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MACROECONOMIC EFFECTS OF CRUDE OIL SHOCKS IN SOUTH AFRICA: A MARKOV SWITCHING INTERCEPTS VAR APPROACH

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ABSTRACT

Purpose- This study examines how fluctuations in crude oil price shocks affect South African macroeconomic indicators.
Methodology- The study employed the Markov Switching Intercepts VAR (MSI-VAR) approach to capture the dynamic and nonlinear effects of crude oil prices on key macroeconomic indicators, including real GDP growth, inflation, exchange rates, interest rates, and the current account balance. The study applied two regime models: regime one for times of growth and regime two for times of recession. Based on this framework, macroeconomic indicators were analyzed from 2000 Q1 to 2023 Q4 for their varying responses to oil price shocks.
Findings- It is evident that South Africa's economy is susceptible to changes in crude oil prices. A crude oil shock has a negative impact on real GDP growth during economic growth (Regime One). In contrast, oil shocks lead to an increase in real GDP growth during recessions (Regime Two). Moreover, crude oil shocks result in a decrease in inflation across both regimes. A crude oil shock has a positive effect on exchange rates and interest rates in Regime One, but a negative effect in Regime Two. Furthermore, crude oil shocks adversely impact the current account balance in both regimes.
Conclusion- Crude oil shocks affect the economy differently depending on the prevailing conditions. Therefore, policymakers must evaluate these conditions and implement suitable policies to reduce adverse effects. Monitoring and responding to changes in the global oil market is crucial for mitigating negative consequences and fostering stability.

Keywords: Macroeconomic variables, oil price shocks, Markov Switching Intercepts VAR (MSI-VAR), South Africa
JEL Codes: E32, F31, Q43

1. INTRODUCTION

The impact of crude oil price shocks on the macroeconomic activity of global economies is well established. Policymakers and scholars have highlighted the role these shocks play in shaping growth fundamentals (Van Eyden et al., 2019; Kırca et al., 2020; Magazzino et al., 2021). Rerezki et al. (2017) explain that fluctuations in crude oil prices are driven by the interplay between supply and demand in global commodities markets. Given South Africa's heavy reliance on oil imports for energy production, the effects of oil price shocks on its economy can be significant. This dependence on oil for transportation, coupled with its impact on the cost of living, makes South Africa particularly vulnerable to price changes. A strong correlation exists between oil shocks and various macroeconomic variables (Sheng, 2020). Key macroeconomic factors, including inflation, interest rates, currency values, and overall economic growth, are directly affected by global crude oil price fluctuations (Azad and Serletis, 2020; Khan et al., 2020; Yildirim and Arifli, 2021). Consequently, any oil price shock is likely to impact the South African economy significantly.

The impact of oil price fluctuations can be observed through various channels. Changes in crude oil prices lead to increased gasoline costs (Jiang and Liu, 2021), which constitute a significant portion of the Consumer Price Index (CPI) in South Africa. Rising oil prices contribute to cost-push inflation, driving up expenses in the manufacturing, transportation, and energy sectors. Increasing costs for consumers result in higher prices for goods and services, which raises the inflation rate overall. Additionally, changes in oil prices have a substantial effect on monetary and fiscal policy (Saddiqui et al., 2018). According to Rafiq et al. (2009), oil price volatility significantly influences investment and currency rates. The rand (ZAR) is affected by fluctuations in oil prices in South Africa. Increasing oil prices can weaken the ZAR since the country will need to allocate more resources to oil imports, negatively impacting the trade balance. Conversely, a decline in oil prices could improve the trade imbalance by strengthening the currency as import costs decrease. Higher oil prices also raise production costs for fuel-dependent industries, which can hinder economic growth (Cheng et al., 2019). The sectors most vulnerable to these price changes in South Africa include transportation, manufacturing, and mining. On the other hand, falling oil prices can stimulate

economic growth by reducing manufacturing and transportation costs, boosting consumer spending, and enhancing sectoral profitability. Consequently, South Africa's economy is highly sensitive to oil price fluctuations. Elevated oil prices have the potential to worsen the country's trade imbalance and impede economic growth. In contrast, decreases in oil prices can lead to increased industry profitability and lower production costs, fostering economic expansion. To effectively manage the economic impacts, South African officials must closely monitor and anticipate fluctuations in oil prices.

Numerous studies present conflicting evidence regarding the relationship between high oil prices and various macroeconomic effects. Jiang and Liu (2021) demonstrated the asymmetric effects of crude oil price uncertainty on shock prices using the NARDL model. Aloui et al. (2018), employing a unique wavelet method, found a positive and non-homogeneous association between oil prices and production growth in Saudi Arabia. Besso et al. (2017), utilizing a panel VAR model, concluded that oil prices have a significant long-term negative impact on GDP growth. During a decline in oil prices, Cheng et al. (2019) found that real GDP and investment are negatively affected by an increase in oil prices. Miamo and Achuo (2021) identified a two-way causal relationship between GDP and crude oil prices. Chisadza et al. (2016) argue that both oil demand and oil-specific demand shocks positively influence production, although shocks to oil supply do not significantly impact output. Nazlioglu et al. (2019), using Toda-Yamamoto causality, found a strong transmission mechanism from oil prices to consumer prices, alongside varying causal relationships between exchange rates and interest rates. This suggests that consumer prices may mediate the link between oil prices and monetary policy. According to Hollander et al. (2018), oil price shocks significantly and durably affect domestic output and consumption, with rising oil costs leading to declines in both areas. This highlights the economy's vulnerability to fluctuations in oil prices. The research suggests that changes in oil prices can substantially influence the overall economy, affecting not only consumer prices but also interest rates and currency values. It underscores the importance of closely monitoring oil price fluctuations and their potential implications for monetary policy and economic stability. These studies collectively stress the need to understand the complex dynamics of oil price movements to anticipate and mitigate risks to economic stability. Policymakers are encouraged to incorporate non-linear and regime-switching models into their analyses to better prepare for the impacts of oil price shocks, enabling informed decisions that protect the economy from adverse outcomes. A more nuanced approach to studying oil price fluctuations is essential for a comprehensive understanding of their implications for monetary policy and economic stability.

This study contributes to the existing literature in several significant ways. First, it examines the macroeconomic effects of crude oil shocks in South Africa using the Markov Switching Intercepts VAR Model (MSI-VAR). Understanding how crude oil shocks influence a country's macroeconomic variables is particularly important for oil-importing nations like South Africa. To the author’s knowledge, this is the first study to explore regime switching in the context of crude oil shocks in South Africa. Second, the MSI-VAR approach facilitates a more comprehensive analysis of the dynamic relationships between crude oil shocks and various macroeconomic variables within the South African economy. This sophisticated econometric tool enables researchers to identify regime changes in the economy, such as transitions between high-growth and low-growth periods, and to analyze how these regimes interact with external shocks like fluctuations in oil prices. Overall, this study provides a deeper understanding of how crude oil shocks affect macroeconomic variables in South Africa, enhancing our knowledge of the transmission mechanisms involved. The findings offer valuable insights for both policymakers and researchers.

Following the introduction, Section 2 presents a literature review, Section 3 details the data and methodology used in the analysis, Section 4 presents the study's findings, Section 5 discusses the results, and Section 6 concludes with the implications.

2. LITERATURE REVIEW

In a recent publication, researchers examined how oil price shocks affect industrialized and emerging countries. The impact of oil price shocks on South Africa, which is heavily dependent on oil imports, is scarcely explored empirically.

2.1. International Studies

Using the vector autoregressive model, Zulfigarov and Neuenkirch (2020) investigated the link between oil price fluctuations and economic activity in Azerbaijan from 2002 to 2018. It was found that other macroeconomic factors responded differently to price volatility and an increase in inflation was associated with changes in oil prices.

Using the VAR model, Yildirim and Arifli (2021) investigated the impact of oil price shocks on the Azerbaijani economy from 2006 to 2018. Trade balances are affected, currencies weaken, inflation is raised, and economic activity is generally slowed by negative oil price shocks.

Azad and Serletis (2020) used statistical models to investigate how oil price volatility affects economic activity. They found that the GDP of the seven emerging market (EM7) nations is significantly impacted by oil price uncertainty. Additionally, they discovered that global crude oil output is adversely affected by oil price volatility.

Using a wavelet-based quantile regression model, Khan et al. (2020) investigated how industrial production and gas, and oil prices are related. They found that, in the short run, natural gas has a negative association with industrial production, while crude oil has a positive one.

Omojolaibi and Egwaikhide (2013) used data from the United States, China, and Japan to examine the effects of crude oil price changes on GDP growth and inflation rates. They found that rising oil prices negatively impacted GDP growth in China but positively influenced GDP growth in the US and Japan. They concluded that developed net oil importers like the US and Japan are less affected by changes in oil prices than emerging economies like China regarding GDP growth rates.

Using secondary data from 2001 to 2022, Alawadhi and Longe's (2024) study investigates the effects of oil price shocks on Kuwaiti macroeconomic indicators. The study examines how Kuwaiti macroeconomic variables respond to oil price shocks using the vector autoregression (VAR) approach. The study reveals that oil price shocks significantly impact Kuwait's macroeconomic variables, emphasizing the need for more policy developments and risk hedging frameworks to mitigate their impact.

The effect of changes in oil prices on macroeconomic variables in Indonesia was examined by Lizein et al. (2024). A structural vector autoregressive (SVAR) model was applied to yearly Indonesian data from 1990 to 2021. The results reveal that shocks to oil prices significantly affect GDP, inflation, and exchange rates. Moreover, oil price shocks adversely affect the index of industrial production and interest rates.

The impact of oil price shocks on real output, inflation, and the real exchange rate in Thailand, Malaysia, Singapore, the Philippines, and Indonesia (ASEAN-5) is examined by Basnet and Upadhyaya (2015) using a structural vector autoregressive (SVAR) approach. ASEAN-5 economies are not affected by long-term fluctuations in oil prices or their ability to explain significant changes in the real exchange rate or inflation.

2.2. South Africa Studies

Fasanya and Makanda's (2024) study examined the relationship between oil shocks and macroeconomic policy uncertainty in South Africa from 1990 to 2022, revealing a weak correlation overall. The strongest relationships emerged at both the lower and higher quantiles. At lower quantiles, macroeconomic policy uncertainty acted as a net receiver, while at medium and upper quantiles, political and economic policy uncertainty served as net transmitters.

Hollander et al. (2018) investigate how major macroeconomic indicators for South Africa a net oil importer is affected by shocks to global (real) oil prices. Foreign real oil price shocks significantly drive output, inflation, and interest rates in both the short and long term, as they have a lasting impact on local production and consumption activities. These oil price shocks can create a trade-off between stabilizing inflation and output, leading to periods of monetary policy tightening that hinder economic recovery in South Africa.

Marna et al. (2007) present a macro-micro paradigm to examine how oil prices impact the global economy and the South African economy. They employ a micro-simulation study and a highly disaggregated general equilibrium model to predict changes in prices, employment, and earnings. They estimate that a 125% increase in crude oil and refined petroleum prices will result in a 2% decrease in employment, a 7% drop in household spending, and a 2% rise in unemployment. Rising oil prices widen the wealth gap, affecting low- and medium-skilled workers and households with higher skill levels.

3. DATA AND METHODOLOGY

3.1. Data Source

Historical time series data from 2000Q1 to 2023Q4 on crude oil prices, RGDP, inflation, exchange rates, interest rates, and the current account balance was obtained from the South African Reserve Bank (SARB).

3.2. Explanation of Key Components

Endogenous Variables

GDP growth rate: Higher oil prices typically slow economic growth by raising production costs for industries that depend on fuel. In South Africa, sectors like mining, manufacturing, and transportation are especially sensitive to fluctuations in oil prices. On the other hand, a decline in oil prices can stimulate economic growth by reducing production and transportation costs, enhancing profitability across various sectors, and boosting consumer spending. The impact of oil shocks on GDP growth is expected to vary based on prevailing economic conditions.

Inflation: Direct impacts of crude oil price shocks lead to higher fuel prices, a significant component of South Africa's Consumer Price Index (CPI). Cost-push inflation caused by rising oil prices increases transportation, manufacturing, and energy costs. As a result of higher fuel costs, businesses often pass these costs on to their consumers, increasing prices for goods and services, further increasing inflationary pressures. Oil shocks are expected to have varying effects on inflation depending on economic conditions.

Exchange Rates: Oil price fluctuations significantly impact the South African rand (ZAR). When oil prices rise, the ZAR often weakens because the country must spend more on oil imports, which negatively affects the trade balance. In contrast, when

oil prices decline, the ZAR typically strengthens as import costs decrease, leading to an improvement in the trade deficit. The effects of oil shocks on the exchange rate are expected to vary based on prevailing economic conditions.

Interest Rates: Interest rates are frequently adjusted by the South African Reserve Bank (SARB) to combat inflationary pressures caused by rising oil prices. When oil price shocks lead to higher inflation, the SARB may raise interest rates to ensure price stability, which can, in turn, slow economic activity. In response to oil shocks, interest rates are expected to vary depending on economic conditions.

Current Account Balance: Since South Africa is relying heavily on oil imports for its current account balance, crude oil price fluctuations have significant effects. When oil prices rise, the current account balance typically worsens as South Africa spends more on imports, leading to increased inflation, reduced consumer spending, and slower economic growth. Conversely, when oil prices decline, the current account balance improves, benefiting the economy through lower inflation and increased consumer spending. Oil price shocks are expected to negatively impact the current account balance in both economic conditions.

Exogeneous Variable

Crude Oil Shocks: This refers to sudden and significant changes in crude oil prices, which can result from supply-side disruptions, such as geopolitical instability, shifts in demand, or speculative activities. Crude oil prices are a key input for many industries, so fluctuations can have a significant impact on the economy.

3.3. Unit Root

The Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests play a vital role in identifying unit roots in time series data, which helps determine whether variables are stationary or non-stationary. These tests enable us to evaluate the long-term relationships between variables and the risk of spurious regression results. In this study, the unit root and stationarity tests form the basis for our Markov Switching Intercepts VAR approach, allowing us to effectively model the dynamic effects of crude oil shocks on the South African economy.

3.4. Econometric Model

Markov Switching Intercepts VAR (MSI-VAR) Model

The MSI-VAR model enhances the traditional VAR model by accounting for changes in the relationships between variables based on different economic regimes, such as periods of growth versus recession. These regimes are represented as hidden states within a Markov process, indicating that the economy transitions between states with specific, unobservable probabilities. By integrating these hidden states into the VAR model, we can effectively capture the dynamic relationships between crude oil shocks and macroeconomic variables in South Africa. This approach provides a clearer understanding of how various economic regimes influence the transmission of oil price fluctuations to key indicators, including GDP, inflation, exchange rates, interest rates, and the current account balance. Analyzing these effects within a Markov switching framework allows us to gain valuable insights into policy implications and strategies for mitigating the macroeconomic impact of crude oil shocks in South Africa.

The formula for the Markov Switching Intercepts VAR model is as follows:

VAR(p) model for Markov-Switching Intercepts includes two regimes as follows:

Where

- $\mathcal{Y}_t$ is an $n\ x1$ is vector of endogenous variables (for example, GDP growth, inflation, exchange rates, interest rare and current account balance) at time t
- $\mu\ (S_t)$ is an $n\ x\ 1$ vector of regime-dependent intercepts, which vary with the state S_t.
- $A_1(S_t),\ A_2(S_t),\ldots\ldots\ A_p(S_t)$ are $n\ x\ n$ coefficient matrices that depend on the regime S_t. These capture the autoregressive relationship of the variables across p lags.
- $\epsilon_t \sim N\ (0, \Sigma(S_t)\ )$ is a vector of error terms with a variance-covariance matrix $\Sigma(S_t)$ that depends on the regime S_t.
- $S_t \in\ \{1.2, \ldots\ldots, k\}$ is a latent state variable (indicating the current regime at time t). that follows a Markov process. k represents the number of regimes.

Regime Switching Mechanism

The Markov process governs the transitions between different regimes:

$P(S_t = j|\ S_{t-1} = i) + p_{ij}$

p_{ij} is the transition probability of shifting from regime i to regime j, and a transition probability matrix summarizes these probabilities:

$$P = \begin{bmatrix} p_{11} & p_{12} & \cdots & p_{1k} \\ p_{21} & p_{22} & \cdots & p_{2k} \\ \vdots & \vdots & \ddots & \vdots \\ p_{k1} & p_{k2} & \cdots & p_{kk} \end{bmatrix}$$

p_{ii}represents the probability of staying in regime i.
p_{ij} represents the probability of transitioning from regime i to regime j

4. FINDINGS

4.1. Descriptive Statistics

The findings of descriptive statistics are presented in Table 1. The average real GDP growth of 2.33% indicates a moderate level of economic expansion, while the high inflation risk mean of 112.88 suggests potential challenges to price stability. The exchange rate, with a mean of 85.69, reflects a relatively stable currency despite external economic influences. The mean interest rate of 10.79 indicates moderate borrowing costs for both businesses and consumers. A negative current account balance mean of -2.06 indicates that South Africa is importing more goods and services than it is exporting. Additionally, the average crude oil shock of 66.18 shows the significant impact fluctuating oil prices can have on the South African economy. Overall, these findings emphasize the importance of analyzing and understanding the relationship between crude oil shocks and various macroeconomic indicators in South Africa.

Table 1: A Summary of Descriptive Statistics

Description	RGDP	INF	EXR	IR	CAB	OIL
Mean	2.330208	112.8761	85.69135	10.79323	-2.016895	66.17688
Median	2.500000	108.0200	82.88500	10.25000	-2.793197	62.64000
Maximum	5.600000	174.9900	108.9900	17.00000	4.123380	121.3100
Minimum	-6.300000	58.14000	64.68000	7.000000	-5.836930	19.40000
Std. Deviation	2.159050	37.24312	11.99395	2.546241	2.795811	28.96720
Skewness	-1.183971	0.188697	0.282692	0.670604	0.535743	0.247786
Kurtosis	5.724747	1.604611	1.830739	2.657945	2.188086	1.978794
Jarque-Bera (JB)	52.12560	8.358145	6.747326	7.663365	7.229146	5.153816
Probability	0.000000	0.015313	0.034264	0.021673	0.026928	0.076009
Observations	96	96	96	96	96	96

Source: Authors' Estimation using Eviews 14.

Real GDP growth (RGDP) has a standard deviation of 2.159050, inflation risk is 37.24312, exchange rate risk (EXR) is 11.99395, interest rates (IR) are 2.546241, the current account balance (CAB) is 2.795811, and crude oil shocks (OIL) have a standard deviation of 28.96720. These figures indicate that the South African economy is particularly sensitive to fluctuations in crude oil prices, as reflected in the high standard deviation of the OIL variable. Additionally, the volatility in inflation and exchange rates suggests a vulnerability to external shocks, which could significantly impact economic stability. Conversely, the relatively low standard deviations of real GDP growth and interest rates indicate a degree of stability in these areas, though they may still be affected by external factors such as crude oil shocks. Overall, these descriptive statistics underscore the importance of considering the macroeconomic effects of crude oil shocks in South Africa and highlight the need for appropriate policy responses to mitigate potential risks.

The negative skewness of real GDP growth indicates a leftward tail, signaling the potential for lower-than-expected growth rates. In contrast, both inflation risk and exchange rate risk exhibit positive skewness, suggesting a rightward tail and the possibility of higher-than-expected risk levels in these areas. Similarly, interest rates and the current account balance also show positive skewness, indicating the potential for higher-than-expected rates and balances. Lastly, the skewness of crude oil shocks is slightly positive, pointing to a rightward tail and the potential for unexpected increases in oil prices that could impact the economy.

The data reveal a high kurtosis in Real GDP growth, characterized by heavy tails and a sharp peak, which indicates a higher likelihood of extreme values. In contrast, inflation risk exhibits a kurtosis of less than 3, reflecting a flatter distribution with lighter tails and fewer extreme deviations. Exchange rate risk has a kurtosis of 1.830739, indicating fewer extreme events compared to a normal distribution. It appears that interest rate movements follow a nearly normal distribution, since their kurtosis is close to 3. The current account balance demonstrates a slightly platykurtic distribution, pointing to a reduced occurrence of extreme values. Lastly, crude oil shocks present a kurtosis below 3, signifying a flatter distribution.

4.2. Unit Root and Stationarity Tests

Unit root and stationarity tests are crucial for assessing the stability and reliability of data when analyzing the macroeconomic effects of crude oil shocks in South Africa. By determining whether the variables display non-stationary behavior, we can gain a clearer understanding of how fluctuations in oil prices affect the economy. The results of the ADF and PP tests are shown in Table 2.

Table 2: ADF and PP Unit Root Test Results

Variables	ADF Test		PP Test	Status
	t-statistic	Status	t-statistic	
lnRGDP	-6.430185***	I(1)	-6.904120***	I(1)
lnINF	-4.931731***	I(1)	-10.97185***	I(1)
lnEXR	-7.819843***	I(1)	-7.834603***	I(1)
lnIR	-6.888212***	I(1)	-6.984926***	I(1)
lnCAB	-4.308496 ***	I(1)	-4.394021***	I(1)
lnOIL	-7.316885***	I(1)	-7.103217***	I(1)

Note. (***), indicate significant at 1%. All the variables are log linearized.
Source: Authors' computation using EViews 14.

The unit root tests indicate that the variables are stationary at I(1), suggesting that the data used in this study are reliable and appropriate for further analysis. Additionally, the stationarity of the variables implies that any observed trends or patterns are likely to be robust, rather than merely the result of random fluctuations. This strengthens the accuracy and significance of the conclusions drawn about the relationship between crude oil shocks and the South African economy. Overall, the results of the unit root and stationarity tests enhance the credibility and validity of the study's findings, underscoring the importance of these preliminary analyses in econometric research.

4.3. MSI-VAR Results

This builds on the previous work of Agyemang-Badu et al. (2024), who employed a two-regime model. In regime one, characterized by high growth, the impact of crude oil price shocks tends to be less severe, as the economy exhibits greater resilience and adaptive capacity. In contrast, regime two represents a recession, during which oil price shocks can have a more pronounced negative effect on macroeconomic variables.

Table 3 presents the coefficients of crude oil shocks and real GDP growth (RGDP). In regime one, the coefficient is -0.005581, indicating a minimal negative correlation during periods of high growth. In contrast, regime two shows a positive link with a coefficient of 0.068224, suggesting that in times of recession, crude oil shocks can contribute to an increase in economic output. This study underscores the significance of recognizing how varying economic conditions can influence the impact of external shocks, such as fluctuations in oil prices, on a nation's macroeconomic performance.

In regime one, the coefficient for crude oil shocks and inflation (INF) is -0.007537, while in regime two, it reveals a stronger negative correlation of -0.125483. This indicates that during periods of economic growth, South Africa is better equipped to absorb and mitigate the impact of oil price shocks. Conversely, during a recession, the economy becomes more vulnerable to the adverse effects of these shocks. Furthermore, the negative relationship between crude oil shocks and inflation in regime two suggests a likelihood of higher inflation rates during economic downturns. Overall, these findings offer valuable insights into the dynamic relationship between crude oil price shocks and macroeconomic variables in South Africa, which can help inform policymakers about effectively managing the economy's response to such shocks.

There is a positive relationship between crude oil shocks and the exchange rate (EXR) in regime one (0.005307), while in regime two, this relationship is negative (-0.206430). The differing reactions of the economy across these two regimes indicate that South Africa's level of economic activity significantly influences the impact of crude oil price shocks. In regime one, the positive correlation suggests that during periods of economic growth, the currency tends to strengthen in response to rising oil prices. Conversely, the negative correlation in regime two implies that during recessions, the exchange rate weakens when confronted with similar oil price shocks. This analysis offers valuable insights into the dynamic relationship between crude oil shocks and macroeconomic variables in South Africa.

There is a positive relationship between crude oil shocks and interest rates (IR) in regime one (0.004182), while in regime two, the relationship is negative (-0.002599). This indicates that during periods of high growth, the South African economy can effectively absorb and mitigate the effects of crude oil price shocks. Conversely, during a recession, the negative impact of these shocks is amplified, resulting in a more significant influence on macroeconomic variables, such as interest rates. This underscores the importance of understanding the dynamics between oil prices and macroeconomic variables under different economic conditions to manage and mitigate potential risks effectively.

Table 3: MSI-VAR Results

	RGDP	INF	EXR	IR	CAB
Regime 1					
C	5.690961	9.797219	6.074549	4.660159	0.159870
	(1.59683)	(4.52926)	(10.2944)	(1.32273)	(0.86378)
	[3.56391]	[2.16310]	[0.59008]	[3.52314]	[0.18508]
OIL	-0.005581	-0.007537	0.005307	0.004182	-0.001207
	(0.00327)	(0.00928)	(0.02109)	(0.00271)	(0.00177)
	[-1.70599]	[-0.81228]	[0.25164]	[1.54324]	[-0.68150]
Regime 2					
C	-2.979085	24.44999	24.54369	3.983364	2.131148
	(2.99902)	(8.50749)	(19.3410)	(2.48458)	(1.62336)
	[-0.99335]	[2.87394]	[1.26900]	[1.60323]	[1.31280]
OIL	0.068224	-0.125483	-0.206430	-0.002599	-0.026770
	(0.02996)	(0.08498)	(0.19321)	(0.02482)	(0.01622)
	[2.27748]	[-1.47660]	[-1.06842]	[-0.10470]	[-1.65051]
Common					
RGDP(-1)	0.938914	-0.335338	0.143448	0.224913	-0.108260
	(0.04609)	(0.13072)	(0.29716)	(0.03818)	(0.02495)
	[20.3717]	[-2.56534]	[0.48273]	[5.89129]	[-4.33971]
INF(-1)	-0.013647	0.968793	-0.006149	-0.005688	0.001613
	(0.00489)	(0.01388)	(0.03154)	(0.00405)	(0.00265)
	[-2.78936]	[69.8128]	[-0.19498]	[-1.40361]	[0.60923]
EXR(-1)	-0.008397	-0.032941	0.890416	-0.044264	-0.003883
	(0.00926)	(0.02626)	(0.05969)	(0.00767)	(0.00501)
	[-0.90690]	[-1.25438]	[14.9164]	[-5.77148]	[-0.77522]
IR(-1)	-0.237552	-0.177534	0.292549	0.910580	0.027629
	(0.04990)	(0.14152)	(0.32170)	(0.04133)	(0.02700)
	[-4.76084]	[-1.25446]	[0.90940]	[22.0312]	[1.02341]
CAB(-1)	0.137553	-0.286752	0.090420	0.025448	0.970949
	(0.03263)	(0.09255)	(0.21035)	(0.02703)	(0.01766)
	[4.21558]	[-3.09850]	[0.42985]	[0.94160]	[54.9752]
SIGMA	0.416419	0.011810	0.603011	-0.180162	-0.072523
	(0.06042)	(0.12078)	(0.28234)	(0.03992)	(0.02429)
	[6.89206]	[0.09777]	[2.13575]	[-4.51293]	[-2.98552]
Transition Matrix Parameters					
Variable	Coefficient	Std. Error	z-Statistic	Prob.	
P11-C	3.078594	0.511605	6.017521	0.0000	
P21-C	19.13593	6928.072	0.002762	0.9978	
Determinant resid covariance		1.745913			
Log likelihood		-655.0018			
Akaike info criterion		15.09477			
Schwarz criterion		16.76152			
Number of coefficients		62			

Note: Coefficients are reported along with standard errors and t-statistics in parentheses () and brackets [], respectively.
Source: Authors' computation using EViews 14.

There is a negative relationship between crude oil shocks and the current account balance in both regimes: -0.001207 in regime one and -0.026770 in regime two. These findings indicate that South Africa's economy is more susceptible to crude oil price shocks during periods of recession, as evidenced by the larger negative impact on the current account balance in regime two compared to regime one. This underscores the need for South Africa to build a more resilient and diverse economy to mitigate the adverse effects of external shocks, such as oil price fluctuations. By strengthening other sectors and reducing its dependency on oil, the country can better withstand economic downturns and enhance its overall economic stability.

RGDP: The lagged RGDP of 0.9389 indicates strong economic growth, while the lagged INF of -0.3353 suggests that higher previous inflation may dampen this growth. EXR lagged at 0.1434 indicates a positive effect, indicating that exchange rate changes can boost economic output. Additionally, the lagged IR of 0.2249 indicates that previous interest rates may positively

impact RGDP. Conversely, the negative coefficient in the lagged CAB suggests that a higher previous current account balance may be associated with lower RGDP, possibly due to resource allocation issues.

INF: The RGDP (-0.0136) indicates a slight negative correlation, suggesting that stronger economic growth does not significantly affect inflationary pressure. The lagged INF (0.9688) reflects stable inflation over time, while the lagged EXR (-0.0062) shows that exchange rate fluctuations have a minimal impact on inflation. Additionally, the lagged IR (-0.0057) indicates that interest rates have a negligible influence on inflation. Finally, the lagged CAB (0.0016) suggests a small positive impact, indicating a weak relationship.

EXR: Lagged RGDP (-0.0084) indicates a minimal influence of past GDP on current exchange rates. Lagged INF (-0.0329) shows a slight negative impact, suggesting that inflation may affect the exchange rate. Lagged EXR (0.8904) has a strong positive coefficient, indicating that past exchange rates significantly influence current exchange rates. The lagged IR (-0.0443) indicates that higher interest rates lead to depreciation of the exchange rate. Finally, the Lagged CAB (-0.0039) indicates a minimal influence of the current account balance on the exchange rate.

IR: The lag in RGDP (-0.2376) suggests that economic growth may lead to lower interest rates, potentially due to increased investor confidence. The negative relationship with Lagged INF (-0.1775) indicates that inflation could increase interest rates, although this impact is not significant. The lagged EXR (0.2925) shows that past exchange rate levels can significantly affect current interest rates. Lagged IR (0.9106) indicates strong persistence, meaning that past interest rates heavily influence current rates. Finally, a lagged CAB (0.0276) indicates a minimal effect on current interest rates.

CAB: Lagged RGDP (0.1376) indicates that higher economic output is associated with an improved current account balance. In contrast, lagged INF (-0.2868) shows that increased inflation negatively impacts the current account, likely due to diminished competitiveness. The small positive effect of lagged EXR (0.0904) suggests a relationship with exchange rates. Lagged IR (0.0254) has a minimal impact on the current account balance. Finally, lagged CAB (0.9709) demonstrates extremely high persistence, indicating strong continuity in current account balances over time.

This analysis offers a detailed examination of the interactions among various macroeconomic variables in South Africa, particularly in relation to crude oil price shocks. The significant persistence observed in variables such as RGDP, INF, and CAB indicates that shocks to the system can have enduring effects. In responding to external shocks, such as fluctuations in crude oil prices, policymakers must consider these interdependencies.

These values offer insights into how sensitive each macroeconomic variable is to fluctuations in crude oil prices across different economic regimes. In the first regime, the positive SIGMA-RGDP indicates that GDP growth is relatively stable and less influenced by oil price shocks. The low SIGMA-INF shows that inflation remains well-contained, while the high SIGMA-EXR demonstrates considerable volatility in the exchange rate. The negative SIGMA-IR suggests that interest rates tend to decline in response to oil price shocks, which could stimulate economic activity. Lastly, the negative SIGMA-CAB indicates that the current account balance worsens during oil price shocks, underscoring their impact on trade balances. Overall, these Sigma values provide a comprehensive overview of the macroeconomic effects of crude oil shocks in South Africa.

The P11-C coefficient is 3.078594, with a p-value of 0.0000, indicating a statistically significant positive response to crude oil price shocks. In contrast, the P21-C coefficient is 19.13593, accompanied by a p-value of 0.9978, suggesting no statistical significance. These results imply that during periods of economic expansion, the economy is better equipped to absorb and respond positively to fluctuations in crude oil prices. However, during recessions, the negative impact of oil price shocks is more pronounced and can have lasting effects on macroeconomic variables. The high p-value in this context points to uncertainty regarding this effect. Moreover, the findings suggest a low probability of transitioning from regime one to regime two, while the likelihood of remaining in regime two is high. This aligns with the notion that once an economy enters a recessionary phase; it can be difficult to recover quickly. Additionally, the high p-value for transitions from regime two to regime one indicates that such shifts are not statistically significant, reinforcing the idea that recovering from a recession poses substantial challenges. Overall, these findings underscore the importance of understanding different economic regimes and their implications for policy-making in response to crude oil price shocks.

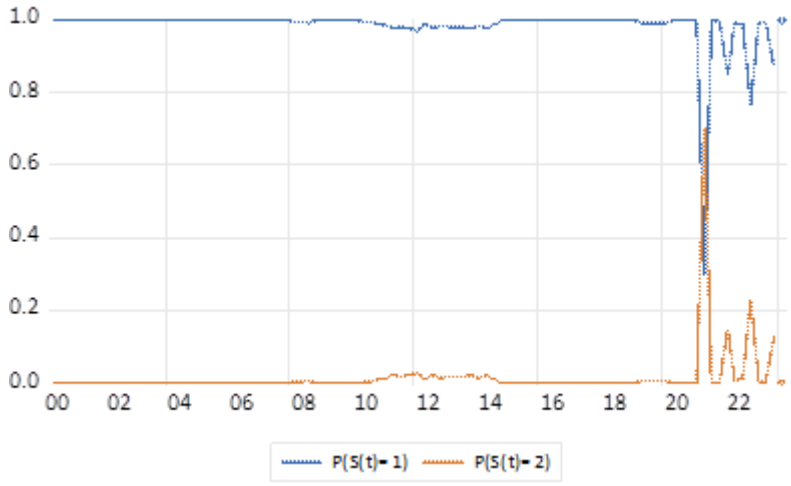
The determinant of residual covariance is 1.745913, the log likelihood is -655.0018, the Akaike Information Criterion (AIC) is 15.09477, and the Schwarz Criterion (SC) is 16.76152. These statistics suggest that the model fits the data well, as indicated by the relatively high determinant residual covariance and the low log likelihood. Additionally, both the AIC and SC fall within acceptable ranges, reinforcing the conclusion that the model is well-suited to analyzing the macroeconomic effects of crude oil shocks in South Africa.

4.4. Diagnostic Test Results

4.4.1. Probability Plot

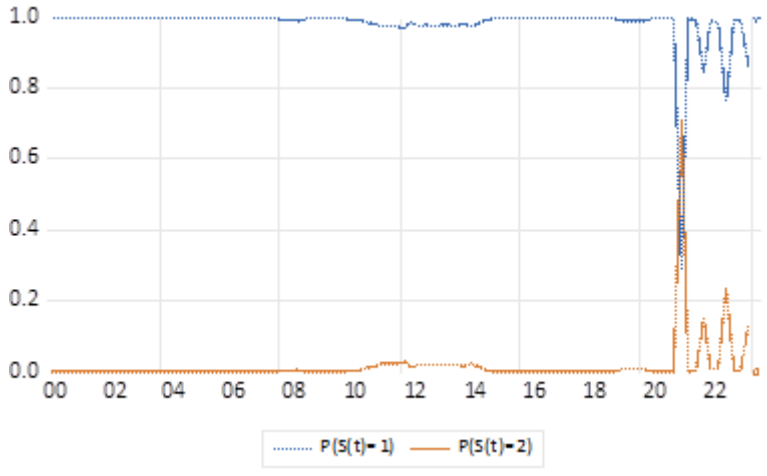
The macroeconomic effects of crude oil shocks in South Africa provide interesting insights into the country's economic performance. These shocks can be better understood by examining the probability plot of their impact. The information can be used by policymakers to mitigate the negative effects of oil price fluctuations on the South African economy.

Figure 1: Filtered Regime Probabilities in the MSI-VAR Model



In Figure 1, the regime probabilities show that South Africa is primarily in regime one, with a high probability of 0.982298. This indicates that the economy is generally experiencing robust growth and is well-prepared to withstand crude oil price shocks. However, there remains a small probability of 0.017702 for regime two, suggesting the possibility of a recession where oil price shocks could negatively affect macroeconomic variables. While South Africa's economy is expected to remain in regime one, reflecting its resilience to crude oil shocks, the small chance of regime two underscores potential vulnerabilities. Policymakers and economists should closely monitor these probabilities and be ready to respond to macroeconomic changes resulting from fluctuations in crude oil prices.

Figure 2: Smoothed Regime Probabilities in the MSI-VAR Model



The analysis of the Smoothed Regime Probabilities indicates that South Africa's economy predominantly operates in regime one, with a probability of 0.981959, as illustrated in Figure 2. This suggests that the economy is generally in a state of high growth, which protects against crude oil price shocks. A small chance of 0.018041 remains for regime two, suggesting that the impact of oil price shocks on macroeconomic variables in South Africa can be greater during recessionary periods. Understanding these regime probabilities can help policymakers better prepare for external shocks and mitigate their effects.

4.4.2. Transition Probability

Transition Probability Analysis is a valuable tool for understanding how crude oil shocks impact the South African economy. By examining the transition probabilities between different economic states in response to fluctuations in oil prices, we can gain insights into how these shocks influence key macroeconomic variables such as GDP growth, inflation, exchange rates, interest rates, and the current account balance. This method helps to comprehend the repercussions of external shocks on the South African economy and to develop effective policy measures to mitigate their adverse effects.

Table 4: Transition Probability and Expected Duration

South Africa	Regime 1	Regime 2
Regime 1	0.956001	0.043999
Regime 2	1.000000	4.89E-09
Durations	22.72784	1.000000

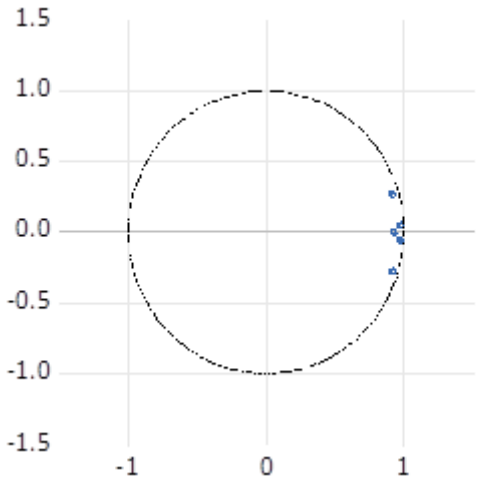
Source: Authors' Estimation using EViews 14

The Markov switching model indicates that South Africa's economy is predominantly in regime one, which is characterized by high growth and resilience to crude oil price shocks. This conclusion is supported by a high probability of remaining in regime one (P(1|1) = 0.956001) and a relatively long expected duration of this regime (22.72784). In contrast, regime two, which signifies a recession, is less likely to occur and has a shorter expected duration (1.000000). This suggests that the economy is well-equipped to withstand and recover from oil price shocks, underscoring its adaptive capacity in the face of external economic challenges.

4.4.3. Inverse Roots

This study analyzes the inverse roots of the AR characteristic polynomial to gain insights into the system's dynamics and stability in response to shocks.

Figure 3: Inverse Roots of AR Characteristic Polynomial



The results indicate that all inverse roots are located within the unit circle, demonstrating that the system is stable in both regime one and regime two. This analysis underscores the importance of comprehending the system's underlying dynamics to effectively mitigate the impact of external shocks on macroeconomic variables.

5. DISCUSSIONS

During the first regime, there was a negative relationship between crude oil shocks and real GDP growth in South Africa. This finding aligns with studies by Omojolaibi and Egwaikhide (2013) and Cheng et al. (2019), which indicated that increases in oil prices inversely affect GDP growth in China. However, in the second regime, the relationship shifts to positive, suggesting that rising oil prices contribute to increased GDP growth in South Africa. This observation is consistent with research by Omojolaibi and Egwaikhide (2013), Zulfigarov and Neuenkich (2020), and Lizein et al. (2024), which noted the positive impact of rising oil prices on GDP growth in the US, Japan, Azerbaijan, and Indonesia, respectively. The MSI-VAR model provides a more nuanced understanding of the relationship between crude oil shocks and GDP growth, capturing its evolving nature over time through multiple structural breaks, in contrast to traditional VAR models.

There is a negative relationship between crude oil shocks and inflation in South Africa across both economic regimes. This aligns with the findings of Al-Mulali et al. (2011), who also reported a negative impact of oil price shocks on inflation in Qatar. These results indicate that oil price shocks affect inflation similarly in various countries, irrespective of their economic conditions and policies. The findings of this study offer valuable insights for South African policymakers, emphasizing the need to monitor and manage the effects of crude oil price fluctuations on inflation rates. By comprehending this relationship, policymakers can take appropriate measures to mitigate the potential adverse effects of oil price shocks on the economy.

There is a positive relationship between crude oil shocks and exchange rates in regime one in South Africa. This finding aligns with the work of Kiliçarslan and Dumrul (2017) in Turkey, who employed the SVAR method and discovered that rising crude oil prices were associated with higher real exchange rates. Conversely, in regime two, the relationship is negative. This outcome corresponds with the findings of Lizein et al. (2024), who also used SVAR and identified a positive link between oil price shocks and exchange rates in Indonesia. It appears that the impact of crude oil shocks on exchange rates varies depending on the economic regime and the country. The MSI-VAR approach provides a more comprehensive understanding of the relationship between oil price shocks and exchange rates in South Africa, facilitating a deeper analysis of the various economic regimes. By acknowledging these differing impacts, policymakers can tailor their responses to effectively mitigate the potential negative effects of oil price fluctuations on exchange rates.

There is a positive correlation between crude oil shocks (OIL) and interest rates (IR) in regime one. This aligns with the findings of Lizein et al. (2024), who utilized SVAR analysis to identify a similar positive relationship between oil price shocks and interest rates in Indonesia. Conversely, in regime two, the relationship turns negative. This unexpected outcome indicates that different factors may influence interest rates during periods of oil shocks in regime two.

There is a negative relationship between crude oil shocks and the current account balance in both regime one and regime two in South Africa. It echoes the findings of Yildirim and Arifli (2021), who used the VAR model to show that negative oil price shocks decrease trade balances in Azerbaijan. The trade balances of oil-dependent countries, including South Africa, are significantly affected by fluctuations in oil prices. As a net importer of oil, South Africa may face challenges maintaining a positive current account balance when confronted with negative oil price shocks. To mitigate the country's vulnerability to oil price fluctuations, policymakers should diversify its energy sources. Additionally, the MSI-VAR model provides more robust estimates of the effects of oil price shocks on trade balances, enabling a more accurate assessment of the potential impact on South Africa's economy compared to the VAR approach used by Yildirim and Arifli (2021).

6. CONCLUSION AND IMPLICATIONS

The study aimed to analyze the macroeconomic effects of crude oil shocks in South Africa using a Markov Switching Intercepts VAR (MSI-VAR) approach, covering the period from 2000Q1 to 2023Q4. PP and ADF tests confirmed the presence of unit roots, indicating non-stationarity of the variables. The MSI-VAR results revealed a minimal negative correlation between crude oil shocks and real GDP growth in regime one, while a positive relationship emerged in regime two, suggesting that oil shocks can boost economic output during recessions. In addition, the negative correlation between crude oil shocks and inflation in South Africa was stronger during recessionary periods, suggesting that these shocks have a greater impact. This highlights the importance of understanding different economic regimes. The relationship between crude oil shocks and the exchange rate also varied depending on economic conditions, displaying positive correlations during periods of economic growth and negative correlations during recessions. Additionally, the connection between crude oil shocks and interest rates varied across regimes, with high-growth periods enabling effective mitigation, while recessions intensified their impact. Under both regimes, crude oil shocks negatively correlated with the current account balance, highlighting the vulnerability of the South African economy. Overall, the findings suggest that South Africa's economy is highly sensitive to fluctuations in crude oil prices, with varying effects depending on the prevailing economic climate.

The findings suggest that the South African government should take measures to diversify the economy and lessen its dependence on crude oil imports. This strategy could help stabilize the current account balance and reduce the economy's vulnerability to external shocks. Furthermore, the government should prioritize maintaining a stable exchange rate through careful monetary and fiscal policies to lessen the effects of crude oil shocks on interest rates and overall economic activity. Ultimately, a proactive approach to addressing these vulnerabilities is crucial for ensuring long-term economic sustainability in South Africa.

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APPENDIX 1: Descriptive Statistics of Data

	RGDP	INF	EXR	IR	CAB	OIL
Mean	2.330208	112.8761	85.69135	10.79323	-2.016895	66.17688
Median	2.500000	108.0200	82.88500	10.25000	-2.793197	62.64000
Maximum	5.600000	174.9900	108.9900	17.00000	4.123380	121.3100
Minimum	-6.300000	58.14000	64.68000	7.000000	-5.836930	19.40000
Std. Dev.	2.159050	37.24312	11.99395	2.546241	2.795811	28.96720
Skewness	-1.183971	0.188697	0.282692	0.670604	0.535743	0.247786
Kurtosis	5.724747	1.604611	1.830739	2.657945	2.188086	1.978794
Jarque-Bera	52.12560	8.358145	6.747326	7.663365	7.229146	5.153816
Probability	0.000000	0.015313	0.034264	0.021673	0.026928	0.076009
Sum	223.7000	10836.11	8226.370	1036.150	-193.6219	6352.980
Sum Sq.	964.1100	1354907.	718595.0	11799.32	1133.088	500134.7
Sum Sq. Dev.	442.8424	131769.8	13666.21	615.9175	742.5732	79714.37
Observations	96	96	96	96	96	96

APPENDIX 2: Dataset

Year	RGDP	INF	EXR	IR	CAB	OIL
2000 Q1	4,2	58,14	103,77	14,5	-0,13765	26,84
2000 Q2	3,8	59,54	100,1	14,5	-0,03384	26,68
2000 Q3	3,5	60,66	101,15	14,5	0,06997	30,6
2000 Q4	3,1	61,26	96,55	14,5	0,17378	29,72
2001 Q1	2,7	62,46	93,55	14,5	0,27759	25,88
2001 Q2	3	63,36	94,84	14,25	0,426205	27,27
2001 Q3	3,2	63,56	85,76	13,33	0,57482	25,33
2001 Q4	3,5	63,9	76,89	13	0,723435	19,4
2002 Q1	3,7	66,06	69,32	14,33	0,87961	21,05
2002 Q2	3,5	68,32	76,25	15,33	0,434135	25,06
2002 Q3	3,3	70,37	75,36	16,33	-0,00378	26,94
2002 Q4	3,1	72,52	83,04	17	-0,441695	26,76
2003 Q1	2,9	73,59	93,09	17	-0,87961	31,61
2003 Q2	3,3	73,98	96,92	16,5	-1,361153	26,08
2003 Q3	3,8	73,45	100,52	14,5	-1,842695	28,5
2003 Q4	4,2	72,04	104,2	11,83	-2,324237	29,35
2004 Q1	4,6	72,3	99,42	11,5	-2,80578	31,92
2004 Q2	4,8	72,71	103,97	11,5	-2,88171	35,3
2004 Q3	4,9	72,8	106,44	11,17	-2,95764	41,13
2004 Q4	5,1	73,23	108,59	11	-3,03357	44,29
2005 Q1	5,3	73,69	108,34	11	-3,1095	47,45
2005 Q2	5,4	74,06	102,85	10,5	-3,450783	51,04
2005 Q3	5,4	74,55	102,93	10,5	-3,792065	61,64
2005 Q4	5,5	74,73	103,81	10,5	-4,133348	56,97
2006 Q1	5,6	75,2	108,99	10,5	-4,47463	61,45
2006 Q2	5,5	75,94	101,97	11,4	-4,708087	69,44
2006 Q3	5,5	77,35	92,47	11,33	-4,941545	69,53
2006 Q4	5,5	78,17	90,67	12,17	-5,175003	59,55
2007 Q1	5,4	79,07	91,25	12,5	-5,40846	57,86
2007 Q2	4,9	80,51	91,87	12,67	-5,485643	69,03
2007 Q3	4,3	82,21	91,16	13,33	-5,562825	75,84
2007 Q4	3,8	83,83	93,78	14,17	-5,640008	89,07
2008 Q1	3,2	86,15	83,77	14,5	-5,71719	97,71
2008 Q2	2	88,49	80,44	15,17	-4,95219	121,31
2008 Q3	0,9	91,48	83,59	15,5	-4,18713	115,86
2008 Q4	-0,3	92,3	73,59	13,9	-3,4221	56,21
2009 Q1	-1,5	93,77	75,1	14	-2,65707	44,49
2009 Q2	-0,4	95,7	87,94	11,67	-2,35391	58,74
2009 Q3	0,8	97,24	92,56	10,67	-2,05075	68,41
2009 Q4	1,9	97,58	94,28	10,5	-1,74759	74,71
2010 Q1	3	98,81	96,64	10,33	-1,44443	76,31

2010 Q2	3,1	99,69	99,26	10	-1,638905	78,61
2010 Q3	3,1	100,51	100,88	9,83	-1,83338	76,75
2010 Q4	3,2	100,98	103,22	9,17	-2,027855	86,48
2011 Q1	3,2	102,45	101,34	9	-2,22233	104,57
2011 Q2	2,8	104,32	102,13	9	-2,95016	117,27
2011 Q3	2,6	105,97	98,68	9	-3,67799	113,16
2011 Q4	2,4	107,26	90,91	9	-4,40582	109,76
2012 Q1	2,4	108,78	95,54	9	-5,13365	118,5
2012 Q2	2,5	110,48	93,34	9	-5,30947	108,63
2012 Q3	2,5	111,48	92,51	8,5	-5,48529	109,6
2012 Q4	2,5	113,3	88,29	8,5	-5,66111	110,47
2013 Q1	2,5	115,17	86,58	8,5	-5,83693	112,7
2013 Q2	2,2	116,64	83,08	8,5	-5,685668	102,86
2013 Q3	2	118,46	80,11	8,5	-5,534405	110,32
2013 Q4	1,7	119,45	78,66	8,5	-5,383143	109,29
2014 Q1	1,4	121,86	74,99	9	-5,23188	108,24
2014 Q2	1,4	124,38	77,76	9	-5,10093	109,91
2014 Q3	1,4	126,02	77,71	9,25	-4,96998	102,16
2014 Q4	1,3	126,26	77,92	9,25	-4,83903	76,66
2015 Q1	1,3	127,08	78,29	9,25	-4,70808	54,14
2015 Q2	1,2	130,01	77,67	9,25	-4,249995	61,78
2015 Q3	1	131,71	74,67	9,5	-3,79191	50,37
2015 Q4	0,8	132,36	70,34	9,67	-3,333825	43,7
2016 Q1	0,7	135,35	64,68	10,33	-2,87574	33,8
2016 Q2	0,8	138,45	67,69	10,5	-2,805575	45,48
2016 Q3	1	140,16	73,41	10,5	-2,73541	45,72
2016 Q4	1,1	141,45	76,91	10,5	-2,665245	49,31
2017 Q1	1,2	144,14	82,05	10,5	-2,59508	53,72
2017 Q2	1,3	145,67	80,88	10,25	-2,780818	49,74
2017 Q3	1,4	146,55	78,92	10,25	-2,966555	52,02
2017 Q4	1,4	147,84	76,74	10,25	-3,152293	61,5
2018 Q1	1,5	149,83	85,03	10,17	-3,33803	66,82
2018 Q2	1,2	151,83	82,73	10	-3,219525	74,45
2018 Q3	0,9	153,94	77,36	10	-3,10102	75,35
2018 Q4	0,6	155,05	78,19	10,17	-2,982515	67,49
2019 Q1	0,3	156,05	79,11	10,25	-2,86401	63,15
2019 Q2	-1,4	158,69	78,36	10,25	-1,585505	68,96
2019 Q3	-3	160,15	77,81	10	0,307	62,13
2019 Q4	-4,6	160,86	77,8	10	0,971505	63,33
2020 Q1	-6,3	162,79	75,88	9,42	2,25001	50,61
2020 Q2	-3,5	162,38	66,31	7,42	2,718353	29,37
2020 Q3	-0,7	165,02	68,76	7	3,186695	42,99
2020 Q4	2,1	165,96	73,26	7	3,655038	44,12
2021 Q1	4,9	167,83	75,57	7	4,12338	60,73
2021 Q2	2,1	170,41	80,37	7	4,0346	68,7
2021 Q3	3,2	173,17	78,78	7	3,23097	73,47
2021 Q4	4,3	174,99	75,91	7,17	2,90457	79,76
2022 Q1	3	173,901	74,91	7,1	2,1297	98,64
2022 Q2	2,1	167,091	73,13	8,89	2,02341	113,39
2022 Q3	3,1	166,9081	73,34	8,9	2,09834	100,88
2022 Q4	2,2	167,093	72,09	7	1,90376	88,88
2023 Q1	2,3	166,0929	69,01	8,2	1,99286	81,22
2023 Q2	3,1	160,6781	69,09	7,9	2,9024	78,47
2023 Q3	1,3	169,0921	70,01	9,09	2,09139	86,42
2023Q4	1,7	156,99	70,67	10,09	2,09123	84,1