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The long run relationship between interest rates and inflation in Iran: Revisiting Fisher’s hypothesis

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This paper analyzes the relationship between interest rates and inflation by using the Johansen’s co-integration approach and then vector error correction model (VECM) approach. It should be noted that this relation has been known as Fisher effect in long run term, so we used the theory of Fisher for theoretical basis. The hypothesis, proposed by Fisher (1930), which states that the nominal rate of interest should reflect movements in the rate of inflation has been the subject of much empirical research in many industrialized countries. The existence of a long run relationship between interest rate and inflation was tested by Johansen’s co-integration test. The result shows that there is one co-integration relation, so there is one co-integration equation too. To estimate the adjustment coefficients, we used VECM. Consequently, the results show that there is a long run relationship between these variables in Iran. Also, the results show that the long run relationship between the weighted average of interest rate is weak, while the long run relationship between rental rates of housing and inflation is strong.

Key words: Fisher effect, Interest rate, inflation, vector error correction mechanism.

INTRODUCTION

The interest rate and inflation are important variables in the macroeconomic subjects, so there are many papers that examined the relationship between these variable especially in the recent decade. It should be note that the Fisher effect states that nominal interest rate move one for one with expected inflation, leaving the real rate of interest unaffected. There are a number of reasons, according to Hawtrey (1997), as to why the Fisher hypothesis has maintained such a key position in economic literature. Firstly, the real rate of interest plays a pivotal role in any economy’s economic growth, savings and investments, while also affecting trade and capital flows through its influence on the exchange rate. Secondly, there is a large amount of evidence, as proposed by Fama (1975), to suggest that nominal interest rates can be used to determine future inflation expectations. Thirdly, the Fisher hypothesis is an important factor of consideration for central banks.

A significant amount of research has been conducted in developed countries to prove and establish this hypothesis: among the most prominent papers are those by Fama (1975), Mishkin (1992), Yuhn (1996), Crowder and Hoffman (1996), Dutt and Ghosh (1995), Hawtrey (1997), Koustas and Serletis (1999) and Mishkin and Simon (1995).

In terms of methodology employed, the thesis utilizes Johansen’s co-integration analysis. This is an ideal analysis technique to validate the Fisher hypothesis, as it is able to verify a long-term unit proportionate relationship between nominal interest rates and expected inflation. However, a co-integrating relationship between nominal interest rates and expected inflation only partially validates the Fisher hypothesis.

Fisher (1930) hypothesized that the nominal interest rate is made up of two components: the expected rate of inflation ($\pi^e_t$) and the real interest rate ($r^e_t$):

$$i_t = r^e_t + \pi^e_t \quad (1)$$

where $i_t$ is the nominal interest rate, $r^e_t$ is the real
interest rate and $\pi^e_t$ is the expected rate of inflation.

It should be noted that in some of the studies, the Fisher’s equation has been written as:

$$i_t = r_t + \beta \pi^e_t$$

Where $\beta = 1$, but if $\beta < 1$, then there will be Fisher effect weakly.

This simple equation is founded on the premise that rational economic agents, being the investors or savers, require compensation for any purchasing power lost on their nominal money due to price level increases. What has come to be known as the Fisher effect postulates a one-for-one relationship between expected inflation and nominal interest rates and the ex ante real rate of interest that is approximately constant over the long-run.

In this study, we examined the relationship between inflation rate and interest rate, on the other hand the existence of Fisher effect in Iranian economy. There are many factors to decrease efficiency monetary or fiscal policies in Iranian economy, such as economic structure of Iran, high risk of investment due to unsuitable conditions of economic, etc. The theoretical basis of this relationship will be presented subsequently, methodology of the model, the estimation, hypothesis tests and interpretation of results will be shown, respectively.

We have two hypotheses in here:

1. There is no long run relationship between inflation rate and interest rate in Iran.
2. There is just one way relationship between inflation rate and interest rate as suggested by Fisher hypothesis.

THEORETICAL FRAME AND LITERATURE REVIEW

The channels through which a change in the interest rate is likely to impact the price level in standard macro models can be distinguished into demand and supply channels. The demand side of the economy is determined by equilibrium conditions in money and goods market. First, consider the impact of a raise in the interest rate on the money market. A raise in the interest rate increases the opportunity cost of holding cash balances which has a negative impact on money demand. The reduction in money demand creates excess supply of credit and stimulates a rise in aggregate demand. Consequently, price must increase so that individuals can be satisfied to hold the existing stock of money rather than spending it on commodities or interest bearing assets (Bose, 2002).

On the other hand, changes in the interest rate are likely to affect the equilibrium condition in the goods market and, in turn, price. A rise in interest rate is expected to impact on disposable income and the public’s preference to consume out of this income. While net interest gets added to the disposable income of lenders in the economy, it decreases the income available for borrowers to spend. Hence, a rise in the interest rate is expected to increase consumption for the lenders and decrease consumption for the borrowers. If marginal propensity to consume for borrowers is higher than that for lenders, an increase in the interest rate would likely lead to decline in consumption demand. In addition to that, a change in the interest rate is expected to impact negatively on investment spending in two directions. First, an increase in the interest rate has a negative impact on the net present value of the expected return on investment. Second, a rise in the interest rate increases the cost of credit, which would also be expected to reduce investment demand. This channel further decreases aggregate demand and, in turn, price. Thus, the interaction between the interest rate and the demand side of the economy does not provide a clear prediction of the impact of the interest rate on price level (Kandil, 2005).

The interaction between the interest rate and the supply side of the economy is also complicated by the presence of conflicting factor. An increase in the interest rate means a higher cost of the output produced and, therefore, a rise in prices. However, an increase in the interest rate has an intertemporal substitution effect on labor supply. Workers prefer to work more today to increase their saving at the higher interest rate. The increased labor supply increases the output supplied and, in turn, decreases prices. In short, the combine effect of demand and supply channels suggests an ambiguous impact of the interest rate on price.

The Fisher effect has been extensively investigated in the USA. Fama (1975) studies the United States government treasury bill market to find evidence to support his efficient market hypothesis. It should be noted that Fama (1975) found some evidences to emphasize the hypothesis of constant in expected real returns on one to six months bills, whereas Carlson (1977) found evidences against this hypothesis.

From the other side, we can examine this relationship from inflation rate to interest rate too, as an increase of price levels lead to increase the interest rate, indirectly. The price level can increase from supply side or demand side of economy. When the price levels increase, it makes the high inflation rate to avoid this phenomenon, the policy makers try to reduce inflation rate by tighter monetary policies, so they will have higher real interest rate. Hence, the higher interest rates are due to a higher real component in the interest rate.

To distinguish this relation, we can rewrite the Fisher equation as:

$$i_t = r_t + \beta \pi^e_t$$

where $i_t$ is the nominal interest rate, $r_t$ is the ex ante real interest rate and $\pi^e_t$ is the expected inflation rate.

Assuming that Fama (1975) expected the actual inflation
to differ by a white noise stationary term and ex ante real interest rates stationary, we can empirically test the Fisher equation in the following form:

$$\pi_t^e = \pi_t + \varepsilon_t$$  \hspace{1cm} (3)

It should be noted that in the long run, the quantity of expected inflation equals to actual inflation rate. It means the average of the error terms $\varepsilon_t$ is zero:

$$E(\varepsilon_t) = 0$$  \hspace{1cm} (4)

After substituting Equation 3 in Equation 2, we obtained Equation 4 as follows:

$$i_t = r_t + \beta\pi_t + \beta\varepsilon_t$$  \hspace{1cm} (5)

We can define $\mu_t = \beta\varepsilon_t$, so aforementioned equation can be rewritten as follows:

$$i_t = r_t + \beta\pi_t + \mu_t$$  \hspace{1cm} (6)

In long run, $\mu_t = 0$; thus, we can show the Fisher equation in long run, as follows:

$$i_t = r_t + \beta\pi_t$$  \hspace{1cm} (7)

Now, we should examine the long run relationship between these two variables. However, we should note that $\mu_t$ in Equation 6 is the error of disequilibrium, actually. If there is every trace of existence of long run relationship between two variables, then they would be co-integrated.

$$i_t - \alpha + \beta\pi_t + \nu_t = \beta\pi_t - i_t = 0$$  \hspace{1cm} (8)

where $\alpha$ is the real interest rate. Canadian results are mixed, with Crowder (1997) finding evidence to support the Fisher equation from 1960:1 to 1991:4, whilst Dutt and Ghosh (1995) find no evidence to support the Fisher hypothesis under both fixed and floating exchange rate regimes in Canada. Junttila (2001) finds no substantial evidence of the Fisher effect in Finland. Evans (1998) cannot prove that a Fisher link existed between expected inflation and interest rates for the United Kingdom. Fahmy and Kandil (2003) realized that there is cointegration relationship between inflation and interest rates in 1980s and 1990s, so there is a long run relationship exists between these variables. Muscatelli and Spinelli (2000) use Italian data for the period of 1948 to 1990 and found that expected inflation and nominal interest rates trended together in the long-run. It should be noted that Atkins (1989) shows, Fisher equation, changes significantly by the effects of tax. Ekinci and Gul (2006) by examine the relation between inflation and interest rate, realized that there is a long run relationship but only from interest rates to inflation in Turkey.

Mundell (1963) and Tobin (1965) argue that nominal interest rates should adjust by less than one-for-one due to the impact of inflation on wealth and subsequently savings. Karni (1972) states that investment increases by decreasing the interest rates in short run, so wealth increases in long run and then consumption and also real interest rates increases, so real interest rates in long run are independent from wealth in long run and confirms the theory of Fisher. Darby (1975) and Feldstein (1976) point out that the effects of tax would result in a more than one-for-one adjustment to expected inflation, while Shome et al. (1988) suggest a premium needs to be incorporated in nominal interest rates to account for covariance risk. Bullock and Rider (1991) by examine the relationship between inflation and interest rate in some of industrialized countries found there is Fisher effect just in 1980s.

### METHODOLOGY

This study will ascertain the existence of such a relationship by implementing the following three-step procedure:

1. To determine the order of integration for two variables by employing tests devised by Dickey and Fuller (1979) and Phillips and Perron (1988).
2. If both variables are integrated as of the same order, a maximum likelihood method of co-integration, proposed by Johansen (1991) and later improved in Johansen (1995), will be applied in order to determine the number of co-integrating vectors. If one or more co-integration vectors are found to exist, any short-run disequilibrium will be corrected with an error correction model.
3. To determine whether causality runs from inflation to interest rates, a weakly exogeneity test suggested by Johansen (1992) will be carried out.

### Unit root tests

In order to determine whether the interest rate and inflation rate series contain unit roots, this study employs tests devised by Dickey and Fuller (1979) and Phillips and Perron (1988). Table 4 presents the results of order of integration. It should be noted that we choose the order of integration based on minimum of Akaike info criterion or the minimum of Schwarz criterion.

A pure random walk is given as:

$$\Delta y_t = \delta y_{t-1} + \sum_{i=1}^{m_1} \delta_i \Delta x_{t-i+1} + \varepsilon_t$$  \hspace{1cm} (9)

A random walk with drift can be represented as:

$$\Delta y_t = \alpha + \delta y_{t-1} + \sum_{i=1}^{m_1} \delta_i \Delta x_{t-i+1} + \varepsilon_t$$  \hspace{1cm} (10)

A random walk with drift and trend is represented as:

$$\Delta y_t = \alpha + \beta t + \delta y_{t-1} + \sum_{i=1}^{m_1} \delta_i \Delta x_{t-i+1} + \varepsilon_t$$  \hspace{1cm} (11)

where $\Delta$ is the difference operator, $\alpha$ is the constant term (drift
term), $\beta$ is the linear deterministic trend (time trend), $t$ is time and $\varepsilon$ is a white noise error term. The null hypothesis is that the time series $y_t$ is non-stationary, that is, if $\delta = 0$ and the series is therefore stationary if $\delta < 0$, using the $\tau$ statistic.

Co-integration analysis

Macroeconomic time series are typically non-stationary, as established by Nelson and Plosser (1982). When traditional regression analysis is used on two non-stationary time series, a spurious regression may result (Innes, 2006). But there is an approach to recognize the existence of long run relationship between various non-stationary time series in which is Bounds Testing Approaches proposed by Pesaran et al. (2001). When traditional regression analysis is used on two non-stationary time series, a spurious regression may result (Granger and Newbold, 1974). The non-stationary nature of the majority of macroeconomic time series has prompted the development of various non-stationary time series analysis techniques, the most prominent being co-integration analysis. This concept of co-integration, introduced by Granger (1981) and later extended by Engle and Granger (1987), was built on the premise that the linear combination of two non-stationary series results in a stationary series. Co-integration can be defined simply as the long term or equilibrium, relationship between two series. The co-integration method by Johansen (1991, 1995) has become the most cited co-integration technique used in Fisherian literature, and is used in this study.

The vector auto regression (VAR) based co-integration test methodology developed by Johansen (1991, 1995) is described here, briefly. The procedure is based on a VAR of order $p$:

$$y_t = A_1 y_{t-1} + \cdots + A_p y_{t-p} + B x_t + \Delta_t$$

(12)

where $y_t$ is a $k$ vector of endogenous variables, $x_t$ is a $d$ vector of exogenous variables, $A_1, \ldots, A_p$ and $B$ are matrices of coefficients to be estimated and $\Delta_t$ is a vector of innovations that may be contemporaneously correlated, but are uncorrelated with their own lagged values and uncorrelated with all of the right hand side variables (Eviews 6, 2007). In here, $y_t$ is a vector of non-stationary $l$ (Equation 1) variables (interest rate and inflation rate). The VAR may be reformulated as:

$$\Delta y_t = \pi y_{t-1} + \sum_{i=1}^{p-1} \omega_i \Delta y_{t-i} + B x_t + \Delta_t$$

(13)

where

$$\pi = \sum_{i=1}^{p} A_i - I$$

(14)

and

$$\omega_i = - \sum_{j=i+1}^{p} A_j$$

(15)

Estimates of $\omega_i$ contain information on the short run adjustment, while estimates of $\pi$ contain information on the long run adjustment, in changes in $y_t$. The number of linearly dependent co-integrating vectors that exist in the system is referred to as the co-integrating rank of the system. This co-integrating rank may range from $t$ to $n - 1$ (Green, 2003).

There are three possible cases in which $\pi y_{t-1} \sim I(0)$ will hold. Firstly, if all variables in $y_t$ are $I(0)$, this means that the coefficient matrix $\pi$ has $\pi = \pi$ linearly independent columns and is referred to as full rank. The rank of matrix $\pi$ could alternatively be zero: This would imply that there are no co-integrating relationships (Gujarat, 2004). The most common case is that the matrix $\pi$ has a reduced rank and there are $r < (n - 1)$ co-integrating vectors present in $\beta$.

This particular case can be presented by:

$$\pi = \alpha \beta^r$$

(16)

where $\alpha$ and $\beta$ are matrices with dimensions $n \times n$ and each column of matrix $\alpha$ contains coefficients that represent the speed of adjustment to disequilibrium, while matrix $\beta$ contains the long run coefficients of the co-integrating relationships. In this case, testing for co-integrating entails testing how many linearly independent columns that are in $\pi$ and effectively testing for the rank of matrix $\pi$ (Harris, 1995). Johansen’s approach uses both the trace and maximum Eigenvalue tests to identify the rank of $\pi$, in effect this tests for the number of non-zero characteristic roots (or eigenvalues) (Kennedy, 2003).

To determine the lag length of the variables in the model, we can use from different criterions, such as the Akaike information criterion (AIC) and Schwarts criterion (SC). It should be noted that we choose the suit lag length based on the minimum of these criterions.

Weak exogeneity

To test whether inflation rate or interest rate is weakly exogenous, a test proposed by Johansen (1992) is utilized. This test imposes a zero restriction on the error correction mechanism obtained from the co-integration analysis. The null hypothesis is given by $\alpha_i = 0$.

Therefore the non rejection of the null hypothesis for every variable (inflation rate and interest rate, in this study) shows that variable should be treated as an exogenous variable. For example, if the null hypothesis is rejected for inflation rate, it means that inflation rate is not an exogenous variable. On the other hand, if null hypothesis is not rejected for inflation rate and rejected for interest rate, it would verify the Fisher equation.

EMPIRICAL RESULTS

Here, we will introduce variables, then estimate the model and test the hypothesis; we will interpret the results, finally. We gathered the quarterly data from 1989 to 2007 of the time series database in Central Bank of Iran (CBI). It should be noted that we used the consumer price index (CPI) time series as inflation rate, the weighted average of expected rates of return on facilities
as interest rate and the rental housing index as a proxy of interest rate.

Variables

As we said earlier, the variables used in this study are as follows:

- $\pi_t$: Inflation rate
- $w_{r_t}$: Weighted average of expected rates of return on facilities
- $r_{h_t}$: Rental rate of housing index

Model specification

All of these variables are non-stationary in level, but they will be stationary by the first difference. The results of the Augmented Dickey Fuller (ADF) to determine the order of integration have been shown in Table 1.

The results of Table 1 show that the null hypothesis of a unit root test is not rejected in all cases for the levels series. On the other hand, by differencing from these variables, they will be stationary. The ADF test also indicating that all the variables are $I(1)$. Since all the variables are integrated to the same order, we can test whether a long run relationship exists through co-integration analysis.

Table 2 reports the results of the trace and the maximum eigenvalue test, as well as, the lag length in each case. The trace and maximum eigenvalue tests utilize a sequential testing procedure. If the null hypothesis of at most zero co-integrating relationships is rejected in favor of at most one co-integrating relationship, then in the next step, the null hypothesis of at most one co-integrating relationship is tested against the alternative of at most two co-integrating relationships, etc. Therefore, if $p$ is the number of variables (interest rate and inflation rate) and $r$ is the rank (number of co-integrating equations), then the trace test, tests the hypothesis that $r \leq p$ against the alternative. The maximum eigenvalue test, tests the null hypothesis of $r$ co-integrating equation against the alternative of $r + 1$ co-integrating equations.

The analysis concludes that a long run co-integrating relationship exists between all of these variables. Since the existence of a long run relationship has been established between these variables, the short run dynamics of the model can be established within an error correction model.

The results from the vector error correction model are reported in Table 3. The $\alpha \times \beta$ forms the error correction mechanism, $\alpha$ is the term which reflects the speed at which a variable shifts to eliminate shocks in the other variable within one period. Therefore, the $\alpha$ coefficient indicates how quickly the system re-establishes its long run equilibrium position (Harris, 1995).

The results from Table 4 show that the long run adjustment coefficient ($\alpha$) for weighted average of interest rate is significant. But it should be noted that the value of the coefficient of long run adjustment is very low. It means weighted average of interest rate adjusts the shocks of inflation rate very slowly. In other words, the
weighted average of interest rate eliminates the shocks of the inflation just seven percent in every period. So, it needs very long time to get to its long run equilibrium position. We can say that the weighted average of interest rate may be controlled from other direction, because the weighted average of interest rate cannot be affected by inflation rate, against the developed countries in the world. On the other hand, we can test the long run relationship from interest rate to inflation that has been shown in Table 4. It seems the speed of long run adjustment for inflation rate is more than that for interest rate or weighted average interest rate. It means after the shocks of interest rate, inflation rate adjusts quickly.

As the results of in Table 4, inflation rate eliminates the shocks of weighted average interest rate, quickly. So, the agents of Central Bank of IRAN who determine the expected rate of interest on facilities should be very careful to increase or decrease this variable (interest rate), because the long run adjustment coefficient of inflation rate is high.

We decided to show the effects of inflation rate shocks on the other variable such as rental rate of housing. The results of vector error correction model for the other variables are reported in Table 5.

The vector error correction model shows that the long run disequilibrium of rental housing index \( r_{ht} \) eliminates by moving, approximately fifty one percent in the same period. So, it seems that this variable eliminates the shocks of inflation rate less than two periods. In other words, we can see that the shocks of inflation rate affect the rental rate of housing, after two periods, approximately. On the other hand, the value of the \( \alpha \) is negative in which indicates if \( r_{ht-1} \) is above its equilibrium value \( \left( c_0 + c_1 \pi_{t-1} \right) \), \( \Delta r_{ht} \) will be negative to restore the equilibrium. That is, if \( r_{ht} \) is above its equilibrium value, it will start falling in the next period to correct the equilibrium error. The \( \beta \) coefficient shows that there is a positive and significant relationship between these two variables in long run.

The tests for distribution of the error terms, heteroskedasticity and serial correlation has been shown in Table 6.

It should be noted that the results in the Table 6 indicate the residual tests for a pair of variables of \( w_{Ft} \& \pi_t \). These results show that the residuals based on these estimates are in normal distribution, homoskedastic and not serially correlated.

The results of Table 7 also show the same results from the Table 6. It means there is no serial correlation and
Table 6. Diagnostic test for residual of $w_{t}$ & $\pi_{t}$.

<table>
<thead>
<tr>
<th>Residual diagnostic test</th>
<th>Test</th>
<th>Test statistic</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normality test</td>
<td>Doornik Hansen</td>
<td>0.804090</td>
<td>0.6690</td>
</tr>
<tr>
<td>Serial correlation</td>
<td>Breusch Godfrey</td>
<td>1.218701</td>
<td>0.8750</td>
</tr>
<tr>
<td>Heteroskedasticity</td>
<td>White</td>
<td>105.0734</td>
<td>0.1324</td>
</tr>
</tbody>
</table>

Table 7. Diagnostic test for residual of $r_{h_{t}}$ & $\pi_{t}$.

<table>
<thead>
<tr>
<th>Residual diagnostic test</th>
<th>Test</th>
<th>Test statistic</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normality test</td>
<td>Doornik Hansen</td>
<td>0.162025</td>
<td>0.9222</td>
</tr>
<tr>
<td>Serial correlation</td>
<td>Breusch Godfrey</td>
<td>5.066855</td>
<td>0.2805</td>
</tr>
<tr>
<td>Heteroskedasticity</td>
<td>White</td>
<td>91.10860</td>
<td>0.1472</td>
</tr>
</tbody>
</table>

Table 8. Weak exogeneity results.

<table>
<thead>
<tr>
<th>Weak exogeneity test on restricted system</th>
<th>LR test</th>
<th>P value</th>
<th>Weakly exogenous</th>
</tr>
</thead>
<tbody>
<tr>
<td>$w_{t}$ &amp; $\pi_{t}$</td>
<td>5.609407</td>
<td>0.017864</td>
<td>No</td>
</tr>
<tr>
<td>$w_{t}$ weakly exogenous to system $A(1, 1)$</td>
<td>4.052212</td>
<td>0.044114</td>
<td>No</td>
</tr>
<tr>
<td>$\pi_{t}$ weakly exogenous to system $A(2, 1)$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$r_{h_{t}}$ &amp; $\pi_{t}$</td>
<td>7.816580</td>
<td>0.005177</td>
<td>No</td>
</tr>
<tr>
<td>$r_{h_{t}}$ weakly exogenous to system $A(1, 1)$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\pi_{t}$ weakly exogenous to system $A(2, 1)$</td>
<td>4.527562</td>
<td>0.033353</td>
<td>No</td>
</tr>
</tbody>
</table>

Weak exogeneity test

The final step requires to verify which variable is weakly exogenous. The results of the weak exogeneity test are reported in Table 8. The weak exogeneity results for weighted average interest rate and rental rate of housing suggest that none of these variables are weakly exogenous. Therefore, though a long run relationship exists between these variables, but causality does not strictly run from inflation to interest rate as suggested by the Fisher hypothesis, instead a two way causality between the variables was found. The first hypothesis of this study is rejected, because there is a long run relationship between two pair of variables and the second hypothesis is rejected too, because these relationships are two way.

INTERPRETATION OF THE RESULTS

Here, we will interpret two kinds of variables, separately.

Weighted average of interest rate and inflation

The weighted average of interest rate obtained from expected rate of interest on facilities has a long run relationship with inflation rate, but as the results show, this relation is very weak, and it can be ignored. The most likely explanation for this weak relationship is because expected rate of interest on facilities are not formed by market forces, but are artificially determined by monetary authorities as part of the monetary policy framework.

In the real terms of the market, by increasing the prices and then inflation rate, the profit of producers will increase, so most of the people like to be shared with producers, because of the high profits of investment, and then their tendency to save their money will increase in somewhere else except banks. This may be caused to disequilibrium. To return to the equilibrium in long run, the interest rate of the banks will increase as well as inflation rate. It remains the monetary market in long run equilibrium. Although, there is a long run relationship between these two variables but this relation is not proportional to each other and it is very low and even ignorable.

On the other hand, if we notice this relationship from interest rate to inflation rate, we can see that there is a real strong long run relationship from interest rate to inflation and if there would be any shocks on interest rate, inflation rate will response very quickly. The authors of central bank of Iran, who determine the interest rate of banks, should be careful that a very little change in interest rate causes change in inflation in long run to
eliminate the shocks. A rational explanation of this result is that every increase in ordered interest rate causes increase in cost of investment of producer and then they increase the prices of the good to discover their costs.

The tests of co-integration show that there is co-integration relation between two variables, but it should be noted that this long run relationship is in two ways. It means inflation rate affects interest rate and vice versa, but this relation from interest rate to inflation is more powerful than inflation to interest rate in Iran, so due to these results the authors of Central Bank of Iran should be careful to every change in expected rate of interest.

### Rental rate of housing and inflation

The variable of rental rate of housing is a proxy of interest rate in this study. As we noted earlier, we used from this variable to establish the real effect of inflation rate shocks on it. In other words, we wanted to find out how inflation rate shocks affect the other variables in informal market, so we chose the rental rate of housing as a suitable variable to reflect this shocks.

As the results of estimates show, the long run relation between these two variables is completely visible. The existence of a strong long run relationship between these two variables indicates that every shock from inflation rate will be eliminated in less than two periods, whereas there are many other factors which affect the rental rate of housing, but inflation rate is an important factor that influences it. So, if everyone wants to study the real effect of inflation rate shocks on the other variables in Iran, the rental rate of housing can be a suitable factor for this purpose.

### REFERENCES


