INVESTIGATING THE EFFECT OF INFLATION SHOCK ON THE ACTIVITY LEVEL OF INDUSTRIAL UNITS IN IRAN

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Abstract

The industry is one of the most essential sectors affecting the economic development of national production of any country and has a significant impact on social, political, and economic relationship at home and abroad. As a result, attention to the development of the industry is a concern of planners in different societies. The primary purpose of this study was to investigate the effect of inflation shock on the activity level of industrial units through a Vector Error Correction Model (VECM) and using monthly time series data from April 2011 to April 2020 in Iran. For this purpose, the level of activity of industrial units was divided into three groups: the count of active industrial units, employment of active industrial units, and investment of active industrial units; the effect of inflation shock on each was estimated. An inflation shock from the first to the third period shows increasing and decreasing fluctuations in the activity of industrial units operating in Iran. From the third period onwards, this shock causes a stable decrease in the count of active industrial units in Iran; however, it causes a steady increase in employment in industrial units operating in Iran. Given the long-term relationship between the variables, if the inflation increases in the long run, the count of active industrial units will decrease, but the employment and investment of active industrial units will increase; these changes will be insignificant in the face of a one percent increase in inflation.

Keywords: Inflation Shock, Industrial Units, Vector Error Correction Model (VECM)

JEL Classification: B26, L52, L78.

1- Introduction

The main sectors of Iran's economy are agriculture, services, industry, and mining (Korakinejad and Najafi, 2008, 3). The industrial sector is one of the main sectors of any country's economy that significantly impacts social, political, and economic relationship at home and abroad and has an essential role in economic prosperity and recession. According to statistics provided by official sources, more than 34% of the country's employment is currently employed in this sector, and 21% of the total investments are made in this sector. Also, 22% of the country's energy is consumed in this sector. The industrial sector in Iran has many strengths and weaknesses. One of the most obvious strengths of this sector is the abundance of human resources and readiness for employment, abundant raw materials for production, substantial energy reserves, and low cost of access. Also, one of the weaknesses of the industrial sector in Iran is the lack of access to up-to-date technologies due to sanctions and the inadequacy of monetary, financial, and exchange rate policies (Daei and Afshon, 2018, 2).

The history of developed countries shows that they first focus on the industrial sector, and after the development of this sector, the other economic sectors such as agriculture and services have achieved high growth and prosperity. However, the economic growth and standard of living in any country depend on that country's national production. National production is one of the most prominent signs of economic development in any country. The favorable conditions indicate an acceptable situation in economic activities, and industry is one of the most fundamental sectors affecting the growth of national production and economic growth. (Jalaei Esfandabadi and Samimi, 2014, 2). Industrial growth and development play an essential and influential role in achieving uninterrupted and sustainable

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economic growth and development. Therefore, the industrial sector can be considered one of the main axes of economic growth which focusing on it for growth and development has been an important part of planners' concerns in different societies (Fetros et al., 2012, 2).

Inflation is also known as one of the most fundamental economic problems in the economy of any country. This economic variable is one of the main macroeconomic variables (Mohammadi Khayareh and Yaghoubi, 2016, 2). In recent decades, inflation as one of the main problems of the Islamic Republic of Iran has always occupied the minds of economists and politicians (Bastani et al., 2016, 1). Inflation has severely negatively affected people's economic well-being and purchasing power, so that people want to reduce prices and stabilize their real income (Dadgar et al., 2006, 6). There is no consensus on the nature of the relationship between inflation and economic growth. Given the positive, neutral, or adverse effect of inflation on economic growth, recognizing the effect of inflation on growth can be a helpful guide for policymakers in terms of the specific circumstances of each country. Higher inflation is considered detrimental to economic growth, and controlling and targeting inflation is mentioned as the main macro goal in most studies. In Iran, despite the high inflation rate in the last four decades, production has not grown as it should, and on the other hand, the reaction of production in different economic sectors to inflation has not been the same. Therefore, inflation may harm some sectors and a positive effect on some sectors; in that case, it is possible the welfare of people working in different sectors will not be affected equally (Pishbahar et al., 2015, 8). Inflation affects economic growth in many ways. The burden of inflation problems is on retirees whose incomes are stable. The effect of inflation on investment occurs directly and indirectly. For example, when inflation creates nominal value uncertainty, it becomes challenging to plan for investment. When inflation cannot be predicted, it creates uncertainty in relative prices, in which case there may be a reluctance to contract. This reluctance to contract will prevent investment over time, which will affect economic growth. In this case, inflation hinders investment and can lead to a recession (Ali and Ibrahim, 2018, 5).

According to the above and the problems resulting from inflation, which poses a severe challenge to the proper growth and movement of the economy and production planning in various activities and sectors, it seems necessary to study the role and impact of inflation in economic sectors. Accordingly, this study tries to determine the inflation trend and its effect on the level of activity of the country's industrial units based on the time series data over 109 months from April 2011 to April 2016.

2- Research Literature

2-1- Theoretical Foundations

Inflation is the "increase in the general level of prices over some time." In the economic literature, the division of inflation into different levels of weak, moderate, severe, or uncontrollable expresses its extent and severity; While all are the same in nature and definition (Sarabadani, 2006, 2). The principle of inflation is an unfavorable economic phenomenon that has high costs for society. In inflationary conditions, in addition to disrupting the prices system, it will lead to a reduction in savings, a decrease in the willingness to investment, and an outflow of capital from the real sector to speculative activities, and in general decline in economic growth. According to Laidler (1976), inflation is the result of a steady increase in the general level of prices or a decrease in the purchasing power of money (Mehnatfar and Mikaeli, 2013, 2). Redistribution of income to the benefit of asset owners and the detriment of payers, increasing uncertainty, and reducing long-term investment are among the destructive effects of inflation (Mehrara and Ghobadzadeh, 2016, 2).

Inflation can be classified into three groups. One group emphasizes the monetary nature of inflation. In this context, inflation is often defined as the result of an increase in the money supply relative to the needs of people and economic agents for money, or as a surplus of purchasing power or a surplus of payment means. The second group is inflation based on excess demand oversupply and introduces inflation as the result of excess demand oversupply. Lerner's theory defines inflation as a mismatch between supply and demand. In the third group, inflation is synonymous with a sharp rise in prices. Raymond Barr states that inflation exists when the general level of prices rises steadily and more or less rapidly. According to another definition, in this context, inflation is the same as the continuous increase in the general level of prices, or in other words, the self-increasing prices. The remarkable thing about inflation is that economists of different schools disagree on the causes of inflation. The classical school believe that the level of production and employment is determined by the conditions of the whole

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competition and Say's Law (There is a constant balance between aggregate demand and aggregate supply) at the level of full employment; any change in the monetary sector of the economy does not affect the actual variables of the economy. Keynesian economists attribute the increase in aggregate demand to aggregate supply as the root cause of inflation and argue that the main reason for the increase in demand should be sought in both money and commodities. In the commodity market, an increase in independent consumer spending, an increase in independent investment, and the like will lead to oversupply and inflation. The claim that inflation is a monetary phenomenon means that the continuous and high growth of money in the economy leads to high inflation. Monetarists in the new interpretation of the Quantity theory states that money is not neutral quickly and affects actual variables, but they accept the classical theory based on the neutralization of money for a long run. The structuralism school states that the leading cause of inflation is not the government's voluntary monetary and fiscal policies, but the fundamental imbalances in the economic system that also lead to the growth of money supply (Mohammadi Khayareh and Yaghoubi, 2016, 3).

One of the topics discussed by economists is recognizing the relationship between inflation and economic growth in different countries, and several theoretical and empirical issues have been presented in this regard. Examining these issues shows that there is no definite conclusion about the impact of inflation on economic growth. The results obtained for each country depending on the conditions and characteristics of that country (Sultan-Tuyeh et al., 2012, 2).

There is no consensus on the relationship between inflation and economic growth. Drucker et al. (2005) classify four main predictions in the literature about the effect of inflation on production rate and growth: (a) Sidrauski (1967) predicted that there is no effect of inflation on growth. That is, money is extraordinarily neutral. (B) Tobin (1965) hypothesizes that money replaces capital and causes inflation to affect long-term growth positively. C) Stockman (1981) presents a cash down payment model in which money complements capital and causes inflation to harm long-term growth. D) A new model in which inflation negatively affects long-term growth, but only if the inflation rate exceeds a certain threshold. These models assume a non-linear relationship between inflation and economic growth (Fakhri, 2011, 3).

Inflation is more or less present in most countries globally, but its rate varies in different societies and times. It has created fewer problems in developed countries in recent years. Because these countries do not suffer from severe and chronic inflation, but less developed countries with severe inflation and adverse effects such as increasing inequality in income distribution, increasing consumption, reducing savings and investment are faced with wastage of resources in unnecessary production, slowing economic growth and the spread of various types of financial and administrative corruption (Sarabadani, 2006, 2).

2-2- Literature Review

The relationship between growth and inflation can be different from other countries according to the economic conditions of each country. The results of these studies on the relationship between growth and inflation are spectral; In some ones the relationship is negative, in some ones it is neutral and in others it is positive. Some studies have also confirmed the nonlinear effects of inflation on economic growth. The following are some of the most important researches that have been done in this field.

In 1995, Barro did a study entitled "Inflation and Economic Growth". The study used data from 100 countries over 1960 - 1990 to assess the effect of inflation on economic performance. Regression results showed that the effect of inflation on growth is small in the short run and significant in the long run. Increasing inflation by 10% per year reduces the growth rate of GDP per capita by 0.2% to 0.3% per year.

In 1996, Sarel did a study entitled "Nonlinear Effects of Inflation on Economic Growth" considering the structural failure point. The results of this study showed that low inflation has no significant effect on economic growth, but at high rates the effect is significant and negative.

In 1997, Alexander conducted a study entitled "inflation and economic growth: evidence from a growth equation". In this study, the combined and cross-sectional time series method has been used to investigate the relationship between inflation and economic growth. According to the results, inflation and its changes have a negative and significant impact on economic growth.

In 2001, Faria and Carnero did a study entitled "Does High Inflation Affect Growth in the Long and Short Term?". This paper examined the relationship between inflation and production in economic conditions with high and persistent inflation in Brazil over 1995 - 1980 using a VAR model.

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The results of this study showed that in the short run, the effect of inflation on economic growth is negative and in the long run, it is ineffective.

In 2001, Malik and Chaudhry did study entitled "Inflation and Economic Growth: Evidence from Four South Asian Countries". This paper examined the relationship between inflation and GDP growth for four South Asian countries (Bangladesh, India, Pakistan and Sri Lanka) using combined and error correction models. According to the results, in the long run, there is a positive relationship between production growth and inflation for all four countries.

In a research done by Dadgar and Salehi Rezveh entitled " Relationship Between Inflation and Economic Growth in Iran" in 2004, the relationship between inflation and economic growth using the model presented by Barro and Alexander over 1951 to 2001 was studied. This paper introduces the Barro model and compatibility feasibility of this model in the Iranian economy. The main achievable results indicate that a 1% increase in inflation reduces economic growth by 0.002% in the short run and 25% in a long run. The main conclusion is that the estimation effects of inflation on growth are adverse. This negative effect has a significant impact on living standards, especially in a long run.

Komijani and Naqdi conducted a study entitled "Study of The Relationship Between Production and Inflation in The Iranian Economy (With Emphasis on Production)" in 2009. This study has used the VAR models and VECM to investigate the relationship between production and inflation in the Iranian economy from 1964 to 2005. The results show that the origin of inflation in Iran is not purely monetary and related to actual variables (i.e., production and this article production). According to the results, there is a long-term relationship between production and inflation, so that increasing production leads to decreasing inflation.

Falihi Pirbasti and Taheri Hanjani conducted a study entitled "The Impact of Inflation and Globalization on the Profitability of Iran's Large Industrial Workshops Integrating Dynamic System and Econometric Approaches" in 2011. For this study, in the period from 2000 to 2007, panel data method, measurement methods and dynamic system method have been used. According to the results, inflation increases revenues more than the cost of industrial workshops and thus increases profits.

Piraei and Dadvar studied "The Impact of Inflation on Economic Growth in Iran with Emphasis on Uncertainty" in 2011. This study examined the effect of inflation and its uncertainty on economic growth over 1954 - 2007 by considering the structural failure point for the Iranian economy. The results showed that inflation had a negative effect on economic growth, so that this effect was weak at rates less than 20% and increased at higher rates.

In 2012, a paper entitled "Inflation Variability and the Relationship between Inflation and Growth", by Jha & Dang examined the impact of inflation on economic growth using annual data from 182 developing countries and 31 developed countries over 1961 - 2009. In this paper, a two-step method is used to examine the relationship between inflation change and growth. First the inflation level threshold was detected using the Hansen method to detect the threshold effect in the panels, and then the same method was used to determine the effect of the inflation change threshold, which is measured by the coefficient of variation. The results showed that in developing countries, when the inflation rate is more than 10%, there is a negative and significant relationship between inflation and economic growth.

Soltantouyeh and his colleagues conducted a study entitled "Relationship Between Inflation and Economic Growth in Iran Using Rolling Linear Regression Model" in 2012. In this paper, first, a modified model based on the Barro model was designed, and then it was investigated the relationship between inflation and economic growth in Iran over 1978 - 2010 using the autoregressive distributed lag models (ARDL) and rolling linear regression. The results show that the effect of inflation on economic growth at all levels of inflation is negative and significant so that a one percent increase in inflation leads to a decrease of 0.0009 percent economic growth in the short term and a decrease of 0.001 percent in the long term.

Pishbahar and his colleagues conducted a study entitled "The Effects of Inflation on Production and Growth of the Iranian Economy based on The Agricultural Sector" in 2015. This study investigates the effects of inflation on different sectors of the economy through structural VAR model and using time series data from 1949 to 2009. The results showed that inflation affects the production of all economic sectors in the short run, but the extent of this impact is low and non-uniform in different sectors. In the medium term, the impact of inflation on sector output decreases sharply and disappears in the long run.

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In 2016, Kutu & Ngalawa did a study entitled "Monetary Policy Shocks and Industrial Performance in South Africa". This study was performed according to the monthly data over 1994 - 2012 using a structural VAR model. The results showed that a large proportion of changes in inflation is along with changes in money supply, exchange rates and industrial production. The money supply shock has a positive effect on the growth of industrial production. Interest rates of less than 1%, changes in industrial production growth and money supply account for 5% of industrial production changes. Total production accounts for 23% of industrial production changes after one year.

In 2016, Ooft did a study entitled "Inflation and Economic Activity in Suriname". This paper examined the relationship between different sources of inflation and economic activity in Suriname from 1975 to 2015 using the VAR model and the Impulse Response Function (IRF) and variance decomposition. The findings of this study showed that inflation hinders the economic development and economic growth of Suriname.

Nazari and Daliri conducted a study entitled "The Effect of Inflation Thresholds on Economic Growth in D8 Countries: The Panel Smooth Transition Regression (PSTR)" in 2018. In this study, the effect of inflation on economic growth over 1994 - 2015 was investigated using a panel smooth transition regression model. The results showed that there was a non-linear relationship between inflation and economic growth and there were two thresholds of about 3.2 and 3.3 percent for inflation; In very low and high inflation, inflation had a negative effect on economic growth and in medium inflation, inflation had a positive effect on economic growth.

In 2020, Adaramola & Dada did a study entitled "The Impact of Inflation on Economic Growth: Evidence from Nigeria". This study used a vector-distributed distribution regression model to investigate the impact of inflation on the growth prospects of Nigerian economy from 1980 to 2018. The findings of this study showed that inflation and exchange rates have a significant negative impact on economic growth, while interest rates and money supply have a significant positive impact on economic growth.

3- Methodology

The present research is applied in terms of purpose and descriptive survey in terms of the data collection method. The method of data collection was library study and documentary review. This study is a correlation al study using econometric methods, and VECM conducted nationally. The data used in this research is a time series that has been collected over 109 months from April 2011 to April 2020. Statistics related to the variables of this research have been extracted from the time series database of the Central Bank, the Statistics Center of Iran, and the Ministry of Economy and Finance. Eviews 10 software packages have been used to estimate the models and perform the relevant tests. Also, the logarithm of the variables' values has been used to examine the data and determine the optimal model. The logarithmic process reduces the amplitude of the variables and gives a better estimate.

In this study, the results of shocks from the point-to-point inflation rate (LINF) variable, the scale of which is an average price of essential and non-essential goods for a period, are measured on the variables of the activity level of industrial units. Variables of the activity level of industrial units, including the count of industrial units (LC), indicates the count of operating licenses issued for active and operating industrial units in the country; employment of industrial units (LEMP) indicates the employment contained in the operating license issued for active industrial units operating in the country and investment of industrial units (LINV) represents the investment contained in the exploitation license issued for active and operating industrial units in the country. In the present study, all four variables are considered endogenous. For this purpose, since the data is of time series type, the significance of the variables must first be examined.

Philips-Perron (PP) Unit Root Test

In the first step, determining the statistical properties of the studied variables using unit root tests is considered. The general strategy is to use the unit root test with different zero hypotheses and summarize the results of this test in order to determine the degree of integration of the studied variables. It is necessary to use the Phillips-Peron unit root test in conditions where the economic system is experiencing severe shocks due to Peron's criticisms of the Augmented dickey-fuller (ADF) unit root test method when there is a structural failure in time series. If the study variable is denoted by y, the following formula is fitted (Ghanbari and Rasouli, 2012, 1).

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$$\Delta y_t = \alpha + \beta t + \delta y_{t-1} + \sum_{i=1}^{p} \theta_i \Delta y_{t-1} + \varepsilon_t$$
(1)

Where y is the same as the four variables LINF, LC, LEMP and LINV. Phillips and Peron proposed a nonparametric method to test the unit root for serial correlation control. The Phillips-Prone method performs the DF test with a modified t-ratio so that it does not affect the serial correlation of the asymptotic distribution of the t-statistic. The Phillips-Peron statistic is as follows:

$$\hat{t} = t_\alpha \left(\frac{\gamma_0}{f_0}\right)^{0/5} - \frac{T(f_0-\gamma_0)(se(\hat{\alpha}))}{2f_0^{0/5}s}$$
(2)

Where $\hat{\alpha}$ is the estimation coefficient AR (1) and t_α is the same ratio t for α. The value of se ($\hat{\alpha}$) is the standard error and s is the standard regression error; the value γ_0 is the consistency estimate of variance of the errors. Component f_0 is also an estimate of the spectral density of error values at frequency zero (Ghanbari and Rasouli, 2012, 1).

Cointegration

The variables' degree of cointegration will be determined here. If the values are stable at the level of the variable, i.e., without any change in this variable, the reliability of this variable is confirmed; in this case the variable is at the stable level (accumulated at level zero I (0)). If the values are not in the stable level, the reliability of the difference of the variable's order d is checked. If the difference of the order d is a stable variable, then the integrated variable is of the order d (I (d)) and is as follows:

$$\Delta^d Y_t = \Delta^{d-1} Y_t - \Delta^{d-1} Y_{t-1}$$
(3)

Convergence Test

In the following, according to the degree of cointegration, the long-time relationship between the variables is examined. Some tests such as Granger Causality test, Johansen -Jocilius test and Boys Band test are used to test convergence between several variables. If all integrated variables are from the first order I (1) and there is a cointegration vector, the Granger causality test is used. If all integrated variables are from the first order I (1) and there is more than one cointegration vector, the Johansen - Jocilius test is appropriate (Enders, 1995, 433) and if a count of variables I (0) (variable at the stable level) and a count of variables I (1) (variable whose first-order difference is stable), the Boys Band test is used.

Optimal Lag

In any econometric model where there is a lag, the appropriate lag must be selected. Johansen cointegration analysis requires the determination of the optimal lag length (P) in the model. There are several criteria to obtain the appropriate count of lag s for the Phillips-Prone test, the choice of which depends on the data. For this purpose, the criteria of Schwarz Bayesian Information Criterion (SBC), Akaike Information Criterion (AIC) and Hannan–Quinn Information Criterion (HQC) are used. In each of these methods, the optimal lag is selected so that a large degree of freedom is not lost and the equation disorder statements do not become cointegrated. After selecting the appropriate count of lag s, the model is studied (Golkhandan and Molaei, 2013, 96).

Vector Auto Regression (VAR) Model

The VAR approach was introduced by Sims in 1972, 1980, and 1982 as an alternative to macroeconomic models. VAR models are based on the empirical relationship between the data; in abbreviated form, they consider a system of simultaneous equations in which each of the endogenous variables on their lag s and other variables' lag s are used in the system. In general, VAR models using dynamic data structure provide better results in the analysis of dynamic relationship of variables (Razavi and Salimifar, 2013, 8). The general form of a VAR model can be expressed as follows:

$$Y_t = \sum_{i=1}^{P} A_i y_{t-i} + \varepsilon_t$$
(4)

In this relationship Y_t is a column vector of observations at time t relative to all model variables, A_i is the coefficient of matrices, P is the count of lags, and ε_t is a column vector of the random perturbation values. Since the VAR model consists of n variables and as a vector, if there is a cointegration vector between the integrated variables of the model, the VECM is used instead of the VAR model.

Vector Error Correction Model (VECM)

It is sufficient to estimate each of the model equations by the ordinary least squares (OLS) to estimate the VECM coefficients. Since the set of (with lag) descriptive variables is the same in all model equations, ordinary least squares estimators are efficient (Noferesti, 1989). The VECM was first introduced to the economic literature by Philips. This model, which is considered as a dynamic model, was later used by Henry and other economists

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(Enders, 1995). Dynamic VECM make it possible to determine long run relationship between endogenous variables. In addition, these models relate the short run behavior of variables to their long run equilibrium values and show how the imbalances associated with long run equilibrium relationship of variables affect their short run dynamic changes. These unique features of VECM, which distinguish them from other econometric models, led to their rapidly evolving growth in the 1990s. The general form of VECM is presented as follows by Lutkepohl (2005).

$$\Gamma_0 \Delta y_t = \alpha \beta' y_{t-1} + \Gamma_1 \Delta y_{t-1} + \cdots + \Gamma_{p-1} \Delta y_{t-p+1} + \beta_0 x_t + \cdots + \beta_q x_{t-q} + CD_t + u_t \quad (5)$$

In this formula, α equals matrix, $k \times r$ equals the loading coefficient ε, which shows the loading coefficient towards the long-run equilibrium. The β is the cointegration $k \times r$ matrix that represents the long-run part of the model. Γ_j is the matrix of $k \times k$ short-run coefficients and u_t is also the vector of the components of the net disorder error with $E(u_t u'_t) = \sum_u$ (Lutkepohl & Kratzig, 2004). After estimating the VECM, the necessary tests for the model are performed and the Impulse Response Function and long-run relationship are investigated.

Impulse Response Function (IRF)

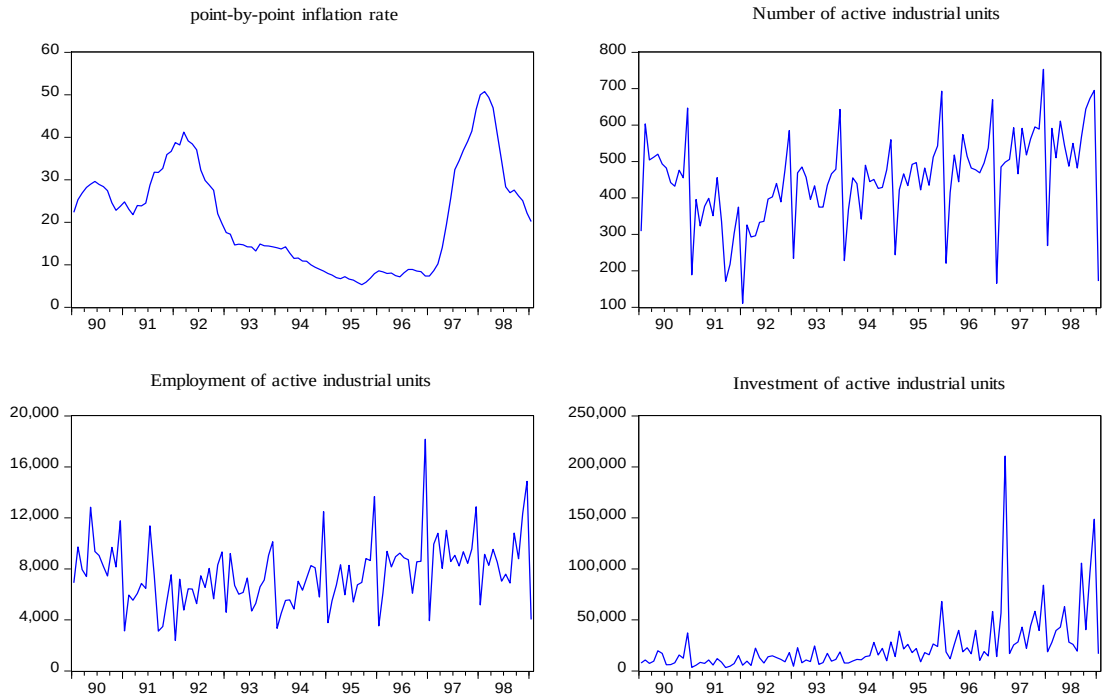
One application of the VECM used by Sims et al. (1980) is to track the reaction of variables following the shock in each of variables, which is called the Impulse Response Function. In other words, these functions show the dynamic path of the system in response to the shocks. Impulse response analysis is considered as a dynamic reaction analysis between endogenous variables in a VECM.

4- Findings

In this study, the results of shocks from the point-by-point inflation rate variable on the variables of the activity level of industrial units have been measured by the VAR model. This model is related to 109 months from April 2011 to April 2020 in the Iranian economy and includes all industrial units in the country.

Statistical Analysis of Research Variables

Figure 1. The trend of research variables from April 2011 to April 2020



Resource: study finding

As observed in Figure 1, the point-to-point inflation rate from April 2011 to April 2020 has not been uniform and has had ups and downs, so that sometimes upward, sometimes downward, and at some point, the trend has been almost uniform. The inflation rate in December 2016 reached its lowest level at 5 percent and in May 2019

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reached its peak at 51 percent. According to the graphs related to the variables of count, employment, and investment of industrial units during the mentioned period, it can be said that these variables, despite large fluctuations during the period, have had a constant trend throughout the period.

Results from Estimating the VECM

The significance of the variables of the count of industrial units, employment of industrial units, investment of industrial units, and inflation variable was examined through the Phillips-Peron test to estimate the effect of the variables; the results are presented in Table 1.

Table 1. Phillips-Peron unit root test results for model variables

variable	Test statistics	Significance level	cointegration degree
D(LINF)	-4/681	0/0002	I (1)
(LC)	-9/549	0/0000	I (0)
(LEMP)	-9/842	0/0000	I (0)
(LINV)	-7/059	0/0000	I (0)

Resource: study finding

Given that the Phillips-Prone test is significant in the variables of count, employment, and investment of industrial units, these variables are on the stationary level and do not have a unit root. Regarding the inflation variable, in the results of stationary and non-stationary according to the Phillips-Prone test, the inflation is not on the stationary level, but the first-order difference is stationary. Given that the inflation variable is not on the stationary level, to estimate the model, if there is a long-run relationship between the inflation variable and other variables, the stationary of the inflation variable can be ignored. To investigate the long-run relationship between the inflation variable and other variables, since the first-order difference of the inflation variable is stable (I (1)) and other variables are at the stable level (I (0)), the Boys Band test has been used. According to the Boys Band test, if the value of the statistics obtained is greater than the critical value of the upper and lower limits of the Boys Band test, it indicates a long-run relationship between two variables. The results in Table 2 indicate a long-run relationship between the inflation variable and the activity level variables of industrial units.

Table 2. Boys Band test results for model variables

cointegration	Test statistics	lower limit	upper limit
LC, LINF	9/46	3/02	3/51
LEMP, LINF	11/413	3/02	3/51
LINV, LINF	12/975	3/02	3/51

Resource: study finding

After examining the significance of the variables, the criteria of Akaike, Schwarz Bayesian and Hanan Quinn were used to determine the optimal lag. As observed in Table 3, the count of lags 2 is proposed for the model.

Table 3. The count of optimal lags for model variables

Count of lags	Akaike statistics	Schwarz Bayesian statistics	Hanan Quinn statistics
0	3/5708	3/6743	3/6127
1	-0/7257	-0/2079	-0/5161
2	-1/1991*	-0/267*	-0/8217*
3	-1/0609	0/2854	-0/5159
4	-0/8926	0/868	-0/1798
5	-0/7625	1/4123	0/1179
6	-0/6942	1/8949	0/3539
7	-0/5737	2/4297	0/6421
8	-0/3647	3/053	1/0188

Resource: study finding

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Then it was investigated whether if the model is run with two lags, each of the first and second lag s are redundant or not. Lag exclusion test has been used for this purpose. According to Table 4, since both the first and second lags are significant, these two lags are not excluded.

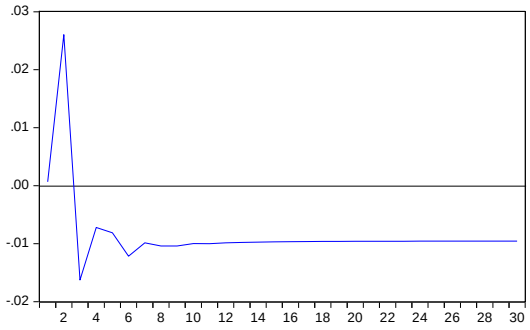
Table 4. Lag exclusion test results

Lag	Test statistics	Significance level
1	534/1201	0/0000
2	103/0708	0/0000

Resource: study finding

After determining the optimal lag, the VECM is estimated due to the long-run relationship between the variables. Johansen 's method was used to estimate the VECM to specify the model. Johansen 's test uses two statistics of Trace and Maximum eigenvalue, which based on both statistics at 95% significance level, at least one long-run relationship between variables is detected. After estimating the VECM, considering that the obtained coefficients are not capable of analysis and interpretation, impulse response functions and analysis of variance table have been used. The result of an inflation shock on the count of industrial units in the form of an impulse response function is described in Figure 2.

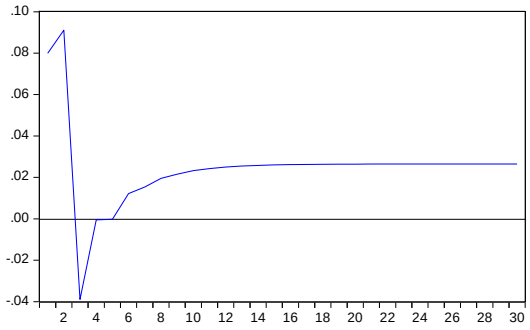
Figure 2. The impulse response function of inflation shock on the count of industrial units in Iran



Resource: study finding

As observed, the count of industrial units in the country has increased from the first period to the second period due to an inflation shock. However, from the second period to the third period, it decreases sharply. This shock will continue to be stable, and this inflation shock from the third period to the end of the period will reduce the count of industrial units.

Figure 3. The impulse response function of inflation shock on investment of industrial units in Iran



Resource: study finding

The results of the inflation shock on the investment of industrial units can be observed in Figure 3. An inflation shock from the first period to the second period partially increases the investment of active industrial units, but it strongly reduces investment from the second period to the third period. This trend has been increasing from the third period onwards and will continue as a stable and increasing shock until the end

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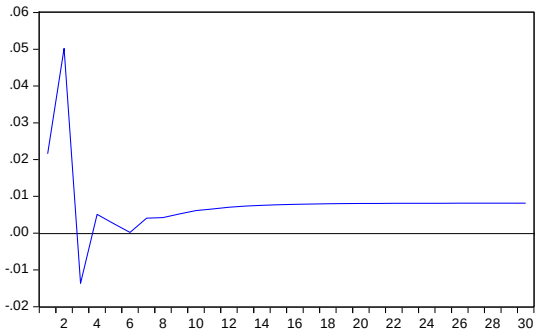
Figure 4. The impulse response function of inflation shock on employment of industrial units in Iran



Resource: study finding

According to Figure 4, with the onset of an inflation shock, the employment of industrial units increases from the first to the second period but decreases sharply from the second to the third period. It then follows an increasing trend, and the effect of this shock will be stable and increasing until the end of the period. The validation tests, including the Serial Correlation Test and Homoscedasticity Variance Test, were used to confirm the accuracy and validity of the model. According to the serial correlation test, residual statements in the model should not have serial correlation. Serial correlation can lead to inaccurate measurements. According to the results of the serial correlation in Table 5, the statistical value of this test has become non-significant at all lags. Therefore, the null hypothesis is accepted, and no serial correlation is observed between the lags in the estimation model. It should be noted that the null hypothesis in this test indicates the absence of serial correlation.

Table 5. Results of serial correlation test

lag	Test statistics	Significance level
1	1/8018	0/7722
2	6/3028	0/1776
3	2/1417	0/7097

Resource: study finding

According to the homoscedasticity variance test, the value of the variance of the residual statements in the model should be constant. It means that the residual statements must have the same variance. The white test was used to investigate the homoscedasticity variance in this model. According to the results of the White test in Table 6, since the chi-square statistic has become non-significant, the null hypothesis is accepted. Therefore, the estimation variance model is the same. It should be noted that the null hypothesis represents the homoscedasticity variance. In general, based on the results of these tests, the model has accuracy and validity.

Table 6. Results of homoscedasticity variance test

Test statistics	Significance level
96/2831	0/1182

Resource: study finding

According to the model results (Table 7), in the long run, there is a negative relationship between inflation and the count of active industrial units, so that if inflation increases by one percent, it decreases the count of active industrial units by 0.04 percentage. In the long run, if inflation increases by one percent, the employment of active industrial units will increase by 0.11 percent and the investment of active industrial units by 0.03 percent.

Table 7. Long-run relationship between variables

variable	Long-run coefficients
Count of active industrial units	-0/0424
Employment of active industrial units	0/1158
Investment of active industrial units	0/0344

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ISSN (Online): 2203-1731

Resource: study finding

5- Conclusions and Recommendations

For centuries, understanding and studying inflation has attracted the attention of economists around the world. In this crisis, the increase in demand over supply is quite evident. The leading cause of inflation is the mismatch between increasing money in society and increasing production. Inflation has acquired wide social and political dimensions in the present age. The reason for this is the close connection between inflation and the lives of people in society. In addition, the political and economic stability of a country is measured by various indices, including inflation. In this study, the effect of inflation shock on industrial units' activity in Iran from April 2011 to April 2020 has been investigated using a VECM. The results indicate a long-run relationship between inflation and the level of activity of industrial units. The result of inflation shock on the variables of the activity level of industrial units in the form of an impulse response function is that with the entry of an inflation shock, the count of industrial units in the country will remain stable, and this inflation shock from the third to the end of the period will reduce the count of industrial units. The results of the inflation shock on the investment of industrial units are such that an inflation shock increases from the third period onwards and will continue as a stable and increasing shock until the end of the period. Also, inflation shock increases the employment of industrial units, and the effect of this shock will be stable and increasing until the end of the period. The results of the VECM indicate that in the long run, if inflation increases by one percent, it will reduce the count of active industrial units by 0.04 percent. In the long run, if inflation increases by one percent, the employment of active industrial units will increase by 0.11 percent and the investment of active industrial units by 0.03 percent. It seems that in the Iranian economy, the factor of inflation, in the long run, does not provide the growth of the count of active industrial units, and the investment growth also occurs due to inflation and rising prices of equipment and machinery.

Regarding employment, it seems that inflation has always led to long-run employment growth. It is not in line with the basics of the Phillips curve in the long run. Industrial units decrease in count in terms of inflation; however, they tend to a higher labor absorption.

In general, inflation is effective in the short run and the long run and reduces the count of active industrial units. As liquidity has been entered into the Iranian economy in different ways, there are different ways to control and prevent it. In the current situation and before reducing inflation, no attempt should be made to reduce bank interest rates. In addition, it is proposed to determine the interest rate on long-run deposits competitively. Preventing the growth of liquidity, increasing the return of money in rials and the possibility of selling government bonds in the market are the positive effects of increasing bank interest rates. The government can also provide applicants with capital goods that can be used in industrial production or small and medium-sized forms with an appropriate down payment, which is a means of accumulating liquidity. It can also control inflation by collecting part of the liquidity. One of the critical ways to stabilize prices in the current inflationary conditions of the country is to prevent any factor that can increase the cost of goods. In these factors, which are fixed and variable costs, state-owned banks can achieve the necessary stability, especially the government services, including the energy, transportation, and consulting sectors, etc., which can stop the trend of rising prices in favor of reducing inflation. Another issue is the facilitation of investment laws. Heavy, time-consuming, and complex arrangements delay the investment process. In addition to implementing the strategies mentioned above, which will lead to controlling inflation and thus reducing the severe pressure on people's lives due to this issue, the implementation of strategies to support people's livelihoods, especially the poor, is necessary because a significant part of the population suffers from providing basic goods. However, it is essential to note that the funding needed to implement this plan must be provided through non-inflationary methods (compensation of the government budget deficit by collecting taxes from high-income earners); otherwise, it will exacerbate the government budget deficit, and as a result, liquidity will increase, and inflation will intensify. In general, most of the solutions that needed to be implemented were parts of budget reform. Therefore, it can be boldly said that controlling inflation and supporting people's livelihood is not possible without the approval and implementation of parts of the budget structure reform, and in this regard, MPs have a heavy responsibility.

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