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Nonlinear Relationship between Inflation and Economic Growth

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Abstract

Economists have been paying special attentions to the factors affecting economic growth. The related literature shows that inflation is a crucial factor in this regard. Therefore, the relationship between inflation and economic growth matters for policymakers. This paper examines this relationship in Iranian economy. We have designed a model and estimated it using econometric techniques. A model with lags has also been estimated. The findings of the paper are(1) Inflation, in low levels (less than ten percent) does have a positive effect on economic growth, (2) For medium levels, the relationship between inflation and economic growth are negative just up to 26 percent for one period, (3) For high levels (which over 26 percent in our study), all inflation rates above 26 percent do, have negative impact on economic growth, (4) Finally, we ,based on causality Granger testing model, have showed that there is a significant relationship from inflation to growth (and not vice versa).

Keywords: Inflation, Economic growth, CLS, Causality Granger, Iranian Economy

Introduction:

Economic growth is one of the main macroeconomic objectives. Economic literature shows that various factors affecting economic growth, including investment, labor and technology. On the other hand, inflation is a major problem, especially in developing countries; mainly adverse effects on the process of economic growth and development. Therefore, in studying of economic growth, it is important to investigate the effects of inflation. According to the principles of economic growth models (with the emphasis on the role of inflation), there are different views on the relationship between inflation and growth which is expressed as compatible or conflicting.

In this study, we identify the level of inflation in Iran. The aim of this paper is to answer the question: What is the relationship between inflation and economic growth? Whether there is a causal relationship duplex or unidirectional relationship between them? Does the inflation has same effect on growth at all levels and or has different effects at different levels? In this regard, the study of the relationship between inflation and economic growth over a period of 46 years (1959- 2004) are examined. At first a model based on Sarel and Alexander's models are designed with the assumption that the Iranian economy, there are two points ahead of inflation, a nonlinear model of the relationship between inflation and growth is projected. Also, given that the effect of inflation on growth may be limited to a period, the model once again interrupted by the arrival of inflation rather than current inflation is estimated. According to the results, a one-sided relationship between the inflation rates of economic growth, there are also 10 and 16 % for the model without lags and inflation rates of 10 and 26 % for the model with interval breakpoints obtained. The organization of the paper is to be reviewed in the next section, inflation and economic growth in Iran. The second section is devoted to introduce and model. In the third section, the model is estimated, and finally concluding the paper is in Section forth.

Theoretical basis of research:

According to Keynesian theory, because of complete inflexibility of wages in the short time, monetary policy can change the production level. In fact, because the wages have little flexibility, so increasing the amount of money (or liquidity) causes increases the price level, decreases real wages and increasing employment and produced levels. Thus, expansionary monetary policy increases in prices and production levels in short-term. In New Keynesian patterns, expansionary monetary policy has no long-term effect on production levels and will only lead to higher prices. In Keynesians' view because of the slow adjustment of real wages, inflation increases economic growth through the redistribution of income from labor (with a low propensity to save) employers (with a higher propensity to save).

According to monetarists' traditional theory, increasing the money supply or expansionary policy increases production levels in the short run but in the long run, the economy returns to the initial equilibrium and the effects of increasing the money supply increased by only prices are reflected. In new monetary school (Friedman, etc.), there is a positive relationship between inflation and growth expectations are caused comparatively short but not the long-run relationship between the two variables. New classic with expressing rational expectations of the project suggest that does not exist relationship between inflation and growth in the short-term and long-term.. According to the new classical theory,

expansionary monetary policy if economic decision factors can be expected, even in the short run is not effective and cannot alter production levels. Unexpected monetary policy impacts on the real sector of the economy in the short-term.

Structuralists, expressing the features of developing economies such as adhesion and various inflexibilities of these countries' economies, believe in positive relationship between inflation and growth rate, at least to a certain price.

There are high and variable inflation rates increase transaction costs and reduce investment toward nonproductive activities and thus decreasing economic growth. Many empirical studies on the relationship between international and domestic level has been done during the last decades. These studies serve two purposes: First, to identify the facts and answer the following questions: What is the empirical relationship between inflation and growth there? Whether this relationship is stable over time for all countries? Second, the interpretation of the relationship in question and answer this question: Does this relationship structural? Does the experiment relationship show that the relationship between monetary policies is concerned, there is a conflict? If there is such a contrast, what are welfare consequences? What is the optimal rate of inflation?

Research Background

Sidrauski " (1967) optimized method of behavior economic agents and real money balances in the utility function and showed that money is neutral and therefore there is no relationship between growth and inflation .

Tobin " (1965) with the assumption of substitution of money for capital growth, as demonstrated by the positive effect of inflation on the growth which is well known as "Tobin effect " .

Stockman " (1981) considers money as a supplement to the capital and proves a negative relationship between inflation and growth . In other studies have noted the growth of inflation required, some have found to be ineffective inflation on growth and some have evaluated inflation is harmful to growth. The consequences of different policies are presented.

Given the positive, neutral or negative effect of inflation on economic growth finding the ultimate effect on growth, according to the specific conditions of each country can be a useful guide for policy makers. In conclusion, more studies of high inflation on economic growth grinding to consider the need to control inflation targeting as the main objectives of the macro listed.

In some studies, such as " Sarel " (1996) and " Khan Senhandji " (2002) non-linearity of the relationship between inflation and economic growth have been noted. Some studies linear or non-linear relationship between inflation and growth, others point of failure has been given. These studies emphasize that inflation has a positive or neutral effect on the growth rate can be given and then acts as an anti- growth. About the causal relationship between growth and inflation, there is no consensus.

Sometimes it is assumed that economic growth will lead to inflation and economic growth is sometimes the opposite of inflation (Akhtar, 2003).

Research methodology

The population, sample and sampling

In this study, we identify the level of inflation in Iran. The aim of this paper is to answer the question: What is the relationship between inflation and economic growth? Whether there is a causal relationship duplex or unidirectional relationship between them? Does the inflation has same effect on growth at all levels and or has different effects at different levels? In this regard, the study of the relationship between inflation and economic growth over a period of 46 years (1959- 2004) are examined. At first a model based on Sarel and Alexander's models are designed with the assumption that the Iranian economy, there are two points ahead of inflation, a nonlinear model of the relationship between inflation and growth is projected. Also, given that the effect of inflation on growth may be limited to a period, the model once again interrupted by the arrival of inflation rather than current inflation is estimated. According to the results, a one-sided relationship between the inflation rates of economic growth, there are also 10 and 16 % for the model without lags and inflation rates of 10 and 26 % for the model with interval breakpoints obtained.

Stylized Facts

Inflation is an important economic problem in developing countries such as Iran. People can realize the negative effects of inflation on economic prosperity and reducing their purchasing power and demand to rein in prices and stabilize of their real income.
Table 1 shows that inflation has entered a new phase from 1970s, so in many years inflation has been double-digit. During 1961 to 1972, prices have been relatively stable. Before the revolution during the Fifth Development Plan (1977-1973) which was accompanied by a sharp increase in oil revenues , the average annual inflation in the 15.73 percent growth . 1978 and 1979 the inflation rate to 10.41 % was recorded. With the start of war and economic sanctions inflation increased density over the 8-year period, the average annual inflation rate of 19.8 percent. By the end of the war, increased oil revenues , debt , structural adjustment policies and increased government spending causes inflation rising trend in the period 1990 to 1993 , so during this period, the average annual inflation rate equal to 18.8 percent.

Table 1: Average inflation and economic growth in selected periods

	1973-77	**1978-79**	**1980-88**	**1989-93**	**1994**	**1995-99**	**2000-2004**
Inflation	15.73	10.41	19.8	18.8	35	27.21	14.12
Economic Growth	4.94	-9.34	4.71	5.35	-0.96	1.77	3.93

Source: Central Bank of the Islamic Republic of Iran

After this period, the decline in oil revenues, plus an inability to inhibit the exchange rate and the doubling of government spending in 1993, the shock of 1995 led to inflation and the inflation rate was 49 percent of the highest rates in the entire period (1959 to 2004). Since then, the relative increase in oil import, manage liquidity and funding and directing it towards stabilizing the exchange rate, inflation fell to less than 20 percent. The year of 1993-95 is the least stable during the course of the Iranian economy.

Expansionary monetary and fiscal policies and the devaluation of the national currency in this period of high inflation pressures imposed on the economy, so that the implementation of stabilization policies took the form of a necessity. The economic stabilization of the exchange rate instrument, attempts to correct past errors, which were banned in 1995 by an act of the free market exchange that began with shock and partly due to inflation and inflation expectations will subside. Thus, the fixed exchange rate policy, price controls, import and export control restriction leads to a reduction in the inflation rate to 23.2 percent in 1996. During this period, jumping from price policies breeding and trait increase budget deficits and thereby monetary policy was expansionary. Method of reserve balances foreign currency commitments have led to an increase in money growth. With improving oil price in 1996 and applying economic stabilization policy the sharp reduction inflation rate and rate of inflation has decreased the least rate from the begging of 1990s.

Adverse developments in the global financial markets areas Southeast Asia and a sharp reduction in oil prices from 1996 onwards have been face the country with problems including reduced growth rate and an increase in especially inflationary expectations . Sharp reduction in oil prices in 1998 as result of decreasing foreign income and transfer its pressures on paying and also the problems related to the financial supply of missing budget of the government in last months of that year, hazard the main balance of the economy and the rate of inflation in that year and the year following became a trend. Despite all the pressures to conform to fiscal discipline and commitment to controlling inflation, stock market trends continue to improve, modify or change the composition of debt management debt in favor of longer-term commitments because of the country in different conditions with many years of experience 1993-94. In addition, the foreign exchange reserve account established in 2000, the independence of the central bank and possession of instruments such as bonds and move towards partial repayment of government debt to the banking system were very positive development in the years 1999-2003. Foreign exchange reserves of the Central Bank follows the oil price increase from mid-1999 onwards and found a significant improvement in terms of exchange rate policy matched and assigned to be available in 2002. In 2002, the inflation rate is about 15.8 percent and average inflation during 2003-2004 was about it.

In the case of economic growth in the period under consideration could also be given a similar conclusion. In the years before 1970 and during the third and fourth economic development programs that have relatively stable prices, output growth would have been higher than anticipated realization of the program. During the period 1963-67, the average growth rate was 8.6 percent, which is the main factor in determination of investment growth. During this period the Group of Industries and Mines of Iran's role in the economic development of the oil group had the highest growth.

During the fifth development plan (1968-72), with the aim of achieving a growth rate of 9 percent, but in practice, due to the growth of value added in all sectors of economic growth to 11.6% were recorded. Period (1973-77) coincides with the fifth development plan, which is the major cause GDP growth was significantly increased oil revenues. On the other hand, an unprecedented leap in oil revenues in 1974, prompting a hasty manner and fifth goals of economic and social development programs and resources, regardless of the physical capacity of the economy to be revised.

In order to achieve economic growth, total investment amount was increased to twice the previous forecast, but in practice, rather than be effective in strengthening the production, inflation, led to the current budget. Projects that were carried out in order to expand the economic base of the country, but inflation were due to the economic capacity constraints. Doing these plans lead to unpredictable cash growth in short term period and because the general presentation couldn't answer to the requests as the result of limitation of work force ,technology, import problems, and also no balance in different parts of economy cause inflation pressure in the country.

After the revolution, when oil revenues, the government has increased its consequent economic growth has also increased, and vice versa. For example in this period we can see the severe decline in economic growth in 1986, that the main reason was the decline in oil revenues. During the 1978-79 we can see the average growth rate lower part which is due to the revolution and inefficiency in government spending of oil revenues. Next Period (1980-88), was along with war, economic sanctions, declining oil revenues in some years, was disorderly production formation decreased the conditions for economic growth to 0.1 % lowered together with the relatively high volatility . Ending war and implementation of two development programs and increased oil revenues cause the average growth of 5 percent, but foreign exchange restrictions for paying the debt reduced the growth. (Nourozi , 1999.)

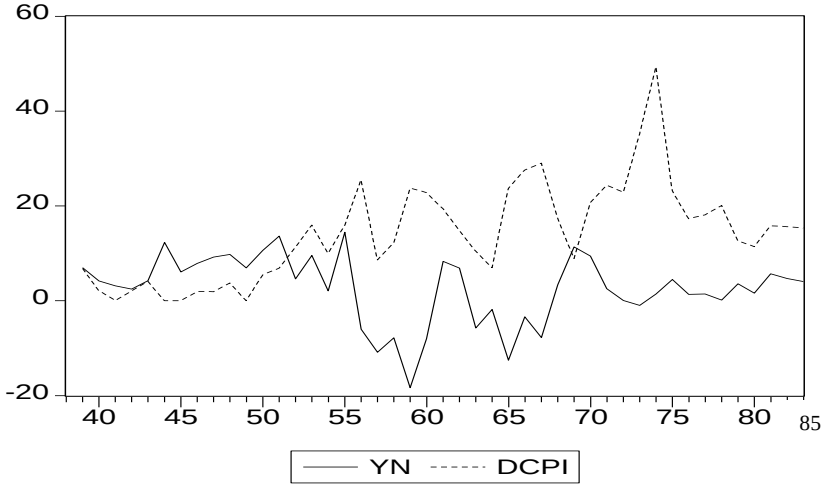
Time series of GDP growth was steady during this period, it means that the shocks on growth are temporary and after some time, their average returns. In these years the main cause of inflation can be government's financial disorderly and due to money growth rate. During the First Development Plan (1989-93) average growth rate per year, 8.1 percent was expected, but in practice it was 6.9. In this period, there has been considerable growth due to oil revenues.

Second Development Plan (1993-99) in the beginning of the Iranian economy was faced with growing inflationary expectations. This trend started in the early second half of 1994, at the end of the expansionary fiscal operations intensified. Although GDP growth was about 3.1 percent inflation rate 49.3% were recorded. In the second year of program the economic growth 4.7 percent was achieved. Acceleration of economic growth due to infrastructure and productive investments and economic policy in the postwar period has been applied throughout the program.

Economic growth in the third year of the program, despite the decline in oil prices in global markets and the slowdown in the construction sector, positive, but compared to the previous year, the rate was lower. This year, Production growth mainly was due to a significant growth in the industrial sector, service and infrastructure sectors. Also this year, reducing inflationary pressures and inflation, the rate of inflation were recorded to 17.3 %. An imbalance of essential variables of the economy in 1998 , along with the structural problems of the economy led the country during two consecutive years of declining growth rates , reduce investment , financial weakness and problems faced balance of payments and an increase in the general price level . Continuing global recession and continuing adverse conditions in the oil market, the most important exogenous factor in the formation of these changes.

In this period, the government did serious action to stabilize the exchange market and move toward standardization in foreign exchange rate to market-based system that most of these measures performed in 1999. In the 2000-2004 period, according to the relative volatility of oil prices and political developments in the Persian Gulf, the government couldn't achieved to average economic growth rate over the course of 3.7 percent. Figure 1 shows the growth and inflation in the period studied.

Figure 1: Trend inflation and growth in real GDP per capita



It is clear that a negative relationship between inflation and output growth in most years is considerable, but in some years the positive relationship between these two variables cannot be denied. Studies to examine the relationship between inflation and growth in the country took place in the most negative relationship between inflation and growth has approved them. (Includeding Kmyjany and Alavi (1999), Moshiri and Sultan Ahmed (2000), Tabatabaee qomi (2001) , Dadgar and Salehi (2004).

The Model

The previous section with respect to the theoretical literature between inflation and economic growth three preliminary conclusions is extracted there is no relationship between inflation and economic growth, the relationship between positive and negative. Some empirical studies confirm the relationship and some have refused. For example, "Fisher" (1993) and "De Gregorio" (1993) , were obtained the evidence of a negative relationship between inflation and economic growth. " Sala - i - Martin " (1997) studies shows that economic growth is not an important to determinant of inflation . Further research in the domain of the states and provinces based on nonlinear effects of inflation are centered on growth. Among the research studies conducted by Sarel (1996), "Anders ..." (1997) and" Ghosh and ... "(1998),. Barro (1995and 1996) also obtain a negative relationship between the inflation rate and the average high is concluded that the relationship between inflation and growth is linear. This is the same conclusion that "Anders ..." (1997), achieved the nonlinear relationship between inflation and growth.

Our assumption is that there is linear relationship between the inflation and growth in that time in Iran and also there are the threshold levels of inflation for interpreting the effect of inflation on economic growth.

According to Sarel's study inflation effect on growth of 8 percent is positive, and then will be the negative effect. Barro in his studies stated the domination for the effect of inflation on growth that until 15 % effect of inflation is positive between 15 and 40 and above 40% has a significant negative effect on growth. Both Sarel and Barro have used of the combination of industrial and developing countries on their studies. " Burdekin and colleagues ' (2000) and Khan and sen Hediji (2002) , while examining the impact of the provinces have concluded that the threshold level of inflation for both industrialized and developing countries is different . This article is based on research conducted by Alexander, Baro and Sarel , a model is developed to explain the relationship between inflation and economic growth in Iran . The patterns of Baro , Alexander and Sarel is briefly introduced , and then introduce a model based on these models . It is useful to point out the theoretical framework of this study, the ratio of research and research -related Moshiri and Soltanahmadi, but at least in some cases has significant different: because at first these researchers based on a structural failure of dummy variable showed the definition.

$E = DUM(\pi_t - \pi_t^*)$ as: $DUM: \begin{cases} if\ \pi_t < \pi_t^* & 0 \\ Otherwise & 1 \end{cases}$

Using the dummy variable E- in have been proposed in growth models that. Obviously dummy variable coefficient E with coefficient of π_t (inflation) is not collected; but the coefficient of the intercept model and growth model estimated as the sum of two functions in parallel with the width of source will vary. This study has solved the above problem; the latter with respect to the first point , this paper because of determining model and considering different thresholds for inflation and their impact on economic growth as the slope ,is not different from the discussed study , third this difference is due to the utilization of conditional estimation method (CLS) will be more efficient and fourth articles referring to 1999 data that is used according to the present data covering the year 2004(almost 6 years) , will proceed different steps.

Barro , and Sala- i -Martin " (1992) in a neoclassical growth generalized model, have examined the factors that affect economic growth . A symbol of this framework is a general set of government policies

and private sector of an economy in the long run will determine what direction it will move. In Barro 's model, are divided into two groups' variables and control variables or environmental variables. Variables included in the initial levels of physical inventory of capital stock of human capital in the forms of education and health. Or control of environmental variables on the ratio of government consumption expenditure to GDP ratio of domestic investment to GDP, exchange rate margins, changes in the exchange relationship between democracy and education expenditures of government to GDP ratio. In the growth rate model per capita of any country in the following form:

$$DY_t = F(Y_{t-1}, h_{t-1}, ...) \qquad (1)$$

Where Y_{t-1} the initial per capita GDP and initial human capital based on education h_{t-1} and health values for every person. Other variables can be written to determine this equation consist set of control variables and environmental impacts. These factors include preferences for saving and fertility, government policy towards spending and market disruptions. Barro (1996) in his study in addition to the inflation variable has used the other variables to test the effect of the variability of inflation on economic growth. For this purpose, the standard deviation of inflation as a substitute for showing the effect of inflation variability on growth proceeds. Barro has considered the negative effects of inflation due the domain of inflation rate. He has estimated the relationship between inflation and growth in studied countries with inflation 15 percent between 15 to 40 percent and over 40 percent estimated separately, and concludes that the effect of inflation on growth is higher than the area average inflation countries. Strong positive correlation between inflation and its variability makes it difficult to distinguish the effects of inflation on these two aspects. So Barro enters these two variables into the model separately. Also, because the Barro's belief that the strong multi col linearity between inflation and investment, he will estimate his model using instrumental variables. The variables used in the model consists of central bank independence, inflation is interrupted and the former colonial status.

"Alexander "(1997) Effect of changes in inflation and economic growth based on the neoclassical growth equation is investigated. At first he determines the real growth production rate on investment (K) and work force (L) and then expresses that if we consider the growth production only on $(\frac{K'}{Y})$ and $(\frac{L'}{Y})$ we'll have a big rest that consist of deleted variables from the model.

Thus to add other factors, the dummy variable(d) which is considered zero for the years before 1973 and for the years after 1973, enters the model . Alexander the variability of inflation and inflation changes are added to the model step by step. He also explains that by entering variables, government spending and exports, may be achieved the better results. The final model is as follows:

$$\frac{Y'}{Y} = a_0 + a_1(\frac{K'}{Y}) + a_2(\frac{L'}{Y}) + a_3 d + a_4\pi + a_5\Delta\pi + b_1(\frac{G'}{Y}) + b_2(\frac{X'}{Y}) + \varepsilon \qquad (2)$$

According to Alexander export model as one of the factors that explain economic growth model. Given the state of the economy in Iran, we use changes in the ratio of revenues from oil and gas exports to GDP. Sarel (1996) studies nonlinear effects of inflation on growth. Sarel in his model in addition to the variables such as population, GDP, consumer price index, terms of trade, real exchange rates, government spending and investment uses from another variable named EXTRA. EXTRA Variable is defined as follows:

$$EXTRA = DUM[\pi - \pi^*]: \begin{cases} if\ \pi > \pi_t^* & DUM = 1 \\ Otherwise & DUM = 0 \end{cases}$$

π^* is the inflation rate which occurs the break point. In Sarel method can be achieved in endogenous break, while in this model the entire domains as inflation break (π^*) test and an inflation rate that maximizes the desired break point is selected. The Sarel's article is proven that when an interruption is

measured to estimate the impact of inflation on economic growth increases. We designed the model of the economy in relation to the breaking point according to the model Sarel. But it's completed according to the Barro and Alexander;s model range. Also unlike Sarel's models we anticipate significantly more than one break point in the Iranian economy. The final model has modified than the three models Barro, Alexander and Sarel . Also we use Wald test to make sure there is more than one break point for the Iranian economy. According to the model, Sarel , Barro and Alexander model is expressed as follows :

$$Yn = \alpha + \beta_1 \cdot (P < P_1) \cdot P + \beta_2 \cdot (P_1 < P < P_2) \cdot P + \beta_3 \cdot (P > P_2) \cdot P + \theta' X + \varepsilon \quad (3)$$

In this model, Yn is the growth rate of real per capita GDP in constant 1998 prices, P inflation, and X a vector of other explanatory variables of the model. Dummy variables entered in the model threshold level of inflation are defined as follows: if $P < P_1$ than $(P < P_1) = 1$ in otherwise is zero. In this way if P equal or between p1 and p2 $(P_1 \le P \le P_2) = 1$ and in is zero elsewhere. It's the same or the high level of inflation. This means that if $P > P_2$, then $(P > P_2) = 1$, and is zero elsewhere . p1 and p2 are two thresholds for inflation. X Vector consist of variables to changes in foreign exchange revenues from oil and gas exports , investment changes in the logarithm of GDP , the logarithm of life expectancy, $\log(OMID)$ the margins of the logarithm of the exchange rate $\log(BMP)$, changes in the exchange relationship $(DTOY)$ GDP , changes in government consumption expenditures (CDY) GDP, changes in educational expenses (CAY) GDP , changes in the ratio of investment GDP $(D(II))$ and population growth rates $(DPOP)$.

Research Findings

Before estimating the model, the data are examined in terms of stationary. If the equation econometric estimation of not stationary data is used, the variance, mean and covariance variables are not independent of time, statistical inference will not valid. Table 2 shows the results of tests for the variables in a generalized Di Dickey Fuller, Dickey Fuller with 95% certainty for the present state of the intercept and linear trend and present state of the intercept and linear trend in the data. In Table 2, the variables $\log(BMP)$ ، $\log(OMID)$, $(DPOP)$, $\log(GDP(-1))$, $D(II)$, and P are not stationary, and the rest of the variables are stationary.

Table 2: Test of Variables of generalized Dickey Fuller and Dickey Fuller

Variable	With intercept and linear trend				With intercept and not trend			
	SBC	**ADF statistic**	**95% critical value ADF**	**Station ary**	**SBC**	**ADF statistic**	**95% critical value ADF**	**Stationa ry**
YN	-137.06	-3.45	-2.93	yes	-138.65	-3.50	-3.52	Yes
P	-143.08	-2.79	-2.93	No	-143.60	-3.23	-3.52	No
OIL	-198.61	-5.64	-2.94	yes	-200.42	-5.56	-3.53	Yes
Log(OMID)	117.64-	-2.78	-2.94	No	116.09-	-1.32	-3.52	No
log(BMP)	33.9	-1.42	-2.93	No	32.11	-0.97	-3.52	No
IY	55.19	-4.26	-2.93	yes	53.50	-4.26	-3.52	Yes
D(II)	-123.93	-5.59	-2/93	yes	-125.74	-5.53	-3.52	Yes
Log(GDP(-1))	52.67	-2.02	-2.93	No	52.27	-2.44	-3.52	No

D(TOT)/GDP (-1)	301.49	-4.92	-2.94	yes	299.64	-4.86	-3.52	Yes
DPOP	-23.33	-0.68	-2.93	No	-23.62	-1.6	-3.52	No
CDY	111.99	-3.81	-2.93	yes	111.09	-4.07	-3.52	Yes
CAY	69.92	-4.82	-2.99	yes	68.44	-4.79	-3.61	Yes

The results in Table 3 for the first order difference variables shows that all variables are stationary once difference since confirming ADF theory of maximum scale (SBC) larger than the critical values at 95% confidence level for all ranges. Therefore we conclude that these jammed variables are the degree of first degree.

Table 3: Test for Dickey Fuller and Dickey Fuller generalized first-order difference variables

Variable	With intercept and linear trend				With intercept and not trend			
	SBC	**ADF statistic**	**95% critical value ADF**	**Station ary**	**SBC**	**ADF statistic**	**95% critical value ADF**	**Stationa ry**
D(p)	-141.52 (1)	-6.99	-2.94	yes	-143.18 (1)	-6.98	-3.52	yes
Dlog(OMID)	111.86 (0)	-5.21	-2.94	yes	112.014 (0)	-5.61	-3.53	yes
D(log(BMP))	31.94 (0)	-5.45	-2.94	yes	30.75 (0)	-5.51	-3.52	yes
D(DPOP)	-23.29	-6.08	-2.94	yes	-24.66	-6.09	-3.52	yes

Causality tests

As mentioned, one way is not exist necessarily a causal relationship from inflation to growth, but this may be related to the growth of inflation or a mutual causal relationship exists between these two. In particular to investigate the causality between these two variables (using Granger causality test) results indicate that the 88.6% confidence unilateral causal relationship from inflation to growth there. But the causal relationship from inflation to economic growth cannot be rejected.

Table 4: Decision on assumptions

Null Hypothesis	Decision	statistic	probability
Inflation does not Granger cause economic growth	Be rejected	2.73	0.114
Economic growth does not Granger cause Inflation	Can not be ruled out	0.064	0.803

The number of lags (1), the period from 1960 to 2005, is used in the inflation test log and the growth log.
As noted above, our model is as follows:

$$Y_n = \alpha + \beta_1(P \prec P_1)P + \beta_2(P_1 \le P \le P_2)P + \beta_3(P \succ P_2)P + \theta' X + \varepsilon$$

P1 and P2 are provincial levels of inflation which inflation can have different effects on the development community. If P1 and P2 was obvious it was possible to estimate the model using OLS, since pi is not specified, so along with the other parameters are estimated by regression. Appropriate estimation method in the case is non-linear least square method. Of course, because that is when Pi enters the regression, the degree of integration in nonlinear search techniques for applying methods is inappropriate $(NLLS)$ (Khan , 2002) and estimation is performed using a method that is called conditional least squares . Thus,

the threshold for inflation is estimated using a model, then as a function of the square error obtained. By selecting the least-squares estimate of the value of the minimum square error is obtained:

$$P_i = aigMin\{S_1(p), p = 3,...,49\}$$

Where S1(P) is the sum of squares residuals. We define two domains for inflation that one inflation domains related to lower levels and in other domains related to high levels of inflation are included. The domains are selected in a way that include entire amount of inflation. For example, in the lower range of the inflation range of 3 to 14% and above 15% and above is selected. Then for selecting the desired rate, the rates are selected which square error is minimal.

Model estimation and interpretation of results

After several estimates from Model 1, the final estimated model is as follows:

$$\begin{aligned} Yn = &-18.58 + 0.025(P < 10)\cdot P - 0.194(10 \le P \le 16)\cdot P - 0.089(P > 16)\cdot P + 0.019Oil \\ &(-3.1) \quad (0.198) \quad (-2.62) \quad (-2.75) \quad (3.095) \\ &+231.42IY - 1.08DPOP - 3.79LogGDP_{-1} - 2.29D(II) + 16.06Log(Omid) + 3.56Log(BMP) \\ &(20.84) \quad (-2.74) \quad (-2.35) \quad (-16.39) \quad (2.173) \quad (1.86) \\ &R^2 = 0.98 \quad , \quad DW = 1.90 \quad , RSS = 50.08 \end{aligned} \tag{4}$$

As you can see, except for a low rate of inflation, other factors have significant differences. So the model and removing low levels of inflation once again reaffirm estimate. Results obtained from these estimates are as follows:

$$\begin{aligned} Yn = &-19.54 - 0.204(10 \le P \le 16)\cdot P - 0.093(P > 16)\cdot P + 0.019Oil + 231.78IY - 1.06DPOP \\ &(-1.14) \quad (-3.83) \quad (-3.96) \quad (3.22) \quad (21.46) \quad (-2.81) \\ &-3.71LogGDP_{-1} - 2.298D(II) + 16.07Log(Omid) + 3.60Log(BMP) \\ &(-2.41) \quad (-16.97) \quad (2.21) \quad (1.92) \\ &R^2 = 0.98 \quad , \quad DW = 1.89 \quad , \quad RSS = 50.14 \end{aligned} \tag{5}$$

The numbers in parentheses are t statistics.

Robustness tests

To ensure that the estimated regression is a spurious regression, unit root test is done to deal with the above two models. The results are as follows:

Table 5: Unit Root Test

ADF Test Statistic	Level	Critical Value ADF
-5.98	0.01	-3.6

Perhaps this question is asked whether it is possible estimated values β2 and β3 do not have significantly different from each other. To answer this question, using a sample function Wald, these two parameters are tested. The results have shown that the confidence level of 0.94, the null hypothesis is rejected based on equality, β2 and β3 (3.9 = F). Despite the disparity of the middle and upper values of inflation is verified by means of the three threshold levels for proper inflation.

We can see that the three levels below 10%, between 10 and 16% and above 16% and inflation is obtained. With the exception of the inflation rate below 10 percent, the rest of the coefficients are statistically significant. Intercept is negative model so it can be interpreted so as not to interfere explanatory variablesmay be negative economic growth. Of course because the intercept is not

statistically significant therefore is not reliable. Inflation to levels below 10% is positive but statistically is meaningless. Middle and upper levels of inflation are also of significant negative effect on their growth.
According to previous expectations, the impact of changes in investment by the oil and gas export revenues to GDP is positive and significant. Logarithm of real GDP in the previous period has a significant negative effect on growth. This means that if GDP in the previous period of high (low), the current period of low growth rates (above) will be high. The regression equations showing the logarithm of the ratio of the absolute value of the coefficient of elasticity is greater than the logarithm of real GDP , the growth rate over the last period of high sensitivity to changes in real GDP . The population growth rate has a negative relationship with economic growth, so for each 1 percent change in the population growth rate, economic growth rate of 1.1 changes. Changes in the ratio of investment to GDP have significant negative relationship with economic growth. The margin of the logarithm of the logarithm of life expectancy and exchange rate are positive and significant effect on growth rate.

Effects of inflation on economic growth
Estimates of inflation at different levels have different effects on growth. At low levels of positive effects, but meaningless, and the middle and upper levels, has a significant negative effect on growth. According to theoretical and experimental studies carried out, it was expected that high levels of inflation would have the greatest effect on growth. But the model is more effective than high levels of inflation in the mid-levels. Because some of the variables may one or more of lag effect on the dependent variable. Therefore, the model of the lag time by importing inflation rather than current inflation reaffirm estimate. Because the model is written as 3 to reaffirm:

$$Yn = \alpha + \beta_1 \cdot (p < p_1) \cdot p_{-1} + \beta_2 \cdot (p_1 \le p \le p_2) \cdot p_{-1} + \beta_3 \cdot (p \ge p_2) \cdot p_{-1} + \theta' X + \varepsilon$$

After estimating the model we have:

$$\begin{aligned} Yn = {} & 3.865 + \underset{(0.21)}{0.11}(P < 10) \cdot P_{-1} - \underset{(2.11)}{0.013}(10 \le P \le 26) \cdot P_{-1} - \underset{(-0.397)}{0.071}(P > 26) \cdot P_{-1} + \underset{(-2.01)}{0.016} Oil \\ & + \underset{(20.53)}{228.86} IV - \underset{(2.41)}{1.499} DPOP - \underset{(-3.59)}{6.048} LogGDP_{-1} - \underset{(-3.98)}{2.30} D(II) + \underset{(-15.86)}{17.299} Log(Omid) \\ & + \underset{(2.21)}{2.68} Log(BMP) \\ & \qquad (1.30) \end{aligned}$$

$$R^2 = 0.97 \quad , \quad DW = 0.97 \quad , \quad RSS = 1.088 \qquad (6)$$

The numbers in parentheses are t-statistics.

It is necessary to mention that according Dickey Fuller generalized model test performed on waste, it's a possible to exist unit root in the residuals rejected model and obtained regression is accumulated. The test of Wald, despite equal levels of inflammatory parameters will be rejected with a high confidence level. According to Model 7, with three levels of inflation below 10 percent, 10 and 26 and between 10 to 26 percent and top 26 percent is obtained. In this case, the inflation thresholds are 10 and 26 percent.
Effect on the growth of inflation below 10 percent is positive and statistically is significant. Intermediate level (10-26%) and negative effects (0.013), but is meaningless. The effect of high inflation (over 26%) negative (0.071-) is significant. Other parameters are the same as model 2. In summary, a comparison between interrupted and uninterrupted models can be referred to the following points:
Because the 10 percent coefficient in 4 model positive and meaningless and in model 7 this coefficient positive and meaningful.so we can conclude that the inflation in the low levels has most effect on the growth rate and remain a interruption.

Also in Model 4, the coefficient between inflation (10-16 percent) is negative and statistically significant, while the coefficients in Model 7 mid- level (10-26 percent) is statistically meaningless. High levels of inflation and negative coefficients in both models are fully observed. According to model 4 with the difference that the inflation rate to 16 percent above the same period affects the growth rate, while Model 7 shows the top 26 % growth rate, inflation, even in negative effects on the same period of higher is pulled effect on the growth rate is approximately equal to the previous period. It means that the high levels of inflation, particularly above 26%, the inflation will have a similar impact on this year and next year growth rate.

Conclusion:

It is concluded that high rates of inflation have a very strong negative effect on economic growth in Iranian economy as it acts as a barrier to the growth. However, this effect is distinct from other devastating effects of inflation on the social structure and other institutions in society. However, inflation and growth aren't bilateral relations in Iran, but also with a confidence level of 86.6 percent is a unidirectional, (from the inflation growth), respectively. So it's not necessary equations to estimate systemic (concurrent) and also estimation inflation equation to explain the growth. Also, as a result, there are two structural breaks for inflation. This means that the inflation effect on growth is at three different levels. Two break points obtained for the Iran economy inflation rates of 10 and 16 per cent. Inflation with lags of 10 and 26 % of the test population was estimated to inflammation. The inflation rate at level below 10 percent has positive and significant effect on the growth and after a break, has a negative impact. In Intermediate levels of inflation and the 26 percent rate, in the same period is negative without having a significant effect on the course of progress. At high levels, especially at high rates of 26 percent (the current period and the next period) has severe negative impact.

Practical suggestions:

Since inflation has a positive effect on growth during the particular slopes, it is appropriate to try to keep the inflation rate in the fixed domain. It can be noted that the determination of break points than during period is sensitive. Therefore, increasing or decreasing the period of the break points obtained different results. Finding breakpoints is of special importance. With determining breakpoints, setting limits in order to control inflation, which has a positive effect on growth, is proceeding. The relationship between fiscal policy and monetary policy is appropriate for the task and exit command mode and can be expert and rational. Setting policies of the government and the central bank should be in a manner as possible the inflation rate does not impose in higher than 10% on the economy or an obstacle to reduce the inflation rate to below optimal levels (below 10% obtained in this paper) , in otherwise the economic growth will decrease .

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