The Influence of Introducing the Taylor Rule on the Exchange Rate in Iran

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Abstract

Recent studies find empirical support for the role of monetary policy rules, such as Taylor rules, in exchange rate determination.

The short term interest rate in Islamic Republic of Iran (IRR) is not determined by any rule based monetary policy that may affect the exchange rate (Rial-Dollar) and its fluctuations. This paper introduces Taylor rule as a new strategy to Iran's monetary policy. Indeed, this is the first attempt to deal with a rule based monetary policy strategy in Iran's economic performance. Hence, we estimate the short term interest rate with respect to the Taylor rule and calculate the difference of actual short interest rate and the fitted interest rate as a Taylor rule deviations. The latter is considered a relationship between the real exchange rate and the interest rate in the Taylor rule exchange rate model. In this step, we consider two specifications. In the baseline specification only the macro fundamentals variables (inflation gap and GDP gap) are considered, whereas in the second specification Taylor rule deviations are included as well.

The empirical results indicate that there are significant effects of inflation gap and GDP gap on real exchange rate, and the Taylor rule deviations cause to reduce significantly the effect of those variables on exchange rate in Iran.

JEL classification: F31, E5, F41

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1. Introduction

It is important for monetary policy makers that can keep stability of economy. In this regard, they need to make proper decision when some changes in fundamental economic variables occur via some rules supporting by empirical studies, such as Taylor rules[1].

Based on findings of recent studies about the role of the Taylor rule as a monetary policy rule, there is a linkage between exchange rates and economic fundamentals. In addition, the empirical studies find that the benchmark Taylor rule model is also found to perform relatively better than the standard monetary model and the purchasing power parity (PPP) model (Wang & Wu , 2009).

Before introducing Taylor rule in 1993, the Meese-Rogoff puzzle in 1983 indicates that exchange rates may be determined by something purely random rather than economic fundamentals such as the money supply, trade balance and national income.

Since then, the application of the Taylor rules to model exchange rate determination is considered by economists and its usage is growing as well, in different aspects like as combinations of economic variables, length of study period (short-term/long-term), fundamental-based framework and econometric methods. In this regard, some studies can be mentioned: deriving the exchange rate as a present-value asset price from a Taylor rule model by Engel and West (2005), using panel data by Groen (2000), Mark and Sul (2001) [Wang & Wu , 2009], and Engel, Mark and West (2007), considering Taylor rule deviations (wilde,2010).

This paper explores the link between an interest rate rule as a monetary policy and the behavior of the real exchange rate. In addition, the aim of this study is to determine whether the deviation from the Taylor rule, when

[1]. Taylor rule (1993) considers nominal interest rate is set as a function of current inflation and output.

monetary policy follows a Taylor rule interest rate reaction function, is an important variable helping to explain the movement of the exchange rate.

The short term interest rate in Islamic Republic of Iran is not determined by any rule based monetary policy that may affect the exchange rate (Rial-Dollar) and its fluctuations. Hence, we try to study the application of the Taylor rule and Taylor rule deviations as a monetary policy strategy for Islamic Republic of Iran's economic performance for the first time.

The outline of the paper is as follows. Section two describes the theoretical models we use. In section three variables and data are introduced. The procedure of variables estimation and computing and measures for the Taylor rule deviations are explained. In section four the empirical results of two models (with and without considering the Taylor deviations) estimation are presented. Finally Section five concludes the paper.

2. Theory

2-1. The Taylor rule for interest rate

The Taylor rule was introduced by John Taylor (1993) for the first time. This rule stipulate that central banks pursuing a policy of economic stabilization, should react to changes in inflation or in output gap by adjusting the short term nominal interest rate in the following manner: if either inflation is above its target and/or output rises above potential output, central banks should raise its nominal interest rate in order to bring the economy back to equilibrium (Cleide Mara, 2010).

The simplest model introduced by Taylor is:

(1)

$$i_t = r^{eq} + \pi_t + 0.5(Y_t + (\pi_t - \pi^*))$$

where i_t represents the recommended policy rate as measured by the central bank; r^{eq} represents the equilibrium real interest rate; $(\pi_t - \pi^*)$ represents the

deviation of the inflation rate (π_t) from its long-run target (π^*); and Y_t represents the output gap—the level of actual GDP (y_t) relative to potential GDP (y_t^*).

According to the Taylor rule, the central bank raises the target for the short-term nominal interest rate if inflation rises above its desired level and/or output is above potential output.

This rule indicates if the inflation rate increases by one percent the interest rate should be increased by 1.5 times and if output gap increases by one percent interest rates should be increased by 0.5 times in order to be able to control the current inflation rate in the economy to sustain the purchasing power. Although, it should be noted that in Taylor rule reaction coefficients and equilibrium interest rate are affected by the economic structure of different countries and they can't remain at a steady rate over time.

Hence, prior to general citation to this rule for setting the interest rate in a country it is necessary to estimate the aforementioned coefficients. In this regard, we explain Taylor's original model as follows and then estimate it.

(2)

$$i_t = \alpha_0 + \alpha_1(\pi_t - \pi^*) + \alpha_2(y_t - y_t^*)$$

where i_t represents the recommended policy rate as measured by the central bank; $\alpha_0 = r^{eq} + \pi_t$ represents the equilibrium real interest rate plus inflation rate; $(\pi_t - \pi^*)$ represents the deviation of the inflation rate (π_t) from its long-run target inflation rate (π^*); and $(y_t - y_t^*)$ represents the output gap—the level of real GDP (y_t) relative to potential GDP (y_t^*).

2-2. The Taylor rule for exchange rate

In this paper the evaluation of introduction to Taylor rule for determining the interest rate as well as Taylor deviations variable on Iran's exchange rate (Rial-

Dollar) is considered. For this purpose we use the Taylor's basic model with consideration of Taylor deviations that is specified as follows:

(3)

$$R_{1t} = \alpha_0 + \alpha_1 GGDP_{1t} + \alpha_2 GP_{1t} + U_{1t}$$

(4)

$$R_{2t} = \alpha_0 + \alpha_1 GGDP_{2t} + \alpha_2 GP_{2t} + \alpha_{3t} DV_t + U_{2t}$$

In the first model, the exchange rate (R_{1t}) is function of macro variables such as output gap ($GGDP$) and inflation gap (GP), while in the second model, Taylor deviations variable (DV) is also added. Taylor deviations are defined as difference between real short-term interest rate and interest rate base of Taylor path.

Thus, the interest rate should be estimated via the Taylor rule, before calculating it.

3. Variables and Data

The information used in this paper is obtained from database of the Central Bank of the Islamic Republic of Iran for the period 1368 - 1390. But it's worth mentioning that according to the Taylor rule in equation (2), the nominal short-term interest rate is a function of the equilibrium real interest rate, inflation gap and output gap.

But since none of the statistical data of these variables are officially published, inevitably they should be estimated before estimating the main models.

3-1. Output gap

Output gap expresses the difference between potential GDP and actual GDP. Hence, in order to calculate this variable, first the potential GDP must be estimated.

The amount of potential GDP is calculated in different methods, such as the production function approach, the trend line between peaks, capital-output ratio, actual output process and the trend line between adjusted peaks.

In this paper, the actual production process method is used. This method is based on the different time trends test for actual output. Such that, the best time trend is determined based on the highest coefficient of determination or the Mean Sum of Square Error.

After the desirable trend between actual output points is identified and calculated, we shift the above estimation upward so that all the points on the fitted function are placed above the actual output. Hence, there will be no points on the fitted above function under the drawn points of the potential output function.

The general equation of estimable models is:

(5)

$$GDP_t = \alpha_0 + \sum_{i=1}^{3} \alpha_i t^i + U_t$$

In that, GDP is the real gross domestic production and t is the trend variable. This equation is estimated by considering polynomials of first, second and third degree.

The results are shown in table (1).

Table (1)- different time trend estimates for output

	1st degree	**2nd degree**	**3rd degree**
α_0	46165/71 (53/03)	47947/59 (38/01)	42656/43 (32/75)
α_1	728/447 (33/19)	570/94 (6/72)	1532/556 (9/21)
α_2	–	2/306 (1/92)	−33/154 (−5/82)
α_3	–	–	0/347 (6/318)
R^2	%91/6	%95/9	%96/2

Source: research calculations

Table (1) shows that the best fitting is related to the third equation which is a time series of trend with three different powers in relation with the actual output variable. After choosing the best model, we calculate the desired trend and shift it upward in a way that all the actual output points are placed beneath it. In this way the actual output and the desired gap are obtained.

3-2. Inflationary Gap

Inflationary gap, shows the difference between targeted inflation and actual inflation. Since targeted inflation is determined annually in development planning, inflation gap is simply calculated by the difference between this amount and the inflation published annually by the Central Bank.

3-3. Equilibrium real interest rate estimation

With respect to recent studies, estimating the real equilibrium interest rate is difficult but there are still some methods for this purpose, using the weighted average real interest rate during the period under review being one of these methods.

Although, in countries with low validity of their monetary policies, the actual interest rate is high which leads to higher than expected estimation of equilibrium real interest rate and Iran is not an exception.

Thus, we attempt to achieve realistic results by eliminating the low validity of monetary policies in related to the past actual interest rate. Hence, we consider the following regression:

$$r^{eq} = \alpha_0 + \alpha_1 dep + u \qquad (6)$$

In that, r^{eq}, is the equilibrium real interest rate and *dep,* is the depreciation rate.

This equation is estimated by using data during the period 1368 – 1389.

The estimation of coefficients is as follows:

$$r^{eq} = 0.07 + 0.2dep$$

After estimating the above regression, we assume the depreciation rate to be zero so that the real equilibrium interest rate equals the intercept that is 0.07.

3-4. Estimation of the nominal interest rate based on Taylor rule

With respect to the equation (2), the equilibrium interest rate, recessionary gap and inflationary gap are explanatory variables that information regarding them for the period 1368 – 1389 as was mentioned above.

However, use of appropriate data for nominal interest rate as the dependant variable is also noteworthy. Because on one hand, even in developed countries obtaining precise data regarding interest rate is very challenging and researchers use different proxy for this variable. On the other hand, the interest rate in Iran is imperatively determined by monetary authorities without considering money market (interaction of supply and demand of money) and reliable data and statistics for interest rate in unofficial market that is subject to supply and demand is also unavailable.

Hence, in this paper based on the result of Iranian experiential studies, short-term nominal interest rate is considered as the weighted average of interest rate of different kind of short term (less than a year) bank deposits (Komeijani et al., 2008).

Before estimating nominal interest rate, the stationary of the aforementioned time series has been tested using Dickey and Fuller test as the most popular.
The results of estimating equation (2) using data for the period 1368 - 1389 are as follows:

$$i_t = 0.28 + 0.6\pi_t + 0.4(y_t - y_t^*) + 0.75(\pi_t - \pi^*)$$

The estimated coefficient of determination is 89 percent which is good evidence for explanation of the specified equation and is actually approving of the Taylor rule for determining the interest rate policy in Iran.

In addition, the coefficients regarding GDP gap and inflationary gap for Iran are 0.4 and 0.75 respectfully. In other words, if inflation gap is increased by one percent the interest rate must increase by 0.75 times of that amount, and if GDP gap increases by one percent the interest rate must increase by 0.4 times, in order to be able to control the inflation of economy for the purpose of maintaining purchasing power.

3-5. Taylor Deviations

Taylor rule deviations occur if the short term interest rate persistently deviates from an interest rate path consistent with the Taylor rule (Wilde, 2010). In this paper, Taylor rule deviations are considered as residual term of estimating regression (2) and are inserted as the explanatory variable in the second model related to exchange rate.

4. Estimation Results

In this section, theoretical models of exchange rate that have been presented in both specifications (3) and (4), are estimated using data for the period 1368 – 1389, and also estimated variables for Iran's economy in the previous section. The results are as follows:

$$R_{1t} = 0.21 + 0.3GGDP_{1t} - 0.45GP_{1t}$$
$$\quad (2.3) \quad (3.6) \qquad (-3.08)$$

$$R_{2t} = 0.2 + 0.17GGDP_{2t} - 0.23GP_{2t} - 1.6DV_t$$
$$\quad (2.01) \quad (5.3) \quad (-4.7) \qquad (-4.2)$$

As a general rule, a country with a consistently lower inflation rate exhibits a rising currency value, as its purchasing power increases relative to other currencies [1:52]. Thus, negative coefficients of inflation gap, in both equations, indicate that as inflation rate exceeds of targeted inflation rate, the inflation gap is increasing at the same percent then exchange rate, is likely to reduce with the coefficient of .45 and 0.23. Respectively, in both equations the coefficients of

output gap are positive, where for one percent increase in this variable, exchange rate is increased by 0.3 and 0.17 percent. In second model considering the Taylor deviations via interest rate deviations, we find a negative sign and 1.6 amounts for its coefficient. It shows that if interest rate deviations increase by one percent, exchange rate will decrease by 1.6 percent. All these estimates are significant at1% level of significance. As results of estimating indicate, the signs of coefficients of the GDP gap in both estimated models are the same, and also the signs of coefficients of the inflation gap are identical but the amounts of mentioned coefficients are different.

In second model considering interest rate deviations as the Taylor deviations, the absolute amounts of coefficients are less than the first model.

5. Conclusion

We have introduced the Taylor rule as a new strategy to Islamic Republic of Iran's monetary policy. In this regard, we have constructed an empirical model that has presented the effects of the Inflation gap and GDP gap on real exchange rate (Rial-Dollar) with two specifications, without and with considering interest rate deviations as the Taylor deviations. The results have supported that the real exchange rate (Rial-Dollar) in IRR is affected by the mentioned fundamental macroeconomic variables and the interest rate deviations. They have showed, for the period 1368 – 1389, the direction of real exchange rate (Rial-Dollar) changes is the same as Iran's GDP gap changes, but it is the inverse of Iran's inflation gap changes.

Finally, by comparing the results of the two estimated models, it can be concluded that the Taylor deviations cause to reduce significantly the effect of fundamental macroeconomic variables on exchange rate in Iran.

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