INFLATION AND THE ECONOMIC GROWTH:
Evidence from Five Asian Countries

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Abstract

The purpose of this study is to investigate the effects of inflation on rate of economic growth of the Five Asian countries; namely, Bangladesh, Iran, Indonesia, Malaysia and Pakistan, for the period 1973 to 2016. Using the appropriate tests, the property was checked and found not to exhibit the unit root, thus making the data to be stationary. Based on data of the study, the Least Squares and traditional panel estimation techniques were used. The Least Squares results revealed that inflation has negative and statistically significant impact on economic growth in all sampled countries. Similarly, the panel data techniques were also confirmed to be negative with significant relationship between the rates of inflation and economic growth. Thus, the main points emerging are that inflation is not helpful but harmful to the rate of economic growth. This study contributes a valuable addition to the existing literature about linkages of inflation rate and the economic growth. The findings suggest that an effective macroeconomic policy-mix needs to be devised to control inflation and encourage the process of economic growth and development; and thereby largely bolster the social well-being.

Key Words: Inflation, Economic Growth, Cross-Sectional Data, Asia-5.
JEL Classification: E3; O40; C20; O53.

I. Introduction

The persistent and continuous rise in overall price level of a country is reckoned by the economists to be inflation. This rising price level is either beneficial or detrimental

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Notes:
1. The theory of co-integration as developed by Johansen-Juselius (1990) postulated that variables are require to be of the same order and of integrated zero at first difference. The study Mallik and Chaudhury (2001), have proved through ADF test that the model variables are of I (0) at level. Hence, violate presumption of describe co-integration approaches.
2. In a specified model, if series are of both nature i.e. one variable is stationary at level and the other is at first difference; then the procedure of autoregressive distribute lag model can be used to carry the analysis for long-run and short-run effects [Pesaran, Shin and Smith (2001)].
3. The inflation rate is one factor that effects economic growth. There are so many other variables that influence economic growth, e.g., population growth, investment, government expenditure, money supply, human capital and trade flows, etc., [Barro (2013)]. The inclusion of such variables in growth regression will possibly enhance the explanatory power or value of R-square in the respective regression.

to economic growth as both theory and empirical evidence remain controversial. As structuralists are of the view that inflation is necessary for growth, while monetarists believe that inflation is detrimental for economic growth. To understand, as to how much the rate of inflation would enhance or deteriorate the rate of economic growth, Khan and Senhadji (2001) show the estimated rate of inflation is termed as 'threshold rate' of inflation. The study maintains that estimated threshold rate for industrial countries is 1 to 3 per cent and for developing countries it is 11-12 per cent. For positive association the inflation rate should be less than the threshold rate.

Usually, inflation is well thought-out as unfavorable for economic growth and development when it surpasses a certain level. Previous studies have demonstrated that a very high or low level of inflation is objectionable for economic growth. Though, some rational rate of inflation between 3 to 6 per cent is somehow regarded to have positive influence on economy performance. However, when it exceeds the rational frontier, it provides adverse effects, accordingly. In a similar manner, undesirable inflation, not only diminishes the value of money but also attenuate investment and economic growth [Hussain (2005), Khan (2005), Khan, et al. (2007)]. The term inflation is not new in literature. In a study, Batten (1981) observed that the United States policymakers have called it a 'public enemy No.1' at least four times in the last decade. Thus, an abnormal rate of inflation is a sign of macroeconomic variability that may disrupt the smooth performance of economy. The study of Mohamad and Said (2011) notes that low inflation is one of the signs of macroeconomic stability and a low inflation rate is linked to established economy. The study suggests that an effective monetary policy is required to regulate inflation in the OIC. On the other hand, low and steady inflation results in stability of financial systems, encourage investment and consequently bolsters the process of economic development.

The study of Easterly and Fischer (2001) has shown that; "the claim, 'inflation is the cruelest tax of all' is often interpreted and means that inflation hurts the poor, relatively more than the rich. It could also mean that inflation tax is particularly unfair because the taxing mechanism is being little understood, the inflation tax can be imposed by stealth." Moreover, in a study by Azam and Rashid (2015) mentions that "it is also a fact that in some situations, inflation is inevitable, during the process of development of poor countries". Sometimes the initial stages of development require inflation to induce resource and expenditure switching among sectors, which will serve to accelerate structural change." The study of Idris and Bakar (2017) also finds that inflation is adversely affecting the process of national economic development in Nigeria. Thus, the government of Nigeria is required to control the disproportionate rise in inflation rate and achieve higher level of growth in the country.

Partly, in the case of South Asian countries, the contribution of Malik and Chaudhury (2001) is interesting in considering the aspects of nature and causal linkages between the two economic variables; namely, the inflation rate and the rate of economic growth for four countries from the South Asia (Sri Lanka, Pakistan, India, and Bangladesh). With significant feedback between inflation and growth, the authors found that growth and inflation were

positively related in the four South Asian countries. The study highlighted that previous work was ignored by using the error correction and co-integration techniques, to cover prevailing methodological deficiencies. Furthermore, finding of the study make sense of the statement of Khan and Senhadji (2001) that an inflation rate of one-digit has positive association with economic growth in the case of developing countries. However, according to the study of Malik and Chaudhury (2001), none of the four countries had high inflation which was 7 to10 per cent for the sampled period and can be considered as temperate.

Certainly, the literature shows many factors that could affect a country's economic growth. However, in this study, the authors' main focus is the inflation rate of perspective country. As mention earlier inflation can be detrimental as well as beneficial which depends on the prevailing inflation rate. The rate of inflation is not unanimous in all country of analysis. Malaysia on an average (during the period) is exhibiting impressive economic growth with low inflation rate, and Iran is exhibiting low economic growth with high rate of inflation. According to the World Development Indicators (2018) inflation and consumer prices (annual percentage) are estimate of 5.513, 8.568, 3.525, 3.725, and 3.127 per cents, while annual growth rate of GDP is estimated at 7.113, 13.393, 5.033, 5.526 and 4.219 per cents, for Bangladesh, Iran, Indonesia, Pakistan and Malaysia, respectively. IMF (2013) reported that global economy remains to achieve well, with increasing resilient growth and trade, but still it muted inflation; whereas, growth in Asia is projected at 5.6 per cent in 2018 and 2019, while inflation is expected to be subdued. Though, inflation in Asia and Pacific region may rise once again but, the worldwide factors containing the United States inflation and the commodity prices becomes less encouraging; the managing authorities should stand ready to act, accordingly.

Motivation of the study is based on significance of inflation and economic relationship highlighted by Barro (1996), (2013) and Malik and Chaudhury (2001). In this study, the core objective is to examine the relationship between growth and inflation rate, in the case of selected Five Asian countries, namely Bangladesh, Iran, Indonesia, Malaysia and Pakistan. The available literature reveals that empirical studies on the said issue are yet scanty for the countries of analysis of this research. It is assumed that these five Asian countries are high Muslim populated; and they are assumed to have similar characteristics. These countries comprise the highest moderate and lowest inflation rate, and have the alternative growth rate.

The remaining part of the study, consist of four main sections. Section II deals with review of relevant literature and Section III discusses the model and method for testing the inflation and growth rate relationship. The data description is interpreted in Section IV. Section V contains results and discussion and lastly, Section VI gives concluding remarks of the study.

II. Literature Review

The existing literature reveals that though, many research studies have analyzed the relationship between inflation and economic growth, but their findings are still in-

consistent. The earlier empirical studies have shown positive association, such as, Tobin (1965) found that inflation contributes to economic growth. As stated earlier, the study of Mallik and Chowdhury (2001) investigates the long-run and short-run dynamics of linkage between inflation rate and the economic growth. Their study covered different time period for each country, such as 1974 to 1997 for Bangladesh; 1961 to 1997 for India; 1957 to 1997 for Pakistan; and 1966 to 1997 for Sri Lanka. The study finds two interesting results: First, positive and significant linkage between inflation and growth for all countries of analysis; second, the growth found no more sensitivity to changes in inflation, as compared to sensitivity of inflation, to changes in economic growth. In a similar vein, the study of Umaru and Zubairu (2012) used data from 1970 to 2010 and employed the Granger Causality test to assess for inflation effect on economic growth in the case Nigeria. The results reveal that inflation contributes positively to the economic growth of Nigeria by boosting productivity and output level in the country.

Instead, some studies are of the view that inflation has negative linkage with economic growth, for instance [Fischer (1993), Barro (1996), Bruno and Easterly (1998)]. This negative relationship has also been observed by different studies in the case of Pakistan, for instance [Ismail, et al. (2010) and Ayyoub, et al. (2011)]. Similarly, Barro (2013) used data for almost 100 countries during 1960 to 1990 and detected that inflation and real per capita GDP growth are negatively related to each other. Ndoricimpa (2017) used five-year average data of unbalanced panel of 47 African countries, and found that above the threshold inflation it is harmful to economic growth. Their findings suggest that while gaining growth advantages of low inflation African management authorities needs to control the high inflation. Likewise, some other studies provided evidence showing mixed or neither positive, nor negative impact of inflation on economic growth [Wai (1995)]. On the other hand, the study of Chowdhury (2002) found that inflation has no statistically significant linkage with growth in Indonesia. He further suggested for a more expansionary macroeconomic policy mix. The finding of Hasanov (2011) indicated that inflation has positive and significant impact on GDP growth of Azerbaijan, but this becomes negative when the rate of inflation surpassed 13 per cent, during 2000 to 2009. In a study, Cuaresma and Silgoner (2014) confirmed the hypothesis that for very low inflation rate (less an estimate of 1.6 per cent) the linkage between inflation and economic growth is positive, insignificant afterward and negative for high two-digit inflation levels for a panel of 14 European Union countries. In a recent study, using data for the period 1990 to 2017 Mukoka (2018) finds no association between inflation and growth for Zimbabwe. The study suggests that Zimbabwean policymakers should focus on sustaining one digit inflation at a low rate in order to sustain economic growth. Some selected empirical studies related to the rate of inflation and growth are described in Table 1.

The aforementioned studies reveal that there is a dire need for a fresh study to verify empirically, whether inflation has positive or negative impact on economic growth. Perhaps this is the reason why Hussain and Chowdhury (1996) stated that it's tricky to find the professional consensus from empirical findings that tell us about relationship of in-

flation and economic growth. Thus, to conclude about the type of relationship between inflation and economic growth, i.e., positive, negative or none of them, is one aspect of the issue in debate. It is fair to say that this study is a natural, fresh and updated development of previous studies in the subject area; which employ both the cross sectional and panel data analysis which pinpoints details of the effects of low, moderate and severe inflation on economic growth. It is also believed that one can be able to provide informative

TABLE 1

Previous Empirical Research on the Effects of Inflation on Economic Growth

Author(s)	Sample Periods and Country	Methodology	Response Variable	Regressors	Findings
Mavikela, et al., (2018)	2001-2016 (Q) South Africa and Ghana	OLS and Quantile	GDP per capita	inflation rate, domestic investment, Govt. size, monetary depth and population	- Positive in case of Ghana - Negative in case of South Africa
Majumder (2016)	1975-2013 Bangladesh	Granger causality and ECM	GDP growth rate	Inflation, money supply, rate, & remittance	Positive relationship
Kasidi and Mwakanemela (2013)	1990-2011 Tanzania	Cointegartion	GDP growth rate	Inflation	Negative relationship
Ahmad and Joyia (2012)	1971-2011	Granger Causality test & OLS	Log of GDP	Log of inflation	Positive relationship
Patra and Sahu (2012)	2000 –2008 South Asian Countries-8	Co-relation coefficient test	CPI	Average annual growth rate	- Positive in case of Sri Lanka, Pakistan, Bangladesh, and India, while, - Negative in case of Nepal
Hussain and Malik (2011)	1960-2006 Pakistan	ECM	Log of GDP	Log of inflation	Positive relationship
Gillman and Harris (2009)	1990-2003 13 Transition countries	Fixed effects panel approach	Log of growth	Log of inflation & money demand	Negative relationship
Ahmed and Mortaza (2005)	1980-2005 Bangladesh	Cointegartion, ECM	Log of real GDP	Log of CPI	Negative relationship

Source: Author's constructed.

estimates on the knowledge of these sequential incidences appearing somehow, deep-ened. Likewise, on the subject topic this study is different than others, in three-folds: First, it (for the first time) considers the inclusive Five Asian Muslim countries. Second, the covered time period is longer and can provide more robust empirical results. Finally, it employs the regression analysis of Ordinary Least Squares (OLS) and the traditional panel data techniques based on the nature of data to estimate on the effects of inflation on economic growth, for an individual country and for the panel countries. Therefore, this study certainly contributes to the literature as analyzing relationship between inflation rate and economic growth. The outcome of this study is expected to assist the policy makers in formulating useful policy to control inflation.

III. Model and Method for Testing the Inflation and Growth Rate Relationship

Economic theory of supply side, aggregate demand, aggregate supply, quantity the-ory and endogenous growth explain the inflation and economic growth relationship. These theories have shown that inflation is growth enhancing as well as deteriorating factor [Gokal and Hanif (2004)]. Thus, the theory accounts for positive, as well as neg-ative association between inflation and economic growth. In this study, an attempt to find empirically, the estimated effects of inflation on economic growth. Therefore, the growth model illustrated by Malik and Chaudhury (2001) has been used to consider re-lationship between inflation and economic growth. Co-integration approach and error correction models were employed to test the relationship of inflation and growth but the data after using the ADF test of unit root shows that their model data were stationary at level, while, this study proceeds with the model of inflation and growth as:

$$y_{it} = \alpha_0 + \pi_i\,INF_{it} + \mu_{it} \tag{1}$$

where y shows the growth rate in Gross Domestic Product (GDP), INF is inflation rate and is derived from annual change in value of consumer price index. The parameter α_0 represents constant term, in the subscripts the term 't' is time trend and 'i' is cross country term, i.e., from 1 to 5. The term μ is the stochastic white noise error term. Fi-nally, π is the slope of coefficient, and it measures the responsiveness of response vari-able in the model, as result of a unit-change in regressors. Equation (1) also shows that coefficient sign of inflation is to be determined in this study.

It is also assumed that growth rate in period t, depends partially on actual flows of growth rate in the previous years, i.e., (t-1), (t-2) and (t-3), etc. Thus, the dynamic growth function is expressed in autoregressive term, as follows:

$$y_{it} = \alpha_0 + \pi_i\,INF_{it} + \sigma y_{i,t-p} + \mu_{it} \tag{2}$$

where p shows the different number of autoregressive; the short-run inflation effects on growth is given by π and the long-run effect by ($\pi/1-\sigma$).

Explicitly, there are many factors which can affect or contribute to economic growth of a country. However, following the study of Mallik and Chaudhury (2001), similar model for four Asian countries including Bangladesh, India, Pakistan and Sri Lanka is used. Therefore, this study takes inflation focus variables and investigate for its nexus with economic growth in Asia-5. Variables in the model are time series; thus the precautionary tests of unit roots for every individual series are needed to understand the nature of variables, either stationary or non-stationary. For this purpose, the existing literature proposes alternative test. Most popular are the ADF and PP tests in case where the series are only time series in nature [Mallik and Chaudhury (2001), Osuala, et al. (2013)]. After identification of the unit root in the series, researcher can decide about the method to be used in order to get best estimates, of parameters. For instance, if this study takes the hypothesis that inflation, as well as growth rate are stationary at level and the test of unit root proves that both series of inflation, as well as the economic growth rate are integrated in the first order, i.e., stationary at first difference is not at level. It is also an admitted fact that variables in the rate of change, often exhibits the property of no unit root. Therefore, with use of stationary variables in the model, the application of ordinary least square method is valid and gives non-spurious results.

IV. Data Description

1. Data Sources

In this study the annual time series data for empirical exercise is used. It covers the period 1973 to 2016 for the selected Five Asian countries. Time period from 1973 to 2016 was selected because of the pre-1973 studies (as Pakistan and Bangladesh were a single country till 1971). The annual percentage change in CPI represents the inflation rate of respective country with exception of Bangladesh. As for Bangladesh the data on consumer prices was not available for the year 1973 to 1985. Therefore, annual percentage changes in GDP deflator are for inflation rate of the country. Likewise, the annual percentage change in GDP is used as growth rate of the country. The data on gross domestic product recorded at market price is based on constant local currency and data on all variables is obtained from the the World Development Indicators (2018).

2. Summary of Descriptive Statistics

Results of descriptive statistics for inflation and growth are given in Table 2, which comprise of mean, median and standard deviation for inflation and growth rate variables. It reveals that in case of Malaysia (with low inflationary rate), the country's growth is high, and the other countries with high inflation, recorded low growth rate (as in the case of Iran). Malaysia is taken for the sample period with an average rate of inflation (3.62 per cent) and has the growth rate on an average of 6.21 per cent. Contrary, Iran has high

TABLE 2

Summary of Descriptive Statistics

Period	Statistic	Bangladesh		Indonesia		Iran		Malaysia		Pakistan	
		INF	y	INF	y	INF	y	INF	y	INF	y
1973-2016	Mean	10.61	4.80	11.58	5.48	18.70	2.05	3.62	6.21	9.28	4.91
	Median	6.95	5.06	8.89	5.94	17.22	2.23	3.07	6.47	8.09	4.84
	Std. Dev.	15.92	2.12	10.10	3.36	8.68	8.87	2.99	3.68	5.33	2.05

Note: INF stands for inflation and *y* represent economic growth variable.
Source: Authors' calculations.

inflation rate of 18.7 per cent, on an average growth rate of 2.05 per cent. By looking at the value of standard deviation, both the inflation and growth, highly deviate from its mean value in highly inflated economy of Iran, as compare to the low inflated economy of Malaysia. Moreover, in Bangladesh and Indonesia, economies inflation deviate highly, from its mean value rather than the growth from its mean.

V. Results and Discussion

1. *Unit Root Analysis*

The ADF test is executed to clarify the order of integration of series, individually. For series, Dickey and Fuller (1981) proposed an estimation of the following regression.

$$\Delta Y_t = \alpha_0 + Y_t + \sigma Y_{t-1} + \sum_{t=i}^{n} \beta_t \Delta Y_{t-i} + \mu_t \tag{3}$$

The test assumes that, for stationary series the coefficient of level lagged variable [in Equation (3)] must be zero, i.e., $\sigma = 0$, and (for unit root) $\sigma = 1$. When null hypothesis is accepted, the series will exhibit unit root; and when it is rejected then there will be no unit root in the series. Table 3 gives the ADF test results for all variables of the study, one by one. It shows that when regression Equation (4) includes only the constant, the growth rate is stationary at 1 per cent for all countries where probability is less than 1 per cent and value of test statistic is high. Instead, with constant and trend all countries growth rate also look stationary even at 1 per cent level of significance. Considering, the case or Bangladesh, Indonesia and Iran, the rate of inflation is stationary at 1 per cents; and either, only the constant or constant and trend in the regression are included. In case of Malaysia, inflation rate has no unit root, as it is statistically significant at 10 per cent when included for constant and trend in the model. This becomes stationary even at 5 per cent when excluded for constant and trend which is not given here. For Pakistan, the inflation rate is stationary at 5 per cent for constant model only and sta-

tionary at 10 per cent for constant with time trend model. Overall, inflation rates, as well as the growth rates are stationary at level for all country of the study.

2. *Least Squares Analysis*

As the ADF test is applied to inflation and growth rate under the assumption of constant and, constant and trend, the results shows that the inflation and growth rates are stationary at level. Based on the ADF test results, it is safe to employ the method of OLS as an analytical technique for parameters estimation in this study. Therefore, we employ the OLS method to empirically verify the link between inflation and growth. Likewise, Equations (1) and (2) are estimated with OLS for all countrries. Table 4 illustrates the OLS results of regression (1) and Table 5 which shows the results for regression (2) with diagnostic tests results.

It is obvious from Table 4 that the rate of inflation influence the economic growth of Bangladesh, Indonesia, Iran and Pakistan, negatively; while the effect is positive in case of Malaysia. In regression equation of Bangladesh and Indonesia, the estimated coefficient of inflation was found significant at 1 per cent. For the remaining three coun-tries, the coefficient was insignificant. Furthermore, using the White's option in the re-gression equation of Iran and Malaysia, inflation coefficient for Iran becomes statistically significant at 10 per cent, and for Malaysia it becomes 5 per cent level of significance. Only in the regression equation of Pakistan, the estimated coefficient of inflation remains insignificant, though inflation is negatively related to economic growth, even after using the white's optio [for White's option, see Gujarati (2007)]. The positive relationship of two variables in case of Malaysia indicate that these results are

TABLE 3

ADF Test Results at Level

Country	Variable	With constant only		With constant and trend	
		τ - test	p - value	τ - test	p - value
Bangladesh	Y	-8.21*	0.0000	-11.01*	0.0000
	INF	-5.61*	0.0000	-5.86*	0.0001
Indonesia	Y	-4.66*	0.0005	-4.71*	0.0025
	INF	-4.74*	0.0004	-5.02*	0.0010
Iran	Y	-4.87*	0.0003	-4.97*	0.0012
	INF	-4.56*	0.0007	-4.47*	0.0049
Malaysia	Y	-5.72*	0.0000	-5.90*	0.0001
	INF	-2.45	0.1341	-3.39***	0.0672
Pakistan	Y	-4.42*	0.0010	-4.75*	0.0022
	INF	-3.34**	0.0190	-3.25***	0.0875

Note: Asterisks *, ** and *** represents the 1, 5, and 10 %, levels respectively.
Source: Authors' calculations.

according to the threshold level [suggested by Khan and Senhadji (2001) and Muzaffar and Junankar (2014)]. The results (Table 4) also reflect the high value of F-statistics when inflation coefficient is highly statistically significant, while it is low when inflation coefficient becomes more and more statistically insignificant. Here, one should note that value of t-statistic is more important than F-statistics, in a model having only one, explanatory variable. The lower value of R^2 in each regression indicates that explanatory power is not high. The values of D-W tests are only reasonable for Bangladesh and Malaysia, and signify positive autocorrelation for the remaining countries regression equations. Due to this problem, the dynamic growth model is estimated for Indonesia, Iran and Pakistan. Results of such estimations are shown in Table 5.

The main discussion of the study focuses on effects of inflation on economic growth in a set of Five Asian Muslim countries. By looking at Table 5, the astonishing finding is that the estimated coefficient of inflation increases when lagged value of response variable is added to the explanatory variables. The estimated coefficients are statistically significant with negative signs, except Iran. The lagged response variable is significant for regression equations of Indonesia, Iran and Pakistan. The moderate value of autoregressive coefficient which gives the long-run inflation effects is slightly higher than the short-run value. In case of Pakistan, not only the lagged term of dependent variable is significant but inflation coefficient is also significant. However, inflation coefficient is of value -0.09 which indicates nominal effects on growth rate, as compare to the other countries of analysis. Results in Table 5 are free of autocorrelation and heteroskedasticity problems, when different diagnostic tests are performed for each regression. Afterward, further investigation is carried out on linkage between inflation and economic growth using panel data approach in order to obtain more robust results and verify that either, there exist or not, some relationship between inflation and economic, during the period under study.

TABLE 4

Ols Estimates of Regression(1) where Response Variable is Growth Rate (y)

Regressors	Bangladesh	Indonesia	Iran[#]	Malaysia[#]	Pakistan
Constant	5.37*	7.52	5.53***	5.11*	5.40*
	-15.03	-11.28	-1.73	-5.93	-8.59
INF	0.054*	-0.176*	-0.185	0.304	-0.052
	-2.86	(-4.04)	-1.19	-1.65	(-0.89)
R^2	0.162	0.279	0.033	0.061	0.018
D-W.	2.14	0.931	1.435	1.795	1.235
F-statistic	8.612	16.303	1.439	2.736	0.798

Note: There are t-statistic values in parenthesis. *represent 1%, **represent 5%, and ***represent 10%, significance level. # in regression equations of Iran the inflation coefficient becomes significant with p-value of 0.09 and in case of Malaysia the inflation coefficient becomes significant with p-value of 0.04 which are significant with 10% and 5%, level of significance, respectively, as we include for the option of white hetroscedasticity-consistent standard error and covariance.
Source: Authors' calculations.

3. Panel Regression Analysis

a) *Panel Unit Root Test Results*

Prior to the panel data analysis, the panel unit root test of Levin, et al. (2002), and Im, et al. (2003) were used to test for unit root in variables under panel data set. Both the tests of Levin, Lin and Chau (LLC) and Im, Pesaran and Shin (IPS) are based on the model given in Equation (4) [Mercan, et al. (2013)]:

$$\Delta Y_{it} = \alpha_i\, Y_{it\text{-}1} + \sum_{j=1}^{n} \beta_{ij}\, \Delta Y_{it\text{-}j} +\ X'_{it}\, \delta + \varepsilon_{it} \qquad (4)$$

These tests take the null and alternative hypothesis, as:

H_0: $\alpha_i = 0$, for all the cross section units (unit root or non-stationary).
H_1: $\alpha_i < 0$, for at least one cross section unit (no unit root or stationary).

Probability value of less than 5 per cent (0.05) means that H_0 is rejected and the series is stationary at level. In the present study, tests were executed, first with constant and then with constant and trend. For inflation and growth rate variables, test

TABLE 5

OLS Estimates of Regression(2) where Response Variable is Growth Rate (y)

Regressors	Indonesia		Iran	Pakistan[+]
Constant	6.152* (6.92)	6.452* (5.926)	4.413 (1.528)	3.898* (5.684)
INF	0.198* (4.96)	-0.290* (3.523)	-0.156** (2.377)	-0.094** (2.098)
$y_{(t\text{-}1)}$ [@]	0.268** (2.34)	0.184** (2.23)	0.243*** (1.675)	0.368* (3.158)
$y_{(t\text{-}3)}$	–	0.163*** (1.82)		–
R^2	0.427	0.609	0.085	0.188
D-W	1.535	1.345	1.799	2.171
F-statistic	14.94	19.199	1.868	4.647
LM-test (F-test)	0.883 [0.421]	1.414 [0.245]	1.590 [0.217]	0.738 [0.484]
Hetroscedasticity test [F-test]^	0.0024 [0.961]	0.767 [0.386]	0.154[0.696]	0.047 [0.827]

Note: *,* and *** shows 1%, 5%, and 10%, level respectively. The bracket values are t-test values and the square bracket values are the F.
      - statistics values of the test.
      - statistic. ARCH test is used while testing forHeteroscedasticity.
+ Here we allow in regression for the option of white hetroscedasticity.
      - consistent standard error and covariance.
@ The autoregressive term or lagged values of respond variable are tested in regression equation for Bangladesh and Malaysia but found their effects statistically insignifiant. Therefore their regression results are not reported in Table 5.
^ See Gujrati (2007; p. 414).
Source: Authors' calculations.

statistic and their respective p-values are given in Table 6. The probability is not different than zero in each case, and thus, it indicates that inflation, as well as growth rate is stationary at level or integrate zero order in panel data set of the study. The level of significance is 1 per cent as shown by asterisk on p-values in column (4) and (6) of Table 6.

b)   *Fixed-Effects and Random-Effects Analysis*

Estimation procedure of Panel data for this model is discussed. It is common in literature that time series data often exhibit the problem of serial correlation and the cross sectional data has the problem of heteroscedasticity. Instead, by combining data in two dimensions, panel data gives more data variations, less collinearity and more degree of freedom. Consequently, panel data provides large sample which is normally expected to produce efficient parameter estimates. As Greene (2003) have reported , the basic benefit of a panel data over cross section or time series is that it will allow the researcher a great flexibility in modelling differences in behavior across individuals. Normally, econometric literature suggests two approaches for investigating relationship between series/variables in panel regression analysis [Dimitrius (2007), Wooldridge (2013)]. These approaches are called the fixed and random effects model. Thus, based on the panel data unit root test which allows employing the traditional panel data approaches, i.e., fixed-effects or random-effects models for further estimation of the parameters. At this stage of analysis, panel regression analyses of fixed and random effects with Hausman's test were executed. In fixed effect model, the intercept term assumed difference across individuals (the Five Asian) but the individual intercept does not change over time, i.e., it is time invariant. In random-effects model, it is assumed that intercept term is a random variable with a common mean value for the intercept. Following are the specifications used for panel regressions.

TABLE 6

Panel Unit Root Test Results for Inflation and Growth Rate at Level

Method@	Variables	With Constant		With Constant and Trend	
		Statistic	Prob.	Statistic	Prob.
LLC	INF	-5.221	0.000*	-5.261	0.000*
	Y	-11.335	0.000*	-12.668	0.000*
IPS	INF	-6.598	0.000*	-6.105	0.000*
	Y	-10.349	0.000*	-11.367	0.000*

Note: *indicates 1 %, level of significance. @indicates that both test statistics are estimated using Eviews-9.
Source: Authors' calculations.

Fixed Effect Models:

$$y_{it} = \alpha_i + \pi \, INF_{it} + \mu_{it} \tag{a}$$

$$y_{it} = \alpha_i + \pi \, INF_{it} + \sigma y_{i,t-1} + \mu_{it} \tag{b}$$

Random Effect Models:

$$y_{it} = \alpha + \pi \, INF_{it} + \varepsilon_{it} \tag{c}$$

$$y_{it} = \alpha + \pi \, INF_{it} + \sigma y_{i,t-1} + \varepsilon_{it} \tag{d}$$

In case of random-effect models, the last term is the composite error term and the sum of two disturbance terms, i.e., $\varepsilon_{it} = \varepsilon_i + \mu_{it}$, where ε_i is the cross section error term which shows the unobserved individual effects; and, µit is the combined time series and cross section error component which indicate both the individual and the time effects. The random effect model is observed for individual error term in the disturbance term, rather than in the intercept. In order to decide whether to choose fixed-effects or random-effects model, the Hausman's test is used. If probability value of Hausman's test in the analysis is less than 5 per cent, the null hypothesis is rejected and the fixed-effect model is preferred [Greene (2003)]; otherwise, the alternative hypothesis is accepted and the random effect estimator is considered appropriate. Actually, Hausman's test in null hypothesis assume that in panel regression the individuals effects are not correlated with regressors of the model, i.e., there is no endogeneity problem but the exogeneity assume for endogeneity in alternative hypothesis. Once the test accepts the null hypothesis, it may use random effects model to avoid the problem of endogeneity. The random effect panel data model gives more efficient and consistent estimates than the fixed effects, when it is correct in specification.

The panel regression results are given in Table 7 Which indicates this result of random effect regression in column (4) and (5). It also indicate that the Hausman's test p-values of 0.365 and 0.457 are larger than 5 per cent (0.05) level of significance. Thus, the random-effects model is considered appropriate for this analysis. Implementing both the fixed-effect and random-effect models, the results are obtained (Table 7). The listed countries of the analysis are of similar nature and foundation though they are not members of the regional group. In this perspective not only the results of random-effect model are presented but also the results of fixed effect model are given without preference between them. If results of both models are different, it would make an easy choice for selection of the model, and it will be up to their interest of readers.

Table 7 column (2) reveals that inflation has significantly inverse impact on economic growth. Results of both the coefficient of lagged response variable and inflation on economic growth rates are shown in column (3) of Table 7, using the fixed effects model. The lagged coefficient is also significant at 1 per cent level. The value of lagged coefficient is high which reflects difference between the short- and long-run effects of

inflation on economic growth. In all estimates, fixed effects regression shows existence of inverse relationship between inflation and economic growth in the selected five Asian countries. The effect of one percentage point increase in inflation is to decrease economic growth by only 0.11 percentages when excluded for the lagged dependent effect; while this inverse effect is 0.10 percentages when included for the lagged dependent effect. It must be known that inflation effect of 0.10 for short-run, but for long-run the value is of 0.13 per cent is further higher than the value of regression (1) coefficient for inflation. In dynamic regression, the long-run coefficient can be obtained as value of inflation co-efficient divided by one, minus value of the coefficient of lagged term.

The empirical results of random effect model, are reported in Table 7 which is sta-tistically significant; where again, inflation has inverse relationship with economic growth. The random-effect models result to reveal that effect of inflation on economic growth in five Asian countries is slightly high when compared to the results of fixed-ef-fects models. In random effects models the value of F-statistics is highly greater as com-pared to fixed-effects regressions. Thus, the overall estimated coefficients in random regressions are highly statistically significant. Consequently, the empirical results of the present study demonstrate that inflation is negatively related to economic growth and statistically significant during the period under study. Results of this study appear to be

TABLE 7

Panel Data Estimates where Response Variable is Growth Rate (y)

Independent Variable	Fixed Effects		Random Effects	
	Regression (1)	Regression (2)	Regression (1)	Regression (2)
	Coefficient (t-ratio)	Coefficient (t-ratio)	Coefficient (t-ratio)	Coefficient (t-ratio)
Constant	5.878 (11.295)*	4.545 (7.144)*	6.124 (12.815)*	4.781 (8.490)*
INF	-0.110 (-2.818)*	-0.103 (-2.471)*	-0.133 (-4.459)*	-0.135 (-4.249)*
$y_{(i,t-1)}$	–	0.246 (3.302)*	–	0.268 (5.367)*
R^2	0.328	0.360	0.084	0.168
D-W.	1.496	1.889	1.403	1.894
F-statistic	1.742 [0.005]	1.948 [0.001]	19.889 [0.000]	21.372
Hausman Test			0.820 [0.365]	1.488 (0.457)
No. Countries/ No. Observation	5/220	5/220	5/220	5/220

Note: Figure in brackets ( ) are t-values, *indicates that a parameter estimate is significant at 1% level. The y(-1) is lagged term of dependent variable. The square bracket values are p-values against the test-statistic. Hausman test as-sume the null hypothesis that there is no covariance between the individual effect and the explanatory variable, i.e., Cov (ε_i, μ_{it}) = 0, the alternative hypothesis is, Cov (ε_i, μ_{it}) ≠ 0.
Source: Author's calculation.

robust and plausible; and therefore, can be useful for onward policy consideration. Over-all results of negative relationship between inflation rate and economic of this study are consistent with finding of Gillman and Harris (2009), Ayyoub, et al., (2011), Kasidi and Mwakanemela (2013), Barro (2013), Azam and Ahmad (2015), and Azam (2016).

VI. Concluding Remarks

The unshakable rise in general price level is normally considered detrimental to eco-nomic growth and development of both; the developed and developing countries. How-ever, developing countries are relatively more vulnerable to this harmful effect of inflation, such that poor people are directly affected. The key objective of this study is to analyze relationship between inflation and economic growth for five selected Asian Muslim coun-tries. The relationship using both methods of simple regression and panel regression are estimated for the period of 1973–2016. First, the variables are tested for unit roots and both the inflation and growth rate are found stationary at level. Then, for individual coun-tries case, simple OLS is employed to estimate the regression model. Simple regression analysis results indicate that there is negative relationship between the two variables in most cases where value of this relationship ranges from -0.09 to -0.29. Further, in the panel analysis, findings of fixed and random effects model also indicate that inflation and growth rate has significant and negative relationship. In panel results, the coefficient of inflation ranges between -0.10 to -0.13. Hence, it is softly concluded that in countries of analysis, economic growth have a negative response to inflation. Thus, the results of this study demonstrate that inflation is detrimental to economic growth and development of Asia-5.

1. Policy Recommendations

Findings of this study suggest that problems of inflation could be overcome by pro-vision of desirable level of productivity and by pursuing policy that could balance the general price level. In particular, policy makers should devise right and effective macro-economic policy mix in order to eliminate inflation and let ahead the economic growth and development. Moreover, policymakers need to make the policy, conducive and smoothing for food supplies in these countries. In context of Asia-Pacific region, it is also documented by Freire, et al., (2012), that given the strong link between food price inflation and overall inflation in the chain of causation, single most important policy ini-tiative that developing countries in the region can adopt it to give priority to boosting productivity in the agriculture sector. Increasing food production is a fundamental ob-jective not only to contain inflation in the short- and medium-terms but also for long-term sustainable development. For future research, it is also suggested that covering larger panel and use of more sophisticated econometric techniques should be followed, in order to obtain relatively robust results and help policy makers to formulate appropriate and desirable results.

Bibliography

Ahmad, N., and S. Joyia, 2012, The relationship between inflation and economic growth in Pakistan: An econometric approach, Asian Journal of Research in Business Economics and Management, 2(9): 38-48.

Ahmed, S., and M.G. Mortaza, 2005, Inflation and economic growth in Bangladesh: 1981-2005, Working paper 0604, World Bank.

Ayyoub, M., I.S. Chaudhry and F. Farooq, 2011, Does inflation affect economic growth? The case of Pakistan, Pakistan Journal of Social Sciences, 31(1): 51-64.

Azam, M., and S. Rashid, 2015, The monetarist hypothesis of inflation in Pakistan – A critique, Journal of the Asia Pacific Economy, 20(4): 559-576.

Azam, M., and M.A. Ahmad, 2015, Role of human capital and foreign direct investment in promoting economic growth: Evidence from Commonwealth of Independent States, International Journal of Social Economics, 42(2): 89-111.

Azam, M., 2016, Does governance and foreign capital inflows affect economic development in OIC countries?, Journal of Economic Cooperation and Development, 37(4): 21-50.

Barro, R.J., 1996, Inflation and economic growth: A cross-country empirical study, NBER working paper 5698, National Bureau of Economic Research, Cambridge, Massachusetts, USA.

Barro, R.J., 2013, Inflation and economic growth, Annals of Economics and Finance, 14(1): 121-144.

Batten, D.S., 1981, Inflation: The cost-push myth, Federal Reserve Bank of St. Louis Review, 63(6): 20-26.

Bruno, M., and W. Easterly, 1998, Inflation crises and long run growth, Journal of Monetary Economics, 42: 3-26.

Chowdhury, A., 2002, Does inflation affect economic growth? The relevance of the debate for Indonesia, Journal of the Asia Pacific Economy, 7(1): 20-34.

Cuaresma, J.C., and M. Silgoner, 2014, Economic growth and inflation in Europe: A tale of two thresholds, Journal of Common Market Studies, 52(4): 843-860.

Dimitrios, A., and H. Stepheng, 2007, Applied econometrics: A modern approach, Revised edition, New York: Palgrave Macmillan.

Easterly, W., and S. Fischer, 2001, Inflation and the poor, Journal of Money, Credit, and Banking, 33(2): 160-178.

Engle, R.F., and C.W.J Granger, 1987, Co-integration and error correction: Representation, estimation and testing, Econometrica, 55: 1-87.

Fischer, S., 1993, The role of macroeconomic factors in growth, NBER working paper, 4556.

Freire, C., A. Hasan and M.H. Malik, 2012, High food prices in Asia-Pacific: Policy initiatives in view of supply uncertainty and price volatility, MPDD working paper WP/12/01, United Nations, Economic and Social Commission for Asia and the Pacific.

Gillman, M., and M.N. Harris, 2009, The effect of inflation on growth: Evidence from a panel of transition countries, Discussion papers MT-DP-2009/10, Institute of Economics, Hungarian Academy of Sciences.

Gokal, V., and S. Hanif, 2004, Relationship between inflation and economic growth, Working paper 2004/04, Economics Department, Reserve Bank of Fiji Suva.

Granger, C.W.J., 1969, Investigating causal relations by econometrics model and cross spectral methods, Econometrica, 37(3):424-438.

Greene, W.H., 2003, Econometric analysis, Upper saddle river, N.J.: Prentice-Hall.

Greene, W.H., 2007, Econometric analysis, Upper saddle river, N.J.: Prentice-Hall.

Hasanov, F., 2011, Relationship between Inflation and economic growth, in Azerbaijani economy: Is there any threshold effect?, Asian Journal of Business and Management Sciences, 1(1): 01-11.

Hossain, A., and A. Chowdhury, 1996, Monetary and financial policies in developing countries, London: Routledge.

Hussain, M., 2005, Inflation and growth: Estimation of threshold point for Pakistan, Pakistan Business Review, 7(3): 01-15.

Hussain, S., and S. Malik, 2011, Inflation and economic growth: Evidence from Pakistan, International Journal of Economics and Finance, 3(5): 262-276.

Idris, M., and, R. Bakar, 2017, The relationship between inflation and economic growth in Nigeria: A conceptual approach, Asian Research Journal of Arts and Social Sciences, 3(1): 1-15.

Im, K., H. Pesaran and Y. Shin, 2003, Testing for unit roots in heterogeneous panels, Journal of Econometrics, 115: 53-74.

IMF, 2018, Asia Pacific - Good times, uncertain times: A time to prepare, World Economic and Financial Surveys - Regional Economic Outlook, International Monetary Fund, Publication Services, Washington, DC, U.S.A.

Ismail, A., K. Zaman, M. Atif, A. Jadoon and R. Seemab, 2010, The role of exports, inflation and investment on economic growth in Pakistan (1980-2009), International Journal of Economic Research, 1(1): 1-9.

Johansen, S., and K. Juselius, 1990, Maximum likelihood estimation and inference on cointegration-with the application to the demand for money, Oxford Bulletin of Economics and Statistics, 52: 169-210.

Kasidi, F., and K. Mwakanemela, 2013, Impact of inflation on economic growth: A case study of Tanzania, Asian Journal of Empirical Research, 3(4): 363-380.

Khan A.A., S.K. Bukhari and Q.M. Ahmed, 2007, Determinants of recent inflation in Pakistan, Research report, 66, Karachi: Social Policy & Development Centre.

Khan, M., 2005, Inflation and growth in MCD countries, Mimeo: International Monetary Fund.

Khan, M.S., and, A.S. Senhadji, 2001, Threshold effects in the relationship between inflation and growth, IMF Staff papers, 48(1): 1-21.

Levin, A., C. Lin and J. Chu, 2002, Unit roots tests in panel data: Asymptotic and finite sample properties, Journal of Econometrics, 108:1-24.

Mallik, G., and A. Chowdhury, 2001, Inflation and economic growth: Evidence from four South Asian countries, Asia Pacific Development Journal, 8(1): 123-133.

Mavikela, N., Mhaka, S., and A. Phiri, 2018, The inflation-growth relationship in SSA inflation targeting countries, MPRA paper, 82141, Available at https://mpra.ub.uni-muenchen.de/82141/.

Mercan, M., I. Gocer, S. Bulut and M. Dam, 2013, The effects of openness on economic growth for BRIC-T countries: Panel data analysis, Eurasian Journal of Business and Economics, 6 (11): 1-14.

Mohammad, N.H., and F.B. Said, 2011, Assessing macroeconomic performance of OIC members countries using data, Envelopment analysis, DEA, Journal of Economic Cooperation and Development, 32(4): 21-50.

Majumder, S.C., 2016, Inflation and its impacts on economic growth of Bangladesh, American Journal of Marketing Research, 2(1): 17-26.

Mukoka, S., 2018, An econometric assessment of the impact of inflation on economic growth: A case study of Zimbabwe economy, Economics, 7(1): 17-22.

Muzaffar, A.T., and P.N.R. Junankar, 2014, Inflation–growth relationship in selected Asian developing countries: Evidence from panel data, Journal of the Asia Pacific Economy, 19(4): 604-628.

Ndoricimpa, A., 2017, Threshold effects of inflation on economic growth in Africa: Evidence from a dynamic panel threshold regression approach, Working paper series, 249, African Development Bank, Abidjan, Côte d'Ivoire.

Osuala, A.E., K.I. Osuala and S.C. Onyeike, 2013, Impact of inflation on economic growth in Nigeria - A causality test, Jorind, 11(1): 206-216.

Patra, S. and K.K. Sahu, 2012, Inflation in South Asia and it's macroeconomic linkages, Journal of Arts, Science and Commerce, 3(2): 10-15.

Pesaran, M.H., Y. Shin, and R.J. Smith, 2001, Bound testing approaches to the analysis of level relationship, Journal of Applied Econometrics, 16: 289-326.

Tobin, J., 1965, Money and economic growth, Econometrica, 33: 671-684.

Umaru, A., and A.A. Zubairu, 2012, The effect of inflation on the growth and development of the Nigerian economy (An empirical analysis), International Journal of Business and Social Science, 3(10): 183-19.

Wai, U.T., 1995, The relation between inflation and economic development: A statistical inductive study, IMF staff papers 7: 302-317.

Wooldridge, J.M., 2013, Introductory econometrics: A modern approach, 5th edition, USA: South Western.

World Development Indicators, 2018, The World Bank.