
Financial instability and oil price fluctuations: evidence from oil exporting developing countries

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Abstract

How financial market stability in oil exporting developing countries might be impacted by oil price fluctuations in the long term? The purpose of this paper is to answer this question. The present study is based on a sample including 35 net oil-exporting developing countries observed between 1987 and 2011. It mainly evidences that an increase in the world oil price can be advantageous for the domestic banking sector through reducing its fragility, measured by the likelihood of systemic banking crisis. To highlight this result, we estimate three logistic prediction crisis models: the random-effects logistic model, the conditional fixed-effects logistic model and the logistic population-averaged process with robust errors. Additionally, we examine the robustness of these estimations considering the changing of interest and control variables and the sub-periods of crises. Our results show that an increase in the oil prices improve the stability of oil exporting financial markets and reduce the occurrence of their systemic banking crisis.

JEL classification: Q43, E44, G15, C1

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1. Introduction

The nature of the link between oil price changes and stock market returns has been the subject of several studies. The results of these studies are mixed and conflicting. For example, Jones and Kaul (1996) find a significant negative relationship between oil price increases and stock market returns while the studies of Chen et al. (1986) and Huang et al. (1996) find no significant impact of oil price on stock returns. Furthermore, Diesprong et al. (2008) showed that oil price volatility helps forecasting stock returns. In a recent study, Narayan and Sharma (2011) find that oil prices have a different impact on firms' returns depending on their sectorial location. The authors detect also a strong evidence of lagged oil prices impact on firms' returns. This conflict in the results may be explained by the dissimilarities in the methodological approaches, the variety of the data applied and the period explored. It can be also attributed to the global oil shocks and the poor prediction tools used in the forecasting accuracy of stock price movement.

Some studies including those conducted by Kilian (2009), and Peersman and Van Robays (2009) assume that an oil price shock can be broken down into three different components: oil

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supply shocks, oil demand shocks driven by the global economic activity and oil specific demand shocks. These authors consider that the effect of oil price volatility can be explained through profound and separate analysis of these three types of price shocks.

Miller and Ratti (2009) examined the relationship between crude oil prices and stock markets returns while considering the role of stock market bubbles as well as oil price bubbles. Their empirical exercise indicated that both variables have cointegration and real oil price shocks inversely affect real stock return in the presence of bubbles. In the same vein, Apergis and Miller (2009) investigate the relationship between structural oil price shocks and stock prices for Australia, Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States. They documented that stock market returns are significantly affected by oil-supply shocks, aggregate-global-demand shocks as well as idiosyncratic-demand shocks. Basher et al. (2012) considered the role of exchange rates while examining the relationship between stock market prices and oil prices by applying the structural VAR model. Their empirical results show that production in oil is negatively linked with oil prices but economic activity leads to oil demand which raises oil prices. They also noted that a rise in stock market prices is aligned with oil price rise. Ciner et al. (2013) examined the association between stocks, bonds, gold, oil and exchange rates for the US and UK economies for the period of 1990-2010. Their empirical results indicated that investment in gold can be safe-hedge against exchange rate compared to stock, bond and oil markets in both economies.

Filis and Chatziantoniou (2014) applied the structural VAR model to examine the effect of oil price shocks on financial and monetary policies for oil-importing and oil-exporting economies using monthly data for the period of 1991-2010. They found that oil price shocks significantly affect inflation and that the interest rate is affected through the monetary policy regime for each sampled economy. Their analysis also reported that stock market returns are inversely and strongly affected by oil price shocks. Wang and McPhail (2014) examined the impacts of energy price shocks on U.S. agricultural productivity growth and volatility of commodity prices covering the period of 1948-2011. Their results showed that energy price shocks have a negative impact on productivity growth in the short run and the impact from energy prices outweighs the contribution of agricultural productivity in the medium-term. Olson et al. (2014) probed the relationship between equity markets by using multivariate BEKK model developed by Hafner and Herwartz's (2006). Based on the volatility impulse response function, they documented that energy prices' volatility increases due to low equity market returns but the response is weak from equity returns to energy prices. Sadorsky (2014) applied the VARMA-AGARCH and DCCAGARCH models to investigate the correlation between equity market

prices and energy prices such as copper, oil and wheat prices. The empirical analysis revealed that investment in oil-and-wheat prices can be the cheapest hedge compared to investment in copper market.

Hammoudeh et al. (2014) investigated the dependence between commodity future markets and stock markets by applying the copula functions. They found that dependence exists between both markets. This suggested for investing in commodity-and-stock markets by diversifying the investment portfolio in the Chinese economy except investment in stocks, grain futures as well as soft commodity futures. Chen et al. (2014) investigated the impact of financial shocks on oil price shocks and the macro-economy using structural VAR by extending the Kilian's (2009) framework. Their empirical results indicated that positive financial shocks have inverse impact on oil price shocks with high explanatory power. The financial shocks not only determined aggregate demand but the linkage between aggregate demand shock and stock prices varies over the time period. Broadstock et al. (2014) examined the linkage between oil prices and energy stocks by applying the asset pricing model. They documented that oil price shocks directly affect energy stocks but indirectly via general market risk. Kang et al. (2015) applied the variance decomposition and impulse response function i.e. structural VAR model to examine the relationship between oil prices, stock prices and stock price volatility using the US economy daily data for the period of 1973_{M1}-2013_{M12}. They found that positive aggregate global demand negatively affects the correlation between stock returns and stock volatility. Their empirical analysis also reported that global oil production has a positive effect on the covariance between stock returns and stock volatility. More recently, Hammoudeh et al. (2015) applied the SVAR model to study the effects of shocks in the monetary policy of the United States on groups of commodity prices. The authors considered both commodity price and the price indices of different sub-sets or sectors of commodities. The empirical framework permits to consider the structural shocks to monetary policy, captured by unexpected variations in the federal funds rate, and then to quantify the effects of these shocks on the various commodity sector prices and the economic activity.

Furthermore, in order to investigate the impact of oil price fluctuations on financial instability in net oil exporting developing countries, in this present study, we build a sample based on unbalanced panel data from 35 net oil exporting developing countries during the period 1987-2011. By doing that, we cover the longest period ever studied compared to recent literature on the determinants of banking crisis, namely Joyce (2011), Hamdi and Boukef Jlassi (2014), Lee, Lin and Zeng (2016) and Boukef Jlassi, Hamdi and Joyce (2018). Also, in sum, these analyses focused on the impact of financial globalization on the occurrence of banking crises in emerging and developing countries. They prove that the effect of foreign capital flows on the

financial instability depends on their nature. As regards this work, the present paper adds a new dimension to these studies that have not integrated oil price fluctuations in their investigations. It also goes one step further than the existing energy finance literature analyzed above because it examines two phenomena rarely conjointly investigated empirically, namely oil price fluctuation and the occurrence of banking crises in the case of oil exporting developing countries.

The remaining of this paper is organized as follows. The second section presents the econometric methodology. The third one discusses the data and the empirical findings. The last one concludes and points to some directions for future research.

2. Econometric Methodology

According to Joyce (2011), Hamdi and Boukef Jlassi (2014) and Boukef Jlassi, Hamdi and Joyce (2018), we used panel logit models to study the determinants of financial fragility, measured by systemic banking crisis. In order to go a step further than these authors, we estimated three logistic crisis prediction models, namely the random-effects logistic model, the conditional fixed-effects logistic model and the logistic population-averaged model with robust errors¹, knowing that these previous studies used only one estimator for their baseline estimates. In addition, in line with this literature, we measured the probability of occurrence of crises through a dummy variable of systemic banking crisis (*BANKCRISIS*). *BANKCRISIS* takes the value of (1) if country *i* in period *t* experiences a systemic banking crisis (financial market fragility) and (0) otherwise. *BANKCRISIS* is explained by oil price variables (*OILP*) and a set of control variables² (*K*) as wrote in the following equation:

$$Z_{it} = \lambda_1 OILP_{it} + \varphi' K_{it-1} + v_{it} \quad (1)$$

Z_{it} indicates whether country *i* experienced a systemic banking crisis (financial market fragility) during the year *t*. $OILP_{it}$ represents the oil price variables. K_{it} regroups the set of control variables. v_{it} is the error term. $i = 1 \dots N$ countries and $t = 1 \dots T$ years. If the economy of country *i* endured a systemic banking crisis (financial market fragility) in the year *t*, $Z_{it} > 0$. Hence,

¹ By referring to Davidson and MacKinnon (1984), Archer and Lemeshow (2006) and Greene (2012), two values should be verified to improve the validity of the panel logit estimations, namely the value of the Wald Test and that of Log-Pseudolikelihood Statistic or Log-Likelihood Statistic. These values confirm the validity of all our estimations at 5% level as reported in the baseline estimates and robustness tests.

² For the descriptive statistics and the correlation matrix of the variables, see Tables A and B in appendix.

$$BANKCRISI = \begin{cases} 1, & Z_{it} > 0 \\ 0, & \text{otherwise} \end{cases} \quad (2)$$

In addition, the probability P that the country i endures a systemic banking crisis in the year t is as follows:

$$P(BANKCRISIS = 1) = P(Z_{it} > 0) = F(\lambda_1 OILP_{it} + \varphi'K_{it-1}) \quad (3)$$

and

$$F(\lambda_1 OILP_{it} + \varphi'K_{it-1}) = \frac{\exp(\lambda_1 OILP_{it} + \varphi'K_{it-1})}{1 + \exp(\lambda_1 OILP_{it} + \varphi'K_{it-1})} \quad (4)$$

Where, F is the log partition function.

Consequently, the probability P that the country i does not endure a systemic banking crisis in the year t is as follows:

$$P(BANKCRISIS = 0) = 1 - P(BANKCRISIS = 1) = 1 - \frac{\exp(\lambda_1 OILP_{it} + \varphi'K_{it-1})}{1 + \exp(\lambda_1 OILP_{it} + \varphi'K_{it-1})} \quad (5)$$

3. Data and Results

To examine the impact of oil price fluctuations on financial market stability in net oil exporting developing countries, we constitute a sample based on unbalanced panel³ data from 35 net oil exporting developing countries covering the period 1987-2011. By referring to Loayza and Rancière (2006) and Gaies et al. (2018), we measure financial stability through the systemic banking crisis dummy variable extracted from the Systemic Banking Crises Database⁴.

The sample⁵ is constituted in two steps. First, we define a list of developing countries, which are characterized by low- and middle-income, in accordance with the classification of the World Bank. Second, in this first list, we maintain only the countries, which are net oil exporters, by referring to the CIA World Factbook list. We deleted higher average income and higher income net oil exporting countries, as Saudi Arabia, Kuwait and United Arab Emirates, because those ones are characterized by a higher level of economic, institutional and financial

³ Due to this, the number of observations varies in the baseline estimates and robustness tests, particularly in the conditional fixed-effects logistic model, which captures the positive probability of crises occurrence.

⁴ The last updated of this database was effectuated in 2012. For this reason, our study comprises the period 1987-2011. That is the same case for recent work on the determinants of banking crisis (e.g., see, Boukef Jlassi, Hamdi and Joyce, 2018).

⁵ For the list of countries, see Table C in appendix.

development than other developing countries. Also, we opted for the study of low- and middle-income net oil exporting developing countries because the latter are relatively neglected among the literature related to energy and finance, which usually is focused on the case of higher average income and higher income developing countries and the biggest oil exporting countries.

Moreover, the real oil price fluctuation is measured by $ROILP_{WTI}$, that is Spot Price FOB (Dollars per Barrel), adjusted to inflation (Index 1982-1984 = 1) and without seasonality (log-difference), and $ROILP_{Brent}$, that is the Europe Brent Spot Price FOB (Dollars per Barrel) adjusted to inflation (Index 1982-1984 = 1) and without seasonality (expressed in log-difference). These indicators are annual and extracted from the oil price database of the U.S. Energy Information Administration (EIA). We chose these indicators because they serve as a major reference for the world oil price fluctuation.

Furthermore, based on the large literature review related to the determinants of financial crisis done by Claessens and Kose (2013), as well as the recent studies on this subject (see, e.g., Joyce, 2011; Hamdi and Boukef Jlassi, 2014; Lee et al., 2016; Boukef Jlassi, Hamdi and Joyce, 2018), we explain the systemic banking crisis through seven control variables. Also, according to this literature, all of the control variables are one period lagged – unlike the interest variable which is contemporary – because this choice obviates the endogeneity and collinearity problems, as is supported by Caballero (2016). The baseline control variables are as follows:

Variable	Description	Expected impact	Source
<i>GROWTH:</i>	GDP growth (annual %)	Negative impact, according to Joyce (2011), Hamdi and Boukef Jlassi (2014), Lee et al. (2016) and Boukef Jlassi, Hamdi and Joyce (2018). <i>GROWTH</i> is an indicator of economic prosperity.	WDI ⁶ .
<i>M2/RES:</i>	Money and quasi money (M2) to total reserves ratio	Positive impact, according to Joyce (2011), Claessens and Kose (2013), Hamdi and Boukef Jlassi (2014), Lee et al. (2016) and Boukef Jlassi, Hamdi and Joyce (2018). <i>M2/RES</i> reflects the vulnerability of the economy to the risk of sudden stop.	WDI.
<i>PRIVCLAIM:</i>	Growth of claims on private sector to GDP	Positive impact, according to Hamdi and Boukef Jlassi (2014) and Claessens and Kose (2013). <i>PRIVCLAIM</i> reflects the vulnerability of the economy to the risk of private sector default.	WDI.
<i>LIFE:</i>	Life expectancy at birth, total years	Negative impact, according to Lee et al. (2016). <i>LIFE</i> is an indicator of human capital quality (Barro (2001)).	WDI.
<i>PRIVCRED:</i>	Domestic credit to private sector (% of GDP)	Positive impact, according to Reinhart and Rogoff (2013) and Davis, Mack, Phoa, and Vandenabeele (2016). <i>PRIVCRED</i> indicates the vulnerability of the economy to the risk of credit boom.	WDI.
<i>LIBtrad</i>	De facto KOF trade globalization Index	Negative impact, according to Joyce (2011) and Hamdi and Boukef Jlassi (2014) and Boukef Jlassi, Hamdi and Joyce (2018). <i>LIBtrad</i> indicates the foreign trade liberalization.	KOF. ⁷
<i>LIBfin</i>	De facto KOF financial globalization Index	Positive impact, according to Caballero (2015). <i>LIBfin</i> indicates the external financial liberalization.	KOF.

⁶ World Development Indicators.

⁷ KOF Globalisation Index.

Table 1 below reports the results of our baseline estimates. It shows that financial instability, measured by the occurrence of systemic banking crisis, decreases with higher level of production, foreign trade and human capital quality, based on the negativity and significance of the coefficients of *GROW*, *LIBtrad* and *LIFE*. Conversely, financial markets endure more crises with higher level of the risks of private sector default and credit boom, as well as in the context of wide spread financial liberalization. These results are deduced from the positivity and significance of the coefficients of *PRIVCLAIM*, *PRIVCRED* and *LIBfin*.

In addition, the coefficients of the indicators of oil price fluctuation, namely *ROILP_{WTI}* and *ROILP_{Brent}*, are significant and negative at the 1% level in all regressions ran by the random-effects logistic estimator, the conditional fixed-effects logistic estimator and the logistic population-averaged estimator with robust errors, as shown in Table 1. This leads to the conclusion that the net oil exporting developing countries can benefit from an increase in the world oil price. Indeed, this increase can improve the stability of their financial markets, by reducing the occurrence of systemic banking crisis in the latter, which indicates the degree of financial instability.

Table 1. Baseline estimates

Variables	Logit regressions			Logit regressions		
	(Re) (1)	(Fe) (2)	(Pa) (3)	(Re) (4)	(Fe) (5)	(Pa) (6)
<i>GROW</i> _{t-1}	-0.120*** (0.038)	-0.120*** (0.039)	-0.108** (0.043)	-0.122*** (0.038)	-0.121*** (0.039)	-0.110** (0.043)
<i>M2/RES</i> _{t-1}	0.248 (0.313)	0.274 (0.318)	0.183 (0.254)	0.245 (0.313)	0.278 (0.318)	0.180 (0.253)
<i>PRIVCLAIM</i> _{t-1}	0.002** (0.001)	0.002* (0.001)	0.002** (0.001)	0.002** (0.001)	0.002* (0.001)	0.002** (0.001)
<i>LIFE</i> _{t-1}	-0.148*** (0.044)	-0.157 (0.110)	-0.116*** (0.038)	-0.149*** (0.043)	-0.170 (0.109)	-0.117*** (0.038)
<i>PRIVCRED</i> _{t-1}	1.498*** (0.330)	1.726*** (0.365)	1.341** (0.595)	1.482*** (0.329)	1.719*** (0.365)	1.323** (0.597)
<i>LIBtrad</i> _{t-1}	-0.062*** (0.017)	-0.055** (0.025)	-0.054*** (0.016)	-0.062*** (0.017)	-0.055** (0.024)	-0.055*** (0.016)
<i>LIBfin</i> _{t-1}	0.043** (0.018)	0.055** (0.021)	0.039* (0.020)	0.043** (0.018)	0.055** (0.021)	0.039* (0.020)
<i>ROILP_{Brent}</i>	-1.943*** (0.651)	-1.928*** (0.662)	-1.660*** (0.395)			
<i>ROILP_{WTI}</i>				-2.065*** (0.688)	-2.022*** (0.699)	-1.783*** (0.425)
<i>Constant</i>	3.300 (2.520)		2.110 (1.855)	3.435 (2.502)		2.221 (1.843)
<i>Observations</i>	621	372	621	621	372	621
<i>Number of Countries</i>	35	35	35	35	35	35
<i>Wald Test Statistic</i>	50.95	85.43	42.91	51.22	85.31	44.50
<i>Log Likelihood</i>	-164.1	-104.3		-164	-104.4	
<i>Likelihood Ratio Test</i>	22.86			22.55		

Notes: Dependent variable is systemic banking crisis dummy. Regressions are estimated using the random-effects logistic estimator (Re), the conditional fixed-effects logistic estimator (Fe) and the logistic population-averaged estimator (Pa) with robust errors. Standard errors are presented below the corresponding coefficient. Period is 1987-2011 (yearly data). Marginal effects and the coefficients of the constant are reported. Symbols *, ** and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

To verify the robustness of our baseline estimates illustrated in Table 1 above, we re-estimated equation 1, through the random-effects logistic model, the conditional fixed-effects logistic model and the logistic population-averaged model with robust errors, after changing the interest (i) and control variables (ii), omitting the OPEC subgroup among the sample (iii) and excluding the crises and oil price shock sub-periods (iv), respectively, 1997-2001 and 2007-2011.

Table 2. Robustness estimations: alternative interest variables

Variables	Logit regressions			Logit regressions		
	(Re) (1)	(Fe) (2)	(Pa) (3)	(Re) (4)	(Fe) (5)	(Pa) (6)
GROW _{t-1}	-0.121*** (0.038)	-0.120*** (0.038)	-0.110** (0.043)	-0.120*** (0.038)	-0.119*** (0.038)	-0.108** (0.043)
M2/RES _{t-1}	0.244 (0.313)	0.279 (0.318)	0.179 (0.255)	0.247 (0.313)	0.275 (0.318)	0.183 (0.255)
PRIVCLAIM _{t-1}	0.002** (0.001)	0.002* (0.001)	0.002** (0.001)	0.002** (0.001)	0.002* (0.001)	0.002** (0.001)
LIFE _{t-1}	-0.150*** (0.043)	-0.175 (0.109)	-0.118*** (0.038)	-0.149*** (0.044)	-0.162 (0.110)	-0.117*** (0.038)
PRIVCRED _{t-1}	1.484*** (0.328)	1.722*** (0.366)	1.329** (0.596)	1.500*** (0.330)	1.729*** (0.365)	1.346** (0.594)
LIBtrad _{t-1}	-0.062*** (0.017)	-0.055** (0.025)	-0.055*** (0.016)	-0.062*** (0.017)	-0.056** (0.025)	-0.055*** (0.016)
LIBfin _{t-1}	0.043** (0.018)	0.055** (0.021)	0.039* (0.020)	0.043** (0.018)	0.055*** (0.021)	0.039* (0.020)
NOILP _{Brent}	-1.985*** (0.668)	-1.935*** (0.679)	-1.711*** (0.407)			
NOILP _{WTI}				-1.876*** (0.633)	-1.850*** (0.644)	-1.601*** (0.380)
Constant	3.582 (2.500)		2.327 (1.852)	3.443 (2.516)		2.213 (1.862)
Observations	621	372	621	621	372	621
Number of Countries	35	35	35	35	35	35
Wald Test Statistic	51.12	85.05	44.36	50.87	85.19	42.78
Log Likelihood	-164.1	-104.5		-164.2	-104.5	
Likelihood Ratio Test	22.50			22.80		

Notes: Dependent variable is systemic banking crisis dummy. Regressions are estimated using the random-effects logistic estimator (Re), the conditional fixed-effects logistic estimator (Fe) and the logistic population-averaged estimator (Pa) with robust errors. Standard errors are presented below the corresponding coefficient. Period is 1987-2011 (yearly data). Marginal effects and the coefficients of the constant are reported. Symbols *, ** and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

First, as indicated above, we included two alternative indicators of nominal oil price fluctuation, namely $NOILP_{WTI}$, which designates the Spot Price FOB (Dollars per Barrel), non-adjusted to inflation and without seasonality (log-difference), and $NOILP_{Brent}$, which identifies the Europe Brent Spot Price FOB (Dollars per Barrel) non-adjusted to inflation and without seasonality (expressed in log-difference). These indicators are annual and extracted from the oil price database of the U.S. Energy Information Administration (EIA). Table 2 below shows that

the negativity and significance of the coefficients of $NOILP_{WTI}$ and $NOILP_{Brent}$, as well as those of the other explanatory variables confirm our main results.

Second, Table 3 below highlights the results of the regressions which included four alternative control variables. These latter are GDP per capita ($GDPPC$), government spending to GDP (GOV), the lack of price stability (INF), namely the logarithm of (100+inflation rate), the sum of exports and imports to GDP ($TRADE$) and the ratio of net financial external position to GDP ($EXTPOSI$). We also excluded $PRIVCLAIM$, $LIFE$, $LIBtrad$ and $LIBfin$. Our basic results and conclusions remain unchanged after this second robustness test.

Table 3. Robustness estimations: alternative control variables

Variables	Logit regressions			Logit regressions		
	(Re) (1)	(Fe) (2)	(Pa) (3)	(Re) (4)	(Fe) (5)	(Pa) (6)
$GROW_{t-1}$	-0.047 (0.042)	-0.044 (0.042)	-0.057** (0.029)	-0.048 (0.042)	-0.044 (0.042)	-0.058** (0.029)
$GDPPC_{t-1}$	-0.354 (0.646)	2.135 (1.350)	-0.259 (0.351)	-0.392 (0.639)	1.927 (1.332)	-0.269 (0.352)
$M2/RES_{t-1}$	0.186 (0.337)	0.003 (0.323)	0.358 (0.252)	0.183 (0.336)	0.012 (0.322)	0.353 (0.254)
$PRIVCRED_{t-1}$	2.333*** (0.435)	2.259*** (0.489)	1.276*** (0.362)	2.315*** (0.433)	2.252*** (0.484)	1.269*** (0.360)
GOV_{t-1}	-0.179 (0.746)	0.032 (0.966)	0.019 (0.723)	-0.163 (0.745)	0.055 (0.962)	0.023 (0.725)
INF_{t-1}	1.868*** (0.509)	1.407*** (0.450)	1.474*** (0.416)	1.866*** (0.508)	1.413*** (0.450)	1.468*** (0.414)
$TRADE_{t-1}$	-2.491*** (0.802)	-4.006*** (1.191)	-1.086*** (0.406)	-2.500*** (0.800)	-3.992*** (1.186)	-1.094*** (0.410)
$EXTPOSI_{t-1}$	0.798* (0.470)	2.139*** (0.780)	0.217 (0.413)	0.798* (0.468)	2.124*** (0.779)	0.219 (0.415)
$ROILP_{Brent}$	-2.007*** (0.726)	-2.243*** (0.752)	-1.337*** (0.348)			
$ROILP_{WTI}$				-2.135*** (0.770)	-2.319*** (0.800)	-1.442*** (0.374)
<i>Constant</i>	-6.222 (6.054)		-6.313 (4.714)	-5.890 (6.021)		-6.176 (4.703)
<i>Observations</i>	583	350	583	583	350	583
<i>Number of Countries</i>	32	17	32	32	17	32
<i>Wald Test Statistic</i>	49.24	105.4	55.16	49.34	104.9	55.99
<i>Log Likelihood</i>	-146.2	-82.44		-146.2	-82.70	
<i>Likelihood Ratio Test</i>	49.15			48.84		

Notes: Dependent variable is systemic banking crisis dummy. Regressions are estimated using the random-effects logistic estimator (Re), the conditional fixed-effects logistic estimator (Fe) and the logistic population-averaged estimator (Pa) with robust errors. Standard errors are presented below the corresponding coefficient. Period is 1987-2011 (yearly data). Marginal effects and the coefficients of the constant are reported. Symbols *, ** and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Third, when we omitted the OPEC subgroup (namely Algeria, Angola, Ecuador, the Islamic Republic of Iran, Iraq, Libya, Nigeria and Venezuela) from the sample, the main results basically hold, as Table 4 below highlights. The purpose of this robustness test is to see if our baseline estimates remain stable after the omission of these countries because they represent the biggest oil exporters in our sample.

Table 4. Robustness estimations: omitting OPEC countries

Variables	Logit regressions			Logit regressions		
	(Re) (1)	(Fe) (2)	(Pa) (3)	(Re) (4)	(Fe) (5)	(Pa) (6)
GROW _{t-1}	-0.110*** (0.040)	-0.113*** (0.042)	-0.100** (0.048)	-0.111*** (0.040)	-0.114*** (0.042)	-0.102** (0.048)
M2/RES _{t-1}	0.265 (0.344)	0.268 (0.347)	0.215 (0.283)	0.264 (0.344)	0.272 (0.348)	0.213 (0.283)
PRIVCLAIM _{t-1}	0.002** (0.001)	0.002* (0.001)	0.002** (0.001)	0.002** (0.001)	0.002* (0.001)	0.002** (0.001)
LIFE _{t-1}	-0.156*** (0.055)	-0.261* (0.143)	-0.102** (0.047)	-0.156*** (0.055)	-0.269* (0.142)	-0.103** (0.046)
PRIVCRED _{t-1}	1.260*** (0.378)	1.548*** (0.428)	0.899 (0.730)	1.251*** (0.377)	1.543*** (0.428)	0.887 (0.729)
LIBtrad _{t-1}	-0.060*** (0.020)	-0.065** (0.032)	-0.046*** (0.018)	-0.060*** (0.019)	-0.064** (0.032)	-0.046*** (0.018)
LIBfin _{t-1}	0.041** (0.019)	0.057** (0.024)	0.032 (0.023)	0.041** (0.019)	0.057** (0.024)	0.032 (0.023)
NOILP _{Brent}	-1.544** (0.737)	-1.569** (0.751)	-1.295*** (0.365)			
NOILP _{WTI}				-1.593** (0.776)	-1.598** (0.792)	-1.367*** (0.364)
Constant	4.427 (3.035)		2.450 (2.083)	4.521 (3.022)		2.528 (2.063)
Observations	524	303	524	524	303	524
Number of Countries	27	27	27	27	27	27
Wald Test Statistic	35.91	62.44	54.29	35.94	62.14	56.10
Log Likelihood	-131.2	-81.89		-131.3	-82.04	
Likelihood Ratio Test	17.18			16.95		

Notes: Dependent variable is systemic banking crisis dummy. Regressions are estimated using the random-effects logistic estimator (Re), the conditional fixed-effects logistic estimator (Fe) and the logistic population-averaged estimator (Pa) with robust errors. Standard errors are presented below the corresponding coefficient. Period is 1987-2011 (yearly data). Marginal effects and the coefficients of the constant are reported. Symbols *, ** and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Fourth, when we excluded the crises and the oil price shock sub-periods, respectively 1987-1991, 1997-2001 and 2007-2011, it appears in Tables 5, 6 and 7 below that our basic results remain significantly stable, knowing that the sub-periods 1987-1991 and 1997-2001 include a strong occurrence of crises in developing and emerging markets, according to Engdahl and Engdahl (2004) and Burton (2017), and the sub-period 2007-2011 covers the international financial crisis 2007-2008 and the oil price jolt in 2008.

Table 5. Robustness estimations: excluding sub-period 1987-1991

Variables	Logit regressions			Logit regressions		
	(Re) (1)	(Fe) (2)	(Pa) (3)	(Re) (4)	(Fe) (5)	(Pa) (6)
GROW _{t-1}	-0.123*** (0.042)	-0.122*** (0.044)	-0.116** (0.046)	-0.125*** (0.043)	-0.123*** (0.044)	-0.117** (0.046)
M2/RES _{t-1}	0.079 (0.336)	0.061 (0.327)	0.066 (0.268)	0.078 (0.336)	0.065 (0.328)	0.065 (0.267)
PRIVCLAIM _{t-1}	0.001 (0.001)	0.001 (0.001)	0.001* (0.001)	0.001 (0.001)	0.001 (0.001)	0.001* (0.001)
LIFE _{t-1}	-0.180*** (0.054)	-0.243* (0.141)	-0.127** (0.051)	-0.180*** (0.054)	-0.258* (0.140)	-0.127** (0.050)
PRIVCRED _{t-1}	1.616*** (0.422)	2.006*** (0.509)	1.352* (0.771)	1.595*** (0.420)	2.001*** (0.509)	1.315* (0.769)
LIBtrad _{t-1}	-0.077*** (0.020)	-0.077** (0.031)	-0.059*** (0.020)	-0.076*** (0.020)	-0.076** (0.030)	-0.059*** (0.019)
LIBfin _{t-1}	0.053*** (0.020)	0.067*** (0.025)	0.046** (0.023)	0.053*** (0.020)	0.067*** (0.025)	0.046** (0.022)
ROILP _{Brent}	-1.832*** (0.692)	-1.744** (0.709)	-1.586*** (0.356)			
ROILP _{WTI}				-1.928*** (0.728)	-1.821** (0.745)	-1.683*** (0.366)
Constant	5.112* (2.971)		2.660 (2.388)	5.203* (2.958)		2.756 (2.354)
Observations	535	303	535	535	303	535
Number of Countries	33	17	33	33	17	33
Wald Test Statistic	38.06	68.27	37.75	38.22	68.19	40.15
Log Likelihood	-136.4	-81.03		-136.4	-81.06	
Likelihood Ratio Test	18.83			18.56		

Notes: Dependent variable is systemic banking crisis dummy. Regressions are estimated using the random-effects logistic estimator (Re), the conditional fixed-effects logistic estimator (Fe) and the logistic population-averaged estimator (Pa) with robust errors. Standard errors are presented below the corresponding coefficient. Period is 1987-2011, excluding sub-period 1987-1991 (yearly data). Marginal effects and the coefficients of the constant are reported. Symbols *, ** and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Table 6. Robustness estimations: excluding subperiod 1997-2001

Variables	Logit regressions			Logit regressions		
	(Re) (1)	(Fe) (2)	(Pa) (3)	(Re) (4)	(Fe) (5)	(Pa) (6)
GROW _{t-1}	-0.109** (0.044)	-0.115** (0.047)	-0.089** (0.043)	-0.113** (0.044)	-0.118** (0.047)	-0.092** (0.044)
M2/RES _{t-1}	0.229 (0.348)	0.316 (0.342)	0.114 (0.281)	0.234 (0.349)	0.328 (0.343)	0.112 (0.283)
PRIVCLAIM _{t-1}	0.002* (0.001)	0.002 (0.001)	0.002** (0.001)	0.002* (0.001)	0.002 (0.001)	0.002** (0.001)
LIFE _{t-1}	-0.214*** (0.060)	-0.280** (0.129)	-0.145*** (0.039)	-0.218*** (0.061)	-0.300** (0.130)	-0.147*** (0.039)
PRIVCRED _{t-1}	1.170*** (0.363)	1.384*** (0.389)	1.049 (0.733)	1.158*** (0.363)	1.387*** (0.390)	1.023 (0.740)
LIBtrad _{t-1}	-0.077*** (0.021)	-0.068** (0.026)	-0.057*** (0.017)	-0.078*** (0.021)	-0.068** (0.027)	-0.058*** (0.017)
LIBfin _{t-1}	0.065*** (0.022)	0.084*** (0.026)	0.041** (0.019)	0.065*** (0.023)	0.086*** (0.026)	0.041** (0.019)
ROILP _{Brent}	-2.693*** (0.948)	-2.736*** (1.020)	-1.973*** (0.603)			
ROILP _{WTI}				-2.821*** (0.970)	-2.910*** (1.047)	-2.099*** (0.644)
Constant	7.558** (3.324)		4.894** (1.933)	7.806** (3.341)		5.081*** (1.928)
Observations	457	216	457	457	216	457
Number of Countries	35	35	35	35	35	35
Wald Test Statistic	40.34	69.25	61.11	40.46	69.80	60.61
Log Likelihood	-110.9	-61.14		-110.8	-60.86	
Likelihood Ratio Test	25.72			25.57		

Notes: Dependent variable is systemic banking crisis dummy. Regressions are estimated using the random-effects logistic estimator (Re), the conditional fixed-effects logistic estimator (Fe) and the logistic population-averaged estimator (Pa) with robust errors. Standard errors are presented below the corresponding coefficient. Period is 1987-2011, excluding sub-period 1997-2001 (yearly data). Marginal effects and the coefficients of the constant are reported. Symbols *, ** and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Table 7. Robustness estimations: excluding sub-period 2007-2011

Variables	Logit regressions			Logit regressions		
	(Re) (1)	(Fe) (2)	(Pa) (3)	(Re) (4)	(Fe) (5)	(Pa) (6)
GROW _{t-1}	-0.151*** (0.042)	-0.158*** (0.046)	-0.130*** (0.044)	-0.152*** (0.042)	-0.158*** (0.046)	-0.131*** (0.044)
M2/RES _{t-1}	0.145 (0.308)	0.078 (0.329)	0.166 (0.250)	0.144 (0.307)	0.081 (0.329)	0.163 (0.247)
PRIVCLAIM _{t-1}	0.002* (0.001)	0.002 (0.002)	0.002** (0.001)	0.002* (0.001)	0.002 (0.002)	0.002** (0.001)
LIFE _{t-1}	-0.096** (0.041)	0.047 (0.150)	-0.074** (0.032)	-0.096** (0.041)	0.048 (0.151)	-0.074** (0.032)
PRIVCRED _{t-1}	0.984*** (0.330)	1.386*** (0.445)	0.724 (0.526)	0.981*** (0.329)	1.376*** (0.445)	0.725 (0.526)
LIBtrad _{t-1}	-0.037** (0.018)	-0.005 (0.032)	-0.038** (0.015)	-0.037** (0.018)	-0.005 (0.032)	-0.038** (0.015)
LIBfin _{t-1}	0.005 (0.021)	-0.016 (0.031)	0.014 (0.019)	0.005 (0.021)	-0.016 (0.031)	0.014 (0.019)
ROILP _{Brent}	-2.433*** (0.801)	-2.694*** (0.831)	-2.047*** (0.543)			
ROILP _{WTI}				-2.727*** (0.877)	-2.976*** (0.907)	-2.308*** (0.606)
Constant	2.504 (2.507)		1.956 (1.988)	2.503 (2.507)		1.960 (1.983)
Observations	467	259	467	467	259	467
Number of Countries	35	35	35	35	35	35
Wald Test Statistic	39.05	59.79	50.43	39.40	60.14	50.02
Log Likelihood	-134	-79.96		-133.7	-79.79	
Likelihood Ratio Test	12.69			12.65		

Notes: Dependent variable is systemic banking crisis dummy. Regressions are estimated using the random-effects logistic estimator (Re), the conditional fixed-effects logistic estimator (Fe) and the logistic population-averaged estimator (Pa) with robust errors. Standard errors are presented below the corresponding coefficient. Period is 1987-2006 (yearly data). Marginal effects and the coefficients of the constant are reported. Symbols *, ** and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

And finally, we conclude that net oil exporting economies are highly interdependent to oil price because their industries are dominated by oil companies. This is in line with the results obtained by Wang et al. (2012). Even more so, an increase in the world oil price can be advantageous for these economies through their domestic banking sectors, by reducing the fragility of the latter.

4. Conclusion

By analyzing two phenomena rarely investigated conjointly, namely oil price fluctuation and financial instability, quantified by the occurrence of banking crises, the present paper has provided a significant contribution to existing energy finance literature in the case of oil exporting developing countries. Indeed, it permits to answer the following question: How financial market stability in oil exporting developing countries might be impacted by oil price fluctuations in the long term? The study is based on a sample including 35 net oil-exporting developing countries observed between 1987 and 2011. It mainly evidences that an increase in the world oil price can be advantageous for the domestic banking sector through reducing its

fragility, measured by the likelihood of systemic banking crises. From this result, we can suppose the following mechanisms:

Oil price shocks exhibit a significant impact on the relationship between oil price and the financial sector in oil exporting economies. Moreover, aggregate demand-side oil price shocks (housing market boom, Chinese economic growth, and the latest global financial crisis) can cause a significant higher correlation between economies of exporting countries and oil prices. The decline in oil prices in the sub-period of crises has changed the macroeconomic picture in these countries. The impact of the low price on the government finance is due to the heavy dependence on the oil sector. Hence, government revenues tend to be highly volatile. Oil price volatility was transmitted to the economy through the decrease in government revenues. Low oil prices demonstrated that fluctuations in the balance of trade are directly correlated with the volume of oil exports. This decline created macroeconomic and financial problems which include, but are not limited to, the increase in budget deficit, the deterioration of the balance of payments, the depreciation of currency and the increase in financial instability.

In conclusion, the negative impact of oil price should prompt oil exporting countries to set new priorities for economic development aimed at restructuring their economic and financial systems and improving banking regulations in order to curb the effects of low oil prices and overcome external shocks.

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Appendix

Table A. Description statistics data from 1987 to 2011

Variable	Observation	Mean	Standard Deviation	Min	Max
BKCRISIS	875	0.1051429	0.3069128	0	1
ROILP_{Brent}	840	0.0381156	0.2195402	-0.4723287	0.4184964
ROILP_{WTI}	840	0.0462313	0.2358001	-0.4479513	0.4375892
NOILP_{Brent}	840	0.0665709	0.2242031	-0.4755373	0.4516089
NOILP_{WTI}	840	0.0746866	0.2401539	-0.4511604	0.4707017
GROW	853	3.719902	7.578531	-64.04711	57.81783
M2/RES	713	-0.0418705	0.5377249	-3.586743	2.682358
PRIVCLAIM	762	40.70325	282.9604	-75.91821	4702.26
LIFE	875	64.67131	8.905724	40.97388	77.16322
PRIVCRED	698	25.59069	23.52067	0.21	155.17
LIBtrad	863	46.65188	21.39517	7.633087	90.64049
LIBfin	863	49.8536	16.63379	5.655427	85.85552
GOV	818	14.00576	6.244068	2.057589	50
INF	758	4.81585	0.5031982	4.429419	10.08051
GDPPC	856	7.453752	0.8798564	5.30694	9.158444
TRADE	824	72.3996	38.40612	11.08746	220.4074
EXPOSI	816	0.6715872	0.7105467	0.0006177	5.853368

Note: This table reports the descriptive statistics of the variables used in the paper.

Table B. Correlation matrix data from 1987 to 2011

	BKCRISIS	ROILP _{Brent}	ROILP _{WTI}	NOILP _{Brent}	NOILP _{WTI}	GROW	M2/RES	PRIVCLAIM	LIFE	PRIVCRED	LIBtrad	LIBfin	GOV	INF	GDPPC	TRADE	EXPOSI
BKCRISIS	1.0000																
ROILP_{Brent}	-0.1174	1.0000															
p-value	(0.0007)																
ROILP_{WTI}	-0.1187	0.9872	1.0000														
p-value	(0.0006)	(0.0000)															
NOILP_{Brent}	-0.1155	0.9990	0.9851	1.0000													
p-value	(0.0008)	(0.0000)	(0.0000)														
NOILP_{WTI}	-0.1171	0.9877	0.9991	0.9876	1.0000												
p-value	(0.0007)	(0.0000)	(0.0000)	(0.0000)													
GROW	-0.1781	0.1398	0.1347	0.1375	0.1329	1.0000											
p-value	(0.0000)	(0.0001)	(0.0001)	(0.0001)	(0.0001)												
M2/RES	-0.0083	-0.1066	-0.1062	-0.1056	-0.1054	0.0598	1.0000										
p-value	(0.8245)	(0.0044)	(0.0045)	(0.0047)	(0.0048)	(0.1139)											
PRIVCLAIM	0.2149	-0.0140	-0.0177	-0.0093	-0.0132	-0.0716	-0.0515	1.0000									
p-value	(0.0000)	(0.7036)	(0.6311)	(0.8009)	(0.7198)	(0.0507)	(0.1717)										
LIFE	-0.0707	0.0400	0.0498	0.0351	0.0451	0.0235	0.0562	0.0224	1.0000								
p-value	(0.0367)	(0.2465)	(0.1491)	(0.3096)	(0.1918)	(0.4924)	(0.1337)	(0.5369)									
PRIVCRED	0.0560	-0.0094	0.0017	-0.0108	0.0001	0.0234	0.0698	0.0014	0.4120	1.0000							
p-value	(0.1397)	(0.8070)	(0.9651)	(0.7783)	(0.9978)	(0.5379)	(0.0750)	(0.9701)	(0.0000)								
LIBtrad	-0.1779	0.0920	0.1001	0.0853	0.0938	0.1397	-0.0308	-0.1226	-0.1789	0.2717	1.0000						
p-value	(0.0000)	(0.0079)	(0.0039)	(0.0139)	(0.0068)	(0.0000)	(0.4114)	(0.0007)	(0.0000)	(0.0000)							
LIBfin	-0.0110	0.0684	0.0776	0.0607	0.0703	0.1000	0.0233	-0.0503	-0.0213	0.2404	0.4821	1.0000					
p-value	(0.7463)	(0.0487)	(0.0253)	(0.0801)	(0.0427)	(0.0036)	(0.5342)	(0.1653)	(0.5324)	(0.0000)	(0.0000)						
GOV	-0.0861	-0.0806	-0.0851	-0.0763	-0.0811	-0.1016	0.0437	-0.0102	-0.1179	0.0793	0.2257	0.1145	1.0000				
p-value	(0.0138)	(0.0237)	(0.0168)	(0.0323)	(0.0228)	(0.0039)	(0.2528)	(0.7827)	(0.0007)	(0.0395)	(0.0000)	(0.0011)					
INF	0.2547	-0.0774	-0.0854	-0.0710	-0.0794	-0.1940	-0.1971	0.4825	-0.1848	-0.1292	-0.1217	-0.1165	0.1067	1.0000			
p-value	(0.0000)	(0.0361)	(0.0207)	(0.0545)	(0.0316)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0008)	(0.0008)	(0.0013)	(0.0044)				
GDPPC	-0.0241	0.0443	0.0542	0.0408	0.0508	0.0138	0.0410	0.0825	0.5909	0.2601	-0.1309	0.2390	0.1157	-0.1391	1.0000		
p-value	(0.4811)	(0.2040)	(0.1200)	(0.2422)	(0.1451)	(0.6877)	(0.2787)	(0.0242)	(0.0000)	(0.0000)	(0.0001)	(0.0000)	(0.0010)	(0.0001)			
TRADE	-0.1388	0.0889	0.0954	0.0831	0.0900	0.0770	-0.0340	-0.1037	-0.0406	0.4610	0.8095	0.4834	0.1291	-0.1214	0.0514	1.0000	
p-value	(0.0001)	(0.0122)	(0.0071)	(0.0192)	(0.0112)	(0.0280)	(0.3716)	(0.0049)	(0.2448)	(0.0000)	(0.0000)	(0.0000)	(0.0002)	(0.0011)	(0.1427)		
EXPOSI	0.0046	-0.0382	-0.0395	-0.0373	-0.0387	-0.1862	-0.0663	-0.0337	-0.4014	-0.1930	0.1768	0.2841	0.1274	0.2005	-0.3129	0.1394	1.0000
p-value	(0.8953)	(0.2842)	(0.2682)	(0.2955)	(0.2781)	(0.0000)	(0.0770)	(0.3535)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0004)	(0.0000)	(0.0000)	(0.0001)	

Note: This table reports the correlation coefficients of Pearson between the variables used in the paper.

Table C. List of countries

Basic sample:	OPEC countries:
Albania, Algeria, Angola, Argentina, Belize, Bolivia, Brazil, Cameroon, Chad, Colombia, Congo. Dem. Rep. of, Congo. Republic of, Ecuador, Egypt, Gabon, Georgia, Guatemala, Iran. Islamic Republic of, Iraq, Kazakhstan, Kenya, Libya, Malaysia, Mauritania, Mexico, Mongolia, Nigeria, Papua New Guinea, Sudan, Suriname, Syrian Arab Republic, Tunisia, Turkmenistan, Venezuela. Rep. Bol. and Vietnam.	Algeria, Angola, Ecuador, Iran. Islamic Republic of, Iraq, Libya, Nigeria and Venezuela.