
Disaggregated Analysis Of Phillips Curve In Pakistan

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Abstract: This study has estimated disaggregated Phillips Curve (PC) in case of Pakistan for food, nonfood and core inflation using annual time series data. The main objective of the study is to compare traditional and open economy Phillips curves using global output gap as external determinant of inflation. The study has estimated global slack hypothesis by augmenting traditional PC with global output gap as measures of global determinant. The accurate measurement of slope of PC has significant role in effective monetary policy formulation to control inflation through managing aggregate demand. There is abundant literature investigating whether Phillips curve still holds, weakened or strengthened as it used to be before 1990. Although less focused in case of Pakistan, for other countries the literature shows evidence of flattening of PC due to many reasons mainly globalization. The results of this study indicate existence of global slack hypothesis where both domestic and global output gaps affect overall inflation in Pakistan positively and significantly. However, when estimated for food and nonfood inflation separately for the period 1976-2019, domestic output gap in presence of global output gap does not affect nonfood inflation in Pakistan. Similarly, for core inflation domestic output gap in presence of global output gap does not affect core inflation in Pakistan. This finding is consistent with existing literature arguing that central banks' monetary policy intervention significantly affects relation between domestic output gap and core inflation. The results have also indicated that global economic crisis 2008 positively affected overall, food, nonfood and core inflation in Pakistan. The main policy implication of the study is that demand management policies in Pakistan need to be accompanied with supply side price controlling measures considering global economic factors.

Keywords: Inflation; Phillips Curve; Global Slack Hypothesis

INTRODUCTION

This study has estimated disaggregated Phillips Curve (PC) in case of Pakistan for food, nonfood and core inflation using annual time series data. (Phillips, 1958) originally introduced negative relationship of money wages and unemployment. Later on, economists started testing the relationship between output gap and CPI inflation. Positive output gap means excess aggregate demand than capacity to produce thus leading towards upward pressure on prices (Mankiw, 2001).

The closed economy Phillips curve was simply the relationship between inflation and domestic output gap but because of globalization Phillips curve augmented by external factors was estimated in the studies which referred PC as New Style Phillips Curve (NSPC). In NSPC, among explanatory variables external determinants like exchange rate, foreign inflation, global commodity prices etc. were incorporated [Engel (2011); (Zaman, Khan, Ahmad, & Ikram, 2011); (Satti, Malik, & Saghir, 2007).

Over the time, an important strand of empirical literature emerged studying possibility of flattening or weakening of Phillips curve relationship involving many factors mainly growing relative importance of global factors relative to domestic macroeconomic condition in influencing inflation. In this strand of literature, a number of recent empirical studies have confirmed flattening of the Phillips curve worldwide depicting that sensitivity of domestic factors in inflation determination has reduced substantially [(Jacob & van Florenstein Mulder, 2019); (Forbes, 2019); (Murphy, 2018; Nagy & Tengely, 2018); (Blanchard, Cerutti, & Summers, 2015; C. Borio, 2017; Szafranek, 2017) (Gordon, 2018; Leduc & Wilson, 2017).

Inflation is one of the core macroeconomic variables that policy makers target while designing monetary and fiscal policies all over the world. In case of weakening relationship between domestic inflation and output gap, demand management policies become relatively ineffective in controlling inflation. One possible explanation of weakening relationship between inflation and domestic demand conditions is that external demand becomes more important in affecting domestic inflation when integration of economies increases under globalization. In recent literature, such phenomenon when global output gap becomes more relevant than domestic output gap in affecting inflation is called Global Slack Hypothesis. A large number of recent studies (e.g., (C. E. Borio &

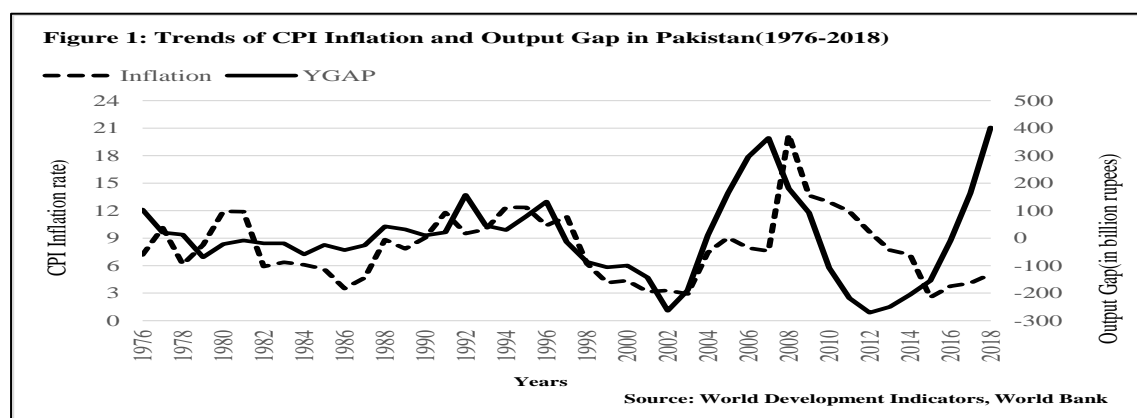
Filardo, 2007); (Rogoff, 2006); (Asjed, Asghar, & Ali Jaffri, 2014) have confirmed this hypothesis and a few have also empirically rejected (e.g., (Ihrig, Kamin, Lindner, & Marquez, 2010); (Ball, 2006; Calza, 2009); (Ball & Mazumder, 2011); (Mishkin, 2009).

In case of Pakistan, inflation has been a burning macroeconomic issue from last few decades since start of surge in globalization. Inflationary experience in Pakistan shows that on average inflation remained high. Average annual inflation from 1972-2019 was 9.01 percent whereas decade wise analysis showed that inflation was 12.42 percent in 1970s, 7.37 percent during 1980s, 9.71 percent during 1990s, 7.97 percent during 2000s, and 10.74 percent during 2011-19. Figure 1 shows that inflation in Pakistan was highest at the time of Global Economic Crisis crossing 20 percent in 2008 whereas it remained below 12 percent in the rest of the years. After 2008, inflation started declining to a range acceptable. In 2019 and 2020 again it started to rise, approaching 10.74 percent in FY2020, however, SBP Monetary Policy Statement released on 22 January, 2021 has forecasted to fall inflation between 7-9 percent in FY2021. Table 1 shows that food inflation was higher than nonfood and core inflation in 1980s, 1990s and 2000s, however, from 2015-19 food inflation remained lower than nonfood inflation. This trend has again reversed as food inflation in FY2020 and H1FY2021 was recorded in double digit much higher than nonfood and core inflation.

	1980s	1990s	2000s	2010s
Overall Inflation	7.37	9.71	7.97	10.74
Food Inflation	7.41	10.11	9.83	6.77
Non Food Inflation	6.58	9.34	6.75	7.25
Core Inflation	-	9.0	6.01	7.49

Source: Various Issues of Economic Survey of Pakistan

An important observation taken from Figure 01 plotting CPI inflation and output gap in Pakistan is a clear positive relationship i.e. Philips Curve relationship. This observation raises some important questions: first, whether domestic output gap has significantly affected inflation in Pakistan or in other words whether Philips curve holds in Pakistan. Second, whether Philips curve relationship has changed its intensity with globalization? Third, whether domestic output gap has significantly dominant effect on domestic inflation as compared to global output gap? However, all these questions need to be addressed empirically to find the evidence related to traditional and new style Philips curve in Pakistan. The evidence produced by current study will support formulation of appropriate demand management policies to control inflation in Pakistan.



There exist wide range of empirical literature on determinants of inflation in Pakistan which shows along with domestic output gap different factors affect inflation (Ahmed & Malik, 2011; Ellahi, 2017); (Bashir, Yousaf, & Aslam, 2016); (Jaffri, Asjed, & Bashir, 2013). A number of empirical studies have specifically studied existence of Phillips curve at aggregate level. However, no study has checked the impact of domestic and global output gap on inflation at disaggregated level for inflation in sub-groups of CPI in Pakistan (Satti et al., 2007; Sharif & Qayyum, 2018); (Zaman et al., 2011); (Riffat, Yousaf, & Mukhtar, 2016). There is scant empirical evidence on relative importance of global factors as compared to domestic factors in affecting inflation in Pakistan, exception are (Asjed et al., 2014) and (Asghar, Jaffri, & Asjed, 2013). To fill the gap in existing empirical literature for Pakistan, this study along with testing traditional and new style Philips curves also presents disaggregated analysis of Phillips curve relation for inflation in sub-groups of CPI for food, nonfood and core inflation. While the rest of the paper includes, section 02 briefly present review of recent literature on the

subject highlighting contribution of this study. Section 03 describes empirical model and data sources. Section 04 discusses empirical findings and section 05 concludes the paper.

REVIEW OF LITERATURE

There is growing literature on relative importance of domestic and global output gaps on domestic inflation in developed and developing countries in the context of globalization in the past few decades. This section briefly reviews recent empirical literature on the subject covering evidence on existence of traditional and open economy Phillips curve at disaggregate level.

In a seminal paper, (C. E. Borio & Filardo, 2007) investigated inflation processes and its sensitivity to economic slack. The study found that inflation is now more global centric rather than country centric. Global economic slack has considerable explanatory power in determining domestic inflation. Role of these global factors is increasing over time. Rogoff (2006) also confirmed increased impact of globalization on price and wage flexibility.

(Auer, Borio, & Filardo, 2017) empirically examined whether expansion of Global Value chain (GVC) is the most important way through which global slack influences domestic inflation both across countries and over time. By considering the role of GVC, study found that traditional measure of openness is poor proxy for transmission channel. Results of the study support the hypothesis that as the GVC expands, competition increases among countries. Due to growing influence of external factors domestic inflation becomes more sensitive to global output gap. The influence of global slack on domestic inflation is relatively greater than its domestic counterpart.

(Zhang, Ji, & Dai, 2017) empirically studied whether globalization lead to affect Chinese inflation in greater context by the global output gap using quarterly data over the period 1995 to 2012. The study found that global capacity constraints have significant explanatory and decisive power of determining CPI inflation in China. The policy implication of the study is that central banks should give more importance to global output gap as determinant of inflation rather than domestic factors.

(Çiçek, 2012) investigated changing inflation dynamics in Turkish economy by using time series data from 1985-2007. The study examined whether globalization has altered effect of domestic output gap on domestic inflation and role of global output gap has increased. The results suggest that role of global output gap in determining domestic inflation is greater than domestic output gap. Changing slope of the Phillips curve has been examined through time varying process by using Kalman Filter which suggests that slope of the Phillips curve has flattened over the period of time. (Nagy & Tengely, 2018) analyzed the impact of external and domestic drivers of inflation in Hungarian economy by using multiple statistical methods for quarterly data between Q1-2003 and Q2-2017. The results show that role of global and external factors have grown significantly in recent years especially after 2012. Strengthening role of external factors is confirmed by rolling window regression throughout the data period.

(Abdih, Balakrishnan, & Shang, 2016) have examined how disaggregated analysis of inflation is useful in understanding inflation dynamics in emerging and developed economies by using quarterly data from 1996-2015. The results showed that domestic forces played relatively smaller role in affecting domestic core inflation as compare to global factors. The study found that core goods inflation is mainly driven by the global prices and dollar price movement. Lagged Inflation, inflation expectations, non-oil import prices and labor market slack are the main determinants of inflation. According to this study the channel through which global factors affect domestic inflation is import prices.

(Lanau, Robles, & Toscani, 2018) have investigated inflation dynamics in Columbia using bottom up Phillips curve approach. A disaggregated analysis of Phillips curve has been conducted using food inflation, core inflation and headline/overall inflation. Traditional Phillips curve model is estimated using lagged inflation, output gaps and supply side shocks. For open economy component international oil prices and exchange rate has been incorporated in the model. Output gap is found positive for both headline and core inflation but point estimates are significant for only core inflation.

(Belz, Wessel, & Yellen, 2020) have explained changing inflationary behaviors over the period of time and how Phillips curve relationship has changed. The empirical findings of the study suggested that slope of the Phillips curve has decreased significantly since 60's or in other words it has become flatter. This diminishing slope may be caused by different reasons for example slack in the labor market is not captured by using correct measure. Incorrect measure of unemployment, downward nominal wage rigidity, greater sensitivity of global factors, slack in foreign economies, technological or structural factors and most importantly policy maker's intervention. It is suggested that the relationship between inflation and unemployment will become weaker if central bank make interventions in order to stabilize inflation in the economy.

(Hooper, Mishkin, & Sufi, 2020) investigated whether relationship of Phillips curve has changed or weekend over the period of time by using city level and state level data for Q11961-Q42018. By using rolling regression results strongly support the evidence that slope of price Phillips curve is getting flattened over the period not the wage Phillips curve since 80's. This changing relationship could be due to monetary policy intervention, lack of

variation in unemployment gap and well anchored inflation expectations. Fed had been actively involved to control overheating of labor market, so to stabilize inflation. The study has used core inflation instead of headline inflation because of high volatility in food and energy prices often caused biased results and did not explain true relationship of inflation and unemployment. Disaggregated analysis gave more precise picture of weakening or strengthening relationship of inflation and unemployment. Results also showed that inflation persistence has declined. (Fitzgerald & Nicolini, 2014) have also explained similar phenomenon that monetary policy intervention to keep inflation stable weakens the effect of fall in unemployment in the economy thus cause flattening or biases in the slope of Phillips curve. Endogenous monetary policy may be called as prime cause of changing or weakening relationship of Phillips curve. These results are also consistent with (McLeay & Tenreiro, 2020).

(Zaman et al., 2011) examined existence of Phillips curve by using 35 year data for Pakistan. The results suggested that there exist significant long run as well as short run negative relationship between inflation and unemployment. The study provided empirical evidence of existence of Phillips curve in Pakistan. (Asjed et al., 2014) investigated impact of global output gap (GOGH) on domestic inflation using time series data from 1982-2012 by employing Auto Regressive Distributed Lag (ARDL) Model in case of Pakistan. The results suggested that Global Output gap positively and significantly affects domestic inflation in case of Pakistan.

(Riffat et al., 2016) investigated empirical existence of open economy New Keynesian Phillips curve for Pakistan using data for the period 1972-2010. Study found that although lagged inflation and expected future inflation both are significant but the coefficient of lagged inflation is larger thus indicating that inflation is dominantly backward looking phenomenon in Pakistan. Output gap is key inflation determining factor in Pakistan and inflation is dominantly affected by external factors. (Mangnejo, Mahar, & Ahmed, 2020) have investigated the relationship between inflation and unemployment in Pakistan using time series data from 1991-2015. By using Granger causality test study found significant relationship between inflation and unemployment thus confirming the existence of Phillips curve in case of Pakistan.

(Sharif & Qayyum, 2018) have estimated inflation output gap tradeoff and time instability of Phillips curve in Pakistan during different periods of inflation by using triangular model using time series data from 1971-2016 for Pakistan. The study used three step methodology to estimate this relationship such as unit root analysis, co-integration analysis and error correction mechanism. Study found long run significant relationship between supply shock variable (international oil prices) and inflation and no significant relationship between inflation and output gap in long run but significant in short run.

The above literature review highlights empirical evidence for many countries on changing relationship of inflation and output gap. Analyzing disaggregated Phillips curve for inflation in sub-groups of CPI is the key area of research having important policy relevance. Disaggregated analysis is useful for sector specific policy intervention since globalization has affected differently output and employment across the sectors. A number of empirical studies have specifically studied existence of Phillips curve at aggregate level. However, no study has checked the impact of domestic and global output gap on inflation at disaggregated level for inflation in sub-groups of CPI in Pakistan which is the major thrust of current research.

Methodology of the Study

This Section presents the model used to estimate traditional and new style Phillips curve for Pakistan to test whether in presence of global output gap the coefficient of traditional Phillips curve declines or not. For this purpose, following model has been estimated for overall, food, non food and core inflation. The models are developed inspired by original models of recent studies by (Abdih et al., 2016; Çiçek, 2012; Hooper et al., 2020)

$$INF_t = \alpha_0 + \alpha_1 INF_{t-1} + \alpha_2 GAP1_t + \alpha_3 GAP2_t + \alpha_4 DCRIS_t + \varepsilon_t \dots \dots \dots (01)$$

$$FINF_t = \beta_0 + \beta_1 FINF_{t-1} + \beta_2 GAP1_t + \beta_3 GAP2_t + \beta_4 DCRIS_t + \mu_t \dots \dots \dots (02)$$

$$NFINF_t = \gamma_0 + \gamma_1 NFINF_{t-1} + \gamma_2 GAP1_t + \gamma_3 GAP2_t + \gamma_4 DCRIS_t + \nu_t \dots \dots \dots (03)$$

$$CINF_t = \delta_0 + \delta_1 CINF_{t-1} + \delta_2 GAP1_t + \delta_3 GAP2_t + \delta_4 DCRIS_t + e_t \dots \dots \dots (04)$$

Where,

INF_t= Current average overall annual CPI inflation in Pakistan

INF_{t-1}= One period lagged average annual CPI inflation in Pakistan

FINF_t= Current average annual Food CPI inflation in Pakistan

FINF_{t-1}= One period lagged average annual Food CPI inflation in Pakistan

NFINF_t= Current average annual Non Food CPI inflation in Pakistan

NFINF_{t-1}= One period lagged average annual Non Food CPI inflation in Pakistan

CINF_t= Current average annual Core CPI inflation in Pakistan

CINF_{t-1}= One period lagged average annual Core CPI inflation in Pakistan

GAP1= Domestic output gap measured as the difference between actual and trend real GDP of Pakistan in natural log

GAP2= Global output gap measured as the difference between actual and trend global real GDP in natural log

DCRIS= Dummy variable to capture effect of global economic crises 2008 assuming value one for year of crisis and zero otherwise

$\varepsilon_t, \mu_t, v_t, e_t$ = Stochastic error terms

- Lagged inflation has been incorporated as an independent variable in the models to capture inertia effect in explaining variation in inflation. The expected sign of its coefficient is positive meaning that previous period's inflation affects current inflation positively. If in the previous period inflation was high, there will be strong anticipation that in future it will rise more (Asghar et al., 2013); (Jašová, Moessner, & Takáts, 2020); (Çiçek, 2012)
- Domestic output gap has been incorporated as main independent variable in the model. Positive value of its coefficient means that actual output is greater than potential level of output resulting rise in inflation and vice versa. According to empirical literature reviewed above, the expected sign of the coefficient is positive representing existence of Phillips curve relationship. (Asjed et al., 2014; Çiçek, 2012); (Auer et al., 2017)
- Global output gap has been incorporated in the model to capture the effect of global or external factors. The expected signs of its coefficient is positive. [(Jašová et al., 2020); (Çiçek, 2012); (Asjed et al., 2014). Global slack hypothesis holds when GAP2 has greater impact on domestic inflation as compared to GAP1.
- A dummy variable DCRIS has been incorporated in the model to isolate the impact Global Economic Crisis 2008. The plot of CPI inflation in Figure 01 clearly shows unusual hike in inflation crossing 20 percent in 2008 as compared to 7.6 percent observed in 2007. The expected sign of its coefficient is positive as guided by a large volume of literature (Asjed et al., 2014); (Bhatti & Qayyum, 2016); (Jašová et al., 2020)].

The data period for all estimated models is 1976-2019 except for the model estimated for core inflation which has been estimated for the period 1991-2019. The data sources of variables include World Development Indicators, World Bank; various issues of Pakistan Economic Survey and SBP Annual Reports.

RESULTS AND FINDINGS

To avoid spurious results in a regression, stationarity of data is checked as a prerequisite for applying Ordinary Least Square (OLS) technique. For this purpose, the study has applied Augmented Dickey Fuller (ADF) developed by (Dickey & Fuller, 1981) test to check stationarity and results are given in Table 1. ADF results show that all variables are stationary at level for the data period 1976-2019. The data for core CPI inflation was available for the duration 1991-2019. When applied ADF test, it was found integrated of order one.

Table 1: Results of Augmented Dickey Fuller Test

Variables	At Level		
	Intercept	Trend Intercept	& Decision
INF	-3.16***(0)	-5.02***(0)	I (0)
FINF	-3.28***(4)	-3.71***(0)	I (0)
NFINF	-3.37***(0)	-3.31***(0)	I (0)
GAP1	-3.95***(1)	-5.01***(4)	I (0)
GAP2	-3.23***(0)	-3.19(0)	I (0)

*, **, *** indicate the level of significance at 10%, 5% and 1% respectively. The critical values of ADF statistics were based on Mackinnon (1996). The lags in parenthesis were based on Schwarz Information Criterion.

Table 02 shows that GAP1 positively and significantly affects overall and food inflation in Pakistan in presence of GAP2 as explanatory variable in the models, whereas, GAP1 does not significantly affect nonfood inflation during the data period 1976-2019. Firstly, it means that Phillips curve relationship for overall and food inflation remains statistically significant even in the presence of global output slack in the regression as an external determinant of inflation. Secondly, GAP2 significantly affects overall, food and nonfood inflation dominantly thus proving evidence for Global Slack hypothesis. Dummy variable incorporated in the model to capture impact of global economic crisis 2008 also positively and significantly affects overall, food and nonfood inflation in Pakistan.

Table-2: Estimation Results of Model 1, 2 and 3 (Overall, Food and Non-Food Inflation)

Dependent Variables				
Independent Variables	INF	FINF	NFINF	

C	4.6498*** (0.000)	9.0969*** (0.000)	4.355*** (0.000)	
INF_{t-1}	0.4046*** (0.0005)	-----	-----	
FINF_{t-1}	-----	0.0600 (0.6295)	-----	
NFINF_{t-1}	-----	-----	0.3956*** (0.000)	
GAP1(-1)	0.0049 (0.077)	0.00856* (0.0410)	0.0014 (0.4739)	
GAP2	0.5525*** (0.001)	1.3671*** (0.0000)	0.4687*** (0.001)	
DCRIS	8.2433*** (0.001)	16.421*** (0.0001)	6.6085** (0.000)	
R²	0.7703	0.6657	0.6601	
ADJ R²	0.7441	0.6275	0.6201	
S.E. of Regression	1.9039	3.1972	1.6165	
F-Stat (Prob)	29.357 (0.000)	16.9288 (0.000)	16.506 (0.000)	
Diagnostic Tests				
Jarque-Bera Histogram Test:				
F-Statistics (prob)	0.6476 (0.7233)	0.8580 (0.651)	8.7013 (0.128)	
Bresch-Godfrey Serial Correlation LM Test:				
F-Stat (Prob)	1.9320 (0.160)	1.3515 (0.273)	0.5318 (0.4701)	
Heteroskedasticity ARCH Test:				
F-Stat (Prob)	1.5935 (0.2147)	0.0755 (0.785)	0.2938 (0.5911)	
Ramsey Reset Test:				
F-Stat (Prob)	0.9341 (0.340)	0.0924 (0.0763)	0.4095 (0.5266)	
Recursive Estimates:				
CUSUM	Stable	Stable	Stable	
CUSUM SQ	Stable	Stable	Stable	

*, **, *** indicates the level of significance at 10%, 5% and 1% respectively.

As discussed above, data on CPI core inflation (CINF) was only available for the subsample period 1991-2019. Further, the series was integrated of order one leading us to apply Autoregressive Distributed lag (ARDL) model to test Phillips curve relationship among CINF and explanatory variables. When Bounds test was applied, it revealed that value of calculate F Stat = 3.719 was above upper critical limit (3.52) based on (Pesaran, Shin, & Smith, 2001) at 10% level of significance thus leading us to conclude existence of cointegration relation presented in Table03 . The existence of cointegration relation was reconfirmed through negative and significant coefficient (-0.90) of lagged error correction term ECM (-1) in the short run model for core inflation.

Table 3: Long Run Estimation Results of Model 4 with global variables

Variables	Coefficients	t-values	Probability
GAP1	-0.003	-0.906	0.395
GAP2	0.790**	3.045	0.018
FINF	0.555*	1.902	0.098
DLER	-51.41	-1.732	0.126
C	7.152***	5.944	0.0006

*, **, *** indicates the level of significance at 10%, 5% and 1% respectively.

CONCLUSION AND POLICY RECOMMENDATION

Phillips curve has been studied both by academia and policy makers from several decades due to its policy relevance and pertinent place in macroeconomic literature. The global slack hypothesis is proved if estimated coefficient of domestic output gap declines when global output slack as a determinant is introduced in the model to estimate Phillips curve. In case of Pakistan, determinants of overall inflation have been studied in a large number of studies at aggregate level. However, no previous study has studied global slack hypothesis both at aggregate and disaggregate level. This study has estimated Phillips curve relationship including global output gap as a determinant of overall, food, nonfood and core inflation in Pakistan. Based on the empirical results of the study it is concluded that global slack hypothesis exists in Pakistan. The domestic output gap in presence of global output gap does not affect nonfood and core inflation in Pakistan. This finding reflects effectiveness of monetary policy intervention by central banks' in controlling nonfood and core inflation. However, domestic output gap in presence of global output gap significantly affects food inflation in Pakistan. Considering ample weight of food items in overall CPI, demand management policies in Pakistan need to be accompanied with supply side price controlling measures. The results have also indicated that global economic crisis 2008 positively affected overall, food and nonfood inflation in Pakistan.

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