The Threshold Effect of Oil Rent on Non-Oil Economic Growth in Light of Financial Development: A Case Study of Iraq

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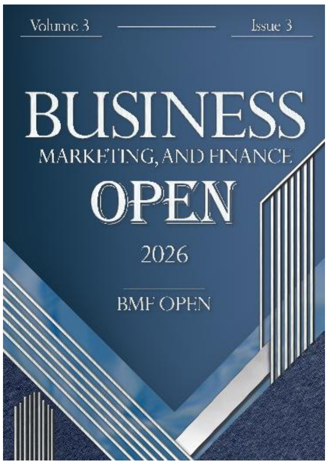

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Abstract: The purpose of this study is to examine the effect of oil rent on Iraq's non-oil economic growth and to investigate the moderating role of financial development as a threshold variable in this relationship. To measure financial development in Iraq's economy, three key indicators—(1) the ratio of credit to the private sector, (2) the ratio of liquidity to GDP, and (3) the ratio of bank credit to GDP—were selected. These indicators were integrated into a composite index using the Principal Component Analysis (PCA) method to address collinearity and the limitations of individual measures. The index was incorporated into an extended Solow neoclassical growth model that includes financial development and oil resource variables. Time series data from 1998 to 2023 were analyzed using stationarity and cointegration tests as well as the threshold regression model. A set of diagnostic tests was also conducted to ensure the validity of the results. All estimations were performed using EViews and Stata software. The findings revealed that Iraq's economic time series variables during the period 1998–2023 exhibited mixed stationarity characteristics—some variables, such as LnYIRAQ and LnFDIRAQ, were stationary at level, while others became stationary after first differencing. Across the four estimated threshold regression models with different financial development indicators, neither capital nor labor variables showed significant effects on non-oil growth, reflecting Iraq's strong structural dependence on oil and institutional weaknesses. Regarding oil rent, at low levels of financial development, its effect was generally positive but statistically insignificant (except in the third model, where it was positive and significant). In contrast, at high levels of financial development, the effect of oil rent became negative and, in some cases, significant (notably in the third and fourth models). Diagnostic tests—including residual analysis, Portmanteau, and CUSUM—confirmed the stability and goodness of fit of the models, except in the fourth model, where heteroskedasticity was detected. This issue was corrected using robust standard errors, which further reinforced the negative impact of oil rent. Overall, the results indicate that even when financial indicators surpass quantitative thresholds, without improvements in institutional quality and resource allocation efficiency, adverse phenomena such as the "resource curse" and "Dutch disease" cannot be avoided.

Keywords: Oil rent, non-oil economic growth, financial development, threshold regression model, Iraq

1. Introduction

Natural resource abundance has long been portrayed as a double-edged sword for economic development: while rents can relax fiscal and external constraints, they may simultaneously weaken incentives for structural transformation, crowd out tradables, and entrench institutional fragilities that suppress long-run productivity growth [1, 2]. Oil-exporting economies are quintessential laboratories for this paradox. In contexts where hydrocarbon receipts dominate public finance and foreign exchange, the growth effects of oil rents are mediated by the quality and depth of domestic financial intermediation, the composition of public spending, the stability of the banking system, and the capacity of institutions to convert windfalls into productive capital accumulation [3-5]. Iraq is emblematic: decades of conflict, sanctions, reconstruction cycles, and commodity price volatility have produced an economy with a large oil sector and a comparatively narrow non-oil base. Understanding whether, when, and how oil rents catalyze (or impede) non-oil growth hinges on the broader macro-financial environment and the thresholds at which financial development changes the sign or magnitude of rent-growth linkages [3, 6].

Classical growth theory provides a natural starting point. The Solow model links steady-state income to savings, population growth, depreciation, and exogenous technological progress, attributing transitional dynamics to capital deepening and long-run growth to total factor productivity (TFP) [7]. Yet the model is intentionally silent on the policy and institutional channels that govern how windfall revenues feed into savings, investment, and technology; in extensions, resource rents may affect growth through TFP or the efficiency with which capital is allocated [8, 9]. Empirically, the impact of capital and labor on growth is state-contingent, varying with development stage, the composition of capital (physical versus human), and the financial sector's capacity to mobilize savings and screen projects [10, 11]. For oil exporters, these interactions can be nonlinear: at low levels of financial depth, rents may ease binding liquidity constraints and stimulate non-oil activity; beyond certain thresholds, however, they can exacerbate real exchange-rate pressures, induce procyclical credit expansions, or encourage rent-seeking that diverts resources from productive uses [2, 3].

Nonlinearity and regime dependence are not merely theoretical curiosities. Threshold regression offers a rigorous way to test whether the effect of a regressor changes once an observable mediator—here, financial development—crosses a critical value [12]. Applications across energy and environmental economics, as well as pandemic-era shocks, document that economic relationships often exhibit sharp breaks that conventional linear models blur or misstate [6, 13]. In resource economics, panel threshold models reveal that financial development can either mitigate or amplify the so-called "resource curse," depending on whether banking systems and capital markets channel resource-based liquidity into tradable, innovation-oriented investment or into speculative and non-tradable activities [2]. For Iraq, where oil receipts dominate government revenue and export earnings, identifying such thresholds is essential to disentangling the conditions under which oil rents foster diversification rather than crowding it out [14, 15].

The financial sector's role in this process is multifaceted. Banking soundness affects confidence, intermediation costs, and credit cycles that transmit oil-price volatility into the non-oil economy [4]. Monetary policy and financial depth shape inflation dynamics and real interest rates, which in turn condition private investment decisions [16, 17]. Exchange-rate uncertainty and forecastability influence expectations and the allocation of portfolios between tradable production and safe assets; accordingly, time-series forecasting tools such as ARMA/ARIMA are central to macro-financial surveillance in resource-rich settings [18, 19]. At the same time, financial inclusion determines whether households and small and medium enterprises (SMEs) can access credit lines that transform oil-driven liquidity into non-oil entrepreneurship and employment [20]. In South Africa and the CFA zone, recent evidence shows that market capitalization, institutional quality, and bank-market complementarity matter for the finance–growth–jobs nexus, underscoring the generalizability of institutional thresholds across regions [21, 22]. Parallel insights from Ethiopia highlight the intertwined roles of inflation, exchange rates, and unemployment in shaping growth, again suggesting that macro-financial conditions mediate the payoff of resource revenues [23]. For Iraq, where SMEs and family businesses operate in a context of volatility and regulatory frictions, the micro-cultural fabric of entrepreneurship can either amplify or dampen the growth transmission of macro-level rents [24].

From a measurement perspective, the construction of credible, summary indicators of financial development is itself nontrivial. Single proxies such as private-sector credit/GDP, liquidity (M2)/GDP, or bank credit/GDP capture different facets—depth, breadth, and intermediation—yet each is noisy and potentially collinear. Principal component analysis (PCA) offers a principled, data-driven approach to aggregate correlated measures into a composite index that explains the maximal variance subject to orthogonality constraints [25]. In the presence of multicollinearity across financial ratios, PCA-based indices reduce dimensionality, sharpen identification, and facilitate threshold estimation by producing a scalar mediator that summarizes multiple market signals [25]. Given the heterogeneity of Iraq's banking system and liquidity conditions over 1998–2023, a PCA-constructed index alongside canonical ratios can enhance robustness and comparability.

The policy literature supplies additional reasons to expect threshold behavior in rent-growth linkages. When banking systems are shallow or fragile, oil-price upswings can finance critical infrastructure, smooth public investment, and catalyze tradable sectors; when systems are deeper but supervisory capacity lags, the same liquidity may fuel credit booms directed toward non-tradables, widen current-account imbalances, and raise the real exchange rate—classic symptoms of Dutch disease [2, 3]. Banking soundness and prudential policy thus operate as safeguards that transform transitory rents into permanent productivity gains [4]. Equally, the composition of public expenditure conditions the marginal product of capital: where oil finances education and infrastructure, growth multipliers can be large; where it underwrites current transfers or unproductive subsidies, multipliers may be small or even negative [5]. Trade openness can complement this process by disciplining real exchange-rate misalignments and scaling markets for non-oil exports, as shown in Iraq's post-2003 experience [15].

The broader developmental agenda—green growth, diversification, and resilience—adds further complexity. Latin America's renewable energy transition illustrates how policy frameworks can reorient growth paths toward sustainability when financial architecture supports innovation, long-term finance, and risk-sharing [26]. Although sectoral contexts differ, these experiences reinforce the notion that the finance–growth nexus is ultimately institutional: the same depth measures can produce radically different outcomes depending on governance, regulation, and policy credibility [22]. Even outside conventional macroeconomics, systems perspectives stress the co-evolution of economic and ecological equilibria, a reminder that diversification strategies in oil exporters must internalize environmental constraints and long-run balance conditions [27]. For economies confronting high macro uncertainty, such as Iran, the growth effects of monetary policy and uncertainty shocks further emphasize the need for robust institutions and countercyclical frameworks—insights that travel to Iraq's policy space [28].

Against this conceptual backdrop, our empirical strategy leverages time-series methods tailored to structural breaks and nonlinearities. As a first step, the order of integration is diagnosed with standard unit-root tests, acknowledging that macro series in fragile, resource-dependent economies often mix I(0) and I(1) processes [18]. Depending on integration properties, cointegration tests help uncover long-run equilibria between non-oil output, oil rents, and financial development; in parallel, ARMA/ARIMA models serve in robustness checks and forecasting auxiliary variables (e.g., inflation or exchange rates) that condition growth dynamics [16, 19]. The core identification relies on single-threshold regressions à la Hansen, in which the slope of oil rent switches when the financial indicator crosses an endogenously estimated γ, thereby directly testing whether "finance makes oil a blessing or a curse" [2, 12]. Because threshold effects have been widely documented in energy intensity and pollution responses to shocks—both domains characterized by adjustment costs and capacity constraints—the same econometric architecture is well-suited to the Iraqi case [6, 13].

Our Iraq-specific contribution is threefold. First, we analyze non-oil growth rather than aggregate GDP, aligning the dependent variable with the diversification objective that policy makers prioritize. This design isolates the transmission of oil rents to the productive, non-hydrocarbon economy—manufacturing, agriculture, and services—where employment and innovation multipliers are typically higher [3, 14]. Second, we treat financial development both as a vector of conventional ratios and as a PCA-based composite, reducing measurement error and addressing collinearity across depth indicators [25]. Third, we embed the analysis in a Solow-type growth framework with explicit controls for capital and labor, but we allow their marginal effects—as well as the oil-rent elasticity—to vary across financial regimes, consistent with evidence that the relative importance of factors is development-stage contingent [7, 8, 10]. In doing so, we speak to the long-standing debate over whether oil rents finance convergence (by easing capital scarcity) or perpetuate divergence (by weakening productivity and tradables), and whether the answer depends on passing institutional and financial thresholds [1, 2].

Related literatures intersect with our inquiry. Studies on financial inclusion in Africa document that access to accounts, credit, and payments infrastructure can reduce poverty and inequality while boosting growth—mechanisms that, in oil exporters, may determine whether hydrocarbon revenues are intermediated to SMEs and households or captured by insiders [20]. Evidence from stock-market development and job creation in South Africa shows that market capitalization can co-evolve with growth and employment under supportive institutional arrangements, highlighting the importance of market depth beyond banking [21]. In the CFA zone, the finance–growth link is found to be conditional on institutional quality, reinforcing our emphasis on governance as a latent threshold that interacts with measured financial depth [22]. On the macro side, the joint dynamics of inflation, exchange rates, and unemployment are critical growth covariates, as recent Granger-causality evidence for Ethiopia suggests [23]. Complementarily, public-expenditure composition shapes industrial growth in ways that are highly relevant for oil-rich, reconstruction-oriented states [5]. These strands converge on a common theme: quantitative increases in liquidity or credit are insufficient; the institutional allocation mechanism is decisive.

We also heed country-specific work on Iraq's non-oil economy. Analyses of non-oil public revenues indicate that fiscal diversification is both a policy goal and a constraint: when oil cycles dominate revenue, countercyclical policy space shrinks, procyclicality rises, and public investment quality can deteriorate, all of which condition the growth effect of rents [14]. Trade integration since 2003 has shaped sectoral outcomes unevenly, interacting with exchange-rate movements and security shocks; these dynamics underscore the need to control for external conditions when interpreting oil-rent coefficients [15]. At the same time, the cultural and managerial underpinnings of SMEs—leadership norms, risk attitudes, and informality—affect how credit shocks translate into firm entry, survival, and scaling [24]. Taken together, Iraq's growth narrative is not reducible to a single factor; it is an institutional equilibrium in which oil, finance, policy, and enterprise ecology co-determine outcomes.

Finally, we situate the study within a forward-looking policy frame. Transitions toward greener energy systems worldwide suggest that future oil demand may be more volatile, strengthening the case for transforming rents into diversified, productivity-enhancing assets today [26]. A systems view—balancing economic growth with ecological constraints—calls for investment selection and financial regulation that favor tradables, innovation, and human capital over consumption booms [9, 27]. Methodologically, threshold identification offers actionable diagnostics: if the oil-rent elasticity of non-oil output turns negative above a given financial-depth threshold, then reforms must pivot from quantitative expansion to qualitative strengthening—banking supervision, governance, and market discipline—so that finance complements, rather than undermines, diversification [2, 6, 12]. In operational terms, PCA-based indices provide compact policy dashboards, while time-series forecasting tools support macroprudential calibration in the face of commodity shocks [18, 19, 25].

In summary, this study integrates a Solow-type growth framework with Hansen-style threshold regression to test whether the effect of oil rents on Iraq's non-oil growth depends on crossing critical levels of financial development as measured by conventional ratios and a PCA-based composite, while situating the analysis within broader macro-financial, institutional, and policy literatures that emphasize nonlinearity, regime dependence, and the primacy of governance.

2. Methodology

Measuring Financial Development Using Principal Component Analysis (PCA)

One of the most important stages of this study involves measuring the level of financial development in Iraq's economy. To construct a composite index of financial development, three key variables—commonly used in similar empirical studies—were employed:

1. The ratio of credit granted to the private sector to gross domestic product (GDP), which reflects the degree of access of firms and households to financial resources from the banking system and serves as a primary indicator of financial depth.
2. The ratio of liquidity (M2) to GDP, which measures monetary expansion and the availability of liquid assets in the economy. This ratio reflects the capacity of the financial system to mobilize savings and allocate them to productive investments.
3. The ratio of banking system credit to GDP, which not only evaluates the intermediation function of financial institutions but also indicates the extent to which banks support the real sector of the economy.

Although each of these indicators is significant individually, using them separately leads to issues such as multicollinearity and limited interpretability. For example, in some years, an increase in liquidity may not necessarily indicate real financial development, since part of that liquidity growth could stem from budget deficits or external shocks. Therefore, relying on single indicators may produce misleading results.

To address this problem, the present study employed Principal Component Analysis (PCA). PCA is one of the most widely used and reliable multivariate statistical techniques, frequently applied in economic and financial research to construct composite indices. The fundamental principle of PCA is to transform a set of correlated variables into a smaller number of uncorrelated components that explain the maximum variance in the data. Consequently, this method allows for the construction of an index that captures information from all three selected variables while also accounting for their intercorrelations and reducing collinearity problems (Jolliffe & Cadima, 2016).

In the standard application of PCA as an exploratory data analysis tool, suppose a dataset contains observations on p numeric variables for each of n units (or individuals). These data values form p-dimensional vectors of length n, denoted as X_1, …, X_p, or equivalently, an $n \times p$ data matrix X, where the i-th column represents the observation vector of the *j*-th variable, i.e., x_j. The goal is to find a linear combination of the columns of matrix X that yields the maximum variance. Such linear combinations are expressed as:

$$Xa = \sum_{j=1}^{p} a_j x_j \qquad (1)$$

where a is a vector of coefficients ($a_1, a_2, \ldots, a_p$).

Taking the derivative with respect to vector a and setting it equal to zero gives the following eigenvalue equation:

$$Sa - \lambda a = 0 \quad \Leftrightarrow \quad Sa = \lambda a \qquad (5)$$

If the eigenvectors in equation (5) are multiplied by negative one, they remain valid; therefore, the signs of the loadings and scores are arbitrary, and only their relative magnitudes and sign patterns are meaningful.

The PCA implementation process in this study involved the following steps: first, constructing the covariance matrix among the three variables; second, extracting components using eigenvalue and eigenvector decomposition; and third, selecting the components based on the Kaiser criterion (Eigenvalue > 1) and the scree plot. The first extracted component, which captured the largest share of common variance among variables, was employed as the composite index of financial development. This index is particularly valuable because the weighting of variables is performed mathematically and statistically rather than arbitrarily or subjectively.

Empirical Model of the Study

The research model is grounded in the theoretical framework of economic growth, particularly the Solow neoclassical growth model, which serves to analyze the determinants of growth and the roles of financial development and natural resources.

The Solow model was developed as a critical response to the Harrod–Domar growth theory, which assumed that capital and labor were non-substitutable and that the system operated under inherent instability. Solow introduced the concept of substitutability between capital and labor, thereby resolving the "knife-edge instability" problem (G.C., 2020). Consequently, the Solow model provides a framework for simultaneously analyzing the effects of capital, labor, and technology on long-term economic growth. It also allows for various extensions and modifications, including human capital accumulation, financial development, endogenous technological progress, and variable demographic and investment trends (Samambet, 2024).

At the core of the Solow growth model are three primary inputs: capital (K), labor (L), and technology (A). The production function used in this study follows the Cobb–Douglas form, assuming constant returns to scale with respect to effective capital and labor. Constant returns to scale imply that doubling both capital and effective labor results in an exact doubling of total output. This characteristic ensures that proportional changes in inputs translate directly into proportional changes in output, facilitating a clear interpretation of the marginal effects of each input on economic growth (Solow, 1956). The production function is expressed as:

$$Y = F(K, AL) = K^{\alpha} (AL)^{1-\alpha} \qquad (13)$$

In this equation, α represents the output elasticity of capital, and $(1-\alpha)$ represents the output elasticity of labor. The term AL denotes effective labor, which incorporates technological progress that enhances labor productivity (Den & Tach, 2024).

The dynamics of capital accumulation in the Solow model are described by the following equation:

$$dK/dt = sY - \delta K \qquad (16)$$

where s is the constant savings rate, δ is the depreciation rate of capital, and Y is total output. This equation indicates that changes in the capital stock result from the difference between gross investment (sY) and capital depreciation (δK).

To refine the analysis, capital per unit of effective labor is defined as $k = K/(A L)$, and its dynamics are expressed as the following differential equation:

$$dk/dt = s f(k) - (\delta + n + g) \cdot k \quad (17)$$

where n is the population growth rate and g is the technological growth rate. The function $f(k)$ represents the intensive form of the production function per effective labor unit. This transformation focuses on effective capital and reduces model dimensionality, facilitating steady-state analysis.

The steady state occurs when capital per effective labor remains constant (dk/dt = 0). In this case, gross investment equals break-even investment:

$$s f(k) = (\delta + n + g) \cdot k \quad (18)$$

The production function satisfies the Inada conditions to ensure diminishing returns to capital, meaning that as $k \to 0$, the marginal product of capital approaches infinity, and as $k \to \infty$, it approaches zero:

$$\lim_{k \to 0} f'(k) = \infty \quad \text{and} \quad \lim_{k \to \infty} f'(k) = 0 \quad (19)$$

These conditions guarantee that the economy converges toward a unique and stable steady state regardless of initial conditions (Ehiakpor & Akapare, 2015; Tsolaridis, 2021). For a Cobb–Douglas production function, the steady-state level of capital is explicitly given by:

$$k^* = [s / (\delta + n + g)]^{(1/(1-\alpha))} \quad (20)$$

Given the importance of financial development and natural resources in oil-dependent economies, the present model extends the production function to include direct effects of oil resources (OR) and financial development (FD) on output:

$$Y(t) = \Omega \, OR(t)^{\gamma} \, FD(t)^{\delta} \, K(t)^{\alpha} \, L(t)^{\beta} \quad (22)$$

where Ω is a time-invariant constant, and γ and δ represent the output elasticities of oil resources and financial development, respectively. The empirical estimation form, after taking the natural logarithm and adding the stochastic error term $\varepsilon(t)$, becomes:

$$\ln[Y(t)] = \varphi + \gamma \ln[OR(t)] + \delta \ln[FD(t)] + \alpha \ln[K(t)] + \beta \ln[L(t)] + \varepsilon(t) \quad (23)$$

where $\varphi = \ln(\Omega)$ is the constant term. This logarithmic form allows for the analysis of relative effects and direct comparison of elasticities, constituting a standard approach in econometric growth studies. The present model follows the theoretical framework proposed by Hasanov et al. (2023), which incorporates the effects of oil rent and financial development on output through parameter A.

Statistical and Econometric Methods

Following the formulation of the theoretical model and conceptual framework, the next stage involved selecting appropriate econometric tools and statistical tests to examine the hypotheses and validate the models. The choice of statistical methods in econometric research—particularly in studies of natural resource economics and financial development—depends not only on the nature of the data but also on the structure of the assumed relationships and the specific characteristics of the economy under study.

Given Iraq's heavy dependence on the oil sector and its fragile financial institutions undergoing transition, this study employed a combination of classical and modern econometric methods. This approach aimed to prevent issues such as spurious regression and inconsistent estimations, while enabling precise analysis of nonlinear oil rent effects within the context of financial development.

The study utilized time-series data for the Iraqi economy over the period 1998–2023. Due to the distinctive features of macroeconomic data—including long-term trends, exposure to external shocks, and sensitivity to political and economic crises—analysis of such data requires adherence to a set of standard econometric procedures, which are described below.

Stationarity Tests

The first and most crucial step in time-series analysis is to test the stationarity of variables. Non-stationary variables, if used without adjustment in regression models, can lead to misleading estimations and spurious regressions. This issue is especially critical for economies such as Iraq's, which experience strong fluctuations due to oil and political shocks.

Therefore, before estimation, the Augmented Dickey–Fuller (ADF) and Phillips–Perron (PP) unit root tests were applied to all variables (Isiaka et al., 2021). The ADF test, by including lagged dependent variables in the regression equation, largely mitigates autocorrelation in the error term, while the PP test uses non-parametric corrections to account for heteroskedasticity and autocorrelation. Employing both tests enhances reliability in determining the degree of integration of the variables. The results indicated that all variables became stationary either at level or after first differencing, eliminating the risk of spurious regression in the main model (Refaie & Zahirul-Haq, 2024).

Cointegration Test

After identifying the order of integration, the next step was to examine the existence of long-term relationships among the variables. Cointegration implies that a specific linear combination of non-stationary variables is stationary, meaning they move together around an equilibrium path over time (Adebayo et al., 2014). This property is crucial for the present study, as one of its main objectives is to investigate the long-term equilibrium relationship among oil rent, financial development, and non-oil economic growth.

Accordingly, cointegration tests were employed to detect equilibrium relationships among the variables. The existence of such relationships suggests that, although short-term fluctuations may occur due to oil shocks or institutional changes, the long-term interaction between oil rent and financial development guides the economy toward a shared equilibrium trajectory.

Threshold Regression Model

The central methodological component of this research is the application of the threshold regression model, originally proposed by Hansen (1996), which enables the analysis of nonlinear relationships where a threshold variable alters the magnitude and direction of effects (Zhou et al., 2021). In this study, various indicators of financial development—such as the ratio of private sector credit to GDP, liquidity-to-GDP ratio, banking credit-to-GDP ratio, and the composite financial development index—served as threshold variables.

The rationale behind using this model is that financial development may moderate the relationship between oil rent and non-oil economic growth. In other words, the impact of oil rent on growth is not necessarily linear or constant; rather, it may shift from positive to negative (or vice versa) depending on the level of financial development. Consequently, optimal threshold points were identified using nonlinear least squares estimation, and the model was subsequently estimated for two regimes—below and above the threshold. This approach made it possible to assess significant differences in the effects of oil rent under varying levels of financial development.

Diagnostic and Validation Tests

The validity of econometric results depends on the robustness of diagnostic testing. Accordingly, a set of diagnostic tests was conducted to verify the classical assumptions and ensure the appropriate fit of the models:

- **Residual Analysis:** The mean, standard deviation, and range of residuals were examined to detect any systematic patterns or bias. The results showed that the residuals had means close to zero and acceptable standard deviations in all models.

- **Portmanteau Test:** Used to check for serial correlation in residuals. The *p*-values were all well above 0.05, rejecting the hypothesis of autocorrelation and confirming that the residuals followed a white-noise process.
- **Heteroskedasticity Test:** The F-statistic was used to compare residual variances across regimes. Homoskedasticity was confirmed in the first three models, while heteroskedasticity was detected in the fourth model. Therefore, the fourth model was re-estimated using robust standard errors, which improved coefficient precision and reduced standard errors.
- **Coefficient Stability Test:** Conducted to assess parameter stability over the 1998–2023 period. The test statistics were below the critical values at all significance levels, indicating stable coefficients and no structural instability.

These diagnostic procedures ensured the validity and robustness of the research findings.

All econometric estimations were performed using EViews and Stata software. These packages are widely utilized in similar studies due to their strong capabilities in handling time-series data and executing advanced econometric tests. In this study, EViews was employed for stationarity, cointegration, and residual analyses, while Stata was used for estimating the threshold regression model and conducting additional diagnostic tests.

3. Findings and Results

A) Empirical Results

To ensure the statistical validity of the threshold model and the significance of the estimated relationships among variables, the Augmented Dickey–Fuller (ADF) test was used. The null hypothesis of this test is the presence of a unit root and, therefore, non-stationarity of the variables. If the test statistic is smaller (more negative) than the critical value and the p-value is less than the significance level (e.g., 5%), the null can be rejected and the variable is deemed stationary. The results of this section are presented in Table (1).

Table 1. Results of Unit Root Tests

Variable	ADF Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value	MacKinnon p-value
LnYIRAQ	-3.440	-3.750	-3.000	-2.630	0.0097
LnORIRAQ	-1.929	-3.750	-3.000	-2.630	0.3186
LnKIRAQ	-1.842	-3.750	-3.000	-2.630	0.3597
LnLIRAQ	0.105	-3.750	-3.000	-2.630	0.9664
LnFD1IRAQ	-0.841	-3.750	-3.000	-2.630	0.8067
LnFD2IRAQ	-0.908	-3.750	-3.000	-2.630	0.7853
LnFD3IRAQ	-3.371	-3.750	-3.000	-2.630	0.0120
LnFDIRAQ	-7.451	-3.750	-3.000	-2.630	0.0000
DLnORIRAQ	-4.790	-3.750	-3.000	-2.630	0.0001
DLnKIRAQ	-3.990	-3.750	-3.000	-2.630	0.0015
DLnLIRAQ	-3.420	-3.750	-3.000	-2.630	0.0103
DLnFD1IRAQ	-8.917	-3.750	-3.000	-2.630	0.0000
DLnFD2IRAQ	-4.665	-3.750	-3.000	-2.630	0.0001

Based on the results in Table (1), the variable LnYIRAQ has a test statistic of -3.440, which is smaller (more negative) than the 5% critical value (-3.000), and its p-value is 0.0097, which is less than 0.01. Therefore, the null is clearly rejected, and this variable is stationary at a high level of significance (1%). By contrast, the variables LnORIRAQ, LnKIRAQ, LnLIRAQ, LnFD1IRAQ, and LnFD2IRAQ have statistics that are not smaller than the critical values, and their p-values exceed 0.05; thus, these variables are considered non-stationary at level. For

LnFD3IRAQ, the test statistic is -3.371, which is smaller than the 5% critical value (-3.000), and the p-value is 0.0120; therefore, this variable is stationary at the 5% level. Finally, LnFDIRAQ has a very low statistic of -7.451 and a p-value of 0.0000, indicating a very strong rejection of the null. Hence, this variable is definitively stationary with high confidence.

However, examining the test results after first differencing shows that all non-stationary variables become stationary at first difference. Nonetheless, the variable DLnKIRAN is stationary at the 10% level.

B) Estimation of the Threshold Regression Model

This section presents the results of estimating the threshold regression model for Iraq to examine the relationships among capital, labor, and oil rent with non-oil economic growth.

In the first model, reported in Table (2), the threshold regression is estimated using the percentage of credit granted to the private sector to gross domestic product as the financial development indicator. Using this model, the optimal threshold value is identified as 1.8843. Accordingly, the sample is divided into two regimes:

Regime 1: when LnFD1_IR < 1.8843 (low financial development).

Regime 2: when LnFD1_IR ≥ 1.8843 (high financial development).

According to Table (2), in neither regime are the coefficients of capital and labor statistically significant. The lack of significance of capital and labor indicates that, in this model, the traditional factors of production (capital and labor) do not play a decisive role in non-oil economic growth. This may be related to structural constraints, technological shortages, or excessive concentration on the oil sector.

Examining the coefficient of oil rent in both regimes shows that it is not statistically significant. In Regime 1 (low financial development), the oil-rent coefficient is positive but insignificant, indicating that under financial constraints, oil resources cannot play a decisive role in growth. In Regime 2 (high financial development), the oil-rent coefficient is negative and insignificant. This result suggests that even with relative development of the financial system, increases in oil revenues may have a negative effect on non-oil growth, although the result is not statistically significant. This outcome may be indicative of a resource-curse phenomenon, whereby natural resources harm, rather than support, growth.

Table 2. Threshold Regression Estimates

Panel A. Threshold variable: percentage of credit granted to the private sector to GDP

Variable	Coefficient	Std. Error	z-Statistic	p-Value
LnK	-0.0442	0.1090	-0.41	0.685
LnL	1.6950	1.7447	0.97	0.331
LnFD1 ≤ 1.8843				
LnOR	0.2296	0.2843	0.81	0.419
Constant	0.4418	0.0400	11.06	0.000
LnFD1 > 1.8843				
LnOR	-0.2349	0.2113	-1.11	0.266
Constant	0.3761	0.0457	8.23	0.000
Threshold value	γ = 1.8843			

Panel B. Threshold variable: liquidity-to-GDP ratio

Variable	Coefficient	Std. Error	z-Statistic	p-Value
LnK	-0.0032	0.1121	-0.03	0.977
LnL	0.2829	1.7932	0.72	0.474
LnFD2 ≤ 3.8777				
LnOR	0.3065	0.3629	0.84	0.398

Constant	0.4524	0.0465	9.73	0.000
LnFD2 > 3.8777				
LnOR	-0.1500	0.2065	-0.73	0.468
Constant	0.3976	0.0447	8.89	0.000
Threshold value	γ = 3.8777			

Panel C. Threshold variable: ratio of bank-provided financial credit to GDP

Variable	Coefficient	Std. Error	z-Statistic	p-Value
LnK	-0.0107	0.1033	-0.10	0.917
LnL	-0.7581	1.7505	-0.43	0.665
LnFD3 ≤ 3.2174				
LnOR	0.6461	0.3149	2.05	0.040
Constant	0.4306	0.0411	10.49	0.000
LnFD3 > 3.2174				
LnOR	-0.3395	0.1940	-1.75	0.080
Constant	0.4514	0.0435	10.39	0.000
Threshold value	γ = 3.2174			

Panel D. Threshold variable: composite index

Variable	Coefficient	Std. Error	z-Statistic	p-Value
LnK	0.0676	0.1135	0.60	0.551
LnL	0.7144	1.6808	0.43	0.671
LnFD ≤ 0.6272				
LnOR	0.2133	0.2059	1.04	0.300
Constant	0.4414	0.0413	10.69	0.000
LnFD > 0.6272				
LnOR	-0.5234	0.3064	-1.71	0.088
Constant	0.4000	0.0458	8.74	0.000
Threshold value	γ = 0.6272			

In the second model, reported in Table (2), the threshold regression is estimated using the liquidity-to-GDP ratio as the financial development indicator. The estimation identifies an optimal threshold at 3.8777, based on which the sample is divided into two regimes:

Regime 1: when LnFD2_IR < 3.8777 (low financial development).

Regime 2: when LnFD2_IR ≥ 3.8777 (high financial development).

The estimation results show that the coefficients of capital and labor are not statistically significant in either regime. Therefore, in this model, capital and labor do not have a substantial effect on non-oil sector growth. This outcome may indicate that, within the framework of the data under review, other factors (such as oil rent) play a more influential role in explaining non-oil sector growth. Examining the oil-rent coefficients in both regimes further shows that they remain statistically insignificant. In Regime 1, the oil-rent coefficient is positive but insignificant, implying that, at low levels of financial development, increases in oil revenues have a positive but unreliable effect on non-oil economic growth. This result may stem from inefficiencies in utilizing oil resources or financial constraints that prevent conversion of these revenues into non-oil growth. The negative oil-rent coefficient in Regime 2 indicates that, under high financial development, increases in oil rent may exert a negative effect on non-oil growth, although this effect is not statistically significant. This result may signal a resource-curse or Dutch disease mechanism, where oil revenues weaken, rather than strengthen, the non-oil sector (for example, through real exchange rate appreciation or inefficient resource allocation).

In the third model, reported in Table (2), the threshold regression is estimated using the ratio of financial credit provided by the banking sector to GDP as the financial development indicator. The estimation identifies an optimal threshold at 3.2174. This threshold splits the sample into two regimes:

Regime 1: when LnFD3_IR < 3.2174 (low financial development).

Regime 2: when LnFD3_IR ≥ 3.2174 (high financial development).

As in the previous estimations, the coefficients of capital and labor are statistically insignificant. By contrast, examining the oil-rent coefficients across the two regimes points to a significant difference. In Regime 1 (low financial development), the oil-rent coefficient is positive and statistically significant at the 5% level. This finding indicates that, under financially underdeveloped conditions, oil resources can play a direct and positive role in economic growth, possibly through direct financing of public projects or government consumption. In Regime 2 (high financial development), the oil-rent coefficient is negative and close to the 10% significance level. This result may reflect the emergence of phenomena such as Dutch disease or institutional inefficiency in the allocation of banking credit under financial expansion. In other words, when the financial system expands quantitatively without improvements in the institutional quality of resource allocation, the link between oil rent and real growth may weaken or even reverse.

Finally, the fourth model is estimated using the composite index, with results presented in Table (2). The estimation identifies an optimal threshold at 0.6272. This threshold splits the sample into two regimes:

Regime 1: when LnFD_IR < 0.6272 (low financial development).

Regime 2: when LnFD_IR ≥ 0.6272 (high financial development).

In this model, as before, the coefficients of capital and labor in both regimes do not have statistically significant effects on non-oil economic growth. The main difference in this model's results pertains to the effect of oil rent. In Regime 1 (low financial development), the oil-rent coefficient is positive but insignificant, such that no strong relationship between oil resources and non-oil growth can be inferred. In Regime 2 (higher financial development), the oil-rent coefficient is negative and on the cusp of statistical significance at the 10% level. This finding, similar to some of the earlier models, shows that as the level of financial development rises (at least quantitatively), the effect of oil rent on economic growth can become negative. Such an outcome may stem from "rent-seeking" in the financial system, inefficiency in credit allocation, or the emergence of Dutch disease; in such cases, financial expansion, absent institutional control, weakens rather than strengthens non-oil production.

Based on the comparative Table (3), in 2023 all four financial development indicators in Iraq exceeded the threshold values determined by the threshold regression models. These indicators include credit to the private sector, liquidity, bank credit, and the composite financial development index. This indicates that, from a quantitative perspective, the level of financial development in Iraq is relatively high. However, analysis of the four models' results shows that merely surpassing quantitative thresholds has not been sufficient for the optimal utilization of oil rent. In many cases, the effect of oil rent in high–financial-development regimes was negative and sometimes significant. These findings clearly demonstrate that financial development in its purely quantitative dimension cannot guarantee effective exploitation of natural resources. In fact, financial development in Iraq—absent institutional reforms, effective oversight, and efficiency in resource allocation—can even entail negative consequences. These results reflect phenomena such as the resource curse or Dutch disease, in which natural resources weaken rather than support growth.

Table 3. Results of Comparing Threshold Values with 2023 Values

Financial Development Indicator	Threshold Value	2023 Value	Status

Credit to the private sector / GDP	1.8843	2.8451	Above threshold
Liquidity / GDP	3.8777	4.8222	Above threshold
Bank credit / GDP	3.2174	4.4940	Above threshold
Composite index	0.6272	1.1585	Above threshold

In contrast with the predictions of the Solow growth model, the results of the four threshold regression models for Iraq indicate that the coefficients of capital and labor are not significant in any regime. This finding is inconsistent with the core of Solow's theory, which emphasizes the decisive role of physical capital accumulation and labor in economic growth. The insignificance of these factors may be related to reasons such as oil dependence, inefficiency in resource allocation, or the absence of the infrastructure needed to utilize capital and labor effectively. The augmented Solow model assumes that exogenous resources such as oil rent can affect growth through total factor productivity (TFP). Nevertheless, the findings show that, in Iraq, in the low–financial-development regimes (Regime 1 in all models), the effect of oil rent is positive but insignificant. By contrast, in the high–financial-development regimes (Regime 2 in all models), the effect of oil rent is negative. It is noteworthy that, in Models 1 and 2, the effect of oil rent is not significant in either regime; however, in Model 3, this effect is significant at the 5% level in the low regime and at the 10% level in the high regime. In addition, in Model 4, the effect of oil rent is reported as significant only in the high regime at the 10% level.

These findings contradict the Solow model's predictions that exogenous resources should contribute to economic growth via improvements in TFP or better resource allocation, because one would expect that even at low levels of financial development, exogenous resources such as oil rent would have a meaningful (positive or negative) effect on growth. In Model 3, the effect of oil rent in Regime 1 (low financial development) is positive and significant. This positive and meaningful effect is consistent with the Solow model's prediction that economies with low capital (often associated with low financial development) have high growth potential provided they receive positive shocks. In such economies, oil rents can activate this potential by alleviating the main growth constraint—namely, capital scarcity. In Models 3 and 4 (composite index), the effect of oil rent in Regime 2 is negative and on the threshold of significance. In Iraq, even the composite index has not established a positive and stable relationship between financial development and the productivity of oil rent. This may stem from broader institutional weaknesses in Iraq's banking and financial system. Overall, these results indicate that Iraq's economic and institutional structure is not aligned with the assumptions of the Solow model. Although financial development has increased quantitatively in some respects, the institutional quality and efficiency of the financial system have not yet reached a level that can transform oil rent into a driver of non-oil economic growth.

In order to evaluate the goodness of fit of the four threshold regression models and test the hypothesis of no systematic error, a detailed statistical analysis of each model's residuals was conducted. The results show that, in all four models, the mean residuals are very close to zero, indicating no systematic bias in the model structures. Regarding the dispersion of forecast errors (based on the residuals' standard deviations), Model 3, with a standard deviation of 0.086, exhibits the lowest dispersion, implying that, on average, its predictions are closer to the actual data (lower error). Model 2, with a standard deviation of 0.095, shows the greatest dispersion, which may indicate a weaker fit to the data (Table 4).

Table 4. Results of Residual Analysis by Model

Model	Mean	Std. Dev.	Minimum	Maximum
Model 1	-7e-10	0.092	-0.284	0.157
Model 2	-5.78e-10	0.095	-0.312	0.144
Model 3	-3.87e-10	0.086	-0.311	0.153

Model 4	-1.52e-10	0.089	-0.283	0.180

The results in Table (5) show that, in all models, the p-values at all lags are far above 5%; therefore, it can be stated with confidence that the residuals of these models lack serial patterns and are white noise. These results indicate that all models are validated by the Portmanteau test, while Model 3, overall, performs better at removing serial structures due to higher p-values at all lags.

Table 5. Portmanteau (Q) Test Results

Model	Q(2)	p-value(2)	Q(3)	p-value(3)	Q(4)	p-value(4)
Model 1	1.5657	0.4571	2.2706	0.5182	2.8820	0.5778
Model 2	3.8978	0.6383	1.1786	0.7581	2.5808	0.6302
Model 3	0.2697	0.8739	0.2903	0.9618	0.6795	0.9538
Model 4	0.7723	0.6797	0.7780	0.8547	1.4760	0.8309

To assess the stability of the coefficients of the four threshold regression models over the 1998–2023 period, the Cumulative Sum of Residuals (CUSUM) test was implemented. Based on Table (6), the results show that, for all four models, the test statistics are 0.8732, 0.5845, 0.3240, and 0.4873, respectively, all of which are less than the critical values at the 1%, 5%, and 10% confidence levels; therefore, in all four models, the null hypothesis of coefficient stability is not rejected. Overall, the results show no significant evidence of structural instability in the coefficients of the threshold models, and parameter stability over the study period is confirmed.

Table 6. CUSUM Coefficient Stability Test Results

Model	Test Statistic	Critical Value 1%	Critical Value 5%	Critical Value 10%
Model 1	0.8732	1.1430	0.9479	0.8499
Model 2	0.5845	1.1430	0.9479	0.8499
Model 3	0.3240	1.1430	0.9479	0.8499
Model 4	0.4873	1.1430	0.9479	0.8499

The results of the heteroskedasticity test are presented in Table (7) for the four models, where the residual variances of the two regimes (Regime 1 and Regime 2) are compared using the F-statistic, and p-values are reported. This test examines whether the residual variances in the two regimes are equal. In Models 1, 2, and 3, since the p-values are well above the 0.05 significance level, the null hypothesis of homoskedasticity is not rejected in these models. By contrast, in Model 4, the p-value is below 0.05, which implies rejection of the null (homoskedasticity). Given the identification of heteroskedasticity in Model 4, the model was re-estimated using robust standard errors. The results of the fourth model with robust standard errors are presented in Table (8).

Table 7. Heteroskedasticity Test Results

Model	Variance Regime 1	Variance Regime 2	F-statistic	p-value
Model 1	0.0088	0.0200	1.008	0.978
Model 2	0.0100	0.0220	1.376	0.566
Model 3	0.0083	0.0220	1.253	0.702
Model 4	0.0076	0.0260	5.161	0.037

The results of Model 4 with robust standard errors show that the coefficients of capital, labor, and oil rent in both regimes are similar to those in the previous model (without robust standard errors). In the robust model, the standard errors of capital and labor decrease, indicating improved estimation precision for these variables; however, as in the previous model, the coefficients for capital and labor remain insignificant. For oil rent, the standard errors decrease in both regimes compared to the previous model, indicating higher estimation precision. Moreover, in the robust model, the p-values decline in both regimes, such that the effect of oil rent becomes significant at the 5% level (in contrast to the previous model, where it was significant at the 10% level). Overall, using robust standard errors reduces standard errors and increases z-statistics, improving the precision of the estimates and, particularly in Regime 2, strengthening the statistical significance of the oil-rent effect.

Table 8. Threshold Regression Estimates with Robust Standard Errors (Threshold Variable: Composite Index)

Variable	Coefficient	Std. Error	z-Statistic	p-Value
LnK	0.0676	0.1009	0.67	0.503
LnL	0.7144	0.7579	0.94	0.346
LnFD ≤ 0.6272				
LnOR	0.2133	0.1477	1.44	0.149
Constant	0.4414	0.0249	17.75	0.000
LnFD > 0.6272				
LnOR	-0.5234	0.2191	-2.39	0.017
Constant	0.4000	0.0445	8.99	0.000
Threshold value	$\gamma = 0.6272$			

4. Discussion and Conclusion

The empirical results derived from the threshold regression analysis provide strong evidence that the relationship between oil rent and non-oil economic growth in Iraq is nonlinear and contingent on the level of financial development. The threshold effects estimated across the four models—each employing a different indicator of financial development—highlight that surpassing quantitative levels of financial depth alone does not guarantee efficient utilization of oil revenues for sustainable growth. In all models, the traditional Solow variables of capital and labor were statistically insignificant in explaining non-oil growth, suggesting that Iraq's long-term dependence on oil revenues has distorted the productive structure of its economy and weakened the classical growth transmission mechanisms [7, 8]. This finding contrasts with the fundamental premise of neoclassical growth theory, which assigns primary importance to capital accumulation and labor expansion as the main drivers of growth. Instead, the results indicate that external rents—rather than internal factor accumulation—remain the dominant determinant of Iraq's output dynamics.

The most striking empirical insight concerns the sign reversal of the oil rent coefficient between regimes of low and high financial development. At lower levels of financial development, oil rents were found to have a positive, though generally insignificant, association with non-oil GDP. This outcome is consistent with the argument that in economies with limited access to finance, oil revenues can serve as a compensatory mechanism to fund investment and consumption in non-oil sectors [1, 3]. Oil revenues at this stage may ease liquidity constraints and provide critical financing for reconstruction, infrastructure, and public-sector wages—key components that stimulate short-term demand and employment. Similar results have been reported in Kazakhstan and other resource-dependent economies, where rents initially play a catalytic role by alleviating capital shortages and supplementing underdeveloped credit markets [1, 4].

However, once financial development surpasses the identified thresholds, the sign of the oil rent coefficient becomes negative, and in some models (notably those using bank credit and the composite PCA index) this effect is statistically significant at the 10% or 5% level. This shift implies that when the financial system expands quantitatively but lacks strong institutions, regulatory oversight, and efficient intermediation, oil revenues can produce adverse effects on growth. This pattern is consistent with the "resource curse" and "Dutch disease" hypotheses, according to which excessive liquidity from resource rents can fuel unproductive investments, distort the real exchange rate, and crowd out tradable sectors [2, 3]. Such an outcome is particularly relevant for Iraq, where financial liberalization has not been matched by institutional modernization, and rent distribution continues to be influenced by political and administrative inefficiencies. In this environment, the expansion of credit and liquidity ratios may reflect financial fragility rather than development, amplifying macroeconomic volatility instead of promoting sustainable growth [4, 22].

The insignificance of capital and labor coefficients across all models also reflects deeper structural weaknesses. In a healthy growth environment as predicted by Solow-type frameworks, capital accumulation and labor utilization should contribute meaningfully to output expansion [7, 10]. The absence of such relationships suggests that Iraq's productive base remains heavily skewed toward the oil sector, with limited spillovers to manufacturing or agriculture. Studies across developing economies support this interpretation, indicating that in rent-dominated economies, investment efficiency is often low, and capital flows are concentrated in low-productivity activities [8, 11]. Moreover, the weak role of labor in the growth process highlights the mismatch between employment structures and economic diversification. Similar patterns have been observed in South Africa and Ethiopia, where macroeconomic growth was decoupled from labor absorption due to sectoral imbalances and inadequate human-capital investment [16, 21].

The robustness of the results is further supported by the diagnostic tests. The residual analyses and Portmanteau tests confirmed that the models were well-specified, and the residuals exhibited no serial correlation or systematic bias. The CUSUM stability tests indicated coefficient stability across the sample period (1998–2023), implying that the observed relationships are not artifacts of structural breaks or crisis episodes. The detection of heteroskedasticity in the fourth model and its correction using robust standard errors strengthened the significance of the oil rent coefficient in the high-finance regime, reinforcing the reliability of the findings. This pattern demonstrates that when robust estimations are applied, the negative impact of oil rent at higher financial-development levels becomes even more pronounced—a finding that aligns with earlier studies on the nonlinear resource-growth relationship [2, 6].

The study's results are in partial alignment with empirical findings from other resource-dependent economies. For instance, in CIS countries, financial development was found to moderate the impact of oil rents on non-oil growth, but only when accompanied by strong institutional quality [3]. Similarly, cross-country evidence from Sub-Saharan Africa and CFA countries reveals that without sound financial governance, higher financial depth can exacerbate volatility rather than stabilize growth [20, 22]. The Iraqi case thus fits within this broader empirical consensus: quantitative indicators of financial expansion (such as credit-to-GDP ratios) may mask fragilities when the qualitative dimensions of finance—like credit allocation efficiency, risk management, and regulatory capacity—are weak. This interpretation echoes findings from the Jordanian banking system, where soundness and supervision, rather than size, were the key determinants of stability [4].

When comparing these results with the theoretical foundations of the Solow model, the divergence becomes evident. The Solow model assumes that savings translate into investment and that capital deepening leads to long-term convergence toward a steady-state equilibrium [7]. However, in the Iraqi context, savings generated by oil rents do not necessarily become productive investment, owing to financial inefficiencies, corruption, and the dominance of the public sector in credit markets [1, 3]. The result is a breakdown in the Solow transmission mechanism, where capital accumulation fails to drive growth due to misallocation. This discrepancy underscores Romer's critique of exogenous technology in the Solow model and his call for endogenous drivers of innovation and productivity [9]. The current evidence supports an endogenous interpretation: institutional and financial inefficiencies act as bottlenecks that suppress the potential productivity gains from oil-financed capital accumulation.

Another noteworthy observation is that the threshold estimates derived from PCA-based composite indices provide a more nuanced view than single-indicator models. The PCA approach, following the methodology of Jolliffe and Cadima [25], allowed the study to integrate multiple financial indicators into a single, statistically coherent index that captures both depth and stability. This composite threshold ($\gamma = 0.6272$) proved to be the most sensitive in distinguishing the regimes in which oil rent effects change sign. This reinforces the idea that financial development is a multidimensional construct and that focusing solely on individual ratios may obscure the systemic interplay between liquidity, credit, and institutional soundness. Comparable results have been reported in environmental and energy economics, where PCA-derived indicators have improved the detection of nonlinear threshold effects [6, 13].

The study's findings also resonate with broader discussions in the development literature regarding the role of institutional capacity in mediating the finance–growth nexus. Evidence from Africa and Latin America demonstrates that without adequate regulatory frameworks, rapid financial deepening can worsen inequality, volatility, and misallocation [20, 26]. Iraq's financial system, while expanding quantitatively, remains constrained by high concentration, political influence, and limited risk-based supervision—conditions that replicate the patterns of weak institutional absorption capacity observed elsewhere. Therefore, it is not surprising that even as financial indicators exceed global thresholds, the qualitative transformation of finance into growth remains elusive [3, 22].

The positive and significant coefficient of oil rent in the low-finance regime of the third model aligns with the "capital-shortage compensation" hypothesis. This view suggests that in early-stage economies, oil rents can substitute for missing domestic savings and help finance infrastructure and public investment [5, 17]. The results from Ethiopia and Nigeria similarly show that government expenditure and oil-related revenues can stimulate growth when channeled into productive sectors [5, 23]. However, the Iraqi experience shows that this positive role diminishes rapidly as financial depth increases without parallel improvements in governance and oversight. This dynamic illustrates that the marginal returns to oil rents are conditional on the efficiency of the financial system in converting liquidity into productive assets—a view consistent with recent findings on the mediating role of finance in the resource–growth relationship [2, 3].

Overall, these results emphasize that financial development in Iraq remains quantitatively high but qualitatively weak. While indicators such as credit-to-GDP and liquidity-to-GDP have exceeded their threshold levels since 2023, the persistence of negative oil-rent effects in the high-finance regime reveals that institutional inefficiencies outweigh potential benefits. This underscores that financial reforms should not be limited to quantitative expansion but must focus on enhancing the quality of credit allocation, strengthening regulatory frameworks, and improving transparency in oil-revenue management [4, 22]. Moreover, the lack of a significant role for capital and labor in explaining growth calls for a structural transformation strategy that reorients Iraq's economic model toward diversification, innovation, and human-capital development [8, 9].

The present findings thus extend the empirical evidence that quantitative financial growth without institutional quality does not mitigate but rather exacerbates the resource curse. They confirm the theoretical propositions advanced by studies that integrate financial thresholds into resource-growth frameworks: below a critical financial-development level, rents serve as substitutes for missing capital; above that level, they may crowd out productivity-enhancing investments [2, 6]. For Iraq, this implies that the challenge is not to increase financial depth per se but to ensure that financial expansion is accompanied by effective governance, credit discipline, and sectoral diversification.

This study, while comprehensive, is not without limitations. First, the analysis relies on time-series data for Iraq between 1998 and 2023, a period marked by wars, sanctions, and political transitions that may introduce structural breaks not fully captured by the model. Second, data quality constraints—particularly in non-oil GDP and financial sector indicators—may affect the precision of the estimates. Third, the threshold regression approach identifies nonlinearities along a single dimension (financial development) but does not explicitly incorporate other mediators such as institutional quality, fiscal policy, or trade openness, which may also influence the oil–growth relationship. Finally, while the PCA-based index improves measurement, it remains sensitive to variable selection and weighting schemes.

Future research should extend the model to a panel framework that includes other oil-exporting economies in the Middle East and North Africa to allow for cross-country comparisons of threshold effects. Incorporating institutional-quality indicators, governance scores, and corruption indices would provide deeper insights into how qualitative dimensions of finance interact with quantitative measures. Further studies could also explore the role of technological innovation, green finance, and digital banking as mediators in the oil rent–growth nexus. Additionally, integrating dynamic models such as Markov-switching regressions or structural VARs could better capture regime transitions and policy shocks over time.

Policymakers in Iraq should prioritize institutional strengthening over mere financial expansion. Developing transparent regulatory frameworks, enforcing credit risk assessments, and improving the governance of oil revenues are crucial steps. The financial sector should redirect resources toward productive non-oil industries, particularly manufacturing, agriculture, and SMEs, to promote diversification and employment. Furthermore, enhancing financial inclusion and digitalization can improve access to finance for underserved groups, strengthening the resilience and inclusiveness of growth. Finally, macroeconomic policy coordination between fiscal and monetary authorities is essential to ensure that oil rents are transformed into long-term productive capacity rather than cyclical volatility.

Authors' Contributions

Authors equally contributed to this article.

Ethical Considerations

All procedures performed in this study were under the ethical standards.

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Conflict of Interest

The authors report no conflict of interest.

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