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Oil shocks and bank profitability in Iran: An empirical study of fiscal and monetary policies transmission channels using a proxy VAR approach

Hadi Adib, Akbar Mirzapour Babajan*, Beitollah Akbari Moghaddam, Roozbeh Balounejad Nouri

Department of Economics, Qazvin, Branch, Islamic Azad University, Qazvin, Iran

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Abstract

This study applies a Proxy SVAR approach to investigate the effects of surprised oil revenue shocks on banking profitability through monetary and fiscal policy transmission channels. To evaluate the efficiency of these transmission channels, we begin by using a VECM model (baseline estimation) to investigate the linkage between monetary and fiscal policies and the profitability of banks. To achieve this objective, we utilize monthly time series data spanning from January 2006 to August 2023, focusing on the banking stock index, money supply, government expenditures and several control variables, including inflation rate, total real consumption, and total real investments. We also use Iran's oil revenues data to identify surprise oil shocks, following the methodology proposed by Wu and Callvo [34]. Our empirical findings not only contribute to the existing literature by revealing the importance of transmission channels through which surprised oil revenue shocks exert their influence on banking profitability, but the study also sheds light on the critical role of monetary policy rather than fiscal policy in this context.

Keywords: surprised oil revenue shocks, banking profitability, proxy SVAR, monetary and fiscal policies, VECM model
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1 Introduction

Over the past decades, oil shocks have sparked numerous concerns. On the one hand, the central concern revolves around examining the effects and consequences of oil shocks, which continues to be a topic of disagreement among economists, policymakers, and financial market analysts. Accordingly, there have been many instances where global oil shocks have profoundly affected a wide range of economic activities across the world [19, 28, 31]. As a result, the examination of how oil shocks affect different macroeconomic indicators has become a major focus in related empirical economics. This concern is especially noticeable in oil-exporting countries, like Iran, whose economies are strongly dependent on oil revenues, making their exports, government budgets, GDP growth, banks' profitability, etc. significantly vulnerable to the major consequences of oil shocks [10, 16, 18, 21]. On the other hand, as analytical methods have progressed and incentives have emerged to enhance economic analysis concerning the impacts of oil

*Corresponding author
Email addresses: h.adib2020h@gmail.com (Hadi Adib), akbar.mirzapour@gmail.com (Akbar Mirzapour Babajan), akbari.beitollah@gmail.com (Beitollah Akbari Moghaddam), roozbeh_noury@yahoo.com (Roozbeh Balounejad Nouri)

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shocks, many scholars have attempted to delve more deeply into various investigations into how oil shocks impact various economic variables. While some researchers strived to enhance their exploration around the consequences of oil shocks by closely analyzing the mechanisms through which these shocks affect various variables [13, 21, 33], there were other scholars such as Bhadury et al [4], Xiuzhen et al [35], as well as Binh and Sala [27] focused on distinguishing between expected and surprise oil shocks. These contributions have been crucial for two main reasons. Firstly, tracking the intricate transmission channels through which different macroeconomic sectors respond to oil shocks has posed a significant challenge for policymakers, economists, and financial institutions. Secondly, surprise oil shocks are inherently unpredictable, leading to potential uncertainty for decision-makers involved in related matters. These shocks also can result in a wide range of severe economic impacts, affecting inflation, consumer confidence, and overall economic stability, all of which necessitate rapid policy responses [19, 28, 31]. Taking into account these concerns, this study investigates the effects and scrutinises the transmission channels of surprise oil revenue shocks in the banking sector in Iran.

While in theory, various channels exist for transmitting the impact of an oil revenue shock to different macroeconomic indicators, this research addresses a critical knowledge gap by empirically examining the transmission channels of fiscal and monetary policies into bank profitability in response to oil revenue shocks. The reason for such an investigation lies in understanding the logic behind choosing each of these channels and comprehending their importance. Firstly, to establish empirical evidence supporting fiscal policy as a mechanism for transmitting oil revenue shocks to the banking sector's profitability, it is essential to highlight the significant influence of governments' reactions to these shocks on public expenditure and the broader economic environment, particularly in oil-exporting countries. Specifically, when oil prices increase, augmented government revenues often result in elevated public spending, stimulating economic growth and benefiting the banking sector due to increased demand for services. Conversely, during periods of declining oil prices, governments may reduce spending or run deficits, impacting banking profitability in varying ways. Reduced spending can hinder economic growth and lending activities, while deficits can provide stability but raise concerns about mounting debt, thereby affecting the country's financial environment. Additionally, in oil-exporting nations with subsidies, adjusting them in response to oil price fluctuations can further influence banking profitability by impacting inflation, interest rates, and overall economic conditions. Therefore, the profitability of the banking sector in oil-dependent economies is closely tied to fiscal policy responses to oil revenue shocks; hence, understanding these channels is imperative for a comprehensive analysis [2, 15]. Secondly, the monetary policy channel serves as an alternative means of transmission. Consequently, the inquiry revolves around how to provide empirical evidence supporting the role of this channel in transmitting the consequences of oil revenue shocks to the banking sector's profitability in an oil-rich country like Iran. In line with this, central banks typically employ various monetary policy tools to manage the impact of oil revenue shocks on the macroeconomic environment; consequently, these responses yield both direct and indirect effects on the banking sector's profitability. Accordingly, commonly used tools within both conventional and unconventional monetary policies usually encompass managing inflation through money supply or interest rate adjustments, influencing exchange rates, changing the foreign exchange reserves, and using interest rates to stabilize the economy in reaction to oil revenue shocks [3, 26, 36]. Understanding these complex interactions is essential for analyzing how monetary policies indirectly transmit the oil shock effects to banking sector profitability. Given these complex interactions and recognizing the fundamental role of monetary policies in oil-exporting economies, the profitability of the banking sector would significantly be connected to how central bank authorities respond to oil revenue shocks. Therefore, for a detailed examination, it is required to properly investigate these mechanisms.

Given these foundations, it is incredibly important to conduct a comprehensive analysis of how surprise oil revenue shocks affect banking sector profitability through fiscal and monetary policy transmission channels. Accordingly, our contributions to the literature and their importance lie in: Firstly, the primary goal and valuable aspect of this research are to accurately monitor how oil revenue shocks affect the profitability of the banking sector. To underscore the significance of this matter, the stylized facts of Iran's oil-dependent economy [12, 14], in which the banking sector plays a leading role within its financial markets compared to other less developed sectors, have demonstrated the complexity of relations between oil revenues shocks and the banking sector's performance in this country. Secondly, due to the lack of empirical research in this field, this study represents one of the initial attempts to scrutinize the repercussions of oil revenue shocks on Iran's banking sector using monetary and financial policies as transmission channels. Thirdly, we concentrate on the surprise oil revenue shocks instead of the average impacts of expected and unexpected oil shocks. The imperative to examine this matter arises from the pivotal roles played by both the banking sector and oil revenues in shaping Iran's overall economic condition. This dual significance underscores the importance of effectively mitigating the impact of surprise oil revenue shocks on the banking sector, as it can significantly influence economic stability, financial robustness, and the sustainable growth of Iran's economy. Finally, due to the substantial influence on Iran's entire economy as well as the exogenous nature of oil revenue shocks, the country's authorities have limited power to significantly control this variable, we utilize a proxy SVAR model in the context of system equations for modelling the interconnections (like impulse-response analyses) among surprised oil revenue shocks and bank profitability in Iran. In this way, the ramifications of oil shocks can be analyzed through two primary transmission channels: monetary and fiscal policies through of system equations.

Overall, to tackle the central concern of understanding the role of monetary and fiscal policies as transmission channels to track the impact of surprised oil shocks on the banking sector in Iran, we explore two distinct rounds, aiming to make a significant contribution by enhancing the enduring prosperity of both the banking sector and the nation's economy. In the first round, we employ a VECM model (baseline estimation) to examine the connection between the monetary and fiscal policies with the bank's profitability. Our objective is to explore the interconnections between these sectors and prepare for analyzing the intermediary role of these policies in transmitting the effects of surprise oil shocks. In the second round, we apply the two-stage Proxy SVAR model to explore how surprised oil revenue shocks impact bank profitability through these key transmission channels, i.e. monetary and fiscal policies.

This study is structured as follows: The next section is reserved for a contextualization of the empirical literature review, which includes "oil shocks and macroeconomic variable: different approaches", "banking industry in Iran", "monetary and fiscal policies: frameworks and transmission channels", and "surprise oil revenue shocks". Section 3 presents the methodologies and data which contains data resources, principles of proxy SVAR models, and the transmission channels of oil revenues. Moving forward, Section 4 sets out the empirical results and, based on that, the conclusions and implications are discussed in section 5.

2 Empirical literature reviews

2.1 Oil shocks and macroeconomic variable: Different approaches

A review of research literature highlights Iran's frequent economic challenges arising from oil shocks, given its status as an oil-exporting country. A considerable amount of literature has explored the connectedness and the magnitude of the effects, between oil shocks and different macroeconomic indicators. These investigations utilize various approaches to analyze the impacts of oil shocks. From this perspective, the existing studies can be concisely classified as (i) Causal studies [1, 9]; (ii) Static or Dynamic studies [13, 33]; (iii) Mean-Level Pass-Through Analyses or Variance-Level Spillover Effects studies [10, 14]; (iv) Symmetric or Asymmetric Effects studies [21, 25]; (v) Regional or Country-Specific studies [16, 18, 27]; (vi) Vulnerability and Resilience studies [6, 32]; (vii) Global Interconnectedness [28, 31, 19]; (viii) Environmental and Sustainability studies [24, 7]; (ix) Event-Oriented studies [5, 20]; (x) Sectoral studies like the effects of oil shocks on banking sector [21, 10, 32, 25, 18, 14] and, finally, some research endeavours employ hybrid approaches to analyze both direct and indirect effects of oil shocks on a specific sector of the economy, e.g. banking industry.

2.2 Banking Industry in Iran

The banking industry in Iran plays a prominent role in the country's financial system and economy. It encompasses a network of public and private banks, financial institutions, and credit agencies that facilitate monetary transactions, provide financing options, and support economic activities. Starting from 2006, privatization, guided by the execution of Principle 44 of the Islamic Republic of Iran's Constitution, has progressively resulted in the significant transfer of substantial ownership stakes in Iranian banks to the private sector through the Tehran Stock Exchange. This strategic reform aimed to boost efficiency and competitiveness in the banking sector, aligning it with the broader efforts seen across the country's various economic sectors [14]. Hence, following the privatization, the Iranian banking industry remains to be a key element of Iran's economic framework. As a result, it is deeply intertwined with the country's economic policies, reacting significantly to exogenous economic shocks like oil revenue shocks. This is due to increased market competition, reduced government's monopoly over resource allocations as well as decreased market assurance in the banking sector [15].

On this basis, numerous research studies have employed the banking stock index, derived from the data of 21 banks listed on the Tehran stock exchange, to act as a representative benchmark for examining the banking industry in Iran [22, 37, 11, 8, 25, 14]. Within this pool of studies, a smaller subset has delved into how oil shocks impact the profitability of the banking sector active in the Tehran stock exchange.

This constraint arises from the fact that international sanctions in recent decades have placed limitations on Iran's share in the global oil supply, which is primarily determined by the OPEC cartel.

Structural Vector Error Correction Model.

2.3 Surprise oil revenue shocks

Empirically, most previous studies did not distinguish between “Surprise Oil Shocks” and “Expected Oil Shocks,” instead, they focused on examining the impact of average oil shocks. As a result, another distinctive aspect of this study is our differentiation between these types of shocks, with a specific focus on surprise oil revenue shocks. Accordingly, the key question that arises is: What is the significance of giving particular attention to surprise oil shocks as opposed to expected ones? Surprise oil revenue shocks, generally, hold greater significance for countries heavily dependent on oil revenues, as a substantial part of their funding for executive decisions depends on income generated through oil exports [17]. In such a situation, the majority of a country’s economic sectors are especially susceptible to the unpredictability, potential uncertainty, and far-reaching economic consequences stemming from the global oil markets, particularly surprise oil shocks [35, 27]. As a result, these surprise oil shocks demand rapid and adaptive responses in order to maintain economic stability [4]. More specifically, any significant surprise oil revenue shock in Iran can, generally, have a profound impact on investor confidence, government revenues, budgetary planning, balance of payments, and overall economic stability. In response, there is a need to rapidly adjust fiscal and monetary policies, including decisions related to government spending, taxation, interest rates, and exchange rate policies. In reaction to the expected shocks, however, better preparation, mitigation strategies, and more effective policymaking can be implemented. Thus, surprise oil revenue shocks carry heightened importance for oil-dependent nations. Therefore, it becomes imperative for them to delve into the consequences of such shocks and gain insights into their effects on various macroeconomic indicators.

Other points to address regarding surprise oil revenue shocks include identifying key factors that existing related studies have considered as substantial triggers of these shocks and also determining the mechanism by which these shocks affect domestic variables. Firstly, the key factors contributing to surprise oil shocks include the fluctuations of global oil prices, the impact of international sanctions, geopolitical and regional tensions, challenges within domestic production and infrastructure, technological advancements, shifts in market demand, fluctuations in exchange rates, as well as the role of economic conditions and government policies [2]. These influencing factors, which have had substantial effects on different occasions, can be ascribed to either demand-side or supply-side factors influencing oil revenues [15]. Secondly, some related empirical studies underscore that the consequences of significant shocks in the oil market don’t solely manifest as their direct impacts; instead, their indirect aftermath can also have significant and substantial effects [23]. Given the complex and unpredictable nature of oil shocks that stochastically hit oil-rich economies like Iran, coupled with the crucial need to uncover the mechanisms and identify the channels through which these shocks influence economic indicators, numerous studies prioritize the analysis of different transmission channels, including fiscal and monetary policies. This approach enables them to comprehensively track how oil shocks impact different sectors.

2.4 Monetary and fiscal policies: Frameworks and transmission channels

In Iran, fiscal policies do not revolve around tax-centered fiscal strategies; instead, they predominantly concentrate on adjusting the volume of government expenditures, and these spending are primarily funded by the oil export revenues, rather tax-derived income. Empirical evidence confirms that such circumstances will be generally accompanied by a lack of accountability and transparency in the implementation of fiscal policies. As a result, when it comes to executing fiscal policies, governments often fail to achieve their objectives, such as budgetary balance, economic growth, inflation management, income distribution and social equity, financial stability, etc.; consequently, they often face budget deficits. Jalali Naini and Naderian [15] have confirmed that within Iran’s economy, governments typically find themselves trapped in a continuous vicious cycle as they attempt to address budget deficits. Many other studies also corroborate this scenario occurs because the governments mostly choose the most straightforward solution to tackle budget deficits, which involves increasing the money supply [3, 36].

Furthermore, Iran’s monetary policies mainly center on managing the money supply within the economy [26]. Accordingly, empirical evidence indicates that despite the historical focus of the Central Bank of Iran on three main policy objectives, the existence of various challenges has resulted in a reduction in the efficacy of these policies, double-digit inflation, and multiple significant volatilities in foreign exchange market. The most significant of these challenges include “ambiguity regarding priorities of goals and policies”, “limitations on types and usage of policymaking tools”, “lack of the Central Bank’s independence”, “inefficiencies in managing inflation expectations”, and ”inconsistencies among members of the Money and Credit Council and other monetary authorities in adopting monetary policies”. These conditions have effectively relegated this sector of the economy to serve as a tool for government control and

Which is also closely linked to social and political stability.

Namely “inflation control”, “promoting production and employment”, and ”ensuring the value of the domestic currency”.

primarily for budget deficit compensation. These conditions have mostly transformed the central bank into a tool for government to primarily compensate the budget deficits, thereby contributing to a continuous vicious cycle [15].

Given the mentioned stylized facts regarding the frameworks of monetary and fiscal policies in Iran, in this research, our central focus of this research lies in precisely investigating and tracking the channel through which exogenous oil shocks transmit into various macroeconomic indicators, particularly the profitability of the banking sector in Iran. Consequently, it is noteworthy to mention that this focus aligns with findings from several prior studies. To be more precise, numerous researchers have concentrated on different transmission channels by which oil shocks can significantly affect a wide range of macroeconomic indicators. Our analysis of empirical studies illustrates the existence of numerous potential transmission channels such as (i) Inflation Channel; (ii) Income Redistribution Channel; (iii) Production Cost Channel; (iv) Exchange Rate Channel; (v) Monetary Policy Channel; (vi) Fiscal Policy Channel; (vii) Wealth Effect Channel; (viii) Global Economic Uncertainty Channel and so forth [23, 22, 11, 8, 26, 1, 13, 6]. Considering the significance and roles of monetary and fiscal policies in Iran, alongside their pivotal roles delineated in the existing literature, particularly within oil-exporting nations, we were driven to focus this study primarily on monetary and fiscal policies as the pivotal transmission mechanisms.

3 Methodologies and data

The complex interconnection between oil markets and the banking sector has consistently held great significance, especially in oil-dependent economies with less developed financial markets like Iran. With its abundant energy resources, Iran's economic prosperity has largely followed the fluctuations in global oil prices [14]. Furthermore, in the ever-evolving realm of global finance and economics, tracking the complex transmission channels through which oil shocks impact different sectors, including the banking industry, presents a formidable challenge for policymakers, economists, financial institutions, and also investors. To address this challenge, scholars have long struggled to appropriately incorporate the oil variable shocks into statistical estimations. As noted in the preceding section, among the existing studies, a notable accomplishment has been the observation of how the effects of these oil shocks are transmitted to various sectors within an economy. In the framework of this research, our aim is to track the effects of oil revenue shocks on bank profitability through fiscal and monetary policies transmission channels.

To this aim, we will initially estimate a VAR system, particularly a baseline VECM model to estimate the monetary and fiscal policies' relation with the profitability of banking sector, without considering the oil shocks. Subsequently, a two-stage proxy SVAR model will be utilized to investigate the role of the monetary and fiscal policies as transmission channels between oil shocks and banking profitability. Technically, the oil shocks are employed as an instrument for monetary and fiscal policies in the first stage. In the next stage, the estimated monetary and fiscal policies will be integrated into the SVAR model. Hence, to provide a comprehensive understanding, we will further discuss the data sources, the theoretical structure of the proxy SVAR model, and finally, the econometrics of the transmission channels.

3.1 Data resources

In this research, we utilize Iran's oil revenue data to investigate how the profitability of the banking sector, active in the Tehran Stock Exchange, responds to surprise oil shocks. According to the main purpose of the study, monthly time series data from January 2006 to August 2023 are applied. To clarify, Iran's oil revenues (LOR), money supply (LMP), government expenditures (LFP) are collected from the Iran's central bank website. Furthermore, the inflation rate (LINF), total real consumption (LCON), and total real investments (LINV) are gathered from Iran's official statistical center of data website. Finally, observations for the real bank performance stock index (LBPSI) are gathered from the Tehran Stock Exchange website.

The first round of this study is clear-cut, employing a VECM model to study the influence of different policies on banking profitability. In contrast, further clarification is needed for the second round, which was established using a proxy VECM model. Consequently, in the upcoming discussion, we will delve into the procedure of extracting the surprised oil revenue shocks, the fundamentals of the Proxy SVAR framework, and scrutinize the channels through which oil revenue shocks affect various variables.

The prefixes of "L" and "d", respectively, represent the logarithm and first-order difference form of each variable.
`www.cbi.ir`
`www.amar.org.ir`
The weighted average prices of the different banks on the Tehran Stock Exchange market.

3.2 Surprised oil revenue shocks

The second round of this study focuses on identifying surprised oil revenue shocks and examining how these shocks impact banking performance. This analysis involves investigating how these shocks are transmitted to the banking sector through monetary and fiscal policy channels, as stated in the previous section. Based on this foundation, it is crucial to initially evaluate the surprised oil revenue shocks. Therefore, based on Wu and Callvo [34], we apply an AR(1) process on oil revenues time series data to decompose it into two components: surprised oil shocks and the expected part representing historical changes in oil revenues, as follows:

$$LOR_t = \sum_{k=1}^{p} \beta_k LOR_{t-k} + \varrho_t \tag{3.1}$$

In which, the ϱ_t series is the surprised oil revenues shocks (residuals of model serving as a representative of unexpected changes in oil revenues), while the LOR_{t-k} signifies lags of oil revenues predicted by the regression model.

3.3 Principles of proxy SVAR models

Generally, VAR models are primarily applied for a dynamic impulse-responses estimation of macroeconomic endogenous variables in a system. Meanwhile, Stock and Watson [29] introduced proxy SVAR models to identify structural shocks, often proxies for unobservable economic factors, within macroeconomic system. However, Stock and Watson [30] endeavored to enhance the practicality of the proxy SVAR models by adjusting the proxies from dummy variables to real event-oriented time series variables. This treatment is precisely what will be employed in this paper. It is chosen because, in addition to the timing of the oil shocks, their sizes of impacts on the Iran's macroeconomic system are pivotal aspects of this research. In essence, if the equation (3.2) represents a matrix form of a VAR regression, the proxy SVAR will be as follows:

$$Y_t = \sum_{k=1}^{p} C_k Y_{t-k} + \omega_t. \tag{3.2}$$

The above is a VAR process that can be adopted into a proxy SVAR, if the residuals of model are linear combinations of structural shocks, $\omega_t = U\varepsilon_t$. In essence, ε_t is a $(n \times 1)$ vector of unpredictable structural shocks with zero mean, $E(\varepsilon_t) = 0$, and an identity variance matrix, $E(\varepsilon_t.\acute{\varepsilon_t}) = I_n$. In this regard, the variance-covariance matrix of equation (3.2) is $E(\omega_t.\acute{\omega_t}) = \Omega = U.\acute{U}$. Thus, for IRFs macroeconomic variables to oil revenues shocks, the proxy SVAR can be taken into account as follows:

$$Y_t = \sum_{k=1}^{p} C_k Y_{t-k} + U\varepsilon_t^{Oil}. \tag{3.3}$$

Indeed, the oil revenues time series shocks variable is the instrumental variable of the study correlated with monetary and fiscal policies.

$$\begin{cases} E\left(Z_t, \varepsilon_t^{Monetary}\right) \neq 0 \\ E\left(Z_t, \varepsilon_t^{Fiscal}\right) \neq 0 \end{cases} \qquad \text{Relevance} \tag{3.4}$$

$$E\left(Z_t, \varepsilon_t^{Other}\right) = 0 \qquad \text{Exogeneity} \tag{3.5}$$

Therefore, if the correlation between monetary and fiscal policy shocks and oil revenues in the VAR model is non-zero, while the correlation between oil revenues and the other endogenous variables of the model is zero, oil revenues can serve as an instrumental variable in the proxy SVAR.

3.4 Oil revenue transmission channels

Numerous studies agree that oil shocks can affect Iran's economy through two primary channels: monetary (related to money supply) and fiscal (related to government expenditures). As a stylized fact of Iran's economy, government expenditures are financed by oil revenues, while the monetary policies are mostly dependent on the government budget deficit. In principle, considering these three crucial variables independent and separate would be thoroughly misleading in the statistical modelling. Hence, the two main transmission channels of oil revenues shocks will be delineated in this paper as follows:

$$LMP_t = \underbrace{\sum_{j=0}^{n-1} \theta_{t-j} LMP_{t-j} + \gamma_t^M \varrho_t}_{\widehat{LMP}_t} + \vartheta_t^n \tag{3.6}$$

$$LFP_t = \underbrace{\sum_{j=0}^{n-1} \delta_{t-j} LFP_{t-j} + \gamma_t^F \varrho_t + \kappa_t^n}_{\widehat{LFP}_t} \tag{3.7}$$

In essence, in the second scenario that applies the proxy SVAR framework, instead of using LMP and LFP in the system equations, the fitted values of both will be utilized, specifically those estimated by the oil revenue instrumental variable.

4 Empirical results

4.1 Summary statistics

Before delving into the estimation of both scenario, namely VECM and Proxy-SVAR, comprehensive descriptive statistics and pre-modeling investigations are meticulously conducted. In line with this, Table 1 presents a comprehensive overview of the primary descriptive statistics for all variables. Descriptive statistics provide insights into the data, along with preliminary tests such as normality, Ljung-Box, and ADF unit root tests.

Table 1: Descriptive Statistics

Statistics / Variables	LOR	LMP	LFP	LINF	LCON	LINV	LBPSI
Mean	13.048251	8.903393	14.16557	1.808623	12.62004	9.261691	7.490874
Standard Deviation	0.738549	0.868877	0.692947	0.513810	0.685288	0.490869	1.021022
Skewness	-0.221075	0.003923	-0.051159	-0.133981	0.098458	0.463943	0.702564
Kurtosis	2.279582	1.781383	2.046245	3.116387	1.985299	1.853381	3.459115
Jarque-Bera (P-value)	32.08 (0.000)	26.74 (0.000)	30.92 (0.000)	29.05 (0.000)	31.57 (0.000)	27.83 (0.000)	21.51 (0.000)
Liang-Box Q(3)	102.52 (0.000)	263.76 (0.000)	221.93 (0.000)	237.85 (0.000)	214.64 (0.000)	270.71 (0.000)	228.36 (0.000)
ADF probability	0.8186	0.9967	0.9974	0.8309	0.9263	0.7930	0.9024
Observations	312	312	312	312	312	312	312
Variables Statistics	**dLOR**	**dLMP**	**dLFP**	**dLINF**	**dLCON**	**dLINV**	**dLBPSI**
Mean	0.041767	0.060528	0.051353	0.003611	0.047993	0.018873	0.082491
Standard Deviation	0.280284	0.023061	0.052657	0.459547	0.093689	0.092782	0.231962
Skewness	0.360165	1.181158	0.544422	-0.479505	1.741408	0.122923	0.218173
Kurtosis	4.699599	6.030238	2.931267	4.346315	4.775918	5.064834	3.123762
Jarque-Bera (P-value)	6.957 (0.031)	30.14 (0.000)	24.33 (0.000)	57.83 (0.000)	31.21 (0.000)	82.14 (0.000)	42.01 (0.000)
ADF	0.0000	0.0013	0.0016	0.0000	0.0000	0.0000	0.0007
Observations	311	311	311	311	311	311	311
Normalized Variables	LOR	LMP	LFP	LINF	LCON	LINV	LBPSI
Jarque-Bera (P-value)	1.48 (0.A20475)	4.55 (0.103)	3.09 (0.214)	1.91 (0.383)	1.17 (0.436)	2.22 (0.328)	4.53 (0.104)

Source: Study Findings

Based on the results, an analysis of the mean and standard deviation of individual variables reveals that these time series demonstrate relatively low levels of volatility. This characteristic is shaped by the nature of macroeconomic variables as well as the monthly frequency of the data. Moreover, the analysis of skewness and kurtosis using the Jarque-Bera normality test suggests that none of these time series follow to a normal distribution. Furthermore, to homogenize and improve the accuracy of modeling the study's data, we will proceed by applying standardized (or normalized) time series in the subsequent analyses. According to the findings from the Ljung-Box test, it is confirmed that there is autocorrelation present in the initial three lags of each variable. Additionally, the outcomes of the ADF unit root test probabilities (p-value) show that all variables, when analyzed in their initial levels, display a unit root. As a result, taking the first difference of them results in making them stationary and transforms them into stationary

Augmented Dicky-Fuller

All the time series have been standardized or normalized by the formula (standardized $(x_t) = \frac{x_t - Mean(x_t)}{SD(x_t)}$) [38].

The accurate numbers of lags will be determined with SBC information criterium in the next parts. According the Ljung-Box, the autocorrelation process is proven.

time series. Therefore, in the estimation phase, instead of opting for a VAR framework, we will choose to apply the Vector Error Correction Model (VECM).

Before reaching the estimation phase, there are three preliminary steps to complete: (i) determining the optimal number of lags, (ii) conducting the Granger causality test, and (iii) performing the co-integration test. To use the VECM models, it is essential to have at least two time series data as endogenous variables. In this context, the Granger causality test becomes necessary. However, it is crucial to note that this test is highly sensitive to the number of lagged variables. In accordance with this, our analysis aimed to identify the "best number of lags" using the VAR model based on the SBC information criterion, which revealed that the optimal number of lags is a maximum of three. This means that for VECM, embedding the first differences of endogenous variables in, the optimum number of lags is two. However, for testing Granger causality, the optimum number of lags is three owing to checking the unilateral or bilateral relationships between the level of endogenous variables.

Table 2: The Granger Causality Test

The null hypothesis	F-Stat.	Prob.	The null hypothesis	F-Stat.	Prob.
LMP does not Granger Cause LBPSI	8.65823	7.E-05	LMP does not Granger Cause LOR	0.88026	0.4220
LBPSI does not Granger Cause LMP	3.31446	0.0458	LINF does not Granger Cause LFP	9.42644	1.E-06
LFP does not Granger Cause LBPSI	7.65054	4.E-05	LFP does not Granger Cause LINF	0.18988	0.8277
LBPSI does not Granger Cause LFP	4.78681	0.0133	LCON does not Granger Cause LFP	5.10604	0.0102
LINF does not Granger Cause LBPSI	6.52174	0.0008	LFP does not Granger Cause LCON	5.29470	0.0088
LBPSI does not Granger Cause LINF	5.42861	0.0072	LINV does not Granger Cause LFP	6.05290	0.0048
LCON does not Granger Cause LBPSI	4.31773	0.0114	LFP does not Granger Cause LINV	3.96906	0.0224
LBPSI does not Granger Cause LCON	4.69961	0.0107	LOR does not Granger Cause LFP	0.88026	0.4220
LINV does not Granger Cause LBPSI	5.11431	0.0101	LFP does not Granger Cause LOR	1.92959	0.1576
LBPSI does not Granger Cause LINV	4.01243	0.0276	LCON does not Granger Cause LINF	3.99310	0.0257
LOR does not Granger Cause LBPSI	5.35806	0.0081	LINF does not Granger Cause LCON	4.15375	0.0224
LBPSI does not Granger Cause LOR	1.48982	0.2368	LINV does not Granger Cause LINF	3.99310	0.0257
LFP does not Granger Cause LMP	6.48629	0.0035	LINF does not Granger Cause LINV	1.27295	0.2903
LMP does not Granger Cause LFP	3. 91624	0.0259	LOR does not Granger Cause LINF	0.61239	0.5467
LINF does not Granger Cause LMP	9.55804	1.E-06	LINF does not Granger Cause LOR	1.58405	0.2169
LMP does not Granger Cause LINF	10.1972	1.E-08	LINV does not Granger Cause LCON	4.85239	0.0179
LCON does not Granger Cause LMP	3.47109	0.0376	LCON does not Granger Cause LINV	4.14589	0.0226
LMP does not Granger Cause LCON	17.6340	3.E-09	LOR does not Granger Cause LCON	1.59763	0.2142
LINV does not Granger Cause LMP	5.28196	0.0093	LCON does not Granger Cause LOR	0.00726	0.9928
LMP does not Granger Cause LINV	8.33074	9.E-05	LOR does not Granger Cause LINV	0.76046	0.4736
LOR does not Granger Cause LMP	3.95874	0.0264	LINV does not Granger Cause LOR	0.64633	0.5290

Source: Study Findings

Regarding the table, the outcomes of the Granger causality test indicate that all variables under examination are endogenous except for LOR. To be more precise, LMP, LFP, and LBPSI are dependent on the LOR, while LOR is independent of all variables. Consequently, they can be employed in the estimation of system equations, such as the VECM. However, it is essential to establish the existence of at least one stable long-term relationship among the unit root variables to prevent spurious regression. This verification has been carried out through the Johansen-Juselius cointegration test.

Table 3: Co-Integration Test

Data Trend:	**None**	**None**	**Linear**	**Linear**	**Quadratic**
Test Type	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
Trace	2	2	2	2	1
Maximum Eigenvalue	2	2	2	2	1

Source: Study Findings

According to both the "Trace" and "Maximum-Eigenvalues" criteria, the Johansen-Juselius test confirms the presence of at least one enduring and stable long-term relationship among endogenous variables of the study. With this foundation, in the next steps, we can employ the VECM approach to explore the static and dynamic interdependencies among these variables.

For all variables, the first difference of the data with Intercept and No Trend can address the unit root problem.

Based on the observations which are higher than 100, the Schwartz Bayesian criterion of information is asymptotically consistent; ergo more reliable than Akaike Information Criterion, AIC. Thus, according to the Schwarz Bayesian Criterion (SBC), the optimum number of lags is two.

4.2 Short-run analysis

4.2.1 The first stage: Oil shocks and transmission channels

After carrying out the pre-modelling tests, in this section, we will first assess the surprised oil revenue shocks and then will specifically define the transmission channels. Firstly, according to Wu and Callvo [34], an AR(3.1) process is applied to capture the historically predictable patterns in oil revenues, aiming to uncover the surprises of oil revenues time series data. Subsequently, the residuals of this process are considered to account for unobservable shocks or the surprises of LOR, as can be seen in the equation (4.1):

$$\begin{cases} & LOR_t = 0.082 + 0.925\ LOR_{t-1} + Surprises_t^{Oil} \\ t: & (5.976) \qquad (9.462) \\ & Surprises_t^{Oil} = LOR_t - \underbrace{(0.082 + 0.925\ LOR_{t-1})}_{\widehat{LOR}_t} \end{cases} \tag{4.1}$$

Secondly, after evaluating the unexpected changes in oil revenue, the mechanisms through which surprised oil revenue shocks influence macroeconomic variables will be defined by tracking the the transmission channels of these shocks in equations (4.2) and (4.3).

$$\begin{cases} & \widehat{LMP}_t = 0.08 + 0.973\ LMP_{t-1} - 0.156\ Surprises_t^{Oil} \\ t: & (3.528) \quad (12.762) \quad (-6.367) \end{cases} \tag{4.2}$$

$$\begin{cases} & \widehat{LFP}_t = 0.09 + 0.936\ LFP_{t-1} + 0.291\ Surprises_t^{Oil} \\ t: & (4.103) \quad (11.822) \quad (7.804) \end{cases} \tag{4.3}$$

The estimations demonstrate that the surprised oil revenues shocks have adversely affected the monetary policies, while they have a positive influence on the fiscal policies. During the study period, from January 2006 to August 2023, it was observed that these shocks in oil revenue indirectly impacted monetary policies, whereas they were directly pass-through the fiscal policies. In essence, the main roots of these surprised oil shocks could be attributed to the international sanctions imposed to Iran's economy. To clarify, during our investigation period, oil revenues shocks resulting from these international sanctions led to a decrease in real money supply. In contrast, these shocks intensified real government expenditures.

To proceed with the remaining steps in the modeling process, the following section will introduce the second stage of estimation via two models, namely baseline VECM and Proxy- SVAR. It is important to note that the non-stationary nature of endogenous variables encouraged the authors to employ Vector Error Correction Models (VECM) in both the baseline and proxy VAR models to prevent spurious regression. This significance arises from the fact that in VECM, generally, not only are short-run endogenous relationships between variables estimated, but the long-run relationships are also evaluated. This approach ensures that Impulse Response Functions and Variance Decompositions (VDs) are highly reliable and can be truly analyzed.

4.2.2 The second Stage: Baseline VECM vs. Proxy SVAR IRFs

Given the transmission channels of surprised oil revenues shocks, the responses of monetary and fiscal policies were markedly different. Accordingly, this section encompasses two distinct models representing the relationships among endogenous variables. To shed the light into the matter, the baseline VAR or VECM model will depict the impulses-responses functions of endogenous variables, ignoring the effects of surprising oil revenue shocks. Clearly, in the VECM, the IRFs have been monitored with the LMP and LFP time series without considering oil revenue shocks. However, in the proxy SVECM (SVAR) model, the fitted values of LMP and LFP, denoted as $\widehat{LMP}_t$ *and* $\widehat{LFP}_t$ respectively, serving as the proxies for the surprised oil revenue shocks transmission channels, are embedded in the model. In order to have the better insights for comparison, the IRFs of VECM and Proxy-SVECM are presented in a unique graph, while the estimation of each model is distinctively processed.

Firstly, it should be noted that the above graphs provide crucial insights into how LBPSI reacts to macroeconomic variables. Accordingly, panel (a) displays the autoregressive nature of LBPSI within the VECM and proxy-SVECM frameworks. In addition, panels (b), (c), (d), (e), and (f) illustrate how LBPSI responds to fluctuations in inflation rates, monetary policies, fiscal policies, total consumptions, and investments within these two models individually.

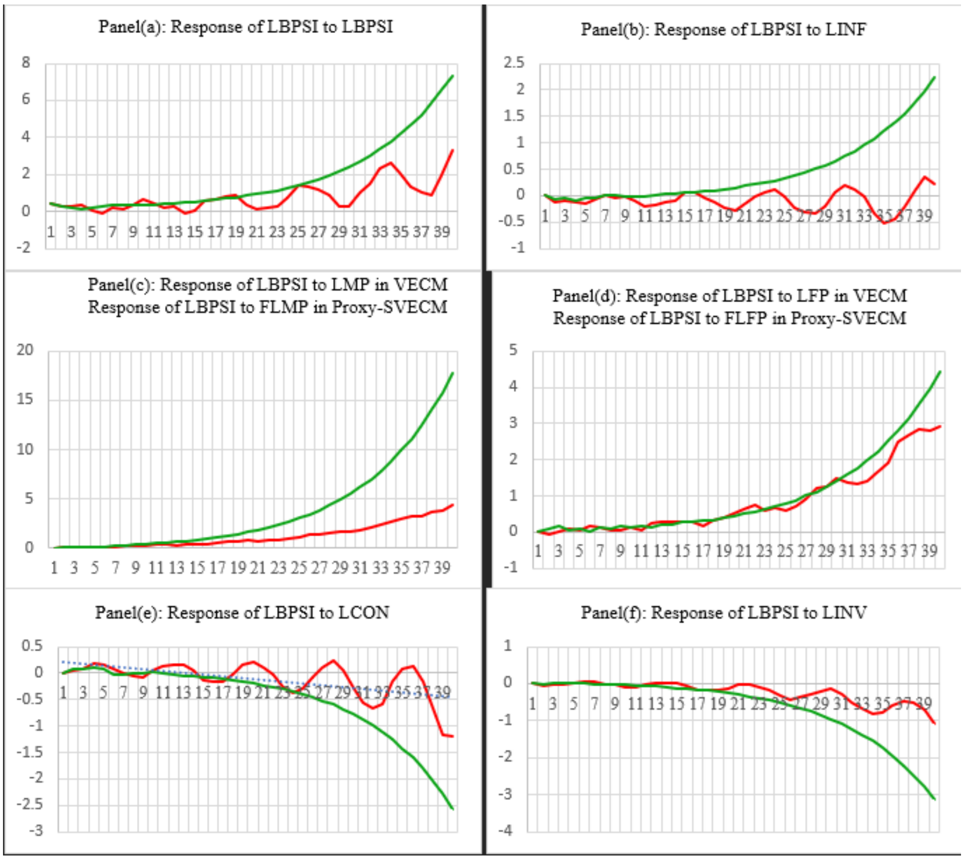

Figure 1: The Responses of LBPSI to Macroeconomic Variables

The red lines represent the IRFs of VECM, while the green lines depict the IRFs of Proxy-SVECM. Furthermore, the reaction of LBPSI to different endogenous macroeconomic variables in the study has been evaluated using the Cholesky variance-covariance approach in both estimated models. This figure exclusively displays the IRFs of LBPSI, which serves as the primary dependent variable in this study.

Secondly, it is evident that in the baseline VECM Model, the 40-month simulations of responses to impulses in each variable exhibit significant fluctuations when compared to the proxy SVECM Model. Specifically, while the LBPSI responses to impulses in endogenous variables follow the same trend in both models, the responses in the baseline VECM are oscillatory, contrasting with the results of the Proxy-SVECM. These fluctuations in LBPSI responses in the VECM can be considered as uncertainties stemming from surprised oil revenue shocks. However, in the proxy-SVECM, where oil revenue proxies are incorporated into the model through the LMP and LFP transmission channels, it appears that the fluctuations in LBPSI responses are reduced. In essence, the uncertainties observed in the LBPSI responses in the VECM are captured by the Proxy-SVECM. Therefore, it can be concluded that incorporating surprised oil revenue shocks leads to more reliable predictions of the endogenous Impulse Response Functions. Furthermore, the responses of LBPSI to all the study macroeconomic variables impulses exhibit greater intensity in the Proxy-SVAR approach rather the baseline VAR.

Thirdly, the most significant part of the study is a comparison of the LBPSI responses to impulses of the "LMP and LFP" in VECM and "$\widehat{LMP}_t$ *and* $\widehat{LFP}_t$" in proxy-SVECM. As it can be seen in the panels (c) and (d) , although there is no sign of counter-cyclical behavior of IRFs in both estimated models, the reactions of LBPSI to monetary policies are strictly increased when the impacts of LOR shocks included. Given the panel (d), taking care of LOR shocks in the first stage for fiscal policies impacts on LBPSI responses corroborates that a smooth transition has happened.

Fourthly, when it comes to comparing the effects of monetary policies to fiscal policies transmission channels of LOR, the responses of LBSPI to $\widehat{LMP}_t$ are much more considerable than those to $\widehat{LFP}_t$. This is while with ignoring the LOR unobservable shocks in the model, the size of LBPSI responses to both policies, LMP and LFP, are almost the same. Thus, the findings can emphasize on the role of LOR shocks influences on the whole macroeconomic system equations.

Ultimately, without LOR proxy, the absolute values of LBPSI responses, from highest to fewest, could be ordered as LBPSI, LMP, LFP, LINF, LCON, and LINV, while this order is adjusted to $\widehat{LMP}_t$, LBPSI, $\widehat{LFP}_t$, LINV, LCON and LINF in the proxy SVECM.

I) **Baseline VAR vs. Proxy SVAR Variance Decompositions**

Regarding the graphical results of LBPSI IRFs, the proxy approach can reduce the estimation uncertainties. In line with this, closely monitoring the variance decomposition (VD) graphs can help to delve more profoundly into the matter. In principle, the total variances of LBPSI in the proxy-SVECM are lower than total variances (the standard deviations) of baseline VECM in each time period and on average. These deviations in variances become evident after 15 months from the initial impulses are imposed.

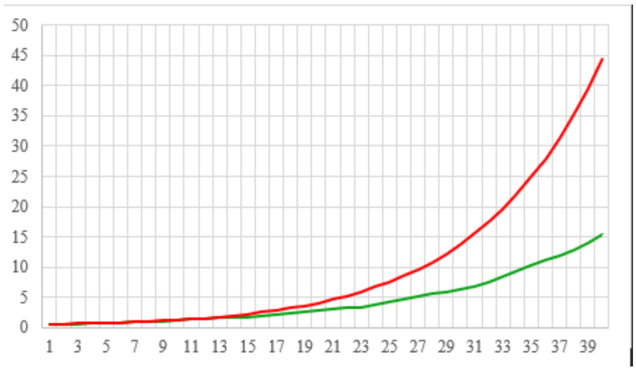

Figure 2: Standard Deviations (total variances) of LBPSI

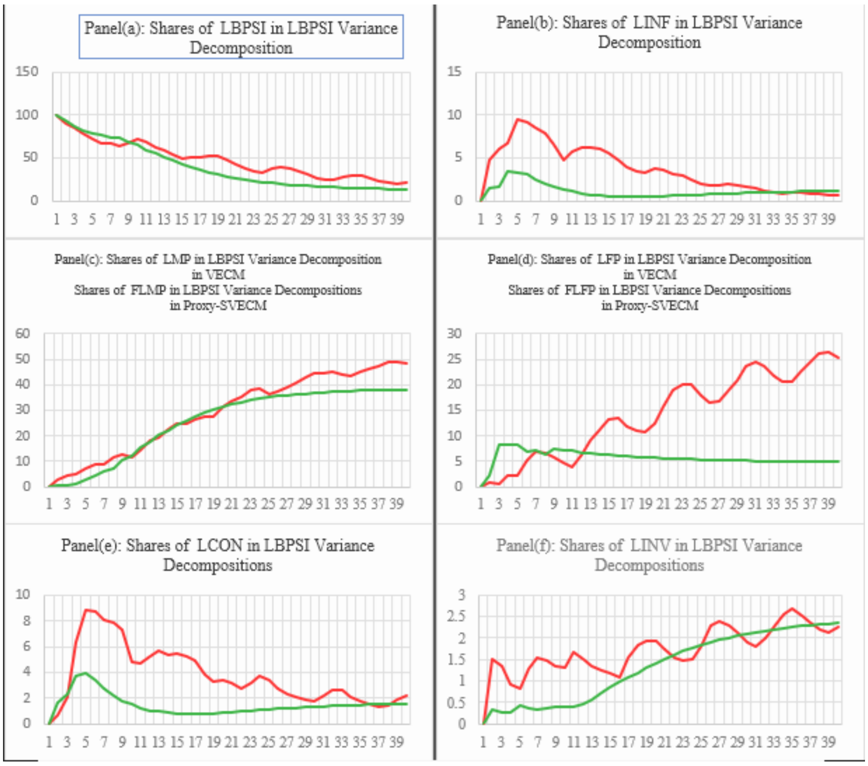

Figure 3: Variance decompositions of LBPSI

The red lines are the variance decompositions of VECM and the green lines are those of Proxy-SVECM and both are evaluated based on Cholesky variance-covariance approach.

In line with the findings of both models total variance, the graphs above illustrate that the shares of each endogenous macroeconomic in the LBPSI variances in VECM are, roughly, higher and more volatile than those of Proxy-SVECM. Regarding the results of both models presented in the figures 1 to 3 as well as relying on the findings of IRFs or VDs, it can be concluded that Proxy-SVECM is superior to VECM. Accordance with this issue, the F-statistics, log-likelihood, and information criteria (AIC and SBC) of both models corroborate the higher robustness of the Proxy-SVECM rather than baseline VECM. These analyses show that incorporating surprised oil revenue shocks through monetary and fiscal policies (combinations of policies effects and oil revenues shocks) results in a smoother trend of uncertainty.

When considering the surprised oil shocks and comparing the impacts of monetary and fiscal policies on banking performance, it should be noted that in the case of fiscal policies in panel (d), the impact of fiscal policies ($\widehat{LFP_t}$) stabilizes at 5 percent after 15 periods, while the effect of monetary policies ($\widehat{LMP_t}$) remains stable at around 40 percent after 25 months, as shown in panel (c). Essentially, in comparison to the share of fiscal policies in the LBPSI variances, those of monetary policies last longer at a higher level of stability. In summary, the findings from VDs and IRFs confirm that surprised oil revenue shock is a significant proxy (or instrumental variable) for monetary and fiscal policies that should not be ignored.

4.3 Long-run analysis

Due to the nature of non-stationarity nature of macroeconomic variables applied in this paper, we opted for the VECM structure over VAR. The crucial difference between these two models lies in how they handle unit root endogenous variables. In VECM, the long-run relationship or the cointegration between unit root endogenous variables is estimated alongside the short-run relationship. In contrast, the VAR assesses only the short-run nexuses. Consequently, in this section, we highlight the extra achievements of VECM for both baseline and proxy models.

Table 4: Normalized Co-Integration Equations

Variables	**VECM**	**Variables**	**Proxy-SVECM**
LMP	10.09824*	**FLMP**	161.0703*
LFP	-10.97802*	**FLFP**	-153.3854*
LCON	-1.078424**	**LCON**	-19.09676*
LINF	0.350205	**LINF**	2.005059
LINV	-0.987690*	**LINV**	-16.52744*
C	-0.148893	**C**	-0.514265

The significance of the variables are reported with various confidence intervals represented (*), (**), (***), indicating (99%), (95%), and (90% and lower), respectively. It is important to state that the negative value of the constant coefficient, representing the fitted LBPSI long-run average, is rooted in logarithmic transformation applied to normalized observations. In other words, since the normalized data fall within the domain of zero to one, their logarithms are negative.

The results of cointegration analysis illustrate that in the long-run, neither in the VECM nor in the proxy-SVECM, the inflation rate has the significant effects on banking performance. However, all other variables exhibit statistically significant long-run impacts on banking performance, confirming the validity of the Fisher rule. Furthermore, the results of long run analysis confirm two main points: (i) the indirect influence of GDP components and direct influence of money supply on banking performance, and (ii) amplifying the impact all variables on banking performance through incorporating surprised oil revenue shocks in Proxy-SVECM model. Therefore, these findings align with the outcomes of short-run analyses and validate the significance of surprised oil revenue shocks as an instrumental variable in transmitting the impact of monetary and fiscal policies on the profitability of the banking sector.

5 Conclusions

This study provides a rigorous and detailed exploration of the impact of oil shocks on bank profitability in Iran, with a specific focus on the transmission channels of fiscal and monetary policies. Utilizing time series data spanning from

Fisher rule describes the relationship between nominal interest rates, real interest rates, and the inflation rate. This confirmation is due to the fact that while the inflation rate does not have significant effects on banking performance in the long run, the significant long-term impacts of other variables support the validity of the Fisher rule, affirming the relationship between nominal interest rates, real interest rates, and inflation rates.

January 2006 to August 2023, the research employs the Proxy VAR approach to elucidate the complex interactions between oil shocks, fiscal and monetary policies, and bank profitability, offering a nuanced understanding of these dynamics. Building upon this foundation, this section examines the research findings related to the central questions posed by this study: specifically, the impact of unexpected oil revenue fluctuations on banking sector profitability through fiscal and monetary policy transmission channels. The discussion in this section synthesizes these outcomes, draws conclusions, and explores potential implications.

Our findings are discussed in two separate sections, covering both short-run and long-run analyses, as follows:

From a short-run perspective, comparing the outcomes of the baseline VECM and Proxy-SVECM models validates that the fluctuations in the banking sector's profitability in response to monetary and fiscal policies are due to substantial uncertainties stemming from surprising shocks in oil revenue, which the Iranian economy heavily depends on. Technically, the uncertainties observed in how the banking sector's profitability reacts in the baseline VECM model are effectively captured in the Proxy-SVECM model. Consequently, the influence of other macroeconomic factors such as inflation rate, total real consumption, and total real investments on banks' profitability becomes more noticeable in the Proxy-SVECM approach compared to the baseline VECM. Following this analysis, it is crucial to emphasize three key points: (i) when surprised oil revenue shocks are taken into account, the impact of monetary policies on LBPSI (a measure of banking sector profitability) intensifies, highlighting the importance of considering these oil revenue shocks. (ii) The results from impulse response functions (IRFs) and variance decomposition analyses confirm that, compared to fiscal policies, the impact of monetary policies remains consistently significant for a longer duration, emphasizing the stability of this influence. (iii) The results of model selection statistics, including F-statistics, log-likelihood, and information criteria such as AIC and SBC, support the superiority of the Proxy-SVECM model over the baseline VECM model. Therefore, based on these findings, it can be concluded that surprise oil revenue shocks serve as a significant proxy or instrumental variable for analyzing the effects of monetary and fiscal policies on the banking sector's profitability.

In the context of analyzing the long-run effects of surprised oil revenue shocks on the relationship between monetary and fiscal policies and banking performance, incorporating these shocks into the proxy-SVECM, instead of the VECM, has notable implications. This approach not only substantially magnifies the influence of these policies on banking performance but also intensifies the effects of other macroeconomic factors on Iran's economy and banks. Considering these oil shocks as a proxy through both monetary and fiscal policy channels reveals that, on average, the impacts of these policies have significantly increased in the proxy-SVECM compared to the VECM. Both the VECM and proxy-SVECM models indicate that Iran's long-run banking performance is indirectly influenced by components of GDP (such as labour force participation, consumption, and investment), while the money supply directly affects the banking sector. Additionally, the analysis of cointegration demonstrates that although the inflation rate does not exert significant effects on banking performance, the substantial long-run influences of other variables on banking performance validate the Fisher rule.

To provide research implications, it should be stated that our findings, firstly, underscore the vulnerability of banks' profit to surprise oil revenue shocks in oil-dependent economies like Iran, highlighting the pivotal role of effective policy interventions in safeguarding the financial stability of the banking sector. As a result, policymakers and especially central bank authorities in Iran should be aware of the significant impact of surprise oil revenue shocks through fiscal and monetary policy channels. Recognizing the stability and prolonged influence of monetary policies compared to fiscal policies can guide the government in formulating more effective and enduring economic strategies. Moreover, the results of this study emphasize the significant impacts of surprise oil revenue shocks on the banking sector as a macroeconomic indicator. Hence, neglecting these shocks can lead to misleading conclusions and flawed policy recommendations. In other words, proper consideration of these shocks in economic models can provide a more accurate understanding of the dynamics influencing banking sector profitability as well as other macroeconomic variables. In addition, given the direct and more intensive influence of the money supply on the banking sector, monetary authorities should pay close attention to managing and regulating the money supply effectively considering surprising oil revenue shocks. Maintaining stability in the money supply can positively impact the banking sector's performance and contribute to overall economic stability. Furthermore, long-run economic planning in Iran should acknowledge the indirect influence of GDP components such as labour force participation, consumption, and investment on banking performance. Understanding these relationships can aid in designing comprehensive economic policies that address both short-run fluctuations and long-run stability in the banking sector. On these bases, the study's implications extend beyond the Iranian context, offering valuable insights for other oil-dependent economies grappling with similar challenges. Ultimately, this research underscores the necessity of a proactive and well-calibrated policy response to mitigate the impacts of surprise oil shocks on the banking sector and ensure sustained economic stability.

To derive research implications, it is crucial to recognize that our findings emphasize several key points. Firstly, we highlight the vulnerability of banks' profitability to surprise oil revenue shocks in oil-dependent economies like Iran, underscoring the essential role of effective policy interventions in safeguarding the financial stability of the banking sector. Consequently, policymakers, particularly central bank authorities in Iran, need to be cognizant of the significant impact of these surprising oil revenue shocks transmitted through fiscal and monetary policy channels. Therefore, incorporating these shocks into economic models is vital for obtaining an accurate understanding of the dynamics influencing banking sector profitability and other macroeconomic variables and, conversely, ignoring these shocks can lead to misleading conclusions and flawed policy recommendations. Secondly, given the direct and prolonged influence of the money supply on the banking sector, monetary authorities should carefully manage and regulate the money supply, especially in the face of significant surprise oil revenue shocks. Consequently, this research underscores the imperative of a proactive and well-calibrated policy response, particularly in monitoring the money supply movements, to mitigate the impacts of surprise oil shocks on the banking sector, ensuring sustained overall economic stability. Finally, long-term economic planning in Iran should recognize the indirect impact of GDP components such as labour force participation, consumption, and investment on banking performance. Understanding these relationships can aid in designing comprehensive economic policies that address both short-run fluctuations and long-run stability in the banking sector. Ultimately, the implications of this study extend beyond the Iranian context, offering valuable insights for other oil-dependent economies grappling with similar challenges.

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