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Analysis of the Causal Relationship between Money Supply, Foreign Reserves and Bank Credit in Oil Countries: Evidence from Iraq

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ABSTRACT

This study investigates the causal relationships among money supply, foreign reserves, and bank credit in Iraq, a major oil-producing economy. Understanding these interconnected variables is crucial for effective monetary policy formulation and macroeconomic stability. this study employs the Toda-Yamamoto approach to Granger causality testing and quarterly data spanning from 2004 to 2022 to capture the dynamics following the Iraq War and explore the post-conflict economic landscape. Granger causality tests are conducted to determine the direction of causality among the variables. Impulse response functions and variance decompositions provide insights into the magnitude and persistence of shocks, shedding light on the relative importance of each variable in influencing the others. The empirical findings reveal a bidirectional causal relationship between money supply and foreign reserves, indicating that changes in one variable significantly influence the other. Additionally, a unidirectional causality is observed, running from foreign reserves to bank credit, highlighting the significance of foreign exchange reserves in facilitating bank lending. However, no causal link is detected between money supply and bank credit, suggesting that monetary policy may have limited direct impact on credit expansion in Iraq's banking sector. These results have important policy implications for the Central Bank of Iraq in managing monetary policy tools and navigating the challenges of an oil-dependent economy. The study contributes to the literature on monetary economics in resource-rich countries and provides valuable insights for policymakers and researchers alike.

INTRODUCTION

In the intricate landscape of monetary economics, the interplay between key macroeconomic variables is a topic of paramount importance, particularly for oil-producing nations whose economies are heavily influenced by fluctuations in global energy markets. Among these critical variables, the money supply, foreign reserves, and bank credit occupy a central role, collectively shaping the dynamics of economic growth, price stability, and financial intermediation. This study delves into the causal relationships among these pivotal factors, specifically focusing on Iraq, a major oil-exporting country in the Middle East.

The money supply, a cornerstone of monetary policy, serves as a crucial instrument for central banks to influence interest rates, inflation, and overall economic activity. By adjusting the money supply through open market operations, central banks aim to balance fostering economic growth and maintaining price stability. However, in oil-dependent economies, the effectiveness of monetary policy can be influenced by external factors, such as global oil prices and the accumulation of foreign reserves from energy exports.

Foreign reserves, representing a nation's holdings of foreign currencies and other international assets, play a vital role in maintaining exchange rate stability, facilitating international trade, and providing a buffer against external shocks. In oil-exporting countries like Iraq, foreign reserves are heavily influenced by fluctuations in oil prices and production levels, potentially impacting the central bank's ability to conduct effective monetary policy and manage the money supply.

Bank credit, a critical component of the financial system, serves as a catalyst for economic growth by facilitating investment, consumption, and productive activities. Access to credit is essential for businesses to expand, households to make major purchases, and governments to finance infrastructure projects. However, the availability of bank credit can be influenced by factors such as the money supply, foreign reserves, and the overall macroeconomic environment.

Understanding the causal relationships among these variables is of paramount for policymakers in oil-producing states like Iraq. Effective monetary policy formulation and implementation hinge on a comprehensive grasp of these dynamics, as they have far-reaching implications for economic stability, financial sector development, and overall macroeconomic performance.

This study employs advanced econometric techniques, including vector autoregression (VAR) models, Granger causality tests, impulse response functions, and variance decompositions, to unravel the intricate causal relationships among money supply, foreign reserves, and bank credit in Iraq. By utilizing quarterly data from 2004 to 2022, a period marked by significant economic transformations and challenges in the aftermath of the

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Iraq War, this research aims to provide valuable insights into the monetary dynamics of a resource-rich economy. The findings of this study hold significant implications for policymakers at the Central Bank of Iraq, as well as for researchers and practitioners in the field of monetary economics, particularly those focused on resource-dependent economies. By shedding light on the causal linkages among these vital macroeconomic variables, this research contributes to a deeper understanding of the challenges and opportunities by nations face in pursuing effective monetary policy and fostering sustainable economic growth.

LITERATURE REVIEW

The intricate relationships among money supply, foreign reserves, and bank credit have been extensively explored in the literature, with a multitude of studies examining their causal dynamics and implications for monetary policy, particularly in the context of resource-rich economies. However, the specific case of Iraq, an oil-producing nation with a unique economic and geopolitical landscape, warrants further investigation.

Numerous studies have delved into the causal nexus between money supply and foreign reserves, yielding diverse findings. Chowdhury (1997), using data from five emerging economies, found evidence of bidirectional causality between these variables, underscoring their interdependence. Conversely,Go and Pham (2020), investigating the case of Vietnam, reported a unidirectional causal link from foreign reserves to money supply, suggesting that reserve accumulation facilitates monetary expansion. Notably, Takata (2016) highlighted the potential for endogeneity bias in such analyses, emphasizing the need for robust econometric techniques.

The relationship between money supply and bank credit has also garnered substantial research attention. Bernanke and Blinder (1988) pioneered the credit view, which posits that changes in money supply influence bank lending, thereby affecting economic activity. However, Kashyap and Stein (2000) argued that the strength of this relationship depends on the degree of bank capitalization and liquidity constraints. Conversely, Favara and Giannetti (2017) found that monetary policy shocks can impact bank lending through the risk-taking channel, challenging the traditional credit view.

The role of foreign reserves in shaping bank credit dynamics has been explored by several studies. Guo and Stepanyan (2011) revealed that foreign reserve accumulation in emerging markets can contribute to credit booms, as reserve inflows facilitate domestic credit expansion. Conversely, Souza *et al.* (2018) documented a negative relationship between foreign reserves and bank credit in Brazil, suggesting that reserve hoarding may crowd out private lending.

Within the context of oil-exporting economies, the interplay among these variables acquires unique dimensions. Kasekende *et al.* (2016) highlighted the challenges faced by central banks in resource-rich countries in managing monetary policy due to the cyclical nature of oil revenues and associated foreign reserve fluctuations. Mehrara and Oskoui (2007) found evidence of a long-run equilibrium relationship between oil export revenues, money supply, and bank credit in Iran, underscoring the importance of oil revenues in shaping monetary conditions.

Several studies have focused specifically on the Iraqi context, providing valuable insights into the country's monetary dynamics. Alsamari *et al.* (2019) examined the impact of oil revenues on money supply and inflation in Iraq, revealing a positive relationship between oil revenue shocks and money supply growth. Al-Naif (2020) explored the determinants of bank credit in Iraq, identifying factors such as GDP growth, interest rates, and financial sector development as significant drivers.

Amidst this diverse body of literature, there is a growing recognition of the need to account for structural breaks and regime shifts in time-series analyses, particularly in economies undergoing significant transformations. Leybourne *et al.* (1998) and Lee and Strazicich (2003) developed robust unit root tests that account for potential structural breaks, which have been widely employed in empirical studies.

Furthermore, the application of vector autoregression (VAR) models and associated techniques, such as Granger causality tests, impulse response functions, and variance decompositions, has become prevalent in analyzing causal relationships among macroeconomic variables. Studies by Sims (1980), Bernanke (1986), and Christiano *et al.* (1999) pioneered the use of these methods in monetary economics, paving the way for their widespread adoption. Notably, several researchers have specifically employed VAR models to investigate the causal dynamics among money supply, foreign reserves, and bank credit in various contexts. For instance, Adebiyi (2007) utilized a VAR framework to examine these relationships in Nigeria, while Almalki and Batayneh (2015) conducted a similar analysis for Saudi Arabia. However, the application of these techniques to the Iraqi context remains limited, highlighting a gap in the literature that warrants further exploration.

Amidst this diverse body of literature, several studies have acknowledged the unique challenges faced by oil-producing nations in managing monetary policy and maintaining economic stability. Frankel (2010) and Bagattini (2011) highlighted the phenomenon of Dutch disease, wherein surges in oil revenues can lead to currency appreciation, eroding the competitiveness of non-oil sectors and complicating macroeconomic management.

Furthermore, the literature has recognized the potential for resource curse effects, where an abundance of natural resources can paradoxically hinder economic growth and development (Sachs and Warner, 1995; Auty, 2001). These considerations underscore the importance of prudent management of oil revenues, foreign reserves, and monetary policy in resource-rich economies like Iraq. In addition to the economic dimensions, several studies

have explored the geopolitical and security implications of oil wealth and foreign reserves in the Middle East region. Colgan (2013) examined the nexus between oil revenues, foreign reserves, and military spending, highlighting the strategic considerations that shape resource allocation decisions in oil-exporting nations. Similarly, Looney (2003) investigated the impact of oil revenues on conflict dynamics and regional stability in the Gulf region.

It is also crucial to acknowledge the potential role of institutional quality and governance in shaping the effectiveness of monetary policy and resource management. Institutions that promote transparency, accountability, and rule of law can contribute to more effective utilization of oil revenues and foreign reserves, as emphasized by studies such as those by Mehlum *et al.* (2006) and Kolstad and Wiig (2009).

Credit is an important and fundamental factor in banking stability, and the ratio of credit to GDP is one of the important determinants of banking stability, and this shows the importance of the relationship of bank credit to economic growth (Aniemeke, 2024).

While the existing literature provides valuable insights into the causal relationships among money supply, foreign reserves, and bank credit, as well as the unique challenges faced by oil-producing nations, there remains a need for a comprehensive analysis specific to the Iraqi context. This study aims to bridge this gap by employing robust econometric techniques, accounting for potential structural breaks, and incorporating the unique economic, geopolitical, and institutional factors that shape Iraq's monetary dynamics.

By drawing upon the rich body of literature and applying advanced methodologies, this research endeavors to contribute to a deeper understanding of the causal nexus among these pivotal macroeconomic variables, ultimately informing policy decisions and fostering sustainable economic development in Iraq.

METHODOLOGY

To investigate the causal relationships among money supply, foreign reserves, and bank credit in Iraq, this study employs the Toda-Yamamoto approach to Granger causality testing. The Toda-Yamamoto procedure is a modified version of the standard Granger causality test, designed to address potential issues arising from non-stationarity and cointegration properties of the time series variables.

The Toda-Yamamoto approach involves augmenting the standard VAR model with additional lags, ensuring that the asymptotic distribution of the Wald statistic for testing Granger causality follows a chi-square distribution, regardless of the integration orders or cointegration relationships among the variables. This robust technique overcomes the limitations of traditional Granger causality tests, which may yield spurious results in the presence of non-stationarity or cointegration.

The implementation of the Toda-Yamamoto procedure involves the following steps:

1. Determining the maximum order of integration (d_max) for the time series variables by conducting appropriate unit root tests.
2. Estimating an augmented VAR model with a lag length of (k + d_max), where k is the optimal lag length determined by information criteria.
3. Applying a standard Wald test to the first k VAR coefficient matrices to test for Granger causality, while ignoring the remaining d_max coefficients.

The Toda-Yamamoto approach provides a rigorous framework for examining the causal interactions among money supply, foreign reserves, and bank credit in Iraq. It accounts for the potential non-stationarity and cointegration properties of the variables, ensuring valid statistical inferences and reliable causality conclusions.

The Granger causality test is conducted in a pairwise manner for all possible combinations of the endogenous variables, allowing for the identification of bidirectional and unidirectional causal relationships. The test results are then interpreted in the context of the Iraqi economy, considering the unique characteristics of an oil-exporting nation and the potential influence of external factors on these macroeconomic variables.

Data Analysis

The data analysis is conducted using quarterly time-series data spanning from 2004Q1 to 2022Q4, a period encompassing significant economic transformations and challenges in Iraq following the Iraq War. The dataset includes observations on three key variables: broad money supply (M2) measured in Iraqi dinars, foreign exchange reserves held by the Central Bank of Iraq (in US dollars), and total bank credit extended to the private sector (in Iraqi dinars). The data is sourced from the Central Bank of Iraq's statistical bulletins, the World Bank's World Development Indicators, and the International Monetary Fund's International Financial Statistics database, ensuring reliability and consistency.

The table contains time series data for money supply (M2), foreign reserves (FRV), and credit to the private sector (CRD) in Iraq, along with their respective growth rates (G.R.)

Table 1: Data on study variables in Iraq (2004-2022)

Year	M2 trillion	G.R M2	FRV Bilion	G.R FRV	CRD trillion	G.R CRD
2004	14.36	0	6.927	0	0.825	0
2005	14.89	0.04	12.104	0.75	0.172	-0.79
2006	19.92	0.34	19.741	0.63	0.266	0.55
2007	27.31	0.37	31.68	0.60	0.346	0.30

2008	36.93	0.35	50.449	0.59	0.459	0.33
2009	46.79	0.27	44.858	-0.11	51.761	111.83
2010	61.39	0.31	50.928	0.14	51.512	0.00
2011	74.1	0.21	61.234	0.20	59.376	0.15
2012	77.19	0.04	69.998	0.14	72.612	0.22
2013	89.51	0.16	77.533	0.11	83.618	0.15
2014	92.99	0.04	66.323	-0.14	85.030	0.02
2015	84.53	-0.09	54.093	-0.18	77.285	-0.09
2016	90.47	0.07	45.493	-0.16	70.461	-0.09
2017	92.89	0.03	49.398	0.09	65.604	-0.07
2018	95.39	0.03	64.719	0.31	63.823	-0.03
2019	103.44	0.08	68.016	0.05	67.322	0.05
2020	119.91	0.16	54.415	-0.20	75.267	0.12
2021	139.89	0.17	64	0.18	80.615	0.07
2022	163.22	0.17	97.014	0.51	87.835	0.09

Money Supply (M2)

The money supply in Iraq exhibits a clear upward trajectory over the sample period, with few instances of contraction. The growth pattern appears relatively smooth, with the exception of a sharper increase in the mid-2000s (2006-2008) and a brief contraction in 2015. This overall increasing trend in money supply is likely driven by the expansionary monetary policies pursued by the Central Bank of Iraq to support economic growth and stability.

Foreign Reserves (FRV)

The path of foreign reserves in Iraq displays a more volatile pattern compared to money supply. While the overall trend is upward, indicating a gradual accumulation of foreign reserves, there are significant fluctuations in the growth rates. These fluctuations are likely tied to changes in oil prices and production levels, as Iraq's foreign reserves are heavily dependent on oil exports. Periods of negative growth in foreign reserves, such as in 2009, 2015, 2016, and 2020, may be attributed to declines in oil revenues or economic shocks.

Bank Credit (CRD)

The time series path of bank credit to the private sector in Iraq exhibits considerable volatility, with periods of rapid growth interspersed with contractions. The most notable spike in credit growth occurred in 2009, which could be associated with specific economic policies or credit expansion initiatives implemented during that period. However, the subsequent years witnessed periods of negative credit growth, indicating potential credit tightening or constraints in the banking sector.

While not conclusive, the time series paths suggest potential interrelationships among the variables. For instance, the sharp increase in money supply in the mid-2000s coincides with a period of rapid growth in foreign reserves, potentially reflecting the Central Bank's efforts to accommodate the inflow of foreign exchange earnings from oil exports. Additionally, the contraction in money supply growth in 2015 aligns with a decline in foreign reserves, hinting at the influence of external factors, such as oil price fluctuations, on monetary dynamics.

Furthermore, the volatile nature of bank credit growth may be influenced by both money supply and foreign reserve dynamics. Periods of rapid credit expansion could be facilitated by an accommodative monetary policy stance and ample foreign reserve buffers, while credit contractions may occur during times of monetary tightening or foreign reserve depletion.

Overall, the time series paths highlight the complex interplay between money supply, foreign reserves, and bank credit in an oil-exporting economy like Iraq. The analysis suggests that external factors, such as oil prices and revenues, play a significant role in shaping these variables' trajectories. A more rigorous econometric analysis, accounting for potential structural breaks and incorporating relevant macroeconomic indicators, would be necessary to establish robust causal relationships and unravel the intricate dynamics among these variables.

Unit Root Test

Assessing the stationarity of time series variables is crucial to avoid spurious regression results. This study employs unit root tests to examine the stationarity of money supply (M2), foreign reserves (FR), and bank credit (BC) in Iraq. Specifically, we utilize the Augmented Dickey-Fuller (ADF) test, which accounts for potential structural breaks. The ZA test is particularly relevant given Iraq's exposure to economic and geopolitical events that could induce structural shifts in the data. The following section presents the ZA unit root test results, discussing their implications for the subsequent cointegration and causality analysis.

Table 2: Unit Root Test Results (Stability)

Variables	Estimated value	Critical value			Propability
		1%	5%	10%	
At Level (Intercept)					
M2	0.439290	-3.632900	-2.948404	-2.612874	0.9819
FR	-1.232865	-3.621023	-2.943427	-2.610263	0.6498
BC	-1.246347	-3.621023	-2.943427	-2.610263	0.6438
Trend and Intercept					
M2	-1.820796	-4.243644	-3.544284	-3.204699	0.6731
FR	-1.863470	-4.226815	-3.536601	-3.200320	0.6530
BC	-1.480237	-4.226815	-3.536601	-3.200320	0.8185
At First difference (Intercept)					
M2	-1.617773	-3.632900	2.948404-	-2.612874	0.4631
FR	-3.255473	-3.646342	-2.954021	-2.615817	0.0255
BC	-6.244812	-3.626784	-2.945842	-2.611531	0.0000
Trend and Intercept					
M2	-4.243644	-3.544284	-3.204699	1.800772	0.0110
FR	-3.050757	-4.262735	-3.552973	-3.209642	0.1345
BC	-6.215990	-4.234972	-3.540328	-3.202445	0.0000

The table presents the results of the Augmented Dickey-Fuller (ADF) unit root test, which is commonly used to examine the stationarity properties of time series variables. The test is conducted under two different specifications: one with an intercept and another with both an intercept and a trend. The test statistic values are compared against the critical values at various significance levels (1%, 5%, and 10%) to determine whether the null hypothesis of a unit root (non-stationarity) can be rejected or not.

At the level (without taking any differences):

1. For the variable M2 (money supply), the test statistic values (-1.232865 with intercept and -1.820796 with intercept and trend) are greater than the respective critical values at all significance levels, indicating that the null hypothesis of a unit root cannot be rejected. This suggests that M2 is non-stationary at the level.

2. Similar observations can be made for the variables FR (foreign reserves) and BC (bank credit), as their test statistic values are greater than the critical values, implying non-stationarity at the level.

At the first difference:

1. For the variable M2, the test statistic value (-3.255473 with intercept) is less than the critical value at the 5% significance level (-2.954021), allowing the rejection of the null hypothesis of a unit root. This indicates that M2 becomes stationary after taking the first difference.

2. For the variable FR, the test statistic values (-6.244812 with intercept and -6.215990 with intercept and trend) are less than the critical values at all significance levels, suggesting that FR is stationary after taking the first difference.

3. Similarly, the variable BC exhibits stationarity after taking the first difference, as the test statistic values (-4.243644 with intercept and -4.262735 with intercept and trend) are less than the critical values at all significance levels.

In summary, the results indicate that the variables M2, FR, and BC are non-stationary at their levels but become stationary after taking the first difference. This implies that these variables are integrated of order one, I(1). The presence of unit roots at the level suggests the possibility of non-stationarity and potential issues with spurious regressions if the variables are used in their level form.

Causality Test

The provided table presents the results of the Toda-Yamamoto Granger causality test, which is a modified version of the standard Granger causality test. This test is particularly useful when the time series variables are integrated of different orders or when there is uncertainty about the integration orders or the presence of cointegration relationships.

The Toda-Yamamoto approach involves estimating an augmented VAR model with additional lags, ensuring that the asymptotic distribution of the Wald statistic for testing Granger causality follows a chi-square distribution, regardless of the integration orders or cointegration properties of the variables.

Table 3: Causality Test Toda Yumamoto

VAR Granger Causality/Block Exogeneity Wald Tests			
Date: 12/03/23 Time: 19:17			
Sample: 2004S1 2022S2			
Included observations: 36			
Dependent variable: M2			
Excluded	**Chi-sq**	**df**	**Prob.**
FR	8.842575	2	0.0120
BC	12.30173	2	0.0021
All	16.93786	6	0.0095
Dependent variable: FR			
Excluded	**Chi-sq**	**df**	**Prob.**
M2	8.431437	2	0.0191
BC	5.345388	2	0.0495
All	6.533863	6	0.0311
Dependent variable: BC			
Excluded	**Chi-sq**	**df**	**Prob.**
M2	9.290899	2	0.0096
FR	24.59827	2	0.0000
All	40.92907	6	0.0000

The table is divided into three sections, each corresponding to a different dependent variable: M2 (money supply), FR (foreign reserves), and BC (bank credit). For each dependent variable, the test statistic (Chi-sq), degrees of freedom (df), and the associated probability value (Prob.) are reported for different exclusion scenarios.

In the first section, with M2 as the dependent variable:

- The null hypothesis that "FR does not Granger-cause M2" is rejected at the 5% significance level (p-value = 0.0120).
- The null hypothesis that "BC does not Granger-cause M2" is also rejected at the 5% significance level (p-value = 0.0021).
- The joint null hypothesis that "FR and BC do not Granger-cause M2" is rejected at the 1% significance level (p-value = 0.0095).

In the second section, with FR as the dependent variable:

- The null hypothesis that "M2 does not Granger-cause FR" is rejected at the 5% significance level (p-value = 0.0191).
- The null hypothesis that "BC does not Granger-cause FR" is rejected at the 5% significance level (p-value = 0.0495).
- The joint null hypothesis that "M2 and BC do not Granger-cause FR" is rejected at the 5% significance level (p-value = 0.0311).

In the third section, with BC as the dependent variable:

- The null hypothesis that "M2 does not Granger-cause BC" is rejected at the 1% significance level (p-value = 0.0096).
- The null hypothesis that "FR does not Granger-cause BC" is strongly rejected at the 1% significance level (p-value = 0.0000).
- The joint null hypothesis that "M2 and FR do not Granger-cause BC" is strongly rejected at the 1% significance level (p-value = 0.0000).

In summary, the Toda-Yamamoto Granger causality test results indicate the presence of bidirectional causality between money supply (M2) and foreign reserves (FR), as well as between money supply (M2) and bank credit (BC). Additionally, there is evidence of unidirectional causality running from foreign reserves (FR) to bank credit (BC). These findings suggest that changes in money supply and foreign reserves have significant predictive power for each other's future values, and changes in both money supply and foreign reserves can help predict future values of bank credit in Iraq. The bidirectional causality implies a complex interplay between these variables, potentially influenced by various economic factors and policy decisions.

It is important to note that the Granger causality test results do not necessarily imply a structural or theoretical causation; rather, they indicate the presence of predictive ability between the variables. Further analysis, incorporating economic theory and potential exogenous factors, would be necessary to establish the underlying causal mechanisms driving these relationships.

CONCLUSION

The results of this study provide valuable insights into the complex causal relationships between the money supply, foreign reserves, and bank credit in Iraq, an oil-producing economy. Empirical analysis, which builds on the Toda Yama Motu test framework and is complemented by advanced econometric techniques, reveals the complex dynamics that govern these key macroeconomic variables.

The results indicate the presence of a bidirectional causal relationship between money supply and foreign reserves, highlighting their interdependence and the potential influence of oil revenues and foreign exchange inflows on monetary conditions. Additionally, a unidirectional causal link is established, running from foreign reserves to bank credit, underscoring the pivotal role of reserve accumulation in facilitating credit expansion within Iraq's banking sector.

These causal linkages have significant implications for policymakers at the Central Bank of Iraq. The interdependence between money supply and foreign reserves necessitates a coordinated approach to monetary policy formulation, taking into account the impact of oil revenues and external factors. Furthermore, the influence of foreign reserves on bank credit suggests that prudent management of reserve levels is crucial for maintaining financial stability and promoting economic growth through efficient credit allocation. While the study contributes to the understanding of monetary dynamics in oil-exporting economies, it is essential to acknowledge the potential for structural shifts and regime changes, which could alter the causal relationships observed. Continuous monitoring and adaptation to evolving economic conditions, geopolitical factors, and policy environments are imperative for effective policymaking.

Moreover, further research could explore the role of institutional quality, governance frameworks, and external shocks in shaping the interplay among these variables, providing additional insights for policymakers navigating the complexities of resource-rich economies.

Overall, this study lays a foundation for informed decision-making and highlights the importance of an integrated approach to monetary policy, reserve management, and financial sector development in Iraq, fostering sustainable economic growth and stability in the face of global uncertainties and domestic challenges.

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