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Short-Run and Long-Run Effects of Monetary Policy on GDP in Iran

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Abstract *In this paper, we investigated the short-run and long-run effects of monetary policy on GDP have been investigated by co-integration analysis in Iran economy during the period 1972-2015. We used Johansen co-integration methods to demonstrate long-term relationship between the variables. The results showed that the Contractionary monetary shocks, has low effects on output whereas the effects of expansionary monetary shocks are neutral. The effects of expansionary monetary shocks after a first lag have significant effects on increasing output. Among the control variables, the investment ratio, inflation, government expenditures, oil revenues and coefficient of exchange rate have significant expected effects on production growth. In addition, there is a long-run relationship between money supply, inflation and output.*

Key words Monetary policy, GDP, Iran economy, co-integration test

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1. Introduction

There are different perspectives on the interaction between monetary and real sectors in economy. Although before the great crisis of 1929, the classical duality theory did not any interaction between nominal and real variables in the short and long term, But today, many economists believe that changes in the prices and money stock i.e. nominal shocks will be affected the behavior of real variables such as manufacture and employment in the short term. Money is a neutral factor. In the new classical theory, money is a neutral factor. According to this theory, in a closed economy, anticipated changes in money stock lead to proportional changes in nominal variables such as prices and wages without any impact on real variables. In an open economy with flexible exchange rates, the nominal exchange rate will change accordingly. The basic result of this theory is that manufacture, employment, interest rates and the real exchange rate and the like are invariable. Of course, in this connection, the only exception is transaction cost related to the change in the portfolio of assets (between the cash and other financial assets). Since the change in the nominal interest rate has affected real demand for money, some real effects is created of this channel, but the effects are not large enough to justify the economic fluctuations. Furthermore, if policies or monetary functions', brokerage costs, saving rates, investment and habits of asset holding change in right direction, different results are obtained.

An increase in legal reserves or restrictions on the payment of interest on deposits, intermediation costs and reduce people's willingness to hold deposits. As in the case of a monetary contraction price level and other nominal variables lowers; but with the production, employment and investment are also declining. So in the face of such shocks, the nominal and real variables move in the same direction. Real shocks such as oil price increase on the other hand in an economy of oil- importing led to be decline in output and prices (even assuming a constant currency basis) in this case; the cost of manufacturing will change in the opposite direction. In an open economy with a fixed exchange rate, monetary authorities can determine how much money they make (determine to make how much amount of money). In order to

keep money growth, government has to create restrictions on foreign trade (commodities and foreign assets). Such restrictions may have effects on the real product; overall, in economic theory does not reject the interaction between nominal and real variable but how is dependent on the nature of the impulses. However the neutrality of money is one of the most basic predictions of the classical theory, and according to its net monetary impulses to the real effects of changes is not in the monetary base. Although monetary impulses can be created huge fluctuation in prices and other nominal variable. But in production, employment and real wage do not change. Most economists neutrality of money is not accept at least in the short term. In fact, many researchers have made contribution of business fluctuations, to monetary impulses. The group is a common view that the expansion of monetary is stimulus of in economic real activity. Similarly, a monetary contraction will lead to a recession. Keynesian and school advocates of monetary when analyzing effect of financial (money) variables on real does not discriminate between anticipated and unanticipated money. In these models predicted money and systematical monetary policies also to make real impacts. For example, opponents of monetary union and fixed exchange rate believe that the will prevent it that countries are nullified with adopting systematic and independent monetary policy effect of country- specific shocks. Systematic monetary policy leads to be the end of long post – war recessions. Literature also evaluates the nominal GDP targeting, it is based on the belief that systematic policies appropriate to reduce the fluctuations in production.

2. Literature review

Monetary theorists have introduced many models in which money leaves real impact anticipated. For example, the patterns of overlap (Taylor, 1979a) patterns of price and wage stickness (Rotemberg, 1982; Blanchard, 1994) limited participation models and the pattern of previous liquidity are among them (Christiano and Eichenbaum, 1992). Limited participation model without resorting to sticky prices and assuming the with drawal of money from banks are done at different time by economic sections show that monetary expansion temporarily reduces the nominal rate and real will lead to a gradual increase in prices. Patterns of previous liquidity assuming that all sections of the economy have to use cash for their purchases (liquidity constraints) and also with emphasis on effect of sources of loan able funds are linked money section with real activity economy. In addition, there is debate over the effect of money on real variables. The key question which deals with the concept of creating money whether the amount of money in the economy respond to changes in economic conditions that it is determined by economic forces or equation of conduct of monetary policy (Levin, 1990).

A banking crisis is a clear example of the endogenous of money in addition, since the volume of money faster than real output responds to moving volume of money may change is occurring before production. As another, consider the effects of a supply shock. The momentum reduces the production and demand of real money. If the monetary base does not change to increase price. But some of the monetary system automatically is adjusted monetary base. For example, if the monetary authorities neutral according to a rule or behavioral equation the impact of economic shocks on prices through changes in the monetary base. Then the momentum of supply and monetary base will lead to lower production. So, in this case a positive association between output and monetary base or volume of money is not shown the effect of money on economy because it is indicative of the response of the endogenous money. An example in this setting to endogenous money in a fixed exchange rate regime (Mishkin, 1982).

In the classical model, the level of employment and labor market conditions are characterized by the production. Assuming full flexibility of prices and wages to resulting to labor market equilibrium and real wages, labor demand by firms are equal with the amount of labor that workers are willing to supply. So there is no involuntary unemployment. Anyone who is willing to work in available wage one will be employed. The lack of demand and unemployment to offer lower wage to workers. Since the firms are in competition, this result leads to proportional reduction in the price so that real wage and employment remain unchanged. Besides lowering the price level, increasing real balance which in turn reduce interest rates and increase aggregate demand and employment. Therefore the interest rate plays as elimination of any issues as lack of demand in the Keynesian model. Aggregate demand must be adjusted with ratio to changes in the supply side. According to three rules, supply creates its own demand and changes in demand in contrast to passive reacts to changes of supply. According to the classical view, an expansionary

monetary policy will lead to the transfer function of the total demand in the economy. But overall supply is vertical; increase of nominal income will only increase in the general price level. Therefore, monetary policy in the economy is causing inflation. Fiscal policy as well as the increase in government spending from taxes or other similar devices to apply except for the direct creation of money, just effect of outside the congestion would be simply to redistribute wealth and income effects are manifested (Cover, 1992; Ravn and Sola, 1996; Ball and Mankiw's, 1994).

Keynesian models of aggregate demand are presented in the form of simple or more complex determinants of employment and production and little attention to the supply side of the economy. Because one of the main characteristics of this pattern is excess supply or price level of goods of redundant ($\overline{P} > P^*$). In these circumstances, only the aggregate demand will be determinates for supply. So the Keynesian analysis of issues such as the transfer of the production function, change in capital the effects of the tax system are emphasized on incentives to work and like as that are not considered in the new school of economics. In fact, the IS-LM in model of Keynes justified many potential economic fluctuations and explaining the relationship between real and monetary sectors of the economy's nominal adherence. For example, fiscal and monetary policies, investment momentum transfer of demand function for money and like lead to changes in production and employment. According to the Keynesian model is generally assumed that the price of ($\overline{P}$) is above its equilibrium (p^*). A negative price momentum, therefore the decrease in the equilibrium price level to reduce interest rate and will increase production and employment. In these models, a similar effect of increasing the quantity of money is the interest rate and the real economy. In other word, increasing the quantity of as a substitute is for the reduced price. Similarly, that are lower a decrease in the demand for money or financial innovations like the price. Exogenous increase in nominal demand as government spending also in the Keynesian model are directly affected output and employment. However, the impact of increase of government spending on private spending due to rising interest rates is not clear (Blinder, 1986; Gordon, 1990). Olarewaju and Adeyemi (2015) investigated the causal relationship between liquidity and profitability of Nigerian deposit money banks using 15 selected banks for the periods 2004-2013 and based on the findings presented above the study succinctly conclude that there is no significant unidirectional and bidirectional causal relationship between liquidity and profitability of most deposit money banks of Nigeria for the period covered in the study.

3. Empirical results

In this section empirical model of asymmetric effects of monetary shocks on production, is specified and estimated. In production growth equation, in addition to positive and negative monetary shocks, the effect of other variables, including supply side factors (such as oil revenues and investment) and demand side ones (such as government expenditures) are considered.

Based on the IS/LM/AS model, growth equation is specified as follow:

$$\Delta \ln y_t = \alpha_0 + \alpha_1 \Delta \ln y_{i.t-1} + \sum_{j=0}^{n} \delta_j pos_{t-j}^{+} + \sum_{j=0}^{n} \gamma_j neg_{t-j}^{-} + \beta X_t + \varepsilon_t \quad (1)$$

In which Δ indicates the first difference, ln natural logarithm, $_{it}$y gross domestic output (without oil), Pos positive monetary shock, Neg negative monetary shock, X Influential variables on economic growth, and ε error term. Positive monetary shocks are unanticipated increase and negative monetary shocks are unanticipated decrease of money. In addition, unanticipated changes in money are that part of the money changes which cannot be anticipated according to the previous short run data. Based on rational expectations theory, we would expect that only unanticipated variables or unanticipated monetary shock have important effects on the production level in the short term. In other words, the effect of any anticipated changes of money on real production is neutral. In addition, unanticipated changes in money are that part of the money changes which cannot be anticipated according to the previous short run data. Based on rational expectations theory, we would expect that only unanticipated variables or unanticipated monetary shock have important effects on the production level in the short term. In other words, the effect of any anticipated changes of money on real production is neutral.

We test the hypothesis by considering amounts of money (the anticipated) in the model. In addition, asymmetric hypothesis tests based on the following model:

$$H_0 : \delta_j = \gamma_j \quad j = 1,...n \tag{2}$$

In growth model, various variables are used as control variables in vector X. Some of these variables are: physical investment, human capital, free trade, inflation rate, population, government expenditures, geographical variables, direct foreign investment, exchange rates premium, abundant natural resources, institutions and the quality of macroeconomic policy. In this study, due to the limited sample size, availability of data and diagnostic test, different combinations of variables, such as government expenditures growth, oil revenues growth, the percentage changes in real exchange rate, inflation rate and the ratio of investment to GDP as control variables in vector X are used. In fact, government expenditures, money balance and inflation variables as the demand side factors and investment ratio as the supply side factor affect the production. Oil income and exchange rate, especially in oil exporting countries, can affect supply and demand side output. Considering the extreme dependence of the domestic production system of these countries to raw material and investment goods it seems that easy access to cheap foreign exchange, plays an import role in production process of firms. That would be quite obvious if we consider the samples of the period. We can see that raw material and investment goods form 80 percent of the total import of the country. In addition, increase of oil revenue through increase of government expenditures increase the general demand in economy. The exchange rate can affect production through similar changes (change in cost of imported goods, budget effects and change in balance payments).

In empirical studies, any unanticipated change is considered as the shock. For example, Mishkin (1982), Cover (1992), Karras (1996) considered the residual of the money supply growth equation (M2) as monetary shocks. The money growth rate equation was specified as ARIMA process and estimated according to the Box- Jenkins methodology. In fact, in these studies money growth is divided into anticipated and unanticipated ones, and the residual from the estimated equation of money growth is used as unanticipated monetary shock.

Some researchers (such as Lee *et al*. (1995) used GARCH model to identify positive and negative shocks of oil price. In this study, we also use the GARCH approach to decompose monetary positive and negative shocks, but as the ARCH effects are not significant (conditional variance is fixed), the residuals ($\hat{e}_t$) from the estimated ARIMA process of money growth are used to measure negative and positive shocks as follows: $pos_t = \max(0, \hat{e}_t)$ and $neg_t = -\min(0, \hat{e}_t)$.

3.1. Research data and statistical of data

All data required to do this research, including money supply, GDP without oil, general price level, real oil revenue, exchange rate, government expenditures and fixed capital formation (investment) have been extracted from economic report and balance sheet of the Central Bank of Iran during 1972-2015. Analysis of the cointegeration is subject to the determination of time series of model variables. Therefore, before cointegeration analysis, first, stationary or non-stationary conditions of all model variables are tested by Augmented Dickey – Fuller (ADF) test and Perron unit root test.

Table 1. PP and ADF test statistic variables in level and 1st difference

Variable	ADF test	5% Critical Values	PP test	5% Critical Values
ln Y	-1.71	-2.91	-2.10	-2.91
ln G	-3.31	-2.91	-2.72	-2.91
ln M2	-0.46	-2.91	-1.33	-2.91
ln P	-1.83	-2.91	-2.54	-2.91
ln M2/P	-2.21	-2.91	-1.80	-2.91
ln OILREV	-0.15	-2.91	-0.21	-2.91
INV/GDP	-1.58	-2.91	-1.67	-2.91
ln EX	-0.38	-2.91	-0.99	-2.91
Δ(lnY)	-4.44	-2.91	-4.35	-2.91

Variable	ADF test	5% Critical Values	PP test	5% Critical Values
Δ(ln G)	-2.54	-2.91	-4.29	-2.91
Δ(ln M2)	-4.04	-2.91	-4.01	-2.91
Δ(ln P)	-4.32	-2.91	-4.24	-2.91
Δ(ln M2/P)	-5.35	-2.91	-5.58	-2.91
Δ(ln OILREV)	-7.11	-2.91	-7.13	-2.91
Δ(INV/GDP)	-6.97	-2.91	-7.11	-2.91
Δ(ln EX)	-4.57	-2.91	-4.56	-2.91

Note: *Length of the lag is estimated based on Schwartz info criterion*

As it can be seen in table (1), according to ADF and PP test, model variables are non-stationary and integrated of order one. On the other hand, it would be stationary differenced once. This result shows that the level of these variables is under the influence of permanent shocks, so that after each shift they do not tend to return to a certain linear trend.

3.2. Long-term tests and co-integration analysis

The next step, given the non-stationarity of levels of variables examined, we should test co-integration between the levels of variables with economic theory. On the theory of demand for money or money market equilibrium theory, it expects that variables of money volume, general level of prices and production have a long-term equilibrium relation together. If there is a long-term among the given variables, remaining resulted which is interpreted money non- equilibrium can, symmetrically and asymmetrically, influence on the gross domestic product. Therefore, in this step, we examine a long-term relation (co-integration). Hence, one can determine degree of co-integration among the variables of model using Johansen method and statistical test effect of ***λ Trance*** and maximum likelihood test ***λ max.***

$$\lambda_{Trace}(r) = -T \sum_{i=r+1}^{n} \ln(1-\hat{\lambda}_i)$$
$$\lambda_{Max}(\mathrm{r}, \mathrm{r}+1) = -\mathrm{T}\ln(1-\hat{\lambda}_{\mathrm{r}+1}) \quad (3)$$

While $\hat{\lambda}_i$ is estimated value of specified roots resulted from estimation of matrix of convergence vectors which is also called eigenvalue and T is number of usable observations in the estimation.

In the test ***λ Trance*** H0 hypothesis is that number of convergence vectors is less and/or equal to r. in fact, hypothesis of maximum number of collective vector is compared with the hypothesis of more than collective vector r. if statistics is more than critical value in certain confidence level, H0 hypothesis is rejected based on the maximum collective vector r. In the test ***λ max*** H0 hypothesis is that number of convergence vectors equals r and competitive hypothesis is number of convergence vector r+1.

Table 2. Determining number of the convergence vectors using the test ***λ Trance***

Null	Alternative	LR statistic	95% critical value
None	1=r	33.06930	29.79707
At most 1	2=r	9.471020	15.49471
At most 2	3=r	0.403103	3.841466

Source: *research findings*

Table 3. Determining number of convergence vectors using the test ***λ max***

Null	Alternative	LR statistic	95% critical value
None	1=r	23.59828	21.13162
At most 1	2=r	9.067917	14.26460
At most 2	3=r	0.403103	3.841466

Source: *research findings*

As it is presented in the given table and in respect of statistics ***λ Trance*** and statistics ***λmax*** it is demonstrated a long-term relation.

3.3. The GDP Growth Equations

In this section, we examine effect of the different factors for demand and supply on the production growth emphasizing on the positive and negative monetary shocks. Hence, we estimate the different specifications according to the table (4). Specifications (columns) of 1-7 examine liquidity effects on the real product (based on the line or symmetric relations). In the other words, in this specification, it is assumed that effect of liquidity negative and positive shocks on the real product is same and there is a linear relation between them.

Table 4. Estimation of Growth Model with Different Specifications

Variable	1	2	3	4	5	6	7
C	-0.003	-0.001	0.003	0.001	0.001	0.004	0.001
$\Delta \ln y_{it}(-1)$	0.19***	0.028	0.03	0.03	0.25***	0.11	0.1
$\Delta \ln M2$	0.19***	--	--	--	--	--	--
pos	--	--	--	--	0.031	0.22	0.13
$pos(-1)$	--	--	--	--	0.03**	0.005**	0.002**
neg	--	--	--	--	0.003**	0.0005***	--
$neg(-1)$	--	--	--	--	-0.86	0.18	--
$\Delta \ln G$	0.15***	0.1*	0.13 ***	--	0.25 ***	0.24 ***	0.29 ***
$\Delta \ln G(-1)$	---	--	--	--	--	--	--
$\Delta \ln OILREV$	0.02**	0.02**	0.02*	0.01*	0.02*	0.01	0.01
$\Delta \ln OILREV(-1)$	--	0.009	0.004	--	--	--	--
$\Delta \ln inv$	0.23 ***	0.26***	0.23***	0.23***	0.23***	0.25***	0.22***
$\Delta \ln inv(-1)$		0.1**	0.08*	0.06*	--	0.07*	0.05
$\Delta \ln P$	-0.15***	--	--	--	--	--	--
$\Delta \ln EX$	0.04	0.1***	0.08***	0.09***	0.06**	0.14***	0.11***
$\Delta \ln EX(-1)$	--	-0.01	--	--	--	-0.003	--
$\Delta \ln(M2/P)$	---	0.19***	0.18***	0.18***	--	--	--
$\Delta \lim$	-0.02	-0.003	--	--	-0.04	--	--
$\Delta \ln Export$		-0.01	-0.017	--	-0.003	--	--
$\Delta \ln Export(-1)$		0.05**	0.05**	0.05**	--	0.07***	0.05**
R^2	0.84	0.88	0.87	0.86	0.85	0.88	0.84
DW	2.30	2.12	2.05	2.08	2.39	2.37	2.24
AIC	-4.17	-4.23	-4.23	-4.29	-4.05	-4.24	-4.07
SIC	-3.63	-3.66	-3.82	-3.95	-3.59	-3.74	-3.69
AR χ^2	3.6	1.43	3.64	2.33	5.46	3.63	2.82
HET	8.70	12.27	11.26	7.87	9.70	6.40	4.13
NORM	0.16	1.96	3.00	2.98	1.23	0.43	2.91

Notes: ***, **and * respectively show the significance in 1%, 5% and 10% levels.

In all of the specification, variables explained between 84-88% explain Fluctuations in real non-oil GDP. Factor of liquidity growth *Δ*lnM2. In the given cases is significantly and has the expected indicator. This results show that the growth of the liquidity increases real non-oil GDP with factor from 0.19 to 0.49. Inflation rate *Δ*ln p with the factor of 0.15, as it is expected, decreases the product. The same results are also obtained as variable of real money balance rate *Δ*ln (M2/p) (growth rate) is used rather than two variables of growth M2 and inflation rates. In the other words, results show that there is a positive relation between liquidity and non-oil gross domestic product. Growth of oil revenues (*Δ* ln*OILREV*) and government expenses (*Δ* lnG) have the positive and significant effect on the growth of product in the same period,

although their interval isn't significant. Growth of investment (Δ ln*inv*) with a factor from 0.22 to 0.26 has also a significant effect on the economic growth rate. Similarly, investment interval growth (Δ ln*inv*) with a factor from 0.1 to 0.05 has also a significant effect on the economic growth rate. Variable factor of exchange rate changes (Δ ln*EX*) with a factor from 0.06 to 0.11 has also a significant effect on the economic growth rate, although their interval isn't significant. Therefore, research results show that there is a positive relation between liquidity, investment ratio, oil revenues and government expenses with non-oil GDP and there is a negative relation between inflation rate and non-oil GDP.

4. Conclusions

In this paper, the effects of monetary positive and negative shocks on the production have been examined during 1972-2015 in Iran economy, based on the cointegration analysis. In addition to monetary shocks, the estimated output growth equations include combinations of the explanatory variables: investment to GDP ratio, government expenditure, inflation and exchange rate. The results showed Contractionary monetary shocks, has low effects on output whereas the effects of expansionary monetary shocks are neutral. The effects of expansionary monetary shocks after a first lag have significant effects on increasing output. Among the control variables, the investment ratio, inflation, government expenditures, oil revenues and coefficient of exchange rate have significant expected effects on production growth. Therefore, results show that although policy makers can increase the economic growth to some extent by supplying unexpected amount of money, but with reduction of money supply and inflation, they should spend much more due to the reduction of economic growth. Thus economic policy makers should always consider monetary disciplines and macroeconomic stability and they should not sacrifice it for short-term meager economic growth interest.

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