Iranian Economic Review, Vol.13, No.20, Fall & Winter 2007

Does Inflation Harm Economic Growth in Iran

Mohsen Mehrara*

Abstract

This paper explores the relation between inflation and economic growth in Iran using annual data for the period 1959-2004 to check whether this relation has a structural breakpoint effect. The results indicate the threshold level of inflation above which inflation significantly slows growth is around 9-12 percent for Iran economy. This range is not surprising, given that it is not possible for the monetary authority to increase or adjust the nominal interest rate above the inflation rate.

Keywords: Iran Economy; Inflation; Economic Growth; Threshold level of inflation.

1- Introduction

The literature about inflation indicates that the economists have spent much time to understand the reasons that causes inflation. The economists have succeeded to give details about the sources of inflation. But, until now the relation of inflation with the other macroeconomic variables such as the economic growth has remained debatable. Specifically, the issue that whether inflation is necessary for economic growth or it is harmful generates a significant debate both theoretically and empirically. In the case of developing countries, the issue originally evolves from the controversies between the structuralists and the monetarists. The structuralists argue that inflation is necessary for economic growth, whereas the monetarists argue

*- Assistant professor, university of Tehran, Department of Economics, Iran. Email address: mmehrara@ut.ac.ir.

the opposite, that is, inflation as detrimental for economic growth (Mallik and Chowdhury, 2001).

Mankiw (2000) addressed the relation of inflation with the other macroeconomic variables as one of the most important unresolved questions of the macroeconomics. Specifically, he mentioned that both the cost of inflation and the cost of reducing inflation are topics on which the economists often disagree. For example, Mundell (1965) and Tobin (1965) predict a positive relationship between the rate of inflation and the rate of capital accumulation, which in turn, implies a positive relationship to the rate of economic growth. They argue that since money and capital are substitutable, an increase in the rate of inflation increases capital accumulation by shifting portfolio from money to capital, and thereby, stimulating a higher rate of economic growth (Gregorio, 1996). Conversely, Fischer and Modigliani (1978) suggest a negative and nonlinear relationship between the rate of inflation and economic growth through the new growth theory mechanisms (Malla, 1997). They mention that inflation restricts economic growth largely by reducing the efficiency of investment rather than its level.

Although few economists now recommend that governments should try to engineer inflation, there is still no consensus as to when the benefits of anti-inflationary programs are likely to exceed the short-run costs. There is the growing concern in developed countries that excessively low inflation threshold may hurt economic growth. It is argued that the developed countries do have very well developed financial markets and less government interventions in goods markets. Such economies are mostly demand driven, in which case stimulus to demand results in rising prices and a clear trade off is observed at low level of inflation. So many argue that it is not worth the transitional costs to bring down inflation rates in industrial countries from 2% or 3% to zero. On the other hand, the developing countries are more vulnerable to supply shocks causing high variability in inflation and disturb the consumption, investment and production behavior. Further, the government interventions in financial and goods markets and macroeconomic rigidities such as rigidities in labour laws cause market failure and macroeconomic instability. Therefore, prices do not give correct signals about the policies and the course of actions of the economic agents.

In this context, it has not been uncommon for economists to judge inflation rates of from 20% to as much as 40% as being satisfactory (Stiglitz, 1998). Negative effects of inflation on growth may well only begin to kick in after some threshold has been breached. In this regard, recently macroeconomists have adopted an econometric technique simply by looking at a nonlinear or structural break effect which states that the impact of inflation on economic growth could be positive up to a certain threshold level and beyond this level the effect turns to be negative (Sweidan, 2004). In other words, harmful effects of inflation are not universal, but appear only over the "threshold" level of inflation. This supports both the view of the structuralists and the monetarists up to a certain extent, that is, low inflation is helpful for economic growth but once the economy achieves faster growth then inflation is detrimental for the sustainability of such growth.

The main objective of this study is to empirically explore the present relationship between inflation and economic growth and estimate the threshold level of inflation for Iran based on annual data over the period 1959-2004. In other words, this paper explores an interesting policy issue of how far the inflation rate is non-detrimental for the economic growth of Iran, following the methodology used by various researchers including Khan and Senhadji (2001), Singh (2003) and Mubarik (2005).

The remainder of this paper is organized as follows: Section 2 reviews the empirical literature on inflation and economic growth. Section 3 discusses the methodology and data used to obtain the empirical findings reported in this paper. Section 4 provides information about the historical trends of inflation and economic growth in Iran as well as empirical results. Finally, section 5 presents a summary of the main conclusions.

2- Empirical Evidence

While few doubt that very high inflation is bad for growth, there have been mixed empirical studies as to their precise relationship. Both in the context of developed and developing countries, there have been extensive theoretical and empirical research to date that attempt to focus on the relationship between inflation and economic growth. This section presents a brief review.

Sarel (1995) mentions that inflation rates were somewhat modest in most countries before the 1970s and after that, rates started to be high. Therefore, most empirical studies conducted before the 1970s show the evidence of a positive relationship between inflation and economic growth and a negative relationship between the two beyond that time period due to the severe inflation hike.

Bruno and Easterly (1995) examine the determinants of economic growth using annual CPI inflation of 26 countries which experienced inflation crises during the period between 1961 and 1992. In their empirical analysis, an inflation rate of 40 percent and over is considered as the threshold level for an inflation crisis. The empirical analysis suggests that there exists a temporal negative relationship between inflation and economic growth beyond this threshold level. The robustness of the empirical results is examined by controlling for other factors such as terms of trade shocks, political crises, and wars. Finally, they find that countries recover their pre-crisis economic growth rates following successful reduction of high inflation and there is no permanent damage to economic growth due to discrete high inflation crises.

Fischer (1993) used a spline regression and found a negative relationship at all levels of inflation. Barro (1996) found inflation harmful to growth but his findings were driven by the observations where inflation exceeded 20%. Below that, the point estimate was negative but statistically insignificant. Bruno and Easterly (1998) found that countries with annual inflation above 40% grow significantly lower than countries with inflation rates below 40%.

Khan and Senhadji (2001) found 1% threshold level of inflation for industrialized countries, which means above 1% it would have negative effects on growth. On the contrary, Burdekin (2000) found a threshold level of 8% for the said countries. This result is also consistent with the findings of Sarel (1996) which tested for a structural break and found that inflation is negatively related to growth after 8%. However, the point estimate for inflation below 8% was found positive but statistically insignificant. Similarly, Ghosh and Phillips (1998) used 2.2% threshold level of inflation in the analysis for industrialized countries while Judson and Orphanides (1996) assumed 10% threshold level without empirical testing.

In the same way, Khan and Senhadji (2001) found 11% threshold level of inflation for

developing countries; again below 11% the inflation-growth effect is positive but insignificant. Another study conducted by Burdekin (2000) found a threshold level of 3% or less for developing countries.

Faria and Carneiro (2001) investigate the relationship between inflation and economic growth in the context of Brazil which has been experiencing persistent high inflation until recently. Analyzing a bivariate time series model (i.e., vector autoregression) with annual data for the period between 1980 and 1995, they find that although there exists a negative relationship between inflation and economic growth in the short-run, inflation does not affect economic growth in the long-run. Their empirical results also support the *superneutrality* concept of money in the long run. This in turn provides empirical evidence against the view that inflation affects economic growth in the long run.

Mallik and Chowdhury (2001) examine the short-run and long-run dynamics of the relationship between inflation and economic growth for four South Asian economies: Bangladesh, India, Pakistan, and Sri Lanka. Applying co-integration and error correction models to the annual data, they find two motivating results. First, the relationship between inflation and economic growth is positive and statistically significant for all four countries. Second, the sensitivity of growth to changes in inflation rates is smaller than that of inflation to changes in growth rates. These results have important policy implications, that is, although moderate inflation promotes economic growth, faster economic growth absorbs into inflation by overheating the economy

Sweidan (2004) examines whether the relationship between inflation and economic growth has a structural breakpoint effect or not for the Jordanian economy from the period between 1970 and 2003. He finds the structural breakpoint effect occurs at an inflation rate equal to 2-percent. Beyond this threshold level inflation affects economic growth negatively.

Mubarik (2005) estimates the threshold level of inflation for Pakistan using an annual data set from the period between 1973 and 2000. He employed the *Granger Causality* test as an application of the threshold model and finally, the relevant sensitivity analysis of the model. His

estimation of the threshold model suggests that an inflation rate beyond 9-percent is detrimental for the economic growth of Pakistan. This in turn, suggests that inflation rate below the estimated level of 9-percent is favorable for the economic growth.

3- Methodology and Data

Most of the studies conducted on the subject have used cross sectional data & panel data with the coverage of a large number of countries. For example, Khan and Senhadji (2001) and Burdekin (2000) used cross sectional data and covered many countries in the analysis. Similarly, Fischer (1993) and Barro (1996) utilized panel data to take into consideration the time dimension of inflation and growth. There are very few studies (Singh (2003) and Mubarik (2005)) which used time series data to estimate threshold rate of inflation for individual countries. The current study also uses annual data for the period 1959 to 2004 for the estimation of threshold level of inflation for Iran.

Threshold models have a wide variety of applications in economics. Direct applications include models of separating and multiple equilibria. This idea is related to nonlinearity of relationship between economic variables. A few studies also focused on the possibility of nonlinear relationship between inflation and economic growth. For the estimation of threshold of inflation, this paper also follows nonlinear approach used by Khan and Senhadji (2001). The equation to estimate threshold level of inflation has been considered in the following form[1]:

$$GDPGR_t = \beta_0 + \beta_1 INF_t + \beta_2 D_t (INF_t - K) + \beta_3 INVGR_t + \beta_4 OILREVGR_t + \varepsilon_t$$

Where

GDPGR=Growth rate of real GDP

INF=*CPI* inflation

INVGR=Growth rate of real gross fixed capital formation

1. Obviously, growth-inflation regressions must include other plausible determinants of growth. The variables are chosen based on empirical literature, theories of economic growth, and diagnostic tests.

OILREVGR=Growth rate of real oil revenue

K=Threshold level of inflation

D=Dummy variable

$D=1 \;\; if \; INF>K$

$D=0 \;\; if \; INF \leq K$

The coefficient of the dummy variable (β_2) measures the incremental effect of inflation rate on the economic growth when it is greater than the assumed structural break level (i.e. inflation is high) and the opposite for the coefficient of inflation rate (β_1). In other words، the coefficient of β_2 indicates the difference in the inflation effect on growth between the two sides of the structural break and its t-statistic value tests whether or not the structural break is significant. In the above threshold model, the sum of the two coefficients ($\beta_1 + \beta_2$) represents the annual growth rate of economic growth when inflation rate is above the structural break. By estimating regressions for different values of *K* which is chosen in an ascending order (i.e., 0.01, 0.02 and so on), the optimal value *K* is obtained by finding the value that maximizes the R^2 from the respective regressions. This also implies that the optimal threshold level is that which minimizes the residual sum of squares (*RSS*). This procedure has become widely accepted in the literature on this topic.

The data are annual over the 1959 – 2004 period. The source of data is the Central Bank of Iran. Before conducting any econometric analysis, the time series properties of the data must be investigated. We used: augmented Dickey Fuller (*ADF*), Phillips Perron(1988)[1], (*PP*) and Kwiatkowski et al.(1992), *KPSS*[2] tests to assess the order of integration of the variables in equation1. In Table 1, results of the unit root tests on relevant variables have

1- This version of the test is an extension of the Dickey Fuller test, which makes a semi-parametric correction for autocorrelation and is more robust in the case of weakly autocorrelated and heteroskedastic regression residuals. According to Choi (1992) the Phillips Perron tests(*PP*) extension appear to be more powerful than the *ADF* tests for aggregate data. For more details see Perron(1990).

2 - The *KPSS* procedure assumes the univariate series can be decomposed into the sum of a deterministic trend, random walk and stationary disturbance and is based on a Lagrange Multiplier score testing principle. This test reverses the null and the alternative hypothesis. A finding favorable to a unit root in this case requires strong evidence against the null hypothesis of stationarity.

been reported. The findings of unit root tests suggest that all the variables are integrated of order zero. Therefore, any estimated relationship between the growth rate and inflation for Iran based on equation 1 would not be spurious. Moreover, statistical inference based on this specification would be valid.

Table 1: Unit-root tests

variable	*ADF*	*PP*	*KPSS*	Decision
INF	-3.19*	-3.21*	0.11	I(0)
GDPGR	-3.88**	-3.92**	0.28	I(0)
INVGR	-4.27**	-3.89**	0.11	I(0)
OILREVGR	-4.48**	-4.48**	0.16	I(0)

Note: * and ** indicate rejection of the null of nonstationary at 10% and 1% significance level respectively. Empirical results indicate that the null hypothesis of unit-root is rejected in all cases at 10% significant level. The lag lengths for the *ADF* and *PP* tests are chosen by using SC's information criterion and Newey and West (1987) method respectively.

4- Empirical Results

4-1- Historical Trends and Data Description

Figure 1 depicts the historical trends of inflation rate (*INF*) and real *GDP* growth rate (*GDPGR*) of Iran during the period of 1959 to 2004. The sample period may be split into two inflation regimes: 1959 – 1973 with relatively low and stable inflation and 1974 – 2004 with higher and more variable inflation. The inflation rates were in single figures from 1959 to1973. After 1973, with the oil price and the quantity of oil exports increasing, the rates of inflation rose sharply and exhibited large fluctuations.

In the period 1959–2004, real *GDP* growth in Iran averaged 4.7 percent a year. During 1959–1978, Iran enjoyed one of the fastest growth rates in the world: the economy grew at an average rate of 10.2 percent in real terms. This outstanding performance took place in an environment of relative domestic political stability, low inflation, and improved terms of trade, as evidenced by the rising oil price relative to import prices. The growth trend was reversed during 1979–1988, reflecting the disorder in the aftermath of the 1978 revolution, the eight-year war with Iraq, the international isolation of Iran, the increased state dominance of the economy, and the falling in oil

output and revenue. This resulted in negative real *GDP* growth of 2.4 per year on average. With the reconstruction effort and a partial recovery in oil output, real economic growth recovered during 1989–2004 to an average of 4.8 percent per year. This period, however, was marked by sharp fluctuations in the growth pattern, as the postwar economic boom (1989–1992) was followed by the stagnation of 1993–1995 when the economy was hit by lower oil prices, lack of external financing, and economic sanctions. The ensuing severe debt crisis, together with inappropriate macroeconomic policies, had an adverse impact on growth, which hovered around 3.6 percent during 1995–2000. In the more recent period (2000–2004), real *GDP* growth picked up to about 6 percent due to significant progress in economic reforms—such as the exchange rate unification, trade liberalization, the opening up to foreign direct investment, and financial sector liberalization—but also to high oil prices and expansionary fiscal and monetary policies.

The plotting of data on inflation (*INF*) and GDP growth (*GDPGR*) reveals a mixed trend. But if we plot the data smoothened by Hodric Prescott (HP) filter, we observe a smooth trend. Apparently, we cannot draw any conclusion about nature of relationship between the two variables. However, the coefficient of correlation (-0.41 and-0.64 for actual and smoothed data respectively) are far from zero, revealing a strong and significant negative relationship between these variables. It would be worthwhile to mention that Corrigan and Yatrakis (1997) found no correlation between the two variables for the US economy.

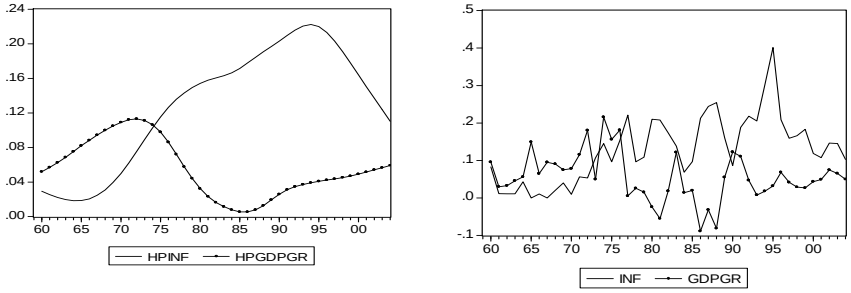

Figure1: Inflation and Real GDP Growth Rates (1959-2004)

The scatter diagrams also indicate an overall negative correlation between the two variables. The diagram with smoothed data illustrates a positive relationship between inflation and GDP growth up to the inflation

rate of 10 percent (approximately) and a negative relationship is observed after that level of inflation rate. Further, we observe extremes in the smoothed data despite using Hodrick-Prescott (HP) filter to remove extremes or volatility in the data. Although it is unwise to conclude anything simply on the basis of a visual inspection of Figures 1 and 2, however, it illustrates more or less an overall inverse relationship between rate of inflation and GDP growth rate in Iran particularly when the inflation is "high" during the underlying period.

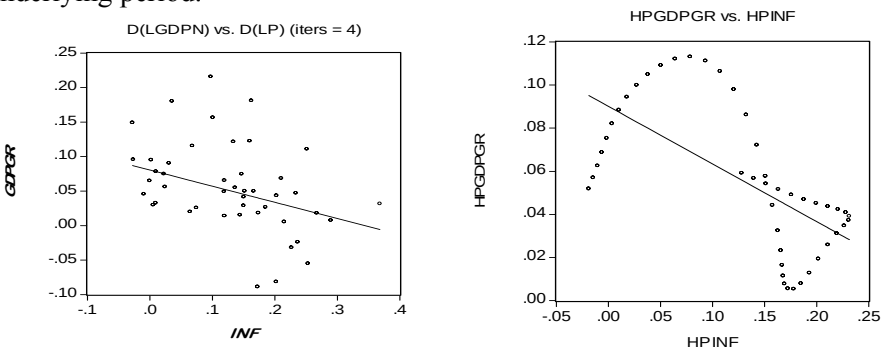

Figure2: Relation Between Inflation and Real GDP Growth Rates(1338-1384*)*

4-2- Estimation of Threshold Effects

In this section, the threshold level of inflation based on equation 1 is estimated for Iran. This process required estimating around 35 regressions, looking for the inflation breakpoint that maximize R^2 or minimize RSS. Figure 3 gives an idea about the goodness-of-fit for different structural breaks. It shows the value of R^2 is maximized when the inflation structural point is 12%. The results with smoothed data also reveal that the structural breakpoint occurs at inflation rate equal to 9% (not reported here).

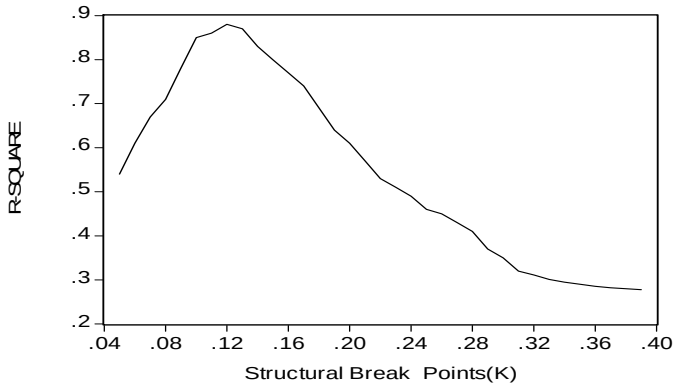

Figure3: Goodness of Fit for Different Structural Breaks

Table 1 present the results of estimating model 1, as well as the value of the threshold of inflation level. These results reveal that the impact of contemporaneous inflation on growth is positive and significant. One percent increase in the inflation rate leads to an increase by %0.027 in the *GDPGR*. On the other hand, the effect of contemporaneous inflation when it is greater than %12 is negative and significant: one percent increase in the inflation rate leads to a decrease by %-0.038 in the *GDPGR*. The sum of the two coefficients (-0.011) means the annual growth rate of real GDP declines by %0.011 when the inflation rate jumps over the structural breakpoint. Also, the results show a positive and significant relation between *INVGR*, *OILREVGR* and *GDPGR* and this result is consistent with the economic theory. Moreover all the diagnostic tests are satisfactory.

Table1: Estimation of Model (sample1959-2004)
(Dependent Variable: GDP growth)

Variables	Coefficient	t-Statistics
INF(-1)	0.64	7.45***
INF	0.027	3.46***
(INF>0.12)*(INF-0.12)	-0.038	2.12**
INVGR	0.12	1.78*
OILREVGR	0.07	1.90*
Constant	4.52	5.98***
R^2	0.88	
D.W	1.86	
Serial correlation	0.54	
Functional Form	0.62	
Normality	1.12	
Heteroscedasticity	0.45	

Notes: For diagnostics, Godfrey's LM test for serial correlation, Ramsey's (1969, 1970) RESET test for functional form, White's (1980) general heteroscedasticity test for heteroscedasticity and, Jarque-Bera test for normality have been performed

***significant at 1%
** significant at 5%
* significant at 10%

To check the stability of estimated parameters over the observation period and establish the usefulness of model with K=0.12, the cumulative sums (*CUSUM*), and *CUSUM* square test (*CUSUMSQ*) tests were conducted

(Figure 4). These tests are based on cumulative sum of recursive residuals and squares of recursive residuals respectively and compare them with the 5% critical levels. Movements outside the critical lines suggest instability of the parameters. The *CUSUM* square test is particularly powerful tool to investigate the stability of estimated parameters if the shifts in the equation are systematic. Figure 4 show the *CUSUM* and *CUSUM* of squares for the estimated equation. Both of the tests confirm the absence of any breakpoint in the relationship between the two variables for Iran.

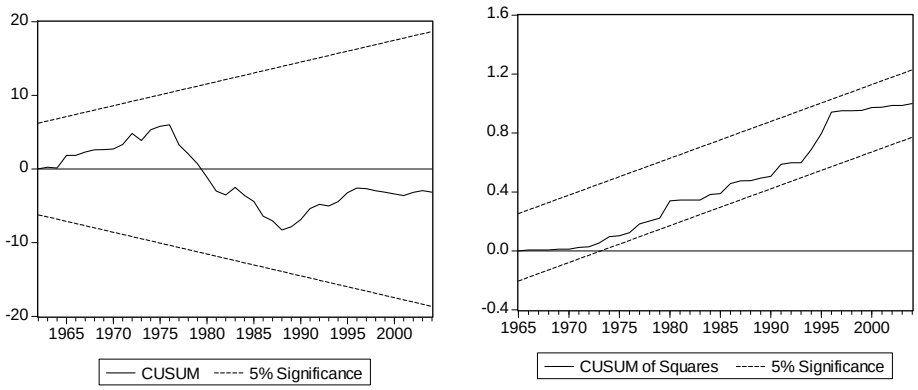

Figure4: stability tests

4- Conclusions

The historical overview shows that Iran has applied an easy monetary policy as a result of oil shocks or crises since 1970s. But, many economists ask an important question which is: For how many years this monetary policy can sustain, especially it is costly and the Iran economy is looking forward to develop its financial markets and reduce the distortions relating to interest rate as the most important relative price in these markets.

The paper is primarily meant to estimate threshold level of inflation for Iran using annual data for the period 1959-2004. The results indicate, by and large, the relation between inflation and economic growth in Iran is negative. But, using the structural breakpoint methodology proved that this relation tend to be positive below an inflation rate ranging from %9 to 12%. And after this range the effect tend to be negative. In other words, This result confirm that the inflation above this range is harmful to the Iran economy.

The above findings have strong implications for the conduct of monetary policy, as price stability is the most important goal of a central bank not only in Iran but also all over the world. These findings suggest that the central bank should keep inflation stable and low, as high inflation is harmful for economic growth. Given that it is not possible for the monetary authority to increase (or adjust) the nominal interest rate above the expected (or actual) inflation rate, keeping inflation within the targeted range of 9 - 12% may be helpful for economic growth in Iran.

References

1-Andres, J. and I. Hernando (1997) "Does Inflation Harm Economic Growth? Evidence from the OECD," NBER Paper No. 6062.

2-Barro, Robert (1991) "Economic Growth in Cross Section of Countries," Quarterly Journal of Economics, Vol. 106, pp 407-443.

3-Barro, Robert (1995) "Inflation and Economic Growth", Bank of England Quarterly Bulletin, May.

4-Barro, Robert (1996) "Inflation and Growth," Federal Reserve Bank of Saint Louis Review, May/June.

5-Bruno, M. (1995) "Does high inflation really lower growth?", Finance and Development, vol. 32, pp. 35-38.

6-Bruno M. and W. Easterly (1996) "Inflation and Growth: In Search of Stable Relationship", Federal Reserve Bank of St. Louis Review, vol.78, pp. 153-169.

7-Bruno, M. and W. Easterly (1998) "Inflation crises and long-run growth", Journal of

8-Monetary Economics, vol. 41, pp. 3-26.

9-Burdekin, et el. (2000) "When Does Inflation Hurt Economic Growth? Different Nonlinearities for Different Economies", Working Papers in Economics, Claremont Colleges, August 2000.

10- De Gregorio, Jose (1991) "The Effect of Inflation on Economic Growth: Lessons from Latin America, Working Paper WP/ 91/95, October, IMF, Washington.

11- Fischer, Stanley (1993) "The Role of Macroeconomic Factors in Growth", Journal of Monetary Economics, Vol. 32, PP 485-512.

12- Gillman, Max, and Michal Kejak,(2000) "A Non-Linearity in the Inflation-Growth Effect", Central European University Department of Economics Working Paper 14/2000.

13- Gillman, Max, and Michal Kejak (2001) "Modeling the Inflation-Growth Effect", Central European University, Department of Economics Working Paper 18/2000; revised.

14- Gosh, A. and S. Phillips (1998) "Warning: Inflation May Be Harmful to your Growth," IMF Staff Paper 45, NO.4.

15- Khan, A. (2000) "The finance and growth nexus. Business Review, Federal Reserve Bank of Philadelphia, January/February, 3-14.

16- Khan, Mohsin S., and Abdelhak S. Senhadji (2000) "Threshold Effects in the Relationship Between Inflation and Growth", IMF Working Paper, WP/00/110

17- Kirmanoglu, Hasan (2000) "Is There Inflation-Growth Tradeoff in the Turkish Economy?" Dep. Economics, Istanbul Bilgi University.

18- Kormendi, Roger and Philip Meguire (1985) "Macroeconomic Determinants of Growth," Journal of Monetary Economics, Vol. 16.

19- Mubarik, Yasir Ali (2005), "Inflation and Growth: An Estimate of the Threshold Level of Inflation in Pakistan", State Bank of Pakistan Research Bulletin, Vol 1, No.1.

20- Motley, B. (1994) "Growth and Inflation: A Cross-Country Study", Federal Reserve Bank of San Francisco, Working Paper 94-08.

21- Sarel, Michael (1995) "Nonlinear Effects of Inflation on Economic Growth," Working Paper WP/95/56, May, IMF Washington.

22- Singh, K. Kaliappa K. (2003), "The Inflation-Growth Nexus in India: An Empirical Analysis", Journal of Policy Modeling", 25(2003), pp 377-396.