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Inflation Threshold Rate and Economic Growth in Iran; A Threshold Regression Approach

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ABSTRACT

We apply a growth model to estimate the threshold regression model for Iran, concerning the effect of inflation on economic growth. The inflation rate is used to find out the threshold point. The results show a non-linear relationship between inflation and economic growth in Iran, in which the threshold effect corresponding to inflation rate of about 20%. In the other words, since the inflation rate is small (the threshold value is less than 0.2059) in two-regime model, inflation rate and economic growth have not a significantly relationship, but when the inflation rate is large (the threshold value is larger than 0.2059), inflation rate and economic growth have a significantly negative relationship.

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INTRODUCTION

Iran's economy is highly dependent on the production and export of crude oil to finance government spending, and consequently is vulnerable to fluctuations in international oil prices. Although Iran has vast petroleum reserves, the country lacks adequate refining capacity and imports gasoline to meet domestic energy needs.

Since the advent of the revolution in 1978-1979, Iran has experienced an inflation rate of more than 600% over the 1978-1990 periods. Such an inflation rate is remarkably high relative to those prevailing in industrial countries. The fact that the income level in Iran is not as high as the income level in the industrial countries makes the relatively high inflation in Iran even worse (or intolerable) for those who make a living there. It was difficult to make them understand that inflation could be due to the excess supply of money, the decline in domestic production, and the depreciation of the Iranian Rial.

Central bank in Iran is dependence to government and the financing of the deficit can be done through money printing, internal and/or external borrowing and use of central bank's foreign reserves. External borrowing and use of reserves combined would correspond to the link between budget and current account deficits, and money printing and use of central bank's reserves combined would emphasize credit extension by central bank. The financing of the deficit by money printing is conventional in Iran economy, so inflation in Iran is always ordinary phenomena.

There is a growing consensus among economists on the distortional effects of inflation on long-term economic growth. Yet, the empirical evidence on the relationship between inflation and economic growth has been surprisingly mixed and elusive. The significant role of inflation usually established by *linear* cross-country growth regressions is not very robust; see e.g. Sala-i-Martin (1997).

Earlier evidence including Dorrance (1966) and Johanson (1967) even suggested that inflation and growth are unrelated. Fisher (1993) and Barro (1995) found that the impact of inflation on economic growth is significant but only small.

However, the relation between inflation and long-term growth might be non-linear. Bruno and Easterly (1998), for example, showed that the effect of inflation on growth increases if it exceeds a threshold level of 40%. Apparently, such huge inflation thresholds can only be relevant for high-inflation countries but not for industrial countries where inflation targets center around 2%. In order to shed more light on the empirical relevance of inflation thresholds, we apply a recent modification of Hansen's (1999) panel threshold model to

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estimate both the number and the level of inflation thresholds as well as the marginal impact of inflation on growth in the various inflation regimes.

Most economists would agree that inflation has distortional effects on long-term economic growth if it gets "too high". Yet how high is too high? In the aftermath of the recent financial crisis, the long-time consensus on inflation targets for industrialized countries centering around 2% has been put up for discussion. Following e.g. Blanchard, DellAriccia and Mauro (2010), the effects of inflation on growth are difficult to discern, so long as inflation remains in the single digits. As a consequence, they suggest that an inflation target of 4% might be more appropriate because it leaves more room for expansionary monetary policy in case of adverse shocks. For developing countries, the appropriate level of the inflation target is also unclear. Bruno and Easterly (1998), for example, showed in a cross-sectional setting that inflation has only a detrimental impact on long-term economic growth if inflation exceeds a critical level of 40% — a rather large value which may be of only of limited relevance for monetary policy of many countries.

The theoretical literature offers various channels through which inflation may distort or even foster economic growth, see Temple (2000). If these different channels overlap or offset each other, or unfold an economic meaningful impact only for certain ranges of inflation, the relationship between inflation and economic growth might be characterized by inflation thresholds, see Vaona (2010).

Further contributions allowing for inflation thresholds in the relation between inflation and growth include Tsionas and Christopoulos (2003) and Cuaresma and Silgoner (2004). Restricting the attention to European countries, both studies report a significant negative impact of inflation on growth if inflation exceeds a certain threshold. However, the differences in the estimated threshold levels of 4.3% and 16%, respectively, are remarkable.

In this paper, we study a non-linear relationship between inflation and economic growth based on two regimes of inflation rate. Paper organized by four sections. The next section introduce model. Third section shows empirical results and final section is conclusion.

Model Specification:

We have used a growth model as following:

$$\dot{Y}_t = \alpha_1 + \alpha_2 \dot{P}_t + \alpha_3 \dot{L}_t + \alpha_4 \dot{K}_t + \alpha_5 \dot{Oil}_t + \varepsilon_t \quad (1)$$

Regression (1) shows that the variables which affect economic growth ($\dot{Y}$) include the inflation rate ($\dot{P}_t$), labor force growth ($\dot{L}_t$), investment ($\dot{K}_t$), and the oil revenue growth ($\dot{Oil}_t$).

Regression (1) is a traditional linear economic growth model, but we alter the linear model into the two regime TAR model of Hansen (2000). The model can be shown as follows:

$$\dot{Y}_t = \left(\delta_{10} + \delta_{11}\dot{P}_t + \delta_{12}\dot{L}_t + \delta_{13}\dot{K}_t + \delta_{14}\dot{Oil}_t\right)A[q_t \le \gamma] + \left(\delta_{20} + \delta_{21}\dot{P}_t + \delta_{22}\dot{L}_t + \delta_{23}\dot{K}_t + \delta_{24}\dot{Oil}_t\right)A[q_t > \gamma] + e_t^* \quad (2)$$

$$A(q_t > \gamma) = \begin{cases} 1 & if \quad q_t > \gamma \\ 0 & if \quad q_t \le \gamma \end{cases}$$

The threshold value γ can be found by estimating the regression (2) through finding the minimum Error Sum of Squared in a re-order threshold variable. The threshold variable can be set by the exogenous variables out of the theoretical model. in this paper we set inflation rate ($\dot{P}_t$) as the threshold variable. We can also apply the statistic coming from the threshold variable. For instance, we adopt the heteroskedasticity-consistent Lagrange multiplier (LM) of Hansen (2000) to test the null hypothesis of the linear assumption.

Once the estimator can be found, we then start with the statistical test, but the test procedure of Eq. (2) is different from the traditional test. Under the null hypothesis of no threshold effect, the threshold parameters will be unidentified. This will cause the traditional test statistic in a large sample distribution to not belong to the χ^2 distribution, but rather to a non-standard and non-similar distribution which is affected by nuisance parameters. This will cause the critical value of the distribution to not be estimated through simulation. In order to overcome the difficulty, Hansen (2000) uses a statistic of his own large sample distribution function to transfer and calculate the asymptotic p-value of a large sample. Under the null hypothesis, the distribution of the p-value statistic is uniform, and this kind of transformation can be calculated through bootstrap. The null hypothesis to test Eq. (2) is as follows:

$$H_0 : \delta_{1i} = \delta_{2i} \quad ; i = 1,2,3,...$$

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If H_0 is not rejected then the relationships between economic growth and inflation rate would be the linear regression as the regression (1). This means there exists no threshold effect. Otherwise, if H_0 hypothesis is rejected, it means that there exist different effects between the two regimes of δ_{1i} and δ_{2i}. The F-test statistics is as follows:

$$F = \frac{RSS_0 - RSS_1}{\hat{\sigma}^2}$$

In which RSS_0 and RSS_1 are the residual sum of squares under the null hypothesis and the alternative, respectively.

Data Description:

The resent socio-economic history of Iran has been subject to the past and political-strategic volatility of the region. Iran has not experienced a relatively free market economy due to the share of oil revenue at large. We have intended to use the annual data from 1959 to 2008 available on the Website database of the Central Bank of Iran (CBI).

Over the last fifty years, the Iranian economy has experienced several events of critical importance, including the 1979 revolution, the 1980–88 war with Iraq, and the 1993 balance of payments crisis; the behavior of the main macroeconomic variables has been strongly influenced by these shocks. Inflation, which experienced sudden bursts in correspondence with these episodes, has been moderately high on average (12.6 percent since 1958/59) and has been generally associated with rapid persistent money growth (24.2 percent for M2). (Bonato(2008)).

The 1979 revolution clearly represents a breaking point in the money-inflation relationship. Inflation increased significantly following the revolution (from 6.6 percent to 17.4 percent on average), but the acceleration in money growth was almost negligible (from 23.8 percent to 24.6 percent on average).2 After the dramatic increase experienced in the mid-1990s, when it reached a peak of 50 percent, inflation declined up until the first quarter of 2006/07, though the annual average remained in the double digits. This decline, however, did not reflect an improvement in monetary control, as both M1 and M2 continued to grow quite rapidly. The divergence in the behavior of inflation and monetary growth in recent years is reflected in the performance relative to the inflation target and the money growth target set by the Five-Year Development Plans (FYDPs). (Bonato(2008)).

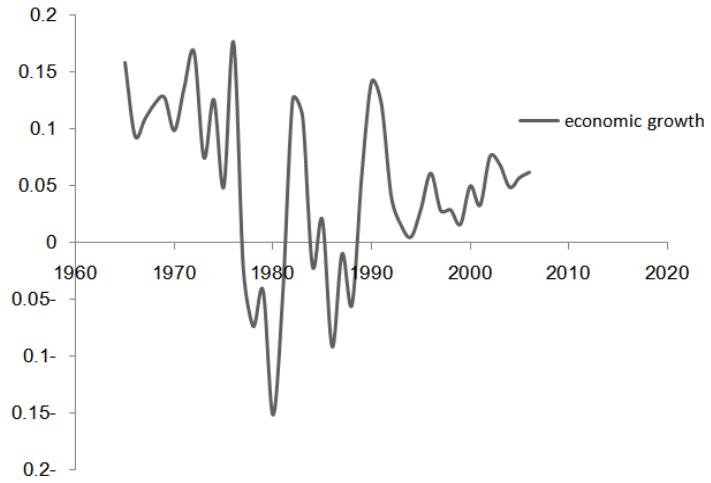

Fig. 1: Economic Growth Plot.

While the performance in reaching the inflation target improved somewhat up until 2005/06, the money growth target was consistently missed by a significant margin.4 What accounts for this divergence? The trade reforms introduced in the early 2000s resulted in a gradual opening of the economy, which may have exposed it to the effects of international competition. The parallel market appreciation that preceded the 2002 exchange rate unification largely explains the better-than-envisaged inflation performance in the first two years under the Third FYDP. Other factors that may have affected inflation are the impact of favorable weather conditions on agricultural prices, and stricter annual limits to the price increases for goods and services by public sector enterprises (Celasun and Goswami, 2002). (Bonato(2008)).

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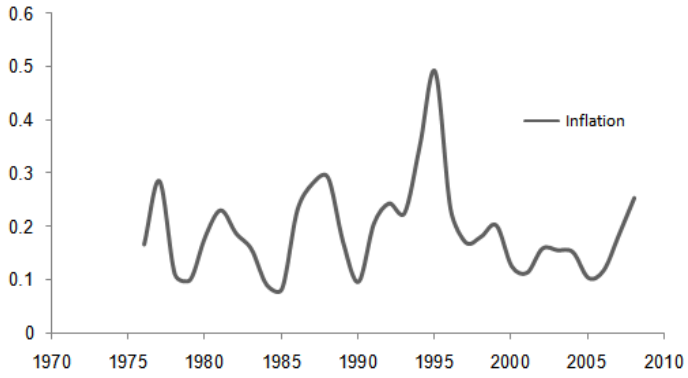

Fig. 2: Inflation Plot.

Some of the decline in per capita income can be attributed to the chaotic years of the revolution (1978-79), the war between Iran and Iraq (1980-88), and the lower oil revenues (see Figure 1). The war ended in mid 1989, the oil revenues were stabilized, and the economy started to grow again. After the war the growth of GDP per capita averaged 5.3 percent for the first four years, during which most of the war damaged infrastructure was reconstructed. But hopes of regaining the pre-revolution growth rates soon faded away as the economic growth slowed down in 1992. On average, from 1989 to 2004, non-oil income per capita in Iran grew by less than 3 percent per annum.

Empirical Results:

This paper uses Hansen (1996, 2000) threshold regression model to study whether a non-linear relationship between "inflation rate" and "economic growth" exists in Iran. As Table 1 shows, we adopt Hansen (2000) advice to use the bootstrapping model. While the threshold variable is “inflation rate”, we find that P-Value is (0.00), which is significant at 1% level. The threshold value is 0.2059, and this means that the threshold exists.

Table 1: Threshold Tests by Bootstrapping Method.

Threshold Variables	Value
P-Value of threshold test	0.00
Threshold regime (%)	20.59%

After making sure that the oil revenues have the threshold effect and achieve the threshold regimes, we analyze the linear and non-linear inflation effects and discuss how the inflation rate affects the economic growth in different threshold regimes.

Table 2: Economic Growth and Inflation Rate (Linear Model).

Variables	*Linear Model*	
	Coefficient	Prob
Interception	0.008	0.92
$\dot{P}_t$	-0.27	0.07
$\dot{L}_t$	0.21	0.90
$\dot{K}_t$	0.62	0.00
$\dot{O}il_t$	0.14	0.00
R^2	0.55	
Ramsey reset (p-value)	0.08	
Jarque-Bera (p-value)	0.16	
Breusch-Pagan-Godfrey (p-value)	0.22	
Breusch-Godfrey Serial Correlation LM Test	0.52	

As table 2 shows, in linear model, the effect of inflation on economic growth is significantly negative. Labor force growth has not significantly effect on growth. Investment and oil revenue growth have a significantly positive effect on economic growth in Iran.

Ramsey Reset test indicate that there is specification error in linear model at 90% confidence level. The normality test of Jarque-Bera shows normality in errors distribution. The Breusch-Pagan-Godfrey and Breusch-Godfrey serial correlation LM test indicate homoscedasticity and no autocorrelation in residuals respectively.

As table 3 shows, “inflation rate” is the threshold variable. Since the inflation rate is small (the threshold value is less than 0.2059) in two-regime model, inflation rate and economic growth have not a significantly relationship, but when the inflation rate is large (the threshold value is larger than 0.2059), inflation rate and economic growth have a significantly negative relationship. Thus, we can make sure that the non-linear relationship between inflation rate and economic growth exists in Iran when “inflation rate” is the threshold

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variable. Moreover, the labor force growth has not a significantly impact on economic growth in two regimes of inflation. The investment and oil revenue growth have a significantly positive impact on economic growth concerning both of the two regimes.

Table 3: Economic Growth and Inflation Rate (Non-Linear Model).

Variables	*Threshold Model*			
Threshold value (%)	≤0.2059	prob	>0.2059	prob
Interception	-0.04	0.58	-0.04	0.58
$\dot{P}_t$	0.26	0.42	-0.38	0.06
$\dot{L}_t$	-0.24	0.88	-0.24	0.88
$\dot{K}_t$	0.48	0.05	0.48	0.05
$\dot{O}il_t$	0.14	0.00	0.14	0.00
R^2	0.60			
Ramsey reset (p-value)	0.18			
Breusch-Pagan-Godfrey (p-value)	0.61			
Breusch-Godfrey Serial Correlation LM Test	0.68			

Ramsey Reset test indicate that there is not specification error in non-linear model at 99% confidence level. So, the non-linear model is better than linear model. The Breusch-Pagan-Godfrey and Breusch-Godfrey serial correlation LM test indicate homoscedasticity and no autocorrelation in residuals respectively.

Conclusion:

Following the non-linear theory of Sala-i-Martin (1997) and Bruno and Easterly (1998), we have tested the presence of a non-linear relationship between inflation rate and economic growth in Iran. Doing so, we have used a growth model into a threshold regression model and apply Hansen (1996, 2000) method to test the threshold effect. The empirical results indicate that threshold effect exist between inflation rate and economic growth in Iran.

Concerning the "inflation rate" as the threshold variable, the threshold regime is 20.59%. This indicates that when the inflation rate is smaller than the regime, inflation rate has not a significantly effect on economic growth, but if the inflation rate is larger than the regime, then the economic growth decreases.

Comparing these results with those of the observed values during the period 1960-2008 indicates that the inflation rate is higher than the threshold value (20.59%). Therefore, the central bank in Iran should shrink the liquidity growth to decrease the inflation rate. Central bank in Iran should independence from government.

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