Inflation and Growth Dilemma: An Econometric Analysis of the Indian Economy

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This study examines the relationship between inflation and growth of the Indian economy during 1981-2004. The results of the causality test prove that the variables, viz., growth and inflation are independent of each other in India. The results of the cointegration test confirm the fact that the two variables—inflation and growth—are not cointegrated. Therefore, it is evident that there is no long run relationship between these two variables in India. Based on the findings, this study suggests that the government has to focus on the acceleration of economic growth and to take timely measures to control inflation to maintain economic stability.

Introduction

Like many countries in the world, India also aims to sustain high economic growth with low inflation. There has been a considerable debate in macroeconomics on the existence and nature of inflation and its relationship with economic growth. Most of the economists recommend that macroeconomic stability, specially defined as low rate of inflation, is positively related to economic growth. But high rate of inflation imposes negative externalities on the economy, when it interferes with the efficiency of the economy.

Inflation creates more burdens on the cost of living, and makes the life of common man more miserable. It is also known that inflation leads to uncertainty about the future profitability of investment projects especially, which have long gestation period. The increased price variability may lead to an increase in cost of production and less profitability. Inflation imposes negative externalities on the economy, when it gets in the way with an economy's efficiency. Besides this, inflation may lead to uncertainty about the future profitability of different investment projects. It may also reduce the country's international competitiveness. When there is an increase in the cost structure and price level, the international competitiveness of the country also may be adversely affected. The export prices of that country also may become relatively more expensive than the prices of the competitors, and thus, adversely affect the balance of payments. The inflation undermines the confidence of domestic and foreign investors about the future course of monetary policy. Besides this,

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inflation also affects the accumulation of other determinants of growth like investment on growth and investment on Research and Development (R&D).

In the light of above discussion, this paper briefly examines several different economic theories and empirical studies to assess the effect of inflation on economic growth, and then, it tests whether a meaningful relationship between these two variables exist in India. They are like Classical, Keynesian, Neo-Keynesian, Monetarist, Neoclassical and Endogenous Growth Theories developed in different versions to the inflation growth relationship. The classical economists recall supply side theories, which emphasize the need for incentives to save and invest, if the economy is to grow, linking it to different factors of production like land, capital and labor. Keynesian and Neo-Keynesian Theories have developed a complete model for linking inflation to growth under the Aggregate Supply (AS) and Aggregate Demand (AD) model. However, the monetarism updated the quantity theory of money by reemphasizing the critical role of monetary growth in determining the rate of inflation, whereas neoclassical and endogenous growth theories sought to account for the effects of inflation on growth through its impact on investment and capital accumulation.

However, there are various conclusions about the responsiveness of growth to inflation. Initially, the inflation growth theories are developed on the basis of cyclical observations. The AS-AD framework developed a positive relationship between inflation and growth. In the 1970s, the concept of stagflation came into focus, which questioned the validity of the positive relationship between inflation and growth. The relation ship between inflation and unemployment has been rightly focused by the Phillips curve at that time. This was confirmed by periods of low or negative output growth and inflation rates that were high in the preceding years. During this period, the countries all over the world experienced the problems of high prices and massive unemployment. Traditional economic analysis takes the behavior of monetary policymakers into consideration, as exogenous factor. The present consensus accept the fact that inflation is a monetary phenomenon which indicates that there would be no inflation without continuous increase in supply of money. It leads to the conclusion that long run price stability can be achieved by limiting that growth rate of money to the long run real growth rate in the economy.

Besides this, there is a general consensus exists amongst policymakers and central banks that inflation is certainly harmful to the economic growth of the country. Now, most of the central banks in the world are dedicated to maintain price stability through transparency in their transactions and procedures to inculcate confidence in the economy. Thus, the common belief is that low rate of inflation or price stability lays the foundation for higher economic growth.

Review of Literature

Girija and Anis (2001) use cointegration and error correction models to empirically test the long run and short run dynamics of the inflation-economic growth relationship for the four South Asian Countries viz., Bangladesh, India, Pakistan and Srilanka. Using the Annual Data, this study finds that there is long run positive relationship between growth and inflation. Further, the sensitivity of inflation to changes in growth rates is larger than that of growth to changes in inflation rates of all the selected countries. These findings have significant

implications. This study concludes that inflation is helpful to growth, but faster economic growth feeds back into inflation. Thus, these countries are on a knife-edge. The challenge for these selected South Asian countries to find a growth rate which is consistent with a stable inflation rate, rather than beat inflation first to take them to a corridor of faster economic growth.

Osama (2004) investigates the relation between inflation and growth to check whether this relation has a structural break point effect or not. This study uses two types of methodologies to achieve its goals: it uses Autoregressive Conditional Hetroskedasticity (ARCH) model to estimate a proxy to the inflation variability; and it employs a multiple regression model consistent with the Jordan economy that able to confirm established facts about the determinants of economic growth as accepted by many other studies. The results of this study concludes that the structural break point effect takes place at inflation rate equal to 2%, and after this level the effect turns to be negative. This study concludes that the central bank of Jordan should pay attention to the inflation phenomenon while conducting the new monetary policy.

Hasan (2001) examines how inflation affects the economic growth in Turkey. This study uses Unrestricted Vector Autoregression (UVAR) technique to estimate a four variable system and concludes that Turkey faced the cost of high inflation in terms of lower economic growth. The findings of this study establish the fact that inflation adversely affected both private investments and the economic growth in Turkey.

Gokal and Hani (2004) review several economic theories to ascertain consensus on the inflation-growth relationship and the empirical literature developed recently on this issue. This study tests whether a meaningful relationship held in case of Fiji. In order to estimate the effect of inflation on the economic growth, regression equations are used, in which many other determinants of growth are held constant. The structure of the study is based on an extended view of the neoclassical models as described by Barro and Sala-I-Martin. The findings indicate a weak negative correlation between inflation and growth, while the change in output remains significant. The results proves that the causality between the two variables ran one-way from GDP growth to inflation.

Richard *et al.* (2000) proves that the effects of inflation on growth change substantially as the inflation rate rises. This study adopts a variation of Sarel's econometric model, but considers the data separately for 21 industrial and 51 developing countries for 1967 to 1992, and also allows for multiple thresholds. The empirical results support the view that the effect of inflation on growth is nonlinear and the nonlinearities are quite different for industrial countries than for developing countries. This study concludes that the threshold at which inflation begins to seriously affect growth is around 8% for industrial countries, but 3% or less for developing countries. It is also obvious from the study that the marginal growth costs for developing countries decline significantly above 50% inflation.

Fakia and Carneiro (2001) examine the relationship between inflation and output in the context of Brazil, a country that faced constant high inflation. In order to test the hypothesis that inflation has long run effects on output, a Bivariate Vector Autoregression consist of output growth and the change in inflation is used. The results of this study conclude that in

the short run, there exists a negative effect from inflation on output. Besides, the results support the supernutrality of money in the long run, but throw doubt on the implications of the model in the short run for separable utility functions in consumption and real money balances as exposed in the earlier studies.

Gillman *et al.* (2001) present a monetary model of endogenous growth and specify an econometric model consistent with it. This empirical estimation of this model is based on a large panel of Organization for Economic Cooperation and Development (OECD) and Asia-Pacific Economic Cooperation (APEC) member countries for 1961 to 1967. The hypothesized negative inflation effect is established widely for the OECD countries to be significant and as in the theory, to increase marginally as the inflation rate declines. For APEC countries also, the results show significant evidence of a similar behavior.

Ghosh and Phillips (1998) use the panel regressions and combine a nonlinear treatment to estimate the relationship between inflation and growth for 145 countries over a period of 1960 to 1996. The results establish a statistically and economically negative relationship between these two variables. Besides this, the decision–tree technique identifies inflation as one of the most important determinants of growth. However, this study does not claim to precisely a 'Growth-Maximizing Rate' of inflation.

Data and Methodology

In the Indian economy, the liberalized economic policies were initiated in 1991. At the time of introducing the new economic policy, the economy faced the danger signal of double-digit inflation. Hence, the new economic policies initially focused on controlling the double-digit inflation. To that extent, the new government has succeeded in bringing down the double-digit inflation. Against this scenario, this study discusses the relationship between growth and inflation rate in the pre- and post-liberalization period—this study takes a lengthy period (24 years) into consideration i.e. from 1981-82 to 2004-05.

In this study the GDP at factor cost (at 1993-94 prices) is taken as a proxy to growth (Y). Similarly, for the estimation of inflation rates, the values of Wholesale Price Index (WPI) based on 1993 are taken into consideration. The basic data of this study is collected from *Hand Book of Statistics on Indian Economy* published by RBI (2004).

To test the causal relationship between inflation and growth, initially the Granger Causality test is made to examine the causal relationship between inflation (WPI) and economic growth (GDP). The test involves the following regression equations:

$$GNP_t = \sum_{i=1}^{n} \alpha_i WPI_{t-i} + \sum_{j=1}^{n} \beta_j GNP_{t-j} + \varepsilon_{1t} \quad ...(1)$$

$$WPI_t = \sum_{i=1}^{n} \lambda_t WPI_{t-i} + \sum_{j=1}^{n} \delta_j GNP_{t-j} + \varepsilon_{2t} \quad ...(2)$$

In this context, it is assumed that the error terms are uncorrelated. In order to test the hypothesis, F test is used. If the calculated value of F exceeds the critical value of F at the chosen level of significance, the null hypothesis may reject otherwise may not reject.

The theory of cointegration and Error Correction Models (ECM) are employed to examine the extent to which the growth is related to inflation and vice versa. To examine the short and long run relationship between growth and inflation, this method is very useful. Therefore, in this context, the Engle Granger two-step cointegration procedure is employed to test the presence of cointegration between the above said variables. When both the time series are found to be integrated of the same order then the next step is to proceed with the estimation of the cointegration regression. In order to estimate this cointegration regression, the following equations are used:

$$y_t = \alpha_{11} + b_{11} p_t + \mu_t \quad \text{...(3a)}$$

$$p_t = \alpha_{21} + b_{21} y_t + \eta_t \quad \text{...(3b)}$$

where y_t refers to economic growth rate, p_t refers to inflation rate at time *t*, and μ_t and η_t indicates random error terms (residuals to the above two equations). These residuals μ_t and η_t help to measure the extent to which y_t and p_t are out of equilibrium.

If μ_t and η_t are integrated of order zero, *I(0)*, then it is evident that y_t and p_t are cointegrated and not anticipated to remain separately in the long run. If cointegration appears, then information about one variable can be utilized in order to predict the behavior of the other variable.

Apart from this, there are some other techniques for estimating the cointegrating relationships in the literature of econometrics. However, among these techniques, the Johansen and Johansen, and Juselius Maximum Likelihood Test procedure is considered as the most efficient, since it tests the existence of a third cointegrating vector. This procedure gives the following two likelihood ratio tests for the number of cointegrating vectors. They are:

- **The Maximum Eigen Value Test**: It tests the null hypothesis that there are at least *r* cointegration vectors, as against the option that there are *r+1*; and
- **The Trace Test:** It can be used, where the alternative hypothesis is that the number of cointegrating vectors is equal to or less than *r+1*.

Theoretically, there can be long run (equilibrium) relationship between two variables in a bivariate relationship only if they are stationary or if each series is at least integrated of the same order (Campbell and Perron, 1991). It means if two series are integrated of the same order, *I(d)* for *d= 0, 1, 2…*then two series are supposed to be cointegrated. The regression on the same levels of the two variables is meaningful (not spurious) and on long run information is lost.

Thus, the first task of this framework is to check for the existence of stationary property in the series for growth rate *(y)* and inflation rate *(p)*. To determine the non-stationary property of each variable, this paper tests each of the series in the levels (log of real GDP and log of WPI)

and in the first difference (growth and inflation rate). Initially, the Dickey Fuller (DF) test is employed, and then, Augmented Dickey Fuller (ADF) with and without a time trend. This ADF test allows for a higher autocorrelation in residuals. Therefore, this study considers the following equation:

$$\Delta X_t = \beta_1 + \pi 1 X_{t-1} + \sum_{i=1}^{n} \rho 1 \Delta X_{t-i} + e_{1t} \quad ...(4)$$

As pointed in the above discussion, it is clear that the ADF tests are not capable to differentiate between non-stationary and stationary series with a high degree of autoregression. As the inflation data in having high degree of auto regression, the ADF test cannot measure the stationarity. The ADF test also may not correctly point out that the inflation series include a unit root, when there is a structural break in this series (Culver and Papell,1997).

Against this background, the PP (Phillips and Perron) test is employed here. The PP test has an improvement over the ADF test, since it provides strong estimates when the series is having the serial correlation and time dependent heteroscedasticity, and there is a structural break. For the PP test, this study uses the following equation:

$$\Delta X_t = \alpha + \pi 2 X_{t-1} + \varphi(t - \frac{T}{2}) + \sum_{i=1}^{m} \varphi i \Delta X_{t-i} + e_{2t} \quad ...(5)$$

In both the above said equations (4 and 5):

Δ represents the first difference operator; and

e_{1t} and e_{2t} represent covariance stationary random error terms.

However, the lag length *n* is determined by Akaike's Information Criteria (AIC) (Akaike 1973) to confirm serially uncorrelated residuals and *m* (for PP test) is determined according to Newly-West's (Newly and West, 1987) suggestions.

The null hypothesis of non-stationary is tested with the help of the t-statistics using the critical values calculated by McKinnon. It is also clear that the null hypothesis that y_t and pt are non-stationary time series is rejected if π_1 and π_2 are less than zero and statically significant for each. Given the inherent limitation of the unit root test to distinguish between the null and the alternative hypotheses, both DF and ADF tests are employed following Engle and Granger (1987), and then, supplemented by the PP test following the tests employed by West (1988) and Culver Papel (1997). X_t carries out these tests for both variables with y_t and p_t in equation 4 for the DF-ADF tests and equation 5 for the PP test.

DF-ADF-PP unit root tests are also employed for residuals μ_t and η_t from the equations 3a and 3b by respecifying equations 4 and 5 in terms of μ_t and η_t instead of X_t). When μ_t and η_t are found to be integrated of order zero, it can be summed up that these two series are

Table 1: Descriptive Statistics of Inflation and Growth

Indicator	Inflation	Growth
Mean	101.4833	932191.8
Median	96.1	839269.0
Standard deviation	47.96911	3637118.2
Skewness	0.290382	0.528935
Kurtosis	-1.34337	0.85739
Maximum	187.3	1675505.0
Minimum	40.3	467139.0

Table 2: Results of Causality Test

Direction of Causality	F Value	P Value of F	Decision
Growth → Inflation	1.462	0.278	Reject
Inflation → Growth	0.227	0.917	Reject

Note: The values are estimated at lag 4.

Table 3: Unit Root Test with ADF and PP

Variables	ADF		PP	
	C	C & t	C	C& t
Inflation	-1.981	-2.190	-4.725	-5.014
Growth	0.411	-3.00	-4.686	-4.625

Table 4: Unit Root Test for the Residuals and the Coefficients of the Dependent Variables from Equation (3a)

Coefficients of Inflation	Unit Root test			
	ADF		PP	
	C	C+t	C	C+t
0.766	-1.0137	-0.826	-1.102	-0.826

Table 5: Unit Root Test for the Residuals and the Coefficients of the Dependent Variables from Equation (3b)

Coefficients of Growth	Unit Root test			
	ADF		PP	
	C	C+t	C	C+t
1.283	-1.0137	-0.826	-1.102	-0.826

cointegrated. If the hypothesis of no cointegration is rejected, it illustrates the existence of a stable long run relationship between economic growth and inflation.

Results and Discussion

To get a broad picture of both inflation and growth, descriptive statistics are estimated for 1981 to 2004 in India.

Table 1 shows that the mean values of inflation and growth are 101.4833 and 932,191.8. It is also evident from Table 1 that the standard deviation of inflation and growth are 47.96911 and 3,637,118.2. The value of inflation variable ranged from 40.3 to 187.3, whereas the value of growth variable ranged from Rs. 467,139 cr to Rs. 1,675,505 cr.

Economic growth rate *(y)* is calculated from the difference of logs of growth. Similarly, inflation rates (*p*) are calculated from the difference of logs of WPI (1993=100). Table 2 shows that the results of causality test proved both growth and inflation are independent to each other in India.

Table 3 presents the results of the unit root test with ADF and PP. The results point out that growth (Y) is integrated of order zero, but the inflation rate is integrated of order 1, when a time trend is incorporated. It may be due to the possibility of structural changes that have taken place in the Indian economy with the advent of liberalized policies in 1991. Thus, when the PP test is found to be 1(0) and inflation at 1.

Further, it is evident from Table 3 that there is the operation of the cointegration test between inflation and growth, i.e., the cointegrating of equation 3(a) and 3(b) as seen in the above analysis. The results of the cointegration test are shown in Tables 4 and 5. The results prove that inflation and growth are not cointegrated. Thus, it is evident that there is no long run relationship between these two variables.

Conclusion

From the descriptive statistics, it is evident from the analysis that the mean values of inflation and the growth are 101.4833 and 932191.8 for 1981-82 to 2004-05. Causality test proved that growth and inflation are independent to each other in India during the study period.

Results of the unit root test with ADF and PP point out that growth (Y) is integrated of order zero, but the inflation rate is integrated of order 1 when a time trend is incorporated. It may be attributed to the possibility of structural changes that have taken place in India since 1991. Thus, when the PP test is found to be 1(0) and inflation is at 1.

Moreover, the results of the cointegration test have confirmed the fact that the two variables inflation and growth are not cointegrated. Therefore, it is evident that there is no long run relationship between these two variables in India. It is also clear from this study that since the growth of the economy is not related to inflation, acceleration of growth should be focused forever as one of the foremost economic objectives of the nation. Similarly, inflation may take place due to supply side and demand side factors. Apart from these, the monetary factors and the international factors also may lead to inflation. Based on the circumstances, the government has to take the timely measures to control the inflation in order to maintain economic stability in the economy. ❖

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