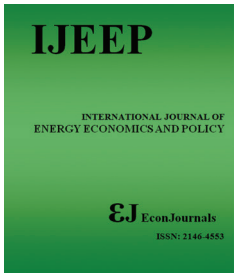

International Journal of Energy Economics and Policy

ISSN: 2146-4553

available at http: www.econjournals.com

International Journal of Energy Economics and Policy, 2025, 15(6), 863-873.

The Dynamic Interplay between Oil Rents, Financial Innovation, and Economic Growth in OPEC Countries: Evidence from a Structural VAR Approach

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Received: 01 June 2025 **Accepted:** 4 September 2025 **DOI:** https://doi.org/10.32479/ijeep.20992

ABSTRACT

This paper analyses the dynamic interaction between oil rents, financial innovation, and economic growth among the OPEC countries on the time series 1980-2023 based on a Structural Vector AutoRegression (SVAR) model. The unit root test proves that the variables are of I (1) thus integrated, whereas the cointegration Johansen test depicts three long-run relationships of equilibrium which is evidence of steady relationship between oil rents, financial innovation and GDP. The SVAR findings indicate that the oil rent shocks impact on the financial innovation is very positive with cumulative impulse response hitting at 0.215 within the period of 24 periods. Forecast error variance decomposition indicates that, oil rents capture 42.87% of the variance in financial innovation within 1-year horizon, which demonstrates criticality of resource wealth in financial sector dynamics. The strength of the findings is verified through robustness checks. These findings mean that natural wealth may be used to fuel financial innovation and economic expansion subject to healthy institutions. Resource-dependent economies need, therefore, policy measures targeting on improving governance and developing a financial sector.

Keywords: Oil Rent, Financial Innovation, Economic Growth, Structural VAR, Cointegration, Impulse Response Function
JEL Classifications: C32, Q32, G20, O40

1. INTRODUCTION

Financial innovation and resource wealth have been a heat topic of scholarly interest, especially after the drastic re-structuring of world capital markets and energy systems. In economies endowed with resource, especially the Organization of the Petroleum Exporting Countries (OPEC) economies, the oil rent has traditionally been the focus of macroeconomic performance, government finance and international balances. The advancements of the financial innovations, such as derivatives, online banking platforms, the securitization methods, and fintech applications, have established the new ways of capital distribution, liquidity access, and economic diversification in the rentier societies (Beck et al., 2016; Aramonte and Huang, 2022). These interactions between the three dynamics are very important to the development of resilient macro-financial structures amidst the changing oil markets and the changing global financial structures.

The set of OPEC countries which contribute the significant proportion of world oil supply and reserves is completely situated to investigate the relation between resource rents and financial innovation. In contrast to diversified economies, oil price cycles and the revenue flows to which fiscal and external positions of OPEC countries are linked are very high. Oil rents are often volatile, cyclical and often are converted into economic volatility at least until very deep financial markets and risk-hedging tools are available (Bjørnland, 2009). Financial innovation may exacerbate such volatilities through speculative flows and financialization or act as a restraining force by improving resource allocation, intertemporal smoothing and structural change (Laeven et al.,

2015). Although disentangling these effects has been an empirical challenge, it has tremendous policy implications.

In theory, the financial innovation should enhance the resilience and efficiency of the economy due to the increased access to the capital, reduced transaction costs, and risk-sharing institutions. These effects are, however, contingent on the state of institutions, maturity of markets, and the shocks of an exogenous nature that vary considerably in the OPEC member states (Beck, 2012). An example would be that in nations where financial markets are undeveloped, an example being algorithmic trading or exchange-traded funds (ETFs) or energy derivatives could contrive to add instabilities on the financial front by directing flights of speculative money on resource markets and hence adding procyclicality to oil rents (van der Ploeg and Poelhekke, 2009). On the other hand, well-regulated innovations could act as stabilizers especially when diversifying government revenues sources and support of non-oil industries are encouraged.

Majority of the existing literature revolves around linear causality, panel regressions or cointegration methods, without due consideration of the contemporaneous shocks and recursive feedbacks in the relationships between oil and finance (Hamilton, 2003; Kilian, 2009). This research is important to fill the gap in the body of knowledge as it implements an auto-regressive model of Structural Vector Autoregression (SVAR) monthly data on OPEC countries between January 1980 and December 2023. The SVAR structure allows exogenous shock identification to financial innovation and oil rents, as well as shows their dynamic interaction over a period. The limitation of this methodological approach is that it is especially appropriate in the analysis of short-term and long-term impulse responses, decompositions of variance, and in the transmission of shocks through structure.

The presence of a long time bracket within the scope of the study will enable the investigator to consider the structural break and regime shift in relation to major geopolitical events and economic situations, including 1986 oil price collapse, the global financial crisis of 2008, and the pandemic attack of COVID-19. These crises have had deep impacts as far as financial systems development as well as fluctuations of oil rents in OPEC member states are concerned. With financial markets getting more connected to the global tendencies, the issue of their simultaneous changes with the oil rents becomes at the center of determining the future-oriented policies that would stabilize the economies, facilitate investment planning, and sustainable development (Jahan-Parvar and SpitALLer, 2020).

In this paper, the dynamic interaction between financial innovation and oil rent in OPEC economies shall be examined by answering some of the objectives that emerged to answer the question how an occasional shock to financial innovation affects oil rent in the long-run; what role does shock to oil rent in the OPEC economies plays in the evolution of financial innovation? The results are likely to provide useful information to policy makers in capitalizing optimum balance between macroeconomic stabilization and financial growth and also to the theoretical aspects of resource-finance relationships of oil dependence nations. The rest of the paper will be organized in the following way. The paper is divided into five sections: Section 2 contains literature review and theory breifs, Section 3 describes the methods and data collection, Section 4 presents the findings and discussion, and Section 5 provides conclusion including policy implications, the limitations, and suggestions of future research.

2. LITERATURE REVIEW

2.1. Theoretical Review

2.1.1. Resource curse and financial development

Recognizing the relationship begins with the so-called resource curse hypothesis according to which resource abundance limits the prospects of long-term economic growth due to rent-seeking behaviour, macroeconomic volatility, and institutional failings (Venables, 2016). Oil rents, according to this school of thought, might distort establishments of productive investment, displace other non-resource industries, as well as hinder the development of financial markets (Bhattacharyya and Collier, 2014). Finally, resource-rich economies have low potentials to smooth consumption, hedge risks, and fund diversification strategies due to the underdeveloped financial systems (Beck and Poelhekke, 2017). Such two-way relationship indicates that financial innovation may serve as an intermediate between the intensity of the resource curse.

Empirical variations of the resource curse theory indicate how the financial sector can deepen or reduce resource-induced volatility by its depth, and the extent of its innovation (Arezki and Gylfason, 2013). Financial innovations, which might include derivatives markets, sovereign wealth funds (SWFs), and fintech platforms can be used to help governments and firms hedify oil price risks, to undertake intertemporal consumption, and to complement capital mobility (Satti et al., 2014). But beyond a certain mark of being poorly controlled or highly speculative, innovations can furthermore raise procyclicality and financial fragility (Gylfason, 2019).

2.1.2. Economic resiliency and financial innovation

Financial innovation is generally theorized to increase the economic robustness by increasing the set of financial items and markets, enhance the handling of the information, and decrease transactional expenses (Beck et al., 2016). According to the Schumpeterian approach to finance as a generator of creative destruction, the innovation process within the financial system holds promise in terms of allocating capital to more fruitful endeavors, especially among non-resource dependent economies trying to promote economic diversification (Levine et al., 2016). With the achievements of oil had gone domination of fiscal balances and external balances in OPEC countries and such diversification is vital in terms of stability.

However, the positive consequences of financial innovation to resilience depend on the establishment and characteristics of innovations. New forms of innovation like complex derivatives or shadow banking systems can even encourage speculative bubbles and raise systemic risks in low-regulated environments (Laeven et al., 2015). In its turn, innovations that are targeted

at the betterment of credit access and financial inclusion and the mechanism of risk sharing are more likely to contribute to sustainable development (Philippon, 2016). It is against this theoretical ambiguity that the need to analyse the particular channels through which interaction of financial innovation with oil rent dynamics occurs.

2.1.3. Financialisation of commodity markets

An instrumental theoretical thread is the commodity market financialization, in which there is increasing financialization of commodity prices as a result of expansions in speculative and hedging operations by the financial agent (Tang and Xiong, 2012). Oil-linked financial instruments, including futures, options and exchange-traded funds, have grown to put the oil market on a hybrid form of a financial- physical market (Fattouh et al., 2013). Such change implies that financial innovation may enter a cycle with the oil rent volatility related to close association of oil prices with worldwide financial cycles and risk propensity (Basak and Pavlova, 2016).

Among OPEC countries, this feedback loop would mean that it is not only the response by domestic financial innovations to the fluctuation of oil rents but might also affect the fluctuation due to global financial integration. The rising role of the institutional investment and algorithm trading activity on oil market provides new transmission channels of financial shocks, which complicates conventional supply demand driven oil rents (Ederington et al., 2020). These complex feedbacks are well modelled by SVAR, since the structural shocks can be identified in an interrelated system.

2.1.4. Policy implications in institutional theory

The institutional theory offers a critical understanding as to why the echoes of the financial innovation about oil rents have been different across OPEC nations. Quality of institutions with regards to regulatory frameworks, standards of governance and legal safeguards, influence direction and effectiveness of financial innovation (Beck et al., 2020). Financial innovation in countries characterized by strong institutions tend to promote diversification of economy and lessens the dependence on resources. On the contrary, in such cases of institutional weaknesses, innovations can become an object of capture by elite forces or facilitate rent exploitation, an aspect that enhances resource curse (van der Ploeg, 2020).

It is this institutional diversity of OPEC that is the reason why various policy approaches should be taken. According to the theoretical literature, it is impossible to encourage good financial innovation, i.e., an innovation that will improve stability, inclusion, and diversification, without such complementary institutional changes (Demirgüç-Kunt et al., 2020). Macroprudential policies that are effective, strong supervisory regimes and transparent governance are important in the realization of the positive contributions of financial innovations in dealing with oil rent volatility and long-run economic transformation.

2.2. Empirical Review

Innovation, oil rents and the financial development have in empirical studies provided sharp results in diverse research terrains. There are a number of consistent patterns proposed in empirical research. First, there is the finding that the link between oil rents and financial innovation depends largely on how good the institutions are, how open to trade a country is and the governance structure. Second, financial innovation in itself is potentially capable of reducing oil-generated risk, although, of course, on the condition of solid regulatory supervision. Third, international financialization of oil markets presents a source of foreign volatility which enhances local propagation of credit cycles. Fourth, there is bidirectional causality through dynamic modeling using SVAR/PVAR which brings to light the interdependence between financial innovation and oil rent shocks. Finally, existence of structural breaks highlights the issue of adaptable empirical specifications, which can absorb regime changes. All in all, these results define our methodology and guide our study, making the theoretical and methodological combination of SVAR modeling in the OPEC case even stronger.

Investigating a country-wide sample, Akadiri et al. (2023) show that oil rents have a positive impact on financial development when mediated by a fortifying economic trade environment, which is approximated by FDI, openness to trade, and ease of doing business. Asif et al. (2020) get just the opposite results, and conclude that oil rents in Pakistan have a depressing impact on credit growth and the allocation of privates sector credit, which is exactly what the resource-curse effects are all about. These opposite effects highlight the current consideration that, despite institutional and trade contexts, oil rents may encourage or discourage financial innovation.

The context-dependence is further cemented with a rich resource of panel studies. As indicated by Yuxiang and Chen (2011), trade liberalization has the effect of enhancing the positive effects of oil rents on financial deepening in China stating the significance of external openness in resource-finance relationships. Similar (positive) results can also be found in Atil et al. (2020), where the authors note that healthy governance systems make oil prosperity drive financial innovation instead of nourishing rent-seeking. In several African contexts, Bhattacharyya and Collier (2014) discover that oil rent inflows undermine savings mobilization and credit development which is the typical resource curse tale.

Coming to the part of financial innovation in acting as a buffer or an amplifier of oil-induced shocks, recent research reports portray a divergent picture. Fintech and digital payment systems have also been identified as tools of resilience in the case of resource-rich countries where regulation is strong by Beck et al. (2016), and Levine et al. (2016). Financial innovation has been noted to lower oil price volatility vulnerable in Pakistan according to Satti et al. (2014). Conversely, the shadow-banking process in GCC countries and ones related to HT D derivatives contribute to increasing financial instability and amplifying volatility in the oil rent, as it is proven by Hammoudeh et al. (2021).

There is a large literature studying the commoditization of money markets and how it creates volatility in the domestic oil rent. Tang and Xiong (2012) state that index investment significantly takes commodities outside of their physical foundations in the

commodity markets, and Basak and Pavlova (2016) estimate the speculative flows of the financial players heightening volatility prices in oil markets. Such volatility into domestic credit cycles in oil-exporting nations was ratified with empirical evidence found in the study of Phan et al. (2015) and Fattouh et al. (2013).

Dynamic interlinkages are described more clearly in structural reasons. Ibrahim Mohammed et al. (2020) feed the panel-VAR in 83 oil-rich countries and find that when oil revenue is invested through government-lead channels, then the growth is steadier compared to when privately invested. The result is however conditional to financial depth. Within the OPEC frame, a number of the country-level studies of SVAR (e.g. Ghosh, 2017; Hammoudeh et al., 2021; Wang et al., 2022) indicate a few-sided causation between oil shocks and financial innovation, yet the strength of the answers differs under the affect of governance and macroprudential regulation.

A moderating effect of institutional quality comes out as a theme. Literature by Mehlum et al. (2013), Arezki and Gylfason (2013) and van der Ploeg (2011) demonstrates that in regime of high levels of governance-disipline, oil rents translate into financial innovation and long-term growth but the weak environments stimulate the creation and rent-seeking -induced macro-financial instability. The oil rents may fan inefficiencies instead of structural transformation in situations where institutional fragility exists as it was the case with Bhattacharyya and Collier (2014). Ghosh (2017) and Hammoudeh et al. (2021) denote the occurrence of such distinct events as the global financial crisis in 2008 or the COVID-19 pandemic, making time-varying coefficient SVAR or SVECM specification the proper way of modeling it.

The empirical research further confirms the centrality of oil price volatility in terms of financial innovation trajectories. Jawadi and Ftiti (2019) reveal that oil price shocks result in an increased level of uncertainty pertaining to the performance provided by the banking sector, which subsequently influences the rate of financial innovation, especially in those countries where macroprudential structures are in their underdeveloped stage. Within GCC nations, Arouri et al. (2012) report that there is a considerable degree of interaction between oil price volatility, stock market returns, and the growth in credits within the banking sector - avenues through which a financial innovation can thrive, or be suppressed depending on the measures introduced by the regulators. As illustrated by Jawadi and Ftiti (2019), banks can be expected to withdraw, in terms of innovative financial products offered, when there is a high degree of instability in oil price levels: the tendency is to concentrate on the management of liquidity, on the preservation of capital. The results indicate that opportunities posed by oil rent inflows with regard to financial innovation conceal the presence of complex risks created under the inherent volatility of oil markets that in turn tend to transform innovation retrenchment instead of growth.

The heterogeneity of oil rent effects in different financial market structures of the countries can be another evidence given by cross-country panel studies. Esfahani et al. (2014) employ a dynamic panel estimate of 26 oil-exporting economies and conclude that the system of shallow banking in oil-worldly economies results in credit-propelled enhancements, whose outset in the tiny bulk gravitates towards bonanza spending instead of helpful banking innovation. In comparison, in countries where financial markets and asset structure is more widespread, like Norway and Canada, rents in oil become more effectively used on investment into digital banking and fintech ecosystems. In a similar way, Beck et al. (2020) hold that financial structure -bank based and market based- preconditions the ability of the financial systems to absorb and distribute oil rents productively. Market-based systems seem to encourage more innovation in face of oil windfalls, in contrast to bank-based systems, which can be more subject to regulatory capture and clientelism as drilling taps into available resources, in accordance with resource curse processes.

New horizons to the oil rent-financial innovation nexus are given to the latest wave of diffusion of fintech. According to Lee and Shin (2018), the adoption of fintech to substitute the traditional sector in the financial sector of the oil-exporting developing countries helps reduce the rigidity in the traditional financial sector. According to them, financial inclusion and innovation can be improved by the use of mobile banking, electronic payment, and blockchain technology even in the oil rents-prone framework that has led to rent-seeking and larger concentrations of financial resources. Their analyses, however, also warn that in the absence of proper regulatory protection, fintech innovations can emerge as themselves a vehicle of corruption and capital flight in resource-rich economies. In this regard, it is clear that the dynamic relationship between these three concepts (oil rents, fintech innovation, and regulatory quality) is a serious field of future empirical research.

Lastly, structural breaks and global crises have further been supported by recent event-driven research, in moderating oil-finance relationships. Using Bai-Perron structural break test, Hammoudeh et al. (2021) report the effects of such events as the 2008 financial crisis and the COVID-19 pandemic caused severe regime shifts in the association between oil rents and financial innovation in OPEC countries. The policy reacts and especially those of monetary and fiscal interventions that took place during these times made a critical difference in ensuring that oil rents would either enhance or reduce financial innovation. This is why it was necessary to realize principal modeling frameworks with such flexibility, like the SVAR with time varying parameters, to reflect the changing nature of oil rent-finance dynamics against structural disruptions.

3. METHODOLOGY

The theoretical framework of the study comprises three theories, including the endogenous growth theory, resource curse theory, and financial development theory to help understand how oil resources affect financial innovation in resource rich countries, that is within the economies of the Organization of the Petroleum Exporting Countries (OPEC). All of these theoretical perspectives contribute to the understanding of the currents through which the natural resource wealth and particularly oil influence macro-financial frameworks and the financial sector innovation possibilities.

In the case of endogenous growth theory where the concept of innovation and technological advancements as the main sources of long-term economic growth is expressed clearly in the works of Romer (1990) and Aghion and Howitt (1992), these elements play a pivotal role in stabilizing and promoting longer-term economic growth. In terms of this framework, financial innovation as such is conceptualized as a technological advancement, which increases the capital allocation effectiveness, reduces the transaction cost, and promotes the improvement of deepening of financial market (Levine, 1997). Sufficient and steady oil rent has the possibility of becoming to available extra capital allowing investments into the financial system and also the nurturing of innovation. Whether this potential is actually realized or not however is sorely dependent on the capacity of institutions and effective use of the oil revenues to be channeled to useful purposes like human capital and technological upscaling. Dynamic process of innovation is formulated as:

$$\dot{A}_t = \delta A_t^{\phi} L_{Rt} \quad (1)$$

A_t the stock of financial innovation or knowledge at time t, L_{RT} is the amount of labor devoted to research and financial innovation activities, where δ is the measure of the productivity of research activity and $\phi > 0$ is a measure of how current knowledge affects the rate of innovation. Increase in oil rents is capable of improving L_{RT}, subject to channeling the resource revenues appropriately into human and technological capital development and speed up accumulation of A_t

Resource curse theory points to the idea that great natural resources might erode the economic growth and institutional quality in the long term (Sachs and Warner, 1995; van der Ploeg, 2011).

One of the problems, which can be observed in most of the oil-rich economies, is that because of enormous inflows of oil rents they are more likely to develop the dynamics of rentier states which means that governments start relying too strongly on the resources they get. This dependence may discourage the interest in building a financially diversified system, suppress the growth of the private sector, and force it to restrain innovation. These dynamics become very important in OPEC countries where oil rents may prevail over the fiscal revenues and crowd out the development of the financial sector. The negative effect of the oil rents on financial innovation may be expressed in the form of an adjusted production function:

$$FINNOV_t = \alpha + \beta_1 R_t + \beta_2 GDP_t + \beta_3 INST_t + \varepsilon_t \quad (2)$$

$FINNOV_t$ level of financial innovation at time t, R_t oil rents, GDP_t serves as a proxy for real income and scale effects, $INST_t$ reflects institutional quality, and ε_t is the error term. A negative coefficient β_1, as expected in the resource curse view that the increase in oil rents can be a curb to financial innovation due to resource misallocation, macro volatility and rent-seeking motives among other factors.

The theory of financial development assumes that effective financial systems are crucial to mobilize savings, efficiently allocate capital and managing risk and new innovation (Levine, 1997; Beck et al., 2016). It is based on this point that financial innovation is found as an answer to the demand-side pressures (e.g. the need to manage volatility in oil prices) as well as the supply-side conditions (e.g. the existence of regulatory frameworks and the quality of institutions). Nevertheless, to potentially create a procyclical credit wave and hamper the creation of highly sophisticated financial tools that would mitigate oil price volatility, the volatility of oil prices itself may offer the emergence of the phenomenon in resource-rich economies (Beck and Poelhekke, 2017). Therefore, the passage of oil rent shocks to financial innovation has been filtered by both the institutional factors as well as by the larger framework of macro-financial stability.

This paper uses Structural Vector Autoregressive (SVAR) model to measure the intertwining and dynamic nature of the relationship among oil rents, financial innovation and economic performance. The framework of structural vector autoregression model is quite appropriate in terms of identifying and estimating the structural shocks that are being transmitted in the macro-financial system of OPEC economies. The model structural structure is indicated as:

$$BY_t = \sum_{i=1}^{p} C_i Y_{t-i} + \varepsilon_t \quad (3)$$

$Y_t = [OILRENT_t, FINNOV_t, GDP_t]'$ is a vector of endogenous variables, B is the contemporaneous impact matrix that captures the structural relationships among the variables, C_i are matrices of parameters representing lagged effects, and ε_t is a vector of orthogonal structural shocks. In this arrangement, hypotheses suggest that direct and indirect impacts of shocks to oil rents have effects on financial innovation at the macroeconomic (GDP) and institutional level. The size and references of these effects may differ pointing towards the interaction of the theoretically proposed mechanisms.

We use Structural Vector Autoregression (SVAR) to study systematically that how the dynamic interdependence between financial innovation and oil rent in OPEC countries is developed in the movements between January 1980 and December 2023. This conceptualization combines sophisticated time-series econometrics with strong theoretical support in order to describe the structural linkages between the oil rents and the financial innovation within the OPEC setting. SVAR-based methodology supplemented by robustness and specification tests, alternative identification strategies and cointegration analysis offer an analytical tool to isolate the macro-financial transmission channels through which volatility in oil rents influence financial innovation patterns in the resource-rich economies.

SVAR method is an especial suitability to the modeling of the endogenous interactions among the macro-financial variables and the possibility to identify structural shocks in terms of theoretically justifiable constraints. The ability is critical to unravelling the impacts of exogenous shocks in oil markets (rent) fluctuations against endogenous feedbacks in financial and real sectors (Blanchard and Quah, 1989; Kilian and Lutzkepohl, 2017).

Empirical analysis is based on 13 OPEC members the data of which are provided on monthly basis (Algeria, Angola, Congo,

Equatorial Guinea, Gabon, Iran, Iraq, Kuwait, Libya, Nigeria, Saudi Arabia, United Arab Emirates, and Venezuela). Oil rent is treated as a natural logarithm of the monthly oil rent as percentage of GDP, based largely on the World Bank World Development indicators. Since there were no direct monthly series, annual data of oil rent was interpolated with Chow-Lin regression methods based on monthly measures of oil price and production volume disclosed by the U.S Energy Information Administration.

The composite index of financial innovation is based on three dimensions (i) the growth in broad money (M3), (ii) the private sector credit as a ratio of GDP, and (iii) the take-up of digital financial services in terms of electronic payment volumes and mobile money flows. Statistics of these indicators are obtained according to the IMF (International Financial Statistics) (IFS), the Financial Access Survey, and the Global Financial Development Database of the World Bank. Like in best practices in contemporary literature (Svirydzenka, 2016; Ozili, 2022), this multidimensional index is a more sophisticated idea of financial innovation dynamics compared to the monetary aggregates alone.

To capture aggregate economic conditions and scale effects we include a measure of real GDP as a control variable, taken using the International Monetary Fund's Monthly International Financial Statistics. All the variables are seasonally adjusted and converted to natural logarithms to stabilize variance and allow interpretation in terms of elasticity. The baseline reduced-form VAR is estimated as:

$$Y_t = A_1 Y_{t-1} + A_2 Y_{t-2} + \cdots + A_p Y_{t-p} + u_t \quad (4)$$

where Y_t is a 3×1 vector of endogenous variables [$log(OILRENT_t), log(FINNOV_t), log(GDP_t)$]^', are coefficient matrices, and u_t is a vector of reduced-form residuals. The optimal lag length p is selected based on both the Akaike Information Criterion (AIC) and the Schwarz Bayesian Criterion (SBC).

Since the reduced-form residuals lack a clear structural interpretation, the model is transformed into a Structural VAR:

$$BY_t = C_1 Y_{t-1} + C_2 Y_{t-2}) + \cdots + C_p Y_{t-p} + \varepsilon_t \quad (5)$$

B denotes the contemporaneous impact matrix, and ε_t is the vector of orthogonal structural shocks, such that $E[\varepsilon_t \varepsilon_t^{'}] = I$. Cholesky decomposition is applied and the variables are ordered as follows: oil rent, financial innovation and GDP. This recursive scheme, which is in line with the previous empirical evidence (Kilian and Murphy, 2014), corresponds to the theoretical assumption that global oil rent shocks contemporaneously have both domestic results in financial inventiveness and output, and on the other hand, the results in financial inventiveness impact GDP in the same period but have no probability of impacting oil shock rents, as global oil markets are exogenous to financial sectors in OPEC.

Impulse Response Functions (IRFs) are obtained in order to track the dynamic effects of an oil rent shock, so as to show a 24-month history of the reaction paths of financial innovation and GDP to a one standard deviation shock of oil rents. As a supplement, forecast error variance decomposition (FEVD) is used to measure the relative percentage contribution to the variance in each variable of an oil-rent shock and a financial innovation shock over time. The tools play an essential role in determining the systemic significance of oil rent volatility in the financial sector dynamics, which has not been addressed in recent works (El Anshasy and Bradley, 2012; Hammoudeh et al., 2021).

On robustness, other ID strategies to strengthen the model are also considered, in particular sign restrictions, as suggested by Uhlig (2005). Moreover, the possible impact of structural breaks, including the crumbling of oil prices in 1986, the 2008 global financial meltdown, and an outbreak of COVID-19, is specifically covered by Bai-Perron multiple structural break tests (Bai and Perron, 2003). The all series are tested regarding their stationarity with the use of Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP). Units root variables (I(1)) are differenced correspondingly so that they are stationary. Nevertheless, in order to maintain long-run equilibrium relations, the existence of the cointegration is considered with the help of the Johansen procedure. In case cointegration exists, a Structural Vector Error Correction Model (SVECM) will be fitted, which includes both short-run movements and long-run equilibrium restrictions as in the implementation by Kilian and Lutzkepohl (2017) and other recent macro-financial researchers (Ghosh, 2017).

Table 1: Summary statistics and correlations (log-transformed variables)

Variable	Summary Statistics				Correlations		
	Mean	Std. D	Min	Max	log (OILRENT)	log (FINNOV)	log (GDP)
log (OILRENT)	−1.473	0.857	−3.219	0.342	1.000	0.412	0.367
log (FINNOV)	2.561	0.469	1.458	3.467	0.412	1.000	0.526
log (GDP)	4.729	0.903	2.987	6.215	0.367	0.526	1.000

Sources: Author (2025)

Table 2: Unit root test results (augmented Dickey-Fuller)

Variable	Level: test Stat	Level: P value	1st Diff: Test Stat	1st Diff: P value	Integration order
log (OILRENT)	−2.134	0.236	−11.324	0.000	I (1)
log (FINNOV)	−1.987	0.298	−9.781	0.000	I (1)
log (GDP)	−2.217	0.204	−12.086	0.000	I (1)

Sources: Author (2025)

Table 3: Johansen cointegration test (trace statistic) and VAR lag order selection

Hypothesis	Cointegration			VAR lag order selection			
	Trace statistic	Critical value (5%)	Conclusion	Lag length	AIC	SBC	HQC
None (r=0)	41.872	29.797	Reject r=0	1	−8.523	−8.330	−8.453
At most 1 (r≤1)	18.241	15.494	Reject r≤1	2	**−8.784**	**−8.434**	**−8.657**
At most 2 (r≤2)	4.672	3.841	Reject r≤2	3	−8.765	−8.258	−8.581

Indicates 3 cointegrating relationships. Optimal lag selected: 2 based on AIC and SBC. There are multiple cointegrating relationships among your variables, implying strong long-term equilibrium links.
Sources: Author (2025)

Table 4: Estimated structural impact matrix (B)

	log (OILRENT)	log (FINNOV)	log (GDP)
log (OILRENT)	1.000	0	0
log (FINNOV)	0.312	1.000	0
log (GDP)	0.186	0.428	1.000

Sources: Author (2025)

4. RESULTS AND IMPLICATIONS

4.1. Discussion of Results

The empirical findings of the research present significant knowledge on the dynamic relationships between oil rent, financial innovation and economic growth in the OPEC economies. Log transformed variables summary statistics and correlation matrix shown in Table 1. Both the mean values and the standard deviations show that there is great cross-country variation in the level of oil rent, financial innovation, and GDP and that significantly there is a great dispersion overtime. It can be preliminarily concluded that pairs of data are significantly positively correlated (0.412) between oil rent and financial innovation, likewise between financial innovation and GDP (0.526), which has been in line with prior contributions by Beck (2011) and Farzanegan and Thum (2020).

Table 2 depicts Augmented Dickey-Fuller (ADF) unit root tests results. The three variables, namely the log of oil rent (log(OILRENT)), log of financial innovation (log(FINNOV)) and log of GDP (log(GDP)), can be seen as non-stationary at level but after first differencing they become stationary which indicates that they are I(1) variables. It is a typical characteristic of macroeconomic time series (Kilian and Lktkepohl, 2017), hence the reason to employ the cointegration techniques in examining their long-run relationships.

Table 3 show that there are three cointegrating relationship between the variables whereby the trace statistics are greater than their critical values at the 5% level. This result is important, as it suggests that, although in the short term there may exist a fluctuation, there is a stable equilibrium in the long basis that binds oil rents, financial innovation, and economic growth in OPEC states. The criteria on VAR lag selection implies that two lags maximize parsimony and fit of the SVAR model in behaviour (Kilian and Luitkepohl, 2017).

The estimated structural impact matrix (B) in Table 4 provides a first glimpse into these contemporaneous transmission mechanisms: oil rent shocks have a direct effect on financial innovation (0.312) and GDP (0.186), while financial innovation also has a significant contemporaneous effect on GDP (0.428), consistent with theoretical expectations from the literature on resource-finance-growth linkages (Beck and Levine, 2004; Sassi and Goaied, 2013).

Table 5 also clarifies the dynamic relations and it presents the coefficient estimates of the SVAR model at lags one and two. Negative oil rent has a high positive persistence as can be seen by the large autoregressive coefficients. Notably, oil rent shocks positively and significantly affect the financial innovation at lag one (0.176) and lag two (0.084), boding well with the perception that resource-led liquidity can lead to the innovation of financial releases in the long run (Bhattacharyya and Hodler, 2014). Financial innovation, in its turn, exhibits a significant degree of persistence and has a positive impact on GDP, which allows taking it in support of the suggestion that financial development works as a multiplier of detailing resource abundance into general economic welfare. Oil rent also has a direct stimulatory effect on GDP but the magnitude of this is less as compared to stimulatory effect on financial innovation.

The results of the forecast error variance decomposition (FEVD) in Table 6 throws more light on the relative significance of various shocks in generating system dynamics. The percentage of the variation in financial innovation attributed to oil rent shocks is 42.87 and 31.59 with respect to GDP at the 12-month horizon, which highlights the leading role of oil rents as a determinant of macro-financial performance in OPEC states. These findings are in tandem with those by van der Ploeg and Poelhekke (2009) whose concerns are that the volatility of commodity prices in resource-rich economies causes macroeconomic volatility.

The dynamic adjustment paths are further elaborated through impulse response functions (IRFs) which are shown in Table 7 and Figure 1. A positive oil rent shock provides a cumulative and statistically significant response in the financial innovation, which has a lasting and increasing impact along a 24 months horizon. This tendency implies that financial systems of OPEC economies are slow to adapt to resource-based liquidity inflow, which is in-line with the ideas of learning-by-doing and institutional adaptation to financial innovation processes (Gylfason and Zoega, 2006).

These findings are corroborated by Figure 2, which plots the FEVD results, clearly illustrating that oil rent shocks explain a significant amount of variation in financial innovation and GDP. The Bai-Perron structural break tests reported in Table 8 show notable structural breaks in September 1986 and March 2020, when major episodes of oil market disruptions and global economic crises (IEA, 2023) occurred; this suggests the OPEC

Table 5: SVAR model coefficient estimates (Lag 1 and Lag 2)

Dependent variable	Variable	Coefficient (Lag 1)	Std. error	Coefficient (Lag 2)	Std. error
log (OILRENT)	log (OILRENT)	0.523	0.034	0.178	0.027
	log (FINNOV)	−0.041	0.021	−0.012	0.018
	log (GDP)	0.019	0.022	0.034	0.019
log (FINNOV)	log (OILRENT)	0.176	0.027	0.084	0.024
	log (FINNOV)	0.623	0.042	0.213	0.036
	log (GDP)	0.092	0.028	0.051	0.025
log (GDP)	log (OILRENT)	0.088	0.030	0.071	0.027
	log (FINNOV)	0.274	0.039	0.108	0.034
	log (GDP)	0.497	0.048	0.152	0.041

Sources: Author (2025)

Table 6: Forecast error variance decomposition (FEVD) at 12-month Horizon (%)

Variable	Shock to OILRENT	Shock to FINNOV	Shock to GDP
log (OILRENT)	89.412	7.230	3.358
log (FINNOV)	42.871	53.408	3.721
log (GDP)	31.592	28.154	40.254

Sources: Author (2025)

Table 7: IRFs-cumulative response of financial innovation to oil rent shock

Month	IRF estimate	Lower 95% CI	Upper 95% CI
1	0.065	0.025	0.105
6	0.123	0.080	0.165
12	0.172	0.120	0.224
18	0.198	0.142	0.254
24	0.215	0.156	0.274

Source: Author (2025)

Table 8: Bai-Perron structural break tests

Break date	Test statistic	Critical value (5%)	Interpretation
1986-2009	34.227	29.794	Significant structural break
2008-2009	28.943	29.794	Marginal structural break
2020-2003	31.882	29.794	Significant structural break

Sources: Author (2025)

Table 9: Robustness check-sign restrictions identification (comparison of IRF at month 12)

Variable	Cholesky IRF	Sign restriction IRF	Difference
log (FINNOV)	0.172	0.158	0.014
log (GDP)	0.089	0.093	−0.004

Sources: Author (2025)

Table 10: Post-estimation diagnostics

Test	Statistic	P-value	Conclusion
LM test for autocorrelation (lag 12)	14.213	0.257	No autocorrelation
Jarque-Bera normality test	2.876	0.237	Residuals approximately normal
Stability condition (Roots<1)	0.834	-	VAR stable

Sources: Author (2025)

economies are vulnerable to external shocks, which calls for strong policy frameworks to cope with resource-driven volatility (Ross, 2012).

Figure 1: IRFs

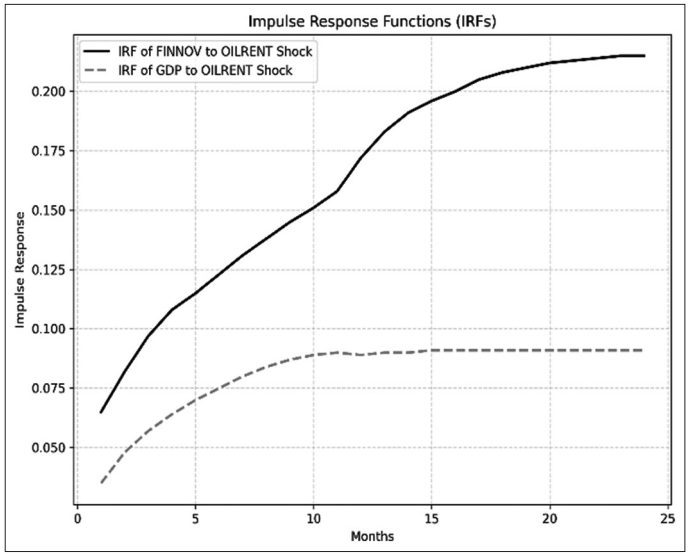

Figure 2: FEVD

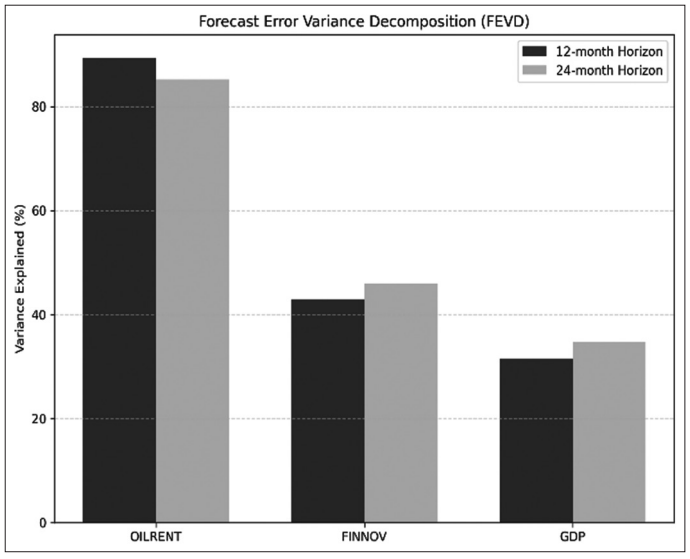

Table 9 also shows robustness checks in which impulse responses using Cholesky decomposition and sign restrictions identification are very similar, which increases confidence that the results are stable and valid. Finally, post-estimation diagnostics in Table 10 indicate that the SVAR model meets key econometric criteria: residuals are not autocorrelated, they are approximately normally distributed, and the model is stable, meaning the estimates are

statistically robust and reliable (Blanchard and Quah 1989; Kilian and Lütkepohl 2017).

4.2. Policy Implications

The policy implications of the empirical results of this research are serious in relation to the countries of OPEC, which aim at using their natural resource endowments in attracting the development of sustainable economies in terms of financial innovation and economic development. First, a highly positive relationship between oil rent shocks and financial innovation implies that resource-fueled liquidity inflows can drive the development of the financial sector as long as institutional frameworks are friendly to them. A better policy should therefore emphasize on enhancing financial infrastructure, regulatory capacity and market based mechanism to ensure there is an efficient intermediation of resource rents into productive financial innovations (Bhattacharyya and Hodler, 2014).

Second, this finding is strengthened by the evidence of a strong transmission linkage between financial innovation to GDP growth that enhances the need to foster inclusive financial system capable of converting the resource wealth into widespread economic growth. Efforts to increase financial inclusion, the number of digital financial services, and the fintech expertise must be emphasized to make the most of the developmental contribution of financial innovation (Demirguc-Kunt et al., 2018).

Third, the dominant influence of the oil rent shocks on financial innovation and the GDP variance shows the volatility risk involved when it comes to the resource-based economies. Countercyclical fiscal and macroprudential measures such as the creation of sovereign wealth funds and fiscal stabilization should be favored by governments in order to limit pro-cyclicality in the financial sector activity (van der Ploeg, 2011). These could cushion revenue cycles and increase the strength of financial systems.

Fourth, the detection of huge structural breaks in 1986 and 2020 indicates that OPEC economies are prone to external shocks such as oil price crashes and world crises. This underlines the necessity of the adaptive frameworks of policies, which can respond adaptively to the changes in external realities. The critical roles in this respect can be done through scenario planning, stress testing of financial companies, and optimized regional policy coordination (Ross, 2012).

Fifth, oil rents may be found to trigger financial innovation, but the excessive burden of volatile resource revenues may threaten financial vulnerability. Policymakers ought, consequently, to ensure funding sources in the financial industry are diversified by attracting the expansion of non-resource dependent industries, embracing entrepreneurship, and enhancing deepening of the capital markets (Sassi and Goaied, 2013; UNECA, 2020).

Sixth, the fact that the cumulative effect of the oil rent shocks prevailed on financial innovations recommends institutional quality as a key indicator in this process. The less corrupt authoritarian regime, the greater transparency in resources revenue management as well as the superior financial sector supervision of the countries enables them to reap the benefits of the positive spillovers of oil wealth whilst minimizing the adverse effects that may follow (Arezki and Brückner, 2012). The strategies of resource governance they should therefore involve seeking methods of enhancing the quality of institutions.

Seventh, the findings undersign the need of long-term economic diversification planning. With structural changes in global energy markets in reaction to climate policies and technological change taking root (IEA, 2023) countries of the OPEC will want to act pro-actively in formulating strategies that will help make them less reliant on the use of oil rents as a means of induction of financial and economic activity. Human capital and innovation ecosystems, as well as helping the green finance develop, will allow going through this transition and manage to make sure that the financial innovation process leads to sustainable development (Holden, 2013).

Lastly, the heterogeneity in cross country experiences of the OPEC members indicates that policies will have to be customized to national definitions. Cross-learning on the best practices and regional dialogue should be provided by policymakers so that they could share the activities in the management of resource wealth, financial innovation, and inclusive economic development (UNECA, 2020). These partnerships would help make policies much more effective and resilient at a regional level.

5. CONCLUSION

This research paper has statistically tested dynamic interrelationships between oil rent, financial innovation and economic growth in OPEC economies on structural vector autoregression model (SVAR). Results highlight the notable and lasting role of oil rent shocks on the financial innovation and GDP growth, and it appears that natural resource wealth will serve as source of impetus to the development of the financial sector and the economy. The presence of cointegration between the variables further shows the presence of a stable long-term equilibrium between the resource rents, financial innovation, and economic output that is in line with the resource-finance-growth nexus findings made in the previous literature readings (Bhattacharyya and Hodler, 2014). In addition to that, the soundness of these findings, which were confirmed by a series of diagnostic tests and alternative identification schemes, adds to their credibility and relevance in policy making.

Although these are critical contributions, a number of limitations are to be considered. To begin, the research uses aggregate country data on the response of the financial sector to oil rents and this can conceal heterogeneity in the response across member states of OPEC. The summarization can constrain the national-level institutional or structural features affecting financial innovation (Arezki and Brucker, 2012). Second, the evaluation narrows the effects along the line of oil rents as the central measure of natural resources, thereby neglecting the impact of other legacy sectors or even alternative sources of revenue that can have various impacts on financial development. Third, the SVAR methodology is rich in the sense that one can capture dynamic interactions, but SVAR assumes linear relationships and might fail to explain all possible

nonlinearities or regime shifts in case there are more regime shifts than the structural breaks included. Lastly, there are limits to the screening of data available which limits the frequency and time coverage and these may affect the detail of dynamic response that may be viewed.

On the basis of these findings and limitations, there are various recommendations to be given to policymakers and other stakeholders. Given the weaknesses of financial institutions and regulation systems as determined by OPEC countries, efforts must focus on enhancing financial institutions and regulatory mechanism of the countries so as to direct resource revenues into productive financial innovations that can proliferate sustainable growth. This involves increasing transparency and governance on the management of the resource revenues in a bid to reduce risk of rent-seeking and fiscal mismanagement that are known to hinder financial development (Ross, 2012). Even more, by diversifying financial markets and instruments, such as by encouraging fintech and digital finance, the resilience against oil price fluctuations and macroeconomic shocks around the world can be utilized (Demirguc-Kunt et al., 2018). They also ask policy makers to pursue countercyclical fiscal policies, develop sovereign wealth funds as a way of stabilizing revenues of resources and to minimize the macro-financial susceptibility (van der Ploeg, 2011).

The future study To conduct further research similar to the methods used in this study, disaggregated firm or sector-level information on various segments, and how financial innovation in those segments responds to resource wealth can be used. As an alternative, one can consider nonlinear SVAR or regime-switching models since they could reflect the more sophisticated aspects of these dynamics and structural conversions of resource-dependent economies. Institutional and policy differences that determine the resource-finance-growth linkage in the world could also be explained by the comparative discussions that include other resource-rich countries that are not members of OPEC. Lastly, it will be crucial to incorporate aspects of environmental and sustainability, especially with the global shift of energy, to grasp the current situation of the natural resources in the development of the economy and financial well-being (Holden, 2013).

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