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Impact of International Crude Oil Price Volatility on Non-Food Inflation in Pakistan: Long-Term and Short-Term Perspective: An ARDL Approach

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ABSTRACT:

The study investigates volatility in international crude oil prices affect the pricing of non-food items prices in Pakistan. It also examines inflation in Pakistan is mainly attached to oil prices and determined as “monetary phenomena”. The "Quantity Theory of Money" (QTM) is used for theoretical justification. While empirical results were obtained using the ARDL (Autoregressive Distributed Lag Model) based on monthly time series from July 2001 to June 2019. The results revealed that oil prices are positive and statistically significant. Non-food inflation is proven to be more effective in the long run than to the short run with an order of 8 lags. Non-food inflation tends to fall by 1.59 % for every 1% increase in real national income, but non-food inflation rises by 1.10 % for every 1% increase in M2. In the long run, a 1% rise in External Debt (EXTDBT) has a 0.4 % impact on non-food inflation. While Non-food inflation would climb by 0.86 % with a 1% increase in current world oil prices. Whereas the real income coefficient is shown to be very elastic, the LSMI (Large Scale Manufacturing Index) coefficient is determined to be between 0.1 and 0.3 %. On average 0.11% non-food inflation occurs due to a percentage change in real M2. However, from a policy perspective, we suspect that inflation can be managed and solved by switching from crude oil to renewable energy, implementing contractionary policies, and enacting long-term solutions to monetary and fiscal challenges.

Keywords: Oil Price Volatility (OPV), Quantity Theory of Money (QTM), Non- Food Inflation, Pakistan.

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Introduction

A vital component of both the production and distribution of goods and services is oil. As a result, swings in oil prices have the potential to have an impact on consumer prices and production costs across the economy. The concept of "cost-push inflation" refers to the effect that rising oil prices have on the cost of manufacturing products and services, which in turn raises consumer prices (Hooker, 2002). On the other hand, oil prices dropping might result in lower production costs and lower retail prices. However, not all industries are equally impacted because non-food commodities are sometimes subject to higher inflationary pressures than food ones. Oil prices have a greater direct impact on non-food items due to factors including energy prices, production costs, and transportation costs (Blanchard & Gali, 2007).

Fuel and non-food items are essential for human survival in both the economic cycle and in life. The modern world depends heavily on energy as a prerequisite for economic activities. Among the fossil fuel family, crude oil is an essential energy source. It is anticipated that oil will continue to account for about 28% of the world's energy mix between 2015 and 2040, surpassing both gas and coal (WOO, 2018). The advancement of the modern world revolves around the energy and oil markets. On the other hand, several variables, such as population increase, technical improvements, shifting demographics, structural change, economic progress, and volatility in oil prices, will all impact future developments in the energy and oil markets (WOO, 2017).

Crude oil is the engine and essential component of any country's economic expansion. Oil-exporting nations benefit from the increase in global oil prices, while oil-importing nations struggle. The main reason for this occurrence makes sense: higher earnings guarantee greater financial stability for nations that export oil, while reduced revenue creates financial instability for those that buy oil, and vice versa (Kurihara,2015). Reports that have been made public state that during the 1990s, the price of crude oil fluctuated between $18 and $23. In 2004-05, it went up from $40 to $60. But between July 2007 and December 2008, it had the biggest known increase in oil prices, going from US $70 to US $174

Considering its variety of applications in the transportation, industrial, agricultural, and domestic sectors of the economy, crude oil has a significant impact on people's lives. People's standard of living consequently varies because crude oil prices are volatile and unpredictability (Jahangir, 2018). The price of other items may be impacted by the price transmission deviations of oil prices. One of the main causes of the overall and non-food inflation has been determined to be the continuous rise in the price of oil (Li, J. 2021). There is a prevalent cause-and-effect relationship between inflation and oil. When oil prices rise, inflation increases, but when prices fall, inflation starts to decrease (Benramdane, A. (2017).

Inflation is frequently the primary goal to prevent economic disaster when economic growth stability is employed as the main indicator of a nation's macroeconomic performance (Ahmad, K. (2017)..Since inflation is detrimental to the economy, especially in developing nations like Pakistan, As a result, since the 1970s, energy and inflation, in particular shocks to the price of crude oil, when coupled with US sanctions against Iran, have become a hot topic for policy makers, scholars, and the general public worldwide, as evidenced by the recent spike in oil prices internationally (Holland, et al., 2013). As a result, the issue of how to stabilize prices by raising both of these crucial macroeconomic variables together goes unanswered, which raises the cost of non-food and entire inflation, particularly in developing

countries In reality, considering the significant non-food inflation brought on by the rise in global oil prices, it is currently regarded as a reasonable problem that requires serious resolution by relevant authorities for the benefit of society as a whole (Tekeber Nigusse, et al., 2019).

If we examine Pakistan's energy and inflation scenario, we find that it is mostly influenced by volatility in the price of imported oil, which affects domestic inflation through food and non-food related inflation. Increases in non-food prices not only make it harder to allocate funds for non-food necessities, but in Pakistan, which is an agricultural nation, the poorest households are likely to spend 70% of their income on food, leaving 30% for non-food expenses like health and education (Murthy P, 2015). However, inflation in Pakistan is frequently considered a monetary problem that is closely linked to the world's crude oil price. Pricing, as is widely accepted in the literature, is a short-term reaction to any economic shocks linked to extremely volatile components of inflation, such as price increases for non-food items that act as the basis for inflationary tendencies, particularly in nations that import oil. Though inflation is mostly disregarded, perspectives on inflation management are somewhat supported by both conventional and contemporary approaches to understanding inflation theories. This justifies our investigation of the mechanisms of transmission driving increases in the prices of non-food items in Pakistan, an open economy.

Non-Food Inflation in Pakistan

Considering Pakistan's Vision 2025, the country has identified energy security as a challenge and has set the goal of accomplishing Sustainable Development Goal 7 by the year 2025: "Ensure access to affordable, reliable, sustainable, and modern energy for all"(UN, 2019). But now country is incapable to fulfil the growing energy demand at the rate of 11 to 13% per year through indigenous resources (Aziz et al., 2017). Pakistan has limited fossil fuel sources, and its per capita energy consumption is modest, at roughly 501.6 kg oil equivalent, compared to the global average of 1790 kg oil equivalent (Mirjat et al., 2017)

The high price of oil on international markets, which permanently affects people's quality of life and daily existence, is one of the main causes of rising inflation in developing nations that import oil, like Pakistan (Sidorenko, O., et al., 2021. The nation mostly depends on oil imports to meet its domestic energy demands; only 15% of the overall demand is satisfied by domestic sources, meaning that the nation must pay about $14 billion in oil import bills annually. To meet domestic demand, Pakistan imported oil valued at about 13.14 billion dollars during the final 11 months of the 2018-19 fiscal year. The petroleum products category includes petroleum gas, petroleum crude, and liquefied natural gas. According to Sarwar et al. (2020), these imports make up almost 30% of all imports, with crude oil accounting for 50% of the petroleum group's contribution. In reaction to oil price volatility (OPV), which manifests itself in the form of inflation at gas stations and utility costs, a significant burden on the Balance of Payments (BOP) is either directly or indirectly transferred to the final consumer (Mabro, 1984). The dearth of crude energy exploration and oil reserves in the nation is the explanation for the significance of this relationship. The transportation and electrical sectors are the main users of oil (Pakistan Economic Survey, 2017).

The primary drivers of overall and non-food inflation are rising oil prices and financial anxieties in developing countries like Pakistan. International research has shown that food and non-food inflation in developing nations that import oil is

consistent with the existence of pass-through effects of oil prices through both vertical and horizontal transmission channels, Demirbas, A., et al., (2017; Salman, H., 2014). Whereas some research, like Khan et al. (2007) and Khan and Qasim (1996), concentrated on internal issues related to fiscal or monetary policy, others were more dependent on external factors. Additionally, research indicates that greater monetary developments—which are impacted by significant borrowing from both the public and private sectors—are the main cause of Pakistan's rise in non-food prices (Khan and Qasim, 1996). But there are other exogenous shocks that contribute to domestic inflation, most notably the volatility of oil prices, and they are not limited to monetary and fiscal factors. In Pakistan, changes in global oil prices are commonly interpreted as indicators of shifts in internal inflation.

An increased trend in oil prices would most likely result in higher production costs at all levels, driving up the cost of goods included in the CPI for both core inflation and non-food inflation (Economist, 2018). Pakistan's CPI average price for food items in the 1990s was Rs. 187.05, while the average price for non-food items was Rs. 173.13. While non-food products cost an average of Rs. 215.23 and food items cost an average of Rs. 226.59 in the 2017 CPI (Handbook of Statistics on Pakistan Economy, 2017). The global crisis's consequences, which continued to drive up the price of commodities and crude oil even as its effects started to diminish. On the other hand, inflation in Pakistan stayed strong, averaging double digits. Because the government ignored the reality of oil inflation and altered its fuel and food subsidy programs for political reasons, which did not assist consumers (Jongwanich and Park, 2011). Through strategic maneuvering, all stakeholders involved were able to transfer the tax burden from the government to the public. Reduced or restricted output growth is the main cause of the supply-side shock. As a result, the demand-side pressure is unable to keep up with the rising cost of oil, which lowers potential output and raises the inflation rate (Bernanke, 2001).

Because terms of trade are determined in US dollars to explain inflation via money supply, the impact of global oil prices through cost of production is supply side determinants as opposed to demand side factors. In the short term, rising oil prices are predicted to contribute to domestic inflation; however, over time, changes in the money supply will lessen the effects of rising oil prices and any channels caused by supply-demand gaps. From a monetarist perspective, inflation is the monetary problem as discussed by Friedman (1963). "Inflation is a monetary phenomenon that exists everywhere and always."

The key to inflation is an increase in the money supply (Lim & Papi, 1997). But in Pakistan's instance, the role of the monetary authorities has significantly expanded in establishing all these impacts, which are driven by the price of oil. Considering that monetary authorities can combat inflationary pressure by using reliable monetary instruments. The perspective of Anderton, R. et al. (2009) is tenable if the inflation-countering tactic establishes a steady state of low inflation, stabilizing inflation expectations and affecting the conduct of those who set prices.

Pakistan's lack of energy sources is caused by a variety of factors, such as inefficient energy distribution, the private sector's considerable influence, a decline in oil and gas exploration, poor management, an unstable state of law and order, a weak monetary policy, and ineffective governance. According to Lutz Killian (2009), the economy can only be protected from uncontrollably high inflation caused by volatile oil prices by lowering its reliance on oil as a major component of production and by enacting cautious

monetary policy.

Thus, to secure the future of the sixth most populated country in the world, it is imperative to develop a national and sensible energy production policy both now and, in the future, (Rehman, M. U. (2018). Variations in oil prices have an impact on the real money balance because they encourage consumers to spend more, drive up borrowing rates, and impede economic growth (Pierce and Enzler, 1974 and Mork, 1994). Following figure depicts Pakistan's inflation rate for non-food inflation and oil price growth from June 2000 to July 2019.

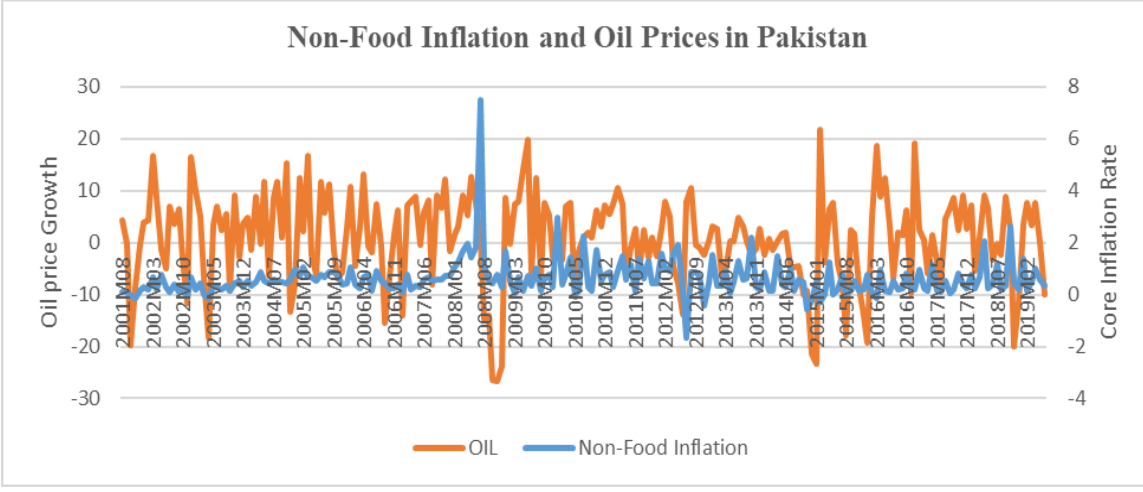

Figure:1 Non-Food Inflation (Core Inflation) and Oil Prices in Pakistan
Data sources: Pakistan bureau of statistics and Fred Database (2019)

The above-mentioned long-term impacts of the global crisis kept commodity and world oil prices relatively high, even as the crisis' effects began to disappear. In Pakistan, inflation levels continued to rise and in double digits, even as the crisis' effects began to fade. Because the government alter the policies of subsidy for fuel and food for political purposes ignoring the true oil -inflation picture and not for the consumer welfare (Jongwanich & Park, 2011). By taking advantage from the situation producers shift the tax burden beard by the government into consumer prices. Similarly, U.S dollar exchange rate movement's pressure against weak currency like rupee, generates inflationary pressure in economy because oil is traded in U.S. dollars. Here the focal point in the supply side shock is affiliated with decreased or limited in output growth and resultant demand side pressure cannot bear the burden of increase in oil prices and may diminish potential output and lead to increase inflation (Bernanke & Mishkin 1997). And if this happens continued with small intervals like, monthly or quarterly the domestic inflation rate for both the food and non-food items persists for a long time coupled with unemployment and poverty level increase at substantial levels (Amjad et al; 2011).

Literature Review

The literature review explores the impact of oil price surge on inflation in oil exporting and importing nations, finding a strong correlation between inflation and oil prices.

Toni, M (2024) have Toni's 2024 study found a significant correlation between inflation and oil prices in OMAN, highlighting the impact of oil prices on the world economy's expansion and the need for policymakers to consider this relationship. According to Chen, Zhu, and Li (2020), energy contributed 7.3% of the CPI in

December 2021, with oil prices having a direct impact on inflation. The cost of goods manufactured of plastic is increased by crude oil, a crucial component of plastics. Transportation expenses are also factored into consumer prices. Nasir, Huynh, and Vo (2020) found that oil prices have a direct and indirect impact on inflation. Inflation directly rises when consumer demand for oil commodities is high. The supply side indirectly affects product costs, which raises producer pricing and production costs. According to Lopez-Villavicencin & Pourroy (2019), there is an indirect link between the price of crude oil and inflation, as indicated by the core CPI index, which excludes the price of food and energy due to their frequent volatility. According to Feldkircher & Siklos (2019), the impact of oil prices on macroeconomic variables varies depending on whether a country exports or imports oil. Exporting nations see higher revenue, spending, and investment, which lowers unemployment. Because of lower consumption, importing nations face higher production costs, lower consumer expenditure, and higher unemployment. According to Nazlioglu, Gormus, and Soy¬tas (2019), there is a direct and considerable impact of oil prices on the rate of inflation. However, the correlation between inflation and oil prices is not as strong as it was in the 1970s. According to this prediction, there will be a link between fluctuations in the price of oil and inflation of about 0.27. Put simply, it showed that a consistent 10% increase in oil prices might result in a 2.7% increase in the consumer price index. Qiang et al. (2019) identified several factors affecting global oil prices, including supply and demand changes, hedgers, traders, and market sentiment. Policymakers must identify these factors to develop effective strategies for reducing oil prices. Al-Salti et al. (2021) found a significant positive link between Oman's inflation and oil prices, with the effect being more noticeable in the near term. Studies show a significant correlation between oil prices and inflation in the US and positive associations in five oil-exploring economies, according to Gagliardone & Gertler (2023). Patel & Patel (2019) argue that the deductive method is effective for quantitative research, as it helps identify explanations for interconnected ideas and variables. Coletti et al (2021) revealed that oil and non-oil commodities have distinct macroeconomic impacts, impacting monetary policy frameworks. Refined oil consumption and demand-driven price movements lead to long-term inflation pressures. Shaikh et al. (2021) found oil price volatility positively impacts food inflation in Pakistan, but the Inflation Targeting Framework is inefficient. Recommendations include profitable policies, strong administrative control, subsidy reforms, renewable energy sources, and monetary policy. Sarwar et al. (2020) found a nonlinear relationship between food and non-food inflation in Pakistan, indicating market power exists, with asymmetric effects only occurring when oil prices rise. Melaku's (2019) study on Ethiopia's inflation using the "Quantity Theory of Money" model reveals a long-term relationship between explanatory factors and consumer price index, with key determinants being real effective exchange rate and money supply.

Research Methodology

Empirical framework

This study is conventionally designed to investigate the impact of international oil price volatility (OPV) on Non-food inflation in Pakistan. For this purpose, QTM (Quantity Theory of Money) is used as a benchmark model Papi, & Lim (1997). This model is carried on by researchers such as, Tekeber Nigusse (2019) in Ethopia and Mehak Moazam & Ali Kemal (2016), Khan and Schimmelpfennig (2006), Qayyum (2006) in context of Pakistan. An autoregressive distributed

lag (ARDL) technique to co-integration is used in this study to investigate the long-term relationship between oil prices and non- food prices. See equation (1)

$$ln\pi_t^{non-food} = \beta_0 + \beta_1 lnOP + \beta_2 lnM2 + \beta_3 lINT + \beta_4 \ln EXDBT + \beta_5 lnLSM + \beta_6 LnRGDPPC + u_i \quad (1)$$

Where in this model equation $ln\pi_t^{non-food}$ log of Non-Food Inflation treated as a dependent variable and independent variables are such as log of Oil Price (lnOP), log of Broad Money Supply (lnM2), log of Interest Rate (INT), log of External Debt (lnEXDBT) and log of Large-Scale Manufacturing Index (lnLSM). Large Scale Manufacturing Index is taken as proxy for output growth. All independent variables in the model are considered as endogenous and exogenous variables. u_i represents an error term. The log-log series of variables inferred as elasticity. However, the model based on the theoretical justification of QTM provided in the literature, Therefore, the short-run and long run behavior in the model of inflation is expected to vary positively with all variables. The data for all variables is taken from the State Bank of Pakistan's monthly statistical bulletins (2018-19), and the Brent crude oil price is taken from Fred-data set 2019, which has also been used extensively in previous studies, e.g. (Abdlaziz et al., 2016; Gazdar, 1992). To disaggregate annual series into monthly we use Lisman and Sandee (1964)2 disaggregation method.

Since, the proper technique to examine the long-run relationship depends on the order of integration of the variables The next section will discuss and presents the econometric study, which began with assessing the order of integration.

Unit Root Test

Using both the ADF and PP tests allows for a more robust and thorough examination of the unit root properties in our dataset, enhancing the reliability of our findings. To do this, the Augmented Dickey Fuller (ADF) test represented as: see equation (2)

$$\Delta \mathbf{Y_t} = \boldsymbol{\beta_0} + \boldsymbol{\beta_1} \mathbf{Y_{t-1}} + \sum_{\mathbf{k=1}}^{\mathbf{n}} \mathbf{d_k} \Delta \mathbf{Y_{tk}} + \mathbf{v_t} \quad (2)$$

Where, above equation shows ADF test statistics, the Y_t is variable having time series characteristics, t shows time series dimension. Yt-1 is a lagged value of that variable where Δ Yt shows the change operator of variable Y in equation. Furthermore, vt shows the white noise error term; under classical assumption error term is assumed to be random and zero.

ARDL Bound Test for Co-integration

The Autoregressive Distributed Lag (ARDL) model after popularization of (Pesaran et al., 2001) is applied in this study because the unit root test confirms- all series are stationary at level and at first difference. The ARDL technique has the advantage of providing consistent estimates of the long-run coefficients that are asymptotically normal irrespective of whether the underlying repressors are (1) or I (0). Besides that, the ARDL approach is more efficient for small sample data. Pesaran and Shin (1998) show that the OLS estimators of the short-run parameters are consistent and the ARDL based estimators of the long-run coefficients are super-consistent in small sample sizes. The ARDL version of is represented in (3).

$$\Delta\pi_{t-p}^{non-food} = \alpha_0 + \sum_{i=0}^{n} \varphi_i \Delta\pi_{t-p}^{non-food} + \sum_{i=0}^{n} \varphi_i \Delta M2_{t-q} + \sum_{i=0}^{n} \varphi_i \Delta RGDPPC_{t-q} + \sum_{i=0}^{n} \varphi_i \Delta \mathrm{LSM}_{t-q} + \sum_{i=0}^{n} \varphi_i \Delta EXDEBT_{t-q} + \sum_{i=0}^{n} \varphi_i \Delta OIL_{t-q} + \beta_i M2_{t-q} + \beta_i RGDPPC_{t-q} + \beta_i LSM_{t-q} + \beta_i OIL_{t-q} + \beta_i \pi_{t-p}^{non-food} + \beta_i EXDEBT_{t-q} + \varepsilon_t \quad (3)$$

Equation (3) shows the impact of independent

variables over time. To investigate long-run relationships, bound testing using the F-test is applied under Pesaran et al. (2001) procedure. The F-test tests the hypothesis of no co-integration among variables against the existence or presence of co-integration. If the F-statistic exceeds the upper bound critical value, the hypothesis (variables are not co-integrated) is rejected.

Error Correction Model

The Error Correction Model is a useful tool for analyzing the short- run relationship between variables. This is only feasible if a long-run relationship between the dependent and independent variables has been established. ECM can be used to test the above ARDL equations parameters stability. As a result, the above equation contains the short-term equation of the ARDL co-integration model (3.3) is represented as equation (4).

$$\Delta\pi_{t-p}^{non-food} = \alpha_0 + \sum_{i=0}^{n}\varphi_i\,\Delta\pi_{t-p}^{non-food} + \sum_{i=0}^{n}\varphi_i\,\Delta M2_{t-q} + \sum_{i=0}^{n}\varphi_i\,\Delta RGDPPC_{t-q} + \sum_{i=0}^{n}\varphi_i\,\Delta LSM_{t-q} + \sum_{i=0}^{n}\varphi_i\,\Delta EXDEBT_{t-q} + \sum_{i=0}^{n}\varphi_i\,\Delta OIL_{t-q} + \Omega EC_{t-1} + \acute{\upsilon}_t \quad (4)$$

Where ∂ is the short run parameters of speed of convergence toward equilibrium and EC with its lagged in above equations (3.4.1) is the residuals generated form long run ARDL co-integration equations (3.3). The ECt-1with its lag must be negative and significant if the short run convergence toward the long run equilibrium exists.

Where in this model equation $ln\pi_t^{non-food}$ log of Non-Food Inflation treated as a dependent variable and independent variables are such as log of Oil Price (lnOP), log of Broad Money Supply (lnM2), log of Interest Rate (INT), log of External Debt (lnEXDBT) and log of Large-Scale Manufacturing Index (lnLSM).

Choosing Appropriate Lag Length

The OLS estimation technique is used to determine the most acceptable lag length and whether a deterministic linear trend should be included. Economic theory rarely provides information on lag length, so empirical estimates are necessary. The vector of autoregressive (VAR) is the best choice for determining lag length. Information criteria determine the amount of dependent variable information in equations. AIC, SIC, and H-Q are commonly used. Minimal AIC and SC values improve model quality. They are calculated in log form using formulas. The AIC information criteria is given as in equation (5).

$$AIC = ln\left(\frac{\sum_{t=1}^{T}\acute{\upsilon}t^2}{T}\right) + \frac{2K}{T} \quad (5)$$

Where T is length of variables in existing sample size of series in model, K shows the number of estimated coefficients, and 〖út〗^2 are the estimated residuals.

The SIC information criteria is given as

$$SIC = ln\left(\frac{\sum_{t=1}^{T}\varepsilon t^2}{T}\right) + \frac{KlnT}{T} \quad (6)$$

Where T is length of variables in existing sample size of series in model, K shows the number of estimated coefficients, and εt2 are the estimated residuals.

Results and Discussion

Variables	Level		First difference	
	C	C & T	C	C & T
	t-static	t-static	t-static	t-static
$\pi_t^{non-food}$	-0.231	-1.533	-5.637*	-5.618*
IR	-2.268	-2.526	-11.835*	-11.834*
LSMI	-3.271**	-3.431***	-2.459	-3.077
M2	-3.301**	-2.327	-2.185	-4.225*
OIL	-2.243	-2.091	-10.978*	-11.002*
EXDBT	-1.891	-2.877	-9.809*	-9.779*

Author's estimation: Note; the natural logarithm is applied over all variables and ***, ** and * shows 10, 5 and 1% percent level of significance.

Unit Root Tests

Table: 1: Augmented Dickey-Fuller Test (ADF)

Table: 2 Phillips-Perron (PP) Test

Variables	Level		First difference	
	C	C & T	C	C & T
	t-static	t-static	t-static	t-static
$\pi_t^{non-food}$	0.066	-1.575	-13.371*	-13.354*
IR	-2.898*	-3.202***	-23.612*	-23.591*
LSM	-2.573	-3.884**	-18.451*	-19.349*
M2	-3.663*	-2.77	-21.577*	-34.748*
OIL	-2.111	-1.841	-10.788*	-10.726*
Exdebt	-1.806	-2.676	-6.915*	-6.841*

Author's estimation: Note; the natural logarithm is applied over all variables and ***, ** and * shows 10, 5 and 1% percent level of significance.

The study used ADF and P-P unit root tests to examine the relationship between the LSM and money supply. Results showed a substantial intertwining order I, rejecting the null hypothesis at 5% significance. The LSM was only significant at a 10% threshold, implying integration at an order of magnitude.

VAR Lag Order Selection Criteria

Table 3: Lags Specification: Vector Autoregressive for Non-Food Inflation

VAR Lag Order Selection Criteria						
Endogenous variables: $\pi_t^{non-food}$ RGDPPC M2 EXDEBT LSM						
Exogenous variables: C Oil						
Lag	LogL	LR	FPE	AIC	SIC	HQ
0	576.566	NA	1.67E-11	-7.78712	-7.54077	-7.687
1	1795.666	2303.68	1.37E-18	-24.1057	-23.120*	-23.705
2	1873.16	140.023	7.75E-19	-24.6781	-22.953	-23.977
3	1951.216	134.5788	4.37E-19	-25.2582	-22.794	-24.257
4	2016.985	107.951	2.93E-19	-25.668	-22.466	-24.367
5	2072.245	86.129	2.30E-19	-25.934	-21.992	-24.332
6	2148.047	111.874	1.37E-19	-26.483	-21.802	-24.581*
7	2191.648	60.740	1.29E-19	-26.588	-21.168	-24.386

Note: * Indicates significant lag order selected by different criterions.

The minimum AIC values with 8 lags found -26.67 and asterisk sign implies statistically significant at 5 percent level of significance. Meanwhile the minimum SIC statistics with 2-time lapse found -23.12 and asterisk sign shows significance with 95 percent confidence interval. The model indicates to choose 8 lags order for our Non-food inflation equation to obtain unbiased coefficient and avoid problem of serial correlation. As a result, the distribution of test data is critical for determining the true delays order (Saleem & Ahmad, 2015) .

Table: 4 ARDL Bound test statistics for Non-food inflation.

Long-Run Association			
F-statistics	I (0) Lower Bound	I (1) Upper Bound	Significance
11.2595	2.08	3	10%
	2.39	3.38	5%
	2.7	3.73	2.50%
	3.06	4.15	1%

Author's estimation; Note: Null Hypothesis, no long-run relationships exist

The ARDL bound co-integration test suggested by Pesaran et al., (2001) is failed to accept null hypothesis that the price of crude oil and food inflation do not have a long-term relationship in the given period (July-2001 to June-2019). Therefore, the alternative hypothesis is accepted that curd oil price volatility, industrial output growth, financial instruments and nominal exchange rate have significant long run relationship with non-food inflation in country.

ARDL Long Run and Short Run Coefficients of Non-Food Inflation

Table 5: Long run coefficients

ARDL: Dependent Variable Non-Food Price ($\pi_t^{non-food}$)				
Selected Model: ARDL (3, 12, 0, 10, 6, 0,)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LSM_t	-0.025	0.024	-1.068	0.288
$M2_t$	1.108	0.052	21.431*	0.000
$EXDEBT_t$	-0.027	0.012	-2.256**	0.026
OIL_t	0.086	0.015	5.776*	0.000
C	9.274	1.664	5.573*	0.000

Author's estimation; Note: Model selection method based on Schwarz criterion (SIC). ***, ** and * shows 10, 5 and 1% level of significance

The study found that output growth (LSM) has a negative long-run effect on non-food inflation in Pakistan, but this is statistically insignificant. Monetary factors like board money (M2) have a positive and statistically significant effect on general price levels, but their impact is lesser than real income. External debt (EXDEBT) significantly influences non-food inflation in the long run, with an average 0.4 percent reduction in non-food

inflation if a 1% increase occurs. Crude oil price volatility has a positive and statistically significant impact on non-food inflation in Pakistan, with an average 0.86% increase in international oil prices. Our findings are compared to Fayaz & Ahmed's (2019) studied on inflation factors in India, which found all factors co-integrated with inflation.

Table: 6 Short Run coefficients

Dependent Variable: Non-food inflation ($\Delta\pi_t^{non-food}$)				
Selected Model: ARDL (2, 6, 4, 4, 4, 4)				
Case 2: Restricted Constant and No Trend				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	0.009	0.002	3.902*	0.000
$\Delta\pi_{t-1}^{non-food}$	0.206	0.078	2.641*	0.009
$\Delta\pi_{t-2}^{non-food}$	-0.112	0.076	-1.473	0.143
$\Delta RGDPPC_t$	-7.883	2.032	-3.880*	0.000
$\Delta RGDPPC_{t-2}$	4.862	5.364	0.906	0.366
$\Delta RGDPPC_{t-4}$	6.888	7.202	0.956	0.341
$\Delta RGDPPC_{t-6}$	-4.854	2.873	-1.689***	0.094
$\Delta LSMI_t$	0.018	0.008	2.352**	0.020
$\Delta LSMI_{t-2}$	-0.023	0.007	-3.432*	0.001
$\Delta LSMI_{t-4}$	0.013	0.006	2.093**	0.038
$\Delta M2_t$	-0.110	0.052	-2.131**	0.035
$\Delta M2_{t-2}$	0.000	0.027	0.001	0.999
$\Delta M2_{t-4}$	0.116	0.026	4.500*	0.000
$\Delta EXDEBT_t$	0.006	0.003	2.199**	0.030
$\Delta EXDEBT_{t-2}$	0.006	0.004	1.396	0.165
$\Delta EXDEBT_{t-4}$	0.004	0.002	1.502	0.135
ΔOIL_t	0.015	0.005	2.849*	0.005
ΔOIL_{t-2}	0.019	0.009	2.196**	0.030
ΔOIL_{t-3}	0.003	0.008	0.391	0.697
EC_{t-1}	-0.352	0.150	-2.343**	0.021

Author's estimation; Note: Model selection method based on Schwarz criterion (SIC). ***, ** and * shows 10, 5 and 1% level of significance

The coefficient of formulating co-integration (ECM) is -0.352, indicating that price levels move toward equilibrium in the long run with 35.2 percent speed in intermediate months. Non-food inflation positively influences previous price levels, with lags positively associated with one-month inflation. The study found that inflation is primarily caused by previous inflation levels, with a 0.20 percent average. Real income is highly elastic, reducing the effect of non-inflation in the short run. Output growth has both positive and negative impacts on non-food inflation, with intermediate and over a quarter lag. The intermediate change in money supply has a negative relationship with core inflation, but a positive lag effect.

Table: 7 Diagnostic test:

Serial Correlation (B-G LM Test)			
F-statistic	0.69574	Prob. F (2,127)	0.5008
Heteroscedasticity (BPG Test)			
F-statistic	1.71825	Prob. F (25,129)	0.0209
Residual Normality test: Jarque Bera test			
Jarque-Bera Statistics	3.442	Prob.	0.135

Author's estimation: Note: BPG stands for (Breusch-Pagan-Godfrey) BG (Breusch-Godfrey)

As a result, the null hypothesis that variance is not homoscedastic across time cannot be accepted. Therefore, to avoid heteroscedasticity we used HAC test that improves standard errors of each repressor. On the other hand, the test statistics J-B test holds the property residual normality.

Structural Stability Test:

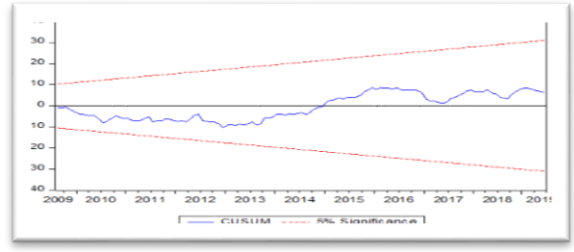

Figure 2: Cumulative Sum test

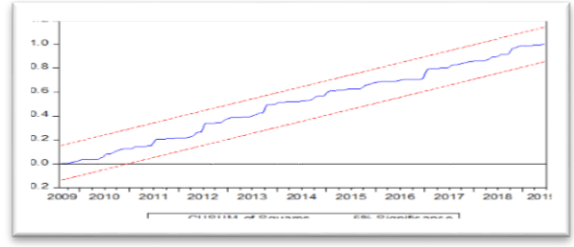

Figure 3: Cumulative Sum squared test

Figures 2 and 3 show CUSUM and CUSUM squared tests results, indicating data falls within a 5% confidence interval, and residuals of the non-food model equation are stable, indicating constant non-food inflation regression coefficients.

Conclusion

Energy and inflation are crucial for the economy's survival, despite adaptive policies. Commodity prices have increased globally, with developing

countries heavily reliant on crude oil. Imported oil costs lead to domestic inflation, affecting the food and non-food sectors. The results as overall conclude that non-food inflation strongly influenced by real per capita income, Money supply, external debts, and oil price volatility in in long run. From the above results, the real income per capita and external debt significantly help to control the inflationary pressure of non-food items. Meanwhile the real money supply, and oil price volatility positively and significantly support non-food price level to spike in the long run. On the other hand, all these factors also have trade-off/relationship with non-food price in the short run. The short-run impact of oil prices also positively causes the non-food price level to rise. Which can be concluded that the oil price volatility in the international market impact domestic inflation in Pakistan to rise in long-run as well as in short-run in the case of non-food inflation. that deteriorates human welfare and create uncertainty in Pakistan caused by oil price increase. "As a whole, we'd like to emphasize the policy implications of our empirical findings." The findings of this study can help policymakers in Pakistan, and oil-importing developing countries around the world.

Policy Recommendations

- The central bank should implement an anti-inflationary policy, analyzing inflation causes to determine if internal demand leads to increased interest rates or if it's due to cost-push.
- Pakistan's increasing reliance on foreign energy, particularly crude oil, is causing currency rate fluctuations. Government should encourage free economic zones, attract foreign investment, manage inflation, and transition to renewable energy.
- An increase in oil prices is believed to increase inflation rates. However, the inverse relationship is complex. The government's primary job is to keep domestic oil costs low, as rising international oil prices may increase demand for goods and services.
- Pakistan's transportation sector is the third-largest oil consumer, consuming over 34% of total energy and 59% of liquid fuel. To transition to green energy, the government should support solar energy.
- The government should enforce price control, prohibit artificial shortages, and discourage bribery and corruption to promote price stability and increase public service delivery transparency.

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