

Impact of Denoised Inflation on Economic Growth of Pakistan

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Received: 09-04-2025

Revised: 10-05-2025

Accepted: 15-06-2025

Published: 11-07-2025

ABSTRACT

Denoised inflation provides a clearer measure of persistent price trends, offering valuable insights into its true impact on economic growth, which is vital for informed and effective macroeconomic policymaking. Therefore, this study analyzes the effect of denoised inflation on the economic growth of Pakistan using quarterly time series data from 1994 to 2021. For data estimation, the ARDL model and the ADF test are used. The long-run estimates of ARDL show that the variables oil prices, denoised inflation, exchange rate, and government borrowing negatively and significantly influenced the economic growth, while the variable import growth positively and significantly influenced the economic growth of Pakistan. The study concludes that denoised inflation has a significant negative impact on Pakistan's economic growth. This highlights the importance of addressing persistent inflationary pressures through effective monetary policies and structural reforms aimed at ensuring macroeconomic stability, enhancing investor confidence, and supporting sustainable long-term economic development in the country.

Keywords: Economic Growth, Inflation (Denoised), Oil Prices, Imports, Exchange Rate, ARDL Model, Pakistan

INTRODUCTION

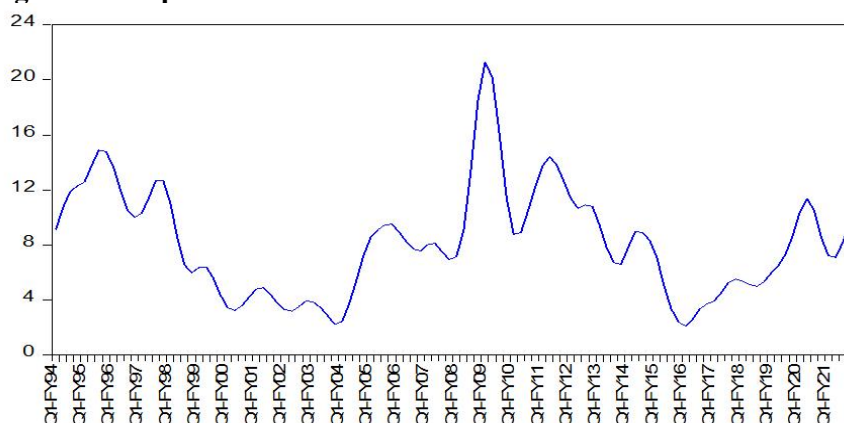
Inflation is considered a main indicator of macroeconomic stability. The policymakers have implemented several measures to maintain inflation stable and low, such as demand-side controls over the money supply, rationalization of the discount rate, and supply-side effective infrastructure provision, such as energy and stable good governance. Several attempts have been made, with the fundamental argument being that low and stable inflation has a beneficial impact on GDP while high and unstable inflation has a negative impact.

Denoised inflation is a new phrase that refers to inflation without noise or inflation free from short-term shocks and noise produced by demand-related components. It is unique from the inflation's demand-

related component. One has to do with the difference between current and future economic activity, and it's the main focus of current monetary policy, which makes exogenous supply shocks a part of inflation (Hanif et al., 2020).

Pakistan's economy has grown at a faster rate since gaining independence than that of South Asia. But over time, several factors, such as political unpredictability, the weight of foreign debt, low exports and high imports, and years of non-implementation of economic programs, impacted Pakistan's economic growth. Figure 1 shows that graphical representation of inflation (denoised) from 1994 to 2021 in Pakistan. It indicates inflation fluctuates over time.

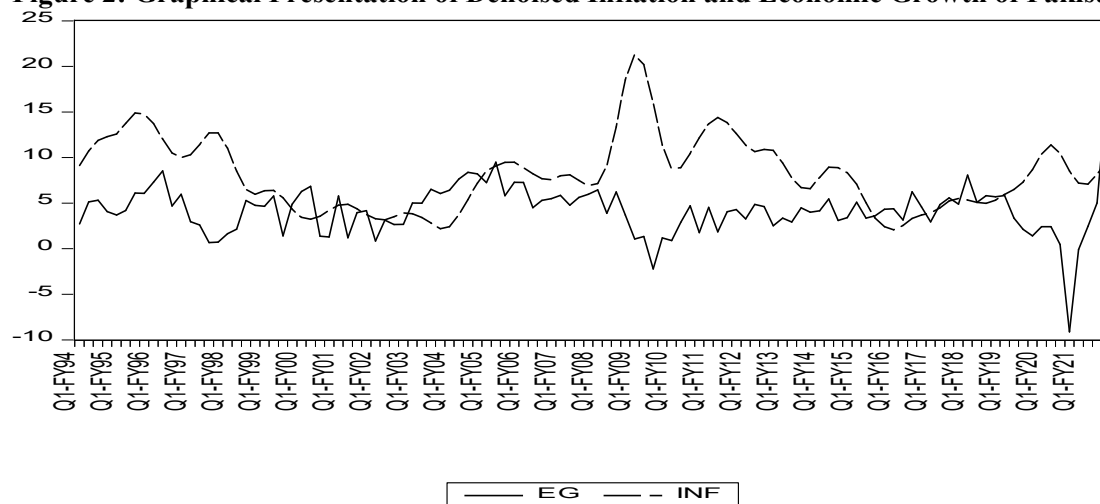
Figure 1: Graphical Presentation of Denoised inflation in Pakistan



Source: State Bank of Pakistan

Figure 2 illustrates the relationship between denoised inflation (INF) and economic growth (EG) in Pakistan from Q1-FY94 to Q1-FY21. Both variables show considerable fluctuations, with inflation generally more volatile. Economic growth dips sharply during crises (e.g., 2008, 2020), while inflation surges, suggesting an inverse relationship in periods of economic instability.

Figure 2: Graphical Presentation of Denoised Inflation and Economic Growth of Pakistan



Source: State Bank of Pakistan

Pakistan's economy has long grappled with persistent inflation, which undermines purchasing power, distorts investment decisions, and hinders sustainable economic growth. Traditional measures of inflation

often contain high-frequency noise or short-term fluctuations that obscure the true long-term inflationary trends. This noise complicates the accurate assessment of inflation's impact on economic growth, leading to inconclusive or inconsistent empirical findings. To overcome this shortcoming, researchers are turning more regularly to the use of a more sophisticated measure of inflation known as denoised inflation, which removes the volatility associated with temporary fluctuations to better gauge the long-term trends in inflation. In spite of its relevance, little has been done on the effects of denoised inflation on economic growth as part of the economic literature in Pakistan. Better comprehension of this association is important to policy makers who wish to achieve a balance between price stability and growth. In a developing economy such as Pakistan, where the structural inefficiency, supply shocks and fiscal imbalances are most often the sources of inflationary pressures, denoised inflation can be used to give more precise signals to the macroeconomic planning. The necessity to comprehend the role of the sustained inflationary developments in the economic performance is more topical than ever, particularly in the context of the current economic shocks that have been caused by the global shocks and national fiscal limits. Underestimating the magnitude of the impact of inflation because of the use of noisy data may lead to the wrong policy reaction, which will worsen the instability of the economy. This paper, thus, aims at empirically examining how denoised inflation affects economic growth of Pakistan. It will offer insights that would be useful in the formulation of more effective inflation-targeting and growth-enhancing strategies in the Pakistani economy based on its structural realities.

LITERATURE REVIEW

Different studies investigated the influence of inflation (INF) on economic growth (EG) such as Meyer & Hassan (2024) analyzed the association between inflation and EG in South Africa from 1995 to 2022. Their study showed that inflation rate at six percent positively affects the economic growth. In addition, exchange rate is negatively linked to the EG in South Africa. Khan & Khan (2018) interrogated the association between the inflation rate and economic growth in the context of selected Asian economies. The selected Asian countries were Iran, Malaysia, Indonesia, Bangladesh and Pakistan. The data of the period between 1973 and 2016 was used. The results indicated that the INF had negative impacts on the EG of the chosen Asian economies. Consequently, this research advised that a good policy should be formulated to regulate the rate of inflation and carry out operations that enhance economic growth and development of Asian nations. Gatawa et al., (2017) established the influence of the macro-economic factors on EG based on the data covering 1973-2013 was used. Vector autoregressive and Granger causality test were used on the data. The results indicated that money supply has a direct relationship with economic growth whereas inflation and interest rate have a negative relationship with EG of Nigeria. The result of the Granger causality test implied that EG is not caused by the explanatory variables inflation, supply of money and interest rate. It was, therefore, proposed that the monetary policy should be handled effectively to increase the economic growth. Ehikioy & Mohammad (2016) evaluated the influence of inflation and monetary factors on the economic growth of Nigeria based on the data observed in 1985-2012. The results indicated that exchange rate, money supply and inflation were the key factors that influenced the economic growth of Nigeria. Conversely Granger causality results showed that there was one-way causality between the variables. Jelilov et al., (2016) evaluated the relationship between the inflation rate, unemployment rate and EG among the chosen members of ECOWAS. This study revealed that monetary and fiscal policy played a significant role and they were applied to control rate of inflation and rate of unemployment. The level of production in the country ought to be increased in order to reduce unemployment in the country and this will create more jobs, and this will consequently reduce the level of unemployment. The researchers also advised the application of labor-intensive methods to generate the level of output to minimize the unemployment level.

Shahid (2014) established the role of unemployment and inflation in EG in Pakistan through the data provided between the years 1980 to 2010. The outcomes of this analysis showed that the inflation rate had

the inverse effect on economic growth and the unemployment rate also had a negative result on the EG of Pakistan. Bibi et al., (2014) evaluated the association between inflation and EG in Pakistan by using the data of the years between 1980 and 2011. The outcomes revealed that both trade openness and FDI was positively affected the EG of Pakistan and the correlation between inflation and EG was generated to be negative. The authors concluded that trade and foreign direct investment were the key factors enhancing Pakistan's economic growth. Behera (2014) evaluated the link between rate of inflation and EG in the case of South Asian countries from the period of 1980 to 2012. The outcomes exposed a direct link between inflation rate and EG in the South Asian economies. The long run association was observed in the case of Malaysia in the cointegration analysis. Sultan & Shah (2013) explored the nexus between inflation and economic growth in case of Pakistan from time period 2005 to 2015. The findings of this investigation exposed that there was a negative and significant association between inflation and EG in case of Pakistan. On foundation of this investigation the authors recommended that policy makers and central bank of Pakistan should control the inflation rate below 8 percent level so that the impact of inflation on EG may come optimistic.

Data and Methodology

The data used in this study is quarterly time series data from 1994 to 2021. The data was collected from the Pakistan Bureau of Statistics and World Data Bank, published by the World Bank. This study used GDP growth rate as a Dependent Variable while denoised inflation, exchange rate, government borrowing, imports, global oil price as explanatory variables. To analyze the impact of denoised inflation on the economic growth of Pakistan, the following model is designed:

$$EG_t = \beta_0 + \beta_1 OP_t + \beta_2 INF_t + \beta_3 EXR_t + \beta_4 IMP_t + \beta_5 GB_t + u_t$$

Where EG indicates economic growth, OP represents oil prices, INF indicates denoised inflation, EXR refer to exchange rate, IMP indicates imports, GB represents government borrowing and u_t is the error term

Table 1: Description of Variables

Variables	Description of Variables		Data Source
Dependent Variable			
EG	Economic Growth	GDP growth rate (Quarterly)	SBP
Independent Variables			
OP	Oil Prices	Growth rate (Quarterly)	OECD
INF	Denoised Inflation	Growth rate (Quarterly)	PBS
EXR	Exchange Rate	Growth rate (Quarterly)	SBP
GB	Government Borrowing	Growth rate (Quarterly)	SBP
IMP	Imports	Growth rate (Quarterly)	SBP

Note: SBP: State Bank of Pakistan, OECD: Oil for Economic Cooperation and Development, PBS: Pakistan Bureau of Statistics

Three important econometric methods are used in this study's data analysis: the Autoregressive Distributed Lag (ARDL) model, the ARDL Bound Test, and the ADF unit root test. To prevent erroneous regression findings, the stationarity of time series variables is assessed using the ADF test. It determines if the variance and mean of the variables remain consistent throughout time. While stationary variables at level are $I(0)$, non-stationary variables at level that are stationary at first difference are referred to as integrated of order one, or $I(1)$. This classification is crucial prior to using the ARDL method. To determine if there is a long-term cointegration relationship between the dependent and

independent variables, the ARDL Bound Test is utilized. This test is more adaptable than conventional cointegration methods and is especially helpful when variables are a combination of I(0) and I(1) but not I(2) (Pesaran et al., 2001). The ARDL model itself concurrently calculates long-term linkages and short-term dynamics. It permits varying lag lengths for every variable and works well with small sample numbers (Pesaran & Shin, 1995). By using these methods, the study guarantees accurate and consistent estimation of the ways in which denoised inflation and other macroeconomic factors impact Pakistan's economic growth across time.

DATA ANALYSIS

Descriptive Analysis

Table 2 illustrates the descriptive statistics of variables. The results show that the mean values of EG, OP, INF, EXR, IMP and GB are 4.223, 9.268, 8.172, 7.012, 8.617 and 15.513, respectively. The maximum values of EG, OP, INF, EXR, IMP and GB are 16.699, 125.689, 21.269, 30.794, 67.360 and 64.356, respectively. The minimum values of EG, OP, INF, EXR, IMP and GB are -9.121, -54.086, 2.080, -7.158, -35.361 and -11.568, respectively. The skewness value indicates that except EG all the variables have positively skewed distributions. Lastly, except IMP all the variables have leptokurtic distributions.

Table 2: Descriptive Statistics

Variables	Mean	Maximum	Minimum	S.D.	Skewness	Kurtosis
EG	4.223	16.699	-9.121	2.716	-0.267	10.397
OP	9.268	125.689	-54.086	35.185	0.694	3.939
INF	8.172	21.269	2.080	3.957	0.719	3.510
EXR	7.012	30.794	-7.158	8.177	0.839	3.079
IMP	8.617	67.360	-35.361	21.640	0.524	2.913
GB	15.513	64.356	-11.568	13.705	0.813	4.959

Correlation Analysis

Table 3 show that economic growth as measured by GDP growth is negatively correlated to the oil prices growth (-0.425), denoised inflation (-0.168), exchange rate (-0.456), and government borrowing (-0.456), while positively correlated to the imports growth (0.496).

Table 3: Correlation Matrix

Correlation	EG	OP	INF	EX	IMP	GB
EG	1.000					
OP	-0.425	1.000				
INF	-0.168	0.092	1.000			
EXR	-0.456	-0.308	0.354	1.000		
IMP	0.496	0.517	0.130	-0.465	1.000	
GB	-0.221	0.052	0.679	0.271	0.077	1.000

Cointegration Analysis

The long-term cointegration of variables in a model is examined using the ARDL bound test. The Wald test, often known as the F-test, is used to verify the long-term cointegration of variables. The bound test results are shown in Table 4. The F-statistic (14.9635) is found to be greater than all upper and lower

bound values, indicating that the variables in a model have long-term cointegration. Thus, we can use the ARDL model to estimate parameters over the long term.

Table 4: Bound Test Analysis

Null Hypothesis: No level relationship				
Test Statistic	Value	Signif.	Lower Bound	Upper Bound
F-statistic	14.9635	10%	2.08	3
K	5	5%	2.39	3.38
		2.5%	2.7	3.73
		1%	3.06	4.15

ARDL Analysis

The ARDL long-run estimates provide valuable insights into the long-term impacts of INF, IMP, GB, EXR and OP on Pakistan's EG. The results indicate that oil prices have a significant negative impact on economic growth, with a coefficient of -0.0364 ($p = 0.0228$). This proposes that rising oil prices increase production costs, reduce consumer purchasing power, and slow down economic activity. Denoised inflation also negatively affects economic growth, with a coefficient of -0.0884 ($p = 0.0123$), implying that persistent inflation erodes real incomes and investment incentives, thereby hindering long-term growth (Chaudhry et al., 2013; Mawufemor et al., 2016; Loto, 2012). The exchange rate shows a strong negative association with EG (-0.1347, $p = 0.0019$), indicating that depreciation of the local currency likely raises the cost of imports and external debt, thereby weakening economic performance (Adeniran et al., 2014; Karahan, 2020). In contrast, import growth positively and significantly influences economic growth (coefficient = 0.0605, $p = 0.0015$), suggesting that productive and capital-intensive imports contribute to industrial and economic expansion (Mishra, 2012; Saaed & Hussain, 2015). However, government borrowing negatively impacts growth, as shown by its coefficient of -0.0626 ($p = 0.0058$), possibly due to crowding out of private investment or inefficient allocation of borrowed resources (Panizza & Presbitero, 2014; Hussain et al., 2015).

Table 5: ARDL Estimates

Dependent Variable: Economic Growth				
Long-Run Form				
Variable	Coefficient	S.E.	t-stat.	Prob.
OP	-0.0364	0.0173	-2.0954	0.0228
INF	-0.0884	0.0408	-2.2012	0.0123
EXR	-0.1347	0.0421	-3.1982	0.0019
IMP	0.0605	0.0184	3.2759	0.0015
GB	-0.0626	0.0221	-2.8220	0.0058
C	4.8075	0.4983	9.6463	0.0000
Error Correction Form				
D(OP)	0.0399	0.0083	4.8049	0.0000
D(INF)	-0.5446	0.3906	-1.3943	0.1665
D(EXR)	-0.0727	0.0492	-1.4775	0.1429
D(IMP)	0.0209	0.0084	2.4660	0.0155
D(GB)	-0.0055	0.0274	-0.2011	0.8410
ECM(-1)	-0.9163	0.0867	-10.5594	0.0000

R²	0.5913
Adj. R²	0.5541
Durbin-Watson	2.0908

On the other hand, the ECM(-1) term turns out to be negative (*Coefficient* = -0.9163) and statistically significant (*t-stat.* = -10.5594; *Prob.* = 0.000). This shows that the long-run equilibrium is adjusted at the rate of 91.63 as moving from short-run to long-run equilibrium in case of disturbances. Lastly, the R² value (0.5913) shows the variation in economic growth due to the explanatory variables in a study and the Durbin-Watson test value (2.0908) indicates no autocorrelation issue in a model.

Model Diagnostic Analysis

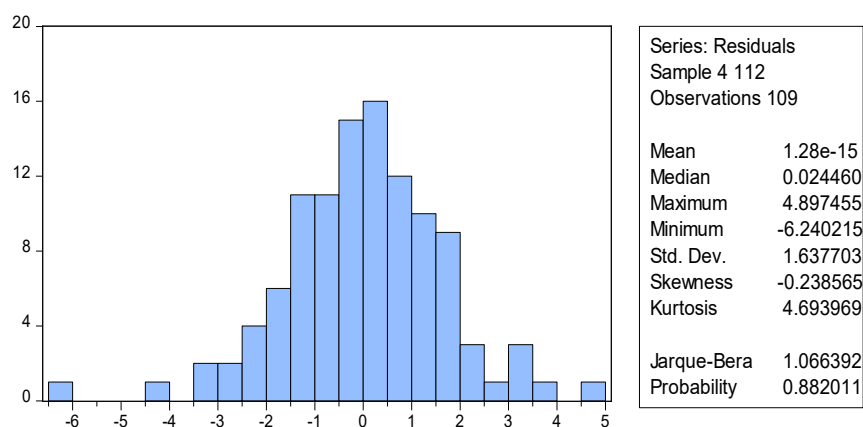
Different model diagnostic tests are employed on a model to check the issues of autocorrelation, heteroskedasticity, and model misspecification. For this purpose, Breusch-Godfrey, Breusch-Pagan-Godfrey, and Ramsey-Reset tests are used. Table 6 shows no autocorrelation and heteroskedasticity in a model. Ramsey-Reset test shows that the model is correctly specified.

Table 6: Model Diagnostic Tests

Problem	Test	Statistic	Prob.	Outcomes
Autocorrelation	Breusch-Godfrey	0.0303	0.9701	Not Found
Heteroskedasticity	Breusch-Pagan-Godfrey	1.0481	0.4150	Not Found
Misspecification	Ramsey-Reset	1.0130	0.3168	Correctly Specified

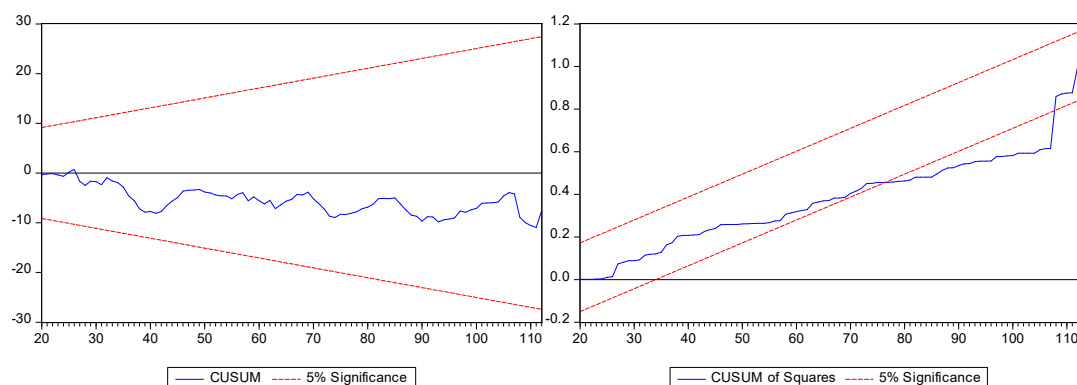
To check the normality of the residuals, the Jarque-Bera test of normality is employed. Figure 3 points out that the Jarque-Bera test value (1.066392) is found to be statistically insignificant (*Prob.* = 0.882011); therefore, we accept the null hypothesis that the residuals are normally distributed.

Figure 3: Residuals Normality Test



Lastly, to analyze the dynamic stability of the model, the OSL recursive residuals of CUSUM and CUSUM of squares test are employed. Figure 4 presents the outcomes. It can be analyzed from the figure that the fitted lines are within the critical region lines at the 5 percent level of significance. In the CUSUM of squares figure, the fitted line is outside the critical lines for a certain period, but again lies within the critical lines. Based on the discussion, it is concluded that the model is dynamically stable.

Figure 4: Model Stability Test



CONCLUSIONS AND POLICY IMPLICATIONS

This study examined the impact of denoised inflation on the economic growth of Pakistan using quarterly time series data spanning from 1994 to 2021. The ARDL model was employed to estimate both short-run and long-run dynamics, and the ADF test was used to assess the stationarity of the variables. The long-run results revealed that denoised inflation, oil price growth, exchange rate depreciation, and government borrowing negatively and significantly impact economic growth in Pakistan. In contrast, import growth positively contributes to economic growth. These results suggest that underlying, persistent inflation, captured through the denoising process, exerts a more harmful influence on growth than transitory inflation. Inflation, when sustained over time, reduces consumer and investor confidence, increases the cost of production, and creates macroeconomic uncertainty, all of which hinder economic performance. The central finding of this study is that denoised inflation has a significant and negative impact on economic growth in Pakistan. This implies that inflationary trends undermine the country's long-term growth prospects. The results underscore the importance of targeting core, structural sources of inflation rather than only responding to short-term price shocks. In sum, maintaining stable and low inflation, alongside supportive macroeconomic policies, is vital for fostering sustainable economic growth in Pakistan.

The main consideration that policymakers ought to consider is to attempt to manage inflation via structural reforms that would aim at managing the ongoing price escalations instead of concentrating on the short-term movements. The monetary policy is to be adjusted so that long-term inflation expectations are pegged on credible measures like denoised inflation. The results also indicate that there is a necessity to minimize the reliance of the fiscal on borrowing because a lot of government borrowing will crowd out the private investment and lead to inflationary pressures. In addition, inflation caused by depreciation of the economy can be prevented by stabilizing the exchange rate by enhancing foreign exchange reserves and export promotion. The beneficial effect of import growth implies that industrial growth and output can be stimulated by access to productive inputs and capital goods. Therefore, the policy of trade must encourage imports of productive goods instead of restrictive policies.

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