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THRESHOLD INFLATION IN PAKISTAN

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Abstract

Inflation is usually considered to have a non-linear relationship with economic growth: a positive relationship when it is low and stable, and negative when it is high and volatile. It is therefore an important research question: what is that threshold level of inflation beyond which it affects growth negatively?

This paper addresses this question in case of Pakistan. We have used two models: one a quadratic model and the other a regression kink model, with unknown threshold. We find the threshold inflation at 6.05 percent and 5.67 percent respectively (on the basis of annual data from 1976 to 2017).

JEL Classification Codes: E31, E22, O40, O47.

Key Words: Inflation, threshold effects, Economic growth.

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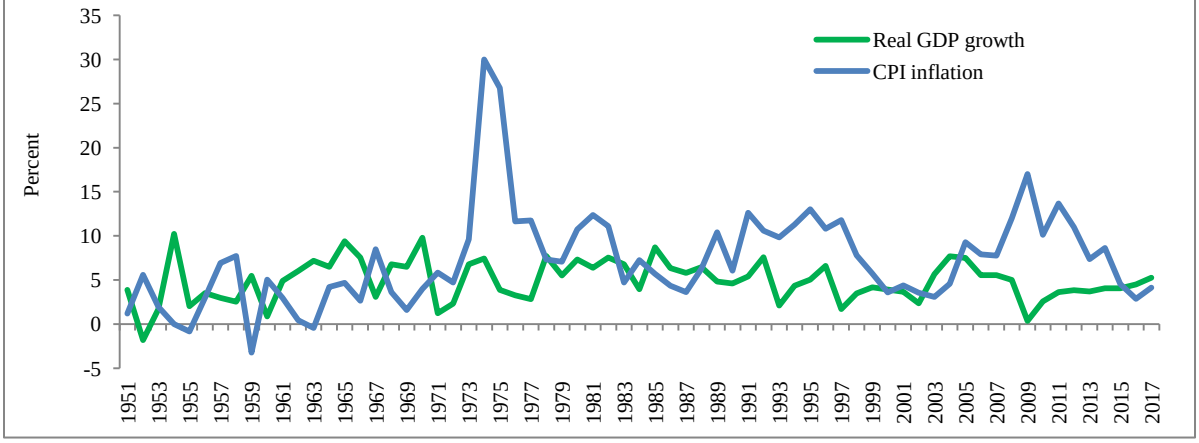
1. Introduction

Nature of a relationship between economic growth and inflation has been widely examined in the economic literature. It is generally believed that a low and stable inflation rate helps economic activities, while high inflation hurts growth. A high inflationary environment affects decision making of almost all players of the economy, like investors, savers, consumers and producers through uncertainty about the expected payoffs from their decisions.1 Moreover, a persistently high inflation also causes erosion of the value of the local currency in terms of foreign currencies. Such uncertainties, in turn have adverse implications for economic activities.

On the other hand, low and stable inflation helps economic agents to predict outcome of their economic decisions with fair level of certainty. Especially, existing producers follow their plans for business expansion with more confidence; and new investment is also undertaken in the expectation of certain returns. This is precisely the reason that policy makers, particularly central banks, strive for low inflation.

Figure 1: Inflation and Real GDP Growth



However, the empirical question is what is the limit for a desirable inflation, beyond which it affects growth adversely? A number of studies have addressed this question and estimated a threshold inflation rate for different countries. A description of some selected studies is given in a matrix given in the Annexure 1. In case of Pakistan, this question has recently become more important as its central bank is about to adopt a flexible inflation targeting. This paper explores the nature of inflation and growth nexus in Pakistan, and attempts to estimate threshold inflation. In fact, a visual look at the growth and inflation trend shows that there do have been some episodes when very high inflation had adversely affected growth (Figure 1).

However, we also find a number of years of co-existence of high inflation and high growth as well as low inflation and low growth (Table 1). Therefore, finding threshold inflation for Pakistan appears not a straightforward task. The earlier studies like Mubarak (2005), Hussain (2005) and Iqbal and Nawaz (2009) have a number of methodological issues. For example, the growth line estimated in Mubarik (2005) does not have a positively sloped line segment before a kink and a negatively sloped one after it. Instead, the growth line estimated in this study has negative slope everywhere – with a slight difference around 9 percent inflation. As the parameters estimated in this study are negative both in case of below 9

[1] High inflation is usually associated with higher price volatility and it also brings about general economic uncertainty.

percent inflation and above 9 percent; it wrongly interprets 9 percent as threshold inflation in the usual sense. Hussain (2005) finds threshold in the range of 4 to 6 percent; Iqbal and Nawaz (2009) also find it to be 6 percent. However, these studies do not test the threshold regression against a non-threshold model. This paper addresses such methodological issues and present new estimates of threshold level.

Table 1: Inflation and Growth Nexus – (1951 to 2017)

		Real GDP Growth (average = 4.9%)	
		Below (or equal) average	**Above average**
Inflation (Average = 7.2%)	**Below (or equal) average**	**(Total 17 years)** 1951, 1952, 1953, 1955, 1956, 1957, 1960, 1961,1971, 1972, 1990, 1999, 2000, 2001, 2002, 2015, 2016	**(Total 19 years)** 1954, 1959, 1962, 1963, 1964, 1965, 1966, 1968, 1969, 1970, 1979, 1983, 1985, 1986, 1987, 1988, 2003, 2004, 2017
	Above average	**(Total 17 years)** 1958, 1967, 1975, 1976, 1977, 1984, 1989, 1993, 1994, 1997, 1998, 2009, 2010, 2011, 2012, 2013, 2014	**(Total 14 years)** 1973, 1974, 1978, 1980, 1981, 1982, 1991, 1992, 1995, 1996, 2005, 2006, 2007, 2008

Source: Authors' calculations

2. Methodology

We have used two approaches to estimate threshold inflation: one is a quadratic equation with inflation and its square term as explanatory variables along with others; and the second is a special case of regression kink model with unknown threshold. As suggested by Hansen (2015), a regression kink model (or continuous threshold model) is a threshold regression constrained to be everywhere continuous with a kink at a threshold (detail is given next).

2.1 Quadratic equation specification

We estimate the following linear regression model wherein inflation appears as second degree polynomial argument in the growth equation:

$$g_t = \alpha + \theta_1 \pi_t + \theta_2 (\pi_t)^2 + \theta_3' z_t + e_t \qquad (1)$$

Where, g_t is real GDP growth rate, π_t is CPI inflation, zt is a vector of other explanatory variables, θ_3' is the vector of parameters associated with zt, and et is error term of the regression with usual assumptions. After trying a number of explanatory variables, traditionally used in a growth model like population, investment, total trade as a proxy for openness, terms of trade, M2 to GDP ratio as proxy for financial sector development, we ended up with real investment growth as the only member of the vector zt. The basis for this choice is intuitively correct signs and significance of the parameters, and overall information criterion.

The threshold inflation is calculated from the estimated parameters as follows:

$$\boldsymbol{\pi}^{*} = -\frac{\boldsymbol{\theta_1}}{\mathbf{2}\times\boldsymbol{\theta_2}} \quad (2)$$

It may be noted that this model will give a theoretically correct threshold only when the sign of θ2 is negative, which ensures an inverted U shape of the growth line.

2.2 Regression kink model

We have followed Hansen (2015) technique for finding a threshold effect of inflation on growth.[2] In this model the regression function is continuous but the slope has a discontinuity at a threshold point – which introduces a kink in the function. The technique developed by Hansen not only estimates the parameters in the regression kink model with unknown threshold, but also gives asymptotic distribution of the parameters and bootstrap confidence intervals for the regression function. This is required as conventional inference methods cannot be applied to this regression due to its non-differentiability at the threshold point. However, the kinked regression is directionally differentiable at all points i.e. both left and right derivatives are defined. Hansen technique also performs a formal test for the significance of the threshold model against a linear (non-threshold) model. Specific form of the model is as below:

$$g_t = \alpha + \beta_1(\pi_t - \gamma)_- + \beta_2(\pi_t - \gamma)_+ + \beta_3' z_t + e_t \quad (3)$$

Where, γ is threshold level of inflation. Note that inflation has been split in to two parts: one below the threshold (π_t - γ)- and the other above it (π_t - γ)+. In this model threshold is unknown, and we have to determine it endogenously within the system.

In order to determine an optimal threshold, a series of regressions are run by setting an appropriate interval for the threshold parameter, with a discrete grid. At each grid point for γ the following least squares criterion is estimated and plotted against the values of the grid points.

$$S_n = (\beta, \gamma) = \frac{1}{n}\sum_{t=1}^{n}(g_t - \alpha - \beta_1(\pi_t - \gamma)_- - \beta_2(\pi_t - \gamma)_+ - \beta_3' z_t)^2 \quad (4)$$

The least square estimators $(\hat{\beta}, \hat{\gamma})$ that jointly minimize Sn are determined by a global minimum of this function.

In the next step, we re-estimate equation (3) by imposing the restriction that β1 = β2, which essentially gives a non-threshold or linear model. This model is then evaluated against the threshold model by using an F statistics. For this purpose, we estimate the error variance of the two models, and an F-statistics is computed as follows:

$$F_n = \frac{n(\tilde{\sigma}^2 - \hat{\sigma}^2)}{\hat{\sigma}^2} \quad (5)$$

Where $\hat{\sigma}^2$ is the error variance of the original threshold regression as given in (3) and $\tilde{\sigma}^2$ is the error variance of the new regression with restriction that β1 = β2. The F-statistic is used as a standard test for the null hypothesis of equality of β1 and β2, against the existence of a threshold effect. If F_n> critical value of F, we reject the Null hypothesis in favor of the existence of the threshold effect. Hansen

[2] We are thankful to Bruce E. Hansen for availability of the R-code for implementing this methodology on Pakistani data.

computes the distribution of this test through bootstrap simulations, codes of which are the part of the program in R, used by this study.

2.3 Data description

In order to estimate these models, we have used growth rates of annual series of real GDP, CPI, and real investment for the period from 1976 to 2017. The selection of variables is according to the existing empirical literature and the source of data is Pakistan Bureau of Statistics. While the data for all the three variables is available for the years as back as 1960, we have excluded years prior to 1976 in estimations because we could not adequately model the relationship between inflation and growth for the full sample. In fact, the period 1960 to 1975 consists of years when the Pakistan's economy witnessed successive shocks and structural changes of varying nature, like green revolution of early 1960s, war 1965, political turbulence of late 1960s (after war), breakup of East Pakistan in 1972, severe floods of early 1970s, nationalization of a wide range of businesses, global oil price shock of 70s, exchange rate depreciation, etc. On the basis of this, we feel that a well behaved relationship between growth and inflation had hardly maintained during this period. Therefore, including this period in the sample distorts the model; and there is a risk of drawing misleading conclusions. Therefore, it is considered more appropriate to focus on the later period i.e. 1976 to 2017.

Table 2: Summary Statistics

	Inflation	Real GDP growth	Real Investment growth
Mean	7.2	4.9	4.6
Median	6.3	4.9	4.0
Maximum	30.0	10.2	27.4
(year)	(1974)	(1954)	(1963)
Minimum	-3.2	-1.8	-12.0
(year)	(1959)	(1952)	(1968)
Std. Dev.	5.5	2.3	7.7
	Average values		
1950s	2.7	3.1	-
1960s	3.2	6.8	8.0
1970s	12.5	4.8	3.7
1980s	7.2	6.1	5.9
1990s	9.7	4.4	2.2
2000s	8.0	4.6	3.6
2010-17	7.5	4.1	4.4

Source: Authors' estimates

Table 2 reports summary statistics for the variables: average inflation during 1951-2017 has been 7.2 percent, while the average for real GDP growth is 4.9 percent. Pakistan has experienced highest inflation of 30 percent in 1974, followed by 26.8 percent in 1975 and 17.0 percent in 2009. In fact double digit inflation was witnessed during 19 years out of 67 years of Pakistan – all of these years are characterized by some sort of cost push/supply side shocks (see Annexure 2 for a description of these shocks). Excluding these double digit inflation years, average inflation in Pakistan has been 4.7 percent, which shows the country is traditionally not a high inflation economy.

Coming towards growth, there was only one year when real GDP growth was negative, i.e., 1952. However, in recent past the country experienced a growth rate as low as 0.4 percent in 2009 (in the aftermath of global financial crisis). The decade of 1960s features a high growth period, followed by 1980s. The supported economic policies mainly get the credit for these high growth rates.

3. Results

Before using the variables in the estimation, we have checked them for the problem of non-stationarity by using Augmented Dickey-Fuller and Phillips-Perron tests. The results are reported in Annexure 3, which show that all the variables are stationary in growth forms, which can be used in ordinary least square estimations. The estimated equations of the two approaches are given and discussed below.

3.1 Quadratic equation specification

Compared to linear, cubic and polynomial of degree 4 specifications, the quadratic model was found a good fit to the data. Moreover, the Akike information criterion (AIC) for the quadratic equation is minimum compared to other specifications. The results of quadratic equation estimated on the annual data gives threshold inflation of 6.05 percent (Tables 3)

Table 3: Threshold Estimation from Quadratic Equation (Annual data 1976 to 2017**)**

Dependent Variable: real GDP growth

Regressors	Coefficient	Std. Error	t-Statistic	Prob.
Constant	3.439	1.205	2.854	0.007
Inflation	0.492	0.293	1.682	0.101
Square of Inflation	-0.041	0.014	-2.875	0.007
Investment growth	0.088	0.067	1.305	0.200
D_double	0.817	1.120	0.729	0.471
Observations:	42	R-Square:		0.268
RSS:	104.644	DW-statistic		1.468
F-Statistic:	3.396	AIC		3.998
Threshold inflation	**6.05**			

*: D_double is a dummy variable having value 1 for the year when a supply/cost push shocks such as sharp depreciation of exchange rate, flood and sudden jump in international prices resulted in double digit inflation (see Annexure 2). Though this dummy is statistically insignificant in quadratic model, it improves the quality of the regression especially of the Kinked regression.

Source: Authors' estimates

3.2 Regression kink model

We also employed a kinked regression model to estimate the threshold inflation and also test this model against a linear model using a WALD F-test. Furthermore, the kinked model searches for an unknown threshold within a defined range and selects the threshold level which is smallest globally against a pre-defined criterion (such as the least square criterion of minimizing the sum of square residuals). Local minima are not relevant in our case. In estimating equation (3), we have set a closed interval [1, 15] for the threshold parameter, with discrete grid increments of 0.01. Keeping in view the history of inflation in Pakistan we expect the threshold to lie in this range. At each grid point for γ the least squares criterion $S_n^*(\gamma)$ was computed and plotted in Figure 2. This function has a global minimum at γ = 5.67, which is the estimated threshold level of inflation. The estimated parameters of the regression kink model are reported in Table 4.

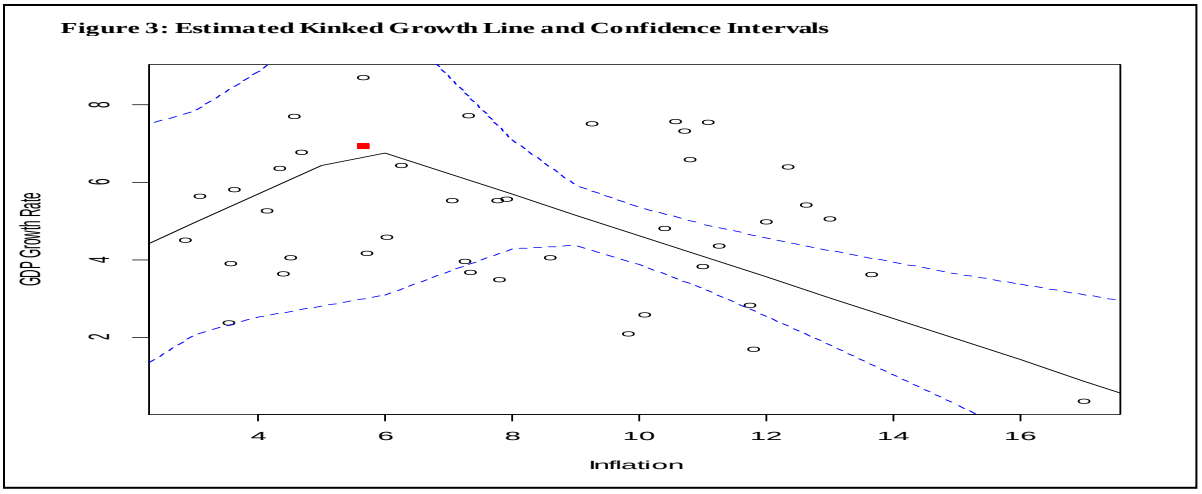
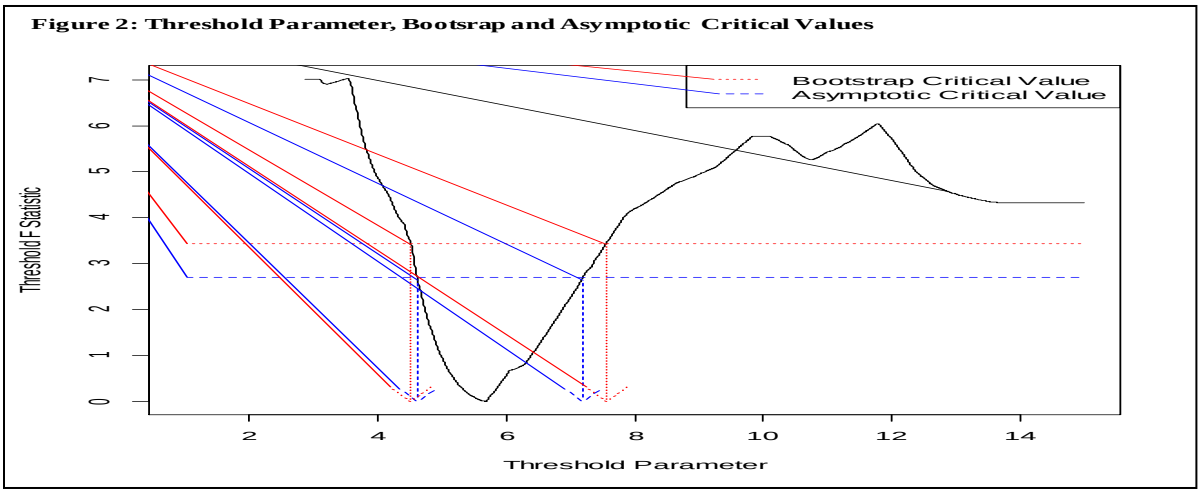


Table 4: Threshold Model Results – Regression Kink model (Annual data; 1976 to 2017)

			Bootstrap 90% confidence intervals	
	Estimates	Standard Errors	Lower	Upper
β1	0.74	0.545	-0.13	1.61
β2	-0.53	0.164	-0.83	-0.23
Investment growth	0.14	0.047	0.07	0.22
D_double	2.00	1.008	0.13	3.88
Constant	5.60	0.615	4.71	6.49
Threshold level	**5.67**	1.023	4.44	7.69
Number of observations				42
Error Variance of kinked regression				2.083
Error Variance of linear regression (with no threshold)				2.497
Wald-F test Value for existence of threshold effect				8.15
Critical Value of F-statistics at 90%				6.12

Source: Authors' estimates



The slope of the regression before threshold inflation is positive 0.74, while after threshold it is negative, -0.53 (Figure 3). It implies a one percentage point increase in inflation may lead to 0.74 percentage point rise in the real GDP growth as long as inflation remains below 5.67 percent. Beyond this threshold level, a one percentage point increase in inflation may lead to 0.53 percentage point reduction in the real GDP growth. The narrow width of the bootstrap confidence intervals suggests that the threshold effect is estimated with enough certainty.

4. Conclusion

The study estimates the relationship between inflation and growth in Pakistan with especially focusing on the existence of threshold effect of inflation. It is generally believed that inflation has a non linear relationship with growth, i.e., it affects growth positively when it is low and stable, and negatively when it is high. However, in case of Pakistan, we can find a number of years when high inflation and high growth co-existed and similarly low inflation was observed in the periods of low growth. Therefore, it becomes a difficult task to find threshold inflation in Pakistan with the given data set.

We have used two different methodologies on annual data and found very close results i.e. 6.05 and 5.67 percent. First we estimate a quadratic equation for growth over annual data from 1976 to 2017 and find that the growth is maximized at 6.05 percent inflation. Second we estimate a regression kinked model by using Hansen (2015) technique which gives threshold inflation of 5.67 percent.

Keeping in view these close threshold inflation levels, we can safely conclude that inflation below 5.67 percent may be favorable for economic growth and inflation above 6.05 percent can hurt growth. Historically, average real GDP growth rate has been more than 5 percent during the low inflation periods (i.e., below 6 percent), and 4.7 percent during very high inflation periods (i.e., above 6 percent). There was only one year (FY1990) when inflation was exactly at 6 percent and average real GDP growth was recorded 4.6 percent – lower than its historical average. Therefore, a more careful policy is required when inflation crosses the threshold level.

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Annexure 1: Review of Selected Previous Studies on the Subject						
Author	**Empirical approach**	**variables**	**Country(s)**	**Whether includes Pakistan?**	**Data**	**Findings**
Sarel (1996)	Regression estimates through OLS	Population, GDP, consumer price indices, terms of trade, real exchange rates, government expenditures, and investment rate	87	Yes	1970-90	Inflation have slightly positive or no effect on growth below 8 percent.
Clark (1997)	Several specifications of the growth-inflation relationship, each of which simply augment the reduced form Solow growth equation	GDP per capita, investment to GDP ratio, average growth rate of population, primary and secondary school enrollment rates, average CPI, coefficient of variation of inflation over time, measuring inflation volatility from residual of equation,	85	Yes	1960-85	Growth-inflation results are highly sensitive to modification to the country sample and also to time period of analysis. The paper discourages the practice of quantifying the inflations' effect with cross-country growth regressions.
Bruno and Easterly (1998)	Simple correlation between cross-section inflation and growth averages over 1961 1994. Historical description of what happened during high inflation crisis. Inflation crisis is defined by taking a threshold level of 40%.	Real GDP, CPI, Total Factor Productivity (TFP) and capital growth from Nehru and Dhareshwar (1993), investment to GDP		Yes	1961-1994	Inflation-growth correlation is only present with high frequency data and with extreme inflation observations; there is no cross-sectional correlation between long-run averages. growth falls sharply during discrete high inflation crises, then recovers rapidly and strongly after inflation falls.
Ghosh and Phillips (1998)	Different inflation-growth regressions using OLS, 2SLS	Investment ratio, first principal component of primary and secondary school enrollment rates and life expectancy as a measure of human capital (HK), the log of the ratio of U.S. per capita income to country j's per capita income in 1960 is measured in international prices (catch-up), revenues to GDP, public consumption to GDP, fiscal balance, ratio of exports plus imports to GDP (Openness), log of black market exchange rate premium (economic mismanagement), trade volatility (external shocks), Current and lagged terms of trade changes dummies for drought and war-related deaths	145		1960-96	A negative relationship between inflation and growth that is both statistically and economically significant. At very low inflation rates, the relationship is positive. At all other inflation rates, the apparent marginal effect of inflation on growth becomes less important as higher inflation rates are considered.

Khan and Sendhaji (2001)	Conditional Least Squares, Non Linear Least Square (NLLS)	Growth rate of real GDP, inflation (growth rate of the CPI index), the initial income level measured as the five year, average of GDP per capita in 1987 PPP prices, gross domestic investment as share of GDP, population growth, the growth rate of terms of trade, and the five year standard deviation of terms of trade	140	Yes	1960–98	The threshold level of inflation above which inflation significantly slows growth is estimated at 1–3 percent for industrial countries and 11–12 percent for developing countries.
Burdekin et al (2004)	Panel GLS	Real GDP per capita and its first lag, inflation rate, different breaks specific inflation rate, first difference of inflation, population growth, real government expenditure to real GDP, ratio of black market exchange rate to official exchange rate, percentage growth in terms of trade	72	Yes	1965-1992	The inflation thresholds lie below the 20–40% levels. A higher threshold for industrial countries than for developing countries, 8% versus 3%.
Hussain (2005)	Conditional Least Squares	Growth rate of real GDP, CPI inflation, Population growth rate, Investment to Income ratio, M2-GDP ratio (Financial Deepening)	Pakistan	Yes	1973-2005	Inflation exceeding a range of 4 - 6% is deterrent to economic growth.
Mubarik (2005)	Conditional Least Squares	Growth rate of real GDP, CPI inflation, population growth rate, investment growth rate	Pakistan	Yes	1973-2000	Study estimates 9 percent as the threshold inflation level for Pakistan.
Bittencourt (2012)	Panel Time series analysis/models	Real gross domestic products per capita, inflation, general government debt share to GDP, ratio of exports and imports to GDP (Openness), ratio of investment to real GDP, ratio of the liquid liabilities to GDP (M2) (Financial Development), interaction term of average years of schooling of those aged 25 and over and percentage of the total urban population (structural development), instruments for democracy, constraints on executives and political competition, proxy for political regime characteristics, government share of GDP, external debt to GDP	Argentina, Bolivia, Brazil and Peru	No	1970-2007	Inflation has had a detrimental effect on growth in the region. Excessive inflation has clearly offset the Mundell–Tobin effect and consequently the high costs that inflation has had on economic activity in the region.

Baroo (2013)	Panel estimates of growth equations	CPI (in few cases GDP deflator), standard deviation of inflation rate, growth rate of real per capita GDP, investment to GDP, male/female schooling (education), life expectancy (health), human capital (overall estimated effect from the levels of school attainment and the log of life expectancy),fertility rate, government consumption ratio, public education expenses to total expenses, black market FX premium (market distortions), rule of law index (measured by Knack and Keefer's (1994) subjective index), terms of trade change, democracy index (Gastil (1982-83) and Bollen (1990))	100	Yes	1960-1990	An increase in average inflation by 10 percentage points per year results in a reduction of the growth rate of real per capita GDP by 0.2-0.3 percentage points per year and a decrease in the ratio of investment to GDP by 0.4-0.6 percentage points.
Vinayagathasan (2013)	Dynamic panel threshold model using Fixed Effects (FE), Bias-corrected Least Square Dummy Variable (LSDVC) and GMM.	Growth rate of GDP per capita, Initial income (initial), Investment ratio, Inflation rate, Population growth rate, Trade openness, Terms of Trade, standard deviation of terms of trade and openness	32	Yes	1980–2009	An inflation threshold of approximately 5.43%, at a 1% level of significance. Inflation has no effect below this threshold level.
Eggoh and Khan (2014)	Panel Smooth Transition model (PSTR) and Dynamic GMM.	Real GDP growth rate and its lag, initial GDP per capita, CPI inflation rate, population growth, ratio of imports plus exports to GDP (Openness), government expenditure to GDP (fiscal indicator), investment (Gross fiscal capital formation to GDP), Government Expenditure, the ratio of liquid liability(M3) to GDP (Financial Depth)	102	Yes	1960-2009	The inflation threshold is found to be 12.4% for the whole sample. When inflation is above its threshold level, increase of 1% in the inflation rate reduces the economic growth by3.998%. Note: Pakistan is classified in lower middle income countries.
Thanh (2015)	Panel Smooth Transition Regression (PSTR) model and GMM-IV specification	Growth rate of GDP per capita, Initial level of output, Employment growth rate, Investment growth rate, Growth rate of terms of trade, Standard deviation of terms of trade, Government spending growth rate, Inflation rate, Semi-log transformation of CPI	Indonesia, Malaysia, Philippines, Thailand, Vietnam	No	1980–2011	The study finds that there exists a statistically significant negative relationship between inflation and growth for the inflation rates above the threshold level of 7.84%, above which inflation starts impeding economic growth in the ASEAN-5 countries.

Annexure 2: Double Digit Inflation Periods in Pakistan

Year	CPI inflation	Factors
1974	30.0	OPEC oil shock (from $3.24 per barrel to $ 11.6 per barrel); floods (affected area = 41,472 Sq Km); and pest attacks
1975	26.8	Floods (affected area = 34,931 Sq km)
1976	11.6	Floods (Affected area = 81,920 Sq Km); and pest attacks
1977	11.8	Floods (Affected area = 4,657 Sq Km); and pest attacks
1980	10.7	Oil price shock (from $12.8 per barrel to $ 29.8 per barrel)
1981	12.4	Floods (affected area = 4,191 Sq Km)
1982	11.1	Delinking of PKR from USD; increase in import prices; increase in administered prices (e.g Petrol, gas tariffs for households, sugar)
1989	10.4	Floods (affected area = 6,144 Sq Km); exchange rate depreciation (12.4%)
1991	12.6	Oil price shock due to Gulf war (33% YoY); exchange rate depreciation (8.8%); increase in unit value of imports; and increase in administered prices
1992	10.6	Depreciation of currency against USD (5.1%); increase in administered prices; floods (affected are = 38,758 Sq Km)
1994	11.3	Depreciation of currency against USD (8%); increase in POL prices; increase in procurement prices of wheat; decrease in imports of key food items such as palm oil; tea, sugar, pulses etc; floods (affected area = 5,568 Sq km)
1995	13.0	Floods (affected area = 16,686 Sq Km); increase in administered prices; supply bottlenecks of essential items due to poor wheat crop; decline in rice output and unsatisfactory performance of minor crops; and increase in global price of palm oil
1996	10.8	Depreciation of currency against USD (12.3%); increase in administered prices
1997	11.8	Depreciation of currency against USD (12.2 %); increase in administered prices such as POL; increase in support prices of agricultural commodities; withdrawal of subsidies on basic food items; withholding tax on imports and supplies.
2008	12.0	Soaring global food and oil prices; exchange rate shock (13.7 percent depreciation)
2009	17.0	Peak of global oil prices just before Global Financial Crisis; exchange rate shock (13.8% depreciation)
2010	10.1	Floods all across Pakistan (affected area = 160,000 Sq Km); rising international prices of sugar, cotton, and oil; and domestic oil prices were also increased
2011	13.7	Floods (affected area = 27,581 Km); higher global prices of edible oils, sugar, cotton, crude oil and petroleum products, and metals, and phasing out of power subsidies
2012	11.0	Floods (affected area = 4,746 Sq Km); exchange rate depreciation (7.6%)

Source: Economic surveys of various years, SBP annual reports, Federal Flood Commission and authors' calculations.

Annexure 3:

A: Results of Unit Root tests – Annual data 1976 2017

(1) Level (With Constant)

	Augmented Dickey-Fuller Test Null Hypothesis: Series has a Unit root		**Phillips-Perron test statistic** Null Hypothesis: Series has a Unit root	
	ADF t-statistics	Probability	Adj. t-Stat	Probability
CPI Inflation	-4.042	0.004	-3.148	0.031
Real GDP Growth	-5.240	0.001	-5.211	0.001
Real Investment Growth	-3.242	0.026	-5.157	0.000
(2) 1st difference	-3.367	0.001	-8.127	0.000
CPI Inflation	-5.461	0.000	-12.544	0.000
Real GDP Growth	-3.949	0.000	-9.061	0.000
Real Investment Growth				

Notes: (a) Lag Length selection is based on AIC; and (b) Probability is based on MacKinnon (1996) one-sided p-values.