

## **Asymmetric Effects of Monetary Shocks on Economic Growth & Inflation: Case Study in Iran**

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### **Abstract**

*In this paper, benefiting from annual data from 1973 to 2008 in the economic or Iran, we have studied unexpected asymmetric effects of money on production and inflation. Respective concerns of monetary policy making deals with how unexpected changes alter production and level pries. In this paper, unexpected monetary shocks have been analyzed using the rest of function of money supply. According to applicable results obtained in this respect, unexpected monetary decrease has influenced on economic growth to great extent (compared with unexpected monetary increase) and unexpected monetary increase has largely influenced inflation (compared with unexpected monetary decrease). Consequently, we come up with this conclusion that although a policymaker is able to increase economic growth through unexpected increase of monetary volume, this policy shall bring about more inflation, on the one hand. On the other hand, if the policymaker decreases monetary growth supply unexpectedly in order to decrease inflation, this shall bring about more effects toward decrease of economic growth.*

**Classification of JEL: E31 and E52**

**Key words:** unexpected monetary policy, asymmetric effects

### **1. Introduction**

There are various viewpoints with respect to interaction between monetary and real economic sectors. Monetary neutralization is regarded as the most fundamental part of prediction for classical theories or real commercial periods. According to such characteristic, net monetary shocks as certain changes in monetary base have no real effects. Considering these approaches, although monetary shocks create great fluctuations in prices and other nominal variables, they don't change production, employment and real wages. Hence, nowadays, many of economists are of this opinion that change in prices and monetary volume, i.e. nominal shocks do influence the behavior of such real variables as production and employment in a short period.

For example, increase of legal reserves or creation of certain limits in payment of interest for deposits shall decrease intermediation costs and tendency of people to keep deposits. These cases like monetary deflation shall decrease level of prices and other nominal variables. However, simultaneous with such decrease, production, employment and other investment shall face decrease accordingly. Eventually, while encountering with such shocks, nominal and real variables move in one direction.

Moreover, there are many studies that have revealed that shocks of monetary supply have asymmetric effects on production. Cover (1992), Karras and Stokes (1996) and (1999) have indicated that unexpected positive shocks on monetary supply has had no effect on production. While unexpected negative shocks have led to decrease of production.

Our primary goal in this article is to study whether the effects of monetary shocks on real production in Iran is asymmetric or not and what is the cause of such asymmetry.

## **2. Theoretic framework**

Researchers have studied asymmetric effects of monetary shocks in two directions (positive or negative shocks and small or large shocks). Cover (1992) explains asymmetry of monetary shocks on real production based on Keens' traditional pattern. Ravn and Sola (1999) has called such pattern as "Keen's Traditional Asymmetry". Keens' Traditional Asymmetry proves that positive shocks of monetary supply are neutral and that negative shocks bring about real effects. One can explain the said result based on downward wage adherence and upward flexibility of the same as well as portioning of demand. In these conditions, entire supply curve is convex downward while L limit is appeared reverse. Although this pattern doesn't enjoy a powerful theoretical aspect based on micro economy, it can be justified based on nominal adherence downward. A few researchers have discussed that the effect of monetary policies on production depends on economic conditions during trading periods so that during recession periods, monetary shocks have stronger effect on real variables.

Barro (1978-1977) with the decomposition of monetary supply by both foreseen and unforeseen, examines how the impact of monetary on the real sector of economy in the context of rational expectations. Barro concluded that only unexpected monetary growth has a significant impact on production. But after Barro many studies have addressed the influence of monetary on the real sector of economy in the Keynesian model. In the following we introduce some of them. Rhee and Rich (1995) have benefited from information of the USA for post world war II and studied the theorem of asymmetry of the effect of monetary shocks on production. Benefiting from the data in the second trimester in 1961 to the fourth trimester of the year 1990, they have found no notable asymmetric effect of positive and negative monetary shocks.

Using the information of eighteen European countries from 1953 to 1990 and maximum likelihood method, Karras<sup>4</sup> (1996) has tested the traditional theorem of Keens' Asymmetry. According to the applicable results obtained from the said test, negative monetary shocks have more effect compared to positive shocks.

Ravn and Sola (1997) have studied the effects of positive and negative shocks of monetary supply, small and large shocks of monetary supply and probable combinations of the two. Upon use of  $fM_1$ , applicable evidence shows that large shocks are neutral while small shocks are effective. Moreover, when federal<sup>6</sup> interest rate is used in stead of  $M_1$ , only small negative shocks shall affect macro variables. Corresponding results are interpreted based on list of price model. The most difference among list of price models is to differentiate the effects of small and great shocks.

Paul (1998) studied the asymmetric effects of unexpected monetary shocks on production in UK in the second trimester from 1973 to the third trimester of 1994. In this research, unexpected monetary shocks are analyzed into positive and negative components by the rest of interest rate equation. Corresponding results reveal that deflationary monetary policy has remarkable effects on decrease of production, while the effect of expansionary monetary policy on production is not meaningful.

Vid (2002) studied symmetric or asymmetric effects of monetary supply and governmental expense on production in Indonesia from the first trimester 1980 to the fourth trimester of 1997. Applicable results indicate that monetary supply shocks have no significant effect on production. It means that monetary authorities can't use monetary supply to stimulate production.

Parker and Rothman (2003) compare the symmetric effects of monetary shocks before and after World War II in USA. Corresponding results show no evidence confirming asymmetry of monetary shocks before World War II. While after the Second World War, monetary shocks are asymmetric.

### 3. Research Methodology

#### 3.1 Asymmetry Test of Monetary Shocks

According to the article, we analyzed and tested the role of positive and negative shocks on monetary growth and inflation variables, using theoretical and empirical literature in the period 1387-1352 in the Iranian economy. Then as karras and Stokes (1996) and (1999) we enter positive and negative shocks monetary into our model of economic growth and also the effect of other elements (control variable) including both groups of elements of supply such as investment and oil revenues and elements of demand such as governmental expenses are regarded simultaneously.

$$d(\ln y_t) = \beta_0 + \sum_{i=1}^Q \beta_i^y d(\ln y_{i,t-1}) + \sum_{j=0}^n \beta_j^+ u_{t-i}^+ + \sum_{i=0}^n \beta_i^- u_{t-i}^- + \beta X_t + \varepsilon_t \quad (1)$$

Where  $y_t$  is gross real domestic production (oil fee),  $U_t^+$  is positive monetary shock,  $u_t^-$  is negative monetary shock,  $X$  is a vector of variables affecting economic growth including governmental expenditure growth ( $d(\ln G)$ ), growth of oil revenues ( $d(\ln OIL REV)$ ), inflation rate ( $d(\ln P)$ ) and investment ratio to gross domestic production ( $INV/GDP$ ).

And  $\varepsilon_t$  represents error part. Considering the theorem of rational expectations, we expect that only variables and/or unexpected monetary shocks would have significant effects on production level in a short period. The theorem of asymmetry of monetary shocks is tested as follows based on the said pattern:

$$H_0 : \beta_i^+ = \beta_i^- \quad i = 1, \dots, n \quad (2)$$

Now, we elaborate methods for analysis of positive and negative monetary shocks on real production. Usually, in experimental studies, all unexpected quantities of time series variables are regarded as associated variables with that variable. For example, according to the studies conducted by Barro (1977-1978), Mishkin (1982), Cover, Karras (1996), the rest of monetary supply growth rate equation (M2) have been used as monetary shocks. In fact, in these studies, monetary volume growth rate has been analyzed into two expectable and non-expectable shocks and regression residue of monetary volume growth rate has been used as non-expectable monetary shocks for study of asymmetric effects of monetary shocks. We also use the said method in this study as well.

First, we introduce a monetary supply function and then, based on the rest of this function, we define positive shocks as  $u_t^+ = \text{MAX}(0, \hat{u}_t)$  and negative shocks as  $u_t^- = -\text{MIN}(0, \hat{u}_t)$ .

We introduce monetary supply function as karras and stokes studies (1996) and (1999) as follows:

$$M_t = \alpha_0 + \sum_{i=1}^N \alpha_i^m M_{t-i} + \sum_{i=1}^M \alpha_i^y Y_{t-i} + U_t \quad (3)$$

Where  $M_t$  is monetary growth rate ( $d(\ln(M2))$ ) and  $Y_t$  indicates real production growth rate ( $d(\ln(y_t))$ ).

#### 3.2 The cause of monetary asymmetry effects: 1. Total convex supply or 2. A string of mechanism

To continue this paper, we study test for the cause of monetary shocks asymmetry in economic via introducing two theories. In this study, like studies of Karras (1996) and Karras and Stokes (1996) and (1999), by adding an inflation equation to the model, we can study the cause of such asymmetry whether production asymmetry interaction with monetary shocks is created due to in convex aggregate supply or "pushing on a string" mechanisms. (karras and stokes (1996) and (1999))

The first theory is dependant on the models where entire supply curve is more slopped or vertical at higher levels of prices. Kinesis models or salary adherence downward is located in this area. Among these models, we can point out insider-outsider model Lindbeck and Snower (1998) as well as asymmetric model of Ball and Mankiw (1997). These models indicate that positive monetary shocks have larger effects on prices compared with negative shocks.

In the second theory, negative shock has more effects on total demand compared with positive shocks. De Long and Summers (1998) has benefitted from this theory and based on credit allotment models or credit theorems, they have studied monetary effects.

In the area of this theory, positive monetary shocks have less effect on entire demand in comparison with negative shocks and eventually, they have fewer effects on prices as well. In order to test which theory from among the above-mentioned theories is followed by monetary asymmetric effects on production, one can examine the case through comparison of positive and negative shocks on prices: If positive monetary shocks have stronger effects on prices compared with negative shocks, total convex supply model is confirmed. However, negative shocks have more effects on prices than positive shocks, the second theory is confirmed. Hence, the effects of monetary shocks on prices are symmetric; none of the two theories explained earlier can explain asymmetric monetary effects on production.

Inflation equation is given as follows:

$$P_t = \gamma_0 + \sum_{i=1}^Q \gamma_i^p P_{t-i} + \sum_{i=1}^R \gamma_i^y O_{t-i} + \sum_{i=0}^S \gamma_i^+ u_{t-i}^+ + \sum_{i=0}^S \gamma_i^- u_{t-i}^- + v \tag{4}$$

Considering the said equation,  $P_t$  indicates growth price of consumer price index and  $O_t$  is also control of the effects of economic supply sector. For this purpose, oil revenues growth ( $d(1nOILREV)$ ) and investment ratio to gross domestic production  $INV/GDP$ . Moreover, the theorem of asymmetry of monetary effects on the level of inflation is tested as follows based on the said pattern:

$$H_0 : \gamma_i^+ = \gamma_i^- \quad i = 1, \dots, S \tag{5}$$

As we have explained earlier we study the case whether asymmetry of monetary polices have been explained based on which of the two theories through  $\gamma_i^+$  &  $\gamma_i^-$ . If such  $\gamma_i^+$  &  $\gamma_i^-$  is accepted, the associated with total supply convex theory will be confirmed and in case such  $\gamma_i^+$  &  $\gamma_i^-$  is accepted, the second theory will be confirmed.

#### 4. Experimental results

All statistics and information required for this research including monetary volume, gross domestic production, oil fee, governmental expenses and fixed capital formation (investment) extracted from economic report and balance sheet of Islamic Republic of Iran Central Bank from 1973 to 2008.

First, we study integrity of respective variables, which have been used in this research.

The results of Augmented Dickey-Fuller test (ADF) show that all the variables used in the model would become integrated by one differentiation.

**Table 1: Unit Root Test Result**

ADF Test		
Variables	levels	1 <sup>st</sup> difference
ln(y)	-0.53	-5.67**
ln(G)	-2.09	-6.62**
ln(M2)	-.3.28	-3.38**
Ln(P)	-2.39	-3.35**
LN(M2/P)	2.83	-3.77**
ln(OILREV)	2.33	-5.71**
ln(INV/GDP)	-1.89	-4.12**

**Note:** \*\* Represents significance at 5 % level of significance

**4.1 Asymmetric monetary shocks test in production and prices**

First, we have explained estimation of monetary supply function coefficient and have used through this function for analysis of monetary shocks into positive and negative shocks:

**Table 2: Estimation of Monetary Supply Function (M<sub>t</sub>)**

	$\alpha_0$	$M_{t-1}$	$Y_{t-1}$
Estimated coefficients	0.11 (0.008)	0.41 (0.02)	-0.4 (0.10)
LM (1)- TEST	<b>P-VALUE=0.11</b>		
LM (2)- TEST	<b>P-VALUE=0.27</b>		
ARCH(1) LM TEST	<b>P-VALUE=0.17</b>		
ARCH(2) LM TEST	<b>P-VALUE=0.30</b>		

**Note:** The values in the parentheses indicate a meaningful level of coefficient (P-value).

**4.2 Asymmetric monetary shocks on production and inflation**

In table 3, we have indicated the results of estimation of positive and negative shocks coefficients of monetary policy at two equations of growth and prices. Estimated coefficients in economic growth equation indicate that positive and negative shocks have meaningful effects on real production. While the effects of negative shocks are more than positive shocks so that the theorem of asymmetric effects of monetary shocks on production ‘ $(\beta_i^+ = \beta_i^-, all i)$ ’, is hereby rejected. Moreover, entire positive shocks (and negative shocks) shall have overall meaningful effects on production after four periods. Furthermore, asymmetric effects of monetary shocks are rejected considering the entire affects during four periods,  $(\sum_i \beta_i^+ = \sum_i \beta_i^-)$  accordingly.

Consequently, we can say that in economy of Iran, monetary shocks have asymmetric effects on production and eventually, the effects of negative monetary shocks are more than positive monetary shocks.

**Table 3: Coefficients of shocks in economic Growth and Inflation equations**

Coefficients of monetary shocks in economic growth equation		Coefficients of monetary shocks in price equation	
Equation 1		Equation 2	
$\beta_0^+$	0.869 (0.14)	$\gamma_0^+$	-1.00 (0.01)
$\beta_1^+$	-1.613 (0.02)	$\gamma_1^+$	-0.72 (0.07)
$\beta_2^+$	-0.3 (0.56)	$\gamma_2^+$	0.11 (0.72)
$\beta_3^+$	-0.718 (0.065)	$\gamma_3^+$	-0.76 (0.06)
$\beta_4^+$	0.273 (0.519)	$\gamma_4^+$	–
$\beta_0^-$	-0.21 (0.52)	$\gamma_0^-$	0.65 (0.04)
$\beta_1^-$	1.25 (0.03)	$\gamma_1^-$	0.95 (0.02)
$\beta_2^-$	-0.324 (0.4)	$\gamma_2^-$	-0.04 (0.88)
$\beta_3^-$	1.038 (0.03)	$\gamma_3^-$	-0.48 (0.13)
$\beta_4^-$	-0.7 (0.1)	$\gamma_4^-$	–
$\chi^2 - Tests$		$\chi^2 - Tests$	
$\beta_i^+ = 0, all i$	12.257 (0.03)	$\gamma_i^+ = 0, all i$	26.33 (0.004)
$\beta_i^- = 0, all i$	14.861 (0.011)	$\gamma_i^- = 0, all i$	7.6 (0.107)
$\beta_i^+ = \beta_i^-, all i$	15.26 (0.009)	$\gamma_i^+ = \gamma_i^-, all i$	12.43 (0.014)
$\sum_i \beta_i^+ = 0$	4.14 (0.04)	$\sum_i \gamma_i^+ = 0$	6.31 (0.012)
$\sum_i \beta_i^- = 0$	3.64 (0.05)	$\sum_i \gamma_i^- = 0$	3.17 (0.074)
$\sum_i \beta_i^+ = \sum_i \beta_i^-$	4.58 (0.03)	$\sum_i \gamma_i^+ = \sum_i \gamma_i^-$	6.07 (0.01)
<i>LM – Test(2)</i>	1.32 (0.249)	<i>LM – Test(2)</i>	3.79 (0.14)
ARCH(1) LM TEST	0.05 (0.8)	ARCH(1) LM TEST	0.99 (0.31)
ARCH(2) LM TEST	2.79 (0.24)	ARCH(2) LM TEST	1.47 (0.47)
ARCH(3) LM TEST	2.23 (0.52)	ARCH(3) LM TEST	1.68 (0.64)
ARCH(4) LM TEST	2.04 (0.72)	ARCH(4) LM TEST	1.95 (0.74)
$R^2$	0.816	$R^2$	0.74

**Note:** Figures that have been given in the parentheses indicate a meaningful level of estimated coefficients. Number of monetary shocks halts in growth and inflation equation has been designated based on statistics of Akaike info criterion and Schwarz criterion as well as  $R^2$ .

Now, we deal with another objective of this paper, study of the cause of asymmetric monetary effects. Considering two theories that have been put forth, we test whether positive monetary shocks have more effects on prices compared with negative shocks.

According to the results given in Table 3, we have estimated inflation equation in consideration of positive and negative monetary shocks. The applicable results reveal that positive and negative shocks have meaningful effects on inflation.

However, positive shocks have more effects compared with negative shocks and eventually, the theorem of asymmetric shocks on inflation in form of individual halts,  $(\gamma_i^+ = \gamma_i^-, \text{all } i)$ , and considering all halts,

$(\sum_i \gamma_i^+ = \sum_i \gamma_i^-)$ , is rejected.

### 5. Conclusions

We have studied asymmetric effects of positive and negative monetary shocks on production and price. According to the results of economic growth equation estimation, the effects of positive and negative shocks have meaningful effects on production and the theorem of asymmetric effects of monetary unexpected changes, both in current period and in the area of the entire halts is rejected. Unexpected monetary decrease has more effects on economic growth in comparison with unexpected monetary increase. The results obtained from inflation equation estimation reveal that unexpected monetary increase has more powerful meaningful effects on the level of prices compared with unexpected monetary decrease, and eventually, by virtue of the theorems that we have explained, we come up with this conclusion that the cause of asymmetric effects on unexpected monetary shocks on production in economy of Iran, is an entire convex supply function. Therefore, one can say that although in economy of Iran a policymaker is able to increase economic growth to some extent via unexpected increase of monetary volume growth, this policy shall lead to inflation to great extent on the one hand. On the other hand, in order to decrease inflation, the policymaker decreases monetary supply growth unexpectedly, this shall lead to more effects for decrease of economic growth. In face, if the policymaker decreases monetary supply in order to decrease inflation, he will pay more cost in this respect in the area of economic growth decrease

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