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ECONOMIC GROWTH AND OIL PRICE SHOCKS IN AN OIL-ABUNDANT COUNTRY: THE CASE OF AZERBAIJAN

ABSTRACT

The study evaluates the macroeconomic effects of oil price shocks and their transmission mechanisms in Azerbaijan, one of the largest oil exporters in the Commonwealth of Independent States. Vector autoregression modelling, together with cointegration techniques, is applied to monthly data on the Brent oil price and five domestic macroeconomic variables over the period January 2005–July 2021. The results show a significant impact of oil prices on real gross domestic product. Oil price shocks affect the economy mainly through the budget channel, while monetary factors also play a role in explaining short-run economic fluctuations. The findings highlight oil price shocks as a salient external risk with direct implications for macro-financial stability in resource-dependent economies. Impulse response analysis further demonstrates a rapid short-run response of most variables to a one-standard-deviation oil price shock.

Keywords: Oil price shocks; Fiscal transmission; Macroeconomic stability; Vector autoregression; Cointegration; CIS countries
JEL Classification: Q43; C32; E32

RIASSUNTO

Crescita economica e shock del prezzo del petrolio in un paese ricco di risorse: il caso dell'Azerbaigian

Questo articolo esamina gli effetti macroeconomici degli shock del prezzo del petrolio ed il loro meccanismo di trasmissione in Azerbaijan, uno dei maggiori paesi esportatori di petrolio della Comunità degli stati indipendenti. Si applica un modello VAR associato a tecniche di

cointegrazione nel periodo gennaio 2005 – luglio 2021. I risultati mostrano un significativo impatto dei prezzi del petrolio sul PIL reale. Gli shock dei prezzi petroliferi influenzano l'economia perché si trasmettono prevalentemente sul bilancio dello stato, mentre i fattori monetari hanno un ruolo nella spiegazione delle fluttuazioni economiche di breve periodo. Le evidenze empiriche mettono in luce come gli shock dei prezzi petroliferi rappresentano un importante rischio esterno con dirette implicazioni per la stabilità macro-finanziaria delle economie che dipendono dal petrolio. L'analisi delle risposte d'impulso dimostra, inoltre, una risposta di breve periodo rapida della maggior parte delle variabili a uno shock del prezzo del petrolio pari a una deviazione standard.

1. Introduction

Changes in the global energy landscape, characterised by large swings in oil prices, have generated significant economic disruptions in countries that rely heavily on hydrocarbon resources. At the same time, the global transition towards green energy, together with growing uncertainty about the future of fossil fuels, poses fiscal risks for these economies and underscores the importance of promoting sustainable economic development.

Commodity price shocks have been widely identified in the literature as a key factor affecting macroeconomic stability, often undermining output growth and future consumption in resource-dependent economies (Arezki *et al.,* 2012). Exogenous shocks, resulting mainly from reductions in capital inflows and major changes in international terms of trade, are among the three main sources of volatility in developing countries (Loayza *et al.,* 2007). The other two include domestic shocks stemming from internal instability and inefficient policies, as well as the lack of appropriate 'shock absorbers', which exacerbates these countries' exposure to external factors. According to Loayza *et al.* (2007), financial markets and stabilisation policies tend to diversify risk and mitigate volatility caused by such shocks. Commodity-dependent countries with low levels of financial development find it particularly difficult to cope with large fluctuations in resource revenues caused by commodity price shocks (Ploeg and Poelhekke, 2009). While resource abundance and large windfalls account for most cyclical fluctuations, procyclical monetary and fiscal policies contribute by amplifying, rather than smoothing, downturns and upturns. Increased spending, fuelled by substantial resource revenues during commodity booms, is mainly directed towards investment projects and public-sector wages

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(Frankel, 2011). However, despite their potential for long-term gains, so-called white elephant projects cannot be completed during periods of declining resource revenues, thereby negatively affecting long-run growth prospects. Fiscal policy is, therefore, not only an important transmission channel but also plays a crucial role in regulating the extent of countries' exposure to such shocks (Pieschacón, 2012). Sluggish investment and growth in resource-based economies are also linked to exchange rate volatility. It is argued that currency crises and low economic activity are most common during periods of low commodity prices, while the boom phase is typically associated with credit expansion and a significant appreciation of the exchange rate. This leads to inflation, a reduction in non-oil exports, and the diversion of capital away from these sectors. These dynamics may also destabilise the financial system, with adverse consequences for banking sector stability, credit availability, and broader macro-financial resilience in resource-dependent economies. (Kilian, 2009; Kolodzeij and Kaufmann, 2014; Hamilton, 2021). A growing body of published work on oil-exporting countries, including the Gulf states, has established that oil price shocks, as well as other external factors such as foreign output, interest rates, and terms of trade, are among the major drivers of macroeconomic volatility. These shocks are mainly transmitted to the real sector through fiscal and monetary channels (Mehrara and Oskoui, 2007; Berument et al., 2010; Rafiq, 2011; Hamdi and Sbia, 2013; Sadeghi, 2017; Mohaddes, Raissi and Sarangi, 2022).

In recent years, there has been growing interest in the macroeconomic performance of oil-dependent Commonwealth of Independent States (CIS) economies due to the transition process's ramifications and these countries' high exposure to external factors. A strong response of output to regional and global shocks has been reported in several studies focusing on selected CIS economies (Rahmanov, 2016; Guliyev, 2018; Mukhtarov, Mammadov and Ahmadov, 2019; Faryna and Simola, 2021). Aleksandrova (2016) argues that the business cycles of most countries in the Caucasus and Central Asia remain sensitive to swings in oil prices, mainly due to these economies' strong reliance on petroleum windfalls. Nevertheless, empirical research on the relationship between exogenous shocks and economic activity in these countries remains scarce.

The existing literature recognises the critical role of oil price shocks in explaining macroeconomic volatility in both oil-exporting and oil-importing countries. Early research on the United States and other advanced economies confirms the adverse impact of oil price increases on real economic activity, whereas the effect of oil price declines is considerably

weaker (Hamilton, 1983; Mork, 1989; Jiménez-Rodríguez and Sánchez, 2005). The literature addressing this question through the lens of demand and supply shocks to the real oil price reports mixed and inconclusive results (Kilian, 2009; Kolodzeij and Kaufmann, 2014; Hamilton, 2021).

Given the significant share of oil and gas in Azerbaijan's total exports, the country's fiscal resources and long-term development may be adversely affected by prevailing conditions in fossil fuel markets and the global transition to a greener economy. This makes Azerbaijan an interesting setting for examining how exogenous oil price shocks affect a resource-abundant economy and through which channels these shocks are transmitted. Against this background, the paper investigates the macroeconomic effects of oil price shocks in resource-dependent CIS economies and addresses the following research question: *What are the macroeconomic effects of oil price shocks and through which mechanisms are they transmitted in Azerbaijan?*

This research contributes to the existing literature in several ways. First, most studies analysing the role of external factors in explaining business cycle fluctuations in resource-rich economies focus on countries with relatively efficient private sectors. We contribute by focusing on Azerbaijan, a country in the Caspian Basin with significant energy resources and serving as a vital regional transportation hub. Secondly, unlike previous studies, this paper employs monthly data covering the period from January 2005 to July 2021. Finally, the dataset spans an extended period, including key economic episodes such as the early years of transition, the global financial crisis, the COVID-19 pandemic, and the sharp declines in oil prices observed in 2014 and 2020.

Our findings confirm the importance of oil price shocks in explaining long-run output growth. While these shocks are primarily transmitted to the real economy through the budget channel, monetary factors also have a significant impact on economic activity in the short run. Impulse response analysis further demonstrates that most variables exhibit a rapid yet short-lived response to a one-standard-deviation oil price shock.

The remainder of the paper is structured as follows. Section 2 presents stylised facts on economic performance and major reforms in Azerbaijan. Section 3 reviews the existing literature. Section 4 describes the data and methodology. Section 5 presents the empirical findings. Section 6 concludes.

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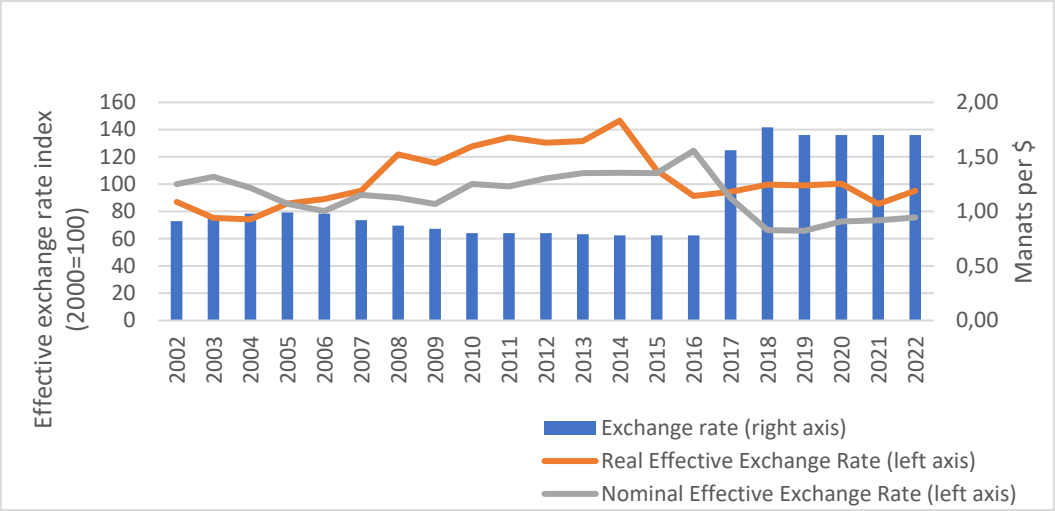
2. STYLISED FACTS

Following the breakup of the Soviet Union in the early 1990s, Azerbaijan regained its independence and embarked on a transition from a centrally planned economy to a market-based system. The initial years of transition were marked by a sharp economic decline, high macroeconomic volatility, and elevated inflation during the period 1990-1994. In 1994, the State Oil Company of Azerbaijan (SOCAR) signed the first Production Sharing Agreement (PSA) with a consortium of international oil companies for the development of three major offshore oil fields: Azeri, Chirag, and the deepwater portion of Gunashli, collectively known as ACG. The agreement, widely referred to as the "Contract of the Century", marked a turning point in the development of Azerbaijan's oil industry. Initially signed for 30 years, the contract was later extended until 2049. BP (British Petroleum) is the main investor and shareholder in the ACG oil field and also operates the Shah Deniz gas field under the Shah Deniz PSA.

Rapid economic growth between 2004 and 2014, which peaked at 34.5% in 2006, was mainly driven by rising world oil prices, strong global demand, and the completion of major offshore production projects such as the Baku–Tbilisi–Ceyhan and South Caucasus (Shah Deniz) pipelines (Asian Development Bank, 2020). The booming oil sector led to an appreciation of the real effective exchange rate of around 106% over the period 2004 to 2015 and an increase in Azerbaijan's foreign reserves to $15.8 billion by 2014 (Kintsurashvili and Kresic, 2019; Asian Development Bank, 2020). Oil wealth was mainly channelled into non-tradable sectors of the economy, including construction, which caused a strong dependence of the non-oil private sector on government investment (Bayramov and Orujova, 2017).

Following the global financial crisis, the prospects for sustaining double-digit growth diminished significantly. A challenging global economic environment, accompanied by declining oil production, led to a significant slowdown in Azerbaijan's growth to 0.1% in 2011, as reported by the State Statistical Committee of the Republic of Azerbaijan (2025). The vulnerability of the economy, its overreliance on the resource sector, and the importance of economic diversification became even more apparent after the sharp decline in world oil prices in 2014. As a result, the country experienced a reduction in oil revenues, leading to two-step currency devaluations and a deterioration in economic activity subsidized by the government (Figure 1).

FIGURE 1 - *Nominal and Effective Exchange Rate, Manat to the US Dollar*



Source: Central Bank of Azerbaijan.

The government's attempts to stabilise the economy under a fixed exchange rate regime required substantial drawdowns of foreign reserves, with negative consequences for production growth, private-sector performance, and the economy as a whole. The abandonment of the dollar peg and the subsequent 50% devaluation of the Manat had an adverse impact on the real and financial sectors. The aftershocks, in the form of soaring prices, a declining current account surplus, and growing public concerns about the financial sector's reliability, were addressed through a combination of contractionary monetary and fiscal policy measures. This episode exposed the country's vulnerabilities and underscored concerns about the sustainability of economic growth. Azerbaijan's reliance on oil rents is risky and hampers the effective implementation of the main functions of the State Oil Fund of Azerbaijan (SOFAZ), established in 1999, which is tasked with managing oil revenues and supporting long-run economic growth.

The need for structural reforms aimed at mitigating the adverse impact of external factors, attracting foreign direct investment into the non-oil sector of the economy, and thereby promoting a private sector-driven economic model became evident. The Strategic Roadmap on National Economy Perspectives (SRENP), which includes eleven sector roadmaps and covers reforms aimed at improving economic performance over the short-, medium-, and long-term horizons, was approved by the Decree of the President of the Republic of Azerbaijan on 6 December 2016. The development of a favourable business environment is one of the key

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priorities under the SRENP. Reforms included the creation of a new credit bureau, specialised business courts, the digitalisation of customs services, and tax reductions for small businesses were implemented (Kintsurashvili and Kresic, 2019). Moreover, given the procyclicality of fiscal policy in commodity-exporting countries, a new fiscal rule was introduced in 2019. With regard to monetary policy, the Central Bank of the Republic of Azerbaijan reduced the refinancing rate from 15% to 8.25% in January 2018 and to 6.25% in 2020 (International Monetary Fund, 2019; Central Bank of the Republic of Azerbaijan, 2020). Nevertheless, substantial challenges remain and were exacerbated by the twin shocks of the COVID-19 pandemic and the further decline in oil prices in 2020. Despite these challenges, 2020 marked an important turning point for Azerbaijan, with the restoration of the country's territorial integrity following the long-standing conflict with Armenia. The economic development of the liberated territories is expected to contribute to the country's future growth and may create new opportunities for regional development and infrastructure investment.

3. Literature review

The macroeconomic effects of various exogenous shocks have been extensively studied over the past decades. Early contributions mainly focused on oil price shocks and their implications for developed oil-importing economies, beginning with the seminal work of Hamilton (1983), who shows that reductions in economic activity in the United States over the period 1948-1972 were preceded by increases in oil prices. This negative relationship is also supported by Mork (1989), who finds that the correlation is considerably weaker for oil price decreases. Whilst one strand of the literature focuses mainly on oil supply shocks, Kilian (2009) takes a different approach by decomposing the real oil price into three structural components: oil supply shocks, aggregate demand shocks, and oil market-specific or precautionary demand shocks. Changes in the demand for industrial commodities are measured using a newly developed Monthly Index of Global Real Economic Activity based on shipping costs. Contrary to earlier studies, the structural vector autoregression (SVAR) analysis conducted by Kilian (2009) demonstrates that unanticipated disruptions to oil supply lead only to a small and partially statistically significant increase in oil prices and a temporary contraction in real economic activity. Demand shocks, in turn, exhibit the largest, persistent, and highly significant positive contribution to the real price of oil, with precautionary demand emerging as the most important transmission channel for external political events such as wars or revolutions. Nevertheless, applying a cointegrating

vector autoregression (CVAR) framework under alternative specifications, Kolodziej and Kaufmann (2014) fail to support Kilian's (2009) argument regarding the importance of demand-side oil price shocks and the relative insignificance of supply shocks. Hamilton (2021), in turn, reflects on the usefulness of the shipping cost-based index introduced by Kilian (2009) and proposes an alternative industrial production index that better captures global real economic activity. A negative long-run impact of oil price movements on real GDP and the Consumer Price Index is also reported by Katircioglu *et al.* (2015) in their study of twenty-six OECD countries. However, the elasticity of unemployment with respect to oil prices is found to be insignificant. Departing from previous studies, Jiménez-Rodríguez and Sánchez (2005) investigate the impact of oil price shocks on real economic activity using both linear and non-linear models. Their results show that, in major industrialised countries, the impact of oil price increases differs significantly from that of price decreases, highlighting the limitations of linear models. The authors also suggest that the real effective exchange rate is one of the key transmission channels in most of the countries examined.

An increasing number of empirical studies examine the relationship between exogenous shocks and the macroeconomic performance of oil-exporting countries, with particular emphasis on Middle Eastern economies. Mohaddes, Raissi and Sarangi (2022) investigate the macroeconomic transmission of global shocks across the Gulf Cooperation Council countries, focusing on Saudi Arabia. The overall findings indicate a short-lived impact of adverse US-originated output shocks, whereas the country is more sensitive to negative changes in China's output, a slowdown in the global economy, and deteriorating world financial conditions. Berument, Ceylan and Dogan (2010) report a significant and positive impact of oil price shocks on output growth in most oil-exporting Middle East and North African (MENA) countries included in their study, although an insignificant effect is found in the case of some small net oil exporters such as Bahrain, Egypt, and Israel. Hamdi and Sbia (2013) confirm the existence of a long-run relationship among oil revenues, government spending, and economic growth in the Kingdom of Bahrain. Similarly, studies focusing on selected oil-exporting Gulf states confirm the importance of exogenous shocks such as oil price volatility, terms of trade, foreign output, and the US real interest rate in explaining fluctuations in real output, while also demonstrating the inability of prevailing pegged exchange rate regimes to protect the real sectors of these economies from adverse shocks (Mehrara and Oskoui, 2007; Rafiq, 2011). Moreover, Sadeghi

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(2017) documents the importance of government size in explaining the transmission of oil price shocks to oil-dependent economies.

Drawing on earlier research and considering a new set of external factors, Maćkowiak (2007) finds that US monetary policy shocks are less important for emerging economies than other exogenous shocks, although the author documents a relatively strong and rapid spillover effect of the former. Doojav and Luvsannyam (2019) examine a broader set of exogenous variables and their transmission channels. Their results support earlier studies and confirm a significant contribution of external shocks to fluctuations in both real output and the Consumer Price Index in Mongolia, while the transmission channels vary by shock type. The significant contribution of trade shocks to fluctuations in real output is also documented by Kose and Riezman (2001) in their study of twenty-two African countries over the period 1970-1990.

Overall, the evidence underscores the significant role of oil price shocks in driving macroeconomic volatility in both oil-exporting and oil-importing economies. However, little is known about the relationship between economic growth and oil prices in resource-rich CIS economies in transition. Faryna and Simola (2021) report a high vulnerability of selected CIS countries to global and regional shocks, while also documenting a strong positive response of CIS output to a 50% increase in oil prices. In a study testing the permanent income hypothesis in Azerbaijan, Kazakhstan, and Russia, Rahmanov (2016) demonstrates a positive response of real imports to both temporary and permanent oil price shocks across all three countries. An appreciation of the exchange rate in response to either shock is observed only in Azerbaijan and Russia. The results of Guliyev's (2018) empirical investigation are also consistent with the literature and provide evidence of a significant contribution of oil prices to the variability of non-oil exports in Azerbaijan.

Recent global trends, coupled with occasional shocks and profound transformations in the energy landscape, have serious implications for economic development and sustainability in commodity-dependent countries. Drawing on the existing literature, this study aims to generate fresh insights into the long-run impact, short-run effects, and transmission channels of oil price shocks in economies with a predominant oil and gas sector. This paper contributes to the relatively scarce research on the macroeconomic performance of CIS economies by focusing on Azerbaijan, an oil-exporting country. As one of the region's largest oil exporters, Azerbaijan is

highly vulnerable to oil price shocks. However, the way and extent to which exogenous shocks affect the Azerbaijani economy, as well as similar resource-rich transition economies, remain underexplored. Azerbaijan's strong reliance on hydrocarbons, coupled with its regional standing as an important transportation hub, makes it a particularly relevant case for analysis. We extend the existing literature by employing monthly data to better capture short-term dynamics in the response of macroeconomic variables to oil price shocks. We also consider a longer sample period than previous research, which enhances the robustness of the model estimates and is particularly valuable given the limited availability of data for Azerbaijan and other CIS economies. Finally, the dataset covers a period that includes important events with significant implications for the economy, such as the early years of transition, the global financial crisis, the COVID-19 pandemic, and the sharp declines in oil prices observed in 2014 and 2020. The findings are therefore expected to provide new empirical evidence and serve as a basis for relevant policy recommendations.

4. Data and Methodology

4.1. Data Description

The dataset consists of monthly time series collected from January 2005 to July 2021. The variables of interest include real GDP growth rate (real_gdp_growth), inflation, M3 money aggregate in millions of Azerbaijani Manat (m3), budget expenditure as a share of GDP (budget_expenditure), real effective exchange rate expressed on the base December 2000=100 (reer) and Brent oil price in US dollars (oil_price). Real GDP growth is measured by the real GDP growth rate, while Brent crude oil is used as a proxy for the world oil price. The monetary effects of oil price shocks are captured by the inflation rate, expressed as the annual growth rate in the Consumer Price Index; the money supply, measured by a broad money aggregate (M3); and the real effective exchange rate. Despite the prevailing managed floating or *de facto* pegged exchange rate regime, the real effective exchange rate and M3 variables are included in the analysis to represent monetary channels that indirectly transmit oil price shocks to the real economy. The central bank's interventions, required to maintain the peg in response to shifts in oil revenues, affect foreign exchange reserves, triggering changes in money supply, liquidity, and inflationary pressures. Budget expenditure, in turn, is used to represent fiscal policy, which is considered one of the main transmission mechanisms of oil price shocks. Budget expenditure is expressed as a

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share of GDP to better capture the dynamics of fiscal spending relative to the country's output. Given the procyclical nature of fiscal policy in oil-exporting economies, the normalised variable reflects relative changes in public expenditure in response to oil price fluctuations with greater accuracy. The data on domestic variables were collected from the Central Bank of the Republic of Azerbaijan and the State Statistical Committee of the Republic of Azerbaijan, while oil price series were extracted from the Refinitiv Eikon database. The data sample covers important economic events, including the early years of transition, the global financial crisis, periods of sharp declines in world oil prices, and the global shock of the COVID-19 pandemic. A summary of the descriptive statistics for all series is presented in Table 1.

TABLE 1 - *Descriptive Statistics*

Variables	Mean	Std. Dev.	Min	Max	Skewness	Kurtosis	Jarque-Bera
real_gdp_growth	7.385	11.919	-4.5	48.1	1.708	4.898	49.62 (0.000)
inflation	6.957	5.511	0.2	21.6	0.930	2.799	18.92 (0.000)
reer	108.749	17.991	76.094	153.124	0.220	1.794	70.65 (0.000)
m3	15103.65	8516.1	1442.9	31507.3	-0.098	1.767	81.24 (0.000)
budget_expenditure	25.404	6.412	5.586	39.615	-0.370	3.068	4.83 (0.090)
oil_price	74.952	24.938	22.74	139.83	0.449	2.182	17.57 (0.000)

Notes: The table summarises descriptive statistics of all variables employed in the study. The variables are presented in the rows. The columns denote mean value, standard deviation, minimum and maximum values, skewness, kurtosis, Jarque-Bera test for normality with p-values reported in brackets. ***, ** and * indicate significance at 1%, 5% and 10% levels, respectively.

Table 1 presents the summary statistics for all variables employed in the study. The highest mean and standard deviation are observed for m3 money aggregate, whereas inflation has the lowest average value and variance. Both m3 money aggregate and budget expenditure tend to have a longer left tail as demonstrated by negative skewness in the variables. The value of kurtosis greater than three, in turn, indicates an excess kurtosis in real GDP growth rate. Finally,

according to the results of Jarque-Bera test for normality, the null hypothesis of normal distribution is strongly rejected for all variables except budget expenditure. The charts of the series are reported in Figure B 1.

4.2. Methodology

The main objective of this study is to examine the impact of oil price shocks on output growth and selected macroeconomic variables in Azerbaijan. The empirical investigation starts from testing the time series for unit root and identifying their order of integration. The time series considered are real_gdp_growth, inflation, ln_m3 (natural logarithm of m3), budget_expenditure, ln_reer (natural logarithm of reer) and ln_oil_price (natural logarithm of oil_price). For this purpose, we apply the Augmented Dickey-Fuller (ADF) unit root test. The null hypothesis is: $H_0: \theta = 0$ (the series contains a unit root, or it is nonstationary), the alternative hypothesis is $H_1: \theta < 0$ (the series is stationary). There exist alternative specifications of the ADF test equation that differ in the presence of a deterministic trend and/or drift. The choice of which specification to adopt depends on the characteristics of the time series considered. In addition, we use the Phillips-Perron (PP) test (1988) that controls for serial correlation and heteroskedasticity.

If all variables are integrated of the same order, we proceed with cointegration analysis. This requires first the specification of the underlying six-variable VAR model:

$$y_t = A_0 + \mathrm{A}_1 y_{t-1} + \mathrm{A}_2 y_{t-2} + \cdots + \mathrm{A}_k y_{t-k} + \varepsilon_t \quad (1)$$

where A_0 is a vector of constants of order (6×1), A_i with $i = 1, \ldots, k$ are matrices of order (6×6) and ε_t is a (6×1) vector of white noise disturbances.

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The six endogenous variables are:

$$y_t = \begin{bmatrix} real_gdp_growth_t \\ inflation_t \\ budget_expenditure_t \\ ln_m3_t \\ ln_reer_t \\ ln_oil_price_t \end{bmatrix}$$

The optimal lag-order of the VAR model is selected based on minimum Akaike (AIC) and Hannan-Quinn (HQ) information criteria. Hence, the above-prsented VAR model with six variables is transformed into a Vector Error Correction Model (VECM) as follows:

$$\Delta y_t = \mu + \prod y_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta y_{t-i} + \varepsilon_t \quad (2)$$

where

$$\prod = (\sum_{i=1}^{k} A_i) - I \qquad \Gamma_i = -\sum_{j=i+1}^{k} A_j$$

$$\Delta Y_t = \begin{bmatrix} \Delta real_gdp_growth_t \\ \Delta inflation_t \\ \Delta budget_expenditure_t \\ \Delta ln_m3_t \\ \Delta ln_reer_t \\ \Delta ln_oil_price_t \end{bmatrix}$$

where μ is a (6x1) vector of constants, Π is a (6x6) long-run coefficients matrix, which can be decomposed into the product of the matrices $\alpha\beta'$, where α is a matrix of adjustment parameters that capture the economic forces that push the model back to long-run equilibrium after a shock that generates disequilibrium, and β is a matrix containing the cointegrating vectors. Γ_i is a (6x6) short-run coefficients matrix, and ε_t is a (6x1) vector of white noise disturbances.

The presence of cointegration among the variables is examined using the Johansen cointegration framework, which employs both the Trace and Maximum Eigenvalue statistics. The Trace statistic is defined as:

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{g} ln\left(1 - \hat{\lambda}_i\right) \quad (3)$$

where T denotes the sample size, g is the number of endogenous variables, and $\hat{\lambda}_i$ are the estimated eigenvalues. This statistic tests the null hypothesis that the number of cointegrating relationships is less than or equal to r against the alternative hypothesis that it exceeds r.

The Maximum Eigenvalue statistic is given by:

$$\lambda_{max}(r, r+1) = -Tln\left(1 - \hat{\lambda}_{r+1}\right) \quad (4)$$

and tests the null hypothesis of r cointegrating vectors against the alternative of $r + 1$ cointegrating vectors.

Finally, the diagnostic tests for normality, serial autocorrelation, and stability of the VECM model are performed to ensure the consistency of the analysis.

5. Empirical results

5.1. Unit Root Tests

The ADF and PP tests are employed to assess the presence of unit roots in the six endogenous variables: real GDP growth, inflation, budget expenditure, ln_m3, ln_reer, and ln_oil_price. Based on the visual inspection of the line plots in Figure B 2, an ADF specification including a constant is estimated for all variables, with the exception of money supply (ln_m3), for which a deterministic trend is also included in light of its observed behaviour. The Ng and Perron (1995) procedure is used to determine the optimal number of lags for ADF regression. The results of the ADF test are presented in Table 2. For all series, except money supply and oil price, we fail to reject the null hypothesis of a unit root at any conventional significance level. For money supply and oil price, we fail to reject the null hypothesis of a unit root at the 1% significance level.

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TABLE 2 - *Results of ADF and PP Unit Root Tests*

Variable	ADF			
	Levels	1st differences	Levels	1st differences
real_gdp_growth	-2.327 (0.163)	-3.560 (0.007)***	-1.461 (0.553)	-14.714 (0.000)***
inflation	-2.143 (0.228)	-4.719 (0.000)***	-2.188 (0.211)	-12.486 (0.000)***
budget_expenditure	-2.393 (0.144)	-4.608 (0.000)***	-6.036 (0.000)***	-23.514 (0.000)***
ln_m3	-3.809 (0.016)**	-4.663 (0.000)***	-2.172 (0.506)	-14.055 (0.000)***
ln_reer	-1.930 (0.318)	-3.625 (0.005)***	-2.160 (0.221)	-9.902 (0.000)***
ln_oil_price	-2.984 (0.036)**	-11.053 (0.000)***	-2.750 (0.066)*	-10.915 (0.000)***

Notes: this table presents the results of the Augmented Dickey-Fuller (ADF) and Phillips-Perron unit root tests for all variables at levels and first differences with p-values reported in brackets. ***, ** and * indicate significance at 1%, 5% and 10% levels, respectively.

The results of the tests on the first differenced series highlight that we reject the null of a unit root at any conventional significance level. The findings are confirmed by the PP test results (with the exception of the test on the level of budget_expenditure). Hence, we can conclude that all variables of interest are nonstationary and are integrated of order one, I(1)[1].

We now proceed with the specification of the VAR and VECM models.

5.2. Cointegration Relationships

The lag-order of the six-variable VAR model is selected based on minimum AIC and HQ information criteria. According to the results in Table 3, the VAR (2) model has the optimal lag structure. The VAR (2) model passes the test for serial autocorrelation. The results of Jarque-Bera normality test lead to the rejection of the null hypothesis that residuals are normally distributed (the misspecification tests are reported together with the estimation results of the

[1] We also tested the real GDP series in levels for a unit root and found it to be nonstationary. Since real GDP growth is likewise nonstationary, but its first difference is stationary, real GDP is an I(2) process. Therefore, in the subsequent analysis, we use real GDP growth to ensure that all variables included in the VECM are integrated of order one.

VAR (2) model in Table A1 and Table A2. However, the VAR model can still be used as an underlying system for the cointegration analysis.

TABLE 3 - *Lag-Order Selection Criteria*

Lag	AIC	HQIC
0	20.012	20.053
1	3.618	3.903
2	3.091*	3.621*
3	3.290	4.065
4	3.497	4.517

Notes: this table summarizes the values of AIC and HQIC information criteria for four lag orders.
* indicates optimal lag length.

The existence of a long-run equilibrium relationship among the variables is examined by applying Johansen's cointegration test. According to the results of the test using both the Trace and the Maximum Eigenvalue statistics reported in Table 4, the null hypothesis of two cointegrating vectors cannot be rejected by either test.

TABLE 4 - *Results of Johansen's Cointegration Tests*

Hypothesised no. of CE(s)	Test Statistics		Critical Values (5%)	
	Trace	Max Eigen	Trace	Max Eigen
r=0	170.03	78.14	94.15	39.37
r≤1	91.89	45.34	68.52	33.46
r≤2*	46.55	23.33	47.21	27.07
r≤3	23.23	10.93	29.68	20.97
r≤4	12.30	9.98	15.41	14.07
r≤5	2.32	2.32	3.76	3.76

Notes: this table reports the results of the Johansen's cointegration test based on Trace and Maximum Eigenvalue statistics. * indicates the selected rank.

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Of the two cointegrating equations, we are primarily interested in the one where the real GDP growth rate is the dependent variable. According to the first cointegrating equation (see Table 5), budget expenditure and oil price have a positive and statistically significant impact on real GDP in the long run. Thus, 1% increase in the oil price and government expenditure leads to a 25% and 3.5% growth in real output, respectively. The findings are consistent with expectations and stress the importance of oil price and government spending in boosting economic activity in the long run. According to economic theory, increases in public expenditure driven by higher oil revenues generate multiplier effects throughout the economy, thereby contributing to long-run growth. Although the estimated coefficient on the real effective exchange rate is negative and statistically significant, it is worth mentioning that the peculiarity of the data and *prevailing de facto* fixed exchange rate regime have an implication for the magnitude of the responsiveness and analysis. The negative sign of the estimated coefficient, however, is consistent with economic theory and implies a reduction in real output following appreciation of the real exchange rate. In countries with a fixed exchange rate regime, a surge in oil prices, accompanied by an increase in foreign currency inflows, expands the money supply and raises domestic prices by increasing demand for non-traded goods. This, in turn, leads to an appreciation of the real exchange rate, which weakens the competitiveness of non-oil exports. However, the extent of the consequent reduction in the country's output depends on the degree of economic diversification and the fraction of the oil sector in the country's total exports. The central bank's interventions required to maintain the peg, in turn, expand the money supply, leading to inflationary pressures and a dampening effect on output growth.

TABLE 5 - *Results of the Long-Run Equilibrium Relationship*

Regressor	Coefficient	Z-value
budget_expenditure	3.493	-6.58 (0.000)***
ln_m3	-22.486	6.52 (0.000)***
ln_reer	-84.08	4.22 (0.000)***
ln_oil_price	24.666	-2.86 (0.004)***

Notes: this table summarizes the results of the long-run cointegration equation from the Johansen analysis, with GDP growth rate being the variable of interest. The p-values are reported in brackets. ***, ** and * indicate significance at 1%, 5% and 10% levels, respectively.

We now turn to the results of the short-run dynamic relationship among the variables presented in Table 6.

TABLE 6 - *VECM Short-Run Relationship*

Regressor	Coefficient	Z-value (p-values)
∆real_gdp_growth(t-1)	-0.057	-0.82 (0.412)
∆inflation(t-1)	-0.342	-2.78 (0.005)***
∆budget_expenditure(t-1)	-0.015	-0.36 (0.718)
∆ln_m3(t-1)	-18.455	-3.72 (0.000)***
∆ln_reer(t-1)	-4.405	-0.67 (0.505)
∆ln_oil_price(t-1)	0.520	0.32 (0.750)
ECT1	-0.034	-3.09 (0.002)***
ECT2	-0.029	-3.15 (0.002)***
C	0.004	0.02 (0.984)

Notes: The table reports short-run VECM estimates and error correction terms derived from the equation, with GDP growth rate being a dependent variable. ***, ** and * indicate significance at 1%, 5% and 10% levels, respectively.

The coefficients are derived from VECM equation that includes **Δ**Real GDP growth rate as dependent variable. The error correction terms (ECTs) are negative and statistically significant, indicating the presence of cointegration. According to the results, money supply and inflation are the only variables that have a statistically significant impact on GDP growth in the short run. The significance of the coefficients highlights the dominating role of monetary factors in driving short-run economic activity. The negative sign, in turn, could be linked to the effects of excess liquidity and increase in money supply caused by the central bank's interventions required under the managed exchange rate. The resulting inflationary pressure tends to erode the value of domestic currency and weaken economic activity. In contrast to the long-run scenario, the estimates of budget expenditure and oil price presented in Table 6 are statistically insignificant. The effect of the variables, therefore, is likely to work through the economy with some lags, validating the results of the long-run analysis discussed earlier.

The diagnostic tests for normality, serial autocorrelation of the residuals of the VECM, and model stability are reported in Table 7. According to the results, the hypothesis of normally

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distributed error terms in Jarque-Bera (JB) test is strongly rejected, whereas no serial autocorrelation in residuals emerges from the Lagrange-multiplier (LM) test applied to examine the first-order and second-order residual autocorrelation. Regarding stability, the VECM satisfies the necessary stability conditions: with six endogenous variables and two cointegrating relationships, the model has four-unit moduli, and all remaining eigenvalues lie inside the unit circle. This confirms that the model is stable in the sense that the implied dynamics are non-explosive and converge to the long-run equilibrium following a shock. However, the strong rejection of normality likely reflects the presence of structural breaks and regime changes over the sample period, including the 2015 currency devaluation, and the COVID-19 pandemic, which may introduce outliers and shifts that the constant-parameter VECM cannot fully capture. While the model satisfies stability conditions and passes autocorrelation tests, the non-normality signals that the assumption of stable long-run relationships may not be satisfied.

TABLE 7 - *VECM Diagnostic Tests*

	χ^2-*Statistics*	p-values
JB normality test	9223.65	0.000
LM test		
1 Lag	31.06	0.702
2 Lags	28.09	0.824
Stability Test	number of unit moduli is 4	

Notes: this table summarizes the output of the Jarque-Bera (JB) and Lagrange-multiplier (LM) diagnostic tests for normality and serial autocorrelation in VECM residuals, respectively. The Eigenvalue model stability test is also reported in the table.

Granger causality among variables can be evaluated based on the VECM model reported in Table 8. The results support findings of the short-run analysis and indicate a unidirectional Granger causality from inflation to real GDP growth rate and to budget expenditure. Along with negative effects of inflation on the value of money and economic activity, it also exerts influence on fiscal policy decisions and public expenditure, in particular. A two-way causality between m3 money aggregate and both inflation and real GDP growth rate is also evidenced. Moreover, oil prices

Granger-causes real effective exchange rate, and there is a two-way causality between the latter and m3.

TABLE 8- *Granger Causality Test Results*

	Explanatory Variables							
Dependent Variables	Δreal_gdp_growth$_{t-1}$ *Short-run causality*	Δinflation$_{t-1}$	Δbudget_exp$_{t-1}$	Δln_m3$_{t-1}$	Δln_reer$_{t-1}$	Δln_oil_price$_{t-1}$	Coefficient of ECT	
							ECT_1	ECT_2
Δreal_gdp	-	-0.342 (0.005) ***	-0.015 (0.718)	-18.455 (0.000) ***	-4.405 (0.505)	0.520 (0.750)	-0.035 (0.002) ***	-0.029 (0.002) ***
Δinflation	-0.015 (0.725)	-	-0.0005 (0.985)	7.691 (0.01) ***	-3.145 (0.428)	-0.593 (0.545)	0.002 (0.806)	-0.003 (0.639)
Δbudget_expenditure	-0.170 (0.102)	-0.474 (0.009) ***	-	-66.52 (0.000) ***	2.658 (0.786)	1.667 (0.491)	0.083 (0.000) ***	-0.066 (0.000) ***
Δln_m3	-0.002 (0.052) *	0.003 (0.067) *	-0.0006 (0.388)	-	0.197 (0.053) *	0.038 (0.130)	-0.0002 (0.329) ***	-0.0006 (0.000) ***
Δln_reer	-0.001 (0.261)	0.000 (0.965)	0.000 (0.891)	-0.16 (0.002) ***	-	-0.066 (0.000) ***	-0.0001 (0.195)	-0.001 (0.000) ***
Δln_oil_price	-0.000 (0.996)	0.000 (0.969)	-0.001 (0.473)	-0.102 (0.658)	-0.282 (0.358)	-	0.000 (0.606)	0.000 (0.303)

Notes: The table presents the results of Granger causality test derived from the estimated VECM model with p-values reported in brackets. ***, ** and * indicate significance at 1%, 5% and 10% levels, respectively.

The impact of oil price on export revenues, foreign exchange reserves and liquidity is likely to trigger movements in REER in countries with pegged exchange rate, thereby explaining a causal relationship between the variables. The results, however, do not indicate Granger causality between government expenditure and real GDP growth rate. This may be due to delays in completing major government-financed investment and infrastructure projects, mainly during periods of high oil prices, which are expected to contribute to increases in real economic activity. The absence of causality from domestic variables to oil prices is consistent with the fact that the country accounts for only a small share of global oil production and therefore has a negligible influence on world oil prices. The results are also confirmed by the alternative causality Wald test that is reported in Table A3.

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5.3. Impulse Response Function Analysis

Due to non-normality and the related potential instability of the cointegrating vectors, we estimate impulse response functions (IRFs) from a VAR in first differences as a robust alternative to the potentially mis-specified VECM. Therefore, based on the VAR in first differences, the analysis traces the short-run transmission of oil price shocks through the domestic economy by examining how a one-standard-deviation impulse to oil price affects each variable over time.

To identify structural shocks, we adopt a Cholesky recursive identification scheme. Recognising that the ordering of variables can influence impulse response results, we employ an ordering that places variables according to their expected speed of adjustment, with the exogenous oil price first, followed by exchange rate, inflation, fiscal variables, money supply, and finally GDP. This ordering reflects both Azerbaijan's economy, namely a small oil-exporting economy, and standard assumptions about the relative speed of adjustment of macroeconomic variables.

Since all variables are in first differences, the IRFs presented in Figure 2 describe how month-on-month changes in macroeconomic variables respond to a shock in the rate of change of oil price. As shown in Panel a, the change in the REER responds immediately and negatively to an oil price shock, with statistically significant responses at Steps 1 and 2. Panel b shows that the change in inflation responds negatively at contemporaneous time (-0.086) before turning slightly positive at Step 2 (0.044). However, no step is statistically significant, as all confidence intervals cross zero throughout, indicating that the pace of inflation does not meaningfully accelerate or decelerate in response to oil price movements in the short run. Panel c illustrates that the change in the budget expenditure-to-GDP ratio shows no significant response on impact or at Step 1, with wide confidence intervals reflecting high uncertainty. However, at Step 2 the response turns strongly and significantly negative (-0.491), with the confidence interval lying entirely below zero. This contraction in the rate of change of the expenditure-to-GDP ratio within two months of the oil price shock demonstrates that government spending growth lags behind any oil-driven output gains, compressing the expenditure-to-GDP ratio in the short run. The effect reverts to zero by Step 3, confirming that it is a short-run adjustment rather than a persistent shift in fiscal stance. Panel d shows that the change in money supply exhibits a small but statistically significant positive response at Step 1 (0.007), with the confidence interval lying entirely above zero. Following a shock to oil price growth, the monthly rate of money supply

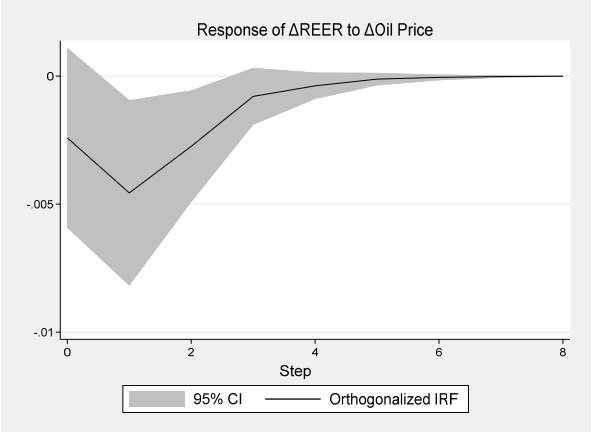
growth accelerates one month later, consistent with monetary accommodation as the central bank expands liquidity in response to oil-driven economic activity. The Central Bank of Azerbaijan's interventions in the foreign exchange market, required to maintain the *de facto* peg amid volatility in oil revenue, directly affect the level of foreign exchange reserves and, consequently, domestic money supply and liquidity conditions. The effect is negligible and statistically insignificant at all other steps, confirming the monetary response is fast but confined to a single month. Finally, Panel e shows that the change in GDP growth responds negatively on impact (-0.076), before reversing to a strong positive response at Step 1 (+0.294). From Step 2 onwards, the response rapidly declines toward zero, suggesting that oil price shocks do not generate persistent changes in the trajectory of GDP growth at the monthly frequency.

Overall, the VAR(1) in first differences results reveal that oil price shocks generate rapid but short-lived macroeconomic responses in Azerbaijan, with most effects dissipating within two to three months. The most robust findings are the significant compression in REER growth at Steps 1 and 2, the sharp procyclical fiscal contraction at Step 2, and the brief monetary accommodation at Step 1. The analysis suggests that the transmission of oil price shocks occurs primarily through fiscal and financial channels. These findings are consistent with an economy operating under a *de facto* fixed exchange rate, where fiscal policy and liquidity management bear the main burden of adjustment to oil price shocks.

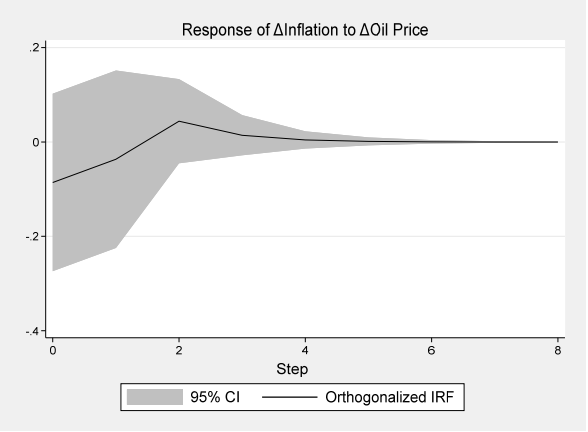
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FIGURE 2 - *Impulse Response Functions*

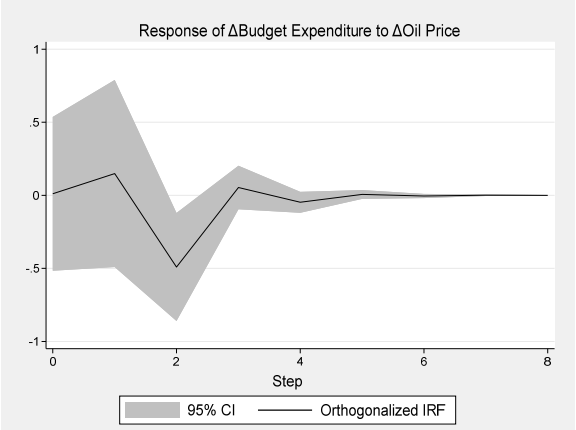
Panel a



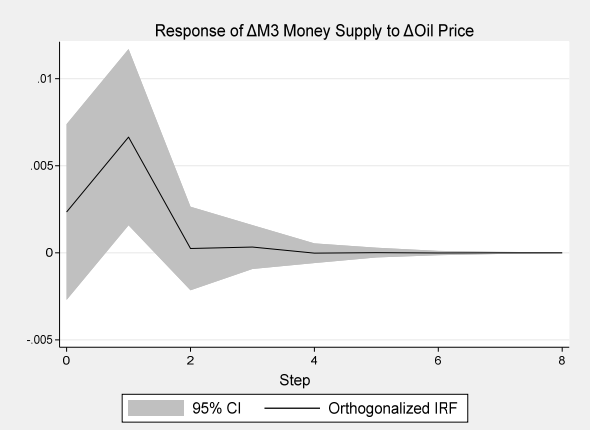
Panel b



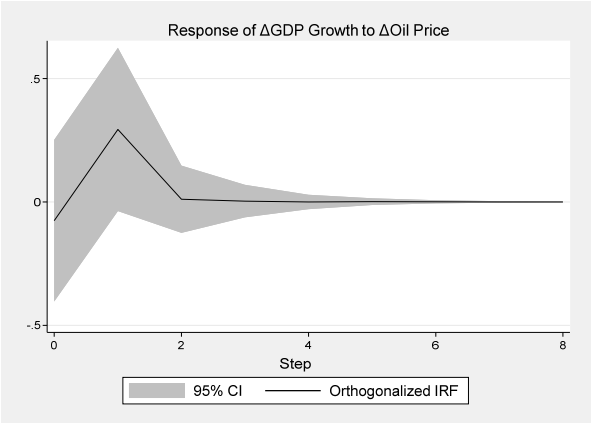
Panel c



Panel d



Panel e



5.4. Robustness Analysis

The robustness of the findings presented in the previous section is further assessed using an alternative benchmark crude oil, namely the West Texas Intermediate (WTI). The results are presented in Table 9 and confirm the positive long-run impact of oil price and budget expenditure on real GDP growth. The sign and magnitude of the REER and m3 coefficients are also consistent with the original findings.

TABLE 9 - *The Results of the Long-Run Equilibrium Relationship*

Regressor	Coefficient	Z-value
budget_expenditure	3.740	-6.42(0.000) ***
ln_m3	-21.674	5.67(0.000) ***
ln_reer	-106.143	4.88(0.000) ***
ln_oil_price	39.181	-4.01(0.000) ***

Notes: this table summarizes the results of the long-run cointegration equation from the Johansen analysis using alternative WTI oil price measure with GDP growth rate being the variable of interest. The p-values are reported in brackets. ***, ** and * indicate significance at 1%, 5% and 10% levels, respectively.

In line with the earlier discussion, monetary variables are among the key drivers of real output in the short run as reflected by statistically significant coefficients of money supply and inflation (see Table 10).

TABLE 10 - *VECM Short-Run Relationship*

Regressor	Coefficient	Z-value(p-values)
Δreal_gdp_growth$_{t-1}$	-0.051	-0.73(0.466)
Δinflation$_{t-1}$	-0.339	-2.72(0.006) ***
Δbudget_expenditure$_{t-1}$	-0.001	-0.02(0.982)
Δln_m3$_{t-1}$	-18.412	-3.67(0.000) ***
Δln_reer$_{t-1}$	-4.476	-0.66(0.508)
Δln_oil_price$_{t-1}$	1.864	1.13(0.259)
ECT$_1$	-0.024	-2.31(0.021) **
ECT$_2$	-0.023	-2.39(0.017) **
C	0.003	0.02(0.988)

Notes: the table reports short-run VECM estimates and error correction terms derived from the equation using alternative WTI oil price measure with GDP growth rate being a dependent variable. ***, ** and * indicate significance at 1%, 5% and 10% levels, respectively.

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As for the results of the Granger causality test displayed in Table 11, there is evidence of a bi-directional causality between m3 and inflation, as well as between the former and real GDP. We also confirm that oil price and money supply Granger-cause the REER.

TABLE 11 - *Granger Causality Test Results*

	Explanatory Variables							
Dependent Variables	$\Delta real_gdp_{t-1}$ *Short-run causality*	$\Delta inflation_{t-1}$	$\Delta budget_expenditure_{t-1}$	Δln_m3_{t-1}	Δln_reer_{t-1}	$\Delta ln_oil_price_{t-1}$	Coefficient of ECT *Long-run causality*	
							ECT_1	ECT_2
Δreal_gdp	-	-0.339 (0.006) ***	-0.001 (0.982)	-18.411 (0.000) ***	-4.476 (0.508)	1.864 (0.259)	-0.024 (0.021) **	-0.023 (0.017) **
Δinflation	-0.018 (0.668)	-	-0.001 (0.984)	7.430 (0.013) ***	-2.034 (0.615)	0.841 (0.394)	0.002 (0.698)	-0.003 (0.609)
Δbudget_ expenditure	-0.170 (0.100)	-0.457 (0.013) **	-	-65.410 (0.000) ***	3.146 (0.753)	1.712 (0.483)	0.083 (0.000) ***	-0.076 (0.000) ***
Δln_m3	-0.002 (0.062) *	0.003 (0.075) *	-0.0003 (0.599)	-	0.181 (0.083) *	0.032 (0.212) *	-0.0001 (0.647)	0.001 (0.000) ***
Δln_reer	-0.001 (0.257)	-0.000 (0.915)	0.000 (0.971)	-0.174 (0.001) ***	-	-0.042 (0.014) **	-0.0001 (0.190)	-0.001 (0.000) ***
Δln_oil_price	0.003 (0.401)	0.002 (0.758)	0.002 (0.313)	0.028 (0.906)	-0.203 (0.521)	-	0.000 (0.317)	0.001 (0.107)

Notes: the table presents the results of Granger causality test derived from the VECM model estimated using WTI oil price measure, with p-values reported in brackets. ***, ** and * indicate significance at 1%, 5% and 10% levels, respectively.

Overall, the analysis using an alternative oil price measure supports the study's original findings.

6. Conclusions and policy implications

The classical 'resource curse' literature suggests that the abundance of natural resources has a negative impact on economic development. However, an increasing number of empirical studies show that volatility, rather than abundance, triggers the resource curse (Ploeg and Poelhekke, 2009; Cavalcanti, Mohaddes and Raissi, 2015). It is argued that commodity price volatility leads to lower accumulation of human, physical, and social capital, thus posing a serious obstacle to economic prosperity in resource-abundant countries with non-diversified exports. The distinction between abundance and dependence is therefore important, since the former, if well managed, can have a positive impact on long-run growth (Gylfason, 2011). Against this background, the goal of this study was to evaluate the impact of oil prices on the macroeconomic performance of Azerbaijan, an oil-exporting country. The economic growth rate in Azerbaijan has reached unprecedented double-digit levels over the period of 2005-2008, mainly driven by a substantial increase in oil production and export. However, a sharp decline in oil prices in 2014 ended the commodity boom and led to a significant reduction in economic activity. The episode has once again demonstrated the country's high vulnerability to oil price shocks. To address the emerging headwinds and challenges that pose risks to sustainable long-term economic development, it is important to build a new, diversified, and inclusive growth model.

Our findings suggest a significant role of oil price shocks in explaining long-run economic growth in Azerbaijan's oil-dependent economy and form the basis for the following policy recommendations. The results of the cointegration analysis indicate that oil prices and government expenditure are the primary drivers of the country's economic growth in the long run. The shocks are mainly transmitted to the real economy through the budget channel, thereby amplifying the procyclicality of fiscal policy. Hence, the optimisation of public expenditure through the application of an appropriate fiscal rule is crucial for managing amplified business cycles and ensuring economic sustainability. Although the government of Azerbaijan introduced a new fiscal rule earlier in 2019, it was not implemented due to an urgent need for fiscal stimulus during the COVID-19 pandemic (World Bank Group, 2022). The reduction in the economy's dependence on public expenditure would weaken the transmission of oil price shocks to the real economy and strengthen resilience by achieving long-term fiscal stability. The negative coefficient of the real effective exchange rate derived from the long-run analysis, in turn, provides evidence for the signs of the Dutch disease widely discussed in the

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literature. Thus, currency appreciation resulting from increases in resource revenues has a negative impact on non-oil exports, hindering long-run economic growth and stability in resource-dependent countries. Moreover, the economic literature suggests that fixed exchange rate regimes have a limited ability to absorb exogenous shocks, thereby causing large fluctuations in liquidity driven by central bank interventions. Underdeveloped capital and money markets, prevalent in oil-exporting developing countries, further constrain shock absorption; consequently, these countries tend to respond more rapidly to shocks compared with advanced economies (Esfahani, Mohaddes and Pesaran, 2014). Hence, these arguments provide a valid explanation for the findings of the short-run analysis, which demonstrate the significance of money supply and inflation in explaining output growth. There is also evidence of a unidirectional causality from oil prices to GDP growth, budget expenditure, and money supply, while the impulse response analysis shows a rapid short-term response of most variables to oil price shocks. Taken together, these findings highlight the importance of mitigating the negative impacts of shocks by introducing more effective shock-absorbing mechanisms. This could be achieved through a gradual move towards a more flexible exchange rate, as well as further reforms aimed at developing the financial system. The government would also benefit from the effective use of monetary policy tools aimed at reducing the adverse consequences of money growth, excess liquidity, and inflationary pressures on economic activity in the short run.

The sustainability and effectiveness of implemented socio-economic reforms are closely tied to the country's efforts to reduce its reliance on hydrocarbon exports and to decarbonise the economy. This becomes particularly important in view of global efforts to achieve net-zero emissions and the resulting changes in demand for fossil fuels. According to the International Energy Agency (2023), global oil demand is expected to shrink from the current level of 2.4 mb/d to 0.4 mb/d by 2028. The energy transition, however, has serious implications for the economic performance of resource-dependent developing countries, mainly due to structural weaknesses that are argued to be among the major obstacles to successful diversification (Karanfil and Omgba, 2023). Nevertheless, despite the challenges associated with economic restructuring, these countries can benefit from broader diversification and reduced reliance on traditional sources of government revenue. Alongside technological progress and cost developments, government policies and legislation are powerful tools for facilitating a smooth transition between different energy sources (World Bank Group, 2022). The government of Azerbaijan has made a new commitment to the implementation of the country's national and climate pledges by

setting a target of a 40% reduction in greenhouse gas emissions and the creation of a "Net Zero Emission" zone in the liberated territories by 2050. According to data published by the Ministry of Energy of Azerbaijan (2025), the country has a promising renewable energy potential, estimated at 27 GW with 3,000 MW and 23,000 MW of wind and solar energy, respectively. The construction of a 240 MW wind power and 230 MW solar power plant, launched in 2022, is a significant step towards strengthening energy efficiency and boosting the use of renewable energy sources. Furthermore, the COP 29 event hosted by Azerbaijan featured presentation of the following important energy initiatives: COP29 Global Energy Storage and Grids Pledge, the COP29 Green Energy Pledge: Green Energy Zones and Corridors, and the COP29 Hydrogen Declaration. Notwithstanding this, the influence of recent global processes and megatrends highlights the importance of accelerating the energy transition by making it a priority on the country's economic agenda and undertaking further steps towards building a sustainable economic development model driven by the private sector.

The insights gained from this study add to the limited empirical evidence on small commodity-abundant transition economies in the Caspian region and are relevant for policymakers in Azerbaijan as well as in other countries with similar economic characteristics. More broadly, the results speak to wider debates on emerging risks, external shock transmission, and policy frameworks in internationally exposed economies, suggesting that resource-dependent countries without robust fiscal buffers and diversified financial systems remain acutely vulnerable to commodity price volatility, a challenge shared across the developing world.

The analysis could be extended by considering a larger set of countries and addressing the relatively small sample size. Moreover, instability remains an unmodelled feature, as indicated by the non-normality of the residuals. This may be explained by the presence of outliers and/or structural breaks, which could be identified and modelled using dummy saturation techniques in future research. Finally, this work could also be extended to relax the assumption of a symmetric impact of oil price shocks and to examine the effects of other exogenous factors.

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APPENDIX A: ADDITIONAL TABLES

TABLE A1 - *The Results of VAR (2) Estimation*

Explanatory Variables	***Dependent Variables***					
	real_gdp_growth	inflation	budget_exp	ln_m3	ln_reer	ln_oil_price
$real_gdp_growth_{t-1}$	0.828	-0.025	-0.108	-0.002	-0.001	-0.001
	(0.000)***	(0.561)	(0.322)	(0.115)	(0.270)	(0.693)
$real_gdp_growth_{t-2}$	0.080	0.039	0.181	0.002	0.001	0.001
	(0.236)	(0.339)	(0.078)*	(0.028)**	(0.414)	(0.844)
$inflation_{t-1}$	-0.364	1.066	-0.537	0.003	-0.000	0.001
	(0.002)***	(0.000)***	(0.003)***	(0.171)	(0.785)	(0.821)
$inflation_{t-2}$	0.243	-0.134	0.443	-0.003	0.000	-0.002
	(0.041)**	(0.063)*	(0.015)**	(0.098)*	(0.831)	(0.759)
$budget_exp_{t-1}$	0.022	-0.016	0.564	-0.001	-0.000	-0.002
	(0.601)	(0.518)	(0.000)***	(0.391)	(0.572)	(0.229)
$budget_exp_{t-2}$	-0.002	-0.006	0.035	0.001	-0.000	0.001
	(0.965)	(0.806)	(0.570)	(0.278)	(0.945)	(0.506)
ln_m3_{t-1}	15.403	8.362	-64.509	0.916	-0.159	-0.054
	(0.002)***	(0.004)***	(0.000)***	(0.000)***	(0.002)***	(0.811)
ln_m3_{t-2}	13.920	-8.171	65.857	0.079	0.158	0.034
	(0.004***)	(0.005)***	(0.000)***	(0.298)	(0.002)***	(0.882)
ln_reer_{t-1}	-7.040	-2.162	4.842	0.128	1.148	-0.159
	(0.275)	(0.581)	(0.625)	(0.205)	(0.000)***	(0.600)
ln_reer_{t-2}	1.381	1.421	-2.981	-0.173	-0.223	0.238
	(0.827)	(0.710)	(0.758)	(0.078)	(0.001)***	(0.421)
$ln_oil_price_{t-1}$	1.856	-0.572	2.362	0.072	-0.033	1.184
	(0.211)	(0.525)	(0.299)	(0.002)***	(0.033)**	(0.000)***
$ln_oil_price_{t-2}$	-0.415	0.555	-1.823	-0.045	0.069	-0.269
	(0.788)	(0.553)	(0.441)	(0.059)*	(0.000)***	(0.000)***
c	35.412	2.536	-12.234	0.167	0.224	0.226
	(0.000)	(0.541)	(0.244)	(0.119)	(0.002)	(0.482)

Notes: This table presents the results of VAR (2) estimated as the underlying model for cointegration analysis. The optimal lag order of two was selected based on the minimum AIC and HQIC criteria. The p-values are reported in brackets. ***, ** and * indicate significance at 1%, 5% and 10% levels, respectively.

TABLE A 2 - *VAR (2) Diagnostic Tests*

	χ^2-*Statistics*	p-values
JB normality test	9238.312	0.000
LM test		
1 Lag	23.46	0.947
2 Lags	30.35	0.734

Notes: This table summarises the results of Jarque-Bera (JB) and Lagrange Multiplier (LM) tests for normality and autocorrelation in VAR residuals. The LM test was performed up to two lags.

TABLE A 3 - *The Results of Wald Test*

Explanatory Variables

Dependent Variables	Δreal_gdp_growth$_{t-1}$ χ^2-*Statistics*	Δinflation$_{t-1}$	Δbudget_exp$_{t-1}$	Δln_m3$_{t-1}$	Δln_reer$_{t-1}$	Δln_oil_price$_{t-1}$
Δreal_gdp_growth	-	7.73 (0.005) ***	0.00 (0.985)	13.87 (0.000) ***	0.44 (0.505)	0.10 (0.725)
Δinflation	0.12 (0.725)	-	0.00 (0.985)	6.68 (0.01) ***	0.63 (0.428)	0.37 (0.545)
Δbudget_exp	2.68 (0.102)	6.75 (0.01) ***	-	81.99 (0.000) ***	0.07 (0.786)	0.48 (0.491)
Δln_m3	3.76 (0.05) **	3.36 (0.07) *	0.75 (0.388)	-	3.74 (0.053) **	2.29 (0.129)
Δln_reer	1.26 (0.261)	0.00 (0.965)	0.02 (0.891)	9.89 (0.002) ***	-	15.39 (0.000) ***
Δln_oil_price	0.00 (0.996)	0.00 (0.970)	0.51 (0.473)	0.20 (0.658)	0.85 (0.358)	-

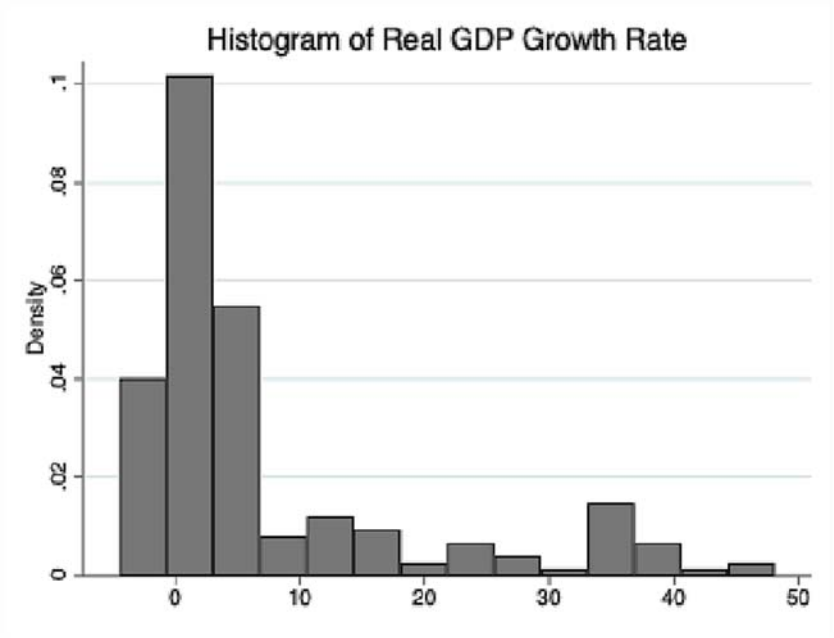
Notes: This table summarises the results of the Wald causality test performed on the first differences of all variables employed in the analysis, with the p-values reported in brackets. ***,** and * indicate significance at 1%, 5% and 10% levels, respectively.

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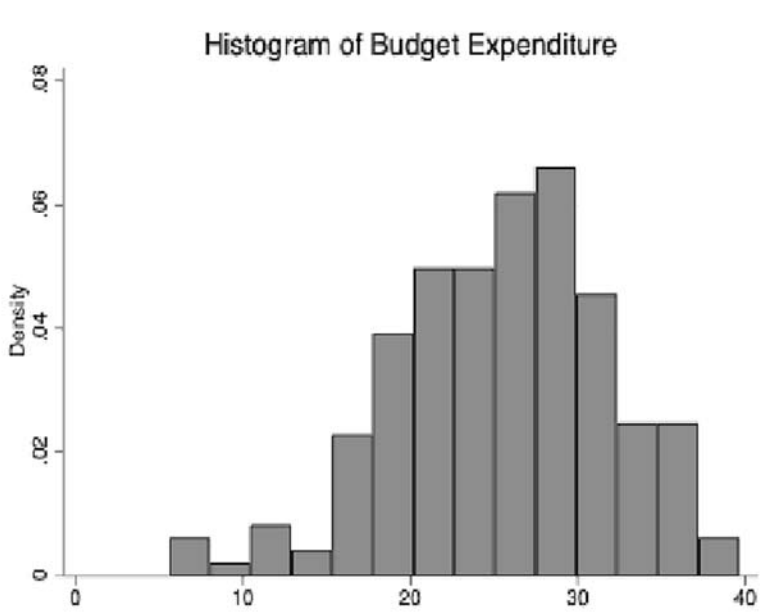
APPENDIX B: ADDITIONAL FIGURES

FIGURE B 1 - *Histogram of Real GDP Growth Rate, Budget Expenditure, Inflation, M3 Money Aggregate, Real Effective Exchange Rate and Oil Price*

Panel a

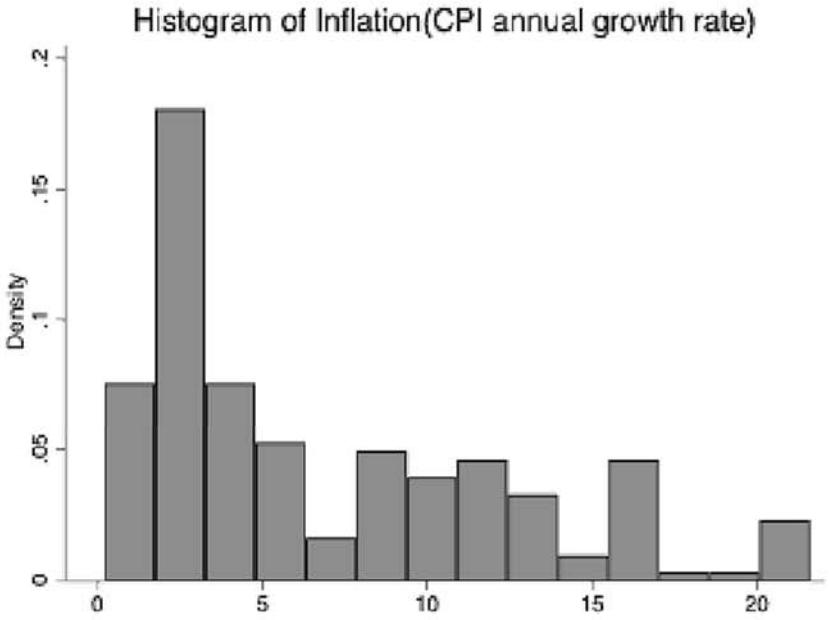


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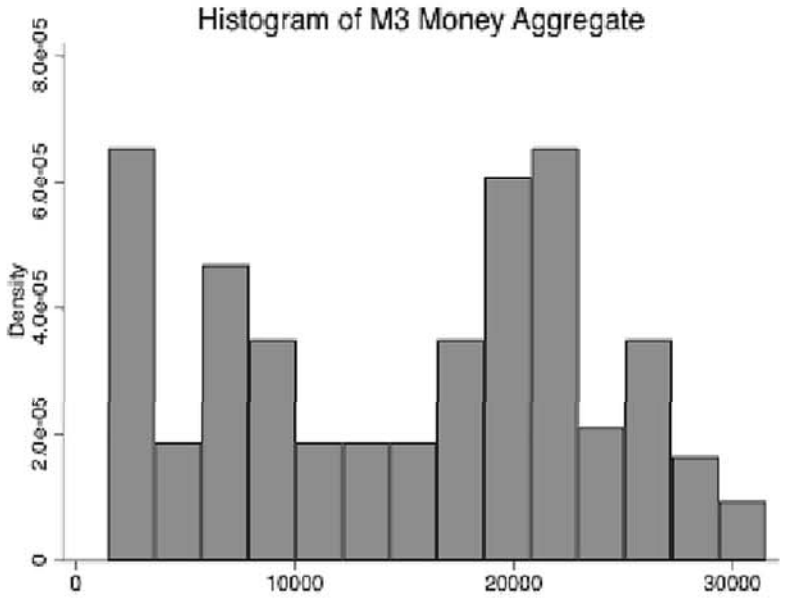


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Panel c

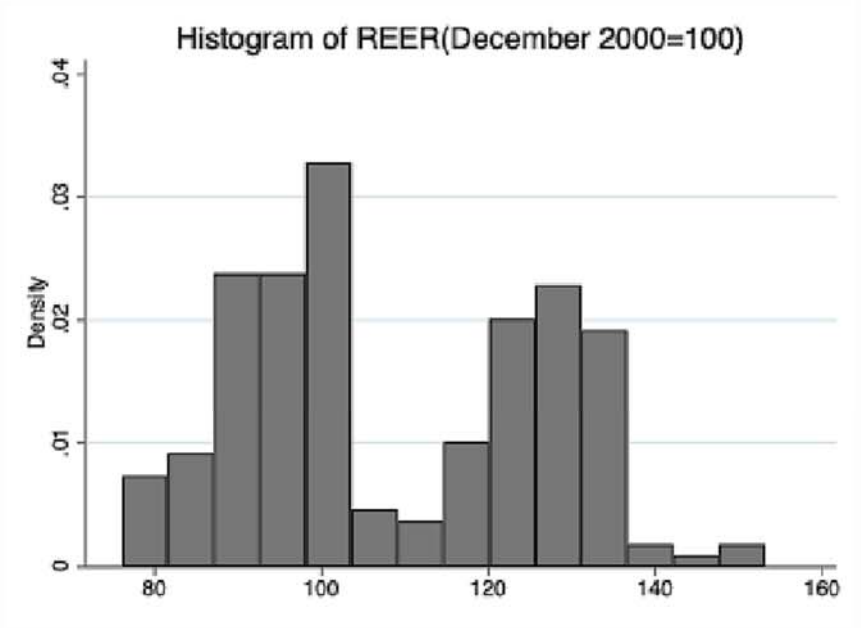


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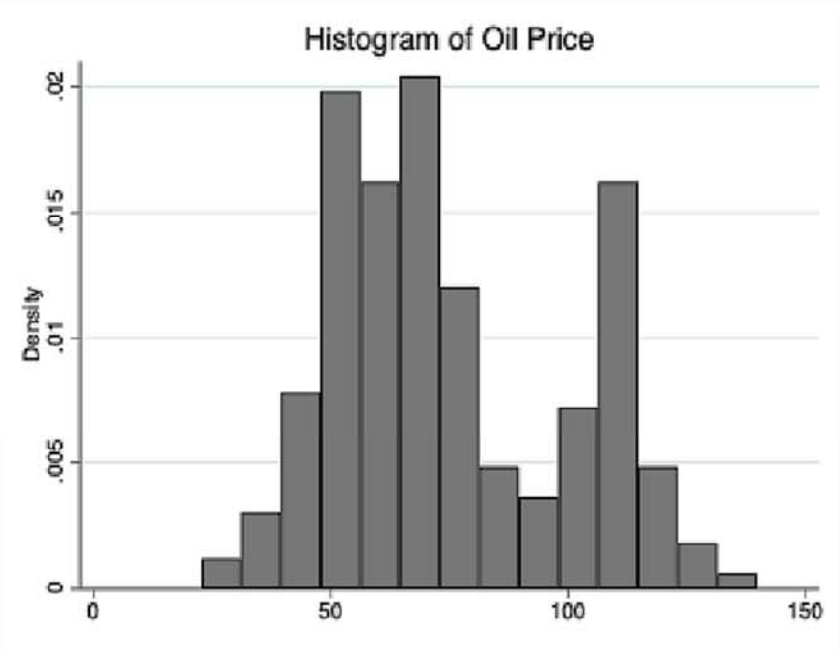


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Panel e



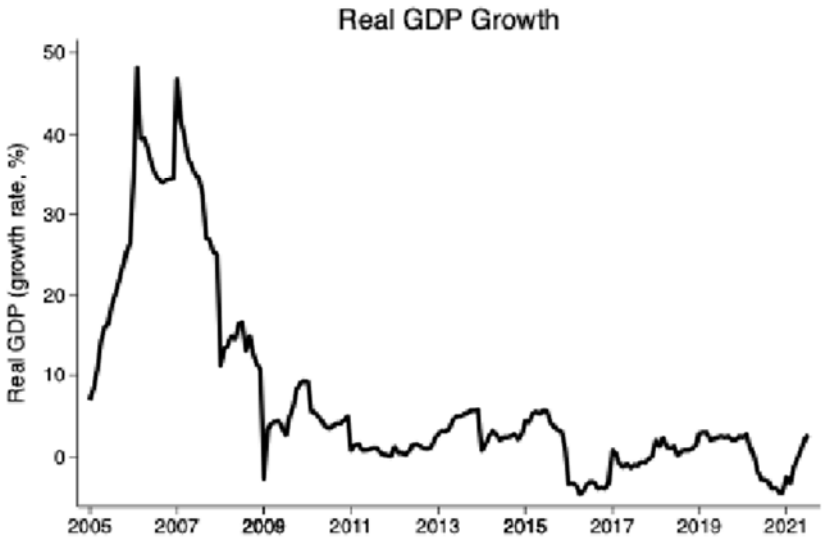
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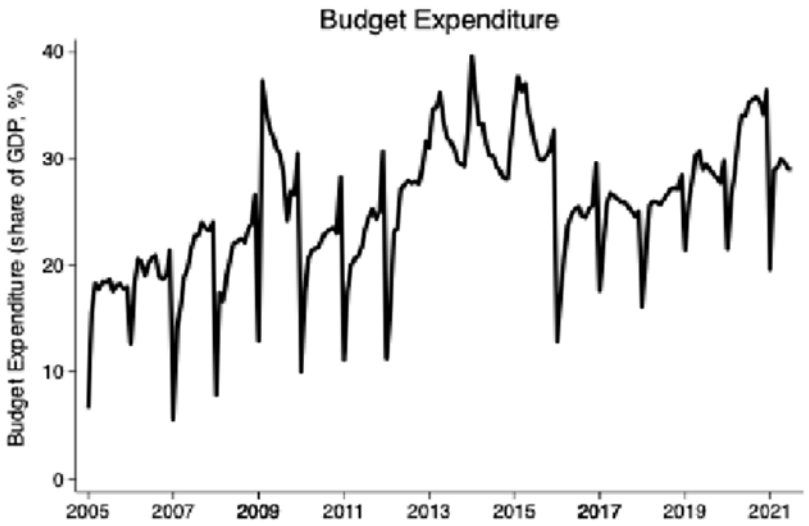
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FIGURE B1 - *Real GDP Growth Rate, Inflation, M3 Money Aggregate, Budget Expenditure, Real Effective Exchange Rate and Oil Price*

Panel a

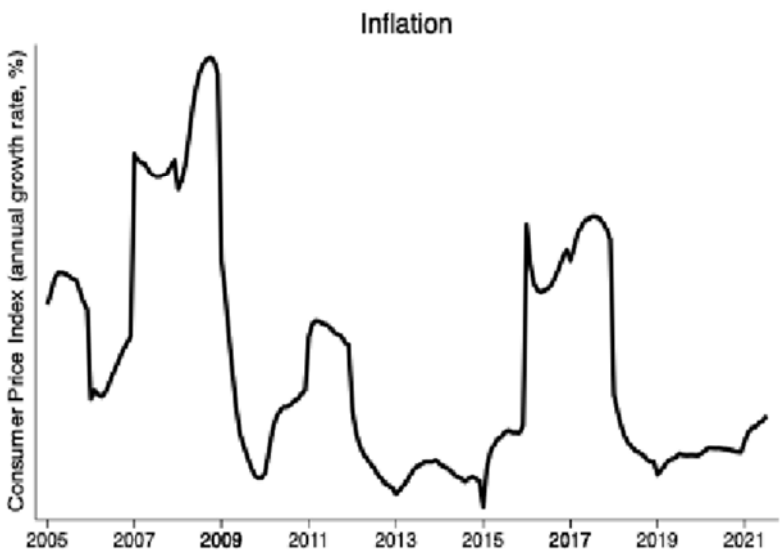


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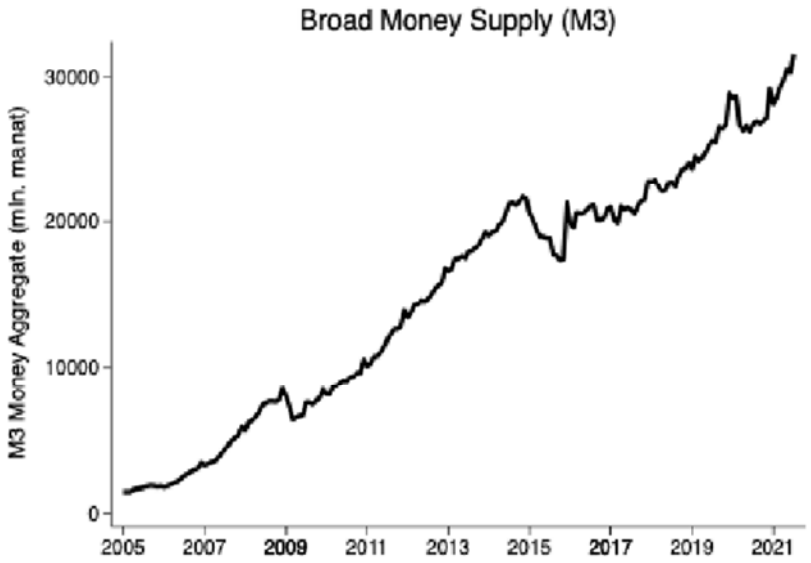


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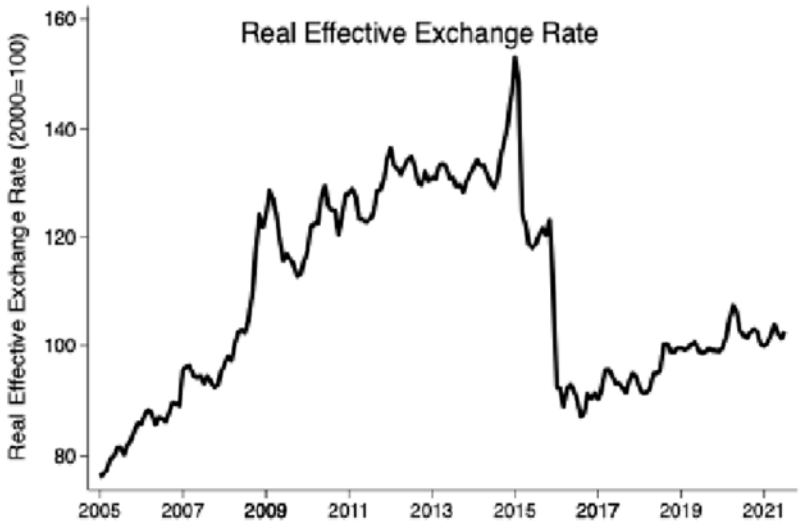


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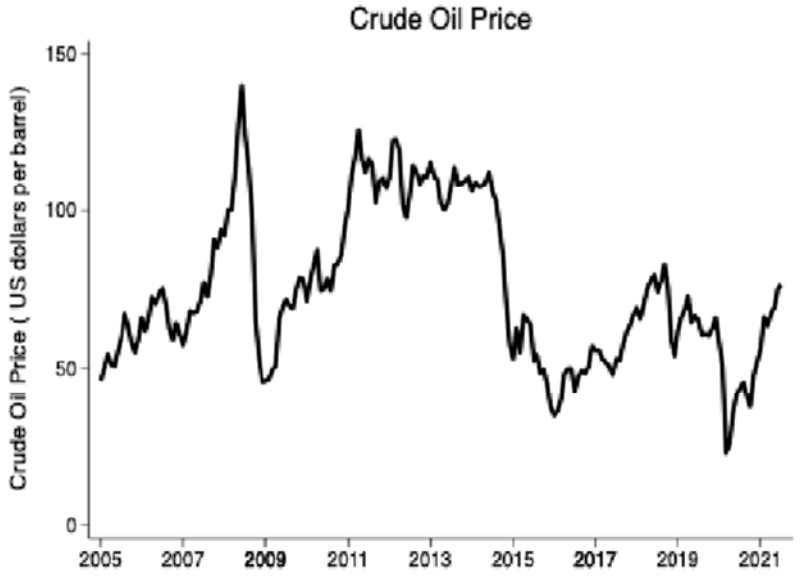


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Panel e



Panel f



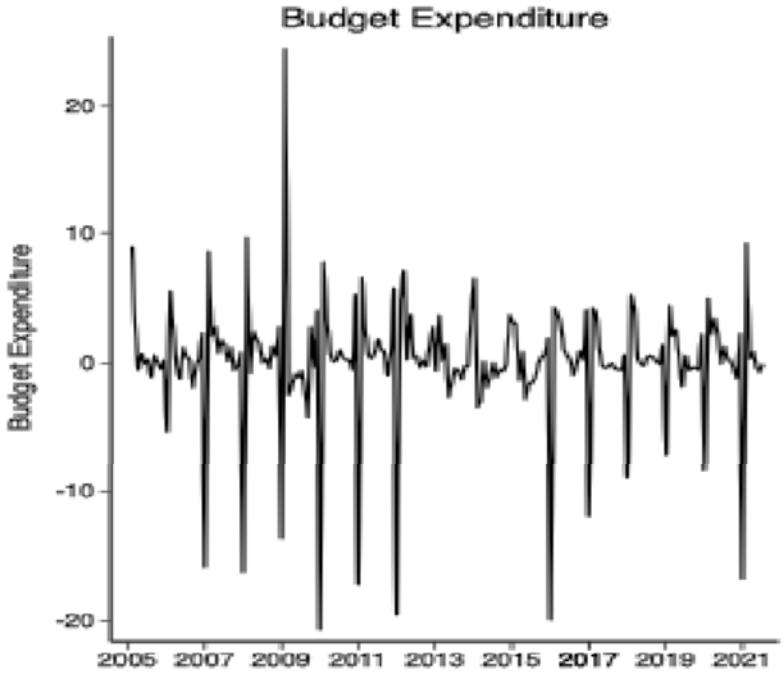
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FIGURE B 2 - *The First Difference of Real GDP Growth Rate, Inflation, M3 Money Aggregate, Budget Expenditure, Real Effective Exchange Rate and Oil Price*

Panel a



Panel b

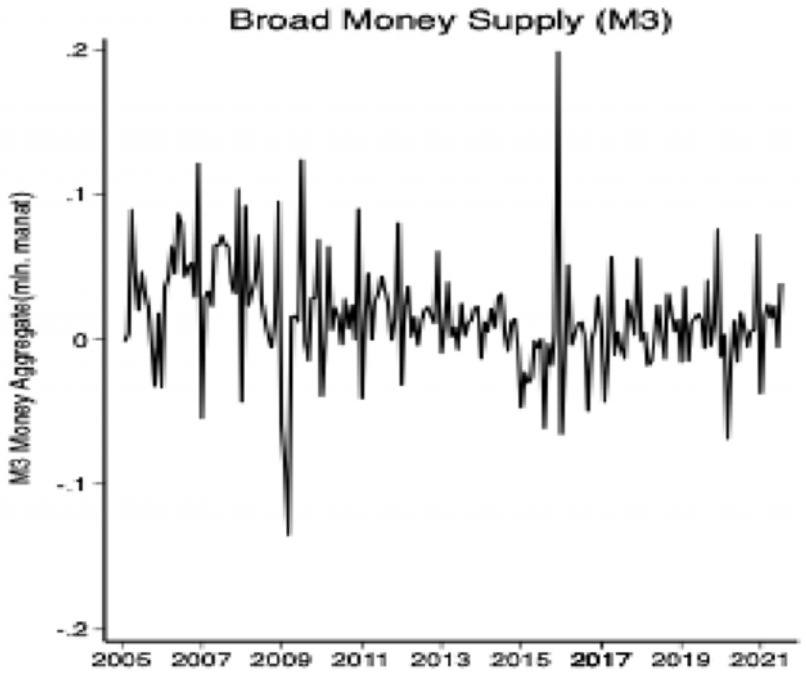


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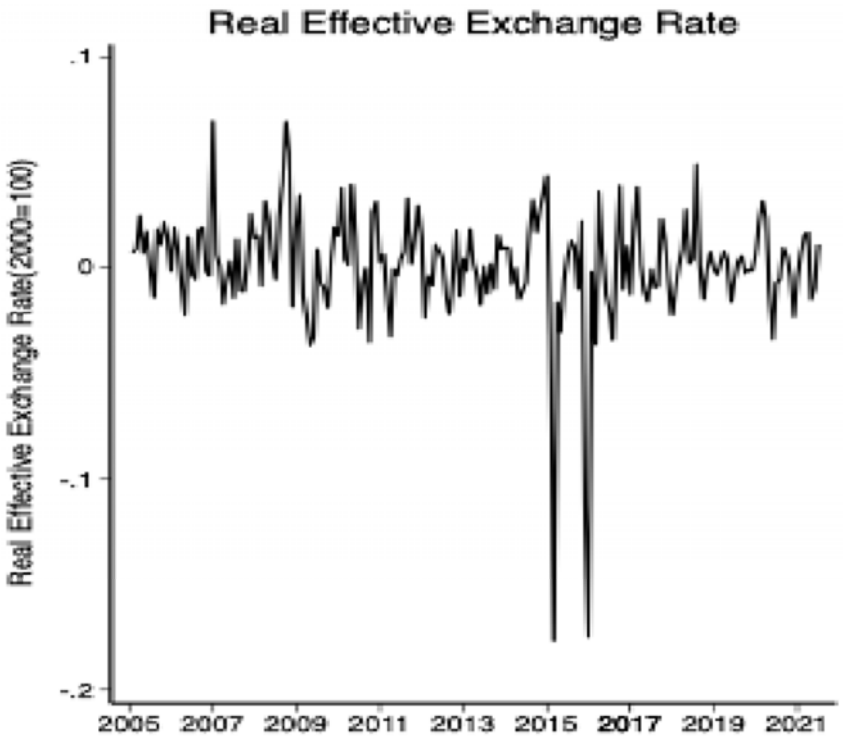


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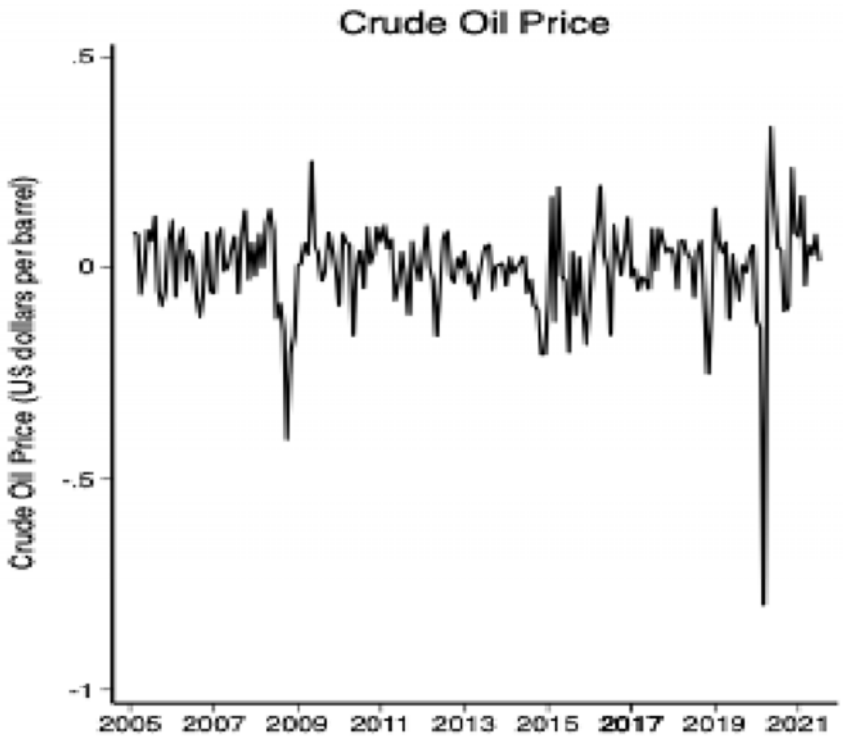


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