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International Oil Price Shocks and Monetary Policy Nexus: Understanding Inflation Dynamics in Pakistan through New Keynesian framework

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ABSTRACT

This study explores the complex link between inflation in Pakistan and changes in oil price. Analyzing the complicated interaction among these variables in both long and short term using a comprehensive 17-year monthly time series dataset (2006–2023), the study employs Johansen co-integration, Vector Error Correction Modeling (VECM), and Autoregressive Distributed Lag (ARDL). Under-lighting their interdependence, our empirical results reveal a strong long-term association between Consumer Price Index (CPI), Core CPI, and oil prices. VECM analysis reveals persistent inflationary forces, marked by notable disequilibrium adjustments in CPI (13%) and Core CPI (32%), respectively, so highlighting the long-lasting effect of oil price fluctuations on Pakistan's inflation trajectory, so indicating that changes in oil prices have a great impact on Pakistan's inflation landscape.

The results imply that monetary policy can reasonably offset the negative consequences of oil price volatility, hence stabilizing inflation rates. A significant fraction of inflationary pressures is long-term corrected, therefore highlighting the continuation of inflationary factors. Moreover, the study emphasizes the need of differentiating between several price indices in order to evaluate the effect of changes in oil prices and offers important information for legislators trying to improve Pakistan's economic resilience against outside shocks, especially considering the nation's great reliance on oil imports. This work adds to the continuous discussion on appropriate policy reactions to minimize the negative consequences of oil price shocks by clarifying the intricate interactions among oil prices, inflation, and monetary policy.

INTRODUCTION

Rising energy use have driven Pakistan's always-rising need for petroleum during the past few years. The energy portfolio not notably moving towards alternative sources, particularly renewables, despite different government initiatives has resulted in Pakistan's terms of trade suffering. The Economic Survey of Pakistan (2018–19) indicates is insufficient to meet the

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energy needs of a growing economy with only 24.6 million barrels of domestic crude oil output. Pakistan so mostly depends on imported oil, mostly from Middle Eastern nations, most notably Saudi Arabia. With almost $16.910 billion down from $17.014 billion in the previous fiscal year, the Pakistan Bureau of Statistics (PBS) reports that petroleum group imports in Pakistan made for a major share of the total imports of the country. Pakistan declared in August 2024 total imports of $4.4 billion with a $1.7 billion trade deficit.

Particularly in the oil markets, the World Energy Outlook report (November 2019) of the International Energy Agency reveals clear variations in the global energy scene. Oil prices averaged over $60 per barrel in 2019, and they stayed the same despite geopolitical issues affecting several countries that produce notable volumes of the fuel. For instance, political unrest and sanctions resulted in lower Iranian and Venezuelan oil exports; but, overall oil prices remained very stable, primarily due to wise management by large oil corporations. As the structural issues of the fossil fuel industry battled, the COVID-19 outbreak generated hitherto unheard-before disruptions in the oil market that led to a historic price shock. The epidemic's consequences were tightly linked with inflation in 2020–21, therefore aggravating the economic environment. Historical studies including those by Kilian & Murphy (2014), Baumeister & Kilian (2016), and Yergin (1992) illustrate how geopolitics events including wars in Iraq and Kuwait have traditionally risen oil prices and changed inventory demand. Rising tensions between the United States and Iran along with the potential of economic sanctions on Iraq create hazards to the stability of the oil supply and could induce speculative price increases. High import dependent nations such as Pakistan suffer increased risk of supply shortages and rising oil prices. Making reasonable policies meant to maintain economic stability depends on an awareness of how oil prices affect the general state of the society. The world's need for oil has substantially dropped as development obviously slows down until late 2022. China's consistent post-pandemic recovery is mostly responsible for this decline in oil usage.

Looking ahead, slower economic expansion means that worldwide oil demand is likely to remain sluggish, averaging less than 1 million barrels daily in 2024–2025. Globally, things are changing. Rising maintenance activities and non-OPEC+ countries have driven more supply-side oil output globally. Forecasts of oil output show significant increase especially from non-OPEC+ countries. Especially in China and Europe, slow demand and low profit margins generate problems for the refining sector. Still, lower inventories and ongoing geopolitical issues have helped crude oil prices to improve recently. Policymakers aiming to reduce the economic consequences of oil import dependency first have to grasp the complex dynamics of oil supply and demand. Monetary authorities of oil-importing nations must develop good policies if they are to negotiate these challenges. Studies by Clarida, Gali, and Gertler (2000) as well as Romer (1989) and De Long (1997) show how responses to oil price shocks by monetary policy could serve to reduce inflationary pressure. Bernanke et al. (1997, 2004) argue that monetary policy greatly influences the home economic response to fluctuations in oil prices. Proactive policies, they contend, could stop recessions at the price of increased inflation. Emphasizing the considerable volatility in crude oil prices, Jalali-Naini & Manesh (2006) remark that this volatility changes with time and that variances between 1987 and 2005 compared to other commodities are seen. Examining the effects of oil price shocks on macroeconomic variables over many Asian nations, Cunado & De Gracia (2005) show that changes in oil price influence economic activity and price indices most especially. They also emphasize the significance of exactly knowing the consequences of oil prices by converting them into native currencies. Other studies, most notably those by Cashin et al. (2014) and Zhao et al. (2016), separate supply from demand shocks in the oil market; the former usually leads in ongoing price increases and inflationary pressure. The results highlight the need of considering local and global changes in oil prices to identify their effects on different spheres of economy.

Emphasizing the Pakistani economy, this paper investigates the dynamics of inflation and oil price shocks inside a New Keynesian framework. It seeks to elucidate the pathways of transmission via which changes in oil prices affect other price indices, so offering relevant information for lawmakers charged with managing the complexities of oil dependence in relation to inflationary pressures.

Problem statement

The IEA World Energy Outlook report (2019) states that energy world is characterized by "increasing disparities between the calm oil markets of today and heightened geopolitical tensions". The calmness is supported by well supplied oil markets and high inventories. Geopolitical instability in Iran and Venezuela has reduced their oil export to 0.003mb/d and 0.6mb/d respectively, attacks on Saudi oil installations in September has further crimped global supply by about 5%, but prices of oil was still hovered around $60 on average in 2019. The reason behind this stability of oil prices was that, major oil producing and exporting countries were trying to manipulate and manage the oil markets and oil production.

According to IEA's report the share of OPEC and Russia will possibly come down to 47% by 2030 which was 55% in the 2000s. That will limit the abilities of these countries to manage the oil markets and give a shape to oil prices. Global oil demand in 2019 grew by 1.1mb/d and supply grew by 1.5mb/d, this trend will continue because non OPEC countries such as US, Norway, Canada, Brazil and Guyana will grow their production by 2.3mb/d. The question arises that what would happen to oil prices if middle eastern oil supply is effected and their hold on manipulating oil prices decreases and what would happen to the economy and inflation rate of countries like Pakistan that import oil from the Middle East?

OPEC has the substantially great hold over the world crude oil markets. Major oil producing countries Iraq, Iran, Libya, Saudi Arabia and Venezuela are facing severe crises regardless of unrest; OPEC managed the stability of prices till December 2019. But the situation changed a bit when in first week of Jan 2020 the price of international crude oil increased to $70 per barrel, a jump of about five percent since December 2019. The price increase comes amid growing fears of a potential war between US and Iran. Oil prices soared but quickly dropped again as it is considered that it will not send sustained shocks through the oil market. Despite Mideast tensions, it's considered that the market will self-correct as it did multiple times in 2019.

With increase in tensions between US-Iran, Saudi Arabia is once again faced with heightened risk of attacks on oil infrastructure and Iraq is threatened of economic sanctions. The world could possibly face the risk of supply shortages and oil price spikes. Surprising stability of oil prices in 2019 regardless of severe geopolitical crises in oil exporting countries and sudden increase in prices 2020 due to increasing unrest in US, Iran, Iraq relationships both of these factors has generated uncertainty which can be anticipated in increase in oil prices. Beside that Coronavirus (COVID-19) caused historic oil price shock of OPEC at a time the fossil fuel industry is faced by worse structural changes. Oil market crash to the lowest settlement price for WTI(Negative $40). Oil importing countries like Pakistan are now faced with greater risk of oil price shock.

Pakistan mainly depends on oil to fulfill energy requirements. According to the Economic Survey of Pakistan (2020-21), production of oil was 11.59 million tons against the consumption of 19.68 tons with the deficit of 8.09 million tones .During FY2019 the domestic oil production of crude oil was 24.6 million barrels, showing increase of 2.8 million barrel than the last year. Pakistan does not produce enough oil to meet its own needs and import sufficient quantity of oil and oil products from Middle Easter countries mainly from Saudi Arabia. Oil imports in FY2019 accounted for 6.6 million tons worth $3.4 billion. Transport and power are two main sectors with relatively high consumption of oil. The share of oil consumption in power sector decreased to 14 percent during FY2019 which was 25 percent during the same period last year. Transport sector share of oil consumption was 77% in FY2019 and 56% in FY2018. Crude oil import bill rose by 15.2% regardless of considerable decline of 14.5 percent in quantity of oil import because higher oil prices resulted in rise in the inflation rate (Economic Survey of Pakistan 2018-19).

Pakistan's economy heavily relies on petroleum, oil, and lubricants (POL) products, particularly in transportation, where motor spirit and high-speed diesel (HSD) are the primary fuels. HSD, furnace oil (FO), and kerosene also serve as alternative fuels in industry [1]. However, fluctuations in POL consumption within the industrial sector often reflect high transportation costs and logistical challenges associated with oil supply. Historically, the power generation sector has largely depended on FO, but the Government of Pakistan has been working to reduce FO usage by integrating alternative energy sources. This shift has led to a significant decline in oil consumption for power generation from 2015 to 2020. The phase-out of FO-based power plants has marked a major shift in the energy landscape. Looking ahead, forecasts indicate that oil and POL products will continue to dominate the energy mix, driven by rising demand in transportation and industrial growth.

Total oil consumption is expected to increase from 17.03 million tonnes in 2020 to 24.15 million tonnes by 2030, with motor spirit and HSD demand projected to reach 20.8 million tonnes by 2030. Pakistan currently meets 82% of its oil demand through imports, totaling 17 million tonnes per annum. While the refining capacity is 19.4 mtpa, actual crude processing capacity is only 10.08 mtpa, indicating significant underutilization. To address this, refineries like Byco Petroleum plan to upgrade facilities to increase operational capacity – (Pakistan energy outlook, 2021-30).

The Refinery Policy of Pakistan 2021 aims to double refining capacity in line with projected demand, boosting motor spirit and HSD production while reducing FO consumption and aligning with Euro Standards. Given the strong linkage between international petroleum prices and inflation in Pakistan, analyzing oil consumption trends and refining capabilities is crucial for policymakers to develop strategies to mitigate global oil price fluctuations and stabilize the economy. Rising international prices of oil did contribute significantly to domestic inflation and remained the dominant stimulus to inflationary pressures on the economy of Pakistan. Further, monetary authorities are required to predict the future risk and construct a mechanism to ensure effective policy response, eluding economic down turn.

Research Gap

Using 'the New Keynesian model', while combining the recent data with shocks in oil prices, the impact of oil prices on Pakistan's GDP deflator, CPI, and core CPI, is evaluated. Analyzing, the dynamics of several inflation measures, will offer a thorough understanding of "how oil prices affect different price indices" is new and advanced appraoch in this domain It underlines the link between domestic economic variables and foreign oil prices thereby enabling a thorough investigation of the pathways via which these prices influence inflation. This study will enable legislators create more successful economic policies by providing a complete examination of inflation behavior in respect to oil prices. Furthermore, the results can form the basis of next studies, therefore enlarging the field of inquiry.

Research Objective

- To assess the impact of international oil and petroleum prices on inflation dynamics in Pakistan.
- To analyze this relationship in the context of the discount rate and monetary policy in Pakistan.

Hypotheses

- Oil price shock doesn't affect the Inflation in case of Pakistan.
- Oil price shock doesn't affect the Monetary Policy.

LITERATURE REVIEW

Sarmah and Bal (2021) observed a positive correlation between crude oil prices and inflation even if they identified an inverse link between economic development. Covering 19 years, their structural vector autoregressive (VAR) model exposed the long-term links among inflation, economic development, and oil prices.

Using co-integration methods across a 1995–2018 dataset, Gylych et al. (2020) examined oil price volatility. Their findings exposed significant long-term relationships between oil prices, inflation, exchange rates, and interest rates; variations in oil prices definitely had inflationary effects for Nigeria's economy. Abdulaziz et al. (2019), using a non-linear ARDL framework, investigated, from January 2010 to December 2017, the asymmetric effects of oil price shocks on food prices. Food and energy prices have a clear causal relationship they discovered. Choi et al. (2018) based on data from 72 advanced and developing countries found that a 10% rise in global oil prices typically results in a 0.4% inflation increase. Though it was sometimes fleeting, they saw this impact in rich as well as impoverished countries.

Salisu et al. (2017) focused on the disparities in the oil price-inflation dynamic between net oil-exporting and importing nations using a dynamic panel data approach from 2000 to 2014. Their results confirmed a long-term link, particularly robust in nations that import oil. From 2001 to 2010, Gelos and Ustyugova (2017) assessed how variations in commodity prices across nations affected inflation rates. Higher food share in consumer price index (CPI), more reliance on fuel, and higher baseline inflation levels were observed to make nations more sensitive to consistent inflation as a result of changes in commodity prices. Studies by Malik (2017) in Pakistan and South Africa respectively as well as Sibanda et al. (2015) in Pakistan and South Africa respectively confirmed the clear influence of oil prices on inflation.

Examining quarterly data from 1987 to 2015, Rasasi and Yilmaz (2016) and Ozturk (2015) identified a clear correlation between oil price shocks and inflation in Turkey, so underlining a notable, although very delayed, inflation sensitivity to oil price changes. Examining the intricacy of the 2014 drop in oil prices. Emphasizing that gasoline represents a significant portion of consumer expenditure, Sánchez and Thomas (2011) looked at the immediate impact of oil price increases on home fuel prices. Their findings revealed that changes in oil prices quickly influence oil product costs, which in turn influence the general consumer price index dependent on household use on oil-based products.

From 1995 to 2005, Wu and Ni (2011) investigated the interactions among oil prices, inflation, interest rates, and money supply in the United States, showing that both symmetric and asymmetric models show notable variations in oil price swings since oil prices are functioning as a Granger cause of inflation. Rising food prices, according to Alom (2011) and Jongwanich and Park (2011), raise import costs, so reducing output and exports. Rising oil costs, they concluded, boost demand for money and interest rates, which influences demand for currencies and consequently determines food prices. Given oil and its derivatives are basic components of the consumer price index, rising oil prices create inflationary pressures, claims Tang et al.

(2010). They noted that although home reactions to these shocks influence responsiveness, initially rising oil prices cause headline inflation to rise.

METHODOLOGY

A Theoretical Explanation of Oil Price Shock

Theoretically, the influence of oil prices is based on demand as well as supply consequences. Higher inflation, lower real income, and lower consumption usually follow from rising oil costs. As so, total output could drop and companies might seek less workers. Rising oil prices translate into a larger import bill for net oil-importing nations, which lowers income, reduces consumption, and therefore reduces aggregate demand (Svensson, 2005; Basher, 2006). This implies that high oil prices cause uncertainty that influences the demand as well as the supply sides of the economy (Hamilton, 1983; Kilian, 2010).

From the supply side, exogenous oil price shocks raise real oil prices, hence fueling inflation. Since oil is a basic manufacturing ingredient, these inflationary shocks increase input costs, therefore increasing production expenses and immediately driving inflation. Since the higher production costs are passed on to consumers via higher pricing, which lowers demand for goods, this condition can further lower overall demand (Barro, 1984; Kim & Loungani, 1992; Backus & Crucini, 2000; Hamilton, 1988, 1996; Abel & Bernanke, 2001). Higher fuel prices raise production's input costs, which can therefore lower demand for these inputs and so lower supply side inflationary pressures (Rasche & Tatom, 1977).

New research have looked at several different ways that oil prices impact the state of the economy. Rising input costs and the overall price level that elevated oil prices bring about reduces real money balances and generates uncertainty for investments, therefore affecting the economy mostly. This causes increased manufacturing costs in many other industries, therefore creating inflationary pressure on the nation. Furthermore greatly affecting oil demand are outside shocks including wars, political upheavals, and revolutions; they typically result in major crises and sharp swings in world prices (Kilian, 2009). Moreover, uncertainty functions as a transmission channel; increasing oil prices cause instability in the actual economy, which usually results in positive inflation effects and negative effects on output and consumption since people may cut their expenditure.

Rising consumer prices could inspire workers to demand better pay in order to offset dropping real incomes, hence causing cost-push inflation. This scenario can also discourage companies from making permanent investments since households can decide to save instead of consume, therefore lowering expected cash flows. Rising oil prices create more uncertainty about expectations of higher consumer prices, higher salaries, and reduced investment, hence further restricting cash flows (Bernanke, 1983; Brown & Yücel, 2002; Pindyck, 2003; Edelstein & Kilian, 2009). Driven by uncertainty on rising oil prices, delays in consumption and investment decisions might impede economic development and growth prospects, hence reducing the incentives for both investment and consumption (Chuku et al., 2010).

Dynamic IS curve Equation

Defines the relationship of output ($\tilde{Y}_t$) to the expected /natural rate of output (Y_t^*) and to real interest rate ($i - \varpi_t^{\pi}$) and the natural rate of interest (r^*).

$$\tilde{Y}_t = Y_t^* - \delta\,(\mathrm{i} - \varpi_t^{\pi} - r^*) + e_t^{\mathrm{Y}} \qquad (1)$$

or

$$Y_t^* - \tilde{Y}_t = \delta\,(\mathrm{i} - \varpi_t^{\pi} - r^*) - e_t^{\mathrm{Y}}$$

The New Keynesian Philips Curve Equation

That relates current inflation (ϖ_t^{π}) to expected future inflation ($\varpi_{t+1}^{\pi e}$), to the current output gap ($Y_t^* - \tilde{Y}_t$) or and to an exogenous supply shock (e_t). The New Keynesian Phillips combines expected price behavior by imperfectly competitive firms. Using this assumption, Phillips curve that takes inflation is determined by output gap and expected future inflation as in the conventional Phillips curve.(Calvo, 1983; Clarida, Gali, and Gertler, 1999).

$$\varpi_t^{\pi} = \varpi_{t+1}^{\pi e} + \lambda\,(\tilde{Y}_t - Y_t^*) + e_t$$

(2)

If it is submitted that expected inflation is the same as the inflation from the previous period, then:

$$\varpi_{t+1}^{\pi e} = \varpi_{t-1}^{\pi e}$$

The Phillips curve would transform into:

$$\varpi_t^{\pi} = \varpi_{t-1}^{\pi e} + \lambda\left(\tilde{Y}_t - Y_t^*\right) + e_t$$

Incorporating supply shocks, such as oil price shocks, modifies the Phillips curve, as discussed by Hooker (2002) and De Gregorio et al. (2007).

$$\varpi_t^{\pi} = \varpi_{t-1}^{\pi e} + \lambda\left(\tilde{Y}_t - Y_t^*\right) + S_t^{p} + e_t \qquad (3)$$

Monetary policy rule Equation

This relates the policy instrument (i) and the natural rate of interest (r^*) to the inflation target (ϖ^π). It describes how central banks conduct policy to regulate short-run nominal interest rates (Clarida, Gali, and Gertler, 1999).

$$i = r^* + \varpi^{\pi^*} + \beta_\pi(\varpi_t^\pi - \varpi^{\pi^*})$$

(4)

If the targeted inflation is equal to the actual inflation ($\varpi^\pi{}_t = \varpi^{\pi^*}$), then Equation 4 simplifies to:

$$i = r^* + \varpi^{\pi^*}$$

Taylor rule

Taylor (1993) introduced the following formula, now known as the Taylor rule, which is widely used by central banks as a policy tool:

$$i = r^* + \varpi^{\pi^*} + \beta_\pi\left(\varpi_t^\pi - \varpi^{\pi^*}\right) + \beta_\pi\left(\tilde{Y}_t - Y_t^*\right)$$

(5)

Output gap

An expression for output behavior is derived by starting with the IS curve and replacing the term i. The value of interest rate is substitute from Equation (5) into the IS Equation (1) to get the following formulation:

$$\tilde{Y}_t = Y_t^* - \delta\left[\left\{r^* + \varpi^{\pi^*} + \beta_\pi\left(\varpi_t^\pi - \varpi^{\pi^*}\right) + \beta_\pi\left(\tilde{Y}_t - Y_t^*\right)\right\} - \varpi_t^\pi - r^*\right] + e_t^Y$$

Now, by multiplying the term (δ), canceling out the terms (δr^*) in this equation and re-adjusting, the following equation is derived:

$$\tilde{Y}_t - Y_t^* = -\delta\left(\varpi_t^\pi - \varpi^{\pi^*}\right) - \delta\beta_\pi\left(\varpi_t^\pi - \varpi^{\pi^*}\right) - \delta\beta_y\left(\tilde{Y}_t - Y_t^*\right) + e_t^Y$$

And

$$\left(\tilde{Y}_t - Y_t^*\right) + \delta\beta_y\left(\tilde{Y}_t - Y_t^*\right) = -\delta\left(1 - \beta_\pi\right)\left(\varpi_t^\pi - \varpi^{\pi^*}\right) + e_t^Y$$

Or

$$\left(1 + \delta\beta_y\right)\left(\tilde{Y}_t - Y_t^*\right) = -\delta\left(1 - \beta_\pi\right)\left(\varpi_t^\pi - \varpi^{\pi^*}\right) + e_t^Y$$

And

$$\left(\tilde{Y}_t - Y_t^*\right) = \frac{-\delta\left(1 - \beta_\pi\right)\left(\varpi_t^\pi - \varpi^{\pi^*}\right)}{\left(1 + \delta\beta_y\right)} + \frac{e_t^Y}{\left(1 + \delta\beta_y\right)}$$

Replacing $\frac{-\delta}{(1+\delta\beta_y)}$ and $\frac{1}{(1+\delta\beta_y)}$ with ϕ and v_t respectively, the equation of output gap is obtained:

$$\tilde{Y}_t - Y_t^* = \phi\,(1 - \beta_\pi)\left(\varpi_t^\pi - \varpi^{\pi^*}\right) + e_t^Y v_t \tag{6}$$

Inflation Dynamics / Behavior

Equation (6) combines the information from the IS curve and the monetary policy rule into a single equation. By Substituting the output gap value from equation (6) into Phillips equation (3), an expression for the behavior of inflation will be derived as follows, by using the Phillips curve and replacing the term for the output gap $\left(\tilde{Y}_t - Y_t^*\right)$:

$$\varpi_t^\pi = \varpi_{t-1}^{\pi e} + \lambda\left\{\phi\,(1 - \beta_\pi)\left(\varpi_t^\pi - \varpi^{\pi^*}\right) + e_t^Y v_t\right\} + S_t^p + e_t$$

Rearranging and adjusting:

$$\varpi_t^\pi = \varpi_{t-1}^{\pi e} + \lambda\phi\,(1 - \beta_\pi)\left(\varpi_t^\pi - \varpi^{\pi^*}\right) + (1 + \lambda)(e_t^Y v_t + e_t) + S_t^p$$

Substituting $\lambda\phi\,(1 - \beta_\pi)$ and $(1 + \lambda)(e_t^Y v_t + e_t)$ with Ψ and $\mho_t$, respectively, the following formulation is obtained as an expression for inflation dynamics. :

$$\varpi_t^\pi = \varpi_{t-1}^{\pi e} + \Psi\left(\varpi_t^\pi - \varpi^{\pi^*}\right) + S_t^p + \mho_t \tag{7}$$

Equation (7) indicates that inflation is influenced by inflation expectations, the inflation target, and supply shocks.

Data and sources

The study will used the monthly data from 2006 to 2023 in order to fully capture the impact of recent shocking economic developments in oil markets and its possible repercussion for inflation dynamics In Pakistan. The data sources for price indices will comprise but not limited to the official sites of State Bank of Pakistan, World bank and IMF.

Two often used benchmarks for oil prices are West Texas Intermediate comes first, then Brent Crude. As they depend on Middle Eastern oil supply also, OPEC, a group of most powerful oil exporting nations, bases pricing on Dubai plus Oman Brent crude oil and Asian market. Dubai crude oil Asian benchmark followed the trend variations in WTI (Nagata et al., 2008), so its fluctuation between 2003 and 2006 had a logical explanation. It demonstrates how better WTI crude is in gauging world oil prices. For oil prices, we have so chosen the West Texas Intermediate; the data comes from the U.S. Energy Information Agency database (EIA).

Model

This paper expands on the empirical models developed by Blanchard and Gali (2007), Blanchard and Riggi (2013), and Rodina (2017) inside the conventional New Keynesian model, especially in connection with the consequences of oil price shocks.

$$\varpi_t^\pi = \varpi_{t-1}^{\pi e} + \Psi\left(\varpi_t^\pi - \varpi^{\pi^*}\right) + S_t^p + \mho_t$$

We improve this structure by include policy rates as an independent variable to simulate changes in interest rates. Using a reduced-form linear equation including oil prices as an exogenous shock and integrating lagged values of three inflation measures—the GDP deflator, core CPI, and CPI—our model generates This addendum seeks to give a more complex knowledge of how interest rates interact with inflation dynamics in the framework of external shocks.

Inflation (Consumer Price Index)

$$\varpi_t^{\pi} = \varpi_{t-1}^{\pi e} + \Psi\left(\varpi_t^{\pi} - \varpi^{\pi^*}\right) + \mathrm{i}_t + S_t^p + \mho_t \quad \text{(A)}$$

ϖ_t^{π} = Inflation

S_t^p = Oil Price Shock

i_t = Policy Rate

$\mho_t$ = Exogenous shock (error term)

Incorporating policy rates as an independent variable to capture interest rate shocks – using a reduced-form linear equation including oil prices as an exogenous shock and incorporates lagging values of CPI-based inflation measurements strengthens the above offered analytical framework. Equation (A) is changed to include these CPI based inflationary impacts. This addendum intends to offer a sophisticated knowledge of the interplay between interest rates and inflation dynamics in the framework of external shocks - Equation (B).

$$\varpi_t^{\pi\mathrm{i}} = \varpi_{t-1}^{\pi\mathrm{i}} + \Psi\left(\varpi_t^{\pi\mathrm{i}} - \varpi^{\pi\mathrm{i}^*}\right) + \mathrm{i}_t + S_t^p + \mho_t \quad \text{(B)}$$

Where

$\varpi_t^{\pi\mathrm{i}}$ = Inflation (consulmer Price index based)

GDP Deflator

The study adopt an approach to add policy rates, interest rates and petroleum product prices as an independent variables to capture its effects on GDP deflator fluctuations.. As such, Equation (A) is changed to include these consequences on GDP deflator-based inflation. This change seeks to give a more complete knowledge of the link between GDP deflator dynamics and interest rates in the presence of external shocks - Equation (C).

$$\varpi_t^{\pi g} = \varpi_{t-1}^{\pi g} + \Psi\left(\varpi_t^{\pi g} - \varpi^{\pi g^*}\right) + \mathrm{i}_t + S_t^p + \mho_t$$

(C)

$\varpi_t^{\pi g}$ = GDP deflator

Core Inflation

Finally, policy rates and oil prices shocks are used as an independent variables along with interest rate variations are used to analyze its impact on core inflation. This approach uses a straightforward linear equation that accounts for oil prices as an external shock and integrates lagged values of core inflation metrics. Equation (A) is then changed to represent these effects on central inflation. This change aims to improve the knowledge of how interest rates interact with core inflation dynamics, especially in the framework of external shocks that results in the development of Equation (D). Using core inflation makes sense in line with Blanchard and Gali's (2007) New Keynesian paradigm.

$$\varpi_t^{\pi c} = \varpi_{t-1}^{\pi c} + \Psi\left(\varpi_t^{\pi c} - \varpi^{\pi c^*}\right) + \mathrm{i}_t + S_t^p + \mho_t$$

(C)

$\varpi_t^{\pi c}$ = core cpi

RESULTS AND DISSCUSSION

The study explore the empirical data analysis and econometric approaches applied to find the links among the variables of interest. Ensuring the validity of our later studies depends on the stationarity of the time series data, hence our main attention is on it. Two tests—the Augmented Dickey-Fuller (ADF) test (Dickey & Fuller, 1981) and the Phillips-Perron (PP) test (Phillips & Perron, 1998) are extensively applied to assess the stationarity of the variables.

ADF tests in a univariate time series for a unit root. The ADF test offers a null hypothesis whereby the series has a unit root, therefore demonstrating non-stationarity. Serial correlation in the errors can be explained by adding lagged differences of the variable to the Dickey-Fuller regression. We reject the null hypothesis and find the series is stationary if the ADF test statistic is more negative than the crucial value. The PP test evaluates for unit root existence just like the ADF test does. To consider serial correlation and heteroscedasticity in the error terms, it does, however, use a non-parametric method. Since the PP test does not demand the specification of lag durations, it is especially strong. In the PP test, a rejection of the null hypothesis denotes stationary series.

Using Johansen cointegration test (Johansen, (1988), we will investigate the long-run relationship should the findings reveal that the variables are integrated of the same order. Using optimal lag-length criterion helps one ascertain the lag order of the model. These tests will help us to direct our next actions. Should we discover that the variables are integrated of the same order—usually either I(0) for stationary or I(1) for non-stationary—we may then investigate the possible long-run correlations among them with the Johansen cointegration test. The Johansen cointegration test (Johansen, 1988) lets us find whether a group of non-stationary series share a common stochastic trend, therefore indicating their cointegration. This is important since the linear combinations of even non-stationary individual series could still be stationary. Using two statistics—the trace statistic and the maximum eigenvalue statistic—the technique estimates the cointegrating vectors and ascertains the number of cointegrating links. Should we discover one or more cointegrating associations, this confirms our application of a Vector Error Correction Model (VECM) for additional investigation.

We have to ascertain the suitable lag length for our model before using the VECM. One can accomplish this using the Akaike Information Criteria (AIC), the Schwarz Bayesian Criteria (SBC), or the Hannan-Quinn Criteria. The right lag duration is absolutely important since it affects the capacity of the model to faithfully depict the dynamics of the data. While too many lags cause overfitting, too few lags might cause omitted variable bias.

We apply the VECM to examine both short-run and long-run dynamics after finding that the variables are cointegrated. The VECM combines the error correction term, which shows the departure from the long-run equilibrium. This model lets us evaluate the speed with which the variables get back to balance following a shock. It clarifies the dynamics involved by showing how transient changes affect long-term interactions, therefore enabling a more complex knowledge of the forces at work (Rambaldi et al., 1995).

Augmented Dickey fuller Test

In time-series analysis, stationarity is a basic presumption since it guarantees that the statistical features of the series do not change with time. Time series data requires one to determine if the series is stationary at its level, first difference, or second difference. Knowing the sequence of integration helps one to expose underlying trends and patterns. Should the data be non-stationary, any forecasts produced from it could be biassed and erratic, therefore producing erroneous conclusions. Ignoring non-stationarity can also lead to false correlations—that is, associations between two unrelated variables that seem linked just because of time trends (Hill, Griffith & Lim, 2011).

TABLE.1 Augmented Dickry Fuller Test Results

Variables	Level	I(1)	I(2)
CPI	0.6536	0.0000*	0.0000
Core CPI	0.1387	0.0001*	0.0000
GDP Deflator	0.3621	0.1448	0.0000*
oil price	0.0000*	0.0000	0.0000
Inflation Target	0.3195	0.0000*	0.0000
Interest Rate	0.4174	0.0000*	0.0000
CPI	0.6536	0.0000*	0.0000

We establish the order of integration for the variables in our time series data using the Augmented Dickey-Fuller (ADF) test. With exception from oil price, the data shown in Table 2 show that every variable is non-stationary at its level. As so, we reject the null hypothesis of no unit root for these variables. The data for oil price (S_t^P) is stationary at the level and intercept with an ADF probability value of 0.0000, much below the required value of 0.05, therefore verifying that this variable is stationary.

Since the remaining variables were non-stationary at level, we then test the ADF on their initial difference. The results reveal that at the first difference the Consumer Price Index (CPI, $\varpi^{\pi i}$), Core CPI ($\varpi^{\pi c}$), Inflation Target (ϖ^{π}), and Interest Rate (i_t) are all stationary, thereby showing they are integrated of order I(1). The GDP deflator ($\varpi^{\pi g}$) is determined to be stationary only at the second difference, with a probability value of 0.0000, which also falls below the crucial value of 0.05, thereby showing it is integrated of order I(2).

We will investigate the short-run and long-run interactions between the GDP deflator ($\varpi^{\pi g}$) and oil price (S_t^P) using the Autoregressive Distributed Lag (ARDL) approach supposing that the variables are stationary at many orders. Consequently, we derive that the ARDL approach will be applied in the study for the GDP deflator ($\varpi\pi g$).

Lag-Order Selection model

Accurate model definitions and avoidance of miscalculations about the genuine lag structure depend on the choice of the ideal lag length (Braun and Mittnik, 1993). Inadequate lag time can cause a loss of degrees of freedom and restrict the information accessible for statistical analysis, hence perhaps hiding significant data correlations. On the other hand, including too many lags could bring problems such multicollinearity and autocorrelation, which would distort the data and cause an overestimation of model parameters (Stock & Watson, 2015).

This work uses optimal lag-length selection criteria to choose the suitable lag length for the VAR models in order to handle these issues. Several other criteria are applied for this aim: the Hannan-Quinn Information Criteria (HQIC), the Schwarz Bayesian Information Criteria (SBIC), and the Akaike Information Criteria (AIC). By balancing goodness-of- fit with model complexity, each of these criteria presents a unique viewpoint on model fit that aids in the most appropriate lag structure identification. The particular criteria and their uses in our study are described here.

Table. 2 Optimum Lag Selection Outcome (Core Cpi)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1938.448	NA	75742.64	22.58660	22.65980	22.61630
1	-1009.507	1803.874	1.858123	11.97101	12.33700*	12.11950
2	-976.6894	62.20055*	1.528569*	11.77546*	12.43424	12.04274*
3	-963.7721	23.88190	1.585581	11.81130	12.76287	12.19738
4	-950.9029	23.19459	1.646726	11.84771	13.09207	12.35258
5	-942.7985	14.22981	1.809238	11.93952	13.47667	12.56318
6	-934.9769	13.36937	1.996511	12.03462	13.86455	12.77707
7	-922.5230	20.70834	2.090376	12.07585	14.19858	12.93709
8	-915.5362	11.29253	2.335920	12.18065	14.59617	13.16069

Table 3 Optimum Lag Selection Outcome (Core Cpi)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1885.632	NA	40984.92	21.97247	22.04566	22.00217
1	-862.7939	1986.209	0.337430	10.26505	10.63103	10.41354
2	-815.6472	89.35950*	0.234981*	9.902875*	10.56165*	10.17016*
3	-802.1675	24.92179	0.242156	9.932180	10.88375	10.31826
4	-789.0048	23.72354	0.250638	9.965172	11.20953	10.47004
5	-781.3240	13.48606	0.276732	10.06191	11.59906	10.68557
6	-774.4848	11.69013	0.308885	10.16843	11.99837	10.91088
7	-762.8944	19.27252	0.326671	10.21970	12.34243	11.08095
8	-757.9242	8.033148	0.373704	10.34796	12.76348	11.32799

The study reveals that both the HQIC (Hannan-Quinn Information Criteria) and SBIC suggest a suitable lag time of two for both Consumer Price Index (CPI) and core CPI as SBIC offers the lowest value among the criteria tested. This is crucial since exactly capturing the dynamics of the variables in a Vector Autoregression (VAR) model depends on selecting a correct lag length.

Conversely, additional metrics like as FPE (Final Prediction Error) and AIC (Akaike Information metrics) indicate that bigger lags—more notably, four and eight—are perfect for the VAR study of the given data set. FPE is well-known for its efficiency in small sample sizes—as Lütkepohl (2005) notes—along with AIC, but when working with tiny data it often exaggerates model complexity. This overestimation could provide models that too closely fit the data, therefore sacrificing generalizability.

These factors lead this study to choose to use HQIC and SBIC for the best lag duration determination. The balance these criteria strike between fit and complexity—especially in small samples—helps one conclude that a lag duration of two is adequate. Moreover, in keeping with accepted criteria in VAR modeling—as described by Ozcicek and McMillin (1999—the study applied a symmetric lag structure). This approach ensures the same lag time for every variable, therefore promoting homogeneity and simplification of model interpretation. Using this method allows the research to reduce overfitting risk and provide a solid structure for understanding the interactions between CPI and core CPI.

Testing for Co-integration: The Johansen Methodology

Co-integration develops, that is, a long-run equilibrium relationship, when a linear combination of non-stationary variables generates a stationary series (Enders, 1995). Fundamentally, the link between even non-stationary individual time series can stabilize with time therefore allowing a meaningful analysis of their dynamics. This long-run equilibrium link implies that any temporary deviations from equilibrium will finally be corrected. Stated differently, over the long run the variables will tend to return toward their equilibrium condition even if they might change momentarily in response to diverse shocks or variations.

At least one variable must be included in the Vector Error Correction Model (VECM) to help account for any deviations from the long-run equilibrium if one wants to properly depict this behavior. This adjustment method is essential since it helps the model to guarantee that the long-term relationship among the variables is kept while allowing it to consider temporary variations (Enders, 1995). Therefore, the VECM provides a strong structure for examining the interrelationships among co-integrated variables, so capturing both long-term trends and short-term changes.

Table 4. Co-integration Test Outcome (Cpi)

Unrestricted Co-integration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigen value	Trace Statistic	Critical Value 0.05)	Prob.**
None *	0.164621	58.21239	47.85613	0.0040
At most 1	0.083797	26.37544	29.79707	0.1179

At most 2	0.044691	10.88481	15.49471	0.2187
At most 3	0.015652	2.792383	3.841465	0.0947

Table 5 Cointegration Test Outcome (Core Cpi)

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigen value	Trace Statistic	Critical Value (0.05)	Prob.**
None *	0.177406	71.00076	47.85613	0.0001
At most 1	0.131348	36.43391	29.79707	0.0074
At most 2	0.049020	11.51012	15.49471	0.1820
At most 3	0.014658	2.613664	3.841465	0.1059

In the above table 4, the trace statistics at r(0) is 58.21 and that is more than its critical value of 47.85. Therefore, the null hypothesis of no co-integrating equations is rejected. The trace statistics at r (1) is 26.37, which is less than the critical value of 29.79. Therefore, we cannot reject the null hypothesis that there is one co-integration relationship between oil price (S_t^P) and CPI ($\varpi^{\pi i}$). Similarly table 5, shows the trace statistics at r (0) is 71.00, exceeding its critical value of 47.85, therefore we reject the null hypothesis that there is no co-integrating equations. The trace statistics at rank (1) is 36.43 that is less than the critical value of 29.79, showing that there is at least one co-integration relationship between oil price (S_t^P) and Core CPI ($\varpi^{\pi c}$). The presence of co-integration suggest that changes in the long run equilibrium of one variable are correlated with changes in long run equilibrium of other variables; providing strong evidence continuous time trend between variables (Woodford, 2008).

Vector Error Correction Model (VECM)

The Vector Autoregressive (VAR) model has become a foundational tool in macroeconomics since its introduction by Sims (1980). It is particularly popular for analyzing time series data, as noted by Kilian and Lütkepohl (2017) and Laséen and Strid (2013). The VAR framework focuses on fitting models to available datasets, capturing both short-run and long-run dynamics, albeit sometimes at the expense of theoretical consistency. One of the advantages of the VAR model is that it does not require simultaneous equations to meet identification conditions, which provides it with a distinct edge over other modeling approaches (Garrett et al., 1998).

The Vector Error Correction Model (VECM) is a constrained variant of the VAR model. In the VECM framework, short-run changes in the variables are modeled as functions of both the lagged values of the variables and the error correction term (ECT). The ECT represents the long-run adjustments in the variables, capturing the equilibrium relationship among them

(Rambaldi et al., 1995). Essentially, the VECM integrates the autoregressive distributed lag structure inherent in the VAR model while imposing constraints that reflect co-integration. The presence of co-integration—indicating a long-run relationship—along with a continuous time trend, suggests that using the VECM is more appropriate than the VAR model when dealing with variables that exhibit stationarity at different levels. This choice allows for a more accurate representation of the dynamics at play, ensuring that both short-run fluctuations and long-run relationships are adequately captured in the analysis

Table 6 Vecm Outcome (Cpi)

Error Correction:	D(CPI___)	D(INFLATIO...	D(INTERES...	D(OIL_PRICE)
CointEq1	0.007702 (0.00458) [1.68158]	0.008877 (0.00217) [4.09755]	0.002652 (0.00171) [1.55265]	-0.048082 (0.02586) [-1.85963]
D(CPI___(-1))	0.126731 (0.07852) [1.61406]	-0.032409 (0.03714) [-0.87261]	0.006569 (0.02928) [0.22439]	-0.131761 (0.44324) [-0.29727]
D(CPI___(-2))	0.003504 (0.07804) [0.04491]	-0.048031 (0.03692) [-1.30111]	0.109017 (0.02910) [3.74629]	0.354728 (0.44055) [0.80518]
C	0.011715 (0.07760) [0.15096]	-4.17000 (0.03671) [-0.000114]	-0.003348 (0.02894) [-0.11570]	-0.032432 (0.43809) [-0.07403]

Table 7 Vecm Outcome (Core Cpi)

Error Correction:	D(CORE_CP..	D(INFLATIO..	D(INTERES...	D(OIL_PRICE)
CointEq1	0.009648 (0.00369) [2.61328]	0.015404 (0.00459) [3.35680]	0.009588 (0.00368) [2.60424]	-0.108798 (0.05384) [-2.02090]
D(CORE_CPI____(-1))	0.333086 (0.07795) [4.27281]	-0.051430 (0.09689) [-0.53081]	0.026543 (0.07773) [0.34146]	-0.327409 (1.13670) [-0.28803]
D(CORE_CPI____(-2))	0.149409 (0.07819) [1.91087]	-0.089966 (0.09718) [-0.92577]	-0.004061 (0.07797) [-0.05208]	1.001319 (1.14012) [0.87826]
C	-0.001536 (0.02997) [-0.05125]	-0.001756 (0.03726) [-0.04715]	-0.003126 (0.02989) [-0.10458]	-0.020827 (0.43708) [-0.04765]

Results of the VEC model and the system equations are represented

The result shows that oil price is negatively and insignificantly related to REER. A unit change in oil price leads to 6.5% appreciation in REER whereas the CPI has a reverse Results of the VEC model and the system equations are represented for CPI ($\varpi^{\pi i}$) and for Core CPI ($\varpi^{\pi c}$). The result shows that the current level of variable CPI ($\varpi^{\pi i}$) and Core CPI ($\varpi^{\pi c}$) are positively related to its own immediate past value. By implication, the value of variable CPI ($\varpi^{\pi i}$) and Core CPI ($\varpi^{\pi c}$) follows a Stochastic-trend historical generation process (Adenutsi and Ahortor, 2008). The VECM results for variable CPI($\varpi^{\pi i}$) shows that oil price(S_t^P) coefficient is negative (-0.1317) and statistically insignificant to be related to CPI($\varpi^{\pi i}$) at 5% level of confidence. The estimated equation shows that the coefficient of the error correction term (ECT) is (-0.1317). Which means that 13% of the disequilibrium from the previous month shock is dissipated to the long-run equilibrium before next month; i.e., the speed of adjustment of disequilibrium is 13.17%. Whereas, the Inflation Target (ϖ^{π}) is negatively and significantly related to CPI($\varpi^{\pi i}$), the ECT value is (-0.048). The interest rate (i_t) is positively related to CPI ($\varpi^{\pi i}$) as the ECT(0.006) value is positive.

According to VECM results for variable Core CPI($\varpi^{\pi c}$) shows that oil price(S_t^P) coeffiecient is negative(-0.3274) and oil price(S_t^P) is insignificantly related to Core CPI($\varpi^{\pi c}$) at 5% confidence level. The estimated equation shows that the coefficient of the error correction term (ECT) is (-0.3274), indicating that 32% of the disequilibrium from the previous month shock is dissipated to the long-run equilibrium before next month; i.e., the speed of adjustment of disequilibrium is 32.74%. In other words, the economy of Pakistan corrects approximately 32% of the previous month disequilibrium in the long run before next month. The Inflation Target (ϖ^{π}) is negatively and significantly related to Core CPI($\varpi^{\pi c}$). The ECT value is (-0.0514), whereas the interest rate(i_t) is positively related to Core CPI($\varpi^{\pi c}$).

The null hypothesis suggests that oil price shock (S_t^P) does not affect CPI ($\varpi^{\pi i}$) and Core CPI ($\varpi^{\pi c}$) and an alternative hypothesis implies that oil price shock affects CPI ($\varpi^{\pi i}$) and Core CPI ($\varpi^{\pi c}$). In this parameter, the alternative hypothesis rejected the null hypothesis. The estimation results reveals that there is a strong long-run equilibrium causality from oil price shocks (S_t^P) and other explanatory variables to CPI ($\varpi^{\pi i}$) and Core CPI ($\varpi^{\pi c}$).

Autoregressive Distributed Lag (ARDL)

This article employs the Autoregressive Distributed Lag (ARDL) model, which effectively facilitates the interpretation of both short-run and long-run impacts of independent variables on the dependent variable. The linear ARDL model is widely recognized as a standard for co-integration analysis (Pesaran & Shin, 1999).

Particularly with small sample sizes and when handling variables displaying a mix of integration orders, the ARDL model offers one of the main advantages in modeling co-integrating relationships (Romilly et al., 2001; Pesaran et al., 1997). The ARDL model is chosen above other co-integration methods mostly due to this adaptability.

Table 8 Ardl Outcome Gdp Deflator

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
GDP Deflator (-1)	1.864516	0.038908	47.92071	0.0000
GDP Deflator (-2)	-0.880261	0.039883	-22.07105	0.0000
Inflation Target	-0.007002	0.036753	-0.190505	0.8491
Inflation Target (-1)	-0.100164	0.047873	-2.092303	0.0379
Inflation Target (-2)	0.094449	0.036467	2.589980	0.0104
Interest Rate	0.020387	0.013099	1.556382	0.1215
Oil Price	0.000235	0.000846	0.278441	0.7810
C	0.015635	0.109408	0.142905	0.8865

The result presented shows the estimated long run model of the impact of oil price shock (S_t^p) on GDP Deflator ($\varpi^{\pi g}$) in Pakistan. The one period lag of dependent variable (GDP Deflator ($\varpi^{\pi g}$) shows a positive relationship with its current value as the coefficient value is 1.8645 and the relationship is also significant because p-value is less than 5%. While oil price (S_t^p) and interest rate (i_t) also show positive relationships with the dependent variable respectively.

The result shows weak and insignificant relationship between oil price shock (S_t^p) and GDP Deflator ($\varpi^{\pi g}$) as probability value is 0.78 greater than 0.05 and T-Value 0.27 is less than 2. A unit increase in the one lag period of GDP Deflator ($\varpi^{\pi g}$) leads to 1.8645 units increase in its current value. A unit increase in oil price (S_t^p) leads to 0.000235 units increase in the GDP Deflator ($\varpi^{\pi g}$).

CONCLUSION, POLICY IMPLICATIONS AND SUGGESTION

The article studied the inflation dynamics and monetary policy rules in the presence of oil price shocks (S_t^p) in Pakistan. Our analysis shows that it is essential to differentiate alternative price indices (CPI($\varpi^{\pi i}$), Core CPI($\varpi^{\pi c}$), and GDP deflator($\varpi^{\pi g}$)) while dealing with shocks, we modeled the impact of oil price shock(S_t^p) using New Keynesian model. The data was analyzed using Johansen test for cointegration and technique of vector error correction model (VECM). The results presented evidently suggest that in the long run, oil price exerts positive influence on CPI ($\varpi^{\pi i}$), Core CPI($\varpi^{\pi c}$), and GDP deflator($\varpi^{\pi g}$) in Pakistan. VECM results revealed that

1% hike in the world oil price will increase CPI ($\varpi^{\pi i}$) by 13%, core inflation ($\varpi^{\pi c}$) by 32%, while GDP Deflator ($\varpi^{\pi g}$) by 0.23%. Alternatively, the results concludes that 13% and 32% of the disequilibrium for CPI ($\varpi^{\pi i}$) and core inflation ($\varpi^{\pi c}$) respectively from the previous months shock is dissipated in the long-run equilibrium before next month. Using VEC model with a long-run equilibrium, the results of the study are in line with the economic theory, establishing positive link of hike in international oil prices with augmented price level in Pakistan.

Further, the results of the study reveals that targeting the change in the GDP Deflator*($\varpi^{\pi g}$) while formulating the monetary policy instead of targeting CPI($\varpi^{\pi i}$) or CORE CPI($\varpi^{\pi c}$) would fail to achieve the desired targets of inflation in the country. The distinction between inflation measures is important with respect to the purpose as our results shows that it's important to take both CPI and core CPI into consideration while dealing with oil price shocks. This distinction has key significance for monetary policy as the State Bank of Pakistan (SBP) has to determine which inflation rate to choose to mitigate the adversities of oil price shocks (S_t^p) in the country.

The empirical findings clearly indicate that a well-designed monetary policy strategy can significantly mitigate the impact of oil price shocks. In the context of Pakistan, rising oil prices have emerged as a primary driver of inflation dynamics, underscoring the necessity for robust policy interventions. As an oil-importing nation, Pakistan must prioritize the implementation of strategies aimed at reducing its dependence on oil and petroleum products.

Promoting investment in alternative energy sources including natural gas, geothermal energy, renewable sources (including solar, wind, and biomass), and hydropower can help to solve this difficulty. Apart from lessening dependency on oil prices, diversifying energy sources improves energy security. Policy debates also have to concentrate on diversifying the oil supply depending on cost comparisons. During times of volatility in world oil markets, depending too much on a small number of suppliers runs major economic risks.

Managing the inflationary pressures resulting from rising world oil prices depends much on energy subsidies. These subsidies provide difficulties for the government even when they contribute to moderate domestic inflation. Along with the possible withdrawal of subsidies, passing on price hikes to consumers could aggravate inflationary pressures—a problem of great relevance for Pakistani government. Monetary authorities have to balance resolving the external shocks from higher oil prices with inflation management.

In this regard, the inflation-targeting system of the State Bank of Pakistan (SBP) becomes very important. Policymakers can possibly reduce the pass-through impact of global oil price shocks on home inflation by using this strategy.

Moreover, by means of strategic procurement strategies including the use of futures contracts for petroleum purchases, international companies can help to offset the effect of predicted price increases. Given that growing oil prices directly affect customer costs at petrol stations, this strategy can help keep final consumer prices low. The dependency of the transport industry on oil consumption makes it a major causal element in Pakistani inflation reactions. The study also points out some directions for more study. Future research might investigate the pass-through processes of oil price shocks to domestic fiscal and monetary variables, therefore offering a more complex knowledge of the interaction between energy prices and economic variables. Examining different monetary policy policies also helps to broaden the field of study in this regard and provides insightful analysis for legislators trying to negotiate the complexity of oil price fluctuations in the framework of inflation control.

REFRENCES

Al-Mutairi, N. H. (1995). Examining the causes of inflation in Kuwait: an application of a vector autoregression model. *OPEC Review*, *19*(2), 137–147.

ÁLvarez, L. J., Hurtado, S., Sánchez, I., & Thomas, C. (2011b). The impact of oil price changes on Spanish and euro area consumer price inflation. *Economic Modelling*, *28*(1–2), 422–431.

Aoki, K. (2001). Optimal monetary policy responses to relative-price changes. *Journal of Monetary Economics*, *48*(1), 55–80.

Arezki, R., Jakab, Z., Laxton, D., Matsumoto, A., Nurbekyan, A., Wang, H., & Yao, J. (2017). Oil Prices and the Global Economy. *IMF Working Papers*, *17*(15), 1.

Bacon, R. (2012, August 13). *Crude Oil Prices : Predicting Price Differentials Based on Quality*.Http://Hdl.Handle.Net/10986/11250.

Baffes, J., Kose, M. A., Ohnsorge, F., & Stocker, M. (2015). The Great Plunge in Oil Prices: Causes, Consequences, and Policy Responses. *SSRN Electronic Journal*. Published.

Balke, N. S., Brown, S. P. A., & Yucel, M. K. (2010). Oil Price Shocks and U.S. Economic Activity: An International Perspective. *SSRN Electronic Journal*. Published.

Bernanke, B. S., Gertler, M., Watson, M., Sims, C. A., & Friedman, B. M. (1997). Systematic Monetary Policy and the Effects of Oil Price Shocks. *Brookings Papers on Economic Activity*, *1997*(1), 91.

Bodenstein, M., Erceg, C. J., & Guerrieri, L. (2007a). Oil Shocks and External Adjustment. *SSRN Electronic Journal*. Published.

Bodenstein, M., Erceg, C. J., & Guerrieri, L. (2007b). Oil Shocks and External Adjustment. *SSRN Electronic Journal*. Published.

Bodenstein, M., Guerrieri, L., & Kilian, L. (2012). Monetary Policy Responses to Oil Price Fluctuations. *IMF Economic Review*, *60*(4), 470–504.

Bodenstein, M., Guerrieri, L., & Kilian, L. (2012). Monetary Policy Responses to Oil Price Fluctuations. *IMF Economic Review*, *60*(4), 470–504.

Byrne, J. P., Lorusso, M., & Xu, B. (2017). Oil Prices and Informational Frictions: The Time-Varying Impact of Fundamentals and Expectations. *SSRN Electronic Journal*. Published.

Cashin, P., Mohaddes, K., Raissi, M., & Raissi, M. (2014). The differential effects of oil demand and supply shocks on the global economy. *Energy Economics*, *44*, 113–134.

Clarida, R., Gali, J., & Gertler, M. (2000). Monetary Policy Rules and Macroeconomic Stability: Evidence and Some Theory*. *Quarterly Journal of Economics*, *115*(1), 147–180. Cunado, J., & Perez De Gracia, F. (2005). Oil prices, economic activity and inflation: evidence for some Asian countries. *The Quarterly Review of Economics and Finance*, *45*(1), 65–83.

Chatziantoniou, I., Filis, G., Eeckels, B., & Apostolakis, A. (2013). Oil prices, tourism income and economic growth: A structural VAR approach for European Mediterranean countries. *Tourism Management*, *36*, 331–341.

Chen, D., Chen, S., & Härdle, W. (2015). The influence of oil price shocks on china's macro-economy: A perspective of international trade. *Journal of Governance and Regulation*, *4*(4), 178–189.

Choi, S., Furceri, D., Loungani, P., Mishra, S., & Poplawski Ribeiro, M. (2017). Oil Prices and Inflation Dynamics. *IMF Working Papers*, *17*(196).

Davig, T., & Gurkaynak, R. S. (2015). Is Optimal Monetary Policy Always Optimal? *SSRN Electronic Journal*. Published.

De Gregorio, J., Landerretche, O., & Neilson, C. (2007). Another Pass-Through Bites the Dust? Oil Prices and Inflation. *Economía*, *7*(2), 155–196.

Edelstein, P., & Kilian, L. (2009). How sensitive are consumer expenditures to retail energy prices? *Journal of Monetary Economics*, *56*(6), 766–779.

Finn, M. G. (2000). Perfect Competition and the Effects of Energy Price Increases on Economic Activity. *Journal of Money, Credit and Banking*, *32*(3), 400.

Gisser, M., & Goodwin, T. H. (1986). Crude Oil and the Macroeconomy: Tests of Some Popular Notions: Note. *Journal of Money, Credit and Banking*, *18*(1), 95.

Gelos, G., & Ustyugova, Y. (2017). Inflation responses to commodity price shocks – How and why do countries differ? *Journal of International Money and Finance*, *72*, 28–47.

Guo, H., & Kliesen, K. L. (2005). Reading Inflation Expectations from CPI Futures. *Economic Synopses*, *2005*(5).

Gylych, J., Jbrin, A. A., Celik, B., & Isik, A. (2020). The Effect of Oil Price Fluctuation on the Economy of Nigeria. *International Journal of Energy Economics and Policy*, *10*(5), 461–468.

Hamilton, J. D. (1983). Oil and the Macroeconomy since World War II. *Journal of Political Economy*, *91*(2), 228–248.

Hamilton, J. D., & Herrera, A. M. (2004). Oil Shocks and Aggregate Macroeconomic Behavior: The Role of Monetary Policy: A Comment. *Journal of Money, Credit, and Banking*, *36*(2), 265–286.

Herrera, A. M., & Pesavento, E. (2009). Oil Price Shocks, Systematic Monetary Policy, and the "Great Moderation." *Macroeconomic Dynamics*, *13*(1), 107–137

Jawad, M. (2013). Oil Price Volatility and its Impact on Economic Growth in Pakistan. *Journal of Finance and Economics*, *1*(4), 62–68.

Jongwanich, J., & Park, D. (2011). Inflation in developing Asia: pass-through from global food and oil price shocks. *Asian-Pacific Economic Literature*, *25*(1), 79–92.

Kehrig, M., & Ziebarth, N. (2013). Disentangling Labor Supply and Demand Shocks Using Spatial Wage Dispersion: The Case of Oil Price Shocks. *SSRN Electronic Journal*. Published.

Khan, M. A., & Ahmed, A. (2011). Macroeconomic Effects of Global Food and Oil Price Shocks to the Pakistan Economy: A Structural Vector Autoregressive (SVAR) Analysis. *The Pakistan Development Review*, *50*(4II), 491–511.

Kilian, L., & Lee, T. K. (2014). Quantifying the speculative component in the real price of oil: The role of global oil inventories. *Journal of International Money and Finance*, *42*, 71–87.

Kilian, L. (2008). The Economic Effects of Energy Price Shocks. *Journal of Economic Literature*, *46*(4), 871–909.

Kumar, S. (2005). The Macroeconomic Effects of Oil Price Shocks: Empirical Evidence for India. *SSRN Electronic Journal*. Published.

LeBlanc, M., & Chinn, M. D. (2004). Do High Oil Prices Presage Inflation? The Evidence from G-5 Countries. *SSRN Electronic Journal*. Published.

Malik, A. (2010). Oil Prices and Economic Activity in Pakistan. *South Asia Economic Journal*, *11*(2), 223–244.

Malik, A. (2010). The Impact of Oil Price Changes on Inflation in Pakistan. *International Journal of Energy Economics and Policy, 2016, 6*(4), 727-737.

McCallum, B. (2000). Monetary policy for an open economy: an alternative framework with optimizing agents and sticky prices. *Oxford Review of Economic Policy*, *16*(4), 74–91.

Mork, K. A. (1989). Oil and the Macroeconomy When Prices Go Up and Down: An Extension of Hamilton's Results. *Journal of Political Economy*, *97*(3), 740–744.

Manera, M., & Cologni, A. (2005). Oil Prices, Inflation and Interest Rates in a Structural Cointegrated VAR Model for the G-7 Countries. *SSRN Electronic Journal*. Published.

Musa, K. S., Maijama'a, R., Mohammed, N., & Yakubu, M. (2020). COVID-19 Pandemic, Oil Price Slump and Food Crisis Nexus: An Application of ARDL Approach. *OALib*, *07*(06), 1–19.

NAKOV, A., & PESCATORI, A. (2010). Monetary Policy Trade-Offs with a Dominant Oil Producer. *Journal of Money, Credit and Banking*, *42*(1), 1–32.

Omolade, A., Nwosa, P., & Ngalawa, H. (2019). Monetary Transmission Channel, Oil Price Shock and the Manufacturing Sector in Nigeria. *Folia Oeconomica Stetinensia*, *19*(1), 89–113.

OZCICEK, O., & DOUGLAS McMILLIN, W. (1999). Lag length selection in vector autoregressive models: symmetric and asymmetric lags. *Applied Economics*, *31*(4), 517–524.

ÖTker, I., Vávra, D., Vázquez, F. F., Jácome, L. I., Habermeier, K. F., Ishi, K., Giustiniani, A., & Kisinbay, T. (2009). Inflation Pressures and Monetary Policy Options in Emerging and Developing Countries-A Cross Regional Perspective. *IMF Working Papers*, *09*(1), 1.

Ozturk, F. (2015a). Oil Price Shocks-Macro Economy Relationship in Turkey. *Asian Economic and Financial Review*, *5*(5), 846–857.

Ozturk, F. (2015b). Oil Price Shocks-Macro Economy Relationship in Turkey. *Asian Economic and Financial Review*, *5*(5), 846–857.

Peersman, G., & van Robays, I. (2012). Cross-country differences in the effects of oil shocks. *Energy Economics*, *34*(5), 1532–1547.

Pesaran, M. H., Shin, Y., & Smith, R. P. (1999). Pooled Mean Group Estimation of Dynamic Heterogeneous Panels. *Journal of the American Statistical Association*, *94*(446), 621–634.

Ratti, R. A., & Vespignani, J. L. (2013). Why are crude oil prices high when global activity is weak? *Economics Letters*, *121*(1), 133–136.

Rotemberg, J. J., & Woodford, M. (1996). Imperfect Competition and the Effects of Energy Price Increases on Economic Activity. *Journal of Money, Credit and Banking*, *28*(4), 549.

SIMS, C. A., & ZHA, T. (2006). DOES MONETARY POLICY GENERATE RECESSIONS? *Macroeconomic Dynamics*, *10*(2), 231–272.

Salisu, A. A., Isah, K. O., Oyewole, O. J., & Akanni, L. O. (2017). Modelling oil price-inflation nexus: The role of asymmetries. *Energy*, *125*, 97–106.

Sarmah, A., & Bal, D. P. (2021). Does Crude Oil Price Affect the Inflation Rate and Economic Growth in India? A New Insight Based on Structural VAR Framework. *The Indian Economic Journal*, 001946622199883.

Shehu, A., Abdullah, S. S., & Yau, N. A. (2019). Asymmetric Effect of Oil Shocks on Food Prices in Nigeria: A Non Linear Autoregressive Distributed Lags Analysis. *International Journal of Energy Economics and Policy*, *9*(3), 128–134.

Sibanda, K., Hove, P., & Murwirapachena, G. (2015). Oil Prices, Exchange Rates, And Inflation Expectations In South Africa. *International Business & Economics Research Journal (IBER)*, *14*(4), 587.

Stock, J. H., & Watson, M. W. (2001). Vector Autoregressions. *Journal of Economic Perspectives*, *15*(4), 101–115.

Tang, W., Wu, L., & Zhang, Z. (2010). Oil price shocks and their short- and long-term effects on the Chinese economy. *Energy Economics*, *32*, S3–S14.

Taylor, J. B. (1993). Discretion versus policy rules in practice. *Carnegie-Rochester Conference Series on Public Policy*, *39*, 195–214.

Valcarcel, V. J., & Wohar, M. E. (2013). Changes in the oil price-inflation pass-through. *Journal of Economics and Business*, *68*, 24–42.

Varghese, G. (2016). Inflationary effects of oil price shocks in Indian economy. *Journal of Public Affairs*, *17*(3), e1614. https://doi.org/10.1002/pa.1614

Wu, M. H., & Ni, Y. S. (2011). The effects of oil prices on inflation, interest rates and money. *Energy*, *36*(7), 4158–4164.

Wu, T., & Cavallo, M. (2009). Measuring Oil-Price Shocks Using Market-Based Information. *Federal Reserve Bank of Dallas, Working Papers*, *2009*(0905).

Zhao, L., Zhang, X., Wang, S., & Xu, S. (2016). The effects of oil price shocks on output and inflation in China. *Energy Economics*, *53*, 101–110.