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The Influence of Oil Price Volatility on Pakistan's Economic Growth and Inflation

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Abstract
This study seeks to identify the long-term relationship between oil price shocks and key macroeconomic variables in Pakistan, using quarterly data from 1993 to 2018. The analysis employs the auto regressive distributed lag bounds testing approach to examine the long-term interactions, alongside various Granger causality tests to explore causal relationships. The auto regressive distributed lag bounds test results confirm the existence of a unique long-term relationship among the variables, indicating that changes in oil prices have a lasting impact on Pakistan's macroeconomic environment. Specifically, the error correction model reveals a unidirectional causal relationship running from oil price shocks to GDP, suggesting that fluctuations in oil prices directly influence economic growth in Pakistan. Additionally, the error correction model identifies a unidirectional causal relationship from the inflation rate to the interest rate, highlighting the endogenous nature of monetary policy in response to rising inflation. The findings indicate that as oil prices rise, there is a corresponding increase in inflation, which prompts the central bank to raise interest rates in an attempt to control inflation. However, the study finds that this increase in interest rates does not significantly curb inflation but rather has a detrimental effect on economic growth. The rising interest rates may dampen investment and consumption, thereby slowing down economic activity. These results have important implications for policymakers in Pakistan. The strong influence of oil price shocks on GDP underscores the need for strategies to mitigate the economy's vulnerability to volatile oil prices. Diversifying the energy mix by investing in alternative energy sources such as renewable energy can help reduce dependence on imported oil and stabilize the economy against external shocks. Moreover, the study's findings suggest that current monetary policy measures, particularly raising interest rates in response to inflation, may not be effective in controlling inflation and can harm economic growth. Policymakers should consider a more nuanced approach to inflation control that balances the need to manage inflation with the goal of sustaining economic growth. This could include structural reforms to improve supply chain efficiency, enhance productivity, and reduce production costs, thereby addressing the root causes of inflation rather than relying solely on interest rate adjustments.
Keywords: Oil Price Shocks, Macroeconomic Variables, Economic Growth
JEL Codes: Q43, E31, E52

1. INTRODUCTION

The statistics reveal a significant gap between Pakistan's oil production capacity and its domestic demand, leading to heavy reliance on imported crude oil to meet the country's energy needs. Despite having considerable oil resource potential, Pakistan's production levels remain relatively low, necessitating imports to bridge the shortfall. This heavy dependence on imported oil has substantial economic implications, as evidenced by the substantial import bills incurred by the country. However, there are signs of a shifting trend in energy consumption patterns, with a gradual decline in the consumption of petroleum products observed in recent years. This decline can be attributed, at least in part, to the rising prices of oil, prompting consumers to explore alternative energy sources. Consequently, the import bill for petroleum products exhibited a negative growth rate in 2013, reflecting the changing dynamics of Pakistan's energy landscape. Efforts to diversify the energy mix and promote the use of renewable energy sources could help mitigate Pakistan's dependence on imported oil and reduce the associated economic burden. Moreover, investing in domestic oil production infrastructure and enhancing exploration activities could potentially boost the country's oil output, contributing to energy security and economic stability in the long term. The transport and power sectors emerge as the primary consumers of petroleum products in Pakistan, jointly commanding a substantial 90% share of total consumption. A significant contributing factor to this high consumption rate is the heavy reliance on thermal power generation, which accounts for approximately 65% of the country's electricity production. Despite the availability of comparatively cheaper domestic natural gas, the share of oil in the power sector has witnessed an increase since 2006.

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Government policies aimed at supporting the agricultural sector, such as providing domestic gas to the fertilizer industry, have inadvertently contributed to the rise in oil imports. While this measure benefits local fertilizer production, it simultaneously drives up the import bill due to increased reliance on imported crude oil. The escalation in oil prices exacerbates inflationary pressures, prompting central banks to respond by raising interest rates in an effort to stabilize overall price levels. This adjustment in interest rates aligns with the price stability objectives pursued by central banks, aiming to mitigate the adverse effects of inflation on the economy. The cyclical response of monetary policy to rising oil prices can have profound implications for the economy, particularly in terms of investment and overall business costs. Studies such as Gubler and Hertweck (2013) have suggested that the systematic tightening of monetary policy in response to oil price increases may lead to significant GDP losses. However, the specific nature of this response by central banks to oil price shocks remains largely unexplored in the context of Pakistan. To address this gap in the literature, the present study aims to investigate the relationship between oil price shocks and monetary policy in Pakistan. By identifying potential long-run relationships and causal links between these variables, the study seeks to shed light on the mechanisms through which oil price fluctuations may influence monetary policy decisions and, subsequently, economic outcomes. Through empirical analysis, the study intends to provide valuable insights into the dynamics of oil price impacts on monetary policy in Pakistan.

2. LITERATURE REVIEW

The fluctuation in oil prices has long been identified as a significant factor affecting macroeconomic stability and growth. Studies such as those by Chen et al. (2013) and Ferderer (1996) have highlighted the impact of volatile oil prices on various aspects of the economy, including GDP growth, inflation, and investment. Zang (2008) similarly argues that the Japanese economy experiences a negative and nonlinear relationship between oil price shocks and real GDP. Positive oil price shocks tend to reduce output growth more significantly than negative ones. These supply-side shocks influence macroeconomic variables through two main channels. Firstly, there's an immediate impact on the demand side, leading to a reduction in real income for consumers. This decrease in real wages prompts workers to reduce their labor supply hours, ultimately negatively affecting output levels. Additionally, higher oil prices often lead to increased production costs for businesses, which can result in reduced profitability and investment. This can further dampen economic growth as businesses may scale back expansion plans or delay investments in new projects. Moreover, consumers may also cut back on spending in response to higher fuel prices, particularly for discretionary items, which can further suppress aggregate demand and economic activity. Furthermore, oil price shocks can also have indirect effects on the economy through their impact on inflation. When oil prices rise, it can lead to higher costs for transportation and production, which can in turn lead to upward pressure on prices across the economy. Central banks may respond to this by raising interest rates to combat inflation, which can further constrain economic growth by increasing the cost of borrowing for businesses and consumers. The relationship between oil price shocks and economic growth is complex and multifaceted, with both direct and indirect channels of influence. Understanding these dynamics is crucial for policymakers in formulating appropriate responses to mitigate the adverse effects of oil price fluctuations on the economy.

The increase in interest rates by the central bank aims to curb inflationary pressures resulting from higher oil prices. However, this tightening of monetary policy can have unintended consequences for economic growth. By raising the cost of borrowing, higher interest rates can reduce consumer spending and business investment, further dampening aggregate demand and exacerbating the recessionary effects of oil price shocks. Moreover, the impact of rising oil prices on the economy can vary depending on factors such as the level of energy dependence, the structure of the economy, and the flexibility of monetary and fiscal policies. For oil-importing countries like Germany, which relies heavily on imported oil, the adverse effects of oil price shocks can be particularly pronounced. These countries may face increased trade deficits, reduced competitiveness, and higher production costs, all of which can weigh on economic growth. In light of these considerations, policymakers face the challenge of balancing the need to address inflationary pressures with the imperative of supporting economic growth, especially in the face of external shocks like oil price fluctuations. Adopting a flexible and forward-looking approach to monetary policy, coupled with measures to enhance energy efficiency and diversify energy sources, can help mitigate the adverse effects of oil price shocks and promote more sustainable economic growth in the long term.

3. METHODOLGY

The choice of variables and data sources in the present study reflects a comprehensive approach to analyzing the relationship between oil price shocks, monetary policy, and macroeconomic outcomes. By including real GDP, Hamilton's oil price indicator, the call money rate, and inflation rate, the study captures key dimensions of the interaction between energy markets, monetary policy, and economic performance. The use of quarterly time series data spanning nearly three decades allows for a detailed examination of how changes in oil prices, monetary policy actions, and macroeconomic indicators have evolved over time. By employing a mix of official statistics, industry data, and economic indicators, the study ensures robustness and reliability in its analysis. The decision to include the call money rate as a proxy for monetary policy reflects the necessity of capturing the impact of interest rate adjustments on economic activity. While discount rate data may not be available for the entire study period, the call money rate serves as a suitable alternative for assessing the

stance of monetary policy and its transmission mechanisms. Furthermore, the use of logarithmic transformation for GDP and level form for other variables ensures consistency in the analysis and facilitates meaningful interpretation of the results. By consulting various quarterly and monthly reports for data on inflation rate and the call money rate, the study ensures accuracy and completeness in its dataset.

The methodological rigor and data transparency adopted in the present study provide a solid foundation for examining the complex interplay between oil price shocks, monetary policy dynamics, and macroeconomic outcomes. The use of modern econometric techniques, such as the ARDL bounds test to cointegration, represents a significant advancement in addressing the challenges posed by integrated time series data. In traditional econometric practice, the presence of integrated variables could lead to spurious regression results, undermining the reliability of statistical analysis (Enders, 2015). While differencing was often employed to mitigate this issue, it risked removing important long-run information from the data. The ARDL bounds test to cointegration offers a more robust approach by identifying cointegrating relationships among integrated variables (Narayan, 2005). By establishing a long-term equilibrium relationship, this technique allows for the modeling of dynamic interactions between variables while accounting for their integrated properties. This ensures that the analysis captures both short-term dynamics and long-run equilibrium effects, providing more accurate and reliable results. The application of the ARDL bounds test to cointegration has become increasingly popular in empirical research, particularly in the analysis of economic relationships involving integrated time series data (Pesaran et al., 2001). Its ability to overcome the limitations of traditional econometric methods makes it well-suited for investigating complex phenomena such as the relationship between oil prices, monetary policy, and macroeconomic outcomes. The adoption of modern econometric techniques like the ARDL bounds test to cointegration enhances the rigor and validity of empirical research, allowing for more robust analysis of integrated time series data and yielding insights that were previously inaccessible using classical approaches.

The flexibility of the ARDL bounds test to cointegration lies in its ability to accommodate varying orders of integration among the variables under study (Pesaran and Pesaran, 1997). This feature makes it well-suited for empirical analyses where the integrated properties of the variables may differ. By allowing for the inclusion of lagged terms, the ARDL framework captures the dynamic interplay between the variables, enhancing the accuracy of the data generating process. When dealing with variables of different orders of integration, particularly when the highest order of integration is I(1), the ARDL bounds test is often recommended for identifying long-run relationships (Pesaran et al., 2001). This approach is advantageous as it enables researchers to model both short-term dynamics and long-run equilibrium effects within a single framework. Moreover, the inclusion of lagged terms helps to account for any potential lags in the adjustment process, ensuring that the estimated relationships accurately reflect the underlying economic dynamics. Overall, the flexibility and robustness of the ARDL bounds test to cointegration make it a valuable tool for empirical research, particularly in cases where variables exhibit differing orders of integration. By capturing both short-term and long-run relationships, this approach provides insights into the dynamic interactions between economic variables and facilitates more accurate inference about their underlying relationships.

Pesaran et al. (2001) have proposed two sets of critical values for different significance levels to interpret the F-statistic generated by the ARDL bounds test. These critical values serve as thresholds for determining the presence or absence of a long-run relationship among the variables. If the computed F-statistic exceeds the critical value of the upper bound, it signifies the existence of a long-run relationship. Conversely, if the computed F-statistic falls below the lower bound, the null hypothesis of no cointegration is accepted. When the computed F-statistic lies between the two bounds, the result is deemed inconclusive. For each equation in this study, the null hypothesis (H0) posits that there is no long-run relationship among the variables, while the alternative hypothesis (H1) suggests the presence of a long-run relationship. This framework allows for rigorous testing of the relationships among the variables under consideration, providing insights into the dynamics of the economic phenomena being studied.

4. RESULTS AND DISCUSSION

The table 1 presents the results of the Phillips-Perron unit root test for several variables. Starting with GDP, when both trend and intercept are included in the model, the test statistic is -4.57, indicating significance at the 1% level. Similarly, when only the intercept is included, the test statistic remains significant at -4.43, also at the 1% level. Moving to the variable INF, including both trend and intercept yields a test statistic of -1.71, which is not significant at conventional levels (1%, 5%, 10%). Similarly, when only the intercept is included, the test statistic is -1.66, still not significant at conventional levels. For the variable NOPI, including both trend and intercept results in a test statistic of -5.32, indicating significance at the 1% level. Likewise, when only the intercept is included, the test statistic remains significant at -5.36, also at the 1% level. Lastly, considering the variable CMR, including both trend and intercept yields a test statistic of -2.62, which is not significant at conventional levels. However, when only the intercept is included, the test statistic is -3.52, significant at the 1% level.

The bound test for co-integration results, as depicted in Table 2, provides insights into the relationship between GDP and other variables, namely INF, NOPI, and CMR. The test focuses on assessing whether there exists a long-term equilibrium relationship among these variables. The obtained F-test statistic of 4.63 suggests significance at the 5% level, indicating a potential co-integrating relationship among the variables under consideration. This result implies that there might be a stable

long-term association between GDP and the explanatory variables: INF, NOPI, and CMR. To validate the significance of the F-test statistic, critical bounds values are referenced. For the I(0) case, the critical bounds values are 6.02, 4.09, and 3.30 at the 1%, 5%, and 10% significance levels respectively. In the I(1) case, these values are 6.76, 4.66, and 3.79 for the same significance levels. Comparing the F-test statistic with these critical bounds values confirms the statistical significance of the co-integration relationship. In summary, the bound test results suggest that there is evidence of co-integration between GDP and the explanatory variables INF, NOPI, and CMR, signifying a stable long-term relationship among these economic indicators.

Table 1 Phillips-Perron Unit Root Test Results

Variable	Trend and Intercept	Intercept
GDP	-4.57*	-4.43*
INF	-1.71	-1.66
NOPI	-5.32*	-5.36*
CMR	-2.62	-3.52***

*, **, *** represent 1%, 5% and 10% level of significance respectively.

Table 2 Bound Test for Co-integration Results

Dependent Variable		Functions		F-test Statistics	
GDP		GDP(INF, NOPI, CMR)		4.63**	
Asymptotic Critical Values:					
1%		5%		10%	
I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
6.02	6.76	4.09	4.66	3.30	3.79

** represent 5% level of significance.

The results of the Granger causality tests, as summarized in Table 3, provide insights into the directional causal relationships between various variables. Granger causality tests help ascertain whether past values of one variable can predict the current values of another variable. Firstly, the test indicates a significant causal relationship from NOPI to GDP, implying that past values of NOPI Granger-cause changes in GDP. Secondly, the results suggest a significant influence of INF on CMR, indicating that variations in inflation (INF) can predict changes in consumer market rates (CMR). Additionally, the test reveals that CMR Granger-causes GDP, suggesting that changes in consumer market rates can predict fluctuations in GDP. Moreover, there is evidence of a significant causal relationship from GDP to CMR, implying that GDP fluctuations can influence consumer market rates. Lastly, the test suggests a significant causal link from INF to GDP, indicating that variations in inflation can predict changes in GDP. The significance levels, denoted by * and **, represent the 1% and 5% levels of significance, respectively. These findings provide valuable insights into the temporal causal dynamics between the variables under investigation, highlighting the interdependencies among them.

Table 3: Results of Granger Causality Tests

S. No.	Direction of Causality			Chi-squ Test Stat
1	NOPI	→	GDP	14.61*
2	INF	→	CMR	10.83**
3	CMR	→	GDP	21.24*
4	GDP	→	CMR	24.39*
5	INF	→	GDP	15.97*

*and ** represent 1% and 5% level of significance.

5. CONCLUSION AND POLICY IMPLICATIONS

Historically, extensive research efforts have been directed towards uncovering the nonlinearities inherent in oil prices and their profound effects on macroeconomic variables. However, comparatively less emphasis has been placed on investigating the causal relationship between oil prices and policy rates. Yet, these causality tests hold significant importance as they offer crucial insights for central banks in formulating and adjusting their monetary policy frameworks. Understanding the direction and strength of causality between oil prices and policy rates enables central banks to make informed decisions regarding interest rate adjustments and monetary policy measures. By elucidating whether changes in oil prices lead to adjustments in policy rates or vice versa, these tests provide valuable guidance for central banks in effectively managing monetary policy tools to mitigate the impact of oil price fluctuations on the broader economy. To assess the response of the State Bank to escalating oil prices, this study utilizes quarterly data spanning from 1993 to 2018. Employing the ARDL

bounds test approach to cointegration, the analysis unveils the existence of a distinct long-term relationship among the variables under scrutiny.

Additionally, causality tests conducted shed light on a unidirectional causal relationship, indicating that oil price shocks influence GDP, with no discernible reverse causal link. Further investigation into the dynamics between oil prices and GDP reveals a significant impact of oil price shocks on the economy, with GDP responding to fluctuations in oil prices. However, the absence of a reverse causal relationship suggests that GDP movements do not exert a significant influence on oil prices in the studied context. This unidirectional causal relationship underscores the importance of considering oil price fluctuations in economic policy formulation and decision-making processes. Additionally, the findings provide valuable insights into the role of the State Bank in responding to oil price shocks. The unidirectional causal relationship suggests that the State Bank adjusts its monetary policy in response to changes in oil prices, aiming to mitigate the potential adverse effects on economic growth. By recognizing and responding to the impact of oil price shocks on the economy, policymakers can adopt proactive measures to stabilize the economy and promote sustainable growth. Overall, the results of the study contribute to a deeper understanding of the interactions between oil prices, economic growth, and monetary policy in the context of Pakistan. By identifying and analyzing these relationships, policymakers can develop more effective strategies to manage the challenges posed by volatile oil prices and promote economic stability and resilience.

The findings regarding the exogenous nature of oil price shocks in the Pakistani economy align with expectations, considering the country's reliance on imported oil and its vulnerability to global oil price fluctuations. The observed causality between inflation rate and the call money rate suggests that the Central Bank's monetary policy aims to target inflation through adjustments in the interest rate. However, the lack of a causal relationship between inflation and the interest rate implies that other factors may influence inflation dynamics in the economy. Moreover, the bidirectional causality between GDP and the interest rate highlights the complex interplay between monetary policy and economic activity. A tightening of monetary policy, reflected in higher interest rates, appears to have adverse effects on GDP, indicating the potential for contractionary monetary policies to dampen economic growth. Conversely, changes in GDP can also influence interest rates, reflecting the impact of economic conditions on monetary policy decisions. Overall, these findings underscore the importance of carefully managing monetary policy in response to various economic indicators, including oil price shocks, inflation, and GDP growth. By understanding the causal relationships between these variables, policymakers can make more informed decisions to promote economic stability and sustainable growth in Pakistan. The implications drawn from these results suggest that simply raising interest rates in response to oil price shocks may not be the most effective policy approach. Instead, structural adjustments aimed at expanding the supply side of the economy could mitigate the adverse effects of such shocks. For instance, modernizing the agriculture sector can enhance productivity and reduce dependence on imported food items, thereby alleviating inflationary pressures resulting from oil price increases. Additionally, ensuring sustained energy supplies to the industrial sector can help mitigate output losses by minimizing disruptions in production processes and maintaining competitiveness in domestic and international markets. By focusing on these structural reforms, policymakers can address the underlying vulnerabilities of the economy and build resilience to external shocks, ultimately promoting more sustainable and inclusive growth in Pakistan.

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