

Financial-monetary integration and sustainable development in Iraq: analysis of the asymmetric impact of green financing thresholds using the tvar-Copula model

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Abstract: this research seeks to analyze the relationship between the integration of monetary and financial policies and green finance in Iraq, focusing on the adjusted role of green finance thresholds, as economic policies in Iraq suffer from structural challenges represented by poor institutional coordination between the central bank and the Ministry of Finance, and the dominance of oil revenues on the public budget, the research used the tzavalis (2023). The research was based on annual data for the period 2004-2023 from official sources, and the research came to the conclusion that there is a critical threshold for green financing exceeding 2.5% of GDP, as the impact of policy integration turns from limited to effective in supporting sustainable development, and the results show that ignoring the threshold variable leads to .biased estimates, which confirms the importance of the proposed methodology

Keywords: monetary-financial integration, green finance, Iraq, tvar model, copula functions

introduction:

integration between monetary and fiscal policy is an essential pillar for achieving macro stability and sustainable economic development, especially in rentier economies that suffer from the dominance of oil revenues and weak institutional coordination, the Iraqi economy is a prominent model of this challenge, as it depends on more than 90% of its revenues on oil, making it vulnerable to external shocks and oil price fluctuations previous studies have indicated that the Iraqi economy suffers from clear financial dominance, as the government determines the size of the deficit without adequate consultation with the central bank, with a clear absence of institutional coordination between policies In this context, the concept of "green finance" has emerged as a pivotal tool to achieve sustainable development, especially in light of the classification of Iraq as the fifth country affected by high temperatures and drought, a recent study indicated that carbon emissions in Iraq increased from about 40 million tons in 2004 to about 197 million tons in 2023, which reinforces the urgent need to shift the financing structure towards environmental sustainability. The Central Bank of Iraq has launched an initiative worth 4 trillion dinars to provide financing at reduced rates for small and medium-sized enterprises, in addition to issuing environmental, social and governance guidelines (ESG) in September 2024.

1. 2. Research gap (Research Gap) 1. Absence of standard studies: the literature lacks standard studies examining the relationship between the integration of monetary and fiscal policies and green finance in Iraq. 2. Neglect of non-linear relationships: previous studies have not addressed the possibility of non-linear relationships or critical thresholds at which the impact of these policies changes. 3. Ignoring the factorization problem: previous standard studies did not address the problem of factorization (Endogeneity) arising from the correlation between the threshold variable and innovations. 1. 3. The importance of research (Significance)

1. 3. 1. Scientific novelty: this research is the first of its kind in Iraq that integrates policy integration analysis and green financing thresholds using the advanced tvar-Copula methodology.

. 3. 2. Applied relevance: the results of the research contribute to guiding policy makers towards determining the optimal levels of green financing.

1. 3. 3. Relevance to national priorities: the research is consistent with Iraq's strategy for Sustainable Development 2030 and the central bank's vision to modernize the financial sector.

1. 4. The problem of Research (Problem Statement)

The research problem is the following main question: "Are there any critical thresholds for green financing that determine the relationship between the integration of monetary and financial policies and sustainable development financing in Iraq, and how can the problem of universality be addressed in estimating these thresholds using copula functions?"

1. 5. Research hypotheses (Hypotheses)

The first hypothesis: there is a critical threshold for green financing, as the effect of policy integration changes asymptotically when this threshold is exceeded.

The second hypothesis: factorization leads to biased estimates of parameters and response functions, which necessitates the use of copula functions for their processing.

1. 6. Research objectives (objects)

1. 6. 1. The main objective: to identify critical thresholds for green finance that change the effectiveness of integration between monetary and fiscal policies.

1. 6. 2. Sub-objectives:

O estimation of the tvar tablet model for nonlinear relationship analysis.

O apply the copula methodology to address the factorization problem.

O compare the results of the factor-treated model with the untreated model.

O draw up specific policy recommendations to promote green financing.

1. 7. Scientific studies:

A-International Studies:

Researchers title methodology Main results

A-International Studies:

Researchers	title	methodology	Main results
Andersen & Jordan (1968)	Monetary vs. Fiscal Policy	OLS	The impact of cash is greater than Financial in the United States
Christopoulos et al. (2023)	Threshold Endogeneity in TVAR	Copula-TVAR	Inflation threshold of 3.6% changes the effect of cash

B-Arabic and Iraqi studies:

Researchers	title	methodology	Main results
Zayer (2019)	Policy Coordination in Iraq	Descriptive	Poor coordination between cash and finance
Ghadeer & Khudhair (2022)	Monetary Policy and Stability in Iraq	VAR	Cash efficiency at 1.8% inflation
Thanoon & Battall (2026)	Monetary Policy and Renewable Energy	Descriptive	Emissions rise from 40 to 197 million tons



1- First :Monetary policy: concept, objectives and tools

1. the concept of monetary policy monetary policy is defined as the set of actions and measures taken by the central bank with the aim of controlling the money supply, interest rates and credit availability, in order to achieve macroeconomic goals such as price stability, economic growth and low unemployment (Mishkin, 2019). Monetary policy is considered a key tool in managing aggregate demand, as it can influence the level of spending, investment and consumption in the economy.

Monetary policy tools are constantly evolving, as they have moved from traditional tools (such as interest rate manipulation and mandatory reserve) to non-traditional tools (such as quantitative easing and targeted lending), especially after the global financial crisis of 2008. in recent years, central banks have begun to adopt green Monetary policy tools aimed at supporting environmental investments and addressing climate change. economic theories vary in explaining the role of monetary and fiscal policy in achieving stability and growth (Najaf, 2024):

2. Objectives of monetary policy :the main objectives of monetary policy are summarized in:

2. 1.Price stability: it is the primary goal of most central banks, and is achieved by controlling the inflation rate at a low and stable level. In Iraq, price stability is a major challenge due to import dependence and exchange rate fluctuations.

2. 2: economic growth: monetary policy contributes to supporting economic growth by providing the necessary liquidity for investment, reducing the cost of borrowing, and improving the business climate.

2. 3: exchange rate stability: especially in economies that rely heavily on imports, as the stability of the exchange rate contributes to price stability and avoiding external shocks.

2. 4: financial stability: by monitoring systemic risks in the banking and financial sector, and taking precautionary measures to reduce these risks.

2. 5: support sustainable development (new goal): in recent years, central banks have begun to adopt environmental and social goals within their policies, such as supporting green finance and financial inclusion.

.3 tools of monetary policy in Iraq the main tools of monetary policy in Iraq are represented by (Al-Hafi, 2025):

3. 1: discount Rate: it is the interest rate at which the central bank lends to commercial banks.

This is considered the most influential tool in achieving monetary stability in Iraq.

3. 2: reserve Requirement: it is the percentage that commercial banks are obliged to keep with the central bank. By adjusting this ratio, the central bank can control the amount of available credit in the economy.

3. 3: Open Market Operations (Open Market Operations): are the purchase and sale of government securities by the central bank.

3. 4: exchange Rate: in Iraq, the central bank follows a semi-fixed exchange rate system for the dinar against the dollar.

4: challenges of monetary policy in Iraq: the implementation of monetary policy in Iraq faces several challenges (Thanoon & battle, 2026):

4. 1: weakness of the banking sector: as most Iraqi banks suffer from weak capital, a high percentage of non-performing loans, and poor governance.

4. 2: credit concentration in commercial activities: where bank credit is concentrated in short-term commercial and consumer activities, at the expense of productive sectors.

4. 3: dependence on the oil sector: makes the Iraqi economy vulnerable to external shocks, which limits the ability of monetary policy to achieve stability.

4. 4: poor coordination with fiscal policy: the lack of coordination between the central bank and the government reduces the effectiveness of both monetary policy and fiscal policy.

4. 5: imported inflation: due to the high dependence on imports, the Iraqi economy is affected by global inflation.

5 integration of monetary and fiscal policies in rentier economies: rentier economies face special challenges in achieving policy integration (Ghadeer & Khudhair, 2022; Zayer, 2019):

5. 1: dominance of oil revenues: dependence on oil for more than 90% of revenues poses a major challenge to financial stability.

5. 2: weak institutional coordination: the Iraqi economy suffers from a clear financial dominance, as the government determines the size of the deficit without consulting the central bank.

5. 3: public sector control: government spending is the main driver of growth, while the private sector suffers from limited access to finance.

5. 4: monetary policy challenges: monetary policy faces difficulties in achieving monetary stability due to the correlation of the money supply with the processes of monetization of oil revenues (Ghazi et al., 2025).

Third, financial policy: concept, objectives and tools

.1 concept of fiscal policy: fiscal policy is defined as the government's use of public spending and public revenues (especially taxes and oil revenues) to influence economic activity. Fiscal policy aims to achieve multiple objectives including: resource allocation, income distribution, and macroeconomic stability (Rosen & Gayer, 2014). The effectiveness of fiscal policy is influenced by several factors, including: the structure of revenues and expenditures, the degree of economic openness, the flexibility of the tax system, and the quality of public spending. In Iraq, the revenue is.

Oil accounts for the bulk of public revenues, which makes fiscal policy closely linked to oil price fluctuations.

2. Objectives of fiscal policy :the main objectives of fiscal policy are summarized in:

2. 1: resource allocation: directing resources towards priority economic sectors and activities, such as infrastructure, education, health, and productive sectors.

2. 2: income redistribution: through the system of taxation and social spending, fiscal policy can contribute to reducing the gaps between different social groups.

2. 3: macroeconomic stability: through the use of public finance instruments (spending, taxation) to mitigate cyclical fluctuations in economic activity.

2. 4: promote economic growth: by investing in infrastructure, supporting innovation, improving the business environment.

2. 5: achieving sustainable development: by directing investments towards green and sustainable projects, and applying tax policies that encourage environmental protection.

.3 instruments of fiscal policy in Iraq: the main instruments of fiscal policy in Iraq are represented by (Rudaw Research Center, 2026):

3. 1: public spending: it is the most influential tool in Iraqi financial policy. Public spending witnessed accelerated growth, rising from 2.8 trillion dinars per month in January 2015 to more than 9 trillion dinars in January 2025, an increase of more than 200%.

3. 2: public Revenue: it consists mainly of oil revenues (85-90% of the total), and non-oil revenues

(taxes, fees, grants).

3. 3: Public Debt: public debt is used to finance the budget deficit.

3. 4: tax policy: it is a tool with limited impact in Iraq due to the weak tax base and the high proportion of the informal economy.

Fourth: integration of monetary and fiscal policy: theoretical foundations and practical applications

1. The concept of institutional integration: integration between monetary and fiscal policy refers to coordination between the central bank and the government to achieve common goals such as economic stability and sustainable growth (Akawee & Atiyah, 2026). Institutional integration requires: exchange of information, coordination of objectives, harmonization of tools, avoidance of conflicting policies.

The Iraqi prime minister stressed the importance of enhancing coordination and integration between fiscal and monetary policies in Iraq, pointing out that this contributes to economic stability and support development efforts.

2. The importance of policy integration :the importance of monetary and fiscal policy integration is evident in several aspects:

2. 1: achieving conflicting goals: monetary policy and fiscal policy may sometimes have conflicting goals. For example, the government may want to increase spending to stimulate growth, while the central bank wants to raise interest rates to curb inflation. Coordination between them helps to avoid such conflicts.

2. 2: enhancing the effectiveness of policies: when monetary policy and fiscal policy work in the same direction, their effectiveness is greater than if they work in opposite directions.

2. 3: avoid financial burdens: lack of coordination may increase the financial burdens on the government or the central bank. For example, if the central bank prints money to finance the budget deficit, this can lead to inflation and increase the burden on the government.

2. 4: enhancing confidence: policy coordination enhances the confidence of investors and financial institutions in the economy, which contributes to attracting investments and improving the business environment.

.3 models of integration between policies: models of integration between monetary and fiscal policy are diverse in the economic literature (Najaf, 2024):

Traditional model: assumes that monetary and fiscal policy operate independently, as the central bank focuses on price stability, while the government focuses on resource allocation and income redistribution.

Dominance model: occurs when one policy dominates the other, as in the case of Iraq, where it has a clear financial dominance (Zayer, 2019).

Coordination model: policies work in a coordinated manner to achieve common goals, which is the ideal model required in Iraq to enhance the effectiveness of green financing.

4. policy integration in Iraq :an analytical study for the period (2005-2024) showed a long-term equilibrium relationship between bank credit and public spending on the one hand and the productivity gap on the other, where bank credit and public spending played an important role in reducing the productivity gap (Akawee & Atiyah, 2026). This suggests that coordination between monetary policy (via bank credit) and fiscal policy (via public spending) contributes to economic stability.

Evidence indicates that there has been an improvement in policy coordination in Iraq in recent years, especially with the formation of the Financial Stability Board and the launch of joint initiatives between the central bank and the government in the field of green finance. However, there is still a lot of room for improvement in this format.

Fifth: green finance

1: the concept of green finance: green finance is defined as" the allocation of financial resources to support economic activities that achieve environmental and social sustainability, while generating economic returns " (ILO, 2025). Green finance includes a wide range of financial instruments, including: green loans, green bonds, environmental investment funds, and green insurance.

The concept of green finance has evolved to include new concepts such as: sustainable finance, climate finance, Blue (Ocean-related) finance, and Social Finance. Criteria and classifications have also emerged to determine which Green activities are eligible for funding, such as the EU green rating.

Green financing in Iraq is of particular importance for the following reasons (Thanoon & battle, 2026):

- * Climate change: Iraq is classified as the fifth country affected by rising temperatures.
- * Dependence on fossil energy: electricity generation from oil decreased from 92% to about 35% between 2004 and 2023.

* Rising carbon emissions: carbon emissions increased from about 40 million tons in 2004 to about 197 million tons in 2023.

The literature indicates that the effectiveness of green finance depends on multiple factors, including: the level of economic development, the quality of institutions, and policy coordination (Najaf, 2024; ILO, 2025).

2. Green finance instruments: green finance instruments include a wide range of financial instruments (World Bank, 2025):

2. 1: green Loans: these are loans dedicated to financing environmentally friendly projects, characterized by concessional financing terms (low interest rates, longer repayment periods).

2. 2: green bonds: these are bonds issued to finance environmental projects, characterized by high transparency in the use of proceeds.

2. 3: Environmental Investment Funds(Green Investment Funds): These are funds that invest in environmentally friendly companies and projects.

2. 4: green insurance: it is an insurance that covers environmental and climate risks.

2. 5: carbon credits: it is a tool that allows the trading of carbon emission rights, motivating companies to reduce their emissions.

3 green finance initiatives in Iraq :the Central Bank of Iraq has launched several green finance initiatives (Central Bank of Iraq, 2024; Thanoon & battle, 2026):

3. 1: green lending program: an initiative worth 4 trillion dinars to provide financing at reduced rates for small and medium-sized enterprises, including green projects.

3. 2: environmental, social and governance guidelines (ESG): the issuance of ESG guidelines in September 2024, to guide banks towards the adoption of sustainability standards in their activities.

3. 3: financial sustainability roadmap: development of a green financing model in cooperation with the World Bank within the financial sustainability roadmap (2023-2029).

3. 4: licensing of green banks: licensing of two banks specialized in climate finance (Al Riyada Bank and Green Bank).

4.Challenges of green finance in Iraq: however, Iraq is still in the early stages of adopting the concept of green finance, with multiple challenges:

1.4: weak legislative framework: lack of clear laws and regulations regulating green financing and setting standards for green projects.

2.4: low institutional awareness: lack of knowledge and experience in financial and government institutions about the concepts and tools of green finance.

3.4: weak financial infrastructure: limited financial markets and lack of a developed market for green bonds or carbon credit.

4.4: lack of data: insufficient data on green projects and their environmental and economic impact.

5.4: high risk: green finance is considered a high-risk activity in Iraq, due to political and economic instability and poor infrastructure.

2.5 threshold methodology in the analysis of economic policies: theoretical foundations and methodological developments

2.5.1 theoretical basis of threshold models: Threshold models (Threshold Models) are advanced standard tools for analyzing nonlinear relationships in which the nature of the effect changes when a critical threshold for a particular variable is exceeded. The self-directed regression model with a threshold (TVAR) is one of the most common such models in macro-policy analysis.

Theoretical justification for the use of threshold models:

* Asymmetry of policy impact: the effects of economic policies vary between boom and bust periods, and between high and low levels of inflation (Christopoulos et al., 2023).

* Non-linear relationships: the relationship between economic variables may be non-linear, as in the case of the influence of public debt on growth (Laffer Curve), or the influence of green finance on sustainable growth.

* The presence of critical thresholds: there may be certain levels of economic variables, exceeding which will lead to a fundamental change in economic relations.

2.5.2 threshold models in the economic literature: threshold models have evolved over time to include diverse applications (Hansen, 1999; Tsay, 1998):

Self-regression model with threshold (TAR-Threshold Autoregression): it is the simplest form of threshold models, as it depends on one variable in self-regression.

Self - directed regression model with threshold (TVAR-Threshold Vector Autoregression): it is an

extension of the TAR model to include several variables, and is used in the analysis of interrelations between macro variables.

Panel Threshold models: these are threshold models that are applied to cross-sectional-temporal data (Panel Data), and allow the analysis of non-linear relationships across countries or sectors.

2.5.3 treatment of factorization in TVAR models using copula functions: Christopoulos, McAdam, and Tzavalis (2023) developed an innovative methodology for addressing the problem of factorization (Endogeneity) in TVAR models, which arises from the correlation between the threshold variable and the vector of innovations in the model.

Sources of factorization in tvar models:

1. Contemporary correlation between the threshold variable and innovations: the threshold variable (green finance) may be related to current shocks affecting internal variables.

2. Feedback: internal variables may influence the threshold variable, creating a bidirectional causal relationship.

3. Bias of deleted variables: there may be influential variables deleted from the model that affect both the threshold variable and the internal variables.

The effect of ignoring factorization: a Monte Carlo simulation by Christopoulos et al. appears. (2023) that ignoring factorization leads to:

1. Bias in estimating the threshold coefficient (δ): the threshold is estimated as low or high than its true value.

2. Bias in estimating the variance-covariance matrix of errors: which affects the accuracy of statistical tests.

3. Pulse response functions (IRFs) are inaccurate: more responses appear slower or faster than reality.

Copula processing methodology: the proposed methodology is based on (Christopoulos et al., 2023):

1. Transformation of the threshold variable using the Gaussian Copula function:

$$z_t(i) = \Phi^{-1}(F_Z(i)(Z_t(i)))$$

Where Φ^{-1} is the inverse distribution function of the normed normal distribution, and $F_Z(i)$

is the empirical Cumulative Distribution Function of the threshold variable.

2.The reformulation of innovations is as follows:

$$u_t(i) = \Lambda(i)z_t(i) + \varepsilon_t(i) \quad u_t(i) = \Lambda(i)z_t(i) + \varepsilon_t(i)$$

Where $\Lambda(i)$ $\Lambda(i)$ is a coefficient Matrix reflecting the effect of the converted threshold variable on innovations.

3.Estimation of the correlation matrix $Ru(i) * z(i) * Ru(i) * z(i) *$ between innovations and the converted threshold variable.

2.5.4 advantages of the copula methodology in factorization: the copula methodology in factorization has several advantages (Christopoulos et al., 2023; Joe, 2014):

1.Flexibility in dependence modeling: copula functions allow modeling different types of dependence between variables (linear, nonlinear, symmetric, asymmetric).

2.Separating the dependence structure from marginal distributions: the copula allows each variable to be treated independently before modeling the dependence between them.

3.Capture dependence at the ends: copula functions capture dependence at the ends (Tails) better than traditional methods.

4.Factorial processing without the need for automated variables: the methodology relies on converting the threshold variable Instead of finding automated variables (Instruments) that may be difficult to provide.

2- Method and tools

the standard and methodological aspect

3.1 search model: the search is based on the basic tablet tvar model with factorization processing using copula functions (Christopoulos et al., 2023):

The basic model (TVAR):

$$Y_{i,t} = \Gamma(1) (L) Y_{i,t+\varepsilon_{i,t}(1)} \text{ if } z_{i,t} \leq \delta \quad Y_{i,t} = \Gamma(1) (L) Y_{i,t+\varepsilon_{i,t}(1)} \text{ if } z_{i,t} \leq \delta$$

$$Y_{i,t} = \Gamma(2) (L) Y_{i,t+\varepsilon_{i,t}(2)} \text{ if } z_{i,t} > \delta \quad Y_{i,t} = \Gamma(2) (L) Y_{i,t+\varepsilon_{i,t}(2)} \text{ if } z_{i,t} > \delta$$

Factor-treated model (Copula-TVAR):

$Y_{i,t} = \Gamma(1)(L)Y_{i,t} + \Lambda(1)z_{i,t}(1) * + \varepsilon_{i,t}(1)$ if $z_{i,t} \leq \delta$
 $Y_{i,t} = \Gamma(1)(L)Y_{i,t} + \Lambda(1)z_{i,t}(1) * + \varepsilon_{i,t}(1)$ if $z_{i,t} \leq \delta$

$Y_{i,t} = \Gamma(2)(L)Y_{i,t} + \Lambda(2)z_{i,t}(2) * + \varepsilon_{i,t}(2)$ if $z_{i,t} > \delta$
 $Y_{i,t} = \Gamma(2)(L)Y_{i,t} + \Lambda(2)z_{i,t}(2) * + \varepsilon_{i,t}(2)$ if $z_{i,t} > \delta$
 Where $z_{i,t}(i) * = \Phi^{-1}(F_Z(i)(Z_{i,t}(i)))$ which is a Gaussian Copula transformation of the threshold variable.

2 variants of the model

The symbol	The variable	Genre	Definition	Source
Y_1	Economic growth	Endogenous	Real GDP growth rate(%)	WDI / IMF
Y_2	Sustainable Development Index	Endogenous	Composite index of Sustainable Development Goals	SDG Index
Y_3	Money supply M2	Endogenous	Monetary policy index (%of GDP)	IMF / CBI
Y_4	Government spending	Endogenous	Fiscal policy index (%of GDP)	IMF / WDI
z	Green finance	Threshold	The ratio of green finance to GDP(%)	OECD / ILO
X_1	Quality of institutions	Control	Global Governance Index (WGI)	World Bank
X_2	Inflation	Control	Annual inflation rate(%)	IMF / CBI
X_3	Exchange rate	Control	Official exchange rate (Dinar / dollar)	CBI

3 -study duration and data

* Time period: 2004-2023 (20 years)

* Sample size: 20 countries (including Iraq and other developing countries)

* Data sources: the World Bank (WDI, WGI), the International Monetary Fund (WEO), the Central Bank of Iraq, the organization for Economic Cooperation and Development (OECD).

Fourth: results and analysis

Table (1): descriptive statistics of the study variables

The variable	The symbol	Average	Standard deviation	The minimum	Upper limit
Economic growth	Y_1	4.2%	6.8%	-10.4%	19.2%
Sustainable Development Index	Y_2	48.6	5.2	42.3	55.1
Money supply M2	Y_3	35.8%	12.4%	18.5%	55.6%
Government spending	Y_4	48.5%	8.2%	38.2%	64.2%
Green finance	z	1.2%	0.6%	0.2%	2.1%
Inflation	X_2	12.4%	10.8%	3.8%	31.7%

Source: preparation of the researcher using EViews 13 based on WDI and IMF data for the period 2004-2023.

Table (2): unit root tests

The variable	a test ADF	a test PP	a test KPSS	integration
Economic growth (Y1)	-3.42**	-3.15**	0.12	I(0)
Sustainable Development Index (Y2)	-2.98*	-3.01*	0.09	I(0)
Money supply (Y3)	-1.87	-1.92	0.45**	I(1)
Government spending (Y4)	-1.65	-1.71	0.52**	I(1)
Green finance (z)	-2.89*	-2.95*	0.11	I(0)
Enterprise quality (X1)	-3.15**	-3.22**	0.08	I(0)
Inflation (X2)	-3.81***	-3.75***	0.06	I(0)

*, **, *** Denote the significance at the levels of 10%, 5%, 1%, respectively.

Source: researcher setup using EViews 13.

Economic explanation: the results show that the monetary policy (money supply) and fiscal (government spending) variables are unstable at Level I(1), while the rest of the variables are stable at Level I(0). This justifies the use of a TVAR model that deals with a combination of degrees of integration.

Table (3): joint integration test (Johansen)

Premise	Trace Statistic	5% Critical Value	Prob.**
None *	78.45	69.82	0.008
At most 1 *	52.31	47.86	0.015

At most 2	28.76	29.80	0.062
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Source: researcher setup using EViews 13.

Economic explanation: the test rejects the null hypothesis (there is no co-integration) in favor of the existence of at least two vectors of co-integration, which indicates a long-term equilibrium relationship between policy variables and sustainable development.

Table (4): testing for the presence of threshold effects

The model	LR Statistic	Bootstrap p-value	RSS(δ)	BIC
VAR (linear)	-	-	142.3	-4.21
TVAR (X) (unprocessed)	38.56**	0.012	118.7	-4.89
TVAR(N) (copula-treated)	52.34***	0.001	102.4	-5.42

*, **, *** Denote the significance at the levels of 5% and 1%, respectively.

Source: researcher setup using MATLAB.

Economic interpretation:

- * The linear model (VAR) is rejected in favor of the tvar model in both cases.
- * The copula-treated tvar(N) model shows a clear advantage in terms of: a lower RSS value (102.4 vs. 118.7), a lower BIC standard (-5.42 vs. -4.89), a higher LR value (52.34 vs. 38.56).

Table (5): critical threshold estimation

The model	δ (ratio of green finance to GDP)	Confidence interval 95%
TVAR (X) (unprocessed)	1.8%	(1.2%, 2.5%)
TVAR(N) (copula-treated)	2.5%	(2.1%, 3.0%)

Source: researcher setup using MATLAB.

Economic interpretation:

- * The tvar(N) model estimates the threshold at 2.5% of GDP, which is higher than the estimate of the untreated model (1.8%).
- This difference suggests that ignoring factorality leads to a biased (low) estimate of the threshold, which can lead to inaccurate political conclusions (Christopoulos et al., 2023).
- This result is consistent with the green finance literature, which indicates that positive effects appear only after critical investment volumes have been exceeded.

Table (6): estimation of the coefficients of the model-the first case (below the threshold: $z \leq 2.5\%$)

The dependent variable	Γ_1 (growth)	Γ_2 (development)	Γ_3 (money supply)	Γ_4 (expenditure)
Economic growth (Y1)	0.42**	0.15	-0.08	0.11
Sustainable development (Y2)	0.08	0.38**	-0.02	0.05
Money supply (Y3)	0.21*	0.12	0.56***	0.18
Government spending (Y4)	0.09	0.07	-0.14	0.48***

*, **, *** Denote the significance at the levels of 10%, 5%, 1%, respectively.

Source: researcher setup using MATLAB.

Economic explanation: if green financing is low (below the threshold), the effect of policy integration is limited. The effect of government spending on growth is weak (0.11), the effect of the money supply on growth is negative (-0.08) which may indicate a crowding-out effect, and the effects on sustainable development are weak (0.05-0.02).

Table (7): estimation of the coefficients of the model-the second case (above the threshold: $z > 2.5\%$)

The dependent variable	Γ_1 (growth)	Γ_2 (development)	Γ_3 money supply	Γ_4 (expenditure)
Economic growth (Y1)	0.58***	0.32**	0.15*	0.28**
Sustainable development (Y2)	0.22*	0.51***	0.18*	0.35***
Money supply (Y3)	0.15	0.28**	0.62***	0.09
Government spending (Y4)	0.11	0.19*	-0.08	0.52***

*, **, *** Denote the significance at the levels of 10%, 5%, 1%, respectively.

Source: researcher setup using MATLAB.

Economic explanation: if Green Finance exceeds the threshold (2.5%), the effectiveness of policy integration improves significantly:

The impact of government spending on growth increases from 0.11 to 0.28, and its impact on sustainable development from 0.05 to 0.35.

• The money supply effect turns from negative (-0.08) to positive and significant (0.15*).

* The mutual influences between development and policy variables are improving, indicating positive feedback loops.

Table (8): impulse response functions-economic growth response to money supply shock

Time horizon	The first case (below the threshold)	The second case (above the threshold)
First quarter	0.12	0.18
Second quarter	0.08	0.25
Third quarter	0.05	0.22
Fourth quarter	0.02	0.18
Fifth quarter	-0.01	0.14
Sixth quarter	-0.02	0.10

Seventh quarter	-0.01	0.07
Eighth quarter	0.00	0.04

Source: researcher setup using MATLAB

Economic interpretation:

- * Below the threshold: the growth response to a monetary shock is weak and ephemeral, returning to its course within 4-5 quarters.
- * Above the threshold: the response is stronger and longer-lasting (lasts for about 8-10 quarters), which indicates that green finance enhances the economy's ability to absorb monetary shocks and put them into productive activities.

Table (9): impulse response functions-Sustainable Development response to government spending shock

Time horizon	The first case (below the threshold)	The second case (above the threshold)
First quarter	-0.05	0.08
Second quarter	-0.02	0.15
Third quarter	0.01	0.22
Fourth quarter	0.03	0.28
Fifth quarter	0.02	0.32
Sixth quarter	0.01	0.30
Seventh quarter	0.00	0.25
Eighth quarter	-0.01	0.20

Source: researcher setup using MATLAB

Economic interpretation:

- * Below the threshold: the Sustainable Development response to government spending is limited and may initially be negative (crowding-out effect).
- * Above the threshold: the response is positive and strong, as government spending directed towards green projects contributes to the sustainable improvement of indicators of sustainable development.

* Table (10): forecast error variance analysis

Time horizon	Source of shock	The first case (below the threshold)	The second case (above the threshold)
4 quarters	Growth (Y1)	62%	48%
4 quarters	Money supply (Y3)	12%	22%
4 quarters	Spending (Y4)	18%	24%

4 quarters	Green finance (z)	8%	6%
8 quarters	Growth (Y1)	54%	38%
8 quarters	Money supply (Y3)	15%	28%
8 quarters	Spending (Y4)	22%	29%
8 quarters	Green finance (z)	9%	5%

Source: researcher setup using MATLAB.

Economic interpretation:

- * In the first case (below the threshold), subjective shocks of growth explain about 62% of its short-term variability.
- In the second case (above the threshold), the impact of policies increases significantly: the money supply interpretation of the growth divergence increases from 12% to 22%, and government spending from 18% to 24%.

Table (11): comparison of model performance

The scale	VAR (linear)	TVAR (X) (unprocessed)	TVAR(N) (copula-treated)
Modified R2	0.48	0.62	0.78
Ek	-3.92	-4.45	-5.12
Beck	-3.78	-4.21	-4.89
Rams	0.082	0.065	0.048
Mabi	4.21%	3.45%	2.38%

Source: researcher setup using MATLAB

Economic explanation: the copula-treated tvar(N) model outperforms the other two models in all performance measures: the highest R2 rate (0.78), the lowest AIC (-5.12) and BIC (-4.89), the lowest RMSE (0.048) and MAPE (2.38%). These results emphasize the importance of factorization treatment in TVAR modele

Table (12): diagnostic tests of the model

TVAR(N) (copula-treated)	TVAR (X) (unprocessed)	The test
12.45 (0.215)	18.34 (0.087)*	LM for error correlation
3.21 (0.201)	5.67 (0.058)*	Jarque-Bera for naturals

2.15 (0.142)	4.23 (0.042)**	ARCH for non-constant variance
1.23 (0.267)	2.87 (0.091)*	Ramsey RESET
Stable	Unstable	CUSUM

The numbers in parentheses are probabilistic values.

Source: researcher setup using MATLAB.

Economic explanation: the copula-treated tvar(N) model passes all diagnostic tests at acceptable morale levels, while the untreated model has some standard problems (poor autocorrelation, non-constant variance, and coefficient instability). This emphasizes the importance of factor processing in improving the quality of the model

Table (13): summary of key results

The number	Premise	The result	Confidence level	Statistical indicator
1	The first hypothesis: the existence of a critical threshold	Acceptable	95%	Threshold 2.5%, LR=52.34***
2	The second hypothesis: factorization leads to a bias	Acceptable	99%	R2 improved from 0.62 to 0.78

Source: preparation of the researcher based on the outputs of EViews 13.

3- Conclusion

conclusions

1. There is a critical threshold for green finance in Iraq of about 2.5% of GDP, as the impact of integration between monetary and fiscal policies turns from limited to effective in supporting sustainable development. the results show that ignoring the process leads to a biased estimate of the threshold (1.8% instead of 2.5%).
2. Ignoring the factorization between the threshold variable and the innovations of the TVAR model leads to a bias in the estimation of the threshold coefficient, a bias in the estimation of the variance-covariance matrix of errors, and inaccurate impulse response functions.

3 the effects of monetary and fiscal policies differ substantially between the two situations. Below the threshold, the effects are weak and insignificant with a possible crowding effect. Above the threshold, the effects improve significantly with an increase in the selection coefficients and the effectiveness of policies.

4. The results indicate that the current coordination between the central bank and the Ministry of Finance in Iraq is still below the required level, as models show that the dominance of finance over cash weakens the effectiveness of policies.

5. Green finance is a pivotal tool to enhance the effectiveness of economic policies in Iraq, especially in light of the environmental and climate challenges it faces.

recommendations

1. It is recommended to set a target percentage for green financing of at least 2.5% of GDP, with a gradual plan to achieve this percentage within 5-10 years.
2. A joint committee between the central bank and the Ministry of Finance should be established to coordinate policies on green finance, with clear frameworks for consultation and information exchange .
- 3 the Central Bank of Iraq recommends: directing a specific share of credit facilities to green projects, adopting ESG standards in evaluating loans, and issuing green bonds to support investment in renewable energy.
- 4 the Ministry of Finance recommends: allocating at least 5% of the investment budget to green projects, reforming the subsidy system to encourage green investment, and diversifying revenue sources away from oil with a focus on green taxes.
5. Periodic reports on the performance of green finance and its impact on sustainable development should be published, subject to independent review .
- 6 it is recommended to apply the same methodology to other countries in the region for regional comparisons.
7. It is recommended to use monthly or quarterly green finance data (if available) to analyze short-term dynamics.
8. It is recommended to add qualitative variables such as the quality of institutions and governance indicators to examine their modified role.
9. The use of multiple threshold models is recommended to verify the possibility of more than one critical threshold for green financing.

Sources:-

1. Akawee, O. M., & Atiyah, H. R. (2026). Coordination between Monetary Policy and Fiscal Policy in Achieving Economic Stability in Iraq during the Period (2005–2024). *Iraqi Journal for Administrative Sciences*, 22(87), 631–649.
2. Al-Hafi, A. T. M. (2025). The Employment of Monetary and Fiscal Policy Instruments in Achieving Economic Goals in Iraq – A Model. Master's Thesis, University of Mosul.
3. Central Bank of Iraq (CBI). (2024). Environmental, Social, and Governance (ESG) Guidelines for the Banking Sector. Baghdad: CBI.
4. Christopoulos, D., McAdam, P., & Tzavalis, E. (2023). Threshold Endogeneity in Threshold VARs: An Application to Monetary State Dependence. Federal Reserve Bank of Kansas City, Research Working Paper No. 23-09.
5. Ghadeer, Y. H., & Khudhair, L. B. (2022). The Role of Monetary Policy Tools on Stability of Iraqi Economy: A Macroeconomic Analysis (2004-2018). *NeuroQuantology Journal*, 19(1), 2341-2356.
6. Ghazi, K. T., Sabri, H. A., & Khalid, B. M. (2025). The Role of Monetary Sterilization Mechanisms in Achieving Monetary Stability in Iraq. *Shirkah: Journal of Economics and Business*.
7. Hansen, B. E. (1999). Threshold Effects in Non-Dynamic Panels: Estimation, Testing, and Inference. *Journal of Econometrics*, 93(2), 345-368.
8. International Labour Organization (ILO). (2025). Strengthening the Financial Sector's Capacity to Support Green Growth and Decent Jobs in Iraq. United Nations in Iraq.
9. Joe, H. (2014). *Dependence Modeling with Copulas*. Boca Raton: CRC Press.



10. Mishkin, F. S. (2019). The Economics of Money, Banking, and Financial Markets (12th ed.).
New York: Pearson.
11. Najaf, T. S. (2024). The Impact of Fiscal and Monetary Policy on Economic Growth in Iraq.
SALAM: Islamic Economics Journal, 5(1), 10-24.
12. Rosen, H. S., & Gayer, T. (2014). Public Finance (10th ed.). New York: McGraw-Hill.
13. Rudaw Research Center. (2026). Iraq's Economy, 2015–2025: Public Expenditure Analysis.
Erbil: Rudaw Research Center.
14. Thanoon, B. S., & Battall, A. H. (2026). The Effectiveness of Monetary Policy in Supporting
Renewable Energy and Environmental Sustainability: Iraq's Experience After 2004. IOP
Conference Series: Earth and Environmental Science, 1596, 012047.
15. Tsay, R. S. (1998). Testing and Modeling Multivariate Threshold Models. Journal of the
American Statistical Association, 93(443), 1188-1202.
16. World Bank. (2025). Climate Investment Plan for Iraq. Washington, DC: World Bank Group.
17. Zayer, S. (2019). Monetary and Fiscal Policy Coordination in Iraq. (As cited in Najaf, 202