An Examination of the Relationship between Food Prices and Government Monetary Policies in Iran

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Abstract

This study examines the relationship between food prices and monetary policy variables, using a Vector Error Correction Model (VECM) approach applied to annual data from 1976 to 2006. Results indicate that food prices in Iran have a long-run and short-run equilibrium granger causality relationship with money supply. More specifically, monetary policy reforms are shown to have a significant impact on food prices and domestic agricultural production. These policies influence consumption patterns and have serious implications for poverty reduction, food security issues, and agricultural growth in Iran.

Keywords: VEC model, food Prices, monetary policy, Iran

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Introduction

The high volatility of food prices in Iran is a major concern to the general public and government policy makers because such price movements are a deterrent to increased agricultural productivity and tend to intensify inflationary pressures. Food price volatility is expected to discourage investment in agriculture as it increases the uncertainty faced by farmers and agribusiness firms. The slowing of the agricultural investment growth rate may have serious ramifications on the agricultural sector, including growing farm debt, reduced farm incomes and productivity.

The general objective of this study is to determine the impact of Iran's monetary policies on domestic food prices. More specifically, this study examines how the recent increases in money supply have affected the general index of consumer food prices. Although the exogenous changes in interest rates are considered in this study, the main focus is on the impact of money supply on food inflation.

The remainder of this article continues as follows. Following a literature review of the theories and empirical studies that have analyzed the relationship between inflation rates and macroeconomic policies, we present an overview of the post-revolution macroeconomic policies in Iran. A model of Iran's food prices is specified next, followed by a description of data and estimation procedures. The next section is devoted to the presentation of estimation results. Summary and conclusions are provided in the final section.

Literature Review

The combination of oil price shocks that have occurred since the 1970s; persistent droughts in some parts of Africa, leading to reductions in global food supplies; as well as inflationary pressures have triggered adjustments in the agricultural and food prices across the globe (Cleaver and Donovan, 1995; Oden, 2003). Extensive research has been devoted to understanding the factors underlying the short- and long-run price volatility (Hathaway, 1974; Belongia and King, 1983; Barnett, Bessler and Thompson, 1983; Kargbo, 2000). Explanations for the rising food prices generally fall in two broad categories. First is the structuralist view which argues that structural shocks in certain sectors of the economy raise the price of food and other commodities. Eventually, these price increases are either accommodated or validated by an increase in money supply, thereby, keeping upward pressure on prices of other goods. Roy and Darbha (2000) argue that the structuralism perspective describes adequately the situation in developing countries, where price and output mechanisms are different across sectors, Moreover, the existence of structural bottlenecks (e.g. low supply elasticity for agricultural products, foreign exchange constraints, and high price and wage indexation in the industrial sector) greatly influence the origins and persistence of inflation.

The second justification for the food price increases is the monetarist view. Monetarists argue that price increases are due to autonomous increases in money supply, and not just a reaction to accommodate real shocks in the economy (Kargbo, 2005). Since Schuh (1974) first pointed out the importance of macroeconomic and financial factors in determining agricultural commodity prices, Frankel (1986) was the first to demonstrate that monetary changes can have short-run real effects on agricultural prices. The results of the study by Frankel (1986) show that monetary changes can cause agricultural prices to overshoot their long-run equilibrium, i.e.

monetary changes can have real short-run effects on agricultural prices. Furthermore, he argues that the relatively slow speed of adjustment of industrial prices to monetary changes adds to overshooting in agricultural prices. Lai, Hu, and Wang (1996), Bordo (1980), Chambers and Just (1980), and Orden (1986) state that agricultural prices may overshoot their long-run equilibrium levels if the monetary changes are unanticipated.

Various theoretical explanations are given for instantaneous changes in agricultural food prices. It is usually assumed that agriculture is a sector in which prices are more flexible than prices in non-agricultural sectors (Robertson and Orden, 1990). Bordo (1980) argues that agricultural commodities tend to be more standardized and exhibit lower transaction cost than manufactured goods so that agriculture prices are characterized rather by short-term contracts and respond more quickly to monetary changes than the prices of other goods.

Recently, several published articles have empirically analyzed the impact of monetary changes on agricultural prices by employing cointegration and VECM analysis. These studies examine whether agricultural and industrial prices respond proportionally to monetary changes in the long run and whether there are predictable deviations from this proportional money price response in the short run. For instance, Orden and Fackler (1989) used a vector auto regression (VAR) model and impulse response functions to show that an increase in money supply raises agricultural prices relative to the general price level for more than a year, suggesting the effect of monetary changes on real agricultural prices both in the short- and long-run. Similarly, Saghaian, Reed, and Marchant (2002) and Bakucs and Ferto (2005) extended Dornbusch`s model using monthly data and found that monetary changes can have real short- and long-run effects on agricultural prices. In other words, their results provide evidence for the overshooting hypothesis, but against the monetary neutrality hypothesis. Among other empirical studies that provide evidence for the overshooting hypothesis and against the money neutrality hypothesis are Bessler (1984), Chambers and Just (1982), and Devadoss and Meyers (1987). In summary, these studies argue that monetary changes can have effects on real agricultural prices only in the short run, but not necessarily in the long run.

The above studies provide evidence of significant linkages between supply shocks, agricultural prices, exchange rates, and international monetary reserves. Exchange rates, interest rates, and the level of money supply are key monetary variables that are determined mainly within domestic or international markets. Macroeconomic variables, including trade policy instruments on imports and exports, are determined by domestic policy makers. These variables are viewed as exogenous to the agricultural sector.

An Overview of Iran's economy and its Macroeconomic Policies

Iran is the second largest oil producer in the Organization of the Petroleum Exporting Countries (OPEC) and its oil and gas reserves rank among the world's largest. Iran's economy is largely dependent on oil and is highly susceptible to oil price shocks. The 1973 oil price bust sent the economy spiraling into crisis, while recent oil price surges have increased Iran's export revenue and reserves. In 1979, Iran went through a revolution and the government changed from a monarchy to a Muslim religion-based government. In 1980, shortly after the revolution, Iran was engaged in a war with Iraq that lasted through 1987. Because of lowered oil prices and the eight-year Iran-Iraq war exhausting available financial resources, Iran experienced a negative rate of total GDP growth. However, starting in 1990, Iran experienced a post-war recovery which lasted only for five years, when Iran faced a severe economic downturn due to a significant drop in international oil prices (Jbili 2007). This recessionary period lasted until 2000 when the oil prices took an upward turn and Iran's economy has followed the upturn in oil prices since (2000-2008). Iran has experienced positive rates of real economic growth as measured by percentage change GDP. Most recently, the annual rate of change in GDP registered at 5.8% for 2006 and was projected to stay level for 2007 (IMF 2007) .However, most of the growth rate is attributed to the non-oil sector. While in the non-oil sector, real GDP growth rate has been above 6% for both 2006 and 2007; the oil sector's real GDP growth has been less than 3% -- 2.7% for 2006 and 2.1% for 2007. Oil-related economic growth has been modest partly due to OPEC oil production capacity constraints (IMF 2007).

Macroeconomic indicators for Iran provide a mixed picture of the country's current economic situation. Although rising oil prices have been cited as a major reason underlying Iran's recent economic growth, positive growth also has been associated with Expansionary monetary and fiscal policy reforms under the current government and weather-related agricultural recovery have also been given as reasons for the growth. Despite the economic growth in Iran has brought double-digit Inflation and unemployment rates in some sectors and therefore, despite the current positive economic stance, the Iranian general population has expressed concern about the prevailing economic conditions. More specifically, producers are concerned about high interest rates and the cost inflation regarding production inputs, while consumers complain about high cost of food and the general inflation in living cost index. In this light, some analysts are concerned about the economy's long-term viability and argue that currently rising international oil prices mask vulnerabilities of the economy.

Inflation and Monetary Policy in Iran

Double digit inflation rates have been a fact of life in Iran for the past 20 years. Between 2002 and 2006, rate of inflation has been fluctuating between 12 and 16%. Monetary policy in Iran has not been successful in meeting the inflation and monetary targets set in the Iranian Five-Year Development Plan, owing mainly to the macroeconomic (mainly inflationary) impacts of government spending out of oil revenues. Although, through its monetary policies, the central bank of Iran has succeeded in controlling the inflation rates and getting closer to the inflation targets as set in the Five-Year Plan during the 2002-2006 period, the objective of a gradual disinflation to single-digit levels has not yet been achieved (IMF Country Report, 2007). Moreover, the implicit intermediate-run targets of monetary policy and growth in money supply has not been achieved. The Central Bank is an arm of the Iranian government and as such it does not operate independently. Interest rates are usually set based on political priorities and not monetary targets. A review of the components of the monetary base shows that the main reason for rise in monetary base in 2004/05 was the increase in the net foreign assets of Iranian central bank and the government's withdrawal from the Exchange Reserve Account and converting it to Rial . IMF estimates that inflation rates in Iran reached 17.2% in 2007 and is projected to surpass 20% in 2008 . High inflation is widespread among the oil-exporting countries in the Middle East and Central Asia, where inflation averaged an estimated 10.0% in 2007. Among the oil exporters, Iran's inflation level was second only to Iraq (30.8%) in 2007.

Because of inflation, Iran's currency, the Rial, has been depreciating in real terms against the U.S. dollar. Inflationary pressures have been associated with government's efforts to curb the interest. In May 2007, the interest rate for loans was capped at 12% for private and state-owned banks, although the Central Bank proposes interest rate hikes. It is predicted that high levels of inflation also have been associated with a growth in Iran's money supply. The Central Bank figures suggest that the money supply growth has been about 40% annually (IMF, Regional Economic Outlook, 2008).

Research Methods

The cointegration analysis of time series data is used in this study to determine the relationship between monetary policies and food prices in Iran. The econometric analysis is comprised of three consecutive tests: the unit root, cointegration, and the Granger Causality tests. The unit root tests were performed on each monetary variable to assess the stationarity of that variable. Then, the Johansen methodology was used to test the cointegration relationships between food prices and monetary variables (Johansen, 1988; Johansen and Juselius, 1990). Finally, Granger-causality tests were conducted on possible causal relationships between each set of relationships (Peng et al, 2004). Each of these tests is described in the following section.

Unit Root Tests

Before applying empirical cointegration tests, the Augmented Dickey Fuller (ADF) method was used to test whether or not each variable was stationary. Most economic variables such as prices that exhibit strong trends are non-stationary. If a stationary process can be produced by taking a first difference on a non-stationary variable, then this variable is said to be integrated of order one, denoted as I(1) (Greene, 2000).

Consider an augmented vector auto regression (VAR) process of order k as given in equation (1):

$$Y_t + \sum_{i=1}^{k} \Phi_i Y_{t-i} + \psi D_t + \varepsilon_t \qquad t = 1,2,...,T \qquad (1)$$

Where Y_t is $l \times 1$ vector of jointly determined non-stationary I(1) dependent variables, (described below), and D_t is a $q \times 1$ vector comprised of q deterministic terms and/or exogenous variables, ε_t is $l \times 1$ vector of innovations, and $\Phi_j \{ j = 1,2,...,k \}$ and ψ are $l \times l$ and $l \times q$ coefficient matrices, respectively. In our case, $l = 3$ and $Y_t = [LFPI, LM, IR]$, where LFPI is the logarithm of food price index, LM is the logarithm of money supply, and IR is interest rate. Equation (1) may be rewritten in a vector error correction (VEC) form as:

$$\Delta Y_t = \Pi Y_{t-1} + \sum_{j=1}^{k-1} \Gamma_j \Delta Y_{t-j} + \psi D_t + \varepsilon_t \qquad (2)$$

Where $\Pi = \sum_{j=1}^{k} \Phi_j - I$, I is the identity matrix (3)

And $\Gamma_j = -\sum_{i=j+1}^{k} \Phi_i$ (4)

ADF tests on the parameter Π can be performed to determine whether or not each series is more closely identified as being either an I(1) or an I(0) process. If the null hypothesis (P=0) cannot be rejected, it can be inferred that each series is more likely to be an I(1) instead of an I(0) Process (Eviews4 User's Guide, 2000; Greene, 2000).

Cointegration Test

Granger's representation theorem asserts that if the coefficient matrix Π, in equation (2) has reduced rank $r \prec 1$, then there exist $l \times r$ matrices α and β each with rank r such that $\Pi = \alpha\beta'$, and $\beta' Y_t$ is stationary (Granger 1981; Engle and Granger 1987). In regards to definitions, r is the number of co integrating relations (the rank), and l is the number of variables included in vector Y_t, in case of this study l equals 3. The elements of α are known as the adjustment parameters in the VEC model and each column of β is the co integrating vector. The hypothesis of co integration can then be formulated as a restriction on the Π matrix where the number of co integration relationships is given by r. The trace test method is used to test for r (the maximum number of cointegration relationships) and the statistic is:

$$\lambda_{trace} = -T \sum_{i=r+1}^{k} \ln(1-\lambda_i) \qquad (5)$$

Where T is the number of time period observations and l is the i-th largest eigenvalue. The null hypothesis states that the co integration rank is r and the alternative hypothesis is that the co integration rank is k (the order of the VAR process).

Granger-causality Tests

In analyzing Granger causality relationships, the main interest is to find the lead/lag relationships between variables. The concept of Granger-causality is fundamentally different from economic causality. However, if A causes B according to economic theory, A must move before B. That is to say, the Granger-causality relationship is necessary, but not a sufficient condition for an economic causality relationship between variables.

Y_t Will be separated into two subgroups, one for food prices Y_{1t}, and another subgroup for monetary variables Y_{2t} consisting of money supply and interest rates. The following two VAR equations can then be used to test whether a Granger-causality relationship exists between food Prices and monetary variables.

$$\Delta Y_{1t} = \alpha_0 + \sum_{i=1}^{k} \alpha_{1i} \Delta Y_{1t-i} + \sum_{i=1}^{k} \alpha_{2i} \Delta Y_{2t-i} + \psi_1 D_t + u_{1t} \qquad (6)$$

$$\Delta Y_{2t} = \beta_0 + \sum_{i=1}^{k} \beta_1 \Delta Y_{2t-i} + \sum_{i=1}^{k} \beta_{2i} \Delta Y_{1t-i} + \psi_2 D_t + u_{2t} \qquad (7)$$

In equation (6), if the parameters α_{2i} are statistically different from zero, the absence of Granger-causality may be rejected and may be concluded that monetary variables Y_2 cause food price Y_1. In equation (7), if the β_{2i} parameters are statistically significant from zero, it may be concluded that the direction of Granger-causality relationship moves from food prices, Y_1 to monetary variables, Y_2.However if both are statistically different from zero, it could be inferred that there exists bicausality between Y_1 and Y_2 (Granger, 1969).

This empirical analysis was carried out using annual data from 1976 to 2006. Data for money supply and interest rates and food prices index were obtained from the World Development Indicators Online. This database is maintained by the World Bank and the Iranian central bank. All Variables except interest rates, were transformed to natural logarithm. Three variables are used in this study: retail-level food prices, money supply, and prime interest rates. Recall that three variables used in this analysis are Logarithm of Food Price Index (LFPI), Logarithm of Money supply (LM) and Interest Rate (IR). Microfit 4.0 was used in this study to conduct the tests

Results and Discussion

Stationary and integration tests

Previous studies indicate that time series data for agricultural and industrial prices, exchange rate, and money supply are likely not to be stationary (see for example Saghaian et al., 2002; Bakucs and Ferto, 2005; Cho et al., 2004). In this study, the Augmented Dickey Fuller (ADF) unit root test is performed to test the stationarity of the variables considered. The results are presented in table 1.

The ADF test is sensitive to the choice of order of the lag. Therefore, the analysis started with an over-specified ADF test where the order of the lag was relatively large, after which the order of the lag that corresponded with the lowest Akaike Information Criterion (AIC) was chosen. The ADF tests for the first four variables in table 1 show that the absolute values of the

ADF test statistics were lower than the 95% critical value. This suggests that the null hypothesis of the unit root for these variables is not rejected and none of these variables are stationary in levels at the 5% significance level.

The ADF test was again performed for each first differenced series to check if all the series are integrated order one, I(1), or integrated of higher order., The results are shown in the last three rows of table 1. The unit root null hypothesis is rejected at the 5% significance level for all series in first difference, suggesting that all the series are I(1). Thus, a cointegration approach is used to obtain the long-run relationship between the variables.

Cointegration Test

The Johansen technique for co integration test is more popular than other techniques for cointegration testing, such as the Engle and Granger and autoregressive distributed lag (ARDL) techniques. One of the reasons for its popularity is that it allows one to determine the number of co integrating relationships present in the data (Fedderke, 2001). Therefore, in this study the Johansen approach was used to determine and estimate the cointegrating relationships between the food prices index, exchange rate and money supply.

First the VECM lag length had to be selected. The procedure is similar to that of the ADF test. In both cases, initially, the model was over specified by using an order high enough to be reasonably confident that the optimal order would not exceed it. Then LR (Likelihood Ratio statistics) tests were used to determine the optimal lag length. The LR statistics test (both adjusted and unadjusted) suggested 1 as the optimal order of the VAR.

Having determined the appropriate VECM, the maximal Eigen value and trace statistics were generated to determine the number of co integration vectors (r) present in the data (table 2). The results reveal that there is one co integrating equation at the 10% significance level on the basis of both $\lambda_{\max}$ and λ_{trace} criteria. Estimated long-run equilibrium relationship between variables is as follow:

$$LFPI = 0.164LM + 0.0023IR, \quad (8)$$

This result suggests that monetary changes can have a long-run real effect on agricultural prices. This conclusion is consistent with the study by Saghaian et al., (2002) and Bakucs and Ferto (2005).

Estimation VECM

Another important feature of the Johansen approach is that it simultaneously Separates short-run dynamics and long-run equilibrium and does not allow the one to contaminate the other (Fedderke, 2001). The coefficient of the cointegration equation (error correction coefficient) in the VECM, known as the “speed of adjustments”, measure how quickly the system returns to its long run equilibrium after a temporary shock.

Table 3, summarizes parameter estimates for vector error correction model. Results show that the food price index and money supply in a lagged one-year period are statistically significant at the 5% and 10% significance level respectively in the determination of a FPI, change but interest rate is not significant. In fact, this result indicates that previous food prices have a significant effect on current prices. Also increasing the money supply in Iran led to higher retail prices for food. Error correction coefficient (ECM) for FPI dependent variable is -0.45 that indicates 45 percent of short-run non equilibrium is adjusted in each period.

Neither of the variables are statistically significant in the determination of a money supply change. The interest rate change in a lagged one-year period is statistically significant at the 5%

significance level in the determination of an interest rate change. When interest rate is considered as an independent variable in model, ECM coefficient is greater than one (41.25) which indicates a negative effect on adjustment of short-run fluctuations.

Granger-Causality Tests

The Wald test and t test were conducted on possible Granger-causality relationships between food price index and monetary variables that are reported in table 4. Left side columns, show short-run granger causality using Wald statistics. The center column uses the t-statistic test to report error correction coefficients. Finally, right hand column show, long-run causality on the basis of the Wald test on both model variable and error correction simultaneously.

The results reveal that there exists a causality relationship from LM to LFPI at 5 percent level. This means that monetary policies Granger cause a FPI change; meanwhile a FPI change doesn't Granger cause monetary policy changes. In a short-run period there is not a causality relationship between money supply and interest rate. According to long-run results, there is a bicausality Granger relationship between LM and LFPI. This means that monetary policies have a significant effect on market food prices and generally, inflation both in short-run and long-run periods.

Oil revenues in Iran have grown significantly during the study period. These oil revenues were pumped back into the economy by the government trough investments and employments. From the results of this study, it can be argued that the injection of income resulted from oil exports has been a major reason behind the large rates of inflation in Iran's economy. Because, ECM coefficient is greater that one (41.25), long-run causality relation for equation with IR as dependent variable can't be accepted.

Summary and Conclusions

Agriculture plays a pivotal role in the Iranian economy. Iran's agricultural sector accounted for 14 percent of the GDP in 2004 and employed a one-fifth of the labor force. Apart from its contribution to GDP, agriculture's strategic importance results from its effect on as well as being impacted by the rest of the economy, food security, foreign exchange earnings, and employment. The relative change in agricultural prices determines the income of the farmers, their investment decisions, and the productivity in this sector. Thus, understanding the factors that influence food and agricultural prices is fundamental for the design of policies aimed that the sustainable growth in this sector and the rest of the economy.

The possible impacts of monetary and macroeconomic factors on agricultural and food prices have attracted the attention of many agricultural economists. In this study a VEC model was used to find Granger causality relationships between monetary variables (money supply and interest rates) and retail-level food prices in the short-run and long-run periods. Results indicate that food prices in Iran have a short-run as well as long-run equilibrium relationship with money supply. In fact, Granger-causality tests reveal that there exists a long-run Granger-bicausality relationship between food prices and monetary variables. Specifically, a change in the money supply causes a change in food prices and a change in food prices causes indirectly a change in money supply. Given this financial environment, Iran's expansionary monetary policy might be inconsistent with its objectives of controlling inflation. Also as a macroeconomic policy instrument, interest rates play a very limited role in affecting food price fluctuations. Hence, the Iranian government may conservatively use money supply as a policy tool to smooth out the variability and fluctuations in food prices and their impact on Iranian farmers' real income and consumers' living expenditures.

Policy Implications and WTO Accession Potential Impacts

Iran's proposal to join the World Trade Organization (WTO) was approved by the WTO officials in previous years; however, Iranian government did not accept the necessary condition which was set for Iran regarding its WTO accession .The Iranian government would have to further expedite and deepen its financial reforms, including the determination of interest rates by economic conditions. From the results of this study, it is expected that further monetary policy manipulations according to WTO requirements would have a notable impact on food prices in Iran.

Furthermore, the results of this study show that expansionary monetary policies significantly affect food prices in Iran. Accession to WTO is expected to increase imports of agricultural products. Because production costs in Iran's agricultural sector are higher than many other countries, it is expected that with opening up the trade, the domestically produced agricultural and food products would not be able to compete with lower-prices imports. Consequently, it is expected that producers lose in welfare and agricultural production would decrease. Therefore, it is recommended that the Iranian government first evaluate the impact of its monetary policies, before joining WTO.

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Appendix

Table 1. ADF Unit Root Tests Results

variable	t statistic	Critical t value	Signification level
LFPI	-0.43	-2.9907	5.0 percent
LM	-2.53	-2.9907	5.0 percent
IR	-1.322	-2.9907	5.0 percent
DLFPI	-3.136	-2.9970	5.0 percent
DLM	-4.22	-3.62	5.0 percent
DIR	-3.12	-2.9970	5.0 percent

Table 2. Co integration Rank Test Results

No. of Cointegrating Equations		Eigenvalue	Critical value at 10 percent level
$\lambda_{\max}$			
$r = 0$	$r \geq 1$	23.52	23.10
$r \leq 1$	$r \geq 2$	10.65	17.18
λ_{trace}			
$r = 0$	$r = 1$	40.60	39.34
$r \leq 1$	$r = 2$	17.08	23.08

Table 3. Vector Error Correction Model Parameter Estimates

Dep. Variable / indep. variable	DLFPI	DLM	DIR
intercept	-0.2807*	-0.427	31.52*
DLFPI1	0.448**	0.451	-14.211
DLM1	0.05772*	-0.183	18.63
DIR1	0.00314	0.006	0.702**
ecm(-1)	-0.45**	-0.867**	41.25*

** denotes 5% significance level and

*denotes 10% significance level

Table 4. Granger-Causality Relationship Tests Results

Dep. variable	Short-run causality			Ecm coefficient	Long-run causality		
	DLFPI	DLM	DIR	ECT	DLFPI & ECT_{t-1}	DLM& ECT_{t-1}	DIR & ECT_{t-1}
DLFPI		6.88^{**}	1.485	-0.45^{**}		7.007^{**}	4.20
DLM	0.197		1.76	-0.867^{**}	9.83^{**}		4.22
DIR	1.94	0.105		41.25^{*}	7.95^{**}	9.123^{**}	

** denotes 5% significance level and

*denotes 10% significance level