The impact of oil price shocks on the performance of U.S. banks

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Dissertation written under the supervision of

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Abstract

The present Dissertation's academic research addresses the impact of oil price shocks on the performance of United States banks in the 2009Q1-2020Q3 period. The two hypotheses advanced are that oil price shocks have a direct impact on bank profitability, or that the effect of oil price movements is channeled solely through general economic activity, through an indirect effect. This Dissertation employs an incremental approach based on both Static and Dynamic Panel Data models. Subsequently, two robustness checks are performed, so as to check the possibility that the distance of banks' Headquarters to Cushing, Oklahoma might affect the severeness of the impact of oil on bank performance; as well as to test the premise that price movements might produce asymmetrical effects. The dependent variable used is ROA, and the independent variables selected are three different oil price shock measures, and vectors of bank-specific and macroeconomic control variables. Bank-specific data were extracted from the Compustat Bank Fundamentals database, while oil and economic data were gathered from Refinitiv Worldscope. This Dissertation's findings show that oil price shocks have a direct positive impact on U.S. bank performance and are robust for both econometric models. Moreover, several macroeconomic and bank-specific are found to affect bank performance. Additionally, the location of banks is noteworthy, since banks closer to Cushing observe a more significant positive impact of oil price on bank performance. However, no asymmetrical effects were observed. The empirical results of this Dissertation pose multiple management/policy challenges for bank executives, banking supervisors, and energy policymakers.

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Resumo

A presente Dissertação aborda como questão científica o efeito dos choques do preço do petróleo no desempenho dos bancos Norte-Americanos durante o período 2009Q1-2020Q3. As hipóteses avançadas prendem-se na possibilidade de os choques terem um efeito direto no desempenho dos bancos, ou o resultado dos movimentos do preço ser sentido somente na atividade económica, verificando-se um efeito indireto. Esta Dissertação utiliza uma abordagem incremental baseada em modelos estático e dinâmicos de dados em painel. Subsequentemente, dois testes de robustez foram aplicados, de forma a aferir a possibilidade da distância da sede dos bancos a Cushing, Oklahoma poder afetar a severidade do impacto do petróleo no desempenho dos bancos; foi igualmente testada a premissa de que os movimentos no preço poderiam produzir efeitos assimétricos. A variável dependente utilizada é o ROA, e as variáveis independentes selecionadas são três métricas de choques de preço do petróleo, bem como variáveis de controlo especificamente bancárias e macroeconómicas. Os dados dos bancos foram extraídos da base de dados Compustat Bank Fundamentals, enquanto os dados económicos e petrolíferos foram recolhidos do Refinitv Worldscope. Os resultados desta Dissertação mostram que os choques de preço do petróleo emitem um efeito positivo no desempenho dos bancos Norte-Americanos, confirmados para ambos os modelos. Mais, verificou-se que variáveis macroeconómicas e bancárias afetam o desempenho bancário. Adicionalmente, a localização geográfica é significativa, dados que se verificou um efeito do petróleo mais acentuado nos bancos mais próximo de Cushing, Oklahoma. Os resultados desta Dissertação colocam vários desafios a executivos, supervisores e legisladores.

Título da Dissertação: The impact of oil price shocks on the performance of U.S. banks

Autor: Luís Manuel Fernandes Justino Patrão

Palavras-chave: Bancos Norte-Americanos, Desempenho bancário, Movimentos no preço do petróleo, Persistência dos lucros, Regulação, Dados em painel.

J.E.L. Classification: C23, G21, Q43

Dedication

Esta Dissertação é dedicada à minha Mãe e à minha Avó. Obrigado por fazerem dos meus sonhos, os vossos sonhos. Obrigado pelo constante apoio, pelo amor incondicional, por todas as dificuldades que tiveram de passar para que eu tivesse esta oportunidade e por acreditarem em mim sempre, em todos os meus sucessos e todas as minhas falhas. Obrigado.

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"You won't find it by yourself

You're gonna need some help

And you won't fail with me around

Come on, let's go"

Broadcast *– Come On Let's Go*

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1. Introduction

Fossil Fuels, especially Petroleum, have been of the utmost importance for the development of modern society for almost 200 years. The first oil refinery in the world was developed by the Polish pharmacist Ignacy Lukasiewicz, whose main discovery was the distillation of kerosene from oil, leading to the first kerosene lamp and streetlamp (Pabis-Braunstein, 1989). Oil is currently used to create products such as plastic and solvents, as well as to provide fuel for cars and produce electricity. As of 2020, existing oil reserves amounted to 1.73 trillion barrels, enough for the next 50 years of production (BP, 2020). According to the United States Energy Information Administration, the United States consumed a total of about 6.63 billion barrels of petroleum in 2020, the lowest value since 1995, due to the Covid-19 pandemic (U.S. Energy Information Administration, 2021). In 2020, the United States became a net exporter in oil, for the first time since these statistics are recorded (since 1949) (U.S. Energy Information Administration, 2021).

In addition to its economic relevance, the derivatives makets for oil are especially relevant in the financial world, namely the futures of West Texas Intermediate crude oil on the New York Mercantile Exchange and the Brent Crude traded on the Intercontinental Exchange. In the past few years, banks have stirred away from traditional Savings & Loans operations, and started offering other services, in a quest to reap potential diversification benefits (Stiroh and Rumble (2006), Calmès and Théoret (2010)).

Several studies have been conducted to demonstrate how oil price shocks impact general economic activity, specifically focusing on the relationship between oil and Gross Domestic Product, Inflation, and Interest Rates. Surprisingly, even though oil plays a significant role in the financial markets, to the best of knowledge, the existing academic literature on the association between oil and bank performance is not vast. Therefore, this Dissertation tries to analyze how oil price shocks affect the Return on Assets of banks in the United States of America (U.S.A.). Moreover, this Dissertation aims to discover whether the distance of the bank's headquarters to Cushing, Oklahoma (the delivery, price settlement point and storage location for WTI crude oil) impacts the significance of oil price shocks in the performance of banks, as well as whether the asymmetrical shocks hypothesis is verified (positive and negative WTI oil price movements have different effects on bank performance). This Dissertation's purpose is to add value to the literature in two different categories: firstly, the literature related to the variables that determine bank's profitability and secondly, the academic literature that addresses the effect of oil price shocks on bank performance.

The academic literature has mostly focused on the effect of oil price shocks on the economic activity. Hamilton (1983) and Gisser and Goodwin (1986) found that business cycles in the United States were affected by oil prices. Even though several articles, such as Hooker (1996), Bernanke et al. (1997), Milani (2009) and Blanchard and Gali (2007) found a diminishing significance of oil on the economy since 1973, Baumeister and Peersman (2010, 2013) concluded that the structural break was observed due to failure to account for the decline of price elasticity in both oil supply and demand. Furthermore, Jones and Kaul (1996) and Filis et al. (2011) found that oil price movements affected the stock market, while Beckmann and Czudaj (2013), Fratzscher et al. (2014) and Basher et al. (2016) observed a significant correlation between oil price and the exchange rate of United States Dollar.

As for the bank profitability, a consensus as arisen that bank profitability outcome relates solely to the grouping of various bank-specific and macroeconomic factors. The first studies focused on how the structure of financial industry affected bank performance, such as Short (1979), Bourke (1989) and Molyneux and Thornton (1992). Demirgüç-Kunt and Huizinga (1999), Berger et al. (2000) and Athanasoglou et al. (2008) found that several bank-specific and macroeconomic control variables have a significant impact on bank performance, specifically the persistence of profits from previous periods, capitalization of banks, exposure to credit risk, operating expenses, inflation and the business cycle, if the GDP output is above its trend.

However, the literature of the effect of oil price on bank performance is not expansive and none of the studies are focused on U.S. banks. Hesse and Poghosyian (2016) focused on a sample of Middle East and African banks from 1994 and 2008 and found that oil has an indirect effect on bank's Return on Assets. Centering on Chinese banks, Lee and Lee (2019) found a significant negative impact of oil on several bank-specific variables (using the CAMEL rating system), while Al-Khazali and Mirzaei (2017) concluded that the rise of oil prices is usually followed by a decrease in bank NPLs, even though the effect is asymmetrical and more pronounced in oil exporting countries. Killins and Mollick (2020) add to the literature by concluding that oil has a positive impact on the profitability of banks in Canada.

In order to research the impact of oil price shocks on the banking performance of United States banks for the time period of 2009Q1 to 2020Q3 since the Great Recession, this Dissertation employs a fixed-effects model with three different oil shock measures: (i) the logarithm of the West Texas Intermediate price oil; (ii) the deviation of oil prices from their underlying trend (proxied by the Hodrick-Prescott filter); and (iii) the Net Oil Price Increase, a variable introduced by Hamilton (2003). Inspired by Hesse and Poghosyan (2016), an incremental approach is used, first running the regressions with only the oil measure and bank-specific (Capital Adequacy, Management Quality and Liquidity) variables, introducing the macroeconomic control variables (Inflation, GDP and Yield Curve) subsequently, in order to test whether oil has a direct impact on bank profitability, or if its impact is channeled through the traditional channels related to general economic activity. Furthermore, due to the persistence of profits in banks, a System Generalized Method of Moments methodology is used with the goal of confirming the robustness of the baseline results. All bank-specific data were collected from the Compustat Bank Fundamentals database, while macroeconomic and oil data were obtained through Refinitiv Worldscope.

This Dissertation's main findings indicate that oil price shocks have a direct significant positive impact on bank profitability, since all three oil measures' coefficients remain significant after the introduction of macroeconomic control variables, except for the Net Oil Price Increase variable. These findings are validated by both the Fixed-Effects and System GMM methodologies. Moreover, the Management Quality proxy variable has a negative impact on bank performance, which was expected. Relating to macroeconomic control variables, the Yield Curve and Inflation have a positive impact on bank performance. However, GDP has a negative coefficient, a novelty in academic literature on banking performance. Furthermore, the conducted robustness tests also indicate that oil price shocks are only significant for the subsample group of banks with headquarters closer to Cushing, Oklahoma, the delivery point of WTI crude oil on the NYME. Furthermore, no specific asymmetrical effect is found between positive and negative oil movements and the Return on Assets of banks.

This Dissertation's is organized as follows: Section 2 provides an overview of the academic literature on the determinants that affect bank profitability, the impact of oil price shocks on economic activity and banking performance. Section 3 and 4 outline the data and empirical methodology used in this Dissertation. Section 5 presents the empirical results of the Fixed Effects and System GMM models, and their full description. Section 6 presents two (2) robustness checks related to the distance of banks' headquarters to Cushing, Oklahoma, and the hypothesis of possible asymmetrical effects of oil price shocks, which fully confirm the baseline findings. Section 7 provides a brief discussion of the implications of the Dissertation's findings. Finally, Section 8 concludes.

2. Literature Review

The current section of the Dissertation outlines a brief summary of the academic literature related to the research topics of this Dissertation, specifically on the research topics connected to bank profitability, the impact of oil shocks on the banking sector and on macroeconomic determinants.

2.1. Bank Profitability

The academic literature usually considers that bank profitability is the outcome of a combination of: (i) bank-specific determinants related to the bank management procedures; (ii) the bank's risk appetite; and/or (iii) external factors, such as the economic, monetary, and legal environment under which the bank operates.

Initially, most research have focused on the relationship between industry concentration and the profitability of banks in the United States. Short (1979) constitutes one of the first studies seeking to explain the interaction between industry concentration and bank profitability in other countries. The author uses a selection of 60 banks from Canada, West Europe and Japan and regresses their Return on Equity from 1972 to 1974 against the concentration of the banking industry of each country, proxied by the Herfindahl-Hirschman (HH) Index, its inverse and other concentration ratios, namely the market share held by the largest, two largest, and three largest banks of the country. Since the observations span multiple countries, the author introduces two country-specific variables to proxy the capital scarcity of each country: The Central Bank discount rate and the interest rate on long-term government securities. Additionally, the author uses explanatory variables specific to each bank. The author finds that while greater concentration leads to higher profit rates, bank profitability is also significantly impacted by the type of ownership, the rate of the growth of assets, and the capital scarcity of each country.

Adding to this initial research, Bourke (1989) reviews the performance of 90 banks from 1972 in 1981 in 12 different countries, using both bank-specific and country- and market-specific explanatory variables. However, the author also sets out to confirm the Edwards and Heggestad (1973) and Heggestad and Mingo (1976) hypothesis that market power and concentration of the banking industry translate into risk avoidance rather than into higher profits. However, instead of using the Return on Equity as the sole dependent variable, the author also includes Return on Assets and two new variables called "Value added return on total assets" (Ratio of Net Income before Taxes and Staff Expenses to Total Assets; and the Ratio of Net Income before Taxes, Staff Expenses and Loan Losses to Total Assets). The conclusion is that loan loss expenses are lower in banks operating in markets with higher level of concentration, confirming the risk avoidance hypothesis. However, even though the author tries to replicate Short (1979), he does not arrive at similar findings, which the author attributes to multiple difficulties faced by Short (1979), more specifically the short time span of the data, the quality of data sources, the reduced number of banks per country and unreliable financial statement information for multiple countries. On the contrary, Molyneux and Thornton (1992) replicate Bourke's approach for a sample of European banks from 1986 to 1989 and find no evidence of the Edwards and Heggestad (1973) hypothesis.

Demirgüç-Kunt and Huizinga (1999) research the explanatory factors of commercial bank interest margins and profitability for banks located in 80 developed and emerging countries, in the years 1988 to 1995. Utilizing a fixed-effects model, this innovative research covers an extensive array of variables derived from bank characteristics (e.g. size, leverage, value of deposits) and macroeconomic factors, such as taxation, inflation, country deposit insurance, the relevance of the banking sector to the country's GDP, legal effectiveness, and corruption. The authors confirm some findings associated with previous research, such as the positive relationship between capitalization and profitability. However, they also determine that macroeconomic factors have a significant impact on bank profitability, namely inflation, the finance sector structure, and tax rates. The positive relationship between inflation and bank profitability implies that an increase in the bank's revenue is superior to the increment in costs. As for the tax implications, banks are subjected to two types of taxation: they are taxed directly through the corporate tax rate and indirectly through the reserve requirements, which is as severe as the opportunity cost of holding reserves. While the amount of reserves has a negative impact on profitability, the authors observe that the tax rate has a significant positive impact. Through the estimation of the interaction between tax rate and the per capita GDP, the authors observe that the tax rates were almost completely passed on to bank customers, which is consistent with the assumption that international investors demand a return on capital invested that is independent of the country's tax laws. The theme of taxation in the banking sector is further explored in Demirgüç-Kunt and Huizinga (2001). The authors find that both domestic and foreign banks pass the burden of tax to their customers. Nonetheless, they also detect that foreign banks pay significantly less taxes than domestic banks and engage in extensive profit shifting opportunities.

Most of the research until this point uses linear models to estimate the effect of several determinants on bank profitability. Due to imperfect competition, information opaqueness and serial correlation in regional/macroeconomic shocks (Berger et al., 2000), the existing literature mostly agrees that bank profits are also persistent. Athanasoglou et al. (2008) use the Arellano-Bond estimator to address the bank-specific, industry-specific, and macroeconomic determinants of bank profitability of the Greek banking sector over the period of 1985 to 2001. This innovative research addresses the business cycle impact on bank profitability with its long period of data, while other studies focus on shorter periods. The authors select the Return on Assets as the measure of profitability since an analysis of the Return on Equity would disregard the fact that financial leverage is often determined by regulation. As for explanatory variables, the authors divide them into three categories: (i) bank-specific (e.g. Capital, Credit Risk, Operating Expenses Management and Size); (ii) industry-specific (government or private ownership and Concentration of the industry); and (iii) macroeconomic specific determinants (Inflation Expectations and Cyclical Output of the GDP). The authors find that bank-specific and macroeconomic variables affect bank profitability, while industry concentration and the banks' ownership status are insignificant. For bank-specific explanatory variables, the authors detect a positive and significant effect of capital and productivity growth on profitability, while exposure to credit risk and operating expenses are strongly related to negative performance. The business cycle effect is asymmetrical since it is only positively linked to bank performances when GDP is above its trend.

Chronopoulos et al. (2015) analyze bank profitability determinants in the United States, covering a sample of 17,500 commercial banks over the period of 1984-2010. It adds to the existing literature by verifying the persistence of short-term profits and whether this persistence is affected by legislation regarding financial regulation and the Global Financial Crisis of 2007-2008. The authors use System GMM estimators with Windmeijer-corrected standard-errors. The selected dependent variable is the Return on Assets and the explanatory variables are divided into four different groups: (i) bank-specific (e.g. Size, Asset Growth, Credit Risk and Loan Portfolio Concentration); (ii) industry structure (Herfindahl-Hirschman index computed at the national level); (iii) macroeconomic (GDP growth); and (iv) Regulatory and Crisis variables. The authors create three separate dummy variables, for: (i) the period after the enactment of the Riegle-Neal Interestate Banking and Branching Efficiency Act of 1994; (ii) the Gramm-Leach-Bliley Act; and (iii) the Global Financial Crisis period. Aiming to estimate the effect of changes in the persistence of profits, the authors also add multiplicative interaction terms between the lagged ROA and the dummy variables. Size, diversification of profits, liquidity, credit risk, and asset growth are found to significantly impact bank profitability, while profits also tend to be pro-cyclical. The article concludes that bank profits are persistent, even though this effect has diminished significantly after the Riggle-Neal Act.

2.2. Effect of oil price changes on the real economy

There is a variety of academic literature related to the relationship between oil shocks, whether through supply, demand, or price shocks - and their effect on macroeconomic determinants. Evidence shows that until the OPEC oil embargo of 1973, oil price had a negative correlation with GDP output in the United States and was positively correlated with inflation and unemployment. While some authors found a structural break in 1973, other authors claim that there has been serious distortion in these studies due to failure to account for changes in the oil market, thus arguing that oil supply and demand shocks still affect economic output. Furthermore, evidence overpoweringly shows that oil shocks have influence over stock market returns and the exchange rates of the US Dollar.

Hamilton (1983) innovatively researches the correlation between the recessions of the United States economy and the oil prices. The author notices that from 1948 up until 1972, oil prices rose significantly before 4 of 5 major recessions in the US. He proposes three hypotheses to explain this reoccurrence: (i) the correlation presents a historical coincidence and there is no relation; (ii) the correlation results from endogenous factors that cause both the oil price increases and the recessions; or (iii) at least some of the recessions over this time period were caused by an exogenous increase in the price of petroleum. The author applies Sims (1980) approach in replicating a macroeconomic reality. The study proceeds in examining other output, price, and financial sector variables that were not present in the Sims system. The only variables found to predict oil price increases (strike activity and coal prices) are unlikely to be key endogenous indicators of economic activity. In conclusion, the study finds that while oil price increases are not a condition for recessions, business cycles are indeed affected by oil price changes in the United States, even though the intensity of the effect is unknown.

Similarly, Gisser and Goodwin (1986) corroborate the results found earlier that oil price shocks have a significant impact on the US macroeconomic indicators. For this purpose, these authors developed several St. Louis models (Batten & Thornton, 1983), covering the 1961-1982 period, aiming to understand the effect of money supply, fiscal policy, and the price of crude oil on macroeconomic performance. The authors find that the impact of oil shocks is negative on the annual growth of Gross National Product (GNP) and real investment, while positive on inflation and the rate of unemployment. These findings are confirmed by running further Granger-Causality and Chow tests.

However, Hooker (1996) observes that even though oil shocks are a significant determinant to the US macroeconomic performance up until 1973, a structural break is observed at that period and the significance of oil shocks decreases drastically afterwards. Furthermore, the author indicates that the oil crisis of 1979 provides no significant interaction with macroeconomic indicators. Using the Vector Autoregression (VAR) methodology, the author provides an explanation to this occurrence by presenting and testing three hypotheses: the first stipulates that there were multiple structural breaks in US macroeconomy determinants around this period and failure to consider them decreases the role of oil; the second stipulates that oil prices were exogenous until 1973, causing the Granger-Causality test to assign a lesser role to petroleum in the later years; the third stipulates that there were asymmetries to oil price changes due to few decreases during the pre-OPEC period until 1973. In sum, the author concludes that the hypotheses do not represent the differences over the period and the author is not able to explain this incidence. Similar conclusions of diminishing significance of oil shocks on the economy have been further pursued in Milani (2009), Bernanke et al. (1997), and Blanchard and Galí (2007).

Baumeister and Peersman (2010, 2013) show that these conclusions are distorted due to the fact that both the price elasticities of oil supply and oil demand have drastically declined throughout time. The authors find that the impact becomes smaller if oil supply and demand shocks are measured as a similar shift in oil prices. Nevertheless, if oil supply and demand shocks are measured as a standardized change in oil production, the interaction is as significant as in recent periods. This normalization can nevertheless be avoided by estimating the effects for a cross-country dimension since the intensity of supply and demand has different extents for each country. Peersman and Van Robays (2012) address the macroeconomic effect of oil shocks on a cross-country basis, employing a Structural Vector Autoregression approach. For this objective, the authors selected a sample of 11 countries from 1986 until 2008. During this period, these countries have experienced different oil supply and demands. For example, Canada and the United Kingdom even switched between net oil-importing to net oil-exporting countries. The authors conclude that for oil demand shocks driven by global economic activity, the United States and Euro Area countries experience a temporary surge in economic activity and a rise in inflation, while oil-specific demand shocks create negligible inflationary effects. As for the case of oil supply shocks, net oil-importing countries observe a decrease in economic activity and a rise in inflation, while the net oil-exporting countries see no significant change in their economy.

Apart from inflation and GDP, other researches address the effect of oil on several other factors that might impact bank profitability. Evidence overwhelmingly shows that oil price has a negative correlation with the stock market. Jones and Kaul (1996) innovatively examine the impact of oil price on the stock market in four oil-producing countries: United Kingdom (1962 until 1991), Canada (1960 until 1991), the United States (1947 until 1991) and Japan (1970 until 1991). The authors employ a regression model based on the effect of oil price shocks on the stock markets and the real cash flows of the stocks, assuming that stock returns in all countries are correlated with current and future changes in expected cash flows. The authors determine that oil prices have a detrimental effect on the stock market on all four countries. Furthermore, the authors indicate that the effect of oil on the stock market in the United States can be almost completely accounted by the effect of oil on real cash flow. Moreover, Filis et al. (2011) employ a DCC-GARCH model (Engle, 2002) to achieve a similar result by also examining the time-varying effect during the 1987-2009 period for three oil-exporting countries (Canada, Mexico, and Brazil) and three oil-importing countries (U.S., Germany, and the Netherlands). The authors confirm that the lagged oil price and the market returns of the stock market are negatively correlated but also find that the effects do not differ for oil-importing and oil-exporting countries.

There is also a vast amount of literature focused on the oil shock effect on exchange rates. Fratzscher et al. (2014) use a structural Vector Autoregression model to study the impact on U.S. Dollar exchange rates. The results reveal that causality is observed in both directions: an increase in the oil price leads to a depreciation of the U.S. Dollar, whereas a weakening of the Dollar causes oil price to rise. Beckmann and Czudaj (2013) also find similar evidence that oil price and exchange rates affect each other. Basher et al. (2016) use a Markov-switching model to examine this effect on the United States exchange with both oil-importer and oil-exporter countries. The Markov-Switching technique has the advantage of capturing possible effects that linear models are unable to capture. The authors find that this is indeed the case since a linear model only detects significant impact of oil shocks on the exchange rate in 4 of the 9 sampled countries. Additionally, through the Markov-Switching methodology, the authors also conclude that there is significant appreciation of the exchange rate for oil exporting countries after oil-market specific and global economic oil demand shocks, while oil importing countries observe both appreciation and depreciation. There is no clear and significant influence of oil supply shocks on the exchange rates.

2.3. Effect of oil price changes on bank profitability

While the literature on the effect of macroeconomic determinants on bank profitability is extensive, the literature regarding the direct impact of oil price shocks on bank profitability is much less expansive. However, the existing literature confirms the expectation that oil has a different effect on banks depending on whether they operate in oil importing or oil exporting countries. Additionally, existing literature strongly supports the perspective that price shocks have significant consequences on banks' portfolio.

Hesse and Poghosyan (2016) innovatively focus on the direct effect of oil price changes on banks. The authors collect annual data for the banks of 11 Middle East and North African banks (Algeria, Bahrain, Iran, Kuwait, Libya, Oman, Qatar, Saudi Arabia, Sudan, U.A.E., and Yemen) from 1994 to 2008. These countries are all major oil net-exporters. The authors use a System GMM approach, due to the persistence of profits in banks, and regress the profitability dependent variable (Return on Assets) on bank-specific, oil price shock measures, and macroeconomic variables. To understand clearly whether oil had a direct impact on bank profitability, the authors use just bank-specific and oil shock variables. Afterwards, when oil is found to be statistically significant, the authors add macroeconomic variables to the regression to examine whether oil has a direct effect (through either oil-related lending, business activity or fees deriving from oil) or an indirect effect (through GDP output or inflation). The authors ultimately find that oil has an indirect positive impact on bank profitability for these countries, transmitted through macroeconomic and institutional country determinants, and that this impact is more prevalent in investment banks. Moreover, the authors also find that the Global Financial Crisis seriously distorted this relationship.

Lee and Lee (2019) cover the impact of oil price shocks in 182 Chinese financial institutions from 2000 to 2014. The authors use the CAMEL ratings system (Capital, Asset Quality, Management Efficiency, Earnings and Liquidity) as dependent variables. As explanatory variables, the authors select the WTI oil price as the oil indicator and added banking sector and macroeconomic control variables such as Size, Concentration of the Sector, GDP, and Inflation. Employing a two-step System GMM Dynamic Panel Data model, the results indicate that oil price shocks have a significant negative impact in all the variables. Additionally, the authors create interactions between the oil variable and economic risk, financial risk, and political risk variables. The authors conclude that the adverse impact is mitigated by political and economic stability. Nonetheless, these results might not be verified in other countries since China is a net oil-importer and its financial market and economy are heavily regulated.

Al-Khazali and Mirzaei (2017) examine the effect of oil price shocks on bank non-performing loans (NPLs) in 30 different countries, finding significantly different results. The authors conclude that the rise of oil prices is usually linked to a decrease in bank NPLs in these countries. This effect is asymmetrical, meaning that the negative oil price movements have a greater impact than positive movements, and the relationship is stronger in larger banks. Nevertheless, the authors also find that the impact of adverse oil price movements decreases the quality of bank loan portfolios in oil-exporter countries, which is in line with the literature that states that oil shocks have different effects in oil importer and exporter countries.

Lastly, Killins and Mollick (2020) analyze the impact of oil price shocks as measured by the change in WTI prices, the deviation from the Hodrick-Prescott trend, and the divergence over the price and the 12-month futures (the uncertainty of the oil prices) on bank profitability (Return on Assets) of the top Canadian banks over the period 1996-2008. This research is quite relevant due to the cultural and commercial relationship between the United States and Canada. Moreover, this innovative research introduces interactive explanatory variables to the System GMM model.

By interacting the oil price shock variable with diversification, capital adequacy, and credit risk proxy variables, the model not only captures the non-linearities in the data, but it also explains the oil effect on those components and its significance. The authors find a positive impact of oil price increases in the profitability of banks, which is expected since Canada is an oil exporter country. Furthermore, the authors also find a positive strong relationship of oil shocks and the diversification measure, which shows that an increase in oil prices leads to a surge in financial transactions. The positive changes in oil prices also lead to a rise in banks' asset quality.

This Dissertation makes some contributions to the academic literature on energy literature and its effect in bank profitability. First, as noted before, the academic literature on the research topic of the effect of oil price shocks on bank profitability is lacking. To the best of knowledge, this constitutes the first research done on this topic for U.S. banks. Second, most articles use only static or dynamic panel data methodologies. This research combines both fixed-effects and System GMM models, to conclude that the results are robust and are not dependent on the chosen methodology. Furthermore, in line with previous research on the impact of oil shocks on net importer and net exporter of oil countries, this Dissertation employs a novel method to analyze the impact of oil shocks on bank profitability, a metric that depends on the distance of banks to Cushing, Oklahoma, the latter being the price settlement point for West Texas Intermediate crude oil, in addition to testing the hypothesis related to the asymmetrical effects of oil price shocks on banking performance.

3. Data

Quarterly income and balance sheet information from 2009Q1 to 2020Q3 is collected for all banks operating in the United States of America from the Compustat Bank Fundamentals on the Wharton Research Data Services website. The selected time period used in this Dissertation essentially represents the latest pre-pandemic business cycle expansion in the United States, according to the National Bureau of Economic Research cycle dating methodology. The dataset includes Total Assets, Tier 1 and Tier 2 Capital Ratio, Total Deposits, Net Income, Net Total Loans, Current Operating Income and Expenses, and Pre-Tax Income. Subsequently, the dataset was filtered in order to exclude banks that are not currently active or do not have observations for all time periods. In order to remove outliers, the data was winsorized at the 5th and 9th percentile, arriving at a sample of 85 U.S. active banks over 47 quarterly periods (a complete list of the banks can be consulted in Appendix A). Lastly, macroeconomic data is obtained through the Refinitiv Worldscope database for the same period.

3.1. Profitability variable

Return on Assets (ROA) has been selected as the model's dependent variable representing banks' main profitability measure. It is calculated by dividing Net Income over Total Assets. The ROA effectively measures how efficiently a given bank's resources are managed, by describing the profit per one unit of assets. This profitability determinant is used since ROE does not account for the risks that arise with high leverage, as financial leverage limits are typically predetermined by banking supervisors (Athanasoglou et al., 2008).

3.2. Oil price shock variables

To fully capture the effect of oil price shocks, three different measures of oil price shocks are employed, following the approach proposed by Hesse and Poghosyan (2016). The first measure is simply the logarithm of quarterly West Texas Intermediate oil prices. All daily closing prices of WTI oil have been collected and the quarterly average price is calculated, arriving at a series that is fully able to seize the oil price movements throughout said period. The determinant is calculated as noted, with *n* being the number of days in the quarter of a given year, *q* representing the quarter of the year and WTI the daily price of West Texas Intermediate crude oil.

$$WTI_q = \log \frac{\sum_t^n WTI_t}{n} \tag{1}$$

The second measure is the deviation of oil prices from its underlying trend (the cyclical component), proxied by the Hodrick-Prescott filter WTI_t^{HP}. This determinant can distinguish between the changes that occur in line with the fundamentals. The variable is calculated as exposed below:

$$HP_q = \frac{\sum_t^n (\log WTI_t - \log WTI_{t-1}^{HP})}{n} \tag{2}$$

Hamilton (2003) points out that an oil price increase of 10% right after a decrease of 20% would not alarm consumers and proposes a measure called Net Oil Price Increase NOP_t that is defined as the average amount in which the price of WTI crude oil of a quarter exceeded its peak of the last 12 months. This third measure is calculated as follows:

$$NOP_q = \frac{\sum_t^n max\,[0, WTI_t - \max_{i=\{1,365\}}[WTI_{t-1,i}]]}{n} \quad (3)$$

3.3. Bank-specific determinants

The selected bank-specific profitability determinants used are the Capital Adequacy, Management Quality, and Liquidity.

Capital Adequacy – Capital Adequacy measures whether the bank has enough capital to absorb potential losses that might arise without severely damaging its financial standing. Capital Adequacy is proxied by the Risk-Adjusted Overall Capital Ratio, collected from the Compustat Bank Fundamentals database. According to Hesse and Poghosyan (2016), this factor is expected to have a positive effect since adequate and prudent capital reserves signal to markets that the bank is safe, and shareholders should expect better future returns. The requirement is set by the regulator; hence the variable is inserted as predetermined in the System GMM model.

Management Quality – Management Quality refers to the executives' ability to identify opportunities and correctly use the bank's assets while also managing the risk and complying with laws and regulations. This factor is proxied by the Ratio of Current Operating Expenses to Current Operating Income. An increase in this ratio is expected to have an inverse impact on bank profitability.

Liquidity – Commercial banks' role is to transform maturity by taking short-term financing, such as deposits, into long-term borrowings. However, it is extremely important for banks to maintain liquidity to comply with regulatory requirements and be able to honor their liabilities' commitments. Therefore, Liquidity is proxied by the Ratio between Total Loans and Total Deposits. While banks are expected by investors to preserve a certain level of liquidity, an increase in this ratio represents an increase in Total Loans or a decrease in Total Deposits, which creates an increase in profitability. Therefore, the impact on the dependent variable is expected to be positive until a certain point since a significant maturity mismatch might create liquidity problems.

3.4. Macroeconomic measures

The model features multiple economic control variables. These determinants strengthen the econometric model's design by providing additional explanations to bank profitability and by clarifying whether the oil price shocks have a direct or indirect effect on banking performance.

Table 1
Summary Statistics

Variable	# Observations	Mean	Std. Dev	Min	Max
Dependent					
ROA	3,995	0.00219	0.00107	-0.00790	0.00514
Oil					
WTI	3,995	1.81586	0.14766	1.43596	2.02405
HP	3,995	-0.01531	0.09736	-0.27967	0.12465
NOP	3,995	0.02816	0.03446	0	0.13536
Bank-Specific					
CA	3,995	0.14613	0.02012	0.10898	0.23490
MQ	3,995	0.75419	0.12370	0.37131	1.92066
LIQ	3,995	0.83846	0.13881	0.43709	1.21479
Macroeconomic					
CPI	3,995	0.00179	0.00184	-0.00342	0.00497
GDP	3,995	0.00179	0.00788	-0.04089	0.03132
YC	3,995	0.00910	0.03552	-0.05997	0.11173

Inflation – Inflation is proxied by the quarterly change in the logarithmic value of the Consumer Price Index for All Urban Consumers. Bourke (1989) and Molyneux and Thornton (1992) observe a positive relation between inflation and bank profitability.

GDP – GDP is the quarterly growth of the logarithmic value of the United States Gross Domestic Product. Demirgüç-Kunt and Huizinga (1999) and Athanasoglou et al. (2008) find a positive association between the GDP and bank profitability.

Yield Curve – The Yield Curve of government bonds measures the current expectations for the economy of the country, namely in inflation and economic growth. The Yield Curve is proxied by the difference between the 90-Day Treasury Bill and 10-Year Treasury Note. Since an increase in the gap embodies the anticipation of economic and inflation growth, the relationship between this and bank profitability is expected to be positive.

Table 2
Variables Definition

Variable	Definition	Name	Expected Effect	Source
Dependent				
Profitability	Net Profit / Total Assets	ROA		Compustat
Oil				
WTI Price	Logarithm of the West Texas Intermediate oil quarter prices	WTI		Refinitiv Datastream
Hodrick-Prescott	Log of WTI oil price - Log of Hodrick-Prescott filtered WTI price	HP		Refinitiv Datastream
Net Oil Price Increase	Average amount the WTI quarter price exceeded last year peak	NOP		Refinitiv Datastream
Bank-Specific				
Capital Adequacy	Tier 1 and Tier 2 Capital / Risk-Weighted Assets	CA	+	Compustat
Management Quality	Current Operating Expenses / Current Operating Income	MQ	-	Compustat
Liquidity	Total Loans / Total Deposits	LIQ	+	Compustat
Macroeconomic				
Inflation	Change in the logarithm of CPI	CPI	+	Refinitiv Datastream
GDP	Change in the logarithm of the United States GDP	GDP	+	Refinitiv Datastream
Yield Curve	10-Year Treasury Note Yield - 90-Day Treasury Bill Yield	YC	+	Refinitiv Datastream

A summary of the descriptive statistics of all variables used in this Dissertation can be observed in Table 1. After winsorizing the data for the 5^{th} and 95^{th} percentile to eliminate outliers, the sample is composed by 85 banks (a list of the banks can be found in Appendix A) over 47 quarterly periods. Since this is a panel with a fixed period of time, increasing the size of the sample would mean increasing the number of banks. Therefore, all selected variables were subjected to the Unit-Root tests of Harris and Tzavalis (1999) and Im et al. (2003). The null hypothesis of Im-Pesaran-Shin is only rejected at the significance level of 10% for the WTI oil measure (*p-value* = 0.0567). Since the Harris-Tzavalis null hypothesis for the same variable was rejected for the 1% significance level (*p-value* = 0.0000), the WTI oil variable was considered stationary. Results are reported in Appendix B and C.

4. Empirical Methodology

This research employs an econometric model, namely a static panel data estimation, in order to analyze the significance of oil price shocks on bank profitability. The general empirical specification is the following:

$$\mathrm{ROA}_{i,t} = \alpha + \beta \mathrm{Oil}_{i,t} + \gamma \mathrm{Bank}_{i,t} + \delta \mathrm{Macro}_{i,t-1} + \varepsilon_{i,t} \qquad (4)$$

in which *i* and *t* denote the bank and time (i.e. quarter) variables, respectively, Oil is one of the three measures of oil price shock, Bank and Macro are the vectors of Bank-Specific and Macroeconomic variables of United States banks and $\varepsilon_{i,t}$ is the error term. The macroeconomic variables are lagged one period, since banks operate under the economic circumstances typically associated with the previous quarter, as they are not perfectly aware of current macroeconomic conditions.

Similar to Hesse and Poghosyan (2016), the estimation is done with two hypotheses in mind. Hypothesis 1 is that oil price shocks have a direct impact on bank profitability. This impact could be felt due to an increase in oil derivatives trading, stock market shocks, increase in overall business, etc (these are the 1^{st} round effects). Hypothesis 2 is that oil price shocks first affect the macroeconomy of the United States, which in turn subsequently impacts bank profitability (2^{nd} round effects).

For the purpose of testing both hypotheses, the estimation strategy is implemented using two incremental steps. First, the regression is estimated with only the oil and bank-specific explanatory variables. If the oil variable is not statistically significant at that point, it is reasonable to conclude that oil price shocks do not *directly* affect bank profitability in the United States of America. However, if oil is statistically significant, the macroeconomic explanatory variables are introduced to the previous regression. If these control variables value are statistically significant and the oil variable is also significant, the oil price shock has a *direct* effect on bank profitability. If the oil variable value is not significant, then the impact of oil is only felt through its impact on the economy, should the macro variables be significant. In this case, it is possible to conclude that the initial oil impact has been channeled through the economic variables and, therefore, the impact of oil in the bank profitability is only *indirect*.

Aiming to correctly select the appropriate static panel data variant (fixed- or random-effects) methodology, the Hausman test is computed. The detailed results can be found in Table 3. The null hypothesis is rejected at the significance level of 10% and, therefore, the chosen model is the Fixed-Effects model.

Table 3
Hausman Tests results

Variable	**$\chi2$**	***p-value***
WTI	16.4300	0.0215
HP	13.8500	0.0539
NOP	13.9100	0.0528

There are, however, some limitations with the model. First, it fails to account for the persistence of bank profits. Second, some bank-specific variables of bank profitability are likely to be endogenous or predetermined (Athanasoglou et al., 2008), which creates a bias in a static panel data model setting. Therefore, in order to address this specific issue, the model is further replicated using the System Generalized Method of Moments (SGMM) statistical model, developed by Arellano and Bover (1995) and Blundell and Bond (1998), with the ultimate goal of confirming the robustness of the baselines results advanced by the Fixed-Effects model

5. Empirical Results

The current section presents and discusses this Dissertation's empirical findings associated with the impact of oil price shocks on bank profitability. Subsection 5.1. describes and discusses the findings of the Fixed Effects Empirical Model. Subsection 5.2. describes and discusses the results and conclusions of the System Generalized Method of Moments dynamic panel data methodology.

5.1. Fixed Effects Empirical Model

First, to control for possible heteroscedasticity and guarantee the efficiency of the estimators, robust standard errors are used. Furthermore, the Variance Inflator Factor (VIF) test is computed in order to ensure that multicollinearity is adequately dealt with in the model applications. The results are presented in Appendix D.

Table 4
Fixed-Effects Regressions with WTI oil measure

Variable	**1**	**2**
WTI	0.00028 ***	0.00035 ***
	(0.00098)	(0.00010)
CA	0.00182 *	0.00184 *
	(0.00098)	(0.00098)
MQ	-0.00791 ***	-0.00791 ***
	(0.00022)	(0.00029)
LIQ	0.00048	0.00045
	(0.00029)	(0.00029)
CPI		0.00927 **
		(0.00399)
GDP		-0.00525 ***
		(0.00179)
YC		0.00118 ***
		(0.00018)
# of Observations	3,995	3,910
# of Banks	85	85
p-value of F-Test	0.0000	0.0000
R-Squared within	0.7688	0.7691
R-Squared between	0.6608	0.6617
Overall R-Squared	0.7373	0.7376

This table presents the results of the oil measure WTI and control variables on bank profitability measured by ROA. The macroeconomic variables CPI, GDP and YC are lagged 1 quarter. The estimated standard errors are robust for heteroscedasticity and presented in parentheses. Column 1 reports only the oil and bank-specific variables, while macroeconomic control variables are introduced in Column 2. * is significant at the 10% level, ** is significant at the 5% level and *** is significant at the 1% level.

Table 4, 5, and 6 present the baseline results utilizing the Fixed-Effects econometric specification. Column 1 of each table shows the regression with only bank-specific variables and each oil price shock determinant, namely the WTI log price, the deviation of oil prices from its underlying trend proxied by the Hodrick-Prescott Filter, and the Net Oil Price Increase. Column 2 of each table introduces the macroeconomic control variables.

Table 5
Fixed-Effects Regressions with HP oil measure

Variable	**1**	**2**
HP	0.00027 ***	0.00033 ***
	(0.00007)	(0.00008)
CA	0.00210 **	0.00219 **
	(0.00102)	(0.00103)
MQ	-0.00784 ***	-0.00782 ***
	(0.00022)	(0.00022)
LIQ	0.00043	0.00039
	(0.00030)	(0.00029)
CPI		0.00956 **
		(0.00373)
GDP		-0.00396 **
		(0.00184)
YC		0.00119 ***
		(0.00017)
# of Observations	3,995	3,910
# of Banks	85	85
p-value of F-Test	0.0000	0.0000
R-Squared within	0.7676	0.7675
R-Squared between	0.6645	0.6658
Overall R-Squared	0.7380	0.7382

This table presents the results of the oil measure HP and control variables on bank profitability measured by ROA. The macroeconomic variables CPI, GDP and YC are lagged 1 quarter. The estimated standard errors are robust for heteroscedasticity and presented in parentheses. Column 1 reports only the oil and bank-specific variables, while macroeconomic control variables are introduced in Column 2. * is significant at the 10% level, ** is significant at the 5% level and *** is significant at the 1% level.

First, focusing on the regressions shown on Column 1 of Table 4, the WTI oil price coefficient is significant at the 1% significance level and therefore, it is possible to conclude this measure positively affects the profitability of banks. A 1% increase in the oil price represents an expected increase of 0.00028% in the quarterly Return on Assets of banks. In fact, this value is actually quite expressive since the mean quarterly Return on Assets of the sampled banks is

0.219%. As expected, the Capital Adequacy and Management Quality determinants are significant at the 10% and 1% significance level, respectively, which is in line with previous research (Hesse and Poghosyan, 2016). Surprisingly, the Liquidity variable is not significant. This measure is initially used by Lee and Lee (2019), which address exclusively Chinese banks. Therefore, this discrepancy of significance might occur due to different country samples. Hence, it is possible to conclude that this measure has a significant impact on bank profitability. However, macroeconomic variables must be introduced in order to test whether the findings confirm the previously stated Hypotheses 1 or 2.

In column 2, the same bank-specific determinants continue to be significant. As expected, the selected macroeconomic variables are all significant at the 1% (GDP and YC) and 5% (CPI) significance level. As previously stated, GDP (Athanasoglou et al., 2008), Inflation (Chronopoulos et al., 2015) and the Yield Curve (Killins & Mollick, 2020) significantly affect banks' profitability. The coefficients for both Inflation and the Yield Curve are positive, which is in line with previous studies on this research topic. However, surprisingly the GDP coefficient is negative, which has not been observed in previous articles. This phenomenon might be observed since this study focuses only on one economic expansion business cycle; hence the observations related to GDP are mostly positive during this period[1]. Even though the association between macroeconomic variables and bank profitability is noteworthy, the oil determinant remains significant at the 1% level and even increases its coefficient to 0.00035. In conclusion, both the WTI oil price and the macroeconomic variables impact U.S. banks' profitability.

Table 5 corroborates Hypothesis 1, which states that oil price shocks directly impact the profitability of US banks, since the deviation of the oil price from its underlying trend proxied by the variable HP (the cyclical component) is still significant at the 1% level even after introducing the macroeconomic control variables. Since the coefficients are quite similar for both regressions (Column 1 HP is 0.00027 and WTI is 0.00028, Column 2 HP is 0.00033 and WTI is 0.00035 (Table 4 and 5)), it is possible to conclude that the significance of the oil price shocks to bank profitability in the United States comes mostly from the deviation from its underlying trend.

[1] Further studies on this subject with a larger time period would have to be conducted to completely analyze this relationship throughout various economic cycles in the United States in the context of the oil-bank profitability nexus.

Table 6
Fixed-Effects Regressions with NOP oil measure

Variable	**1**	**2**
NOP	0.00062 ***	0.00052
	(0.00023)	(0.00033)
CA	0.002122 **	0.00224
	(0.00101)	(0.00103)
MQ	-0.00789 ***	-0.00782 ***
	(0.00023)	(0.00022)
LIQ	0.00014	0.00040
	(0.00030)	(0.00030)
CPI		0.01151 ***
		(0.00432)
GDP		-0.00379 **
		(0.00188)
YC		0.00106 ***
		(0.00016)
# of Observations	3,995	3,910
# of Banks	85	85
p-value of F-Test	0.0000	0.0000
R-Squared within	0.7676	0.7668
R-Squared between	0.6658	0.6656
Overall R-Squared	0.7382	0.7376

This table presents the results of the oil measure NOP and control variables on bank profitability measured by ROA. The macroeconomic variables CPI, GDP and YC are lagged 1 quarter. The estimated standard errors are robust for heteroscedasticity and presented in parentheses. Column 1 reports only the oil and bank-specific variables, while macroeconomic control variables are introduced in Column 2. * is significant at the 10% level, ** is significant at the 5% level and *** is significant at the 1% level.

However, after introducing the macroeconomic variables in Column 2 of Table 6, the Net Oil Price Increase coefficient changes from being significant at the 1% level to not being significant at all (*p-value* = 0.111). Simultaneously, an increase in the coefficient and significance of the CPI variable is also detectable. This surge is compatible with previous findings that oil price shocks have a positive relationship with Inflation (Peersman & Van Robays, 2012). Therefore, according to this variable, one would be able to demonstrate the proposed hypothesis that oil price shocks do not have a direct impact on bank profitability since its effect is channeled through macroeconomic conditions. However, since the *p-value* is actually very close to the 10% significance threshold, it is also possible to assume that this statistical insignificance might be due to the idiosyncrasies of the Net Oil Price Increase variable.

5.2. System Generalized Method of Moments model

To fully understand the impact of oil price shocks on U.S. banks' profitability, three regressions are computed utilizing a Dynamic Panel Data model. As previously stated in the Empirical Methodology section of this Dissertation, there are essentially two reasons for employing Dynamic Panel Data econometric methods: (i) empirical results advanced by the academic literature suggest that bank profits are highly persistent due to several reasons (e.g. information imperfection); and (ii) some bank-specific variables might be endogenous or even predetermined (e.g.. regulatory-related variables). The choice is typically between the First-Difference Generalized Method of Moments, developed by Arellano and Bond (1991), or the System Generalized Method of Moments, developed by Arellano and Bover (1995) and Blundell and Bond (1998). The System Generalized Method of Moments is chosen, since it allows for the coding of predetermined and endogenous variables and also due to the existence of weak instruments for lagged variables, which might induce a downward bias (Blundell & Bond, 1998).

The results for the Two-Step System GMM estimation are presented in Table 7. The estimated standard errors are robust for heteroscedasticity. The first column shows the estimation involving the WTI variable, while the second column introduces the HP variable, and the third column accounts for the NOP measure. The STATA command xtabond2 is used for these regressions, with Capital Adequacy being considered a predetermined variable and Return on Assets, CPI, GDP and YC being lagged one period. All the instruments used are valid since the Hansen test's null hypothesis is not rejected and, therefore the restrictions of overidentification are applied. The *p-value* is large but it's not close to 1, so it is possible to conclude that the asymptotic properties of the test have been applied (Roodman, 2009). Furthermore, the AR(2) null hypothesis is not rejected, so the absence of serial autocorrelation in the errors is confirmed (Labra & Torrecillas, 2018).

Firstly, the computed estimations confirm that bank profitability is highly persistent. In all three columns, it is possible to observe that the one period lagged Return on Assets variable's coefficient is significant at the 1% significance level. It is also the largest coefficient in all three regressions, ranging from 0.07077 to 0.08007.

Table 7
Two-Step System Generalized Method of Moments Regressions

Variable	**1**	**2**	**3**
ROA	0.08007 ***	0.07077 ***	0.07302 ***
	(0.02069)	(0.01886)	(0.01996)
WTI	0.00027 ***		
	(0.00010)		
HP		0.00029 ***	
		(0.00008)	
NOP			0.00043
			(0.00032)
CA	0.00634 ***	0.00826 ***	0.00947 ***
	(0.00220)	(0.00245)	(0.00243)
MQ	-0.00754 ***	-0.00747 ***	-0.00748 ***
	(0.00033)	(0.00033)	(0.00032)
LIQ	0.00010	0.00018	0.00023
	(0.00033)	(0.00029)	(0.00028)
CPI	0.01041 *	0.01045 *	0.01371 ***
	(0.00541)	(0.00535)	(0.00499)
GDP	-0.00506 ***	-0.00399 *	-0.00381 *
	(0.0019)	(0.0021)	(0.0020)
YC	0.00121 ***	0.00130 ***	0.00110 ***
	(0.00021)	(0.00020)	(0.00019)
# of Observations	3,910	3,910	3,910
# of Banks	85	85	85
# of Instruments	99	99	99
AR(1)	-6.25	-6.32	-6.21
p-value	0.0000	0.0000	0.0000
AR(2)	0.010	-0.150	0.110
p-value	0.991	0.880	0.913
Hansen	81.830	83.740	82.010
p-value	0.718	0.666	0.714

This table presents the results of the System Generalized Method of Moments for the three oil variables: WTI, HP, and NOP. Column 1 presents the regression with the WTI measure, Column 2 presents the regression with the HP measure and Column 3 presents the regression with NOP measure. Capital Adequacy is modelled as a predetermined variable. The macroeconomic variables CPI, GDP and YC are lagged 1 quarter. The estimated standard errors are robust for heteroscedasticity and presented in parentheses. * is significant at the 10% level, ** is significant at the 5% level and *** is significant at the 1% level.

However, even though the addition of the lagged Return on Assets supplements the possible explanations to bank profitability in the United States, the results are still quite stable when compared with the Fixed-Effects model regressions. Specifically, the coefficients for the WTI and HP variables (0.00035 and 0.00027, 0.00033 and 0.00029, for fixed-effects and SGMM respectively) are truly similar and remain significant at the 1% significance level. The NOP variable coefficient is not statistically significant. This finding indicates that the Fixed-Effects static panel data model is robust, and its estimations do not suffer from endogeneity bias.

In sum, the first main finding is that the three oil price shock variables are significant when the equation only presents the oil and bank-specific variables. The oil price shock coefficients are significant and impact bank profitability. Secondly, by introducing macroeconomic control variables, the coefficients show that two out of the three oil price measures remain significant, while the remaining one (Net Oil Price Increase) presents a *p-value* close to the 10% significance level (0.111). Therefore, it is possible to conclude that while oil price can be absorbed by the economy in different manners (e.g. Inflation, GDP output), the oil price shocks also directly affect the bank profitability, a finding which is consistent with the previous literature herein reviewed.

There are several implications to the previously described findings. First, bank executives, regulators and investors should carefully monitor the movements in oil prices since the latter variable's price trajectory may pose risks and benefits to the performance of U.S. banks. Moreover, the importance of oil will only stand to increase due to the strategy of energetic independence implemented by the United States. More specifically, according to the U.S. Energy Information Administration report, imports of oil have peaked in 2005, and in 2020 the United States has become a net oil exporter. It is expected that the U.S. oil exports will continue to rise, while the imports will continue to decrease. Policymakers and regulators should also address the impact of oil on banking performance when designing and implementing U.S. oil policies and banking supervision laws, given U.S. banks' preeminent role in credit lending.

6. Robustness Checks

This section presents and discusses the robustness tests involving further regression results related to the effect of oil price shocks on bank performance. In sub-section 6.1., the distance to Cushing, Oklahoma is implemented in order to test the theory that the relevance of crude oil in the at-large economy differentiates its effect on bank performance, similar to oil importing and exporting countries; and in section 6.2. the hypothesis of asymmetrical effects of oil price shocks is also tested.

6.1. Distance to Cushing, Oklahoma

The academic literature denotes a difference in the effect of oil in the macroeconomy of net importing and exporting oil countries. Peersman and Van Robays (2012) demonstrate that net oil importing countries see a decrease in GDP and a rise in inflation, while net exporting countries see no significant change in the economy. According to Basher et al. (2016), the exchange rate of oil exporting countries appreciates after oil-market specific and global economic oil demand shocks, while importing countries observe both appreciation and depreciation. Filis et al. (2011) conclude that there is no different effect for oil importing and exporting countries in the stock market.

According to the Federal Reserve Economic Data, the total assets of United States commercial banks at the end of the third quarter of 2020 amounted to almost 20 trillion U.S. Dollars. Due to the vast size of the industry and the country itself, it is expected that banks focus on different types of assets and business operations. By adapting the logic of oil importing and exporting countries and since oil has taken a major role in U.S. exports, one can expect that banks close to major petroleum trading hubs will have their performance impacted by oil price shocks in a different manner than other banks that operate farther from the oil industry's main U.S. locations.

The major type of crude oil exported by the United States is the West Texas Intermediate (WTI), which is the metric used to compute the oil variables. Cushing, Oklahoma is the delivery location for WTI on the New York Mercantile Exchange. According to the CME Group, Cushing, Oklahoma currently holds the capacity to store 90 million barrels of crude oil and the maximum inventory level was reached at 69 million barrels in early 2017. Therefore, to measure the possible different effect of oil price shocks on bank profitability, the distance from all banks' headquarters to Cushing, Oklahoma is calculated and the sample is divided into three sub-samples: (i) one for the banks which were the farthest; (ii) one for the banks which were the nearest; and (iii) one sample of banks in the middle range.

The results of the regressions for the nearest and farthest distance sample groups with bank-specific and macroeconomic variables are presented in Table 8 and Table 9. The incremental approach for the three sample groups, used in the baseline results, can be seen in Appendix E, F, G, H, I, J, K, L, and M.

Table 8
Fixed-Effects Regressions for the nearest to Cushing, Oklahoma sample group

Variable	**1**	**2**	**3**
WTI	0.00045 ***		
	(0.00016)		
HP		0.00061 ***	
		(0.00015)	
NOP			0.00106 *
			(0.00060)
CA	0.00354 ***	0.00394 ***	0.00411 ***
	(0.00118)	(0.00115)	(0.00111)
MQ	-0.00836 ***	-0.00824 ***	-0.00826 ***
	(0.00027)	(0.00027)	(0.00027)
LIQ	0.00010	0.00083	0.00086
	(0.00016)	(0.00060)	(0.00061)
CPI	0.01479 ***	0.01167 **	0.01456 **
	(0.00534)	(0.00563)	(0.00639)
GDP	-0.00961 ***	-0.00794 ***	-0.00758 *
	(0.00219)	(0.00236)	(0.00250)
YC	0.00111 ***	0.00118 ***	0.00095 ***
	(0.00027)	(0.00025)	(0.00024)
# of Observations	1,334	1,334	1,334
# of Banks	29	29	29
p-value of F-Test	0.0000	0.0000	0.0000
R-Squared within	0.7958	0.7950	0.7928
R-Squared between	0.6946	0.7101	0.7087
Overall R-Squared	0.7697	0.7733	0.7713

This table presents the results of the Fixed-Effects model for the nearest to Cushing, Oklahoma sample group. Column 1 presents the regression with the WTI measure, Column 2 presents the regression with the HP measure and Column 3 presents the regression with NOP measure. The macroeconomic variables CPI, GDP and YC are lagged 1 quarter. The estimated standard errors are robust for heteroscedasticity and presented in parentheses. * is significant at the 10% level, ** is significant at the 5% level and *** is significant at the 1% level.

For the sample group nearest to Cushing, Oklahoma, the results are similar to the baseline results with the Fixed-Effects model. The main difference is that the Net Oil Price Increase variable is significant at the 10% level for the nearest group, while it was not significant in the baseline findings. The robustified coefficients of all three oil variables are larger (i.e. more expressive) than the initial ones calculated for the complete sample group in the baseline findings.

As for the subsample group for the banks with the largest distance to Cushing, Oklahoma (Table 9), none of the oil variables are significant at the 10% level. Furthermore, while in Table 8 most coefficients are significant (apart from the Liquidity proxy variable), in Table 9 the only significant coefficients are the Management Quality proxy variable and the Yield Curve variable. The joint reading of these tables suggests that geographical distances might have an impact on bank profitability, as distance from this key WTI delivery location is an important determinant for U.S. bank profitability, especially taking into consideration the economic relevance of U.S. oil markets and the close linkages to the U.S. banking industry. Further research is warranted on this specific research issue, although this is nevertheless beyond the scope of the present Dissertation.

Table 9
Fixed-Effects Regressions for the farthest to Cushing, Oklahoma sample group

Variable	**1**	**2**	**3**
WTI	0.00025		
	(0.00017)		
HP		0.00008	
		(0.00014)	
NOP			0.00058
			(0.00059)
CA	-0.00118	-0.00090	-0.00092
	(0.00188)	(0.00193)	(0.00191)
MQ	-0.00719 ***	-0.00711 ***	-0.00712 ***
	(0.00039)	(0.00037)	(0.00037)
LIQ	0.00054	0.00056	0.00055
	(0.00037)	(0.00060)	(0.00038)
CPI	0.00776	0.01072	0.00782
	(0.00815)	(0.00709)	(0.00893)
GDP	0.00138	0.00231	-0.00252
	(0.00451)	(0.00460)	(0.00464)
YC	0.00114 ***	0.00108 ***	0.00105 ***
	(0.00035)	(0.00034)	(0.00032)
# of Observations	1,288	1,288	1,288
# of Banks	28	28	28
p-value of F-Test	0.0000	0.0000	0.0000
R-Squared within	0.7639	0.7628	0.7630
R-Squared between	0.6523	0.6514	0.6518
Overall R-Squared	0.7365	0.7359	0.7362

This table presents the results of the Fixed-Effects model for the farthest to Cushing, Oklahoma sample group. Column 1 presents the regression with the WTI measure, Column 2 presents the regression with the HP measure and Column 3 presents the regression with NOP measure. The macroeconomic variables CPI, GDP and YC are lagged 1 quarter. The estimated standard errors are robust for heteroscedasticity and presented in parentheses. * is significant at the 10% level, ** is significant at the 5% level and *** is significant at the 1% level.

In conclusion, by dividing the sample of banks into three different groups according to their distance to the price settlement point of West Texas Intermediate crude oil, a similar distinction is achieved to that of oil importing and exporting countries. While the oil variable coefficients are significant for the group of banks nearest to the location, which proves that oil has a direct impact on banking performance, there is no direct or indirect impact of oil for the group of banks farthest from Oklahoma (the price settlement point). This confirms the expectation that oil price shocks affect banks differently according to the relevance of petroleum in their economy, which has been previously addressed in the division of oil importing and exporting countries. That is, for U.S. banks closest to the oil industry, their profitability metrics typically improve. Furthermore, the macroeconomic variables' coefficients do not have a direct effect on the bank performance of banks with the longest distance, a surprising and unexpected finding. Further studies would have to be carried out in order to understand the reason for this specific finding and what exactly affects bank performance for this specific sub-sample of banks.

6.2. Asymmetrical Shocks hypothesis

Existing academic literature also addresses whether oil price shocks have an asymmetrical relationship with economic activity (e.g. Hamilton (1996); Cologni and Manera (2009); and Jiang and Gu (2016)). Balke et al. (2002) use a VAR approach for the US Economy and confirm the asymmetry in the effect of oil price shocks. That is, the effect of decreasing oil prices in stimulating the economy is smaller than the decreasing of economic activity due to increasing prices. The authors find that there are multiple explanations for this trend, for example financial stress caused by increasing oil prices, downward wages and prices, and pressure in the interest rates. Related to bank-specific factors, as previously noted, Al-Khazali and Mirzaei (2017) find an asymmetry in the influence of oil prices in banks' Non-Performing Loans (NPLs), more specifically negative movements of the oil price have a greater impact than positive movements.

To further investigate the asymmetry of oil price shocks on bank performance, the quarterly WTI crude oil price change is calculated. There were 22 quarters with negative WTI crude oil price change and 25 quarters with an increase in the price. Subsequently, the current sample of U.S. Banks from 2009Q1 to 2020Q3 is broken into two different subsamples: the first one composed by the quarters in which the oil price increases and the second one for the time periods with decreasing oil prices. In order to test the hypothesis of asymmetrical effects, the incremental fixed-effects model approach is used, similarly to the baseline results methodology.

Table 10
Fixed-Effects Regressions for the sample group with negative quarterly oil price change

Variable	1	2	3
WTI	0.00033 ***		
	(0.00011)		
HP		0.00041 ***	
		(0.00011)	
NOP			-0.00056
			(0.00053)
CA	0.00198	0.00232 *	0.00244 *
	(0.00128)	(0.00133)	(0.00134)
MQ	-0.00777 ***	-0.00768 ***	-0.00766 ***
	(0.00029)	(0.00028)	(0.00028)
LIQ	0.00051	0.00044	0.00049
	(0.00033)	(0.00033)	(0.00034)
CPI	0.00484	0.00431	0.01061 **
	(0.00536)	(0.00525)	(0.00522)
GDP	-0.00988 **	-0.01140 **	-0.01685 **
	(0.00494)	(0.00499)	(0.00666)
YC	0.00048 *	0.00055 **	0.00051 *
	(0.00026)	(0.00026)	(0.00026)
# of Observations	1,870	1,870	1,870
# of Banks	85	85	85
p-value of F-Test	0.0000	0.0000	0.0000
R-Squared within	0.7409	0.7402	0.7389
R-Squared between	0.6635	0.6691	0.6664
Overall R-Squared	0.7153	0.7172	0.7155

This table presents the results of the Fixed-Effects for the sample group when the quarterly oil price change is negative. Column 1 presents the regression with the WTI measure, Column 2 presents the regression with the HP measure and Column 3 presents the regression with NOP measure. The macroeconomic variables CPI, GDP and YC are lagged 1 quarter. The estimated standard errors are robust for heteroscedasticity and presented in parentheses. * is significant at the 10% level, ** is significant at the 5% level and *** is significant at the 1% level.

The results of the regressions with bank-specific and macroeconomic variables are present in Table 10 and 11, for the subsample with the negative and positive oil price change, respectively. The coefficients of the estimations with only bank-specific control variables are shown in Appendix N, O, P, Q, R, and S.

First, the WTI and HP oil variable coefficients are similar (0.00033 and 0.00041 to 0.00042 and 0.00031, respectively for WTI and HP in negative and positive changes) and remain significant at the 1% significance level. However, the Net Oil Price Increase variable is negative and not statistically significant when the oil price change is negative, while its coefficient is positive and significant at the 1% level (0.00123) when the change is positive. In essence, these findings are quite in line with the baseline results. It is also important to note that for both cases, similarly to the baseline results, the Management Quality proxy variable, the GDP and the Yield Curve continue to be significant for both subsamples, at different levels of significance.

Table 11
Fixed-Effects Regressions for the sample group with positive quarterly oil price change

Variable	**1**	**2**	**3**
WTI	0.00042 ***		
	(0.00011)		
HP		0.00031 ***	
		(0.00011)	
NOP			0.00123 ***
			(0.00042)
CA	0.00179 *	0.00214 **	0.00207 **
	(0.00100)	(0.00104)	(0.00102)
MQ	-0.0081 ***	-0.00798 ***	-0.00800 ***
	(0.00023)	(0.00021)	(0.00022)
LIQ	0.00041	0.00037	0.00037
	(0.00029)	(0.00030)	(0.00030)
CPI	0.00556	0.00675	0.00614
	(0.00611)	(0.00603)	(0.00653)
GDP	-0.00487 **	-0.00310	-0.00361 *
	(0.00201)	(0.00208)	(0.00208)
YC	0.00156 ***	0.00146 ***	0.00124 ***
	(0.00026)	(0.00024)	(0.00022)
# of Observations	2,040	2,040	2,040
# of Banks	85	85	85
p-value of F-Test	0.0000	0.0000	0.0000
R-Squared within	0.7947	0.7923	0.7928
R-Squared between	0.6620	0.6648	0.6645
Overall R-Squared	0.7566	0.7563	0.7565

This table presents the results of the Fixed-Effects for the sample group when the quarterly oil price change is positive. Column 1 presents the regression with the WTI measure, Column 2 presents the regression with the HP measure and Column 3 presents the regression with NOP measure. The macroeconomic variables CPI, GDP and YC are lagged 1 quarter. The estimated standard errors are robust for heteroscedasticity and presented in parentheses. * is significant at the 10% level, ** is significant at the 5% level and *** is significant at the 1% level.

In conclusion, while there are some expected differences in the coefficients by dividing the samples into two categories, the robustness test results generally confirm that no asymmetrical effect of oil price shocks on bank performance is observed and that the oil price shocks coefficients remain statistically significant and have similar dimensions whether the movements of oil price are positive or negative. This finding constitutes a novelty in relation to existing academic literature on the effect of oil in the economic activity. Nevertheless, further academic research on the interaction of oil price shocks and bank performance must be conducted in order to fully confirm these results, as well as the corresponding implications thereof.

7. Discussion

To sum up, it has been possible to conclude that the selected oil variables are statistically significant throughout the regressions computed and therefore, oil price movements have a noteworthy impact on U.S. banks' performance. The WTI, HP, and NOP variables are statistically significant at least at the 5% significant level, both for Fixed-Effects and SGMM panel data econometric methodologies when only bank-specific measures are present. However, after introducing the macroeconomic variables, while WTI and HP remain statistically significant and positive, the NOP determinant changes to non-significant in static and dynamic panel data methods, meaning that the effect of this variable on the Return on Assets of the sample of banks is mainly channeled through macroeconomic measures. Nevertheless, since the *p-value* of this variable is close to the 10% significance level, and the other two measures remain significant, this finding can be attributed to the idiosyncrasies of this specific variable.

Furthermore, two robustness checks of the results were conducted: one which divided the sample into three different groups, depending on the distance of their headquarters to Cushing, Oklahoma, the major hub for crude oil in the U.S.; and another robustness test to analyze the possibility of existing asymmetrical effects of oil price shocks. Findings suggest that no asymmetrical effect is observed. However, the distance to the WTI price settlement spot is significant. The sample of banks closer to Cushing, Oklahoma observes a more meaningful positive impact of oil price movements on bank performance than banks farther from this location. Besides, for the first sample, oil variant's coefficients remain significant even after the introduction of macroeconomic variables, which conform the hypothesis that oil has a direct impact on profits of banks.

These findings have multiple policy implications. First, the study indicates that bank executives must pay attention to oil price movements, since their banks' profits are dependent on them. This is particularly relevant for those U.S. banks involved with the energy markets. Throughout the past few years, as banks try to diversify their revenue sources and aim to create further non-interest income streams, the academic literature on the topic of diversification and the effect of non-interest income on banks has vastly increased. Since Calmès and Théoret (2010) and Maudos (2017) indicate that non-interest income is sensitive to economic activity, it is important for banks to closely monitor the movements in the oil market. Subsequently, banks whose headquarters are located next to Oklahoma (the main U.S. oil settlement point) observe a more pronounced effect, so the executives of these banks should be even more attentive to this important determinant to bank profitability.

Moreover, the findings of this Dissertation suggest serious implications for banking supervision. A careful focus is needed from banking supervisors when monitoring these banks, since apart from the typical macroeconomic indicators, they also must take into account oil price movements. For banks farther from Cushing, Oklahoma, since the oil shock variables effect is channeled through the economic activity, as suggested by several studies (previously mentioned Hamilton (1983); Baumeister and Peersman (2013); and Peersman and Van Robays (2012)), supervisors could use oil price movements to monitor the business cycle, since data is available on a daily basis and its access is simplified, as proposed by Hesse and Poghosyan (2016).

Aside from the banking sector, energy policymakers, when creating legislation, must contemplate the effect of their procedures on the financial sector, namely on the U.S. banking industry. Even though renewable energy policies are needed in order to maintain energetic sustainability, a possible incentive to decrease oil consumption might lead to consequences on bank performance, since oil has a positive impact on the Return on Assets of banks, especially for those banking institutions located in areas of augmented oil activity.

8. Conclusion

This Dissertation's main objective was to analyze the impact of oil price shocks on the performance of a sample of United States' banks from 2009Q1 to 2020Q3. In order to answer this question, two hypotheses are presented to understand whether oil has a direct impact or whether its effect is channeled through the U.S. economy.

Additionally, two robustness checks are performed. First, the sample of United States' banks is divided into three subsamples, conditional on their headquarters' distance to Oklahoma, Cushing (the delivery and price settlement point for West Texas Intermediate crude oil price). The goal is to fully understand whether the significance of oil in the economy of the region creates a difference in its impact on U.S. banking performance, similarly to the rationale behind the differences in oil importing and exporting countries. Furthermore, since Al-Khazali and Mirzaei (2017) found asymmetries in the oil price shocks' effect on Non-Performing Loans of banks in 30 different countries, concluding that negative oil price movements had a greater impact than positive movements, this hypothesis is tested on the profitability of banks by dividing the sample into two subsamples, one accounting for positive movements and the other for negative movements.

This study employs an incremental approach utilizing both a Fixed-Effects and a System Generalized Method of Moments model, with inputs from three different oil price shock variables, as well as several bank-specific and macroeconomic control variables. Similarly to Hesse and Poghosyan (2016), the three oil measures used are (i) the logarithm of the West Texas Intermediate crude oil price, (ii) the deviation of oil prices from their underlying trend by subtracting the logarithm of the price and the logarithm of the Hodrick-Prescott filtered price; and (iii) the Net Oil Price Increase, introduced by Hamilton (2003). Firstly, the regressions are estimated only using the oil price shock variable and bank-specific control variables and subsequently macroeconomic measures are introduced (incremental approach), to fully understand the effect of oil on bank performance. Data are obtained through Compustat Bank Fundamentals and Refinitiv's Worldscope databases.

The Dissertation's main findings indicate that oil price shocks have a positive and direct impact on bank profitability in the United States, meaning that when oil price increases, bank performance moves in the same direction, and vice-versa. These findings are observable in the Fixed-Effects model, where two out of the three variables in study are significant at the 1% level even after the introduction of macroeconomic control variables. These findings are further corroborated by the System GMM methodology, which shows similar results. Furthermore, the Robustness checks further confirm the absence of asymmetrical shocks, while demonstrating that the geography of banks' headquarters creates a difference in the magnitude of oil price shocks on bank performance. Banks headquartered in proximity to Cushing, Oklahoma observe a more notorious effect of oil shocks, than banks more distantly headquartered from this important delivery point for WTI crude oil on the NYMEX.

Thus, it is possible to conclude that oil price shocks are significant for bank performance in the United States for the period of 2009Q1 to 2020Q3. These findings have multiple implications, namely the fact that bank executives, banking supervisors, and policymakers must carefully consider and scrutinize oil price market movements, in order to be able to anticipate risks that might be created for banking institutions. Additional emphasis has to be undertaken when dealing with banks whose headquarters are located in the South and Midwest regions of the United States, thus closer to Cushing, as the results show a more noticeable impact of price movements on bank performance of these specific banks.

The academic literature on the subject of bank profitability and oil price shocks is not very expansive and while some studies (namely Hesse and Poghosyan (2016), Lee and Lee (2019) and Killins and Mollick (2020)) have been undertaken with the goal of researching the possible influence of oil price on multiple bank determinants, to the best of knowledge, this innovative Dissertation is the first research that focuses on multiple United States banks for this specific time period. Additionally, most articles related to bank profitability only employ static or dynamic panel data methodologies, whereas the present research addresses both. Due to the persistence of profits, this Dissertation focuses on these two methodologies and finds that both provide robust estimators.

Further research on this subject should contemplate investing whether this dynamic applies to larger Wall Street banks, since those have been left out of the sample due to the removal of outliers (winsorizing), as well as a possible introduction of interactive variables of oil price shocks and macroeconomic or bank-specific, in accordance with Lee and Lee (2019).

Renewable energy is growing exponentially in the United States, as its production has increased by 100% from 2000 to 2008, comprising approximately 17% percent of the U.S. electricity generation in 2018, according to the Center for Climate and Energy Solutions. However, as has been demonstrated throughout this Dissertation, oil presently still has a defining role to the banking sector and requires extraordinary attention from all stakeholders, to anticipate possible risks and dangers for the banking sector in these troubling and volatile times.

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Data Appendix

Appendix A
List of banks in the sample

#	Identifier	Name of the bank
1	AMNB	American National Bankshares, Inc.
2	ASB	Associated Banc-Corp
3	ASRV	Ameriserv Financial, Inc.
4	AUB	Atlantic Union Bankshares Corporation
5	BANF	BancFirst Corp
6	BHB	Bar Harbor Bankshares, Inc.
7	BMTC	Bryn Mawr Bank Corporation
8	BOCH	Bank of Commerce Holdings
9	BOH	Bank of Hawaii, Inc.
10	BOKF	BOK Financial Corporation
11	BPFH	Boston Private Financial Holdings, Inc.
12	BXS	BancorpSouth Bank
13	CAC	Camden National Corporation
14	CATY	Cathay General Bancorp
15	CCBG	Capital City Bank Group, Inc.
16	CCNE	CNB Financial Corporation
17	CFFI	C&F Financial Corporation
18	CFR	Cullen/Forst Bankers, Inc.
19	CIZN	Citizens Holding Corporation
20	CMA	Comerica, Inc.
21	CTBI	Community Trust Bancorp, Inc.
22	CVBF	CVB Financial Corporation
23	CVCY	Central Valley Community Bank
24	CVLY	Codorus Valley Bancorp
25	EGBN	Eagle Bancorp, Inc.
26	ENBP	ENB Financial Corporation
27	FBIZ	First Business Financial Services, Inc.
28	FCCY	1st Constitution Bancorp
29	FCF	First Commonwealth Financial Corporation
30	FCNCA	First Citizens Bancshares
31	FFIC	Flushing Financial Corporation
32	FISI	Financial Institutions, Inc.
33	FKYS	First Keystone Corporation
34	FMBH	First Mid Bancshares, Inc.
35	FMNB	Farmers National Banc Corporation
36	FNB	First National Bank Corporation
37	FNRN	First Northern Community Bancorp
38	FRME	First Merchants Corporation
39	FULT	Fulton Financial Corporation
40	GABC	German American Bancorp, Inc.
41	GBCI	Glacier Bancorp, Inc.
42	HBNC	Horizon Bancorp, Inc.
43	HOPE	Hope Bancorp, Inc.
44	HTLF	Heartland Financial USA, Inc.
45	HWBK	Hawthorn Bancshares, Inc.

46	HWC	Hancock Whitney Corporation
47	INDB	Independent Bank Corporation
48	ISBA	Isabella Bank Corporation
49	LARK	Landmark Bancorp, Inc.
50	LCNB	LCNB Corporation
51	LKFN	Lakeland Financial Corporation
52	NBTB	NBT Bancorp Inc.
53	NWBI	Northwest Bancshares, Inc.
54	ONB	Old National Bancorp
55	OPOF	Old Point Financial Corporation
56	PBCT	People's United Financial, Inc.
57	PEBK	Peoples Bancorp of North Carolina, Inc.
58	PEBO	People's Bancorp, Inc./Ohio
59	PFLC	Pacific Financial Corporation
60	PGC	Peapack-Gladstone Financial Corporation
61	PRK	Park National Corporation
62	PWOD	Penns Woods Bancorp, Inc.
63	QNBC	QNB Corporation
64	RNST	Renasant Corporation
65	SASR	Sandy Spring Bancorp, Inc.
66	SBNY	Signature Bank/NY
67	SBSI	Southside Banchsares, Inc.
68	SFNC	Simmons First National Corporation
69	SFST	Southern First Bancshares
70	SRCE	1st Source Corporation
71	STBA	S&T Bancorp, Inc.
72	SYBT	Stock Yards Bancorp, Inc.
73	TCBK	Trico Bancshares
74	THFF	First Financial Corporation
75	TOWN	Townebank
76	TRMK	Trustmark Corporation
77	TRST	Trustco Bank Corporation
78	UBSI	United Bankshares, Inc.
79	UMBF	UMB Financial Corporation
80	UVSP	Univest Financial Corporation
81	VLY	Valley National Bancorp
82	WASH	Washington Trust Bancorp, Inc.
83	WBS	Webster Financial Corporation
84	WSBC	Wesbanco, Inc.
85	WTFC	Wintrust Financial Corporation

Appendix B
Harris-Tzavalis unit-root test results

Variable	Z	*p-value*
ROA	-60.6608	0.0000
WTI	-7.9394	0.0000
HP	-34.6907	0.0000
NOP	-41.9944	0.0000
CA	-12.6302	0.0000
MQ	-50.0527	0.0000
LIQ	-7.90580	0.0000
CPI	-120.0000	0.0000
GDP	-200.0000	0.0000
YC	-130.0000	0.0000

Appendix C
Im-Pesaran-Shin unit-root test results

Variable	Z	*p-value*
ROA	-22.5702	0.0000
WTI	-1.5827	0.0567
HP	-15.7253	0.0000
NOP	-21.4571	0.0000
CA	-6.7378	0.0000
MQ	-19.8898	0.0000
LIQ	-5.93020	0.0000
CPI	-35.8003	0.0000
GDP	-44.3769	0.0000
YC	-37.6897	0.0000

Appendix D
Variance Inflation Factor results

Variable	WTI	HP	NOP
WTI	1.21		
HP		1.36	
NOP			1.03
CA	1.16	1.15	1.15
MQ	1.04	1.00	1.01
LIQ	1.15	1.15	1.15
CPI	1.46	1.65	1.38
GDP	1.35	1.35	1.35
YC	1.02	1.02	1.02

Appendix E

Fixed-Effects Regressions for the nearest to Cushing, Oklahoma sample group with the WTI oil measure

Variable	**1**	**2**
WTI	0.00032 *	0.00045 ***
	(0.00016)	(0.00016)
CA	0.003644 ***	0.00354 ***
	(0.00114)	(0.00118)
MQ	--0.00835 ***	-0.00836 ***
	(0.00026)	(0.00027)
LIQ	0.00102 *	0.00092
	(0.00059)	(0.00059)
CPI		0.01479 ***
		(0.00534)
GDP		-0.00961 ***
		(0.00219)
YC		0.00111 ***
		(0.00027)
# of Observations	1,363	1,334
# of Banks	29	29
p-value of F-Test	0.0000	0.0000
R-Squared within	0.7934	0.7958
R-Squared between	0.6853	0.6946
Overall R-Squared	0.7659	0.7697

This table presents the results for the sample group of banks nearest to Cushing, Oklahoma with the oil measure WTI and control variables on bank profitability measured by ROA. The macroeconomic variables CPI, GDP and YC are lagged 1 quarter. The estimated standard errors are robust for heteroscedasticity and presented in parentheses. Column 1 reports only the oil and bank-specific variables, while macroeconomic control variables are introduced in Column 2. * is significant at the 10% level, ** is significant at the 5% level and *** is significant at the 1% level.

Appendix F

Fixed-Effects Regressions for the nearest to Cushing, Oklahoma sample group with the HP oil measure

Variable	**1**	**2**
HP	0.00044 ***	0.00061 ***
	(0.00015)	(0.00015)
CA	0.00394 ***	0.00394 ***
	(0.00112)	(0.00115)
MQ	--0.00827 ***	-0.00824 ***
	(0.00026)	(0.00027)
LIQ	0.00095	0.00083
	(0.00059)	(0.00060)
CPI		0.01167 **
		(0.00563)
GDP		-0.00794 ***
		(0.00236)
YC		0.00118 ***
		(0.00025)
# of Observations	1,363	1,334
# of Banks	29	29
p-value of F-Test	0.0000	0.0000
R-Squared within	0.7930	0.7950
R-Squared between	0.6971	0.7101
Overall R-Squared	0.7689	0.7733

This table presents the results for the sample group of banks nearest to Cushing, Oklahoma with the oil measure HP and control variables on bank profitability measured by ROA. The macroeconomic variables CPI, GDP and YC are lagged 1 quarter. The estimated standard errors are robust for heteroscedasticity and presented in parentheses. Column 1 reports only the oil and bank-specific variables, while macroeconomic control variables are introduced in Column 2. * is significant at the 10% level, ** is significant at the 5% level and *** is significant at the 1% level.

Appendix G

Fixed-Effects Regressions for the nearest to Cushing, Oklahoma sample group with the NOP oil measure

Variable	**1**	**2**
NOP	0.00109 ***	0.00106 *
	(0.00039)	(0.00056)
CA	0.00398 ***	0.00411 ***
	(0.00109)	(0.00111)
MQ	-0.00830 ***	-0.00826 ***
	(0.00026)	(0.00027)
LIQ	0.00091	0.00086
	(0.00061)	(0.00061)
CPI		0.01456 **
		(0.00639)
GDP		-0.00758 ***
		(0.00250)
YC		0.00095 ***
		(0.00025)
# of Observations	1,363	1,334
# of Banks	29	29
p-value of F-Test	0.0000	0.0000
R-Squared within	0.7926	0.7928
R-Squared between	0.7039	0.7087
Overall R-Squared	0.7702	0.7713

This table presents the results for the sample group of banks nearest to Cushing, Oklahoma with the oil measure NOP and control variables on bank profitability measured by ROA. The macroeconomic variables CPI, GDP and YC are lagged 1 quarter. The estimated standard errors are robust for heteroscedasticity and presented in parentheses. Column 1 reports only the oil and bank-specific variables, while macroeconomic control variables are introduced in Column 2. * is significant at the 10% level, ** is significant at the 5% level and *** is significant at the 1% level.

Appendix H

Fixed-Effects Regressions for middle distance to Cushing, Oklahoma sample group with the WTI oil measure

Variable	**1**	**2**
WTI	0.00015	0.00030 *
	(0.00039)	(0.00015)
CA	0.00339 *	0.00341 **
	(0.00168)	(0.00158)
MQ	-0.00854 ***	-0.00859 ***
	(0.00024)	(0.00026)
LIQ	-0.00009	-0.00010
	(0.00046)	(0.00045)
CPI		0.00510
		(0.00695)
GDP		-0.00736 ***
		(0.00166)
YC		0.00133 ***
		(0.00025)
# of Observations	1,316	1,288
# of Banks	28	28
p-value of F-Test	0.0000	0.0000
R-Squared within	0.7715	0.7711
R-Squared between	0.7708	0.7683
Overall R-Squared	0.7671	0.7657

This table presents the results for the sample with middle distance to Cushing, Oklahoma with the oil measure WTI and control variables on bank profitability measured by ROA. The macroeconomic variables CPI, GDP and YC are lagged 1 quarter. The estimated standard errors are robust for heteroscedasticity and presented in parentheses. Column 1 reports only the oil and bank-specific variables, while macroeconomic control variables are introduced in Column 2. * is significant at the 10% level, ** is significant at the 5% level and *** is significant at the 1% level.

Appendix I

Fixed-Effects Regressions for middle distance to Cushing, Oklahoma sample group with the HP oil measure

Variable	**1**	**2**
HP	0.00003	0.00020 *
	(0.00010)	(0.00010)
CA	0.00356 *	0.00365 **
	(0.00180)	(0.00177)
MQ	-0.00849 ***	-0.00850 ***
	(0.00023)	(0.00024)
LIQ	-0.00015	-0.00020
	(0.00048)	(0.00048)
CPI		0.00678
		(0.00605)
GDP		-0.00635 ***
		(0.00181)
YC		0.00129 ***
		(0.00024)
# of Observations	1,316	1,288
# of Banks	28	28
p-value of F-Test	0.0000	0.0000
R-Squared within	0.7710	0.7696
R-Squared between	0.7723	0.7671
Overall R-Squared	0.7676	0.7662

This table presents the results for the sample with middle distance to Cushing, Oklahoma with the oil measure HP and control variables on bank profitability measured by ROA. The macroeconomic variables CPI, GDP and YC are lagged 1 quarter. The estimated standard errors are robust for heteroscedasticity and presented in parentheses. Column 1 reports only the oil and bank-specific variables, while macroeconomic control variables are introduced in Column 2. * is significant at the 10% level, ** is significant at the 5% level and *** is significant at the 1% level.

Appendix J

Fixed-Effects Regressions for middle distance to Cushing, Oklahoma sample group with the NOP oil measure

Variable	**1**	**2**
NOP	0.000021	-0.00001
	(0.00031)	(0.00049)
CA	0.00356 *	0.00370 **
	(0.00177)	(0.00180)
MQ	-0.00850 ***	-0.00850 ***
	(0.00024)	(0.00025)
LIQ	-0.00015	-0.00020
	(0.00048)	(0.00049)
CPI		0.01038
		(0.00755)
GDP		-0.00639 ***
		(0.00194)
YC		0.00122 ***
		(0.00022)
# of Observations	1,316	1,288
# of Banks	28	28
p-value of F-Test	0.0000	0.0000
R-Squared within	0.7710	0.7693
R-Squared between	0.7724	0.707
Overall R-Squared	0.7677	0.7660

This table presents the results for the sample with middle distance to Cushing, Oklahoma with the oil measure NOP and control variables on bank profitability measured by ROA. The macroeconomic variables CPI, GDP and YC are lagged 1 quarter. The estimated standard errors are robust for heteroscedasticity and presented in parentheses. Column 1 reports only the oil and bank-specific variables, while macroeconomic control variables are introduced in Column 2. * is significant at the 10% level, ** is significant at the 5% level and *** is significant at the 1% level.

Appendix K

Fixed-Effects Regressions for the farthest to Cushing, Oklahoma sample group with the WTI oil measure

Variable	**1**	**2**
WTI	0.00026	0.00025
	(0.00016)	(0.00017)
CA	-0.00131	-0.00118
	(0.00181)	(0.00188)
MQ	-0.0072 ***	-0.0072 ***
	(0.00039)	(0.00039)
LIQ	0.000523	0.00054
	(0.00037)	(0.00037)
CPI		0.00776
		(0.00815)
GDP		0.00138
		(0.00068)
YC		0.00114 ***
		(0.00035)
# of Observations	1,316	1,288
# of Banks	28	28
p-value of F-Test	0.0000	0.0000
R-Squared within	0.7614	0.7639
R-Squared between	0.6510	0.6523
Overall R-Squared	0.7344	0.7365

This table presents the results for the sample group of banks farthest to Cushing, Oklahoma with the oil measure WTI and control variables on bank profitability measured by ROA. The macroeconomic variables CPI, GDP and YC are lagged 1 quarter. The estimated standard errors are robust for heteroscedasticity and presented in parentheses. Column 1 reports only the oil and bank-specific variables, while macroeconomic control variables are introduced in Column 2. * is significant at the 10% level, ** is significant at the 5% level and *** is significant at the 1% level.

Appendix L

Fixed-Effects Regressions for the farthest to Cushing, Oklahoma sample group with the HP oil measure

Variable	**1**	**2**
HP	0.00008	0.00008
	(0.00013)	(0.00014)
CA	-0.00106	-0.00090
	(0.00188)	(0.00193)
MQ	-0.00712 ***	-0.00711 ***
	(0.00037)	(0.0037)
LIQ	0.00053	0.00056
	(0.00038)	(0.00038)
CPI		0.01072
		(0.00709)
GDP		0.00231
		(0.00460)
YC		0.00108 ***
		(0.00034)
# of Observations	1,316	1,288
# of Banks	28	28
p-value of F-Test	0.0000	0.0000
R-Squared within	0.7601	0.7628
R-Squared between	0.6507	0.6514
Overall R-Squared	0.7338	0.7359

This table presents the results for the sample group of banks farthest to Cushing, Oklahoma with the oil measure HP and control variables on bank profitability measured by ROA. The macroeconomic variables CPI, GDP and YC are lagged 1 quarter. The estimated standard errors are robust for heteroscedasticity and presented in parentheses. Column 1 reports only the oil and bank-specific variables, while macroeconomic control variables are introduced in Column 2. * is significant at the 10% level, ** is significant at the 5% level and *** is significant at the 1% level.

Appendix M

Fixed-Effects Regressions for the farthest to Cushing, Oklahoma sample group with the NOP oil measure

Variable	**1**	**2**
NOP	0.00067	0.00006
	(0.00047)	(0.00059)
CA	-0.00105	-0.00092
	(0.00185)	(0.00191)
MQ	-0.00713 ***	-0.00712 ***
	(0.00037)	(0.00037)
LIQ	0.00051	0.00055
	(0.00038)	(0.00038)
CPI		0.00782
		(0.00893)
GDP		0.00252
		(0.00464)
YC		0.00105 ***
		(0.00032)
# of Observations	1,316	1,288
# of Banks	28	28
p-value of F-Test	0.0000	0.0000
R-Squared within	0.7606	0.7630
R-Squared between	0.6519	0.6518
Overall R-Squared	0.7343	0.7362

This table presents the results for the sample group of banks farthest to Cushing, Oklahoma with the oil measure NOP and control variables on bank profitability measured by ROA. The macroeconomic variables CPI, GDP and YC are lagged 1 quarter. The estimated standard errors are robust for heteroscedasticity and presented in parentheses. Column 1 reports only the oil and bank-specific variables, while macroeconomic control variables are introduced in Column 2. * is significant at the 10% level, ** is significant at the 5% level and *** is significant at the 1% level.

Appendix N

Fixed-Effects Regressions for sample group with negative quarterly oil price movements with the WTI oil measure

Variable	**1**	**2**
WTI	0.00036 ***	0.00033 ***
	(0.00011)	(0.00011)
CA	0.00200	0.00198
	(0.00129)	(0.00128)
MQ	-0.00778 ***	-0.00777 ***
	(0.00029)	(0.00029)
LIQ	0.00059	0.00051
	(0.00033)	(0.00033)
CPI		0.00484
		(0.00536)
GDP		-0.00988 **
		(0.00494)
YC		0.00048 *
		(0.00026)
# of Observations	1,870	1,870
# of Banks	85	85
p-value of F-Test	0.000	0.0000
R-Squared within	0.7402	0.7409
R-Squared between	0.6639	0.6635
Overall R-Squared	0.7149	0.7153

This table presents the results for the sample group of periods with negative quarterly oil price movements with the oil measure WTI and control variables on bank profitability measured by ROA. The macroeconomic variables CPI, GDP and YC are lagged 1 quarter. The estimated standard errors are robust for heteroscedasticity and presented in parentheses. Column 1 reports only the oil and bank-specific variables, while macroeconomic control variables are introduced in Column 2. * is significant at the 10% level, ** is significant at the 5% level and *** is significant at the 1% level.

Appendix O

Fixed-Effects Regressions for sample group with negative quarterly oil price movements with the HP oil measure

Variable	**1**	**2**
HP	0.00045 ***	0.00041 ***
	(0.00011)	(0.00011)
CA	0.00238 *	0.00232 *
	(0.00134)	(0.00133)
MQ	-0.00768 ***	-0.00768 ***
	(0.00028)	(0.00028)
LIQ	0.00042	0.00044
	(0.00033)	(0.00033)
CPI		0.00431
		(0.00525)
GDP		-0.01140 **
		(0.00499)
YC		0.00055 **
		(0.00026)
# of Observations	1,870	1,870
# of Banks	85	85
p-value of F-Test	0.0000	0.0000
R-Squared within	0.7394	0.7402
R-Squared between	0.6703	0.6691
Overall R-Squared	0.7170	0.7172

This table presents the results for the sample group of periods with negative quarterly oil price movements with the oil measure HP and control variables on bank profitability measured by ROA. The macroeconomic variables CPI, GDP and YC are lagged 1 quarter. The estimated standard errors are robust for heteroscedasticity and presented in parentheses. Column 1 reports only the oil and bank-specific variables, while macroeconomic control variables are introduced in Column 2. * is significant at the 10% level, ** is significant at the 5% level and *** is significant at the 1% level.

Appendix P

Fixed-Effects Regressions for sample group with negative quarterly oil price movements with the NOP oil measure

Variable	**1**	**2**
NOP	-0.00002	-0.00056
	(0.00041)	(0.00053)
CA	0.00251 *	0.00244 *
	(0.00135)	(0.00134)
MQ	-0.00767 ***	-0.00766 ***
	(0.00028)	(0.00028)
LIQ	0.00046	0.00049
	(0.00034)	(0.00034)
CPI		0.01061 **
		(0.00522)
GDP		-0.01685 **
		(0.00666)
YC		0.00051 *
		(0.00026)
# of Observations	1,870	1,870
# of Banks	85	85
p-value of F-Test	0.0000	0.0000
R-Squared within	0.7374	0.7389
R-Squared between	0.6682	0.6664
Overall R-Squared	0.7150	0.7155

This table presents the results for the sample group of periods with negative quarterly oil price movements with the oil measure NOP and control variables on bank profitability measured by ROA. The macroeconomic variables CPI, GDP and YC are lagged 1 quarter. The estimated standard errors are robust for heteroscedasticity and presented in parentheses. Column 1 reports only the oil and bank-specific variables, while macroeconomic control variables are introduced in Column 2. * is significant at the 10% level, ** is significant at the 5% level and *** is significant at the 1% level.

Appendix Q

Fixed-Effects Regressions for sample group with positive quarterly oil price movements with the WTI oil measure

Variable	**1**	**2**
WTI	0.00024 **	0.00042 ***
	(0.00010)	(0.00011)
CA	0.00173 *	0.00179 *
	(0.00100)	(0.00100)
MQ	-0.00807 ***	-0.0081 ***
	(0.00021)	(0.00023)
LIQ	0.00048	0.00041
	(0.00029)	(0.00029)
CPI		0.00556
		(0.00611)
GDP		-0.00487 **
		(0.00201)
YC		0.00156 ***
		(0.00026)
# of Observations	2,125	2,040
# of Banks	85	85
p-value of F-Test	0.000	0.0000
R-Squared within	0.7930	0.7947
R-Squared between	0.6630	0.6620
Overall R-Squared	0.7558	0.7566

This table presents the results for the sample group of periods with positive quarterly oil price movements with the oil measure WTI and control variables on bank profitability measured by ROA. The macroeconomic variables CPI, GDP and YC are lagged 1 quarter. The estimated standard errors are robust for heteroscedasticity and presented in parentheses. Column 1 reports only the oil and bank-specific variables, while macroeconomic control variables are introduced in Column 2. * is significant at the 10% level, ** is significant at the 5% level and *** is significant at the 1% level.

Appendix R

Fixed-Effects Regressions for sample group with positive quarterly oil price movements with the HP oil measure

Variable	**1**	**2**
HP	0.00013	0.00031 ***
	(0.00009)	(0.00011)
CA	0.00197 *	0.00214 **
	(0.00103)	(0.00104)
MQ	-0.00800 ***	-0.00798 ***
	(0.00021)	(0.00021)
LIQ	0.00044	0.00037
	(0.00030)	(0.00030)
CPI		0.00675
		(0.00603)
GDP		-0.00310
		(0.00208)
YC		0.00146 ***
		(0.00024)
# of Observations	2,125	2,040
# of Banks	85	85
p-value of F-Test	0.0000	0.0000
R-Squared within	0.7918	0.7923
R-Squared between	0.6657	0.6648
Overall R-Squared	0.7561	0.7563

This table presents the results for the sample group of periods with positive quarterly oil price movements with the oil measure HP and control variables on bank profitability measured by ROA. The macroeconomic variables CPI, GDP and YC are lagged 1 quarter. The estimated standard errors are robust for heteroscedasticity and presented in parentheses. Column 1 reports only the oil and bank-specific variables, while macroeconomic control variables are introduced in Column 2. * is significant at the 10% level, ** is significant at the 5% level and *** is significant at the 1% level.

Appendix S

Fixed-Effects Regressions for sample group with positive quarterly oil price movements with the NOP oil measure

Variable	**1**	**2**
NOP	0.00098 ***	0.00123 ***
	(0.00025)	(0.00042)
CA	0.00189 *	0.00207 **
	(0.00100)	(0.00102)
MQ	-0.00804 ***	-0.00800 ***
	(0.00021)	(0.00022)
LIQ	0.00041	0.00037
	(0.00030)	(0.00030)
CPI		0.00614
		(0.00653)
GDP		-0.00361 *
		(0.00208)
YC		0.00124 ***
		(0.00022)
# of Observations	2,125	2,040
# of Banks	85	85
p-value of F-Test	0.0000	0.0000
R-Squared within	0.7930	0.7928
R-Squared between	0.6674	0.6645
Overall R-Squared	0.7573	0.7565

This table presents the results for the sample group of periods with positive quarterly oil price movements with the oil measure NOP and control variables on bank profitability measured by ROA. The macroeconomic variables CPI, GDP and YC are lagged 1 quarter. The estimated standard errors are robust for heteroscedasticity and presented in parentheses. Column 1 reports only the oil and bank-specific variables, while macroeconomic control variables are introduced in Column 2. * is significant at the 10% level, ** is significant at the 5% level and *** is significant at the 1% level.