



The Physical Commodities, Economic Cycle, and Financial Stability: The transmission mechanisms in oil-exporting countries.

*Marei Elbadri¹

¹Department of Banking and Finance, Faculty of Economics, University of Benghazi

Abstract

This study tries to investigate how physical commodity prices (oil and gold) affect bank stability and how these prices interact with interest rates, exchange rates, economic growth, and inflation, with an emphasis on the transmission mechanisms of price impact in 17 oil-exporting countries over the period 1996–2016, using Panel Co-integration, the PMG estimator and Panel Causality tests. Our findings show that oil price, GDP, and the interest rate positively affect the long run, while gold price, inflation, and exchange rate negatively affect it, significantly tightening the interest rate's role in financial stability. However, only the exchange rate and gold price have a positive and significant effect on financial stability in the short run. Furthermore, the Causality findings confirm that Financial Stability has Bidirectional transmission channels with physical commodities and economic cycles. Physical commodities and economic cycles also drive each other through oil prices and the exchange rate.

Keywords: Oil, Gold, Economic Cycle, Banks Stability, Oil exporting Countries.

1. Introduction

Physical commodities such as oil and gold have unique characteristics that underpin the global economy and are traded in vast quantities worldwide. The crude oil market has a dual nature, functioning either as a physical commodity, similar to traditional goods markets, or as a financial asset due to the trading of futures contracts on commodity exchanges. It is traded in two different markets, which makes it different from other goods markets. For many decades, the oil market has been a crucial macroeconomic factor affecting the economic performance of many countries around the globe. This is partly because oil is a crucial component of energy consumption and one of the most traded commodities in the world, with its price affecting the commodity markets (Baffes, 2007). The crude oil price serves as one of the major economic indicators in the financial world, mainly due to the significant influence that fluctuations in oil prices exert on the world economy and the business cycle, as deduced by most financial authorities and policymakers.

Recently, the price of Brent crude rose to reach almost \$133 a barrel in July 2008 before experiencing a sharp decline to \$39.95 per barrel by the end of the year. In early 2011, the price rose again to more than \$100 per barrel and remained at this level until mid-2014. Then in January 2016, it fell sharply to nearly \$30 per barrel. Therefore, fluctuations in oil prices have been the leading cause of turmoil in the economic activities of oil-exporting countries. Since the oil sectors of these countries are subject to the uncertainty of the world oil markets, these fluctuations are also believed spill over into other macroeconomic variables, causing significant impacts. These fluctuations in oil prices have macroeconomic and financial



effects through different transmission channels, such as the interest rate and exchange rate channels, and the banking sector is not isolated from these fluctuations

Gold is a leader among precious metals and a commodity that plays an essential role in most economies; it is also considered the best commodity for preserving capital and combating recessions because of its low volatility, high liquidity, frequency, and volume of trade (Tiwari & Sahadudheen, 2015). Since the financial crisis of 2008, gold prices have risen to nearly \$1000 per troy ounce before falling somewhat over the next three years. Because of economic turbulence and worldwide political instability, gold soared close to \$1700 per troy ounce in 2012. Gold, on the other hand, is a one-of-a-kind instrument for long-term inflation hedging (Ghosh, 2011). Gold plays the role of money as a monetary asset and has a storage feature, especially during period of economic instability and political instability, while averting financial risk. In addition, gold is a safe haven because of its negative correlation with some of the financial assets. Soytaş et al. (2009) show that gold is also a financial asset frequently referred to as a “haven” during period of economic turmoil. As it is known, in order to diversify their portfolios, investors in both developed and emerging economies frequently alternate between gold and oil or mix the two (Soytaş et al., 2009).

Oil and gold have recently received much attention from researchers due to their significant price volatility. Crude oil and gold prices are influenced by many of factors, including inflation, economic development, interest rates, currency rates, political issues, and even cultural and social variations. According to Akgül et al. (2015); Tiwari & Sahadudheen (2015), changes in the supply-demand equilibrium, unanticipated future volatility in production and consumption prices, OPEC decisions (indirectly for gold), business cycles, market speculation, and government policies, for instance, are the main causes of price increases in gold and crude oil. According to Sari et al. (2010), changes in gold prices from 1999 to 2007 were attributable primarily to fluctuations in oil prices, which accounted for 1.7 percent of gold returns.

Bank stability is a critical element of economic health, which means allocating funds to the most profitable investments and absorbing shocks without severe disruptions (Elbadri and Bektaş, 2017). Many researchers have empirically studied the determinants of bank stability, which mostly comprise of bank-specific and macroeconomic factors (e.g., Athanasoglou et al., 2008; Chakroun and Gallali, 2015; Uhde and Heimeshoff, 2009). Others have examined factors relating to liquidity (Mink, 2016), economic performance (Creel et al., 2015), political risk (Al-shboul et al., 2020), political Uncertainty (Ghenimi et al., 2015), and Capital regulation and bank competition (Hakenes and Schnabel, 2011).

Nevertheless, with the exception of studies by Hesse and Poghosyan, 2016, Alodayni, 2016; Khandelwal et al. 2016, Al-Khazali and Mirzaei, 2017 and Ibrahim, 2019, which focus on NPLs, the impact of oil prices on the banking system has not received much attention. At the same time, the effect gold prices has not been mentioned in previous studies. Only Elbadri and Bektaş (2020) studied the impact of oil and gold prices on Islamic banking stability without considering at the economic cycle. In this regard, we studied the possible effects of changes in oil and gold prices on bank stability in the presence of economic growth, inflation, and interest rate movements for oil-exporting countries. We believe that the findings of the study will be helpful to policymakers since they will give valuable insights into how to enhance policies aimed at improving economic stability in these countries.

Although many studies have tested the interaction and feedback effects between gold and oil prices, inflation, economic growth, and interest rates, to the best of our knowledge, no research has so far considered how shocks to these variables altogether affect the financial

stability of oil – exporting countries. In particular, the period of study has witnessed increasing fluctuations in the prices of oil and gold, largely as a result of the oil price crisis (1998), the 2000 energy crisis, the global economic crisis (2008), and the Arab Spring (2011), leading many investors to purchase gold as a safe haven. These significant events led to increasing uncertainty in oil prices and their impact on the global economy. Given the crucial role and substantial implications of oil and gold price movements for economies and financial systems were motivated to conduct this study. Therefore, the dynamic link among the previously mentioned variables simultaneously and financial stability has not been mentioned in previous literature. Thus, this study is a novel one considered as an addition to the existing literature and will serve as a very interesting discussion for future research to develop and elaborate on this subject with further studies. Therefore, this study examines the effects of gold and oil prices on financial stability in the presence of interest and exchange rates in oil-exporting countries. In this context, the study tries to answer the following three sub-questions: Do the transmission channels exist between physical commodities and financial stability? Do the transmission channels exist between the economic cycle and financial stability? Do physical commodities drive the economic cycle or vice versa?

The main results are summarised as follows: First, our findings support a long-run equilibrium relationship among our variables. Second, the PMG estimator indicates that oil and gold significantly affect the financial stability of banks, and banks will benefit from positive shocks in oil prices. In the long run, gold performs poorly as a hedge against inflation. Also, strong interactions exist between oil prices and the gold price, interest rates, exchange rates, economic growth, and inflation, which reflect the significant role of oil prices and their transmission mechanisms in the macroeconomic performance and the financial sector. Overall, our findings suggest that policymakers should develop macroeconomic policies to benefit from oil booms and reduce the adverse effects during oil busts to strengthen the stability of their banks.

The rest of the paper is organised as follows: Section 2 presents the literature review, Section 3 presents the data and methodology employed in this study, including the model specification and econometric methods, and Section 4 discusses the empirical results. Finally, Section 5 presents the conclusion and policy recommendations.

2. Related literature

2.1 The transmission Channels between Oil and Gold prices

Gold and crude oil are strongly and directly linked and tend to move in tandem for several reasons, including the fact that gold and oil are dollar-denominated assets, inflation, economic growth, equity markets, central banks, and geopolitical tensions. For instance, Melvin and Sultan (1990) were the first researchers to look at the link between gold and oil prices; they confirmed a strong positive relationship. Zhang and Wei (2010) discovered a strong positive link between the price of gold and the price of crude oil. Furthermore, both face a fairly direct linear interactive mechanism.

Both gold and crude oil prices positively impact each other in the short term, and both positively influence each other in the preceding period, according to Wang and Chueh (2013); This might be due to the fact that both prices move in lockstep with industrial production, inflation, and interest rates. According to Lee and Lin (2012) and Sari et al. (2010), oil shocks had a soothing impact on gold. When crude oil prices are low, gold with the lowest volatility serves as a hedge; when oil prices are high, gold serves as a hedge and a safe haven for underdeveloped nations. Gold is a precious metal utilized as an international reserve, investment asset, and store of value to hedge against risk. Significant connections

between the two markets were discovered by Arfaoui and Ben Rejeb (2017). The authors discovered that gold affects the price of oil substantially and positively and that changes in the oil market impact the gold rate due to their growing usage as financial assets for speculation or hedging, strengthening such interdependencies.

2.2 The transmission channels between Physical commodities and Financial Stability

Few studies have documented the impact of oil markets on many countries and their contribution to the banking sector (e.g. Al-Khazali and Mirzaei, 2017; Alodayni, 2016; Hesse and Poghosyan, 2016; Ibrahim, 2019; Khandelwal et al., 2016). For example, Al-Khazali and Mirzaei (2017) discovered that bank non-performing loans (NPLs) in oil-exporting nations are significantly impacted negatively by fluctuations in oil prices; this effect is often more noticeable in big banks.

There is no evidence, according to Hesse and Poghosyan (2016), that oil price shocks in MENA countries that export oil have a direct effect on bank profitability through an increase in lending or commercial activity connected to oil. Instead, the results support the indirect channel hypothesis, which holds that the impact is communicated through the country's institutional and macroeconomic characteristics, which are strengthened by higher expectations and business sentiment. For the GCC region, Alodayni (2016) indicates that oil prices, non-oil GDP, housing prices, interest rates, and stock prices are important factors that influence NPLs. The existence of oil-macro-financial links was verified by Khandelwal et al. (2016), who found that oil prices and economic activity substantially impacted bank asset quality. In addition, loan loss provisions and capital adequacy ratios are linked to business and financial cycle indicators that have aided the banking system's resilience to the drop in oil prices since mid-2014. Recently, Ibrahim (2019) finds that oil prices can act as a financial accelerator and have an asymmetric impact on risk, lending, bank profitability, and GDP growth in the GCC.

Other empirical literature confirmed the effects of oil and gold prices on banks' balance sheets that it transmits through the sovereign credit risk and stock market channels. Mensi et al. (2019) argue that combining them in a GCC portfolio offers better diversification benefits and hedging effectiveness for GCC banks. According to Julio et al. (2019), oil price booms enhance fiscal policy, the real exchange rate for oil-exporting countries due to foreign currency inflows, political stability, and lower sovereign credit risk due to increased oil income. Settlements (2011) identifies four critical channels via which a decline in sovereign creditworthiness might harm bank funding. To begin, it makes the bank's balance sheets more vulnerable. Second, the collateral value that banks can use to receive wholesale financing and liquidity from the central bank is reduced. Third, because banks are more prone than other sectors to be affected by the sovereign crisis, downgrades in sovereign ratings nearly invariably result in lower ratings for domestic banks. Finally, when the sovereign's credibility deteriorates, banks' financing benefits from implicit and explicit government guarantees reduce.

Furthermore, the theoretical literature has identified liquidity as one of the routes for transmitting bank credit shocks to the economy (Vousinas, 2013). Excess liquidity in the banking sector is directly related to oil prices (Hesse and Poghosyan, 2016). According to Tiwari & Sahaduddeen (2015), gold is the ideal commodity for capital preservation and combating recessions and high liquidity. The validity of an inverse U-shaped link between crude oil price and banking sector indices was established by Alqahtani et al. (2020). Furthermore, the authors show a critical non-linear link between oil-banking portfolio management and hedging methods with oil price risk. According to Albulescu (2020), a drop

in worldwide oil prices sends a negative signal to stock market investors, negatively affecting bank share prices and reducing their ability to create sustainable profits. Bank financial stability may be put at risk in this situation. According to the IMF (2015), A negative feedback loop through bank balance sheets might arise from the GCC's vulnerability to decreased oil prices, which is expected to lead to fiscal tightening, lower growth rates for non-oil GDP and real credit, as well as lower equities and asset values. Compared to tangible common stocks, heavy credit exposure in the oil industry could indicate a problem if borrowers start to default en masse because banks will then need to add loan loss reserves, which would eliminate profits and lower equity. This might lead to a halt in share repurchases, a halt in dividend increases, or possibly a reduction in payouts.

Regarding reverse transmission channels, Banks play a critical role in providing credit to oil-related firms. According to Domanski et al. (2015), the recent drop in the oil price reflects a considerable reduction in the value of the assets supporting this debt. Higher leverage puts a larger premium on the liquidity of the markets for the assets that back debt, and higher leverage places a greater premium on the liquidity of the markets for the assets that back debt, and rising leverage has influenced oil producers' reactions to lower prices and, eventually, oil price dynamics. Also, because it influences on capital investment and government budgets, as well as the interaction with a stronger currency, oil industry leverage makes assessing the macroeconomic repercussions of lower oil prices more difficult. In addition, financial shocks have played a significant role in setting the oil price since the early 2000s, and to a considerably greater extent since the mid-2000s, according to Morana (2013), with these shocks accounting for 44 per cent of the 65 per cent real oil price rise between 2004 and 2010. According to Zhang et al. (2009), the 2008 financial crisis (Global banking crisis) caused the crude oil price to drop by more than \$60 until December 2008, nearly 40% below its peak.

2.3 The transmission Channels between Economic Cycle and Financial Stability

Financial and banking organisations are the main drivers of the world economy; they are particularly vulnerable to shifts in the economic cycle. Theoretical literature considers transmission channels between them to operate in both directions (BCBS 2011). Theoretically, three routes have been established for understanding the transmission of financial sector shocks to the real economy and the amplification and retransmission of real economy shocks via the financial sector; according to Vousinas (2013), these channels are often related to a bank's or a borrower's total asset and liabilities position (bank balance sheet channel, borrower balance sheet channel, and liquidity channel).

Policymakers that base their monetary policy choices on economic expectations are particularly interested in the relationship between bank financial stability and the economic cycle. As a result, the literature supports the hypothesis that the bank's role in economic policy transmission is represented in the contributions of Bremus et al.(2018), Ashraf et al. (2017), Vousinas (2013), Buch and Neugebauer (2011), Blanchard (2009) and Pradhan et al. (2014). For instance, Bremus et al. (2018) find that big banks have a positive and significant influence on aggregate credit or GDP growth. The variations in aggregate growth are a result of banking market concentration and individual bank loan growth volatility. The variation of bank-specific shocks and the degree of concentration in the banking sector rise as macroeconomic outcomes fluctuate. They conclude that measures that enhance banking sector concentration, in the long run, can raise macroeconomic outcomes' aggregate volatility. Also, Vousinas (2013) find that the emergence of the liquidity channel is a key factor in the transmission of bank credit shocks to the real economy. According to Buch and

Neugebauer (2011), changes in lending by central banks have a significant short-run influence on GDP growth.

Banks improve macroeconomic performance, according to Ashraf et al. (2017), by funding both new and existing trade businesses, funding replacement businesses, and providing additional assistance to existing ones in the event of a negative shock. More severe restrictions (such as lower loan-to-value ratios or greater capital requirements) wreak havoc on the economy because they stifle lending activity, which is critical in the event of a rare calamity. According to Buch and Neugebauer (2011), changes in lending by large banks have a considerable short-run influence on GDP growth. Also, according to Blanchard (2009), the financial crisis has had a negative impact on the economy due to credit restriction, or banks' tightening of lending requirements. The existence of causal linkages between banking sector development, stock market development, economic growth, inflation rate, foreign direct investment, trade openness, and government consumption spending is established by Pradhan et al. (2014). A robust banking system instils trust in savers, allowing resources to be efficiently deployed to boost economic output.

In contrast, the economic cycle theoretically plays a significant role in the banking system. For example, according to CGFS (2018), bank profitability and strength may be dampened in an environment marked by "low-for-long" interest rates, which might constitute a source of vulnerability for the financial system. Furthermore, low rates may alter firms' incentives to take risks, thereby exposing the financial sector to extra dangers (low-for-long scenario). Also, Demirgüç-Kunt and Detragiache (1998) discover that systemic banking crises are considerably increased by low GDP growth, excessively high inflation rates, and real interest rates. Macroeconomic policies that lead to high loan growth and financial overheating, according to Eichengreen and Arteta (2000), typically set the ground for future difficulties. Excessive lending is frequently accompanied by domestic interest rate liberalisation. On the other hand, they indicate little evidence of any special relationship between exchange-rate regimes and banking crises. According to Soedarmono et al. (2011), increasing market dominance in the banking sector leads to increased financial instability. In less competitive marketplaces, faster economic growth helps to offset more risk-taking and volatility. The authors also emphasise the relevance of economic development in combating bank risk-taking and insolvency risk. According to Foglia and Angelini (2019), increases in GDP have a beneficial impact on bank financial stability in Italy by increasing asset quality and credit growth, resulting in changes in profitability and soundness. In contrast, Alsamara et al. (2019) found that GDP growth has a negative long-run and a positive medium-short-run effect on financial stability and that unexpected shocks to real GDP growth harm real loan provisions, with the most significant contribution in real loan provision changes coming essentially from real GDP growth changes in the Qatari economy. Batuo et al. (2018) found that in 41 African nations, economic growth is reducing financial instability. Moreover, elevated NPL levels ultimately hurt bank lending. According to De-Bock and Demyanets (2012), slowing economic growth, a weak currency rate, and fast credit expansion are all linked to greater levels of NPLs in 25 developing countries. Also, Klein (2013) confirmed that GDP growth, inflation, stock prices, the currency rate, and interest rates all substantially influence the proportion of NPLs in Central, Eastern, and Southeast Europe.

2.4 The transmission channels between Economy Cycle and Physical commodities

In economics, and especially in monetary theory, the interest rate is critical. Historically, as a variable that captures monetary policy tools, the interest rate is frequently claimed to be the most important because of its direct effect on economic variables and because the interest

rate is directly controlled by the central bank (Taylor, 1995). Lower interest rates result from expansionary monetary policy, which lowers the cost of capital, lowers the cost of investment, and encourages more investment. Increased investment leads to increased total demand, leading to increased output and increasing financial assets (Mishkin, 1996).

Regarding Physical commodities, when nominal interest rates are low or negative, investors want to acquire gold, which leads to greater demand for gold, and therefore the gold price rises, according to Koutsoyiannis (1983) and Fortune (1987). Furthermore, Cai et al. (2001) and Hammoudeh and Yuan (2008) both verified that interest rates hurt gold prices and have a beneficial impact on oil prices through the exchange rate channel. Also, Wang and Chueh (2013) recently asserted that in the long run, interest rates impact the US dollar. Consequently, the US dollar, in turn, affects global oil price. For instance, to boost the economy, the Federal Reserve cut interest rates; oil prices fluctuate based on market expectations (changes in oil demand). Market expectations alter in the gold market when interest rates are reduced and the US dollar depreciates, causing investors to transfer their capital to gold to safeguard their capital and battle recessions. In contrast, according to Cologni and Manera (2008) and Wang and Chueh (2013), international gold and crude oil prices have feedback effects on interest rates through inflation. Thus, a rise in prices to a certain level would trigger inflation, whose shocks are transmitted to the real economy by raising interest rates.

Theoretically, it is a monetary policy transmission channel and has a specific connection to the other variables. Zhang et al. (2008) found that the impact of the US dollar on the international oil price is significant in the long run, but limited in the short run. Zhang et al. (2008) find that US dollar depreciation against the euro leads to a higher oil price and vice versa. The change in the US dollar exchange rate against other currencies in the world has several effects, such as reactions of foreign oil production and oil demand, domestic oil demand, domestic oil supply, and exports and imports of goods and services. But there are exceptions; for instance, in the six oil-producing Arabian Gulf countries that peg their currency to the US dollar, this pegged currency alters supply and demand effects. Mishkin (1996) mentioned that, when the US central bank cuts the interest rate, the return of deposits in US dollars decreases compared to the returns of other currencies. Demand for the dollar and its exchange rate decrease against other currencies. This Depreciation makes US exports cheaper abroad and raises the price of US imports. This leads to an increase in net exports as well as US production. As long as global trade in crude oil is denominated in US dollars, the depreciation of the US dollar threatens the gains of oil companies producing outside the USA. These companies raise the price of oil to avoid diminishing revenue measured in their currency. Accordingly, with the depreciation of the US dollar, oil can be bought cheaper, and oil demand from outside the USA increases. Lizardo and Mollick (2010) find a long-run relationship between oil and the exchange rate. Higher oil price depreciates currencies partially reverse for significant oil importers like Japan, and mainly relative to significant oil exporters and large economies such as the euro area where the share of oil imports is lower relative to total imports. Therefore, the depreciation of the US dollar exchange rate is driven by higher oil prices, and the effect of the exchange rate on the oil price is well established.

In contrast, in the early studies, the link between the exchange rate and oil prices has been documented. Exchange rates are impacted by changes in oil prices, according to Golub (1983). Rising oil prices raise demand for the US dollar since oil prices are expressed in US dollars. According to Krugman (1983), rising oil prices cause a country's current account to deteriorate, and the exchange rate will decline in oil-exporting nations since exchange rate

fluctuations are correlated with current account fluctuations. Real oil prices may be the primary factor influencing changes in real exchange rates, according to Chen and Chen (2007) analysis of data on G7 nations, global oil prices, and intermediate oil prices. Other studies, such as Akram (2009) and Lizardo and Mollick (2010), show a negative relationship between the price of oil and the U.S. dollar. Zhang and Wei (2010) and Fratzscher et al. (2014) confirm the bidirectional causality between oil and USD. In comparison, no support is found for the hypothesis that oil prices respond to shocks to exchange rates.

Further, Sari et al. (2010) investigated the information transmission and co-movements among the price of gold, oil, and the US currency relative to the euro, they discover that when short-term aftershocks happen, the price of gold and the exchange rate may be tightly related, and disruptions in the oil and gold markets have a slight but reciprocal positive influence; over time, this effect fades. According to Bedoui et al. (2019), there is a greater reliance on oil, gold, and the USD exchange rate during times of crisis than there is during untroubled times. Additionally, the extraordinary movement of the US dollar during the global financial crisis of 2007–2009 explains why the joint movement is accelerating. Le and Chang (2011) show that gold price changes are better explained by fluctuations of the US dollar than by oil prices. Gold and the US dollar, according to Arfaoui and Ben Rejeb (2017), have a big and beneficial impact on oil prices. The gold price is affected by movements in the oil, USD, and stock markets. The stock market, as well as the prices of oil and gold, effects the USD. Indirect impacts exist all the time, confirming global interdependencies and including the financialization of commodities markets, as well as confirming that the USD exchange rate influences oil prices on worldwide markets via demand and supply.

Regarding the impact of oil and gold prices on GDP growth, Khan (2015) found that oil and gold prices have a substantial effect on GDP and that GDP growth in developing countries is negatively connected with the gold market. Stocks and other financial assets other than gold tend to do well when the economy is robust. Also, Brown and Yücel's (2002) and Ghosh's (2011) survey studies reveal various mechanisms that might contribute to an adverse connection between oil prices and economic activity. The most fundamental is the typical supply-side effect, in which higher oil prices signal a reduction in the availability of a critical production component. Income transfers, the aggregate demand impact, the real balance effect, monetary policy role, and inflation are some of the other channels. According to Ghalayini (2011), oil prices are adversely correlated with economic growth in countries that import oil and favourably correlated with economic growth in countries that export oil. According to Timilsina (2015), rising oil prices assist in boosting GDP in oil-exporting countries. According to Mehrara (2007), the negative impacts of the oil bust on economic growth were more long-lasting, whereas booms had a limited influence on GDP stimulation. Also, Le and Chang (2011) find that a decline in the price of a commodity causes sluggish economic development in both importing and exporting nations.

According to Tang et al. (2010), shocks to the oil market have both immediate and long-term effects on economic performance via demand and supply pathways, and vice versa. On the supply aspect, a rise in crude oil prices can influence an economy's short-term output by immediately boosting the marginal cost of industrial production, causing businesses and industries to reduce output. Long-term, the effect of oil price changes is ascribed to lower investment due to increased input prices. In the meantime, the demand-side channel will have an effect on investment and consumption. An increase in crude oil prices will reduce output and create a decrease in labor demand due to slower economic development, lowering

real wages. Less consumption and discretionary income are positively connected to this decrease (Ftiti et al., 2016; Tang et al., 2010; Maeda, 2008). In addition, according to Ftiti et al. (2016), the negative effects of oil price shocks on aggregate demand have an influence on the link between oil and economic development in OPEC nations. Because rising energy costs suggest that businesses buy less energy, rising oil prices reduce aggregate supply. As a result, both the potential production and the productivity of a given quantity of labour and capital decrease. Real wages will be lower due to the fall in productivity factors. As a result, a portion of the labour supply is leaving, which directly causes productivity to decline.

In contrast, regarding to the impact of economic growth on oil prices, Morana (2013) finds that macroeconomic shocks have been the main driver of high oil prices since the mid-1980s, thus providing support for the demand side of real oil price determination. Also, Kilian (2009) discovered reverse causation between real GDP growth and inflation and oil prices, arguing that oil shocks have various patterns and hence have different effects on macroeconomic indicators. The author categorizes these shocks into three categories: crude oil supply shocks, crude oil demand shocks, and global demand shocks for all industrial commodities.

When investors predict rising inflation, they may shift from soft assets like equities to physical assets like oil and gold, which are priced in dollars, according to Sari et al. (2011). Gold prices are impacted by oil price changes, possibly owing to the projected inflation-linked to the present period's rise in oil prices, making gold an appealing alternative for fighting anticipated inflation, preserving its value, and speculating (safe-haven) (Hammoudeh and Yuan, 2008). Also, Wang and Chueh (2013) noted that impending inflation raises gold prices because investors think gold will continue to be valuable. Therefore, investors can buy more gold to avoid exchange rate shocks. Kilian (2010), on the other hand, believes that an isolated recessionary oil shock will result in deflation rather than inflation. In order to understand the relationship between inflation and interest rates. Wang and Chueh (2013) demonstrate that both gold and crude oil prices lead interest rates below and above the barrier. When crude oil prices reach a particular level, the monetary authorities adopt long-term inflation-tightening monetary policy by raising interest rates to counteract inflation caused by rising oil prices.

Regarding the link between inflation and the exchange rate, Narayan et al. (2010) find that gold is a hedge against inflation, and inflation is one of the most critical factors contributing to local currency depreciation, which leads to a decline in the nominal price of domestic assets. Nevertheless, gold can maintain its value and may quickly react to inflation. When the connection between the exchange rate and gold price is high, exchange rate shocks have a more significant impact on domestic price levels and wealth denominated in local currency, causing home investors to acquire more gold to escape these shocks (e.g., Le and Chang, 2011; Wang and Lee, 2011). In terms of the relationship with economic growth, Umaru and Zubairu (2012) looked at the impact of inflation on Nigeria's economic growth as an oil-exporting country and discovered that GDP caused inflation and not the other way around.

3 Data and Methodology

3.1 Data

In this study, the effects of physical commodities (the price of gold and oil) on stability in the presence of economic cycles (GDP, inflation, interest rate, and exchange rate) were investigated in Seventeen oil-exporting countries, including; Kuwait, Saudi Arabia, the UAE, Russia, Iraq, Libya, Nigeria, Canada, Venezuela, Algeria, Brazil, Ecuador, Norway,

Mexico, Gabon, Azerbaijan, and Malaysia. The countries were selected as per their oil production and export capacities. The data set follows an annual frequency of 21 years from 1996 to 2016 for each country.

The variables used in this study include the annual OPEC crude oil price averages (USD/per barrel) (OP), the annual averages of gold prices (USD/oz.) (GP), the financial stability indicator (FS) measured by the natural logarithm of Banks' Z-score, the natural logarithm of GDP (constant 2010 US\$) (GDP) as a proxy for economic growth, Inflation (consumer prices) (INF), Real interest rates (RIR), and the real effective exchange rate (RXR). Data used in the current study were transformed to their natural logarithmic form for FS, OP, GP, GDP, and RXR variables to reduce the variation of the model investigated. The data were retrieved from Thomson Reuters, World Bank, and International Monetary Fund datasets. Table 1 shows the results of the Variance Inflation Factor (VIF) for each variable. It indicates that all VIF values are less than 5, which suggests they are free from multicollinearity.

Table 1 Variance Inflation Factors.

Variable	VIF	1/VIF
OP	4.96	0.201
GP	4.91	0.204
RXR	1.11	0.900
RIR	1.13	0.886
INF	1.07	0.930
GDP	1.04	0.961
Mean VIF	2.37	

3.2. Methodology

We analyse the link between physical commodities (the price of gold and oil) and the financial stability of oil-exporting countries. For this purpose, we built our model in the traditional style, where the financial stability (Z-score) of oil-exporting countries is affected by changes in oil and gold prices, after setting up the necessary control variables (GDP, inflation, interest rate, and exchange rate). Therefore, we model the financial stability of our selected oil-exporting countries as a function of oil and gold price fluctuations, with the control variables imposed. That is to say, we have

$$FS = f(OP, GP, GDP, INF, RIR, RXR) \quad (1)$$

Statistical descriptions reveal that our data set contains many differences. As a result, the log-linear form of the data is employed to decrease the data's variability. After that, the empirical equation for the estimate will be as follows:

$$FS_t = \alpha_i + \beta_1 OP_t + \beta_2 GP_t + \beta_3 GDP_t + \beta_4 INF_t + \beta_5 RIR_t + \beta_6 RXR_t + \varepsilon_{it} \quad (2)$$

where FS_t is the natural log (logarithm) of the financial stability index, OP_t is the natural log of the oil price, GP_t is the natural log of the gold price, GDP_t is the natural log of GDP, INF_t is the inflation rate, RIR_t is the real interest rate, RXR_t is the natural log of the real effective exchange rate, and ε_{it} is the residual term.

For the estimation of equation (2), we follow the procedure explained below. First, we applied the Panel unit root tests to determine the order of integration. Second, we applied the panel cointegration test to examine the long-run relationships. Third, we applied the pooled

mean group (PMG) estimation to analyse the validity of the short- and long-run relationship between the explanatory variables and FS. Lastly, we have applied panel causality to investigate causality direction.

3.2.1. Panel unit root tests

Before performing the cointegration test, variables had to be checked for stationarity. Therefore, determining the order of integration is necessary. In this framework, the preferred method is the so-called first-generation panel unit root tests, such as the Levin, Line and Chu (2002), Breitung (2001& 2005), and Im, Pesarane and Shin (2003) tests, where the null hypothesis states that all panels contain a unit root. These methods are taking into account the sample size and the asymptotic properties of each test, and it is assumed that the common factors are not stationary, which we believe is true for commodity prices such as oil and gold prices since it is considered to be homogenous as it is a cross-section invariant.

2.2.2. Panel cointegration test

We use the Pedroni (2004, 1999) panel cointegration approach in the second step, which permits cross-sectional dependence with various individual effects. This test is used under the null hypothesis of no cointegration. If the null hypothesis is rejected, there must be a long-term cointegration connection between the variables under consideration. The most often used panel cointegration test is the Pedroni (2004, 1999) test, which is more dependable in small samples since it accounts for heterogeneity by employing certain parameters that are permitted to differ among sample members. The following are the specifications for the panel cointegration test:

$$Y_{it} = \alpha_i + \delta_t + \beta_{1i} X_{i,t-j} + \varepsilon_{it} \quad (3)$$

$i = 1, \dots, N$ for each country and $t = 1, \dots, T$ for each period, α_i and δ_t are country and time fixed effects respectively. ε_{it} show the estimated residuals. These residuals' structure:

$$\varepsilon_{it} = \rho_i \varepsilon_{i,t-1} + u_{it} \quad (4)$$

2.2.3. Pooled Mean Group (PMG) estimation

We apply the panel ARDL model developed by [Pesaran and Smith \(1995\)](#) & [Pesaran et al. \(1999\)](#). The short-term parameters of the PMG panel ARDL estimation method take cross-sectional heterogeneity into consideration. Whether the variables are integrated of order one (I(1)) or zero (I(0)), it makes it easier to conclude about long-term and short-term causalities. The ARDL surpasses other dynamic panel methods. For instance, unless the coefficients are the same across countries, the fixed effects and GMM methods created by [Anderson and Hsiao \(1982, 1981\)](#), [Arellano \(1989\)](#), and [Arellano and Bover \(1995\)](#) may yield conflicting estimates of the average values of the parameters. The following is a description of the ARDL dynamic panel model:

$$FS_{it} = \sum_{j=1}^p \alpha_{ij} FS_{i,t-j} + \sum_{j=0}^q \delta_{ij} X_{i,t-j} + \mu_i + \varepsilon_{it} \quad (5)$$

Where $X_{i,t-j}$ is (k x1) vector of the explanatory variables for group i , and μ_i presents the fixed effects. Countries may have different values for p and q . When we reparametrize the model, it turns into:

$$\Delta FS_t = \phi_i (FS_{i,t-i} - \beta'_i X_{i,t}) + \sum_{j=1}^{p-1} \alpha_{ij} \Delta FS_{i,t-j} + \sum_{j=0}^{q-1} \delta_{ij} \Delta X_{i,t-j} + \mu_i + \varepsilon_{ij} \quad (6)$$

Where β'_i represents the long- term parameters (error correction speed of adjustment or impact of the explanatory variables on FS) and ϕ_i is the error correction term. The remaining parameters are the short run coefficients. The disturbances ε_{ij} is independently and normally distributed with a zero mean and constant variance.

The error correction model is estimated by a mean group (MG) or pooled mean group (PMG) estimator developed by Pesaran and Smith (1995) and Pesaran, Shin and Smith (1999), a mean group (MG) estimator that calculates the parameters and group averages for every nation. Therefore, it is not a more accurate estimate in situations when the number of nations or the duration of the time is limited, but it does allow for variability in the short and long term. The PMG estimator requires the long-term parameters to be uniform but permits the short-term parameters to differ between nations. In the presence of unit roots and endogeneity, MG and PMG outperform the traditional fixed effects method (FEM) and are more reliable. Lastly, the variables must be combined and arranged using a combination of $I(1)$ and $I(0)$ to use these techniques and be interpreted as an error-correction mechanism.

2.2.4. panel causality test

Lastly, we have applied the Dumitrescu and Hurlin (2012)¹ panel causality test to examine the robustness of the PMG estimation. Because this test is based on VAR, which assumes that there is no cross-sectional reliance, it may account for both heterogeneity and cross-sectional dependence that may exist in the panel. Additionally, it can be applied when $N > T$ and $T > N$. The Monte Carlo simulations demonstrate that this test may yield robust findings even in the presence of cross-sectional dependency. This test is used for heterogeneous and balanced panels. The linear model is as follows:

$$Z_{it} = \alpha_i + \sum_{m=1}^M \gamma_i^{(m)} Z_{i,t-m} + \sum_{m=1}^M \beta_i^{(m)} y_{i,t-k} + \varepsilon_{it} \quad (7)$$

Where y , z , and T are two stationary variables in time periods (T). α_i and $\beta_i = (\beta_i^{(1)} \dots \beta_i^{(m)})$ are the intercept term and coefficient respectively, which, in the time dimension, are seen as fixed. The autoregressive parameter and regression coefficient are represented by $\gamma_i^{(m)}$ and $\beta_i^{(m)}$, respectively, and they differ between cross-sections.

The Dumitrescu and Hurlin (2012) tests investigate causality with a null hypothesis for the pairs of no causal relationship for any of the cross-sections in the panel ($H_0: \beta_i = 0 \quad \forall i = 1, 2, \dots, N$). On the other hand, it has an alternative hypothesis of: $H_a: \beta_i \neq 0 \quad \forall i = 1, 2, \dots, N$

¹ Dumitrescu and Hurlin (2012) Panel Causality Analysis: It is a type of causality analysis in which panel data is analyzed. It is an advanced form of Granger causality analysis.

& $\beta_i \neq 0 \quad \forall i = N_1+1, \dots, N$. This hypothesis is assumed to specify two sub-groups of cross-sectional units. When examining a heterogeneous panel data model with a fixed coefficient, the first asserts that there is a causal link from y to z , while the second asserts that there is no such relationship.

The Dumitrescu and Hurlin (2012) tests propose two average statistics including $W_{N,T}^{HNC}$ and $Z_{N,T}^{HNC}$. The average statistic given by $W_{N,T}^{HNC}$ is expressed as follows:

$$W_{N,T}^{HNC} = \frac{1}{N} \sum_{i=1}^N W_{i,T} \quad (8)$$

In Eq. (4), $W_{i,T}$ shows the cross-sectional individual Wald statistical results, which is expressed as follows:

$$W_{i,T} = (T - 2M - 1) \left(\frac{\xi \phi \xi}{\xi_i K \xi_i} \right) \text{ for } i = 1, 2, \dots, N \quad (9)$$

The standardized test statistic, $Z_{N,T}^{HNC}$ for $T, N \rightarrow \infty$ has asymptotic distribution which is expressed as follows²:

$$Z_{N,T}^{HNC} = \sqrt{\frac{N}{2M}} (W_{N,T}^{HNC} - M) \rightarrow N(0,1) \quad (10)$$

3. Empirical results

Panel unit roots tests were reported for the levels in Table 2 and for the first differences in Table 3. The panel unit root tests results provide strong evidence of unit root for the variables OP, GP, GDP, INF, and RXR i.e., the series are $I(1)$. Regarding the variable FS, there are some signals of the presence of a unit root at levels. In such cases, it is deemed that we have mixed results. Nevertheless, the majority of tests show that the unit root is present, i.e., the series are $I(1)$. The unit root test findings for RIR demonstrate that the unit root null hypothesis can be rejected at levels, offering compelling proof that the series are $I(0)$.

Table 2: Stationarity tests at Levels.

Variable	Im-Pesaran	Breitung	Levin-Lin-Chu
FS	-0.442	-0.935	-2.693***
OP	4.977	2.982	8.257
GP	1.148	-1.706**	2.345
GDP	-0.188	0.340	-1.501
INF	-0.706	-2.327**	1.524
RIR	-4.138***	-3.381***	-3.702***
RXR	-0.306	0.816	-0.533

Notes: ***, ** represent significance levels at the 1% and 5% levels respectively.

Eventually, when we observe the results in their first differences as reported in Table 3, all series are stationary. Therefore, all variables, the except RIR which is $I(0)$ and used in the model are $I(1)$, which is a condition necessary for ARDL estimation (e.g. Pesaran and Smith, 1995 & Pesaran, Shin & Smith, 1999).

² For further details on the heterogeneous panel causality test, see Dumitrescu and Hurlin (2012).

Table 3: Stationarity Tests at first differences.

Variable	Im-Pesaran	Breitung	Levin-Lin-Chu	Decision
FS	-7.828***	-4.435***	-7.155***	I(1)
OP	-11.486***	-2.766***	-11.976***	I(1)
GP	-0.763	-2.645***	-3.356***	I(1)
GDP	-4.484***	-2.811***	-5.644***	I(1)
INF	-7.786***	-3.519***	-5.144***	I(1)
RIR	-15.879***	-6.355***	-13.106***	I(0)
RXR	-4.977***	-1.891***	-6.276***	I(1)

Notes: ***, ** represent significance levels at the 1%, and 5% levels respectively.

The next step of our analysis comprises of testing for panel cointegration. The summary of the estimation from the Pedroni (2004, 1999)³ panel cointegration test is reported in Table 4. The alternative hypothesis, which claims that all the variables are cointegrated for all panels, is supported by all test statistics, which reject the null hypothesis of no cointegration. Therefore, the null of no cointegration is rejected, implying that there is an existing long-run cointegrating relationship among the variables in panel model.

Table 4: Panel cointegration test results (Pedroni test)

	Statistic	P-value
Modified P-P t	4.4107	0.000
Phillips-Perron t	-4.5547	0.000
Augmented D-F t	-6.4000	0.000

Note: All tests have a common null hypothesis of no cointegration.

Regarding Pooled Mean Group (PMG) estimation, Co-integration is assumed by the PMG approach. It provides the error correction coefficient in addition to enabling the estimation of the long-term connection between the co-integrated variables. This coefficient confirms the presence of a long-term relationship when its sign is negative and significant. The short- and long- term causality findings obtained by the PMG estimator are reported in Table 5⁴.

Firstly, we used both the Mean Group (MG) estimator and the Pooled Mean Group (PMG) estimator to estimate equation (2). Furthermore, we used the Hausman test to compare the PMG estimator against the MG estimator in order to make sure it was sufficient. The homogeneity assumption of long-run parameters is tested using the Hausman test (e.g. Hausman, 1978; Pesaran et al., 1999). By testing the null hypothesis that the differences between the MG and PMG estimates is not systematic, the Hausman test evaluates the effectiveness of the PGM estimator in comparison to the MG estimator. Because the Hausman test result is statistically insignificant at the 5% level, the null hypothesis of long-run homogeneity limitation is not rejected. This guarantees the validity of the PMG over the MG method and yields more accurate and efficient outcomes.

Table 5: PMG estimation results.

³ Panel-specific means, panel-specific AR parameters, and a temporal trend are all part of the model that underpins the provided statistics. The Newey-West techniques selected a Bartlett kernel with two lags for all three statistics in order to account for serial correlation. A regression with just one extra lag was utilized in the ADF test.

⁴ The lag length of estimated model was as the PMG (1, 1, 1, 1, 1) model.

Dependent variable:		Coefficient	T-statistic	P-value
Long-Run Coefficients	OP	0.200***	(3.700)	0.000
	GP	-0.177***	(-3.600)	0.000
	GDP	0.196**	(2.230)	0.026
	INF	-0.744***	(-4.090)	0.000
	RIR	0.953***	(5.740)	0.000
	RXR	-0.297***	(-4.190)	0.000
Short-Run Coefficients	ECT	-0.467***	(-5.530)	0.000
	Δ OP	0.028	(0.700)	0.484
	Δ GP	0.100*	(1.730)	0.083
	Δ GDP	-0.075	(-0.200)	0.844
	Δ INF	-0.160	(-0.430)	0.665
	Δ RIR	-0.155	(-1.510)	0.130
	Δ RXR	0.252*	(1.440)	0.068
	Cons	-0.386**	(-3.380)	0.001
Hausman test		4.23 (0.646)		
N		340		

* PMG denotes the Panel ARDL Long-Run PMG estimation, the estimation was performed in STATA software.

Our results show that the relationship between the explanatory variables and FS is valid in the long run. The results demonstrate that FS is positively related to OP, GDP, and RIR (see, e.g., CGFS, 2018), while GP, INF, and RXR have a negative one. However, all the variables are significant at the 1% level except GDP, which is significant at 5%. In this regard, the short-term estimate and co-integrating relation are established by the error correction model. Table 5 confirms the presence of a statistically significant long-term relationship between the variables of our study. As indicated, the error correction coefficient is negative (-46.7%) and statistically significant at a 1% level, which shows that the rate of convergence to the long-run equilibrium is high.

The aforementioned provides evidence of mean-reverting characteristics to a long-term equilibrium that is not false, in other words, meaning cointegration. Moreover, the PMG short-run estimates reveal that the OP, GP, and RXR coefficients are positive and statistically significant at the 10% level except for OP, whereas the INF, GDP, and RIR coefficients are negative and statistically insignificant.

3.5 Dumitrescu-Hurlin Panel Non-Causality Test

The results of the Dumitrescu and Hurlin (2012) panel causality test are reported in Table 6⁵. Regarding unidirectional causality, the findings show that causality runs from OP and RXR to all the variables. Therefore, our findings reflect the role of OP and RXR changes and their contribution to the banking sector, macroeconomic performance, fiscal and monetary policies. Strangely, RIR has only one channel passing through RXR. On the other hand, GP change appears to influence all the variables except RIR. Furthermore, GDP growth appears to cause FS, GP, INF and RIR. These findings are consistent with the findings such as Cologni and Manera (2008), Morana (2013), Khan (2015), and Umaru and Zubairu (2012). Lastly, almost all the series, except OP and GDP, seemed to be influenced by INF.

⁵ The results are available upon request.

Concerning the feedback effects, a bidirectional causality is found between the following set of variables: OP and with both RXR and FS. GP with both FS, GDP and RXR. GDP with both FS and RXR, following INF and both RXR and RIR. Finally, RXR with FS. Therefore, we conclude that these variables can be used in predict each other.

Table 6: Heterogeneous Panel Causality Test

Null Hypothesis	The decision
FS and OP	Bidirectional
FS and GP	Bidirectional
FS and GDP	Bidirectional
FS and INF	Unidirectional from FS
FS and RIR	No Causality
FS and RXR	Bidirectional
OP and GP	Unidirectional from OP
OP and GDP	Unidirectional from OP
OP and INF	Unidirectional from OP
OP and RIR	Unidirectional from OP
OP and RXR	Bidirectional
GP and GDP	Bidirectional
GP and INF	Unidirectional from INF
GP and RIR	No Causality
GP and RXR	Bidirectional
GDP and INF	Unidirectional from GDP
GDP and RIR	No Causality
GDP and RXR	Bidirectional
INF and RIR	Bidirectional
INF and RXR	Bidirectional
RIR and RXR	Unidirectional from RXR

- At least 10% level of significance.

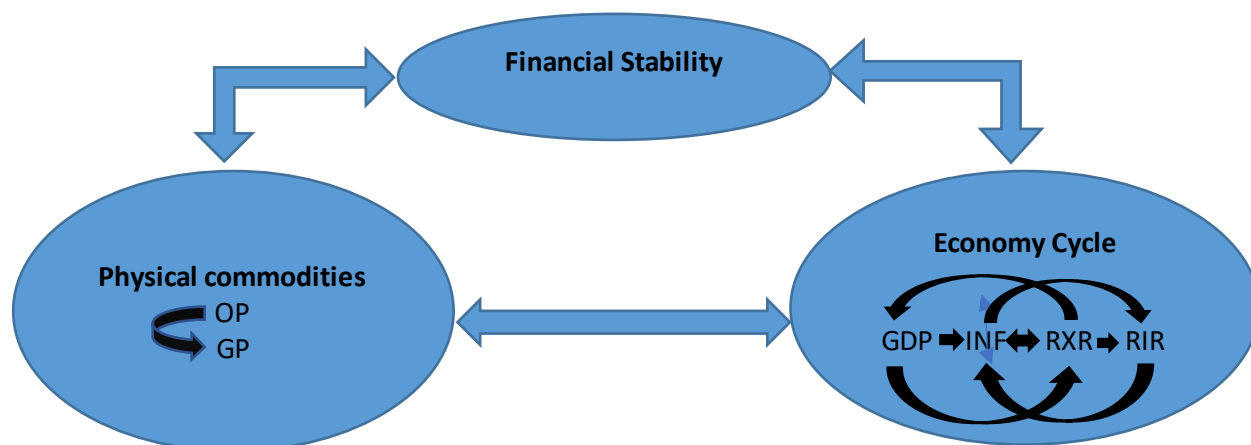
- The appropriate lags were determined to be 1 in all of the cases.

Figure 1 shows the causal directions. Interestingly, our findings show that OP, RXR, GP, and GDP directly cause the FS of the banking sector in oil-exporting countries. In addition, we find that OP and RXR affect FS indirectly through their effects on other variables. Moreover, concerning interactions, we find a set of multiple-way directed interactions. For instance, OP, RIR, RXR, and GDP pass through to INF. Also, RIR (set by central banks) affects INF. As a result, these interactions affect GDP. In addition, OP passes through to INF, and INF reacts in feedback to GP. As such, INF adjusts according to these interactions.

The latest findings support both the earlier research and our theoretical analysis (e.g., Elbadri and Bektaş (2020), Hammoudeh and Yuan (2008), Baffes (2007), Sari et al. (2011), Wang and Chueh (2013), Khan (2015), Brown and Yücel (2002), Ghosh, (2011), Timilsina (2015), Morana (2013) Narayan et al. (2010), Le and Chang (2011), Wang and Lee (2011), Cai et al. (2001), and Cologni and Manera (2008) with respect to the nexus between OP, GP, GDP, INF, RIR, and RXR. Consequently, our empirical results indicated that all variables had a

significant impact on FS. In this context, OP and RXR are significant components of the FS of the financial sectors of oil-exporting countries.

Figure 1. Causality directions.



Robustness checks

We used the Kao (1999) cointegration test panel to evaluate the robustness of our findings. In Table 7, the cointegration of the variables is confirmed by the Kao statistics. Again, to check how robust the PMG estimator is. Additionally, the robustness of the long-run coefficients from the PMG estimate was examined using the Panel Dynamic Least Squares (DOLS) approach in Dumitrescu and Hurlin (2012) panel causality test. The causality results are presented in Table 6, which confirmed that our variables had an existing causal relationship. Table 8 demonstrates that the primary findings (sign and significance of the coefficients) are almost the same across all approaches, with just a few discernible variations in the projected size of impacts. As a result, the conclusion will not change, and the long-run coefficients derived from PMG estimates are resilient throughout DOLS estimation, indicating that both our analysis and the model selected for the study are robust.

Table 7: Panel cointegration test result (Kao test)

	Statistic	P-value
Modified D-F t	-2.4043	0.0081
Dickey-Fuller t	-2.5963	0.0047
Augmented D-F t	-1.3156	0.0942
Unadjusted modified D-F t	-3.5097	0.0002
Unadjusted Dickey-Fuller t	-3.0893	0.0010

Note: All tests have a common null hypothesis of no cointegration

Table 8: Panel Dynamic Least Squares (DOLS)

Variable	Coefficient	t-Statistic	Prob.
OP	0.140	3.176	0.001
GP	-0.100	-2.047	0.041

GDP	0.269	3.147	0.001
INF	-0.320	-2.454	0.015
RIR	0.397	3.201	0.002
RXR	-0.166	-2.803	0.005
R-squared	0.623		
Adjusted R-squared	0.598		

5. Conclusion

This study investigates the effect of oil and gold prices on the stability of banks in the presence of GDP, inflation, interest rates, and exchange rates (economic cycle), using the Pedroni (2004, 1999) panel cointegration technique, the Pooled Mean Group (PMG) and the Dumitrescu and Hurlin (2012) Panel Causality tests. The panel data is made up of 17 oil-exporting countries covering the period of 1996–2016. First, the Pedroni (2004, 1999) panel cointegration test indicated a long-run cointegrating relationship among the variables. Then, the Hausman (1978) test demonstrated the superiority of the PMG over the MG approach for this data set, given that it provided more precise and efficient results.

Results from the PMG estimator suggest that OP, GP, GDP, IF, RIR, and RXR have a long-term effect on financial stability with an error correction coefficient of -48%. These results confirm a long-term relationship among the variables with a high rate of convergence to the equilibrium in the long run. In the long run, our findings show that the relationship between the explanatory variables and FS is valid. The explanatory variables have both positive and negative relationships with FS. OP, GDP, and RIR have a positive relationship with FS, meaning that banks will earn from positive shocks in oil prices, and the monetary policy impact on the crude oil market enhances financial stability. Meanwhile, the coefficients of GP, INF, and RXR are negative, implying that gold is not an excellent long-run hedge against inflation and a potential oil price crisis. However, all the variables are significant. In the short run, the PMG estimate shows that OP, GP, and RXR have a positive effect. Meanwhile, GDP, INF, and RIR have a negative effect. Nevertheless, only GP and RXR are statistically significant.

Our findings from the Dumitrescu and Hurlin (2012) panel causality test strongly reject the null hypothesis that OP and GP do not homogeneously cause FS, GDP, INF, RIR, and RXR, which reflects the more significant role of OP and GP in contributing to the financial strength, macroeconomic performance, fiscal and monetary policies of those economies. Lastly, we note that the feedback effect between OP, GP, GDP and RXR with FS is valid. In contrast, INF and RIR show no direct causality to FS, but they pass through RXR. Also, we find that indirectly, both OP and GP influence RIR and RXR, GDP, and INF, which in turn cause FS of the financial sector. Consequently, our empirical results indicate that OP and GP are significant components in the FS of the financial sector as they have essential effects on the macroeconomic sector, in oil-exporting countries. Finally, the robustness results confirm the conclusion derived from the baseline PMG model.

Our findings have important policy implications since all oil-exporting countries are oil-dependent; we propose that policymakers enhance financial stability by implementing macroeconomic policies that allow these countries to profit from oil booms while mitigating

the negative impacts of oil busts. However, relying only on oil revenue exposes the economy to oil price shocks, particularly during an oil price slump. Therefore, governments should actively monitor abnormal circumstances in the oil and gold markets caused by severe events and exercise prudential supervision. Governments are being pushed to encourage industrial diversification to achieve long-term, balanced economic development, with a focus on SME diversification and expansion. Policymakers may need to implement more financial control mechanisms to track cross-market co-movements. For example, risk management and portfolio diversification can be more successful if policy decisions consider gold market information. Furthermore, since inflation is the worst enemy of any economy, authorities should implement the appropriate monetary policies (especially the interest rate channel) to combat inflation and mitigate the negative effects of price volatility.

References:

- [1] Akgül, I., Bildirici, M., Özdemir, S., 2015. Evaluating the nonlinear linkage between gold prices and stock market index using Markov-Switching Bayesian VAR models. *Procedia - Soc. Behav. Sci.* 210, 408 – 415.
- [2] Akram, Q.F., 2009. Commodity prices, interest rates and the dollar. *Energy Econ.* 31, 838–851. <https://doi.org/10.1016/j.eneco.2009.05.016>
- [3] Al-Khazali, O.M., Mirzaei, A., 2017. The impact of oil price movements on bank non-performing loans: Global evidence from oil-exporting countries. *Emerg. Mark. Rev.* 31, 193–208. <https://doi.org/10.1016/j.ememar.2017.05.006>
- [4] Al-shboul, M., Maghyreh, A., Hassan, A., Molyneux, P., 2020. Political risk and bank stability in the Middle East and North Africa region. *Pacific-Basin Financ. J.* 60, 101291. <https://doi.org/10.1016/j.pacfin.2020.101291>
- [5] Albulescu, C., 2020. Bank financial stability, bank valuation and international oil prices: Evidence from listed Russian public banks (No. hal-02554299, HAL), Work peper.
- [6] Alodayni, S., 2016. Oil Prices, Credit Risks in Banking Systems, and Macro-Financial Linkages across GCC Oil Exporters. *Int. J. Financ. Stud.* 4, 23. <https://doi.org/10.3390/ijfs4040023>
- [7] Alqahtani, F., Samargandi, N., Kutan, A.M., 2020. The influence of oil prices on the banking sector in oil-exporting economies: Is there a psychological barrier? *Int. Rev. Financ. Anal.* 69, 227–251. <https://doi.org/10.1016/j.irfa.2020.101470>
- [8] Alsamara, M., Mrabet, Z., Jarallah, S., Barkat, K., 2019. The switching impact of financial stability and economic growth in Qatar: Evidence from an oil-rich country. *Q. Rev. Econ. Financ.* 73, 205–216. <https://doi.org/10.1016/j.qref.2018.05.008>
- [9] Anderson, T.W., Hsiao, C., 1982. Formulation and estimation of dynamic models using panel data. *J. Econom.* 18, 47–82.
- [10] Anderson, T.W., Hsiao, C., 1981. Estimation of Dynamic Models with Error Components. *J. Am. Stat. Assoc.* 76, 598–606.
- [11] Arellano, M., 1989. A note on the Anderson-Hsiao estimator for panel data. *Econ. Lett.* 31, 337–341.
- [12] Arellano, M., Bover, O., 1995. Another look at the instrumental variable estimation of error-components models. *J. Econom.* 68, 29–51. [https://doi.org/10.1016/0304-4076\(94\)01642-D](https://doi.org/10.1016/0304-4076(94)01642-D)

-
- [13] Arfaoui, M., Ben Rejeb, A., 2017. Oil, gold, US dollar and stock market interdependencies: a global analytical insight. *Eur. J. Manag. Bus. Econ.* 26, 278–293. <https://doi.org/10.1108/EJMBE-10-2017-016>
- [14] Ashraf, Q., Gershman, B., Howitt, P., 2017. Banks, market organization, and macroeconomic performance: An agent-based computational analysis. *J. Econ. Behav. Organ.* 135, 143–180. <https://doi.org/10.1016/j.jebo.2016.12.023>
- [15] Athanasoglou, P.P., Brissimis, S.N., Delis, M.D., 2008. Bank-specific, industry-specific and macroeconomic determinants of bank profitability. *J. Int. Financ. Mark. Institutions Money* 18, 121–136. <https://doi.org/10.1016/j.intfin.2006.07.001>
- [16] Baffes, J., 2007. Oil spills on other commodities. *Resour. Policy* 32, 126–134.
- [17] Basher, S.A., Haug, A.A., Sadorsky, P., 2016. The impact of oil shocks on exchange rates: A Markov-switching approach. *Energy Econ.* 54, 11–23. <https://doi.org/10.1016/j.eneco.2015.12.004>
- [18] Basher, S.A., Haug, A.A., Sadorsky, P., 2012. Oil prices, exchange rates and emerging stock markets. *Energy Econ.* 34, 227–240. <https://doi.org/10.1016/j.eneco.2011.10.005>
- [19] Batuo, M., Mlambo, K., Asongu, S., 2018. Linkages between financial development, financial instability, financial liberalisation and economic growth in Africa. *Res. Int. Bus. Financ.* 45, 168–179. <https://doi.org/10.1016/j.ribaf.2017.07.148>
- [20] BCBS, 2011. The transmission channels between the financial and real sectors: a critical survey of the literature, BIS Working Papers.
- [21] Bedoui, R., Braiek, S., Guesmi, K., Chevallier, J., 2019. On the conditional dependence structure between oil, gold and USD exchange rates: Nested copula based GJR-GARCH model. *Energy Econ.* 80, 876–889. <https://doi.org/10.1016/j.eneco.2019.02.002>
- [22] Blanchard, O., 2009. The Crisis: Basic Mechanisms, and Appropriate Policies.
- [23] Bremus, F., Buch, C.M., Russ, K.N., Schnitzer, M., 2018. Big Banks and Macroeconomic Outcomes: Theory and Cross-Country Evidence of Granularity. *J. Money, Credit Bank.* 50. <https://doi.org/10.1111/jmcb.12545>
- [24] Brown, S.P.A., Yücel, M.K., 2002. Energy prices and aggregate economic activity: An interpretative survey. *Q. Rev. Econ. Financ.* 42, 193–208. [https://doi.org/10.1016/S1062-9769\(02\)00138-2](https://doi.org/10.1016/S1062-9769(02)00138-2)
- [25] Buch, C.M., Neugebauer, K., 2011. Bank-specific shocks and the real economy. *J. Bank. Financ.* 35, 2179–2187. <https://doi.org/10.1016/j.jbankfin.2011.01.023>
- [26] Cai, J., Cheung, Y., Wong, M., 2001. What moves the gold market? *J. Futur. Mark.* 21, 257–278.
- [27] CGFS, 2018. Financial stability implications of a prolonged period of low interest rates.
- [28] Chakroun, M.A., Gallali, M.I., 2015. Islamic Banks and Financial Stability: An Empirical Analysis of the Gulf Countries. *Int. J. Bus. Commer.* 5, 64–87.
- [29] Chen, S.S., Chen, H.C., 2007. Oil prices and real exchange rates. *Energy Econ.* 29, 390–404. <https://doi.org/10.1016/j.eneco.2006.08.003>
- [30] Cologni, A., Manera, M., 2008. Oil prices, inflation and interest rates in a structural cointegrated VAR model for the G-7 countries. *Energy Econ.* 30, 856–888. <https://doi.org/10.1016/j.eneco.2006.11.001>
- [31] Creel, J., Hubert, P., Labondance, F., 2015. Financial stability and economic performance. *Econ. Model.* 48, 25–40. <https://doi.org/10.1016/j.econmod.2014.10.025>
- [32] De-Bock, R., Demyanets, A., 2012. Bank Asset Quality in Emerging Markets: Determinants and Spillovers, WP/12/71.
-

- [33] Domanski, D., Kearns, J., Lombardi, M.J., Shin, H.S., 2015. Oil and Debt, BIS Quarterly Review.
- [34] Dumitrescu, E.-I., Hurlin, C., 2012. Testing for Granger non-causality in heterogeneous panels. *Econ. Model.* 29, 1450–1460.
- [35] Eichengreen, B., Arteta, C., 2000. Banking crises in Emerging Markets: Presumptions and Evidence (No. 115). <https://doi.org/10.1017/CBO9781107415324.004>
- [36] Elbadri, M., Bekta, E., 2017. Measuring the Financial Stability of Islamic and Conventional Banks in Turkey. <https://doi.org/10.1007/978-3-319-66872-7>
- [37] Elbadri, M., Bektaş, E., 2020. Dynamic relationship among the bank stability, oil, and gold prices: Evidence from the Islamic banks operating in the Gulf Cooperation Council countries. *Int. J. Financ. Econ.* 1–16. <https://doi.org/10.1002/ijfe.2265>
- [38] Foglia, M., Angelini, E., 2019. An explorative analysis of Italy banking financial stability. *Econ. Bull.* 39, 1294–1308.
- [39] Fortune, N.J., 1987. The inflation rate of the price of gold, expected prices and interest rates. *J. Macroecon.* 9, 71–82.
- [40] Fratzscher, M., Schneider, D., Robays, I. Van, 2014. Oil Prices, Exchange Rates and Asset Prices. ECB Working Paper No. 1689, Frankfurt, Germany.
- [41] Ftiti, Z., Guesmi, K., Teulon, F., Chouachi, S., 2016. Relationship Between Crude Oil Prices And Economic Growth In Selected OPEC Countries. *J. Appl. Bus. Res.* 32, 11–22.
- [42] Ghalayini, L., 2011. The Interaction between Oil Price and Economic Growth. *Middle East. Financ. Econ.* 13, 127–141.
- [43] Ghenimi, A., Oweis, K., Ao, M., 2015. Financial Stability of Islamic Banks in the MENA Countries during Financial Crisis and Political Uncertainty: An Emperical Investigation. *J. Account. Mark.* 04, 2–8.
- [44] Ghosh, S., 2011. Examining crude oil price – Exchange rate nexus for India during the period of extreme oil price volatility. *Appl. Energy* 88, 1886–1889.
- [45] Golub, S., 1983. Oil Prices and Exchange Rates. *Econ. J.* 93, 576–593. <https://doi.org/10.2307/2232396>
- [46] Hakenes, H., Schnabel, I., 2011. Capital regulation, bank competition, and financial stability. *Econ. Lett.* 113, 256–258.
- [47] Hammoudeh, S., Yuan, Y., 2008. Metal volatility in presence of oil and interest rate shocks. *Energy Econ.* 30, 606–620. <https://doi.org/10.1016/j.eneco.2007.09.004>
- [48] Hausman, J., 1978. Specification Tests in Econometrics. *Econometrica* 46, 1251–71.
- [49] Hesse, H., Poghosyan, T., 2016. Oil Prices and Bank Profitability: Evidence from Major Oil-Exporting Countries in the Middle East and North Africa, In: Gevorkyan A., Canuto O. (eds) *Financial Deepening and Post-Crisis Development in Emerging Markets*. Palgrave Macmillan, New York. <https://doi.org/10.1057/978-1-137-52246-7>
- [50] Ibrahim, M.H., 2019. Oil and macro-financial linkages: Evidence from the GCC countries. *Q. Rev. Econ. Financ.* 72, 1–13. <https://doi.org/10.1016/j.qref.2019.01.014>
- [51] IMF, 2015. Oil prices, financial stability, and the use of countercyclical macroprudential policies in the GCC, Annual Meeting of Ministers of Finance and Central Bank Governors (2015).
- [52] Kao, C., 1999. Spurious regression and residual-based tests for cointegration in panel data. *J. Econom.* 90, 1–44.
- [53] Khan, H., 2015. The Impact of Oil and Gold Prices on the GDP Growth: Empirical Evidence from a Developing Country. *Int. J. Manag. Sci. Bus. Adm.* 1, 34– 46.

-
- [54] Khandelwal, P., Miyajima, K., Santos, A., 2016. The Impact of Oil Prices on the Banking System in the GCC (No. IMF 2016/161). <https://doi.org/10.5089/9781475523393.001>
- [55] Kilian, L., 2009. Not all oil price shocks are alike: disentangling demand and supply shocks in the crude oil market. *Am. Econ. Rev.* 99, 1053–1099.
- [56] Klein, N., 2013. Non-Performing Loans in CESEE: Determinants and Impact on Macroeconomic Performance, Working Paper No. 13/72.
- [57] Koutsoyiannis, A., 1983. A short-run pricing model for a speculative asset, tested with data from the gold bullion market. *Appl. Econ.* 15, 563–581.
- [58] Krugman, P., 1983. Oil and the dollar: in Bhandari, J.S. and Putnam, B.H. (eds) *Economic Interdependence and Flexible Exchange Rates*, Cambridge.
- [59] Le, T.-H., Chang, Y., 2011. Oil And Gold: Correlation Or Causation? *Econ. Bull.* 31, A31.
- [60] Lizardo, R.A., Mollick, A. V., 2010. Oil price fluctuations and U.S. dollar exchange rates. *Energy Econ.* 32, 399–408. <https://doi.org/10.1016/j.eneco.2009.10.005>
- [61] Maeda, A., 2008. On the Oil Price-GDP Relationship. *Japanese Econ.* 99–127, 99–127.
- [62] Mehrara, M., 2007. Energy consumption and economic growth: The case of oil exporting countries. *Energy Policy* 35, 2939–2945.
- [63] Melvin, M., Sultan, J., 1990. South African political unrest, oil prices, and the time varying risk premium in the gold futures market. *J. Futur. Mark.* 10, 103–111.
- [64] Mensi, W., Hammoudeh, S., Mohammad, I., Al-jarrah, W., 2019. Risk spillovers and hedging effectiveness between major commodities , and Islamic and conventional GCC banks. *J. Int. Financ. Mark. Institutions Money* 60, 68–88. <https://doi.org/10.1016/j.intfin.2018.12.011>
- [65] Mink, M., 2016. Aggregate liquidity and banking sector fragility.
- [66] Mishkin, F., 1996. The channels of monetary transmission: lessons for monetary policy. NBER Work. Pap. Ser. 1–29. <https://doi.org/10.3386/w5464>
- [67] Morana, C., 2013. Oil price dynamics, macro-finance interactions and the role of financial speculation. *J. Bank. Financ.* 37, 206–226.
- [68] Narayan, P.K., Narayan, S., Zheng, X., 2010. Gold and oil futures markets: Are markets efficient? *Appl. Energy* 87, 3299–3303. <https://doi.org/10.1016/j.apenergy.2010.03.020>
- [69] Ngene, G., Wang, J., Hassan, M.K., Julio, I., Yu, J.-S., 2019. Oil and Sovereign Credit Risk: Asymmetric Nonlinear Dynamic Interactions. *Emerg. Mark. Financ. Trade* 1–17. <https://doi.org/10.1080/1540496x.2019.1668775>
- [70] Pedroni, P., 2004. Panel Cointegration: Asymptotic and Finite Sample Properties of Pooled Time Series Tests with an Application to the PPP Hypothesis. *Econom. Theory* 20, 597–325.
- [71] Pedroni, P., 1999. Critical Values for Cointegration Tests in Heterogeneous Panels with Multiple Regressors. *Oxf. Bull. Econ. Stat.* 61, 653–670.
- [72] Pesaran, M., Smith, R., 1995. Estimating long-run relationships from dynamic heterogeneous panels. *J. Econom.* 68, 79–113.
- [73] Pesaran, M.H., Shin, Y., Smith, R.P., 1999. Pooled Mean Group Estimation of Dynamic Heterogeneous Panels. *J. Am. Stat. Assoc.* 94, 621–634.
- [74] Pradhan, R.P., Arvin, M.B., Hall, J.H., Bahmani, S., 2014. Causal nexus between economic growth , banking sector development , stock market development , and other macroeconomic variables : The case of ASEAN countries. *Rev. Financ. Econ.* 23, 155–173. <https://doi.org/10.1016/j.rfe.2014.07.002>
-

- [75] Sari, R., Hammoudeh, S., Soytas, U., 2010. Dynamics of oil price, precious metal prices, and exchange rate. *Energy Econ.* 32, 351–362. <https://doi.org/10.1016/j.eneco.2009.08.010>
- [76] Sari, R., Soytas, U., Hacıhasanoglu, E., 2011. Do global risk perceptions influence world oil prices? *Energy Econ.* 33, 515–524.
- [77] Settlements, B. of I., 2011. The impact of sovereign credit risk on bank funding conditions (No. CGFS Paper No. 43), 43.
- [78] Soedarmono, W., Machrouh, F., Tarazi, A., 2011. Bank market power, economic growth and financial stability: Evidence from Asian banks. *J. Asian Econ.* 22, 460–470. <https://doi.org/10.1016/j.asieco.2011.08.003>
- [79] Soytas, U., Sari, R., Hammoudeh, S., Hacıhasanoglu, E., 2009. World oil prices, precious metal prices and macroeconomy in Turkey. *Energy Policy* 37, 5557–5566.
- [80] Tang, W., Wu, L., Zhang, Z., 2010. Oil price shocks and their short- and long-term effects on the Chinese economy. *Energy Econ.* 32, S3–S14.
- [81] Taylor, J.B., 1995. The Monetary Transmission Mechanism: An Empirical Framework. *J. Econ. Perspect.* 9, 11–26. <https://doi.org/10.1257/jep.9.4.11>
- [82] Timilsina, G.R., 2015. Oil prices and the global economy: A general equilibrium analysis. *Energy Econ.* 49, 669–675.
- [83] Tiwari, A.K., Sahadudheen, I., 2015. Understanding the nexus between oil and gold. *Resour. Policy* 46, 85–91.
- [84] Uhde, A., Heimeshoff, U., 2009. Consolidation in banking and financial stability in Europe: Empirical evidence. *J. Bank. Financ.* 33, 1299–1311. <https://doi.org/10.1016/j.jbankfin.2009.01.006>
- [85] Umaru, A., Zubairu, A.A., 2012. Effect of Inflation on the Growth and Development of the Nigerian Economy (An Empirical Analysis). *Int. J. Bus. Soc. Sci.* 3, 183–191. <https://doi.org/10.30845/ijbss>
- [86] Vousinas, G.L., 2013. The Transmission Channels between Financial Sector and Real Economy in Light of the Current Financial Crisis a Critical Survey of the Literature. *Mod. Econ.* 04, 248–256. <https://doi.org/10.4236/me.2013.44028>
- [87] Wang, K.M., Lee, Y.-M., 2011. The yen for gold. *Resour. Policy* 36, 39–48.
- [88] Wang, Y.S., Chueh, Y.L., 2013. Dynamic transmission effects between the interest rate, the US dollar, and gold and crude oil prices. *Econ. Model.* 30, 792–798.
- [89] Westerlund, J., 2005. New Simple Tests for Panel Cointegration. *Econom. Rev.* 24, 297–316.
- [90] Zhang, Y.J., Fan, Y., Tsai, H.T., Wei, Y.M., 2008. Spillover effect of US dollar exchange rate on oil prices. *J. Policy Model.* 30, 973–991. <https://doi.org/10.1016/j.jpolmod.2008.02.002>
- [91] Zhang, Y.J., Wei, Y.M., 2010. The crude oil market and the gold market: Evidence for cointegration, causality and price discovery. *Resour. Policy* 35, 168–177.

Acknowledgments

Funding

- Yes ☐
- No ☒

Conflict of Interest

- Yes ☐
- No ☒

Data Availability

- Yes ☐
- No ☒

Authors' Contributions

N.	Author Name and Email and ORCID link	Study Conception / Idea	Data Collection or Contribution to Data Collection	Contribution to Previous Studies / Literature Review	Study Methodology	Conducting Analyses (Practical Aspect)	Data Analysis	Interpretation and Discussion of Results	Approval of Final Version
1	Marei Elbadri elbadrimarei@yahoo.com https://orcid.org/0000-0002-2386-558X	✓	✓	✓	✓	✓	✓	✓	✓
2									
3									