Abstract

This study seeks to test the hypothesis that policy interest rate in Jordan adjusts differently to expansionary versus contractionary monetary policies. The answer highlights on the behavior of the central bank of Jordan (CBJ), and helps to conclude if the CBJ is biased in favor of certain policy. The current study applies threshold autoregressive (TAR) and momentum TAR (MTAR) models. The results show that policy interest rate in Jordan displays symmetric adjustment which supports the idea that the CBJ is not prejudice of either easy or tight monetary policy. 

JEL Classification: C12, E58

Keywords: Hypothesis Testing, Monetary Policy, Central Bank, TAR Model.

1. Introduction

Economic studies on the macroeconomic level confirm that many important economic variables display asymmetric adjustment and asymmetric effect. Sichel (1993) stated that the importance of such phenomenon arises from a desire to understand facts about business cycles and other economic variables. Also, standard time series models are unable to represent asymmetric behavior under certain assumptions. Economists used different techniques to explore both asymmetric adjustment and asymmetric effect. Literature provides us with considerable studies concerning both effects. Neftci (1984) demonstrated that the U.S. unemployment rate has an asymmetric adjustment over various phases of the business cycle. Terasvirta and Anderson (1992) presented evidence from 13 countries that the industrial production responds more to negative shocks than to positive shocks.

Cover (1992) showed that an expansionary monetary policy in the U.S. economy does not affect the output, while a contractionary monetary policy affects the output. On the contrary, Ball and Mankiw (1994) showed that positive monetary shock is more likely to induce price adjustment than is a negative shock. Holly and Stannett (1995) found tentative evidence of asymmetric adjustment of consumers’ expenditure in the UK. Karras (1996) found strong evidence from 38 countries in favor of asymmetric effect of monetary policy. Enders and Granger (1998) presented evidence from the U.S. economy showed that the movement toward the long-run equilibrium of the interest rate is asymmetric process. Similarly, Dueker (2000) found evidence supports asymmetry in the prime rate in favor of lower prime rate. Kaufmann (2001) confirmed asymmetric effect of monetary policy in Austria. Peersman and Smets (2001) used data from 7 countries of the euro area and found asymmetric effect of monetary policy in Germany, France, Italy, Spain, and Belgium. Thompson (2006) proved that the prime lending-deposit rate spread displays asymmetric adjustment.

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Dueker (2000) explained why to expect asymmetric adjustment, and said banks are risk averse; they prefer smooth profits rather than a volatile one. Also, banks avoid false starts for either not to lose their market share or not to have a higher risk of default. Moreover, Thompson (2006) argued that the asymmetric adjustment is due to information asymmetries between banks and their customers. If arrangement is set between bank and customer, it becomes costly for the borrower to switch to a different lender.

Thus, the goal of this paper is to test whether movements of the policy interest rate in Jordan display asymmetric or symmetric process. The answer to this question is vital because it highlights on the behavior of the central bank of Jordan (CBJ), and investigates if the CBJ is prejudice of certain policy. Sweidan and Maghyereh (2006) showed that the CBJ suffered losses in some years because the CBJ itself issued certificates of deposit (CD). Therefore, the question is does the CBJ is biased in favor of easy monetary policy, lower policy rate, to reduce its loss? The rest of the paper is organized as follows: Section 2 presents the main tools of monetary policy in Jordan. Section 3 introduces the methodology of the current study. Section 4 presents the empirical results of the econometric model. Conclusions are made in the last section.

2. Monetary Policy in Jordan

Jordan is a small open economy living in an unstable region. As a result, the economy is vulnerable to external developments. The primary objective of the CBJ is to maintain a pegged exchange rate to the U.S. dollar. In 1988/1989 the Jordanian economy experienced bad economic shock leads to high inflation rate reached to 25.7% and negative economic growth get in touch with -16.7%. At that time, Jordan adopted an economic adjustment program in the course of consultation with the International Monetary Fund (IMF) aimed to achieve economic stability and to move toward market-oriented economy.

Accordingly, in September 1993 the CBJ moved toward the indirect method i.e. CD issued by the CBJ to control monetary policy. The reasons behind this new policy are its convenience to the philosophy of free market economy, and its effect on both deposit and lending rates. Prior to mid of 1995, Jordan targeted the monetary aggregate \( M_2 \) to achieve its economic goals. After the mid of 1995, the CD auction’s rates started to be the main tool to conduct monetary policy in Jordan. The new operating procedure of the CBJ is to influence bank deposits and lending rates\(^1\) to guarantee a high demand of the Jordanian dinar relative to the U.S. dollar. Hence, the success of monetary policy to achieve its goals depends on how the CD rate affects the bank’s interest rates. In 1998, CBJ added the overnight deposit facility (ODF) as a new tool to manage the liquidity on daily basis. The interest rate of ODF is the floor of the interbank rate. Figure (1) shows the movements of the three-month CD rates in Jordan over the 1994:1-2007:1 period which is the time horizon of this study.

\(^1\) As stated by the Keynesian model.
3. Methodology

The current paper utilizes threshold autoregressive (TAR), and momentum TAR (MTAR) models developed by Enders and Granger (1998). Moreover, in order to guarantee a stationary sequence of the CD rates\(^2\), we used two methods; first, calculate the first difference of the three-month CD rates. Second, estimate a reaction function of the policy interest rate in Jordan based on some features from the Jordanian economy, and use the resulting residuals \((\varepsilon_i)\) to estimate these models (TAR and MTAR). The reaction function\(^3\) of the policy rate is as follows:

\[
i_t = \alpha \pi_t + \beta y_t + \gamma ffr_t + \rho i_{t-1} + \varepsilon_t
\]

where \(i_t\) is the policy interest rate, the three-month CD rates, \(\pi_t\) stands for inflation rate, \(y_t\) stands for output gap, \(ffr_t\) is the federal fund rate as an indicator of the U.S. interest rate because of adopting fixed exchange rate of the Jordanian dinar with the U.S. dollar in October 1995, \(\varepsilon_t\) is a white noise disturbances. \(\alpha, \beta, \gamma\) and \(\rho\) are the model’s parameters. All variables are in logarithm form.

The TAR model captures any deep movement in a time series. It can be best described as a general formula of the standard Dickey and Fuller (1981) unit root test which assumes symmetric adjustment. However, the TAR model assumes asymmetric process. The standard Dickey and Fuller (1981) model is estimated as follows:

\[
\Delta \varepsilon_t = \mu \varepsilon_{t-1} + \sum_{i=1}^{j} \lambda_i \Delta \varepsilon_{t-i} + \nu_t
\]

\(^2\) For more details see Gujarati (2003).
\(^3\) Policy interest rate in Jordan is not a trend-stationary process.
where \( \nu_t \) is a white noise disturbances, the standard evaluation is to estimate \( \mu \) and to check whether \(-2 < \mu < 0\). Adding lagged \( \Delta \varepsilon_{t-1} \) is to guarantee uncorrelated residuals. Enders and Granger (1998) developed the standard Dickey and Fuller (1981) model to allow for asymmetric adjustment. The TAR model’s version is as follows:

\[
\Delta \varepsilon_t = H_t \mu_1 \varepsilon_{t-1} + (1 - H_t) \mu_2 \varepsilon_{t-1} + \sum_{i=1}^{I} \lambda_i \Delta \varepsilon_{t-i} + \nu_t
\]

where \( H_t \) is the Heaviside indicator function such that:

\[
H_t = \begin{cases} 
1 & \text{if } \varepsilon_{t-1} \geq \psi \\
0 & \text{if } \varepsilon_{t-1} < \psi 
\end{cases}
\]

Equations (3) and (4) explain the TAR model’s idea. The condition \(-2 < \mu < 0\) is a sufficient for the stationarity of \( \varepsilon_t \). In this case, if the sequence is stationary, then the system converges to long run equilibrium. If \( \varepsilon_{t-1} \) is above its long run equilibrium, the adjustment is \( \mu_1 \varepsilon_{t-1} \), and if \( \varepsilon_{t-1} \) is below its long run equilibrium value, the adjustment is \( \mu_2 \varepsilon_{t-1} \). Technically, if, for example, \(-2 < \mu_2 < \mu_1 < 0\), then the positive segments (peaks) of the series \( \varepsilon_t \) tend to be more persistent than the negative segments (troughs). This type of asymmetry is known in the literature as “deep” movements. However, if \( \mu_1 = \mu_2 \) then the adjustment of the \( \varepsilon_t \) sequence is symmetric.

On the other hand, the MTAR model allows the decay to depend on \( \Delta \varepsilon_{t-1} \) and not on \( \varepsilon_{t-1} \). As a result, the Heaviside indicator function is as follows:

\[
H_t = \begin{cases} 
1 & \text{if } \Delta \varepsilon_{t-1} \geq \psi \\
0 & \text{if } \Delta \varepsilon_{t-1} < \psi 
\end{cases}
\]

The model constructed using equations (3) and (5) known as the MTAR model. This model captures “sharp” movement in the sequence; if, for example, \( |\mu_1| > |\mu_2| \) the MTAR model reveals substantial decay for positive \( \Delta \varepsilon_{t-1} \) (expansion), and exhibits little decay for negative \( \Delta \varepsilon_{t-1} \) (contraction). Overall, in both the TAR and MTAR models we are looking to test two hypotheses: First, the null hypothesis of unit root, \( \mu_1 = \mu_2 = 0 \). Second, the null hypothesis of symmetry adjustment, \( \mu_1 = \mu_2 \).

4. Empirical Results

This paper utilizes quarterly data of Jordan from the International Financial Statistics (IFS) CD-ROM over the 1994:1-2007:1 period. To examine the hypothesis of this paper, we estimate two stationary sequences of the CD rates as stated above, and employ both of them in the estimation of the TAR and MTAR models. Figure (2) shows the normalized estimate of stationary series of the policy interest rate generated by using both methods;

\[\text{For more details about “sharp” versus “deep” cycles see Sichel (1993).}\]
the first difference and the reaction function model. It is apparent that both series are stationary or convergent, \( \varepsilon_i = 0 \) is the long run equilibrium value of the sequence. Hence, in both equations (4) and (5) the value of \( \psi = 0 \).

**Figure (2): The Estimated Stationary CD Rates by Using the First Difference and the Reaction Function.**

![Graph showing estimated stationary CD rates](image)

Table (1) in Appendix A reports six models: the Dickey-Fuller, TAR and MTAR. Each model is calculated twice with each generated stationary sequence of the policy interest rate. First and second columns of Table (1), Appendix A, report the estimate of \( \mu_0 \) from the Dickey-Fuller model of both series; the first difference and the reaction function model the results prove that the stationarity condition is satisfied, \(-2 < \mu_0 < 0\), at the 1% level. Notice that lag lengths in the six models are chosen based on analysis of the regression residuals, Akaike Information Criterion (AIC) and Schwarz Criterion (SC). Third and fourth columns of Table (1) report the estimate of \( \mu_1 \) and \( \mu_2 \) from the TAR model of both sequences. It is obvious that the values of \( \mu_1 \) and \( \mu_2 \) satisfy the convergence condition at the 1% level too. To confirm stationarity of the series, the null hypothesis of unit root, \( \mu_1 = \mu_2 = 0 \), should be tested. The calculated F-statistics of the first difference and the reaction function model are 9.80 and 12.8, respectively, and both values are higher than the critical values at the 1% level reported by Enders and Granger (1998). Hence, the null hypothesis of unit root is rejected at the 1% significance level. At

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5 For more different modifications of the TAR model see Enders and Granger (1998).
6 We test for the autocorrelation. All tests reject the hypothesis of autocorrelation.
7 For more details see Table (1), page 306.
this stage, this test succeeds to prove that the new generated series of the policy interest rate by the first difference and the reaction function model are stationary. Therefore, the null hypothesis of symmetric process, $\mu_1 = \mu_2$, can be tested for each method. The estimated F-statistics of the first difference and the reaction function model are equal to 1.48 and 2.42, respectively, and both values are less than the critical values at the 10% level reported by Enders and Granger (1998). That's why the null hypothesis of symmetry cannot be rejected at the 10% level.

Fifth and sixth columns of Table (1) report the estimate of $\mu_1$ and $\mu_2$ from the MTAR model. The values of $\mu_1$ and $\mu_2$ satisfies the convergence condition at the 1% level. To confirm stationarity, the null hypothesis of unit root, $\mu_1 = \mu_2 = 0$, should be tested. The calculated F-statistic of the first difference and the reaction function model are 9.18 and 10.97, respectively, and it is higher than the critical values at the 1% level. Thus, the null hypothesis of unit root is rejected at the 1% significance level. Since the policy interest rate is stationary. The null hypothesis of symmetric adjustment, $\mu_1 = \mu_2$, can be tested. F-statistics of the first difference and the reaction function model are equal to 0.61 and 0.02, respectively, which are less than the critical values at the 10% level. Consequently, the null hypothesis of symmetry cannot be rejected at the 10% level. Overall, the empirical results of this paper present evidence that the generated new series of the policy interest rate by the first difference and the reaction function model are stationary. In addition, the policy interest rate in Jordan does not display any asymmetric adjustment. The CBJ is not biased in favor of either easy or tight monetary policies.

5. Conclusions

There is a sizable literature concerning both asymmetric adjustment and asymmetric effect of economic variables. The importance of such studies arises from two facts: desire to understand facts about business cycles and other economic variables. Also, standard time series models are unable to represent asymmetric behavior under certain assumptions.

This paper aims to examine the hypothesis that policy interest rates in Jordan adjust differently to expansionary versus contractionary monetary policies.

The answer to this question is vital and highlights on the behavior of the CBJ, and investigates if the CBJ is biased in favor of certain policy. The first step to start-up our exercise is to generate stationary series from the policy interest rate. To do so, this study applies two methods; first, find the first difference of the CD rates. Second, estimate reaction function of the policy interest rate in Jordan based on some features from the Jordanian economy, and uses the captured residuals $(\epsilon_t)$ to estimate the threshold autoregressive (TAR), and momentum TAR (MTAR) models developed by Enders and Granger (1998). The results show that the policy interest rate in Jordan displays symmetric adjustment. This implies that the CBJ is not in favor of either expansionary or contractionary monetary policy.
## Table 1: Estimates of the Models

<table>
<thead>
<tr>
<th>Coefficients</th>
<th>Dickey-Fuller (FD)</th>
<th>Dickey-Fuller (RF)</th>
<th>TAR (FD)</th>
<th>TAR (RF)</th>
<th>MTAR (FD)</th>
<th>MTAR (RF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\mu_0$</td>
<td>-0.85 *** (0.20)</td>
<td>-1.27 *** (0.27)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>$\mu_1$</td>
<td>-</td>
<td>-</td>
<td>-1.03 *** (0.25)</td>
<td>-1.47 *** (0.29)</td>
<td>-0.74 *** (0.24)</td>
<td>-1.30 *** (0.33)</td>
</tr>
<tr>
<td>$\mu_2$</td>
<td>-</td>
<td>-</td>
<td>-0.63 ** (0.26)</td>
<td>-0.95 *** (0.33)</td>
<td>-0.97 *** (0.25)</td>
<td>-1.25 *** (0.29)</td>
</tr>
<tr>
<td>$\lambda_1$</td>
<td>0.30 * (0.17)</td>
<td>0.33 (0.23)</td>
<td>0.34 * (0.17)</td>
<td>0.40 * (0.23)</td>
<td>0.35 * (0.19)</td>
<td>0.33 (0.23)</td>
</tr>
<tr>
<td>$\lambda_2$</td>
<td>0.31* (0.16)</td>
<td>0.37* (0.19)</td>
<td>0.27 (0.16)</td>
<td>0.43 ** (0.19)</td>
<td>0.33 * (0.16)</td>
<td>0.38 * (0.20)</td>
</tr>
<tr>
<td>$\lambda_3$</td>
<td>0.21 (0.15)</td>
<td>0.35 ** (0.14)</td>
<td>0.21 (0.14)</td>
<td>0.38 *** (0.14)</td>
<td>0.23 (0.15)</td>
<td>0.35 ** (0.15)</td>
</tr>
<tr>
<td>$\psi$</td>
<td>-</td>
<td>-</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>AIC</td>
<td>1.86</td>
<td>-2.24</td>
<td>1.87</td>
<td>-2.25</td>
<td>1.89</td>
<td>-2.20</td>
</tr>
<tr>
<td>SC</td>
<td>2.06</td>
<td>-2.08</td>
<td>2.10</td>
<td>-2.05</td>
<td>2.12</td>
<td>-2.00</td>
</tr>
</tbody>
</table>

Notes: Standard errors are in parentheses. */**/***: denotes significance at the 10/5/1 percent level, respectively. FD: Indicates stationary CD rates estimated by taking the first difference. RF: Indicates stationary CD rates estimated by utilizing the reaction function. AIC: Akaike Information Criterion. SC: Schwarz Criterion.

## References


