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AN ASSESSMENT OF PRICE ACCELERATING IN IRAN USING FRANKEL PRICE MODEL AND ARDL METHODOLOGY

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Abstract
As reaching to economic growth, development and stability in any economy needs and assessment and determination of such important factors as inflation, occupation and production, hence relation between inflation and effective factors on prices' level can play an important role in economy. This paper surveys short term and long term effects of effective variables on inflation and evaluates possibility of commodities price accelerating in Iran.
Key words: *Inflation rate, accelerator, error correction model, liquidity*

INTRODUCTION

Price accelerating is defined as price short term changes on more than its long term balance level which happens when some markets are not able to react immediately against variations of sudden monetary supply. Assuming neutral monetary in a long term period, it is also possible to survey short term relation between monetary and relative prices which finds significant sensitivity. Therefore, accelerating model in price provides us with necessary conditions to evaluate short term effects of monetary policies on different prices of an economic system. [2] In other hand, supply variations through interest rate fluctuations effects on commodities price but price fluctuations are greater than monetary supply variations. So, adaption of monetary policies is an important factor at generation of fluctuations on commodities price. [3]

Frankel price accelerating model

As we know, commodities prices have considerable sensitivity against macroeconomic changes and such factors as monetary policies, variations on monetary

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volume and interest rate. During a long term period, it is expected that all commodities would find price changes due to economic developments; while, during a short term period, commodities prices would be stable due to different reasons including long term contracts, specifying employees' salary, etc. Unexpected increasing or decreasing of monetary growth effects prices.[4] During a short term period, such prices are confronted with accelerating so that short term increasing or decreasing is greater than long term fluctuations. Frankel defines two models for specifying price accelerating model against monetary supply variation: price of base products (p_c) and manufacturing products (p_m). Based on Frankel definition, interest rate is variation in expected rate of price minus products' maintenance expenses. So that:

$$i = \overset{\circ}{p}_c^{\,e} - s_c$$

The risk is zero and total sum of products maintenance expenses is a stable value. According to Philips equation, we have:

$$\overset{\circ}{p}_m = \pi(d - \bar{y}_m) + \mu$$

Where:

d : Demand logarithm of manufacturing commodities

$\bar{y}_m$: Logarithm of potential product of each unit

μ : Expected inflation rate

π : Stable coefficient

Extra demand has been defined as increasing function of price and decreasing function of interest rate:

$$d - \bar{y}_m = \delta(p_c - p_m) - \sigma(i - \mu - \bar{r})$$

$\bar{r}$: Stable value

Extra demand is zero on long term period and $d = \bar{y}_m$ and price of p_c and p_m products are obtained by specified criteria of $\bar{p}_c$ and $\bar{p}_m$.

$$\overset{\circ}{p}_m = \pi[\delta(p_c - p_m) - \sigma(i - \mu - \bar{r})] + \mu$$

Monetary demand simply has been assumed as following:

$$m - p = \phi y - \lambda i$$

Where:

i : Interest rate

m : Logarithm of nominal monetary supply

p : Logarithm of public level of prices

y : Logarithm of total product

ϕ : Attraction of monetary demand in comparison to production

λ : Attraction of monetary demand in comparison to interest rate

Public level of the prices has been specified as weighted mean of manufacturing commodities and other commodities.

$$p = ap_m + (1-a)p_c$$

By substituting above equations, monetary long term functions can be extracted:

$$m - ap_m - (1-a)p_c = \phi y - \lambda i$$

$$\overline{m} - a\overline{p}_m - (1-a)\overline{p}_c = \phi\overline{y} - \lambda i = \phi\overline{y} - \lambda(\overline{r} + \mu)$$

Assuming $m = \overline{m}$ and $y = \overline{y}$, difference of above equations is shown as following:

$$a(p_m - \overline{p}_m) + (1-a)(p_c - \overline{p}_c) = \lambda(i - \mu - \overline{r})$$

If $m = \overline{m}$ and $y = \overline{y}$, by using combination of relations in base commodities, we have:

$$\overset{\circ}{p}_c^{\,e} = \frac{a}{\lambda}(p_m - \overline{p}_m) + (\frac{1-a}{\lambda})(p_c - \overline{p}_c) + \mu + \overline{r} + s_c$$

Similarly, formula of manufacturing commodities price is obtained:

$$\overset{\circ}{p}_m = \pi\{\delta[(p_c - \overline{p}_c) - (p_m - \overline{p}_m)] - \frac{\sigma}{\lambda}[a(p_m - \overline{p}_m) + (1-a)(p_c - \overline{p}_c)]\} + \mu$$

Above equations act like a matrix:

$$\begin{bmatrix} \overset{\circ}{p}_m \\ \overset{\circ}{p}_c \end{bmatrix} = \begin{bmatrix} -\pi(\delta + \sigma a/\lambda) & \pi(\delta - \sigma(1-a/\lambda)) \\ a/\lambda & (1-a)/\lambda \end{bmatrix} \cdot \begin{bmatrix} (p_m - \overline{p}_m) \\ (p_c - \overline{p}_c) \end{bmatrix} + \begin{bmatrix} \mu \\ \mu + \overline{r} + S_c \end{bmatrix}$$

Specific roots of above matrix are as following:

$$[-\pi(\delta + \sigma a/\lambda) + \theta][(1-a/\lambda) + \theta] - (a/\lambda)\pi[\delta - \sigma(1-a)/\lambda] = 0$$

$$-\theta = [-((1 - a/2\lambda + \pi(\delta + \sigma a/\lambda))\ 1/2]$$

$$\pm\sqrt{[-(1-a)/\lambda + \pi(\frac{(\delta + \sigma a/\lambda)}{2})]^2 + \delta\pi/\lambda}\ ,$$

Solving of mentioned equation for base and industrial prices is as following:

$$p_m(T) = \bar{p}_m(T) = \exp(-\theta T)\left[p_m(0) - \bar{P}_m(0)\right]; T \to 0, \infty$$
$$p_c(T) - \bar{p}_c(T) = \exp(-\theta T)\left[P_c(0) - \bar{p}_c(0)\right]$$

Variation rate of above formulas can be found as follows:

$$\overset{\circ}{p}_m = -\theta\,(p_m - \bar{p}_m + \mu)$$
$$\overset{\circ}{p}_c = -\theta\,(p_c - \bar{p}_c) + \mu + \bar{r} + S_c$$

Note that in the conditions where manufacturing commodities price is so important, θ is indefinite. By using $\overset{\circ}{p}_c$ formula in Arbitrage conditions (efficiency rate is less than expected sum of commodities price increasing plus maintenance expenses), equation of base commodities is:

$$p_c = \bar{p}_c - \tfrac{1}{\theta}(i - \mu - \bar{r})$$

According to above equation, if macro policy causes a change in real rate of interest, base commodities' price is changed inversely. θ shows slow acceleration of commodities' price balancing and price accelerating phenomena is added. Therefore,

$$\bar{p}_c = \bar{p}_m = \bar{p} = \bar{m} - \phi\bar{y} + \lambda(\bar{r} + \mu)$$

If we insert monetary demand relation in the formula, following equation can be obtained:

$$p_c = \bar{m} - \phi\bar{y} + \lambda(\bar{r} + \mu) - \tfrac{1}{\theta}(i - \mu - \bar{r})$$

As well as above equation, in addition to interest rate, expectable increasing in monetary growth (μ) effects on flow of base commodities' equilibrium price. So, it also causes Pc with some fluctuations. To get instant changes due to variation in monetary supply, by using above equations, we have:

$$\Delta i = \Delta \overset{\circ e}{p}_c = -\theta\Delta(p_c - \bar{p}_c) + \Delta\mu = -\theta\Delta p_c + \theta\Delta m + (1+\theta\lambda)\Delta\mu$$

By using assumption of sensitive i and p_c against monetary variations, we have:

$$(1 - a)\Delta p_c - \Delta m = \lambda\Delta i$$

Where generally equation of price variations is calculated:

$$\Delta p_c = \frac{1 + \lambda\theta}{1 - a + \lambda\theta}\Delta m + \lambda\frac{1 + \lambda\theta}{1 - a + \lambda\theta}\Delta\mu$$

Above equation is result of Frankel study on sensitivity rate of price variations against monetary volume variations what is the main relation in mentioned study which approves prices' accelerating against monetary supply variations because Δm coefficient is greater than the unit and in limit status (where θ moves towards

infinite), mentioned equation will not have price accelerating. Therefore, the phenomenon of prices' accelerating is observed during a short term period. In fact, Frankel introduces prices' accelerating as a short term phenomenon and believes that on a long term period, prices' balancing is performed at all economic sectors according to economic conditions' variation.

Introducing variables of the function

Most of the researchers have used "variable" title in their studies around inflation. Such variables as Gross Domestic Product (GDP), real volume of private liquidity (wide definition of money M_2), long term interest rate are being used.

LM2: Natural logarithm of real volume of money with wide definition of money
LGDP: Natural logarithm of gross domestic product with stable price in 1997
LIN: Natural logarithm of inflation rate
LLIN: Natural logarithm of long term interest rate
RPG: Growth rate of agriculture sector prices
RPI: Growth rate of industry sector prices

Also, due to annual time series used to specify optimized interval duration, Shwartz-Bizin criterion and interval 4 were used. [5] According to unit root tests to assess stability of the variables including extended procedure of Dickey Fouler (ADF) and Philips Prone (PP) in econometrics,[8] the results of such test about pattern of this paper and comparison with critical values of the test (in 5% level) are shown in following table:

Table of unit root tests such as Dickey Fouler (ADF) and Philips Prone (PP)

Variable name	*ADF*	*PP*	*ADF*	*PP*
	Intercept		*Trend and Intercept*	
LM2	$I\ (\circ)$	$I\ (1)$	$I\ (2)$	$I\ (2)$
LIN	$I\ (\circ)$	$I\ (\circ)$	$I\ (\circ)$	$I\ (1)$
LGDP76	$I\ (1)$	$I\ (1)$	$I\ (1)$	$I\ (1)$
LLIN	$I\ (1)$	$I\ (1)$	$I\ (1)$	$I\ (1)$

Pattern estimation

According to mentioned theoretical basics, following pattern has been discovered in order to change monetary demand behavior of LM_2:

$$LIN = C + \sum_{i=1}^{p_1} B_{1i} LM_{2t-i} + \sum_{i=\circ}^{p_2} B_{2i} LGDP_{t-i} + \sum_{i=\circ}^{p_3} B_{6i} LLIN_{t-i}$$

The results yielded through model estimation during a short term period are presented in following table:

Table of function estimation 1971-2011

variable	*Coefficient*	*Standard Deviation*	*t-test*	*Possibility of t-test*
LIN(-1)	0.259	0.19	1.35	0.18
LIN(-2)	-0.581	0.19	-3.04	0.006
LIN(-3)	0.202	0.18	1.17	0.27
LIN(-4)	-0.474	0.18	-2.57	0.17
LGDP76	-2.68	0.81	-3.29	0.003
LLIN	2.01	0.56	3.56	0.002
C	9.61	2.9	3.29	0.003
LM2	0.48	0.34	1.34	0.19

According to yielded results through estimation of one percent increment in Gross Domestic Product, inflation is reduced as much as 2.68 percent. Coefficient of monetary volume is obtained of 0.48 which approves economic perspectives about relation between inflation and monetary volume. According to gained statistics for long term rate (2.01), it can be argued that interest rate variable is significant in the function. The sign of such coefficients is obtained positive which shows direct relation between interest rate and inflation.

Table of diagnostic tests and statistics

Serial Correlation	*Functional Form*	*Normality*	*Heteroscedasticity*
0.07	0.58	0.60	0.75

According to diagnostic tests and statistics, it can be concluded that the model has the best status in terms of classic assumptions and structural break statistics and is confronted with no problem.

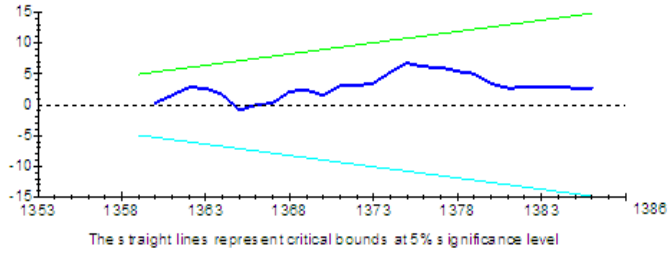
According to error correction pattern which is used in order to explain short term behavior of monetary demand and also error correction coefficient which shows balancing acceleratory towards long term equilibrium for which following results have been yielded:

Table of error correction test

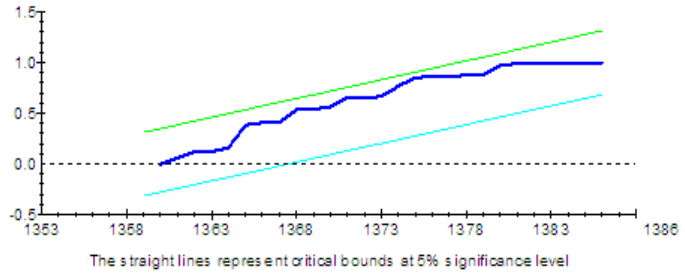
variable	*Coefficient*	*Standard Deviation*	*t-test*	*Possibility of t-test*
ECM	-0.59	0.33	-4.68	0.000

As coefficient of error correction is estimated of -0.59, so annually half of imbalance of a period is balanced in the inflation of next period. Therefore, balancing towards equilibrium is done with a relatively mild acceleratory.

Plot of Cumulative Sum of Recursive Residuals



Plot of Cumulative Sum of Squares of Recursive Residuals



According to cumulative sum of recursive residuals (CUSUM) and Cumulative sum of squares of recursive residuals (CUSUMSQ) and also above plots, zero hypothesis around structural stability existing is accepted and its lack is rejected, actually we can say that structural stability existing is approved.

Table of function estimation during a long term period 1971-2011

variable	*Coefficient*	*Standard Deviation*	*t-test*	*Possibility of t-test*
LGDP76	-1.68	0.38	-4.37	*0000.0*
LLIN	1.26	0.21	5.82	*000.0*
C	6.03	1.47	4.08	*000.0*
LM2	0.29	0.20	1.40	0.17

According to yielded results, due to greater affectivity of price on agricultural sectors than industrial ones in terms of inflation survey, the policy makers should pay more attention to markets of agricultural products particularly on price as acceleratory of agriculture sector prices is considerable.

According to yielded coefficients during short and long term periods, it can be argued that money is neutral during a long term period as long term coefficient of money is lower than its short term. Accelerating means faster affectivity of money volume on price indices, in other hand also inflation rate is affected of agricultural and industrial sectors so it can be concluded that accelerating in agricultural prices index is sensed in a short term period at a comparison with industrial commodities and ultimately accelerating impact would cause prices changing in a short term period.

While flexibility of agricultural products price versus price of industrial commodities and services means that because agricultural commodities are relatively equal, storable, and transportable, they are some deals on competitive markets and in other hand price of industrial commodities and services is pasted due to agreements of price changes expense, insufficient and heterogeneous information of such commodities and services. It should be taken into account that decreasing impact of production on price indices is always a lever to control the prices and economy products should generally be increased because its affectivity on inflation is sensed from monetary volume during a long term period.

As price changes are faced with different expenses including expenses of new prices' printing, social expenses and expenses of losing customers, low acceleratory of prices' decreasing is observed. Mentioned expenses are of the factors which cause prices' cohesion. Nevertheless, in some cases, having prices on optimized level causes a resistance against changes because a change in such conditions needs expense. Rotemberg believes that price balancing acceleratory for industrial commodities is lower than economic sectors due to industries structure.[9] Also, mentioned expenses next to long term contracts and particular structure of industrial sectors in comparison with other sectors have been a reason for managers to resistant against price changes as much as they can. Furthermore, in order to match prices with new conditions, comprehensive information with sufficient time is needed which totally causes low acceleratory of prices' balancing in industrial sector and prices' cohesion.

Table of function estimation during a long term period 1971-2011

variable	*Coefficient*	*Standard Deviation*	*t-test*	*Possibility of t-test*
RPG	0.016	0.004	3.48	0.0006
RPI	0.0017	0.004	0.42	0.68
C	-1.10	0.037	-29.56	*000.0*

In other hand, lots of studies approve accelerated fluctuations of prices in other sectors of economy. Studies suggest that different policies adaption in order to improve economic status has more impact on agricultural sector than other sectors. In fact, as agricultural sector is confronted with long term contracts issues and

also has more sensitivity; such a sector is affected more rapidly by economic changes. Experience has shown that fluctuations of monetary volume decreasing cause deeper decreasing on prices during a short term period. During a long term period, based on rational expectations principle, mentioned changes would be balanced and changes process would proceed with a lower acceleratory. Therefore, it is important to note that price balancing acceleratory in different economic sectors and considered time series (long term and short term) is significant and must be paid attention.

CONCLUSIONS

Based on yielded results, it has been clear that price accelerating in Iranian economy is approved as a meaning like effects of liquidity growth on growth of prices' index. So, if the goal is to control inflation particularly in a short term period, then the government must specifically try to control liquidity volume. In other hand, always the impact of production growth on commodities' price index growth is negative which is matched by yielded results, therefore it was considered as a bilateral lever to control inflation and impacts of liquidity volume increasing on prices which was resulted in products and commodities in order to make prices stable. In other hand, the liquidity among populations can be controlled and collected by increasing the rate of banking interest which can resistant versus prices' increasing through guiding the people towards investment and production. According to price accelerating in economy, if the aim is to control inflation particularly on a short term period, then the government should try to specifically control price of agricultural commodities during a short term period. In order to control prices, interfere in the market, stabilize prices and apply roof prices we can use the principles of this paper because agricultural productions themselves can make the market competitive and despite of governmental cross interventions to limit fluctuations of such products, competitive system and its benefits would not be confronted with danger.

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