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# IS CURRENT INFLATION A DEMAND-PULL OR A COST-PUSH?

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**Abstract**

The correct identification of the type of inflation is very important from a policy perspective. This is because misidentification of the type of inflation leads to an incorrect policy action thereby hurting the economy as opposed to helping it. In this study, we applied both the ARDL model and the Threshold model. While the finding from the ARDL model fails to establish any long-run causal relationship among the model variables, INF, CPI, and PPI, the Threshold model, however, finds that, in both regimes of CPI and PPI, CPI has a negative and statistically significant impact, whereas PPI has a positive and statistically significant impact on the inflation rate. So, our conclusion is that the current US inflation is cost-push rather than demand-pull. Therefore, interest rate hikes by the Federal Reserve won't ease current inflation rather worsen it.

**JEL Classification:** E31, E52

**Keywords:** demand-pull inflation, cost-push inflation, ARDL model, Threshold model.

## 1. INTRODUCTION

While demand-pull inflation occurs due to increase in aggregate demand, cost-push inflation occurs due to increase in per-unit cost of production caused by disruption in the supply of key inputs, with all other factors influencing the aggregate demand and the aggregate supply remaining constant. The distinction of the type of inflation is important from a policy perspective. This is because a wrong identification of the type of inflation would lead to a wrong policy action thereby hurting the economy more than helping it. For example, if cost-push inflation is misunderstood as demand-pull, raising the federal funds rate will increase market interest rates and investment costs, worsening cost-push inflation. On the other hand, if the demand-pull inflation is misunderstood as cost-push, it would prompt the Fed to lower the target federal funds rate which would lower the market interest rates, which, in turn, would raise the

aggregate demand thereby making the demand-pull inflation even worse. In this study, we seek to identify the nature of current US inflation.

Several studies have examined the demand-pull and cost-push inflation issue. One such study by Zhang (2012) has examined the factors driving China's inflation in the past decade and has concluded that although demand-pull factors seem to be more important currently, supply-push factors will soon be more important in driving China's inflation. So, he recommends that more attention be given to supply-side management such as dismantling monopolies, boosting private investment, encouraging innovation, and improving productivity.

Hussain and Obaid (2013) examined the nature of Pakistan's inflation between 1990 and 2010. Trends in indicators such as wage rate, government expenditures, exports, and interest rate were used to determine if it was a cost-push inflation. Indicators such as money supply, net foreign aids, imports, net foreign grants, and interest rate were used to determine if it was demand-pull inflation. The conclusion was that current inflation in Pakistan was demand-pull.

Dedu and Dumitrescu (2009) distinguish inflation by three types: demand-pull, cost-push, and imported. They used output gap as a measure for demand-pull inflation, unit labor cost as measure for cost-push inflation, and exchange rate as a measure for imported inflation. They found the most important factor causing persistent inflation in Romania to be output gap, followed by the exchange rate and the change in unit labor cost.

Shaikh, Siddiqui, and Wizarat (2014) combined the monetarist, New Keynesian and Structuralist approaches and used a multivariate cointegration technique to determine the nature of inflation in Pakistan. It was determined that inflation in Pakistan was not only demand-pull as characterized by monetarists but also cost-push and structural in nature.

Rahmani, et al (2013) apply a cointegration VAR model to examine the long-run relationship between 4-decade long inflation in Iran and the money supply and find a long-run relationship between the price level and the money supply but not between the price level and the cost-push factors. So, they concluded Iran's inflation to be demand-pull.

Barth and Bennett (1975) conducted a study on postwar inflation in the U.S. Applying Sims' test for causality they found a one-way causal link that ran from money to wholesale and consumer prices and concluded that the inflation was demand-pull.

Jongwanich and Park (2009) examine the factors causing inflation in developing Asia. They found that contrary to popular misconception, Asia's inflation was largely

homegrown and had risen due to excess aggregate demand and inflationary expectations, rather than external price shocks.

However, none of these studies has used CPI and PPI to distinguish between the types of inflation. Therefore, this study will make a significant contribution to the literature in the field in three ways. First, we develop a model of inflation with CPI and PPI as independent variables. We did not find any such model in the literature. Second, we examine how CPI and PPI affect inflation in both the short and the long run using a auto-regressive distributed lag model. Third, CPI and PPI are segmented into different regimes using the Threshold regression model and examine how CPI and PPI affect U.S. inflation under different regimes. The rationale for using the Threshold model is to capture the responses of market agents – consumers and producers – to high and low levels of CPI and PPI. This is because if CPI and PPI are low market agents may consider this as a temporary phenomenon. But if CPI and PPI are considerably high market agents may consider as a result of structural problem, which they may belief to be persistent. This belief may lead them to hoard the things they need, which will cause an increase in current demand thereby causing inflation. Based on the response of inflation to changes in CPI and PPI, we will then determine whether current inflation is demand-pull or cost-push.

The organization of this study is as follows. Section 2 describes the model, section 3 explains data sources, section 4 conducts empirical analyses, and the final section provides conclusions.

## 2. THE MODEL

When there is a positive demand shock in the economy, it causes a rise in prices. Since consumer demand is the largest portion of the U.S. aggregate demand, this rise in the price level is reflected in the CPI. So, in the short run, inflation rate and consumer price index tend to move in the same direction. However, households tend to keep the current level of real demand for goods and services to maintain their current standard of living by using their savings. But as they start depleting their savings, they tend to adjust their demand to their reduced real income due to inflation. They reduce their demand thereby lowering consumer spending, which applies a downward pressure on the CPI. This decline in consumer spending lowers the aggregate demand in the economy putting downward pressure on price levels, causing the inflation rate to fall. Thus, the consumer price index has a positive effect on the rate of inflation. On the other hand, when there is a negative supply shock due to the disruption in supply of key raw materials or intermediate products, the producer price index rises. Later, when suppliers pass this increase in the price of raw materials and intermediate products to consumers by raising the price of finished products, it causes a rise in general price levels, which causes inflation. Thus, the rise in consumer price index or producer price index each contribute to inflationary pressure. A simple model of inflation is therefore:

$$INF_t = a + bCPI_t + cPPI_t + e_t \quad (1)$$

Where, $INF$ is the inflation rate, $CPI$ is the consumer price index, $PPI$ is the producer price index, $e$ is the random error, and $a$, $b$, and $c$ are constants. If b turns out to be positive and statistically significant and c turns out to be statistically insignificant, then the current inflation is demand-pull, but if b turns out to be statistically insignificant and c turns out to be positive and statistically significant, then the current inflation is cost-push. If both coefficients turn out to be positive and significant, then the current inflation is a mixed outcome of demand-pull and cost-push inflation. Such identification will help the Federal Reserve apply the right monetary policy to fight inflation.

## 3. THE DATA

Data on US inflation rates from 1990 to 2019 was obtained from World Data: Development of Inflation Rates in the United States (https://www.worlddata.info/america/usa/inflation-rates.php) and that on US CPI and PPI are from the Economic Report of the President: https://www.whitehouse.gov/wp-content/uploads/2022/04/ERP-2022.pdf. This data can be found in Appendix A at the end of this article.

## 4. EMPIRICAL ANALYSIS

In this study the goal is to determine how INF is influenced by CPI and PPI both in the short run and in the long run as well as in different CPI and PPI regimes (or ranges). For variables to be in a long-run relationship they must be integrated of the same order, in other words they must follow similar path, otherwise any short-term fluctuation in the value of a variable pushes it further away from its long-run value. To see if they are, unit root tests were conducted on all three model variables. The result of the test is shown in Table-1 below.

**Table-1: Augmented Dickey-Fuller Unit Root Test**

| Variable | t-statistic | Critical t-value at 5% Significance Level | Stationary? |
|---|---|---|---|
| INF | -4.225116 | -2.967767 | Yes |
| CPI | -0.096289 | -2.967767 | No |
| ΔCPI | -4.342483 | -2.971853 | Yes |
| PPI | 0.169222 | -2.967767 | No |
| ΔPPI | -6.314530 | -2.971853 | Yes |

The above results show that while the dependent variable, INF, is integrated of order zero, the independent variables, CPI and PPI, are integrated of order 1. If model variables are integrated of different orders and none is integrated of order higher than one, the right model to examine if any long-run relation exists among the model variable is the ARDL (auto-regressive distributed lag) model, as it shows how the lagged (i.e. past) values of each variable affect the current value of all model variables. Since the ARDL model is sensitive to the lag length of the model variables, the Akaike Information Criteria is applied to determine the appropriate lag length of each of the three model variables. The results are shown in Figure-1 below. The criteria selected 4 lags for INF, 2 lags for CPI, and 4 lags for PPI.

**Long-Run Equation:**

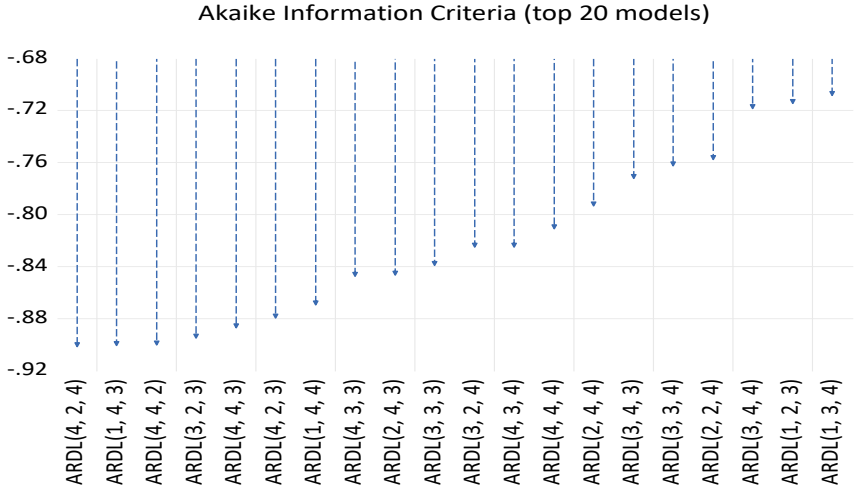
$$INF_t = 13.09881 - 0.291245CPI_t + 0.185854PPI_t \quad (2)$$

The corresponding p-values for the terms above are: 0.2851, 0.3818, and 0.4435, respectively.

The above result shows that none of the independent variables in the long-run equation are significant at the 5% level. To confirm this finding, the bound test revealed the F-statistic from the long-run equation to be 3.451023, which is between the lower bound of 3.1 and upper bound of 3.87. This makes the test inconclusive and thereby the long-run relation indeterminate.

**Figure-1: Akaike Information Criteria for Selecting the Right ARDL Model**

A Method to Select the Right Model with Right Number of Lags for Each Model Variable




The longest bar for ARDL (4, 2, 4) suggests that the best model to estimate will be the one with 4 lagged values of variable, INF, two for variable, CPI and four for

variable, PPI. So, we estimated the model suggested by the above criteria and obtained the following result.

**ARDL Equation:**

$$INF_t = 3.007956 + 0.1738617INF_{t-1} + 0.126695INF_{t-2} - 0.018252INF_{t-3} - 0.076696INF_{t-4}$$
$$+0.752085CPI_t - 1.962295CPI_{t-1} + 1.143329CPI_{t-2} + 0.148429PPI_t - 0.026251PPI_{t-1}$$
$$-0.150110PPI_{t-2} + 0.044074PPI_{t-3} + 0.026536PPI_{t-4} \quad (3)$$

The p-values for the t-statistics (for the independent variables) in equation (3) are: 0.0695, 0.0081, 0.2739, 0.8168, and 0.1659, .01, 0.0000, 0.0032, 0.0004, 0.5042, 0.0038, 0.2123, and .2662, respectively.

The model has R-squared = 0.990352, adjusted R-squared = 0.981446, F-statistic = 111.1989, and the significance of F = 0.000000.

Before interpreting the result from the above ARDL model, tests for serial correlation, heteroskedasticity, and stability were conducted to verify that the ARDL model does not suffer from serial correlation, heteroskedasticity and instability problems. The results are shown in Tables 2 and 3 and Figure 2 below.

**Table-2: Test of Serial Correlation**

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 2 lags

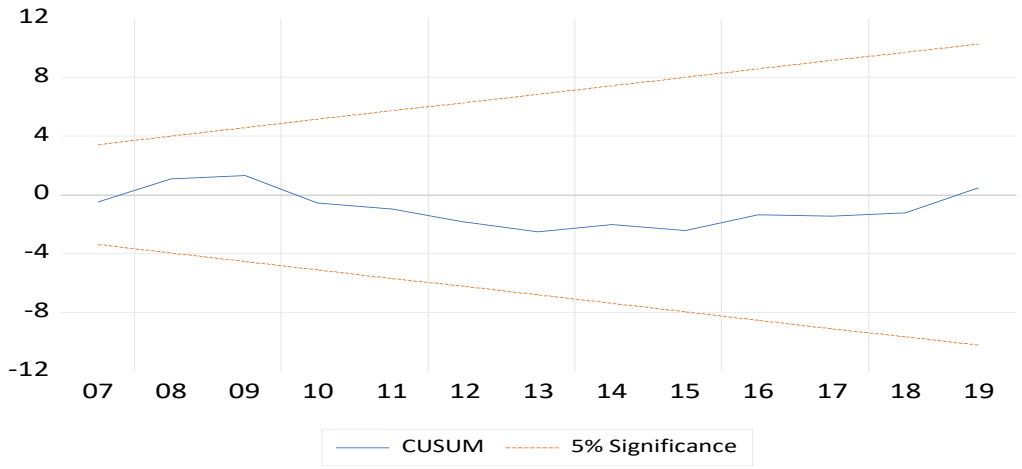
| | | | |
|---|---|---|---|
| F-statistic | 0.059350 | Prob. F(2,11) | 0.9427 |
| Obs*R-squared | 0.277570 | Prob. Chi-Square(2) | 0.8704 |

**Table-3: Test of Heteroskedasticity**

Heteroskedasticity Test: Breusch-Pagan-Godfrey
Null hypothesis: Homoskedasticity

| | | | |
|---|---|---|---|
| F-statistic | 0.748129 | Prob. F(12,13) | 0.6890 |
| Obs*R-squared | 10.62067 | Prob. Chi-Square(12) | 0.5617 |
| Scaled explained SS | 3.418927 | Prob. Chi-Square(12) | 0.9918 |

**Figure-2: Test of Normality: The CUSUM Test**




Since the probability of Chi-Square (2) shown in Table 2 is greater than 0.05, the model does not suffer from a serial correlation problem. Similarly, since the probability of Chi-Square (12) shown in Table-3 is greater than 0.05, the model does not have heteroskedasticity problem either. Further, since the blue line in Figure-2 falls within the two red lines, the model is stable also. So, the model is sufficient to infer the findings. The estimation result, shown in Equation (3) indicates that the coefficient associated with variables, $\mathrm{INF}_{t-1}$ has a positive and significant effect on INF. This implies that an inflation episode in one year prior also raises the inflation rate in the following year. The reason could be that any episode of inflation in prior year creates inflation expectations leading to an actual inflation episode in the following year.

On the other hand, $\mathrm{CPI}_t$ has a positive and significant effect, $\mathrm{CPI}_{t-1}$ has a negative and significant effect, and $\mathrm{CPI}_{t-2}$ has positive and significant effect on INF. It implies that CPI has a cyclical effect with an immediate positive effect on INF. That is because CPI is one of the components of INF. So, when CPI rises it causes an immediate rise in INF. But when inflation rises it lowers the real income of households leading to a decline in real aggregate demand thereby lowering price levels and causing a fall in the rate of inflation. A fall in the rate of inflation then raises the real aggregate demand leading to a rise in price levels and causing inflation in the following period. So, CPI has a cyclical effect on the rate of inflation.

Further, $\mathrm{PPI}_t$ has been found to have a positive and significant effect and $\mathrm{PPI}_{t-2}$ has been found to have a negative and significant effect on the dependent variable, INF. This implies that when PPI rises, it raises the per-unit cost of production which then is passed on by producers to consumers by raising the price of products thereby increasing inflation. But when inflation rises it leads to a fall in real aggregate demand.

This then leads to a rise in business inventories. To get rid of the unplanned inventories, producers or sellers lower the prices of finished products leading to a fall in the general price level and thereby a fall in the rate of inflation. But because this inventory adjustment occurs with a time lag (two-period lag in this study), PPI shows its negative effect on INF with a two-period lag.

Also, usually households do not decrease their demand immediately after the rise in prices. Rather, they use savings to keep their current level of demand in an attempt to maintain their current standard of living and only respond to the rise in the price level with a cut in demand when their savings are depleted. This phenomenon sets a threshold on CPI only above which households respond negatively to a rise in CPI. This implies that CPI has a negative impact on real aggregate demand and thereby on the rate of inflation, INF, above a certain threshold value of CPI. Similarly, producers try to keep their customer base intact avoiding any price war and are reluctant to raise the price of their products immediately after the rise in producers' goods and services. They do so by absorbing some of the increase in the price of inputs by accepting a lower profit margin. So, they tend to pass on the increased price of inputs to consumers in the form of increased price of outputs only when the PPI rises beyond a certain level. This sets a threshold on PPI only above which producers respond to a rise in input prices by raising the price of output thereby causing the rate of inflation to go up. This implies that PPI only has an impact on INF above a certain threshold value of PPI. In view of the importance of these threshold values in households' and producers' response a Threshold regression was performed with INF as the dependent variable and CPI and PPI as the independent variables with thresholds (structural breaks) in both CPI and PPI and obtained the following results:

**When CPI < 94.06**

$$INF_t = 7.137455 - 0.249289CPI_t + 0.206030PPI_t \quad (4)$$

t-value = (5.319196) (-4.747786) (4.253315)

**When CPI => 94.06**

$$INF_t = 7.137455 - 0.562544CPI_t + 0.485104PPI_t \quad (5)$$

t-value = (5.319196) (-5.666331) (5.219801)

**When PPI < 93.60**

$$INF_t = 7.137455 - 0.249289CPI_t + 0.206030PPI_t \quad (6)$$

t-value = (5.319196) (-4.747786) (4.253315)

**When PPI => 93.60**

$$INF_t = 7.137455 - 0.562544CPI_t + 0.485104PPI_t \quad (7)$$

t-value = (5.319196) (-4.747786) (5.219801)

The above results show that, in both regimes of CPI and PPI, CPI has a negative and significant impact whereas the PPI has a positive and significant impact on the inflation rate. So, the threshold (i.e. regime switch or structural break) model indicates that the current US inflation is cost-push rather than demand-pull.

## 5. SUMMARY AND CONCLUSION

Demand-pull inflation and cost-push inflation occur due to the increase in aggregate demand and per-unit cost of production, respectively. The distinction of the type of inflation is very important from a policy perspective, as the wrong identification of the type of inflation would lead to a wrong policy action thereby hurting the economy as opposed to helping it. If the cost-push inflation is misunderstood for demand-pull, it prompts the monetary authority to mistakenly raise the target federal funds rate which raises the market interest rate, which raises the per-unit cost of production, and thereby making the cost-push inflation even worse. On the other hand, if demand-pull inflation is misunderstood for cost-push, it would prompt the monetary authority to mistakenly lower the target federal funds rate which would lower the market interest rate, raising the aggregate demand and thereby making the demand-pull inflation even worse.

In this study, the ARDL model is applied to determine if any long-run relation exists between the model variables. The Threshold model is used to determine how the inflation rate in the United States responds to any change in the US consumer price index (CPI) and producer price index (PPI). The finding from the ARDL model does not establish any long-run causal relation among the model variable, INF, CPI, and PPI. However, the threshold model finds that, in both regimes of CPI and PPI, CPI has a negative and statistically significant impact, whereas PPI has a positive and statistically significant impact on the inflation rate. So, the conclusion is that the current US inflation is cost-push rather than demand-pull.

The policy implication of this study is that, since the current US inflation is the cost-push one, interest rate hikes by the Federal Reserve won't ease the current inflation problem, rather worsen it. So, policy targeted toward increasing the aggregate supply must be taken to ease the current inflation problem. It could include reinforcing anti-trust regulations to curb covert or overt monopoly practices, boosting private investment through government subsidy of tax incentives, encouraging innovation through government financial support, and improving productivity through government funding on research and development.

One limitation of this study is the dates studied: the years from 1990 to 2019. We intentionally exclude the period after 2019 to avoid any outlier in data due to the effect and post-effect of COVID. The study period Results could be different if the study was conducted over different time intervals. In addition, while these models are based on inflation rates, CPI and PPI in the United States, inflation may be affected in different ways in other countries, based on many factors such as political climate, consumer demand and spending habits, attitudes toward saving money, as well as country specific fiscal and monetary policies.

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**Appendix A**

**U.S. Inflation Rate, Consumer Price Index, and Producer Price Index, 1990-2019**

| YEAR | INF | CPI | PPI |
|---|---|---|---|
| 1990 | 5.40 | 63.23 | 62.92 |
| 1991 | 4.23 | 65.35 | 63.06 |
| 1992 | 3.03 | 67.09 | 63.44 |
| 1993 | 2.95 | 68.76 | 64.37 |
| 1994 | 2.61 | 70.19 | 65.20 |
| 1995 | 2.81 | 71.67 | 67.53 |
| 1996 | 2.93 | 73.20 | 69.12 |
| 1997 | 2.34 | 74.48 | 69.07 |
| 1998 | 1.55 | 75.07 | 67.36 |
| 1999 | 2.19 | 76.16 | 67.92 |
| 2000 | 3.38 | 78.09 | 71.85 |
| 2001 | 2.83 | 79.66 | 72.64 |
| 2002 | 1.59 | 80.70 | 70.98 |
| 2003 | 2.27 | 82.40 | 74.77 |
| 2004 | 2.68 | 84.44 | 79.39 |
| 2005 | 3.39 | 86.88 | 85.20 |
| 2006 | 3.23 | 89.32 | 89.18 |
| 2007 | 2.85 | 91.61 | 93.46 |
| 2008 | 3.84 | 94.33 | 102.63 |
| 2009 | -0.36 | 94.06 | 93.60 |
| 2010 | 1.64 | 95.75 | 100.00 |
| 2011 | 3.16 | 98.17 | 103.87 |
| 2012 | 2.07 | 100.00 | 105.80 |
| 2013 | 1.46 | 101.35 | 107.25 |
| 2014 | 1.62 | 102.89 | 108.94 |
| 2015 | 0.12 | 103.12 | 107.99 |
| 2016 | 1.26 | 104.15 | 108.45 |
| 2017 | 2.13 | 106.05 | 110.97 |
| 2018 | 2.44 | 108.32 | 114.19 |
| 2019 | 1.81 | 109.92 | 116.12 |