the importance of following a rule rather than discretionary in reducing the inflation rate and credible monetary policy. In addition, the simple Taylor rule can be applied on MENA countries but it requires some modification such as adding the exchange rate and the foreign interest rate.

Key Words: *Taylor Rule, Monetary Policy, Exchange rate.*

JEL Classification: E52.

1. INTRODUCTION

1.1 Simple Taylor Rule vs. Extended Taylor Rule

After Taylor (1993) came up with his innovation rule, a growing literature and empirical studies have been presented mainly on developed economies. The rule

declares that the central bank formed the interest rate with regard to two variables; deviations of inflation from an announced target rate and deviations of real output from its equilibrium level. Orphanides (2003) noted that monetary policy of Fed since the Treasury Federal Reserve accord and during 1920s can be broadly addressed with Taylor rule framework.

Researches extended Taylor rule from closed economy to an open economy framework. Most empirical study as Clarida et al. (1998) has reported the importance of adding external factors for open economies. Ball (2000) implied a Taylor rule with exchange rate on small open economies. He suggested that the original Taylor rule should be modified for an open economy by including the exchange rate in the interest rate rule. Svensson (2000) estimated Taylor rule including the foreign interest rate, the foreign exchange risk premium, as well as the real exchange rate in a forward-looking framework.

Now, can 'Taylor rule' describe the reaction function of the monetary policy in developing countries? The features of the developing economies differ from those of developed ones, so monetary policy rules as Taylor (2000) stated, needed some modifications before applying them on such economies. Some researches, as Alper and Ozan (2006), investigated the importance of including the exchange rate in Taylor rule. Filosa (2001) found that most countries under investigation[1] responded strongly to the exchange rate. Others as Clarida et al (1998) argues that the international interest rate has an impact, besides the movements of the exchange rate on setting the interest rate. The finding shows empirically significant influence of these two variables in setting the interest rate with varying degree of the influences among the countries under investigation

In an attempt to partially fill the gap in the lack of the empirical studies in this area, this piece of research has been chosen to investigate the idea, of whether the simple Taylor rule could work for MENA economies, or if it requires some modifications such as adding the movement of exchange rate and foreign interest rate. In order to do so, simple Taylor rule has been estimated and extended Taylor rule with exchange rate and foreign interest rate has been estimated also.

2. METHODOLOGY

The existing empirical studies on baseline Taylor rule use the following rule,

1-These countries are Indonesia; Korea; Malaysia; Thailand; Brazil; Chile, and Mexico

$$i_t = \bar{i} + \beta(\pi - \pi^*)_t + \gamma(y - y^*)_t + \varepsilon_t \qquad (1)$$

i_t is the desired nominal interest rate, $\bar{i}$ is the equilibrium nominal interest rate, π is the rate of inflation, π^* is the inflation target, y, y^* are the natural log of the output and ,potential output respectively, β reflects the weight that monetary authority puts on inflation stabilization, γ express the relative weight that the central bank places on output expansions relative to inflation stabilization, and ε_t is a white noise error term.

Allowing for interest rate smoothing and as Clarida et al (2000) pointed out that the lagged value of actual interest rate i_{t-1} and the target level i^*_t can form the actual interest rate i_t. The mathematical equation will be as following:

$$i_t = (1-\rho)i_t^* + \rho i_{t-1} + \nu_t \qquad (2)$$

By defining $\alpha = \bar{i} - \beta\pi_t^*$ and rewrite both equations (1) and (2), we obtain the following equation with the interest rate smoothing policy:

$$i_t = \rho i_{t-1} + (1-\rho)\alpha + (1-\rho)\beta(\pi - \pi^*)_t + (1-\rho)\gamma(y - y^*)_t + \eta_t \qquad (3)$$

For the purpose of estimating equation (3) the term $(1-\rho)\alpha$ can be expressed as $c = (1-\rho)\alpha$. The monetary interest rate target will be presented in the following model:

$$i_t = c + \rho i_{t-1} + (1-\rho)\{\beta(\pi - \pi^*)_t + \gamma(y - y^*)_t\} + \eta_t \qquad (4)$$

The above model does not take account to the additional factors that might have an effect on setting the interest rate in developing economies such as exchange rate movements and foreign interest rate. The external influence can be measured by adding the term z_t to (4) as Clarida et al (1998) demonstrated.

$$i_t = c + \rho i_{t-1} + (1-\rho)\{\beta(\pi - \pi^*)_t + \gamma(y - y^*)_t + \theta z_t\} + u_t \qquad (5)$$

Where z_t is a parameter that captures the external effects on setting the interest rate, for example the movement in nominal exchange rate from its target and the nominal foreign interest rate for the USA and Germany. We estimate Augmented Taylor rule by defining z_t as the exchange rate gap and foreign interest rate.

$$i_t = c + \rho i_{t-1} + (1-\rho)\{\beta(\pi - \pi^*)_t + \gamma(y - y^*)_t + \phi(x - x^*)_t + \lambda i_t^f\} + u_t \quad (6)$$

Where $(x - x^*)$ is the deviation of actual nominal exchange rate from its trend, and i_t^f is the nominal foreign interest rate.

3. EMPIRICAL RESULTS AND DISCUSSION

3.1 Data and unit root test:

We use quarterly data 2002Q1-2009Q4 for Turkey, 1994Q1-2009Q3 for Israel, 1992(1)-2010(1) for Jordan, and 1994(1)-2009(4) for Morocco. The data sources are from the International Financial Statistics Published by the International Monetary Fund (IMF) and also from the Central banks of the countries under investigation.

We use the money market rate for Turkey, Jordan and Morocco and the discount rate for Israel. Inflation calculated as the annual change in the consumer price index (CPI). We model the output gap as the difference between the log of real GDP (y) and the log of potential output (y^*) which is calculated by using Hedrick-Prescott filtering (HP). The nominal foreign interest rate (i^f) used for Turkey is the interest rate in Germany and the U.S federal funds rate for Israel, Jordan, and Morocco. We use nominal exchange rate (x) for each country against the USA dollar. The nominal exchange rate gap $(x - x^*)$ calculated as the difference between the nominal exchange rate and Hedrick-Prescott trend value (x^*).

Stationary test applied using Augmented Dickey-Fuller (ADF) test (Said and Dickey, 1984) and Phillips-Perron (PP) test. (The results are not reported but are available on request). The finding reports that output gap and exchange rate gap are stationary variables for the entire sample. The inflation rate and the foreign interest rate became stationary after the first difference in the case of Turkey and Israel. However, they are stationary on the level value in Jordan and Morocco. The order of integration of the interest rate is more ambiguous but we consider this variable as stationary following Martin and Milas (2002). (See also for more information about this issue Fuhrer and Moore 1995)

3.2Monetary policy rule for MENA countries with inflation target:

The estimation will be for two sets of countries: the MENA countries with inflation target regime (Turkey and Israel) and the MENA countries with exchange rate target (Jordan and Morocco).

Equation (4) estimated by using Generalized Method of Moments (GMM) (Hansen, 1982), with an optimal weighting matrix (linear estimation with 1 weight update estimation weight matrix: HAC – Bartlett Kernel Newey-Westfixed Bandwidth= 4.0000) that accounts for possible serial correlation in u_t.

In the case of Turkey, we estimated simple Taylor rule for the inflation target period started in 2002. The findings in table (1) show that inflation is significant at 5% critical values, while the output gap is insignificant. These findings match the theoretical assumption about the positive sign of the inflation rate and the output gap. It is also found that the central bank of Turkey uses interest rate smoothing (0. .88) in managing its monetary policy

In the case of Israel equation (4) suggests a relatively high degree of interest rate smoothing as the coefficient on the lagged interest rate is (0.97). With regard to the inflation, the coefficient appears to be positively highly significant at all critical value. A 100 basis point rise in the annual inflation rate induces the central bank to raise the nominal interest rate by 17 basis points. With respect to output gap, table (1) shows statistically significant coefficient with a very small weight placed on the output gap. This finding shows that the central bank of Israel is concerned about fighting the inflation.

Now, we consider alternative to the baseline specification, equation (6). We add the exchange rate gap and the foreign interest rate. To begin with, introducing the foreign interest rate plays a significant role in setting the interest rate in Turkey. More specifically, as can be seen from table (1), the movement in the exchange rate has a highly significant effect on the interest rate in Turkey (6.56). In addition, the model confirms the role of the foreign interest rate in setting the interest rate in Turkey. After adding the exchange rate gap and the foreign interest rate, the output gap became significant. The estimate of smoothing parameter is high and significant (0.84). The validity of the over-identifying restrictions is confirmed by the J-statistic.

Table (1): Estimated results for Taylor Rule **in Turkey & Israel**, using GMM estimator

	Turkey		**Israel**	
	Baseline Taylor Rule	Extended Taylor Rule	Baseline Taylor Rule	Extended Taylor Rule
Variables	2002 (1)- 2009(4)		1992(1)-2009(3)	
c	0.802656 (0.399499) *	1.549743 (0.370039) ***	0.050597 (0.165067)	0.180485 (0.040071) ***
i_{t-1}	0.883371 (0.029122) ***	0.848183 (0.019007) ***	0.965494 (0.016292) ***	0.955076 (0.005406) ***
$(\pi_t - \pi^*)$	0.198198 (0.083060) **	0.229425 (0.044784) ***	0.166326 (0.044690) ***	0.189407 (0.012472) ***
$(y - y^*)$	0.568487 (0.572615)	1.276808 (0.256131) ***	0.052541 (0.023669) **	0.142039 (0.015325) ***
$(x - x^*)$		6.561136 (1.354774) ***		0.995732 (0.268223) ***
if		2.371135 (0.216936) ***		0.512655 (0.090369) ***
R^2	0.97	0.98	0.94	0.95
S.E.R	2.206	2.007	1.08	1.05
DW	1.49	1.86	1.72	1.82
Inst.validity	[0.79]	[0.96]	[0.97]	[0.99]

Note:

(a) *, ** and *** indicate significant at 10, 5 and 1% respectively. Numbers in parentheses are the standard errors of the estimates. Numbers in square brackets are the probability of test statistics. Inst.validity is the p-value of J-test of exogeneity values of the instrument,

A constant and up to 4 lags of all variables are included for the estimation as instruments

By looking at the R-squared of the augmented Taylor rule (0.98), we can draw a conclusion that the optimal policy rule for central bank is to include the movement in the exchange rate and the foreign interest rate in its reaction function.

About the monetary policy in Israel, after adding the foreign interest rate and the exchange rate gap to baseline Taylor rule, the weight on output gap increase from (0.05) to (0.14). Table (1) shows that the movement in the Federal Fund rate has an effect on setting the nominal interest rate in Israel. In another word, a 100 basis point increase in the Federal Fund rate will increase the nominal interest rate in Israel by 51 basis point. Also, the central bank of Israel is sensitive to the movement in the exchange rate gap as the coefficient of the exchange rate gap is statistical significant (0.99).

Adding the exchange rate gap and the foreign interest rate increase the fit of the model as the R-squared becomes (0.95). This results reports that the optimal

policy rule for central bank is the augmented Taylor rule with the exchange rate and the foreign interest rate.

3.3Monetary policy rule for MENA countries with exchange rate target:

For many years the central bank of Jordan has operated within a regime of fixed exchange rate. The central bank of Morocco announced its policy target as monetary target of (M1) and price stability but the official target preserves the stability of currency. In our estimating for these two countries, we replace the inflation gap with the inflation rate, because the two countries do not have any announced inflation target.

First, we estimate simple Taylor rule. In Jordan, the key finding reports that the Monetary Authority is not concerned about fighting the inflation as the coefficient is insignificant. However, the estimation of the output gap reports a positive and also statistically significant sign (6.86). The high coefficient on the output gap (6.86) explains the high concern of the central bank to the movement in the output gap.

Now, we will look at the monetary policy in Morocco. The finding shows that the parameter of the inflation rate is insignificant at all critical value. In addition, the coefficient of estimated output gap (0. 36) is insignificant. Another interesting result is that the monetary authority in Morocco is using the adjustment parameter in order to smooth the interest rate. The coefficient on the lagged interest rate is highly significant (0.96).

Now, the estimated equation coefficients for the augmented Taylor rule in Jordan and Morocco using GMM are reported in Table (2). With regard to whether the foreign and exchange rate gap play any role in setting the nominal interest rate in Jordan. Table (2) shows that the movement of the exchange rate gap is a concerned for the central bank of Jordan. In addition, a rise in the Federal Funds rate of one percent induces the monetary authority in Jordan to increase the nominal interest rate by (0.159).

Table (2): Estimated results for Taylor Rule **in Jordan &Morocco**, using GMM estimator

	Jordan		**Morocco**	
	Baseline Taylor Rule	Extended Taylor Rule	Baseline Taylor Rule	Extended Taylor Rule
Variables	1992(1)-2010(1)		1992(1)-2009(3)	
c	0.192356 (0.166926)	0.165439 (0.164640)	0.080448 (0.107772)	0.091100 (0.102143)
i_{t-1}	0.979636 (0.015705) ***	0.983648 (0.015405) ***	0.963700 (0.016953) ***	0.953048 (0.018969) ***
(π)	0.914004 (0.905589)	0.075450 (0.730793)	2.069470 (3.166250)	4.194498 (2.067390) **
$(y - y^*)$	6.865777 (3.408377) **	9.754302 (2.785887) ***	0.369525 (1.598403)	2.059792 (2.227526)
$(x - x^*)$		0.534156 (0.112935) ***		-1.488873 (0.507782) ***
if		0.157099 (0.042752) ***		0.291635 (0.043671) ***
R^2	0.97	0.98	0.96	0.96
S.E.R	0.268	0.241	0.411	0.411
DW	1.52	2.07	2.07	2.15
Inst.validity	[0.23]	[0.53]	[0.50]	[0.68]

Note:

(a) *, ** and *** indicate significant at 10, 5 and 1% respectively. Numbers in parentheses are the standard errors of the estimates. Numbers in square brackets are the probability of test statistics. Inst.validity is the p-value of J-test of exogeneity values of the instrument,

(b) A constant and up to 4 lags of all variables are included for the estimation as instruments.

The estimated results in Jordan suggest that the central bank of Jordan with its fixed exchange rate policy is to maintain economic growth rather than focusing on price stability.

With regard to Morocco, adding the exchange rate gap and the foreign interest rate make the inflation coefficient significant as reported in table (2). This explains the important role of the two variables in setting the interest rate in Morocco. The bank of Morocco looks different from the Bank of Jordan. We find that the output gap is insignificant in the case of Morocco while it is highly significant in Jordan. On the other hand, the inflation rate seems to be statistical significant in Morocco but it is the opposite in Jordan. According to this, we could draw a conclusion that the central bank of Morocco aims to fight the inflation, while the central bank of Jordan concerns about the growth of the GDP. With respect to the lagged of the interest rate, the coefficient is positive and significant

(0.96). All the variables enter the extended Taylor rule with the expected positive sign except the coefficient on the exchange rate gap with negative sign. Studying whether the bank of Morocco takes USA monetary policy as external constraint, the results show the Federal Fund rate is significant at all conventional critical values.

The conclusion, we could draw about monetary policy in Morocco is that the central bank is using it policy to achieve price stability rather than output growth as in the case of Jordan.

4. CONCLUSION

In this piece of research, we investigate the idea of whether the output gap and the inflation rate is enough to describe the state of the economy in MENA countries, or additional elements should be added, such as the exchange rate and foreign interest rate.

Firstly, we find that the reaction of the central bank to inflation differs across the studied sample. The nominal interest rate responses significantly and positively to inflation in Turkey, Israel and Morocco. However, the results report that monetary authority does not care about stabilizing the inflation rate in Jordan.

Secondly, the finding shows that the monetary policy in Jordan cares about stabilizing the output gap.

Thirdly, the results show that all four central banks in the sample adjust and smooth the interest rate movement as the lagged of the interest rate is significant. Fourthly, introducing the exchange rate gap and the foreign interest rate play a significant role on setting the interest rate. More specifically, all the four countries appear to be sensitive to the exchange rate gap. Also, in the case of Turkey, the foreign interest rate has more influence in setting the nominal interest rate than the other variables with (6.56).

Finally, the behavior of the central bank of MENA countries can be described by simple Taylor rule. Furthermore, it has been found that there are other elements affect on the behavior of the nominal interest rate, besides the inflation and output gap, namely exchange rate gap and foreign nominal interest rate. According to that, we could conclude that simple Taylor rule need some modification to be applied on the MENA economy.

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