

## **Measuring the impact of oil price volatility on the money supply of the Iraqi economy using the threshold model for the period (2004-2023)**

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### **ABSTRACT**

The research examined how oil price fluctuations affect M2 money supply in Iraq throughout the period from 2004 to 2023 based on monthly statistical records. The research aimed to determine how oil price fluctuations impact monetary supply within nations which export oil such as Iraq. The research employed threshold regression modeling to analyze how this connection evolved through time while showing non-linear patterns. The Phillips-Perron test served our purpose to determine if the data maintained stationary properties. The research findings demonstrated that oil prices maintain stationary behavior in their original form and M2 data becomes stationary after performing its first difference. The threshold model identified three threshold points which established four distinct data segments. The data shows that M2 responds positively to oil price changes in both low and moderate economic environments. The effect becomes negative in high regime settings while the very high regime produces a non-significant weak effect. The model successfully passed all diagnostic tests which checked for autocorrelation and heteroskedasticity and the residual data appears free from major issues. The research findings demonstrate that oil price movements create different effects on money supply based on current monetary conditions. The development of monetary and fiscal policies by policymakers needs to take into account these economic factors which affect nations that heavily rely on oil production.

The research includes the following essential terms: oil prices and money supply and Iraq and threshold model and nonlinearity.

## **1. Introduction:**

The worldwide commodity market depends on crude oil as its primary essential asset which serves as a fundamental component for various financial trading instruments across global financial systems. Most economies depend on it for their fundamental operation. The world has become more aware of how essential oil-based industries are because oil price fluctuations now affect the entire worldwide economic system. The financial sector gained control of the oil market during the mid-2000s which created substantial market volatility in financial markets. The way oil prices shift through the market produces risks which match those which macroeconomic announcements create. The amount of money circulating in the economy becomes difficult to determine because oil price fluctuations occur. The analysis of oil price fluctuations through time becomes essential for investors and businesses and resource policymakers to understand. The primary focus should be on how these modifications impact the money supply. The research investigates the intricate bond between oil prices and monetary policy through money supply changes to produce meaningful findings.

Recent research has shown that changes in oil prices have a close relationship with important macroeconomic changes. For example, stock prices, inflation and changes in money supply. As we can see in our syllabus, benk and Gillman (2023) look at the impact of money and inflation expectations on real oil price changes. They showed that credit trends and oil markets are in a two-way relationship. In a same-way, Balounejad Nouri and Farhang (2022) employed Quantile ARDL to examine the effects of oil revenue, exchange rate, and money supply on inflation measure CPI and WPI and found an essential and complex relation. Mahdi (2019) focused on Oman and showed that price fluctuations in crude oil have a significant influence on broad money stock (M2) of oil dependent economies. Altintas and Yacouba (2018) evaluated how variations in liquidity units and oil price affected the Turkish stock prices differently. Reaction of the Financial Markets Financial markets reacts not only to the direction of the shock but also to the magnitude of the shock. Another reason is that Sharma and Dahiya (2023) identified the Indian case and pointed out that inflation is significantly influenced by broad money (M3), currency rates, and oil prices. This study illustrates the way monetary transmission mechanism works in developing economies. The limits of profit and loss in financial markets have also been measured via threshold measurement with the help of random forest depending on various variables, including in particular oil prices (Alakkari & Ali, 2025). All these findings are an

important consideration in how the oil prices fluctuate to formulate monetary policy, especially in resource-based economies.

Although some previous studies have provided useful insights into how oil price, money supply and other big economic factors impact each other, most studies are either targeted not developing economies and/or use not complex enough models which do not appropriately capture changes and effects prevailing in oil-exporting developing economies. The study of the Iraqi economy that is mainly oil-oriented is unique in the proposed research. Further, the use of the threshold model is also unique in the sense that it studies the non-linearities that are presented and the relationship that exists between the changes in the oil prices and money supply during 2004-2023 in the Iraqi economy. The preliminary study focuses on the interface between the institutional field and behavioral insights that is the basis for contextual analysis of policymaking and implementation. The research paper posits generic uncertainty over denomination cashing. Such uncertainty will influence somebody's decision to cash the denomination or pay the borrowed amount; in return somebody will decide not to pay the borrowed amount it will not have sufficiency in monetary aggregates; borrowers do pay the alternative denomination with alternative cashing mechanism. It concludes with the open policy – policy must engage with the borrower through alternative monetary options.

### **Research Significance**

The theoretical implications of the study are necessitated by the necessity to improve the literature on the connection between oil price volatility and money supply as a not always stable relationship and which can change in terms of both magnitude and direction, in time and under different liquidity conditions in rentier economies like Iraq. This importance is further aggravated when the uncertainty is intense in the global oil markets as well as the consequent challenge of predicting monetary aggregates in the event of oil price shocks justifying the employment of nonlinear models with the potential of capturing structural changes. Its practical importance is that it offers quantitative evidence that can help to inform monetary and fiscal decision makers in Iraq to design differentiated policy responses across liquidity regimes by elucidating the channel of transmission through which oil price changes impact broad money, including the dynamics of reserves, the liquidity position of banks, and the behavior of government spending and by drawing policy implications out of threshold based results which can suggest regime dependent effects on M2.

## **Research Problem**

Are there significant variations in the effects of oil price volatility on broad money supply (M2) on the Iraqi economy that are not linear in nature and include a change of sign or statistical significance in the relationship over the study period between 2004 and 2023?

## **Research Hypotheses**

H1. Impact of oil prices and M2 in Iraq is not linear and the direction and strength of the impact is influenced by monetary regimes according to M2 thresholds.

H2. The existence of several estimation regimes in a threshold framework and the existence of significantly different coefficients of the oil prices in various regimes indicates the change of the impact in the various liquidity conditions.

## **Research Objectives**

1. To determine the impact of oil prices volatility on broad money supply (M2) in Iraq between years of 2004 and 2023 on monthly data.
2. To determine monetary levels at which the direction or magnitude of the oil price impact on M2 varies and to differentiate the sample into separate estimation regimes.
3. To obtain policy relevant implications that are useful in informing the liquidity management and public expenditure in an oil dependent economy.

## **Research Methodology**

The current study has a quantitative time series design where monthly data was collected between January 2004 and December 2023. Dependent variable is the broad money supply (M2) in million Iraqi dinar. Oil price data are taken through the international energy databases and then converted to Iraqi dinars based on the exchange rate mentioned in Central Bank of Iraq and M2 data are taken in the official reports and statistical bulletins of Central Bank of Iraq. The empirical strategy follows in a step-by-step approach. To start with, descriptive statistics are calculated to describe the data. Second, the Phillips Perron unit root test is used to estimate the level of stationarity. Third, it estimates a nonlinear discrete threshold regression model by capturing regime dependent effects, in which the thresholds are endogenously estimated by the Bai Perron methodology. Fourth, a 15 percent trimming rule is used to select the optimum number of thresholds by sequential threshold

tests. Lastly, the model adequacy is tested by diagnostic tests of autocorrelation, heteroskedasticity to make sure that the inference and interpretation are robust.

## **2.Theoretical framework**

### **First: The perspective of money supply in economic schools**

Monetary policy uses the money supply as a tool to influence economic activity, with the aim of achieving economic growth and stability. This is achieved through its impact on macroeconomic variables. Changes in the money supply directly affect interest rates in the economy, which in turn are reflected in vital economic indicators (Boyes & Melvin, 2011). The money supply refers to the total means of payment available in society, of all types, during a specific period of time (Kanaan, 2012). The money supply refers to the total means of payment in circulation locally and owned by the public sector. This concept includes individuals, businesses, and all entities that hold money, with the exception of the central government or the treasury. Cash balances held by the government or the treasury are excluded from the components of the money supply for a fundamental reason, as this money is generated from non-commercial operations (Khalil, 1982). The money available for spending held by the public consists of legal tender and bank money (deposit money). Accordingly, the money supply can be simply defined as the total monetary units available to society during a specific period of time. Pioneers of the commercial school believed that an increase in the money supply in circulation stimulates economic activity and contributes to an increase in the national product (Salvato, 2009). The classical school focused on the fact that a change in the money supply leads to proportional changes in the general price level. Thus, inverse changes in the value of money (Okedigba et al., 2024) are expressed by the (exchange equation):  $MV = PT$ . To avoid the difficulty of measuring the volume of exchange (T), it was replaced by Y), which represents the quantity of final goods and services produced. Later, economists Marshall and Pigou reformulated this theory by introducing the demand for money and replacing the velocity of money circulation for transactions with the "velocity of domestic money circulation." This theory was called the money balance theory or the Cambridge equation:  $MD = KPY$ . That is, the demand for money is a direct function of the general price level. This addition by Marshall and Pigou represents the Neoclassical School (Vane & Thompson, 1979). The Keynesian school asserts that a change in the money supply affects the interest rate, to which investment is inversely related, which ultimately leads to an increase in investment and consumption,

which are components of aggregate demand. According to this approach, changes in the money supply are an effective tool for managing short-term fluctuations in production and employment for developing countries and transitional economies (Skousen, 2007). According to the monetarist school, the money supply controls inflation and economic stability in a country in which it is used. Therefore, expanding the money supply can stimulate economic activity, but It must be regulated at a fixed and stable rate that is consistent with the economic growth rate to avoid inflationary pressures, thus achieving monetary stability (Bajrami et al., 2025). The Neo-Keynesian school focuses on managing the growth of the money supply with the primary goal of price stability. In this regard, they call for increasing the money supply when production is below the full employment level, and conversely, reducing the money supply when production exceeds the full employment level (Abdel Azim, 1986). The rational expectations school believes that the expected increase in the money supply will only raise the price level and will have no real impact on output and employment, while the unexpected increase in the money supply (the monetary surprise) is the only one that can affect real variables in the short run (Snowdon & Vane, 2005). The supply-side economists school believes in the necessity of reducing government spending and adopting a less expansionary monetary policy to restrict aggregate demand. This aims to avoid invalidating the increase in output and reducing the price level, which results from the shift of the aggregate supply curve to the right thanks to the reduction in tax rates on investment and labor and the increase in the supply of goods and services. They believe that consumption and investment can compensate for the decrease in government spending and the low growth rate of the money supply, and this will lead to a decrease in inflation and thus a decrease in interest rates, especially if economic units realize the central bank's efforts to reduce inflation and adjust their expectations. To achieve this decrease in interest rates, They call for a return to the gold standard (Abdejamman, 2019). The Austrian school also calls for a return to the gold standard, which brings them closer to the ideas of the supply-side school. However, they also call for eliminating the monopoly of the central bank and the Ministry of Finance over monetary control. They propose granting private banks and companies the right to issue money to compete with government money. This competition between private banks, among themselves, and with the government will make individuals prefer the money issued by banks due to the interest it provides. This competition will force the government to control the excessive growth of the money supply, thus protecting individual savings (Hayek, 1976). The measures of the money supply are as follows:

## 1- Money supply in the narrow sense (M1)

M1 is the narrowest definition of the money supply and focuses on the function of money as a medium of exchange. This measure includes two basic components: the net currency in circulation outside the banking system (CC) plus private current deposits at banks (DD) (Baumol & Blinder, 2009). M1 can be expressed according to the following equation:

$$M1 = CC + DD$$

This measure is determined jointly by the central bank (through the issuance of currency and its impact on credit) and commercial banks through their ability to (deposit creation and lending) It should be pointed out that the monetary base (M0) or monetary base is not to be confused with(M1). It is equivalent to the sum of currency in circulation and reserves of commercial banks with the central bank. These reserves are the legal reserve (RR), and the additional reserves (ER), and can be written as the following relationship (Al-Bayati & Samarah, 2013): Formula (1)  $RR = ER/\Delta$  Piroboh PR Xao SM where continuance to function definitions above.

$$M0 = C + TR$$

Where TR represents the total reserves. As such, the monetary base plays a vital role in determining the extent of new deposits. More reserves increase banks' ability to extend loans, adding to the supply of money. This gives central banks the ability to lend.

A direct measure of the money supply is monitored by monitoring the monetary base.

## 2- Broad money supply (M2).

Although M1 is commonly used as a measure of the money supply, M2 is more comprehensive. M2 includes everything included in M1, in addition to savings deposits, savings deposits, and time deposits (TD) at commercial banks. M2 can be expressed as follows (Case, Fair, & Oster, 2012):

$$M2 = M1 + TD$$

$$M2 = CC + DD + TD$$

We can simply say that the broad concept of M2 depends on the banking system's ability to create deposits and individuals' desire to hold their assets in the form of time deposits.

### 3- Broader Money Supply (M3):

With economic development and the diversification of financial assets, the concept of M3 emerged in developed countries. This concept consists of domestic liquidity (M2) plus savings deposits deposited outside commercial banks. It can be expressed using the following formula:

$$M3 = M2 + \text{Deposits Deposited Outside Commercial Banks}$$

$$M3 = CC + DD + TD + \text{Deposits Deposited Outside Commercial Banks}$$

This concept (M3) refers to the money used as a unit of account and highlights the increasing role of non-cash intermediary financial institutions in money creation.

### 4- Money Supply by Liquidity Measures (M4)

M4 is the broader concept of money supply, sometimes called the overall liquidity of the economy. This measure includes the broader money supply (M3) as well as highly liquid and semi-liquid assets, such as short-term treasury bills, premium commercial paper, and bankers' acceptances (Swaanberg, 2008). It may be introduced by a linear combination of the following:

$$M4 = M3 + \text{Highly Liquid Assets}$$

It includes a variety of and short term financial instruments that are similar to cash, meaning they can be readily converted into cash. It is meant to be a measure of the general level of liquidity in financial markets and the real economy.

### **Second: Fluctuations in stock prices and their relationship to the money supply.**

One of the most important markets affected by economic fluctuations is the global oil market, as oil prices are determined by the forces of supply and demand, which are subject to economic, political, and competitive factors. Consequently, the determinants of oil prices consist of a set of factors related to achieving a balance between supply and demand in the global oil market. The most important factors on the demand side of oil are global economic fluctuations, wars, political crises, and the economic growth of oil-consuming countries. The supply side factors for oil are concentrated in the policies of OPEC and OAPEC, and technological progress in oil-producing countries (University of Karbala, 2022). This instability has significant effects on the economic indicators of exporting and importing

countries, such as its impact on the gross domestic product, consumption, inflation, money supply (Aasim, 2015), and other economic indicators. Oil prices are defined as the value of a petroleum product or commodity expressed in cash over a specific period of time and under the influence of a set of economic, social, and political factors. Oil price fluctuations are defined as unexpected and sudden changes in oil prices, which are sometimes so sharp that they leave clear economic effects on both the consumer and the producer, with the nature of this effect differing between them. Oil price fluctuations have both negative and positive effects. For both oil-exporting and importing countries, rising oil prices are positive for exporting countries and negative for importing countries. Conversely, falling oil prices benefit importing countries due to increased real income gains. Conversely, for exporting countries, this decline is due to the significant dependence of other activities on oil revenues through general government spending (Al-Omari & Ahmed, 2016). Oil price fluctuations are linked to the money supply in oil-exporting countries through two channels:

1- The direct channel: The liquidity channel or the reserves channel.

What's happening? This channel concentrates on the impact of oil price variations upon oil exporting countries. Oil revenues cause a flow of foreign currency into the central bank and increase foreign reserves. And this means enhanced local liquidity for commercial banks. This added liquidity will enable banks to lend and credit expands, resulting in the money supply circulating in the economy expanding directly. There is another side to the coin when oil prices drop.

2- Indirect Channel: Government Spending Channel or Budget Channel

This channel is about the influence of oil revenues and forecasts on a country's fiscal policy, in particular government spending. In oil exporting countries that are dependent on oil revenues, as prices go higher so does government revenue which can allow schools, hospitals and other human-centered programs to be built or improved in the country.

**3. Data, tools and Econometrics methods:**

In this paper, we use monthly time series data from January 2004 to December 2023, which means the total number of observations will be 240 for each variable. These two are the main variables considered, namely, the broad money supply (M2) expressed as the number of million Iraqi dinars and the world oil prices converted into Iraqi dinars. International energy databases were used to find data on oil prices, and they were converted to Iraqi

currency based on the Central Bank of Iraq exchange rate. The official reports and bulletins from the Central Bank of Iraq provided the data on m2:

**Table 1. Variables and Codes**

| Code | Variable Name in English           |
|------|------------------------------------|
| M2   | Money Supply (M2) (Million Dinars) |
| OIL  | Oil prices - Dinar                 |

**Source: Prepared by the researcher based on EViews13**

The nonlinear threshold regression model was used in this study because it can describe change at different levels. This model is good for looking at nonlinear relationships in economic time series. It has been used in a number of past studies to find important points where the relationship between variables changes. Statistical analysis was undertaken using EViews 13 that presents sophisticated facilities for testing stationarity and model estimation of variable structure. The stationarity of the data was confirmed by said Phillips-Perron test: with null as with the stationarity test, expression is (Bai and Perron, 2003)(Phillips and Perron, 1988).

$$\Delta Y_t = \alpha + \beta t + \gamma Y_{t-1} + \sum_{i=1}^p \delta_i \Delta Y_{t-i} + \varepsilon_t$$

where  $Y_t$  is the time series being looked at and  $\gamma$  is the stationarity coefficient. The Bai-Perron method was used to apply the threshold model after making sure that the series was stationary. This method finds the best number of thresholds by looking at how the coefficients change over time. This is the formula that shows the model (Hansen, 2000) (Enders, 2014):

$$M2 = \begin{cases} \beta_0^{(1)} + \sum_{k=1}^n \beta_k^{(1)} X_{kt} + \varepsilon_t & \text{if } M2_{t-1} < \tau_1 \\ \beta_0^{(2)} + \sum_{k=1}^n \beta_k^{(2)} X_{kt} + \varepsilon_t & \text{if } \tau_1 \leq M2_{t-1} < \tau_2 \\ \vdots & \\ \beta_0^{(m)} + \sum_{k=1}^n \beta_k^{(m)} X_{kt} + \varepsilon_t & \text{if } M2_{t-1} \geq \tau_{m-1} \end{cases}$$

where  $X_{kt}$  are the independent variables, and  $\tau$  represents the threshold values separating the different regimes. The model was estimated using a 15% trimming algorithm to determine the optimal number of thresholds based on the sequential Bai-Perron test. The model was also validated using diagnostic tests to measure the presence of autocorrelation

and heteroscedasticity. This approach has the potential to provide a dynamic description of the effect and is more accurate than traditional linear models in dealing with shifts in economic structure over time.

### **Results and discussion:**

To start with, the paper gives a descriptive overview of the two key variables, namely the broad money supply (M2) and oil prices, which are measured monthly between the years 2004 and 2023. Table 2 marks the summary of salient statistical features about the dataset, such as the use of mean, median, maximum, and minimum values, standard deviation, and skewness and kurtosis in each of the variables. These overview statistics provide a first idea about the concentration and differentiation of the data and permit the determination of patterns, a possible asymmetry of the statistics, as well as outliers. These are the fundamental properties that should be understood first before entering the econometric modeling stage because they create a background about the kind of data they are and whether there is nonlinearity or structural changes in the relationship between oil prices and money supply:

**Table 2. Descriptive Statistics of Money Supply (M2) and Oil Prices**

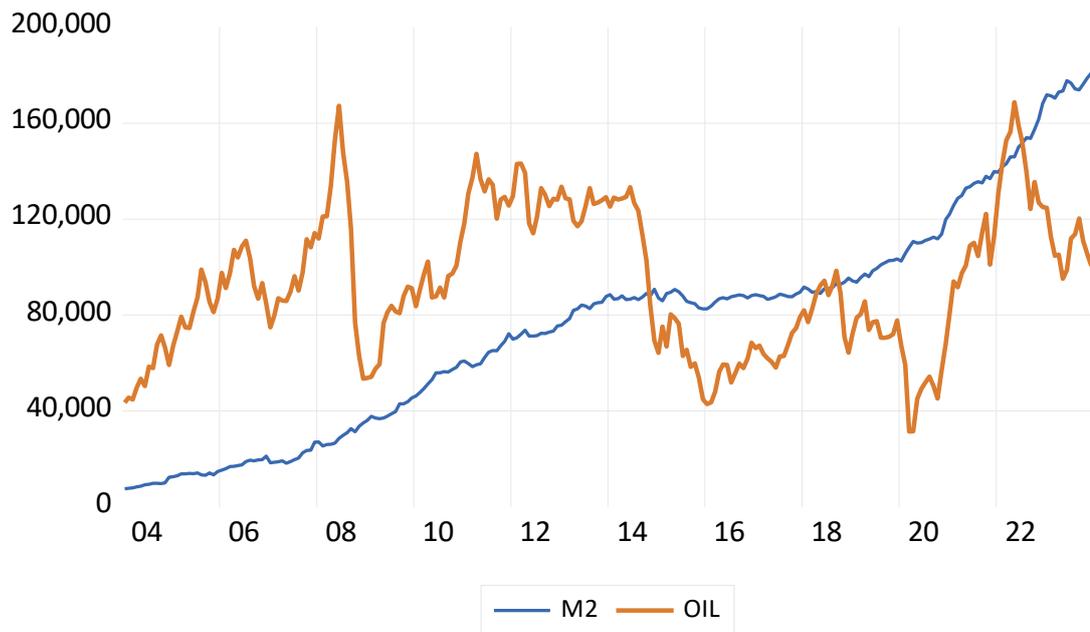
|                    | <b>M2</b>       | <b>OIL</b>      |
|--------------------|-----------------|-----------------|
| <b>Mean</b>        | <b>75584.38</b> | <b>93603.94</b> |
| <b>Median</b>      | <b>84422.50</b> | <b>90979.20</b> |
| <b>Maximum</b>     | <b>180976.0</b> | <b>168776.0</b> |
| <b>Minimum</b>     | <b>7445.000</b> | <b>31356.50</b> |
| <b>Std. Dev.</b>   | <b>45000.28</b> | <b>29966.45</b> |
| <b>Skewness</b>    | <b>0.353584</b> | <b>0.200157</b> |
| <b>Kurtosis</b>    | <b>2.552106</b> | <b>2.169860</b> |
| <b>Jarque-Bera</b> | <b>7.006963</b> | <b>8.493846</b> |
| <b>Probability</b> | <b>0.030092</b> | <b>0.014308</b> |

|                     |            |            |
|---------------------|------------|------------|
| <b>Observations</b> | <b>240</b> | <b>240</b> |
|---------------------|------------|------------|

**Source: Prepared by the researcher based on EViews13**

Based on 240 monthly observations, Table 2 shows the descriptive statistics for the money supply (M2) and oil prices in Iraq from 2004 to 2023. The average value of M2 is about 75.6 trillion Iraqi dinars, and the average price of oil during the same time is about 93.6 thousand dinars. The median values for both variables are pretty close to their means, which means that the distribution is fairly balanced. The difference between the highest and lowest values, on the other hand, is very big. The floor for M2 is 7.4 trillion dinars and the ceiling is 181 trillion dinars. What this shows is that the monetary base has increased greatly over time. Oil is also very volatile, fluctuating from 31.4 to 168.7 thousand dinars. This may be due to shocks in the world market for oil and important episodes in the political arena. The high standard deviations—45 pln for M2 and almost 30 thousand pln for oil—indicate a significant amount of dispersion, especially in the money aggregates. This would make sense for Iraq, as an oil-dependent economy that can see drastic swings. The skewness values for both variables are slightly positive, which means that there is a mild right-tail asymmetry. This means that values that are very high are more common than values that are very low, but not by a lot. When the kurtosis values are less than 3, it means that both distributions are platykurtic, or flatter than a normal distribution. The Jarque-Bera statistics for both variables are statistically significant at the 5% level, with p-values of 0.03 for M2 and 0.014 for oil prices. This means that the null hypothesis of normality is not true for either variable, which means that nonlinear econometric models can be used.

**Figure 1. Co-Movement of Money Supply (M2) and Oil Prices in Iraq (2004–2023)**



**Source: Prepared by the researcher based on EViews13**

Figure 1 illustrates the co-movement between the money supply (M2) and oil prices in Iraq from 2004 to 2023. One can reveal a clear difference in the behavior of the two variables presented in the chart. M2 in the blue line portrays an upward continuous trend with time, signifying uninterrupted increase in monetary growth in the Iraqi economy. A trend of growth indicates a continuing increase in liquidity, probably through oil earnings, government expenditure levels, and developments in banks. Conversely, there is much volatility in the oil prices as portrayed in orange. It can be observed under significant influences of world financial crises, geopolitical and oil market shocks. Demonstratively, sharp peaks are even visible in 2008, 2011, 2012, and 2022, whereas low troughs are observable in 2009, 2015 and 2016, and 2020. These oscillations can fit into well-documented world oil shocks, such as the 2008 financial disaster, the 2014 oil price disaster, and the COVID-19 epidemic. Despite the fact that M2 is rising at a gradual rate and the oil price is moving at a sharp rate, the figure reveals periods of coordinated motion. Oil price increases tend to be associated with a faster increase in M2 and it seems that oil revenues may be transmitted into domestic liquidity in a direct or indirect way using fiscal means. Nevertheless, the relationship is not steady as a whole, which suggests the presence of nonlinear dynamics, nonlinear regime shifts, and effect delay, which will be further analyzed by applying the threshold regression model in this paper.

**Table 3. Phillips-Perron Unit Root Test Results for M2 and Oil Variables**

| <b>Null Hypothesis: M2 has a unit root</b>                       |                  |  |                    |               |
|--|------------------|--|--------------------|---------------|
| <b>Exogenous: None</b>   |                  |  |                    |               |
| <b>Bandwidth: 5 (Newey-West automatic) using Bartlett kernel</b> |                  |  |                    |               |
|  |                  |  | <b>Adj. t-Stat</b> | <b>Prob.*</b> |
| <b>Phillips-Perron test statistic</b>                            |                  |  | <b>7.054303</b>    | <b>0.9991</b> |
| <b>Test critical values:</b>                                     | <b>1% level</b>  |  | <b>-2.574674</b>   |               |
|  | <b>5% level</b>  |  | <b>-1.942159</b>   |               |
|  | <b>10% level</b> |  | <b>-1.615814</b>   |               |
| <b>Null Hypothesis: D(M2) has a unit root</b>                    |                  |  |                    |               |
| <b>Exogenous: None</b>   |                  |  |                    |               |
| <b>Bandwidth: 8 (Newey-West automatic) using Bartlett kernel</b> |                  |  |                    |               |
|  |                  |  | <b>Adj. t-Stat</b> | <b>Prob.*</b> |
| <b>Phillips-Perron test statistic</b>                            |                  |  | <b>-12.29278</b>   | <b>0.0000</b> |
| <b>Test critical values:</b>                                     | <b>1% level</b>  |  | <b>-2.574714</b>   |               |
|  | <b>5% level</b>  |  | <b>-1.942164</b>   |               |
|  | <b>10% level</b> |  | <b>-1.615810</b>   |               |
| <b>Null Hypothesis: OIL has a unit root</b>                      |                  |  |                    |               |
| <b>Exogenous: Constant</b>                                       |                  |  |                    |               |
| <b>Bandwidth: 4 (Newey-West automatic) using Bartlett kernel</b> |                  |  |                    |               |
|  |                  |  | <b>Adj. t-Stat</b> | <b>Prob.*</b> |

|                                       |                  |                  |               |
|---------------------------------------|------------------|------------------|---------------|
| <b>Phillips-Perron test statistic</b> |                  | <b>-2.944861</b> | <b>0.0418</b> |
| <b>Test critical values:</b>          | <b>1% level</b>  | <b>-3.457630</b> |               |
|                                       | <b>5% level</b>  | <b>-2.873440</b> |               |
|                                       | <b>10% level</b> | <b>-2.573187</b> |               |

**Source: Prepared by the researcher based on EViews13**

Table 3 reports the results of the Phillips-Perron (PP) unit root tests used to assess the stationarity of the time series data for money supply (M2) and oil prices. For M2 in levels, the test statistic is 7.054, with a p-value of 0.9991, which is far above any conventional significance level. This indicates strong evidence of non-stationarity, meaning that M2 follows a unit root process. However, when the first difference of M2 is tested, the PP statistic becomes -12.29 with a p-value of 0.0000, which is highly significant and well below the 1% critical value. This result confirms that the first-differenced M2 series is stationary, indicating that M2 is integrated of order one, I(1). In the case of oil prices, the test was conducted with a constant term. The PP test statistic is -2.944, which exceeds the 5% critical value (-2.873) but not the 1% threshold (-3.457). The associated p-value of 0.0418 suggests that the null hypothesis of a unit root can be rejected at the 5% level, indicating that oil prices are stationary in levels, or I(0).

the unit root test results suggest that the two variables are of different orders of integration—M2 is I(1) and oil prices are I(0). This combination supports the use of threshold regression models, which can accommodate mixed integration orders and nonlinear dynamics without requiring cointegration between the variables.

**Table 4. Linear and Nonlinear Correlation between M2 and Oil Prices**

|                                    |                                   |
|------------------------------------|-----------------------------------|
| <b>Linear<br/>Correlati<br/>on</b> | <b>Non Linear<br/>Correlation</b> |
| <b>0.190</b>                       | <b>0.848</b>                      |

**Source: Prepared by the researcher based on EViews13**

Table 4 shows the correlation coefficients that are linear and nonlinear between money supply (M2) and oil prices during the period of study. It is a relatively weak correlation between the two findings, whereby the coefficient is 0.190 indicating that there is a low direct linear relationship between the two variables. This indicates that differences in the prices of oil do not show the proportional or regular differences in the amount of money supplied as assessed within a basic linear model, with the nonlinear correlation score ascertained as significantly high at 0.848. This means that there is a significant nonlinear correlation between M2 and oil prices, which implies that the relationships between the two variables can differ in various regimes or even at various cutoffpoints. Much discrepancy between the linear and nonlinear correlations implies that the asymmetric or regime-dependent effects may be present in the response of money supply to the change in oil price; that is, that the response of money supply to the change in oil price will be influenced by the amount or the direction of the change. Having ensured that the variables under study are stationary in time and that there is indeed a strong nonlinear relationship that exists between oil prices and money supply, the study moves on to estimating the threshold regression model. This model encounters the determination that the effect of oil price variability on M2 is the same across the level of money supply. Through the Bai-Perron approach, it is possible through the model to identify the existence of structural breaks and estimation of distinct coefficients within the regime. The approach reflects on the possibility that oil prices might affect the supply of money with varying directions under different economic conditions or the environment of monetary availability. The estimated coefficients corresponding to each of the regimes identified are presented in Table 5 and are seen to give a complete picture of the changes in the strength and direction of the relationship between oil and M2 when they cross various monetary thresholds:

**Table 5. Threshold Regression Results for the Impact of Oil Prices on Money Supply  
(M2)**

|  |
|--|
| <p><b>Dependent Variable: M2</b></p> <p><b>Method: Discrete Threshold Regression</b></p> <p><b>Sample: 2004M01 2023M12</b></p> <p><b>Included observations: 240</b></p> <p><b>Selection: Trimming 0.15, Max. thresholds 3, Sig. level 0.05</b></p> |
|--|

| <b>Threshold variable: M2</b>                 |                    |                              |                    |                 |
|---|--------------------|------------------------------|--------------------|-----------------|
| <b>Variable</b>                               | <b>Coefficient</b> | <b>Std. Error</b>            | <b>t-Statistic</b> | <b>Prob.</b>    |
| <b>M2 &lt; 33579.98 -- 58 obs</b>             |                    |                              |                    |                 |
| <b>OIL</b>                                    | <b>0.206886</b>    | <b>0.046486</b>              | <b>4.450499</b>    | <b>0.0000</b>   |
| <b>C</b>                                      | <b>-1068.500</b>   | <b>4374.199</b>              | <b>-0.244273</b>   | <b>0.8072</b>   |
| <b>33579.98 &lt;= M2 &lt; 77212 -- 51 obs</b> |                    |                              |                    |                 |
| <b>OIL</b>                                    | <b>0.434738</b>    | <b>0.048536</b>              | <b>8.956992</b>    | <b>0.0000</b>   |
| <b>C</b>                                      | <b>10673.60</b>    | <b>5316.097</b>              | <b>2.007790</b>    | <b>0.0458</b>   |
| <b>77212 &lt;= M2 &lt; 122037 -- 95 obs</b>   |                    |                              |                    |                 |
| <b>OIL</b>                                    | <b>-0.141612</b>   | <b>0.035211</b>              | <b>-4.021838</b>   | <b>0.0001</b>   |
| <b>C</b>                                      | <b>103016.7</b>    | <b>2963.742</b>              | <b>34.75899</b>    | <b>0.0000</b>   |
| <b>122037 &lt;= M2 -- 36 obs</b>              |                    |                              |                    |                 |
| <b>OIL</b>                                    | <b>0.020091</b>    | <b>0.074820</b>              | <b>0.268531</b>    | <b>0.7885</b>   |
| <b>C</b>                                      | <b>150569.2</b>    | <b>8983.572</b>              | <b>16.76050</b>    | <b>0.0000</b>   |
| <b>R-squared</b>                              | <b>0.957632</b>    | <b>Mean dependent var</b>    |                    | <b>75584.38</b> |
| <b>Adjusted R-squared</b>                     | <b>0.956353</b>    | <b>S.D. dependent var</b>    |                    | <b>45000.28</b> |
| <b>S.E. of regression</b>                     | <b>9401.357</b>    | <b>Akaike info criterion</b> |                    | <b>21.16786</b> |
| <b>Sum squared resid</b>                      | <b>2.05E+10</b>    | <b>Schwarz criterion</b>     |                    | <b>21.28388</b> |
| <b>Log likelihood</b>                         | <b>-2532.143</b>   | <b>Hannan-Quinn criter.</b>  |                    | <b>21.21461</b> |
| <b>F-statistic</b>                            | <b>749.1138</b>    | <b>Durbin-Watson stat</b>    |                    | <b>1.855420</b> |

|                          |                 |  |  |  |
|--------------------------|-----------------|--|--|--|
| <b>Prob(F-statistic)</b> | <b>0.000000</b> |  |  |  |
|--------------------------|-----------------|--|--|--|

**Source: Prepared by the researcher based on EViews13**

The discrete threshold regression model in Table 5 tries to figure out how oil prices affect the money supply (M2) in four different monetary systems. We used the Bai-Perron method to figure out what the M2 threshold values were. There are 240 monthly observations in the sample from 2004 to 2023. When M2 is less than 33,579.98 million dinars, oil prices have a statistically significant and positive effect on the money supply, with a coefficient of 0.2069 ( $p < 0.01$ ). This means that when there isn't a lot of money in the economy, higher oil prices directly lead to more money in the economy. This may be because they draw foreign exchange and make banks more liquid. Another similar relationship is stronger in the second regime ( $33,579.98 \leq M2 < 77,212$ ), with the coefficient of oil price increasing to 0.4347 and still significant. So if there is average liquidity in the market, the relationship of oil and money supply will accelerate. This may be due to the more “active” channels of monetary and fiscal transmission. In contrast, in the third regime ( $77,212 \leq M2 < 122,037$ ), it turns to be negative and significant (-0.1416) indicating that the relationship has reversed. That may have to do with inflationary pressures or even government actions that transform rising oil prices into something less impactful on liquidity. In the highest regime ( $M2 \geq 122,037$ ) the coefficient becomes small and statistically insignificant (0.0201;  $p = 0.7885$ ). So when there is too much money in circulation, fluctuations in the oil price are less significant. That could be because money doesn't matter as much anymore, or because the economy is less responsive to money. The model fits quite well in general, with a decent R-squared score of 0.9576 and an F-statistic that is significant by statistical conventions. This indicates that the threshold model accounts for most of the dynamical evolution of M2. . The Durbin-Watson value of 1.85 indicates not a lot of history in the residuals. These findings strongly imply the presence of non-linear, regime-based effect. By examining the relationship of oil to money supply in oil-exporting countries such as Iraq, these studies also demonstrate the importance of considering monetary thresholds. From the threshold regression model estimates we can derive four equations that describe how the money demand (M2) and oil price will be related under different regimes. The fundamental functional form of the model is:

$$M2_t = \alpha_i + \beta_i \times OIL_t + \varepsilon_t$$

Here,  $M2_t$  is the money supply at time  $t$ .  $OIL_t$  is the oil price at time  $t$ .  $\alpha_i$  is the intercept in regime  $i$ .  $\beta_i$  is the coefficient of oil prices in regime  $i$ .  $\varepsilon_t$  is the error term. The estimated equations for each threshold regime are:

$$\text{Regime 1: } M2 < 33,579.98$$

$$M2_t = -1068.5 + 0.2069 \times OIL_t$$

$$\text{Regime 2: } 33,579.98 \leq M2 < 77,212$$

$$M2_t = 10,673.6 + 0.4347 \times OIL_t$$

$$\text{Regime 3: } 77,212 \leq M2 < 122,037$$

$$M2_t = 103,016.7 - 0.1416 \times OIL_t$$

$$\text{Regime 4: } M2 \geq 122,037$$

$$M2_t = 150,569.2 + 0.0201 \times OIL_t$$

These equations show the changing magnitude and direction of the relationship between oil prices and the money supply. This variation happens across different levels of monetary expansion. The results confirm that nonlinear effects exist.

**Table 6. Summary of Threshold Specification Based on Bai-Perron Sequential Method**

|  |
|--|
| <b>Discrete Threshold Specification</b>                              |
| <b>Description of the threshold specification used in estimation</b> |
| <b>Summary</b>   |
| <b>Threshold variable: M2</b>  |
| <b>Estimated number of thresholds: 3</b>                             |
| <b>Method: Bai-Perron tests of L+1 vs. L sequentially determined</b> |
| <b>thresholds</b>  |
| <b>Maximum number of thresholds: 3</b>                               |
| <b>Threshold data values: 33579.985, 77212, 122037</b>               |
| <b>Adjacent data values: 32536.077, 75779, 119906.3</b>              |

**Thresholds values used: 33579.98, 77212, 122037**

**Source: Prepared by the researcher based on EViews13**

The summary of the thresholds as identified by the Bai-Perron sequential method is displayed in Table 6. The analysis shows that there are three important thresholds for the money supply (M2): 33,579.98 million dinars, 77,212.00 million dinars, and 122,037.00 million dinars. These thresholds establish boundaries between different regimes that are incorporated into the model estimation. The thresholds were selected according to statistical optimization methods and indicate where a significant structural shift in the relationship between oil prices and M2 occurs.

**Table 7. Bai-Perron Sequential F-Test for Multiple Thresholds**

| <b>Multiple threshold tests</b>  |                    |                    |                 |
|--|--------------------|--------------------|-----------------|
| <b>Bai-Perron tests of L+1 vs. L sequentially determined thresholds</b>          |                    |                    |                 |
| <b>Sample: 2004M01 2023M12</b>   |                    |                    |                 |
| <b>Included observations: 240</b>  |                    |                    |                 |
| <b>Threshold variable: M2</b>  |                    |                    |                 |
| <b>Threshold varying variables: OIL C</b>  |                    |                    |                 |
| <b>Threshold test options: Trimming 0.15, Max. thresholds 3, Sig. level 0.05</b> |                    |                    |                 |
| <b>Sequential F-statistic determined thresholds:</b>                             |                    |                    | <b>3</b>        |
|  |                    | <b>Scaled</b>      | <b>Critical</b> |
| <b>Threshold Test</b>  | <b>F-statistic</b> | <b>F-statistic</b> | <b>Value**</b>  |
| <b>0 vs. 1 *</b>   | <b>322.5845</b>    | <b>645.1690</b>    | <b>11.47</b>    |

|   |                 |                 |              |
|---|-----------------|-----------------|--------------|
| <b>1 vs. 2 *</b>  | <b>158.0310</b> | <b>316.0620</b> | <b>12.95</b> |
| <b>2 vs. 3 *</b>  | <b>178.1019</b> | <b>356.2039</b> | <b>14.03</b> |
| <b>* Significant at the 0.05 level.</b>                           |                 |                 |              |
| <b>** Bai-Perron (Econometric Journal, 2003) critical values.</b> |                 |                 |              |

**Source: Prepared by the researcher based on EViews13**

Table 7 reports the sequential F-tests used to determine the number of thresholds. The results show that all three thresholds are statistically significant at the 5% level. The F-statistics for testing 0 vs. 1, 1 vs. 2, and 2 vs. 3 thresholds are 322.58, 158.03, and 178.10 respectively—all well above the corresponding Bai-Perron critical values (11.47, 12.95, and 14.03). These results confirm that a model with three threshold breaks best fits the data, supporting the use of a four-regime structure in the analysis.

**Table 8. Identified Threshold Values for M2 from Sequential and Repartition Methods**

| <b>Threshold values:</b> |                        |                         |
|--------------------------|------------------------|-------------------------|
|                          | <b>Sequenti<br/>al</b> | <b>Repartiti<br/>on</b> |
| <b>1</b>                 | <b>82548</b>           | <b>33579.98</b>         |
| <b>2</b>                 | <b>122037</b>          | <b>77212</b>            |
| <b>3</b>                 | <b>33579.98</b>        | <b>122037</b>           |

**Source: Prepared by the researcher based on EViews13**

Threshold values derived from an analysis using sequential and repartition methodology are shown in Table 8, and while, due to the method of analysis, slight differences exist between orderings, there is also complete consistency across both methodologies with regard to the identification of the three main threshold values, namely, 33,579.98; 77,212; and 122,037; thus, providing additional support of their reliability.

**Table 9. Heteroskedasticity Test Results (Breusch-Pagan-Godfrey Test)**

| <b>Heteroskedasticity Test: Breusch-Pagan-Godfrey</b> |                            |                            |                          |
|---|----------------------------|----------------------------|--------------------------|
| <b>Null hypothesis: Homoskedasticity</b>              |                            |                            |                          |
| <b>F-statistic</b>                                    | <b>3.8476</b><br><b>81</b> | <b>Prob. F(1,238)</b>      | <b>0.071</b><br><b>0</b> |
| <b>Obs*R-squared</b>                                  | <b>3.8182</b><br><b>86</b> | <b>Prob. Chi-Square(1)</b> | <b>0.080</b><br><b>7</b> |
| <b>Scaled explained SS</b>                            | <b>2.3510</b><br><b>93</b> | <b>Prob. Chi-Square(1)</b> | <b>0.125</b><br><b>2</b> |

Source: Prepared by the researcher based on EViews13

The result of the Breusch-Pagan-Godfrey Test for Heteroskedasticity that is shown in Table 9 shows that we cannot reject the null hypothesis of Homoskedasticity at conventional Significance levels. The associated with the F-statistic (p-value = .0710) and the Obs\*R-squared test (p-value = .0807) were above the 5% threshold; therefore, there is currently not enough evidence to determine that the model residuals are Heteroskedastic. Therefore, we can feel confident about estimating and interpreting the model because the Coefficient estimates are reliable and stable.

**Figure 2. Autocorrelation and Partial Autocorrelation of Residuals for the M2 Model (Lags 1–5)**

| Autocorrelation   | Partial Correlation   | AC       | PAC    | Q-Stat |
|---|---|----------|--------|--------|
|  |  | 1 -0.093 | -0.093 | 2.0904 |
|  |  | 2 0.142  | 0.135  | 7.0312 |
|  |  | 3 -0.010 | 0.014  | 7.0565 |
|  |  | 4 0.056  | 0.038  | 7.8275 |
|  |  | 5 0.073  | 0.083  | 9.1554 |

Source: Prepared by the researcher based on EViews13

The autocorrelation and partial correlation coefficients of the money supply (M2) threshold regression residuals are shown in Figure 2, which looks at the first five time periods. The autocorrelation (AC) and partial autocorrelation (PAC) values for each time period are low and fluctuate around zero, with none exceeding important thresholds. The autocorrelations

and partial correlations within the residuals of the models are very small across all lags, indicating no serial correlation of the errors. The autocorrelations are ranged between -0.093 and 0.142, and the partial correlations are between -0.093 and 0.135; therefore, the lags all fluctuate around the value 0. The results show evidence that the residuals have not been exhibiting any systematic patterns associated with serial correlations and appear to be behaving like white noise. This finding supports that the models provide an unbiased representation of the data and confirm the dynamic consistency of the specified models. Furthermore, the absence of autocorrelations increases confidence in the reliability of the model estimates and the appropriateness of threshold regressions for exploring the nonlinear characteristics of the M2 oil price relationship.

### **Conclusions:**

- 1- There is no single straight linear movement of oil prices and broad money in Iraq. These points have the support of having a regime dependent relationship in the sense that the direction and magnitude of the effect varies once M2 transcends a certain monetary level.
- 2- The test of stationarity indicates that: oil prices are at a stationary point in terms of the level, whereas M2 is stationary after an initial difference. Such mixed pattern of integration allows application of nonlinear threshold framework instead of imposing the unique specification of a linear form.
- 3- The threshold regression determines three statistically significant thresholds of M2 which divide the sample into four regimes. These disjunctures assist in capturing the changes in structure in the process of transformation of oil revenue circumstances into domestic liquidity between 2004 and 2023.
- 4- The price of oil increases in the low and medium liquidity regimes cause a statistically significant increase in M2. This is in line with an oil revenue conduit that widens reserves and domestic liquidity and consequently drives monetary growth.
- 5- The oil price effect becomes negative and significant in the high liquidity regime and weak and statistically insignificant in very high regime. It means that when the liquidity already exists, oil price gains cease to be converted into the further money growth and can be accompanied by sterilization measures, price inflation or institutional vowels.

### **Recommendations:**

- 1- Regime based liquidity management rules that vary within M2 regimes rather than responding in a consistent way to the changes in oil prices should be applied by the Central Bank of Iraq.
- 2- Fiscal smoothing should be enhanced by the Ministry of Finance through rules based stabilization buffer so that increase of spending will not mechanically increase the oil booms into excess liquidity in the low and medium regimes.
- 3- The sterilization instruments and timing of the occurrence of M2 when it draws close to the high regime could be synchronized by the Central Bank and the Ministry of Finance to decrease the likelihood of inflating liquidity and to stabilize the monetary expansion.
- 4- Oil price scenarios should be incorporated in the liquidity stress testing and balance sheet planning by commercial banks and the regulators and each of the identified monetary regimes should have different assumptions to enhance resilience during oil shocks.
- 5- Monetary and oil revenue indicators should be more often and transparent, and the regular series and documents should be stated by official statistics bodies and allow recognizing the regime changes faster and communicating the policy more credibly.

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