economies

Article

The Impact of Commodity Price Shocks on Banking System Stability in Developing Countries

Nicholas Ngepah, Margarida Liandra Andrade da Silva and Charles Shaaba Saba *

Auckland Park Kingsway Campus, University of Johannesburg, Johannesburg 2006, South Africa; nngepah@uj.ac.za (N.N.); dasilvamargarida7@gmail.com (M.L.A.d.S.)
* Correspondence: sabacharlesshaaba@yahoo.com

Abstract: This study examines the impact of commodity price shocks on the banking sector stability of 18 African commodity-exporting economies using an unbalanced panel dataset spanning a 16-year period from 2000–2015. The study on the impact of commodity price shocks on African commodity-exporting economies' banking sectors was estimated using a panel fixed effects model. The empirical findings indicate that commodity price shocks increase bank credit risk (non-performing loans) and, thus, pose a risk to the banking sector stability of African commodity-exporting economies. The results for the disaggregated shocks reveal that both positive and negative shocks weaken banking sector stability. In addition, commodity price shocks are discovered to decrease credit extension to the private sector, highlighting an additional channel through which the impact of commodity price shocks may be perpetuated to the real economy.

Keywords: commodity price shocks; banking sector stability; panel data; Africa

Citation: Ngepah, Nicholas, Margarida Liandra Andrade da Silva, and Charles Shaaba Saba. 2022. The Impact of Commodity Price Shocks on Banking System Stability in Developing Countries. *Economies* 10: 91. https://doi.org/10.3390/economies10040091

Academic Editor: Ralf Fendel

Received: 2 March 2022
Accepted: 1 April 2022
Published: 12 April 2022

1. Introduction

African countries are highly dependent on commodities; this exposes them to risks of economic, political, and financial instability (Christensen 2016). The economic and political implications of commodity dependence are well-rooted in the literature, with a plethora of research focusing on how it impacts economic growth, debt, conflict, and financial development (Hamilton 1983, 2009; Deaton and Miller 1995; Lescaroux and Mignon 2008; Kilian et al. 2009; Rafiq et al. 2016; Montfort and Ouedraogo 2017; Bangara and Dunne 2018). Limited research has examined the possible impact of commodity price shocks on financial sector stability, specifically on banking sector stability (Alodayni 2016; Kinda et al. 2016; Agarwal et al. 2017; Eberhardt and Presbitero 2018). Commodity price shocks affect the corporate, household, government, and banking sectors of the economy (Christensen 2016). The banking sector may, therefore, be an additional channel through which the impact of commodity price shocks is perpetuated to the real economy.

African economies are mainly dominated by large domestic and foreign banks (Chironga et al. 2018), and as such, banking stability (or instability) can play a significant role in lessening (or intensifying) the impact of commodity price shocks on the macroeconomy (Poghosyan and Hesse 2009; Miyajima 2016; Kooros and Semetesy 2016; Alodayni 2016; Kinda et al. 2016). For example, the 1980s and 1990s comprised extensive banking crises, with most of the instability concentrated in commodity-exporting economies (Eberhardt and Presbitero 2018). Few African economies experienced banking crises during this period. According to Eberhardt and Presbitero (2018), factors such as long periods of economic growth, financial deepening, and high and stable commodity prices contributed to the resilience of African banking sectors. Structural reforms for sound macroeconomic policies and improved regulatory frameworks have further supported African banking sectors (Caggiano et al. 2013; Bangara and Dunne 2018). Despite this resilience, macroeconomic and banking sector vulnerabilities are clearly still in place and are likely to emerge

as financial deepening increases and as the financial system becomes more complex. In 2014–2015, several economies began experiencing financial distress, indicated by declining bank profitability and deteriorating asset quality (UNDP 2016; IMF 2017). Even though the country-specific problems faced by these countries may have contributed to the financial distress, the sharp and persistent decline of commodity prices has certainly perpetuated the issue for commodity-exporting economies (see Figure 1).

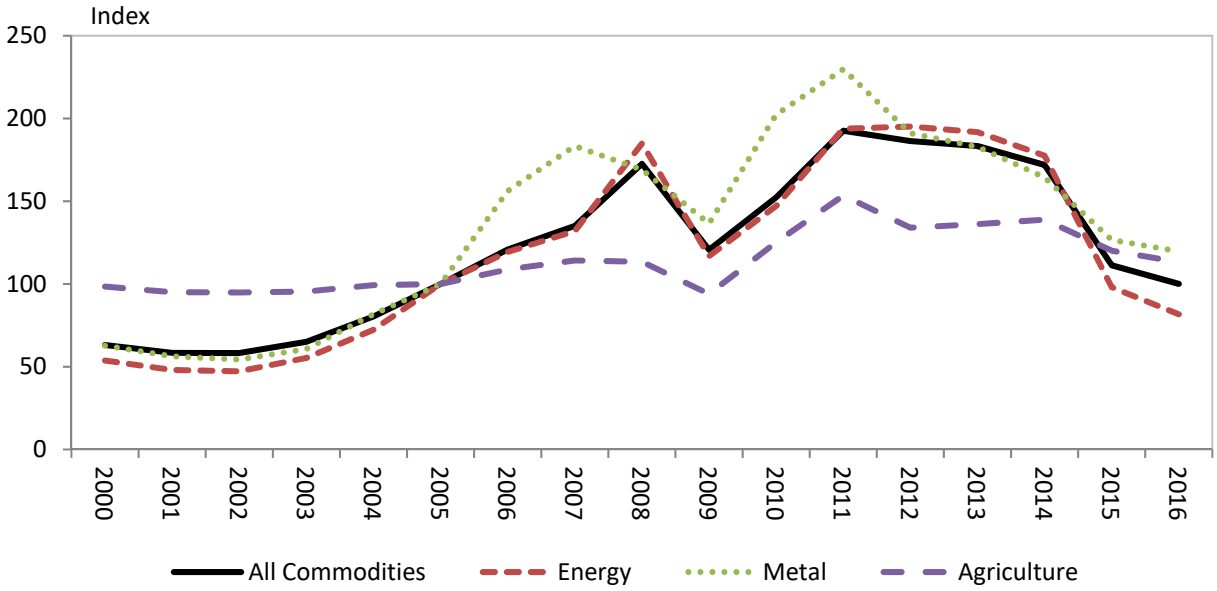

Figure 1. Commodity price indices (2005 = 100). **Source**: Author's own presentation using IMF data.

Given these developments and considerations, this study examines the vulnerability of the banking sectors of 18 African countries to commodity price shocks. The analysis covers the period spanning 2000 to 2015. The dependence of African economies on commodity exports has long been debated and analyzed. Even though most African countries benefit from commodity price booms, commodity price busts remain a concern due to their magnitude and duration. Commodity price volatility may not be avoided, but countries can ensure that they are not largely impacted by diversifying and reducing their commodity dependence. There is clear consensus on the impact of commodity price shocks on macroeconomic factors. Limited research has focused on how the banking sectors of African economies are impacted. There is a need to examine whether the banking sector may be an additional channel through which commodity price shocks impact the real economy. The 2007–2008 GCF brought to light the pieces that were missing in maintaining financial sector stability. The close link between commodity markets and the banking sector (Kinda et al. 2016), therefore, supports the need to understand how the financial sector is impacted by commodity price shocks. This study contributes to the literature in three key ways. First, the study emphasizes the role of commodity price shocks in triggering banking sector instability. In a related paper, Kinda et al. (2016) showed that commodity price shocks are associated with financial sector fragility in developing countries. Kinda et al. (2016) limited the focus of their study, focusing only on minerals, fuels, and metals. This study extends the research by Kinda et al. (2016) by focusing on most commodity groups. Second, while previous studies have focused on advanced, emerging, developing (not just African), and low-income countries, this study examines the experience of only African commodity-exporting countries. This is specifically relevant because of the financial sector vulnerabilities that were revealed in African countries following the 2015 commodity price decline. African economies' exposure to and dependence on commodity prices increased financial sector vulnerabilities in these countries (Eberhardt and Presbitero 2018). Third, while Kinda et al. (2016) outlined how the financial sector responds to both negative and positive shocks, this study examines this relationship using overall positive

and negative shocks. Further, the study contributes to the extant literature by emphasizing the differences in commodity price asymmetries between various commodity groups. To the best of the author's knowledge, the only work that emphasized this relationship was Addison et al. (2016).

Employing a panel fixed effects (FE) model, the results of the study indicate that commodity price shocks weaken banking sector stability through increasing bank credit risk (NPLs). More specifically, a one-unit increase[1] in the commodity price shock increases bank credit risk by 0.381%, which is in line with previous studies (Kinda et al. 2016). When disaggregated by positive and negative commodity price shocks, the results reveal that both positive and negative commodity price shocks weaken banking sector stability and that positive shocks, surprisingly, have the greatest impact on banking sector stability. The lack of asymmetry is in line with Addison et al. (2016), who found, using a similar commodity price shock measure, that positive and negative agricultural commodity price shocks in sub-Saharan African countries did not necessarily respond differently. Finally, the estimation of the impact of commodity price shocks on bank lending[2] shows that commodity price shocks do indeed decrease bank lending, which is in line with Agarwal and colleagues (2017). As a matter of fact, negative mineral, fuel, metal, and chemical price shocks have substantive negative implications on bank lending in African countries. Given these findings, this study deduces that commodity price shocks do not only have an impact on banking sector stability (which can be perpetuated to the real economy) but also have a direct impact on bank lending as a means of economic growth and development (Greenwald and Stiglitz 1991, 2003).

The remainder of the study is divided as follows. Section 2 briefly discusses the channels through which commodity price shocks can impact the economy and the banking sector. Section 3 reviews the theoretical and empirical literature. Section 4 defines the data, model specification, and estimation techniques. Section 5 presents the results, and Section 6 provides the main conclusions.

2. Commodity Price Shocks—Transmission Mechanism

Economic relationships are hardly ever clear and direct. This is no different when trying to understand and examine the relationship between commodity price shocks and banking sector stability. In order to unpack this, the various transmission channels through which commodity price shocks may impact the economy (with a specific focus on how the banking sector is impacted) are briefly discussed. *To be specific, the macroeconomic, fiscal, exchange rate, and banking channels are discussed. Further, the scenario discussed below is based on the assumption of a decline in commodity prices. One would expect the opposite deductions in the case of an increase in commodity prices.*

Macroeconomic channel: Following a fall in commodity prices, economies usually experience a decline in exports, investment, and output. Declining exports, investment, and output weigh on the corporate and household sectors. Exports decline and, thus, economies fail to generate as much export revenue as is generated during periods of higher commodity prices. Investment in commodity extraction and supporting industries weakens, impacting not only actual output but also potential output (Christensen 2016). Several authors have established a negative relationship between commodity price shocks and economic growth (Deaton and Miller 1995; Dehn 2000; Karl 2004; Bruckner and Ciccone 2010; Hammond 2011; Christensen 2016). African commodity exporters experience economic growth averaging 5% each year. A reversal of this growth was witnessed following the commodity price crash that began in late 2014 (Ighobor 2016). For example, Nigeria's oil revenue accounts for approximately 90% of its export revenue; as a result of the decline in commodity prices, its revenue declined substantially, and the country's economic growth moderated from 5.4% in 2014 to 2.9% in 2016 (Ighobor 2016). Low growth can impact firms', governments', and consumers' ability to service their bank debts, which, in turn, exposes the banking sector to credit risk. In line with a fall in commodity-exporting firm production and, thus, revenue, unemployment may rise, leaving households at risk in an already vulnerable economic

environment (Blanchard and Gal 2008). Vulnerable firms and individuals means a greater risk of defaulting on payments, impacting bank balance sheets and, through contagion[3], the greater banking system (Makri et al. 2014).

Fiscal channel: African commodity-exporting countries rely heavily on commodity export revenue to boost and support economic growth and development. The commodity export proceeds of some countries in Africa account for more than 70% of the national budget (Alesina et al. 2008; UNDP 2015; Christensen 2016; Ighobor 2016). This reliance means that negative commodity price shocks can certainly decrease fiscal performance (Spatafora and Samake 2012; Kinda et al. 2016). A decline in export revenue causes a decline in government revenue (and, thus, a decline in government expenditure) of commodity-dependent economies. Kinda et al. (2016) reiterated this by saying that commodity price shocks reduce tax revenue, worsen terms of trade, increase fiscal deficits, and decrease the competitiveness[4] of government-dependent institutions. Governments also borrow from the banking sector, so a reduction in government revenue will also impact their ability to service their bank (and other) debts. Commodity price shocks can, therefore, also pose a banking stability risk through the weakening of fiscal performance.

Exchange rate channel: It is also important to note that, as commodity exporters, African economies encounter two possible scenarios: first, increasing foreign exchange reserves as a result of higher prices or, second, decreasing foreign exchange reserves due to lower commodity prices. A substantial decline in commodity prices can increase fiscal deficits and impact exchange rate reserves. This may influence the government and domestic banks to borrow internationally to withstand domestic economic conditions brought on by commodity price shocks. In turn, this increases the foreign-denominated debt of both agents (Kinda et al. 2016). Any sudden and substantial depreciation of the domestic currency or increase in international interest rates increases the vulnerability of the banking sector and, thus, impacts its stability.

Banking channel: African countries' dependence on commodities may also have a direct impact on the banking system. First, commodity dependence structures the bank lending channel in ways which can create 'system risk' not just for the banking system but also for the greater financial system (Christensen 2016). As witnessed during the 2007–2008 global financial crisis (GFC), banks freely extend credit during periods of economic and financial boom. Similarly, during periods of commodity boom, domestic credit extension grows, with banks extending credit even to the less creditworthy. Credit extension is important for growth and development, but rapid and extensive credit growth can seriously impact the stability of the financial system. Second, previous research indicated that commodity exporters held savings as a precautionary measure to address the volatile nature of commodity prices (Bems and Filho 2011). "If the windfalls are saved in domestic banks, this could threaten the banking sector in case of negative shocks that could lead to sizeable withdrawals" (Kinda et al. 2016; Christensen 2016). Challenges in one bank can spread to other banks; this can result in bank runs[5] with the potential to completely destabilize the financial system. There were several bank runs during the 2007–2008 GFC, and the linkages between banks and financial institutions resulted in contagion, impacting the stability of the entire international financial system.

3. Literature Review

A theoretical model underpinning the analysis on the determinants of credit risk is the financial accelerator theory. This theory posits that endogenous developments in the credit markets propagate shocks to the real macroeconomic environment (Bernanke et al. 1999). The theory posits that credit shock is amplified through information asymmetries between lenders and borrowers and through a balance sheet effect. Credit risk is one of the largest risks faced by banks. As such, several studies have focused on the implications of credit risk on the banking system (Mpofu and Nikolaidou 2018).

During periods of commodity price boom, banks generate a lot of liquidity, which makes them more lax in their lending (Ftiti et al. 2016). Thus, banks may increase lending

during commodity price booms, but the opposite may hold during commodity price busts, resulting in both a reduction in credit extension and a deterioration in loan quality. This notion is supported by Ftiti et al. (2016), who analyzed the relationship between the commodity price cycle and credit cycle in three commodity-exporting African economies. Their findings indicated that the credit market is sensitive to persistent commodity price shocks. Kablan et al. (2017), who used a sample of African commodity-exporting countries, established similar results showing a positive relationship between commodity price booms and credit growth. Kablan et al. (2017) also emphasized that a commodity boom reversal affects both the macroeconomic and financial sectors, decreasing commodity exporters' capacities to service their debts. Knock-on effects increase NPLs and weigh on banking sector stability, which, in African economies, eventually impacts the entire financial system. The findings of Kablan et al. (2017) are crucial given the volatility and uncertainty related to commodity prices. The views of both Ftiti et al. (2016) and Kablan et al. (2017) are in line with Cashin and McDermott (2002), who established that African economies' commodity dependence makes them sensitive to lending booms and, thus, rising NPLs.

Most of the literature related to this study has focused specifically on oil prices. For example, Miyajima (2016), with evidence from Saudi Arabia and using generalized method of moments (GMM) and panel vector autoregression (PVAR) methods, indicated that low oil prices and non-oil GDP led to a rise in NPLs. In turn, this transmitted to the balance sheets of banks through weak macroeconomic variables. This is in line with Alodayni (2016), who focused on the oil–macrofinancial linkages in the Gulf Cooperation Council countries (GCC) region. The study, also employing a panel GMM and PVAR model, on 24 GCC banks during the period 2000 to 2014 established that oil prices, along with other macroeconomic variables, have an impact on NPLs and that higher NPLs have adverse effects on GCC economies. Al-Khazali and Mirzaei (2017) also established related results when they analyzed the impact of oil price movements on the NPLs of 30 oil-exporting countries over the period 2000 to 2014 using panel GMM. Their results revealed three things: first, that a rise (or fall) in oil prices leads to a decrease (or increase) in the NPLs of oil-exporting economies; second, that oil price shocks have asymmetric effects on bad loans (NPLs), and finally, that the negative impact of adverse oil price shocks has greater implications for the loans of large banks. These findings are significant considering that the banking sectors in developing countries (specifically African countries), dominate the financial sector (Allen et al. 2011). Any vulnerability in the banking sector, therefore, places the whole system at risk. Kooros and Semetesy (2016) assessed the relationship between international oil prices and the financial system in GCC countries. Their analysis incorporated data for 42 GCC banks spanning from 2000 to 2014. The study employed a system GMM technique and a PVAR model to assess the macroeconomic and bank-specific determinants of NPLs and the feedback loops between macroeconomic and bank balance sheet variables, respectively. In the first place, the study established that bank asset quality (NPLs) is impacted by oil prices and macroeconomic variables; second, the study also established feedback loops between oil price movements and bank balance sheets, emphasizing the notion that instability in the banking sector results in unwanted economic consequences for the real sector.

The closest literature to this empirical study comes from Kinda et al. (2016) and Eberhardt and Presbitero (2018). Kinda et al. (2016) examined how commodity price shocks impact financial sector fragility by focusing on 71 commodity-exporting emerging and developing economies for the period of 1997 to 2013. The study employed a panel fixed effects model to estimate the effect of commodity price busts on financial soundness indicators[6]. The results revealed that commodity price shocks weaken the financial sector and that larger shocks have a greater impact on financial sector stability. The study then went on to analyze a banking crisis using a conditional fixed effects logit model; the results of this estimation indicated that commodity price shocks are associated with banking crises. Eberhardt and Presbitero (2018) developed an empirical model to predict the relationship between commodity price movements and banking crises on a sample of 60 low-income countries (LICs) over the period of 1981 to 2015. The authors employed

a random effects Mundlak logit model in their estimation. Their results are in line with the findings from Kinda et al. (2016), showing that commodity price movements are an economically substantial and robust driver of banking crises in LICs. These findings are in line with Kaminsky and Reinhart (1999), who provided evidence for how instability in the banking sector can trigger a financial crisis. The study found, using a sample of emerging market economies, that risk in the banking sector leads to a currency crisis. The authors indicated that, when and if a currency crisis deepens, it spreads to the entire economy. In the empirical literature, the studies of Rudolf et al. (2021), Doumenis et al. (2021), and Sami and Abdallah (2022), among others, have highlighted the importance of digital commodities (such as Bitcoin and cryptocurrency), but given that this study is not focused on the impact of digital commodities on banking systems in Africa, we paid less attention to the review of previous studies focusing on digital commodities and the effect they have on banking systems of African countries. While most of the empirical literature on the linkages between commodity price shocks and credit risk has focused specifically on oil price shocks, this study adds to the current limited research by considering all commodities. Including all commodities broadens the scope of the research and, thus, allows for a more comprehensive analysis. The paper closest to this study, Kinda et al. (2016), focused only on fuel, mineral, and metal commodities. This study is also motivated by Kinda et al. (2016) focusing on emerging and developing countries, without isolating African economies. African economies are isolated in this study because of their dependence on commodity exports and the potential vulnerability their banking sectors could encounter because of commodity price shocks. This study further expands on the previous literature by examining how the various commodity groups impact the banking sector and how they impact bank credit extension.

4. Data and Methodology

4.1. Methodology

Several equations were estimated to analyze the relationship between commodity price shocks and banking sector stability. This study adopted a model similar to that employed by Kinda et al. (2016). Panel data was characterized by observations of multiple phenomena which were obtained over multiple periods of time. The characteristics of the panel data were synonymous to the data sample used in this study, making panel analysis the most appropriate technique (Kinda et al. 2016). More specifically, the panel fixed effects[7] econometric model was employed because each country included in the sample had its own unique set of economic, political, and institutional characteristics that could be correlated with the explanatory variables. The panel fixed effects technique controlled these country-specific effects and prevented biased estimates.

Related studies, such as Alodayni (2016), Kooros and Semetesy (2016), and Al-Khazali and Mirzaei (2017), have opted to employ a system generalized method of moments (SGMM) technique. It is a system estimator that combines the regressions in differences and levels, resulting in consistent estimates of the parameters of interest. The consistency of this model, however, depends on the validity of the moment conditions (Arellano and Bover 1995). The Sargan[8] test of over-identified instruments was employed to test the overall validity of the instruments and, thus, the consistency of the model. The null hypothesis was rejected, rendering the SGMM an inappropriate method for this study. As a result, the FE model was employed. The equations that were estimated are shown below.

The baseline model estimated the effect of the overall commodity price shocks on banking sector stability. The empirical specification takes the following general form:

$$NPL_{it} = \beta_0 + \beta_1 CPS_{it} + \sum \gamma_K X_{i,tK} + \sum \gamma_{Km} Z_{i,tm} + \varepsilon_{it} \quad (1)$$

where NPL_{it} represents the banking sector stability variable (non-performing loans). CPS_{it} represents the commodity price shock variable. $\sum \gamma_K X_{i,tK}$ and $\sum \gamma_{Km} Z_{i,tm}$ represent the vectors of the banking specific and macroeconomic control variables, respectively, and,

finally, ε_{it} represents the error term, including country-specific fixed effects and an idiosyncratic term.

Equation (1) was re-estimated using a positive and a negative commodity price shock. These shocks were derived from the overall commodity price shock equation:

$$NPL_{it} = \beta_0 + \beta_1 CPSpos_{it} + \sum \gamma_K X_{i,tK} + \sum \gamma_{Km} Z_{i,tm} + \varepsilon_{it} \quad (2)$$

$$NPL_{it} = \beta_0 + \beta_1 CPSneg_{it} + \sum \gamma_K X_{i,tK} + \sum \gamma_{Km} Z_{i,tm} + \varepsilon_{it} \quad (3)$$

where all other variables remain as in (1), while $CPSpos_{it}$ and $CPSneg_{it}$ represent positive and negative commodity price shocks, respectively.

The equations for the disaggregated commodity groups (agriculture, minerals, fuels, metals, and chemicals) were estimated using the same equations.

4.2. Data

An unbalanced panel dataset of 18 commodity-exporting African countries and the list of commodities can be found in Tables A1 and A2, respectively. The dataset comprised bank-specific financial stability indicator (FSI) (IMF 2006), macroeconomic, and commodity data for all the countries in question. The data period of 2000 to 2015 captured the commodity price bust (and the 2007–2008 GFC) that occurred in 2007–2008 and the recent 2014–2015 one. The bank-specific FSI data were sourced from the Federal Reserve Economic Data (FRED) of St. Louis and from the World Bank (WB) Global Financial Development databases. The macroeconomic (control variables) data were compiled using data from the World Bank Global Financial Development database and the IMF. The United Nation (UN) Comtrade database served as the source for the disaggregated commodities data.

The variables were defined as follows: the main dependent variable was non-performing loans (NPLs). It was a ratio of NPLs to total loans and was employed as a measure of credit risk in the study. Domestic credit extension was also employed as a dependent variable when estimating the impact of commodity price shocks on bank lending.

A number of independent variables were included in the study. The bank specific variables of profitability, capital adequacy, and liquidity were some of the variables used as financial stability indicators (IMF 2006). This is in line with studies, such as Kinda et al. (2016) and Eberhardt and Presbitero (2018), that used these variables, alongside others, as determinants of banking sector fragility and banking crises, respectively. In essence, the banking sector variables acted as proxies for a country's financial sector position.

The study also considered variables that could act as proxies for macroeconomic policy sustainability and stabilization issues, as well proxies for monetary and fiscal policy. The macroeconomic variables included economic growth, inflation, and unemployment. The monetary policy proxy variables included change in the exchange rate, real interest rate, M2 over external reserves, and domestic savings. Government revenue was employed as the fiscal policy proxy. These variables, as well as their expected priori, are summarized in Table A3.

There are various approaches through which commodity price shocks have been quantified in the literature. This study adopted the real commodity price change measure as a proxy for commodity price shocks (Mork 1989; Poghosyan and Hesse 2009). The commodity price shock measure in this study was computed per country, per time period (annual), and per commodity. The real commodity price measure is indicated below:[9]

$$cps_t = \frac{\sum_{i=1}^{365} \min[0, \log(p_t) - \min[\log(p_{t-1})]] * 100}{365} \quad (4)$$

where cps_{it} is the commodity price shock for country i at time t; p_{it} is the commodity export revenue in the current period; and p_{it-1} is the commodity export revenue in the preceding period. Cps_{it}, therefore, simply measures the annual commodity price shock for every country and each commodity included in the study for the period of 2000–2015.

Prior to computing a commodity price shock variable, unit root tests were conducted in order to ensure that all variables were stationary. This was performed in light of the concern raised by Kinda et al. (2016) that the commodity price measure above does not account for the potential trend related to price changes, making the commodity price measure nonstationary. A Phillips–Perron unit root test (Phillips 1987; Phillips and Perron 1988) with a time trend and lag of 5 was computed for all the relevant variables. The results reported in Table A4 show that all variables, including the commodity price shock (CPS) variable, contained no unit roots at level and were, therefore, stationary[10]. Two additional CPS variables were computed by splitting the original shock into positive and negative commodity shocks during estimation. This allowed the study to test for symmetry between positive and negative CPSs[11].

5. Empirical Results and Discussion

5.1. Descriptive and Correlation Analysis

Tables A5 and A6 provide the summary statistics and correlation analysis of the variables employed in the study, respectively. The mean for the dependent variable, NPL (credit risk), was 9.187; this was much higher than those obtained in other developing countries. According to Dietrich and Wanzenried (2014), the mean NPLs for low, middle, and high income economies were 1.990, 1.970, and 0.730, respectively. This high NPL level emphasizes the risk and vulnerability faced by banks in commodity-exporting African economies. There are advanced economies with elevated levels of NPLs, although the average is still below the 9.187 established in this study. In Europe, for example, the average rate of NPLs in 2016 was 5.1% (Magnus et al. 2017), which is also much higher than the 0.73 average established by Dietrich and Wanzenried (2014).

The mean for the capital adequacy ratio (NPL provisioning) was substantially high at 61.558%, indicating that African banks are safe and highly likely to meet their financial obligations[12]. The mean value for profitability (return on assets) is 1.958; it is almost in line but slightly lower than what was established for Middle East and North Africa (MENA) and sub-Saharan African banks, where values have been reported at 2.250 and 2.35, respectively (Flamini et al. 2009; Poghosyan and Hesse 2009). The mean liquidity ratio was substantially high at 29.838 in comparison to the average growth in deposits for low, middle, and high income countries of 21.630, 14.290, and 7.621, respectively (Dietrich and Wanzenried 2014). This high liquidity ratio implied that African banks are in a position to sufficiently cover current debt obligations without needing to raise funds in the capital markets.

The correlation matrix (Table A6) indicates that the CPS variable was positively correlated to NPL (0.128). A positive relationship was also observed between the CPS variable and the other banking sector variables in the study (capital adequacy (0.009), profitability (0.081), and liquidity (0.093)), emphasising the possible impact of commodity price dynamics on the banking sector, as established by Kinda et al. (2016). Another important negative correlation was that of the CPS and domestic credit extension (−0.115); this correlation is in line with findings from Agarwal et al. (2017).

Unemployment had the strongest negative relationship with NPL; this was expected, since loss of revenue weighs on the ability to service debt and vice versa. NPL was also highly negatively related to government revenue (−0.246) and domestic credit (−0.196). The correlation between NPL and real economic growth was also negative and significant (−0.014), but not as strong.

5.2. Results

The baseline model presented in Table 1 shows that the CPS coefficient increased credit risk (non-performing loans). This finding was the same across all three models, but the pooled OLS and SGMM models had weaknesses. The pooled OLS model was biased because it failed to account for the unique differences between countries, which could impact the dependent variable. On the other hand, the SGMM model was inconsistent because it failed the Sargan test. This indicated that the pooled OLS and the SGMM models

were not appropriate models for this study; going forward, only the FE results are presented and discussed.

Table 1. Baseline results: the impact of commodity price shocks on NPLs.

Dependent Variable: NPL (Credit Risk)					
	POLS	**SGMM**	**FE**	**Positive**	**Negative**
NPL (lagged)		0.603 ***			
		(0.004)			
CPS	0.325 **	0.525 ***	0.381 ***	0.926 ***	0.218
	(0.127)	(0.097)	(0.094)	(0.279)	(0.261)
Capital adequacy	−0.009 ***	0.006 ***	0.026 ***	0.027 ***	0.025 ***
	(0.001)	(0.001)	(0.002)	(0.003)	(0.003)
Profitability	−3.080 ***	−0.364 ***	−0.835 ***	−1.149 ***	−0.746 ***
	(0.042)	(0.042)	(0.044)	(0.085)	(0.090)
Liquidity	−0.081 ***	0.069 ***	0.108 ***	0.122 ***	0.105 ***
	(0.004)	(0.005)	(0.005)	(0.008)	(0.007)
Economic growth	−0.195 ***	−0.230 ***	−0.068 ***	−0.157 ***	0.010
	(0.013)	(0.011)	(0.008)	(0.016)	(0.013)
Inflation	0.461 ***	0.076 ***	−0.009	−0.023 *	0.001
	(0.008)	(0.006)	(0.008)	(0.013)	(0.015)
Unemployment	−0.453 ***	−0.156 ***	0.016	0.054 ***	−0.009
	(0.007)	(0.009)	(0.012)	(0.017)	(0.020)
Gov. revenue	0.075 ***	0.074 ***	−0.080 ***	−0.123 ***	−0.034
	(0.008)	(0.010)	(0.011)	(0.022)	(0.024)
Lending rate	−0.052 ***	0.040 ***	−0.015	−0.006	−0.078 ***
	(0.013)	(0.015)	(0.020)	(0.028)	(0.030)
M2 and reserves	−0.205 ***	−0.056 ***	−0.695 ***	−0.684 ***	−0.679 ***
	(0.016)	(0.018)	(0.014)	(0.022)	(0.023)
Exchange rate	−0.173 ***	0.048 ***	−0.023 ***	−0.016 ***	−0.029 ***
	(0.004)	(0.003)	(0.003)	(0.004)	(0.006)
National savings	−0.176 ***	−0.085 ***	0.198 ***	0.242 ***	0.204 ***
	(0.005)	(0.007)	(0.013)	(0.018)	(0.018)
Constant	22.765 ***	4.486 ***	6.843 ***	7.146 ***	6.300 ***
	(0.419)	(0.471)	(0.498)	(0.735)	(0.693)
Observations	41,421	41,421	41,421	21,936	19,485
R-squared	0.336		0.143	0.156	0.158
Number of newid		7931	7931	6914	7001
F-statistics	5022.600		1729.77		
	(0.000)		(0.000)		
Wald chi-squared		56,726.550			
		(0.000)			
Sargan		29,804.040			
		(0.000)			

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Discussing the results in more detail shows that a one-unit change in the CPS yielded a 0.381% increase in credit risk (Column 4, Table 1). The CPS coefficient of 0.381% was positive and strongly significant at a 1% level of significance. These findings are in line with similar studies (Kinda et al. 2016). The study, therefore, concluded that CPS increases bank credit risk and, thus, poses a risk to the stability of African commodity-exporting economies' banking sectors. This finding adds to the current limited literature on the relationship between CPSs and banking sector stability. Most importantly, it emphasizes that CPSs can yield both macroeconomic and banking sector instability risks.

Briefly focussing on the other banking variables, the coefficient for profitability behaved as expected and was strongly significant at a 1% level of significance. The capital adequacy and the liquidity coefficients did not yield the expected signs, but they were also strongly significant at a 1% level of significance. Basel 3 requirements maintain that rising capital adequacy requirements should act as a safety net for the banking sector and uphold financial stability (Bank for International Settlements 2010), hence the prior statement that it would decrease credit risk. Oduor et al. (2017) established that higher capital adequacy ratios do not necessarily make African banks safer. Similarly, higher liquidity may also not necessarily mean safer banking systems in the case of African countries.

With the macroeconomic variables, real economic growth behaved as expected and was strongly significant at a 1% level of significance. The unemployment and inflation coefficients behaved as expected but were insignificant at all levels. All other macroeconomic variables yielded the expected signs and were significant.

While the CPS variable (Column 4, Table 1 in the previous page) provided valuable information about the impact of unexpected CPSs on banking sector stability, it did not provide any information on whether the impact of a positive CPS on banking sector stability differed from that of a negative CPS. The baseline model was augmented by positive and negative CPS variables in the next estimation.

The estimation results reported in Columns 5 and 6 in Table 1 suggested that positive CPSs in African commodity-exporting economies have a bigger impact on credit risk than negative CPSs. The results indicate that a unit increase in the CPS variable increased credit risk by 0.926% with a 1% level of significance. Even though the negative CPS also increased credit risk, the effect of the coefficient was not significant. These results are not in line with similar studies on the impact of CPSs on banking sector stability (Kinda et al. 2016). These interesting findings are partly explained by the results of Addison et al. (2016), who found, using a similar CPS measure, that positive and negative agricultural CPSs in sub-Saharan African countries did not necessarily respond differently from responses in economic growth[13]. These findings emphasize the importance of disaggregating shocks and isolating the African region because African banking sectors do not seem to respond to positive and negative CPSs in the same manner as those of other developing countries.

5.3. Sensitivity Analysis—Commodity Sub-Categories

This section examines how the banking sector was impacted by the different commodity group shocks, comparing its findings to those reported in the baseline models. The results for the disaggregated commodities are reported in Tables A7–A10.

The estimation results reported in Table A7 suggested that agricultural price shocks increased credit risk and, thus, pose a risk to banking sector stability. The agricultural price shock indicated that a one-unit increase in the agricultural price shock resulted in a 0.394% increase in credit risk; the coefficient was significant at a 1% level of significance. When disaggregated, the results yielded positive coefficients for both the positive and negative agricultural price shocks, but the effect of the coefficients were not significant. The result of no asymmetry between a positive and negative agricultural price shock in African economies was again reiterated in line with the baseline model and Addison et al. (2016).

Table A8 indicates that the mineral and fuel price shock had a positive but insignificant (0.404%) effect on bank credit risk. Further, the disaggregated result (Columns 2 and 3 of Table A8) yielded negative (−0.122%) and positive (1.029%) coefficients for the positive and negative price shocks, as expected, but with no significant[14] impact on credit risk. Even though insignificant, these results behaved as expected and were in line with previous studies that had focused specifically on mineral- and fuel- exporting countries (Poghosyan and Hesse 2009; Alodayni 2016; Miyajima 2016; Al-Khazali and Mirzaei 2017). Al-Khazali and Mirzaei (2017) also finds evidence of asymmetric mineral and fuel price shocks. These findings imply that mineral and fuel commodities are one of the main (or only) commodities where the findings for Africa are exactly in line with those of other developing countries.

The estimation results in Table A9 suggested that metal price shocks significantly increased bank credit risk, with a unit increase in the metal price shock resulting in a 0.324% increase in credit risk at a 10% level of significance. Results for the disaggregated shocks indicated that, with a one-unit increase for the positive, metal price shock increased credit risk by 1.109% at a 5% level of significance. While a negative metal price shock yielded the expected positive sign, the effect was insignificant at all levels. The results behaved as the agricultural results, showing no asymmetry between positive and negative metal price shocks. This implies that metal price fluctuations, in general, could pose a threat to banking sector stability in African countries.

Table A10 presents the results for the chemicals commodity group. The chemicals price shock had a positive but insignificant impact on credit risk (0.375%). The positive chemical price shock was also positive but highly significant with a coefficient of 2.332%. None of the African countries included in the study export chemicals[15], so it was not surprising that a positive chemical price shock resulted in a large increase in bank credit risk. Conversely, a negative chemical price shock yielded a negative coefficient (−0.449%) with no significant effect on credit risk. These results imply that, even though African economies are not exporters of chemicals, their banking systems are still vulnerable to rising chemical price shocks, probably as a result of the exposure of the firms to whom they lend.

5.4. Do Commodity Price Shocks Impact Domestic Lending?

The empirical estimations so far have shown that CPSs increase bank credit risk and, as such, pose a threat to the stability of the banking sector. While instability in the banking sector has been shown to trickle down into the real economy (Agarwal et al. 2017), this section examines whether CPSs have a direct impact on domestic credit extension in commodity-exporting economies.

The results in Table 2 (below) show that the CPS yielded a negative coefficient of −0.053% (as expected) but that it had no significant effect on bank credit extension. When disaggregated, the results revealed that a positive shock increased domestic credit extension (as one would expect) by 0.667% and was significant at a 1% level of significance. Further, the negative shock indicated that commodity price busts substantially decreased domestic credit extension (−0.910%); this result was also established to be significant at a 1% level of significance. These results are in line with Greenwald et al. (1984) and Stiglitz (2016), who said that macroeconomic conditions that have implications for bank balance sheets or that increase risk perceptions usually lead to a contraction in the supply of funds by banks. The findings are also supported by the findings of Agarwal et al. (2017).

In addition to the aggregated findings, Tables A11–A14 show that the overall agricultural, mineral, fuel, and metal price shocks had no significant effect on credit extension in commodity-exporting African economies. However, the overall chemical price shock was found to statistically and significantly decrease credit extension by 0.377% in African countries. The exposure of banks in the sector could be direct or indirect (through firms that are exposed to the sector to which banks lend). When disaggregated, positive agricultural and chemical price shocks, again, had no significant effect on credit extension. However, the mineral, fuel, and metal positive shocks were found to statistically and significantly increase credit extension. Finally, negative price shocks in the mineral, fuel, chemical, and metal commodity groups seemed to have large negative impacts on bank lending in African countries. It is important to outline that, while all coefficients for the agricultural group were insignificant, the results did indeed show the true reality of the agricultural sector in African countries. The agricultural sector has constantly struggled and continues to struggle with accessing funding from the banking sector (Varangis 2018). Therefore, it is not entirely surprising that agricultural shocks had no significant effect on bank lending. The statistically significant findings are in line with Greenwald et al. (1984) and Stiglitz (2016), who said that macroeconomic conditions that have implications for bank balance sheets or that increase risk perceptions usually lead to a contraction in the supply of funds by banks. These findings are further supported by the findings of Agarwal et al. (2017). As

previously observed, the African countries included in this sample have extremely high capital adequacy ratios. High capital adequacy ratios have a negative impact on bank lending, since they limit the amount available for lending. This, combined with the fact that CPSs decrease lending, could, therefore, worsen lending conditions and stifle economic growth and development. Overall, the results revealed that certain CPSs not only weaken banking sector stability through credit risk but could also have a direct impact on bank credit extension.

Table 2. The impact of commodity price shocks on credit extension.

Dependent Variable: Domestic Credit Extension			
	Overall	**Positive**	**Negative**
Commodity price shock	−0.053	0.667 ***	−0.910 ***
	(0.074)	(0.247)	(0.276)
Real economic growth	0.304 ***	0.288 ***	0.346 ***
	(0.010)	(0.013)	(0.016)
Unemployment	−0.660 ***	−0.674 ***	−0.690 ***
	(0.021)	(0.026)	(0.026)
Savings	−0.874 ***	−0.875 ***	−0.890 ***
	(0.021)	(0.024)	(0.026)
Lending rate	−0.101 ***	−0.086 ***	−0.100 ***
	(0.014)	(0.017)	(0.017)
Constant	67.718 ***	67.684 ***	68.050 ***
	(0.518)	(0.632)	(0.657)
Observations	65,053	34,442	30,611
R-squared	0.173	0.173	0.179
Number of newid	9470	8293	8348

Note: Robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

6. Conclusions

Considering the volatility of commodity prices and African economies' dependence on commodities, this study investigated the impact of CPSs on the banking system stability of African commodity-exporting economies. The study employed a FE model on a sample of 18 African commodity-exporting economies. The findings revealed that CPSs are associated with a rise in bank credit risk (NPL) and, thus, pose a risk to the banking sector stability of African commodity-exporting countries. An important finding from this study was that positive and negative CPSs do not necessarily vary in their impact on banking sector stability. This finding is not in line with previous studies (Kinda et al. 2016). These results are supported by Addison et al. (2016), who established that positive and negative agricultural price shocks in African countries do not necessarily yield asymmetric results[16].

When disaggregated, the agricultural and metal price shocks behaved as in the baseline model, with the shocks increasing credit risk and, thus, posing a threat to banking sector stability. These two commodity groups indicated no asymmetry as both positive and negative shocks yielded positive signs. The positive metal price shock was the only statistically significant coefficient. The positive and negative mineral and fuels shock yielded the desired effects, but none was statistically significant. The mineral and fuel sector was the only commodity group that seemed to behave in line with other developing countries. In contrast, a positive chemical price shock significantly increased bank credit risk, which can possibly be explained by the fact that African economies import more chemicals than they export. The negative chemical price yielded the expected sign but was statistically significant. The results for the mineral, fuel, and chemical commodity groups indicated asymmetry when the CPS was disaggregated.

Following the estimation of the impact of CPSs on bank lending, the findings indicated that CPSs decrease bank lending. When disaggregated, the results revealed that positive CPSs insignificantly increased bank lending but that a negative CPS substantially and significantly decreased bank lending. These results suggested that, while a positive CPS

boosts bank lending, the boost is not to the same magnitude that a negative CPS decreases bank lending. Further, negative price shocks in the mineral, fuel, chemical, and metal commodity groups seemed to have large negative impacts on bank lending in African countries. Therefore, the study deduced that, even though CPSs weaken banking sector stability through credit risk, they could also have a direct impact on bank lending as bank perceptions of macroeconomic risks rise. The results of this study cannot be generalized for all developing countries given that the banking system and financial sector of the African region differs from other regions of the world.

The main policy implication of this study is that it highlighted that commodity price shocks can impact the banking sector of African commodity-dependent countries. This finding implies that African countries need to adopt and implement policies that protect the banking sector from CPSs. The study makes the following recommendations: First, considering the finding that commodity price shocks can impact the banking sector, as well as credit extension to the private sector, African central banks need to strengthen the macroprudential regulation and oversight of the banking sector in order to ensure that it remains resilient to CPSs. Further, their policies should help mitigate systemic risk so that the vulnerabilities faced by one sector do not spill over to other sectors in the economy. Second, the study also found that both positive and negative shocks weigh on banking sector stability. This finding highlights the need for African economies to extensively diversify their exports and economic activities. A more diversified economy means that countries can rely on alternative sources of revenue. This is especially important for the agricultural and metal-dependent African countries. Third, in line with the finding that mineral and fuel, as well as chemical, price shocks resulted in a substantial increase in credit risk, African economies must establish and maintain a robust sovereign wealth fund[17] that can be used to protect the economies from excess export revenue volatility.

The managerial implications of this study are: (i) Bank managers and the financial sector should put mechanisms in place such as consistently maintaining enough fiscal reserves (e.g., through the establishment of a sovereign wealth fund) because this will help reduce the detrimental impact that is usually associated with commodity price fluctuations on the banking system. (ii) Bank managers and the financial sector should partner with the government by strongly supporting the development of counter-cyclical capital buffers that will help mitigate the impact of commodity price shocks on bank balance sheets. (iii) Bank managers and stakeholders in the banking sector should closely and regularly monitor and anticipate uncertainty that may likely occur in the return process of agricultural projects, since, by nature, agricultural projects supported by loans are sensitive to many risk factors (e.g., price of inputs, demand, weather conditions, and uncertainty of spot price of produce). (iv) Stakeholders in the banking sector should adopt macroprudential policies, since they act as an important factor for the stability of the financial sector and given that they are also gaining attention internationally as a useful tool to address system-wide risks in the banking sector. (v) Bank managers and stakeholders should revisit prudent guidelines to stem the credit risks associated with the systemic risks of oil price volatility and should also consider establishing early warning and response mechanisms for commodity price shocks in order to operate with better performance.

Provided that this study focused on 18 African commodity-exporting economies, it would be beneficial for future research to probe the CPS and banking sector stability relationship for a single commodity-exporting country. The study used aggregated banking data; it would be extremely interesting to analyze this relationship at a bank-specific level for African economies, as it would provide more granular information on the banks that pose the greatest risk to banking sector stability. In addition, with the popularity of cross-border bank expansions in Africa, research on whether banking sector instability in a host country (and resulting CPSs) exacerbates banking sector instability in the home country would also be of interest. Finally, the NPL data employed in the study were aggregated; it would be extremely useful to find granular data that separates credit risk by government, corporate, and household sectors.

The biggest difficulty with this study was data collection. Data for African economies are quite difficult to collect, and this made it impossible to include a larger sample of African countries. Additionally, the dataset was unbalanced, but the econometric method employed was suitable for an unbalanced dataset. Another limitation of this study was that it could not extend the period to cover the COVID-19 pandemic period due to data problems for the variables used. Therefore, future studies should take into account the pandemic period for the purpose of obtaining a better understanding in terms of the impact of commodity price shocks on banking system stability in developing countries. Future studies should also investigate by forecasting the commodity price shocks and the possible impact they will have on the banking system stability of developing countries.

Author Contributions: Conceptualization, N.N. and M.L.A.d.S.; methodology, N.N., M.L.A.d.S. and C.S.S.; software, N.N.; validation, N.N., M.L.A.d.S. and C.S.S.; formal analysis, N.N., M.L.A.d.S. and C.S.S.; investigation, N.N., M.L.A.d.S. and C.S.S.; resources, N.N., M.L.A.d.S. and C.S.S.; data curation, N.N., M.L.A.d.S. and C.S.S.; writing—original draft preparation, N.N., M.L.A.d.S. and C.S.S.; writing—review and editing, N.N., M.L.A.d.S. and C.S.S.; visualization, N.N., M.L.A.d.S. and C.S.S.; supervision, N.N. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The data used for this study can be found at: (i) Federal Reserve Economic Data (FRED) of St. Louis (https://fred.stlouisfed.org/# (accessed on 1 July 2016)); (ii) The World Bank (WB) Global Financial Development databases (https://www.worldbank.org/en/publication/gfdr/data/global-financial-development-database (accessed on 1 July 2016)) and the IMF (https://www.imf.org/en/Data (accessed on 1 July 2016)); and (iii) The United Nation (UN) Comtrade database (https://comtrade.un.org/ (accessed on 1 July 2016)).

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. List of countries included in the sample.

1.	Botswana	2.	Mozambique
3.	Egypt	4.	Namibia
5.	Gabon	6.	Nigeria
7.	Ghana	8.	Rwanda
9.	Kenya	10.	Senegal
11.	Lesotho	12.	Sierra Leone
13.	Mauritius	14.	South Africa
15.	Morocco	16.	Swaziland
17.	Tunisia	18.	Uganda

Table A2. Commodity groups included in the sample.

1.	Aluminum	2.	Inorganic Chemicals
3.	Cocoa	4.	Coffee, Tea, and Spices
5.	Copper	6.	Cotton
7.	Dairy	8.	Fish
9.	Fruit	10.	Iron
11.	Lead	12.	Livestock
13.	Trees	14.	Meat
15.	Minerals and Fuels	16.	Nickel

Table A2. *Cont.*

17.	Ores	18.	Organic Metals
19.	Precious Metals	20.	Animal Products
21.	Hides	22.	Silk
23.	Salts	24.	Sugar
25.	Tin	26.	Tobacco
27.	Vegetables	28.	Wheat
29.	Wool	30.	Zinc
31.	Organic Chemicals		

Table A3. Data description and sources.

Variables	Description	Sources	Expected Impact
Dependent variable			
Non-performing loan	The value of NPLs to total value of loans (annual %)	WB	+/-
Financial stability indicators (FSIs)			
Capital adequacy		FRED/WB	-
Profitability	Net income to yearly averaged total assets (annual %)	FRED/WB	-
Liquidity	Value of liquid assets to short-term funding plus total deposits	FRED/WB	-
Macroeconomic/control variables			
Commodities	Annual trade value of exported commodities	UN Comtrade	+
Real economic growth	Annual % growth rate at constant prices	WB	-
Inflation	Annual % consumer prices	WB	-
Unemployment.	Unemployment as a % of total labor force	WB	+
Credit extension	Credit to private sector by bank (% of GDP)	WB	+
Government revenue	All taxed, excluding grants (% of GDP)	WB	-
Lending rate	Lending interest rate %	WB	-
M2 and reserves	Broad money to international reserves	FRED	-
Exchange rate	Annual percentage change exchange rate	Penn World Table 9.0	+
Savings	GDP minus final consumption expenditure (% of GDP)	WB	-
Commodity price shock determinant			
Commodity price shock (CPS)	Real oil price change (Farzanegan and Markwardt 2009; Mork 1989)	UN Comtrade	+

Source: Author collection.

Table A4. Phillip-Perron unit root test.

Variables	Level
Non-performing loans	4243.23 (0.00) ***
Capital adequacy	4416.50 (0.00) ***
Profitability	7623.87 (0.00) ***
Liquidity	4238.25 (0.00) ***
Real economic growth	10,300.00 (0.00) ***
Inflation	5084.31 (0.00) ***
Unemployment	2581.38 (0.00) ***
Government revenue	4030.54 (0.00) ***
Lending rate	1094.76 (0.00) ***
Domestic credit extension	3786.62 (0.00) ***
M2 and reserves	1980.33 (0.00) ***
Exchange rate	4219.53 (0.00) ***
Savings	2379.46 (0.00) ***
Commodity price shock	16,200.00 (0.00) ***

Source: Author computations. H_0: All panels contain unit roots; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A5. Descriptive statistics.

Variable	Obs	Mean	Std Dev	Min	Max
Non-performing loans	41,421	9.187	8.153	1.000	74.100
Capital adequacy	41,421	61.558	24.520	1.800	188.100
Profitability	41,421	1.958	1.378	−0.630	9.910
Liquidity	40,415	29.838	12.384	6.520	90.680
Real economic growth	41,421	4.474	2.685	−20.491	26.269
Inflation	41,386	6.458	4.601	−3.286	32.905
Unemployment	41,421	15.307	8.120	0.744	37.600
Government revenue	39,674	24.694	7.737	4.977	63.512
Lending rate	39,276	13.520	4.446	4.460	26.708
Domestic credit	41,421	43.089	23.494	1.944	106.260
M2 and external reserves	41,235	4.493	3.383	0.227	55.924
Exchange rate	40,754	4.458	13.438	−28.233	104.363
Savings	41,412	16.195	9.739	−37.008	60.490
Commodity price shock	41,421	0.160	0.466	−2.290	2.858

Source: Author computations.

Table A6. Correlation matrix.

	Non-Performing Loan	Capital Adequacy	Profitability	Liquidity	Real GDP	Unemployment	Gov. Revenue	Domestic Credit	Commodity Price Shock
NPL	1.000								
Capital adequacy	−0.104 ***	1.000							
Profitability	−0.241 ***	0.196 ***	1.000						
Liquidity	0.074 ***	−0.010 ***	0.007 **	1.000					
Real GDP	−0.014 ***	0.183 ***	0.289 ***	0.126 ***	1.000				
Unemployment	−0.426 ***	−0.019 ***	−0.050 ***	−0.232 ***	−0.234 ***	1.000			
Gov. revenue	−0.246 ***	0.142 ***	−0.190 ***	−0.267 ***	−0.157 ***	0.655 ***	1.000		
Domestic credit	−0.196 ***	−0.324 ***	−0.479 ***	−0.158 ***	−0.286 ***	0.349 ***	0.414 ***	1.000	
Commodity price shock	0.128 ***	0.009 **	0.081 ***	0.093 ***	0.005	−0.040 ***	−0.105 ***	−0.115 ***	1.000

Source: Author computations. *** $p < 0.01$, ** $p < 0.05$ and * $p < 0.10$.

Table A7. Agricultural commodity price shock and the banking sector.

Dependent Variable: Credit Risk			
	Overall	**Positive**	**Negative**
Commodity price shock	0.394 ***	0.451	0.199
	(0.152)	(0.459)	(0.402)
Capital adequacy	0.019 ***	0.022 ***	0.012 **
	(0.003)	(0.005)	(0.005)
Profitability	−0.752 ***	−1.364 ***	−0.343 ***
	(0.064)	(0.132)	(0.125)
Liquidity	0.083 ***	0.088 ***	0.086 ***
	(0.006)	(0.009)	(0.009)
Real economic growth	−0.075 ***	−0.129 ***	−0.031 *
	(0.010)	(0.021)	(0.017)
Inflation	−0.039 ***	−0.047 **	−0.052 **
	(0.013)	(0.021)	(0.022)

Table A7. *Cont.*

Dependent Variable: Credit Risk			
	Overall	**Positive**	**Negative**
Unemployment	−0.039 **	0.005	−0.068 ***
	(0.017)	(0.025)	(0.025)
Government revenue	−0.110 ***	−0.183 ***	−0.047
	(0.015)	(0.031)	(0.033)
Lending rate	0.010	0.113 **	−0.151 ***
	(0.031)	(0.044)	(0.044)
M2 and reserves	−0.779 ***	−0.777 ***	−0.762 ***
	(0.019)	(0.032)	(0.031)
Exchange rate	0.004	0.001	0.012
	(0.005)	(0.007)	(0.009)
Savings	0.175 ***	0.183 ***	0.212 ***
	(0.018)	(0.027)	(0.022)
Constant	9.345 ***	10.163 ***	9.204 ***
	(0.694)	(0.974)	(1.001)
Observations	16,545	8898	7647
R-squared	0.157	0.168	0.185
Number of newid	2884	2566	2607

Robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. **Source**: Author computations.

Table A8. Mineral and fuel commodity price shock and the banking sector.

Dependent Variable: Credit Risk			
	Overall	**Positive**	**Negative**
Commodity price shock	0.404	−0.122	1.029
	(0.282)	(0.774)	(0.750)
Capital adequacy	0.012 **	0.004	0.025 **
	(0.006)	(0.009)	(0.010)
Profitability	−0.734 ***	−0.187	−1.440 ***
	(0.007)	(0.010)	(0.008)
Liquidity	0.113 ***	0.132 ***	0.117 ***
	(0.015)	(0.025)	(0.020)
Real economic growth	−0.055 **	−0.212 ***	0.023
	(0.022)	(0.051)	(0.036)
Inflation	−0.065 **	−0.082 *	−0.081 *
	(0.028)	(0.042)	(0.047)
Unemployment	−0.002	−0.042	0.049
	(0.033)	(0.046)	(0.051)
Government revenue	−0.051 **	−0.059	−0.002
	(0.026)	(0.063)	(0.053)
Lending rate	−0.008	−0.033	−0.013
	(0.062)	(0.079)	(0.093)
M2 and reserves	−0.665 ***	−0.716 ***	−0.558 ***
	(0.037)	(0.067)	(0.057)
Exchange rate	−0.016	0.010	−0.035 *
	(0.010)	(0.013)	(0.020)
Savings	0.189 ***	0.206 ***	0.230 ***
	(0.036)	(0.048)	(0.037)
Constant	7.663 ***	8.396 ***	5.365 ***
	(1.497)	(2.499)	(1.915)
Observations	4235	2250	1985
R-squared	0.163	0.147	0.215
Number of newid	796	708	694

Robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. **Source**: Author computations.

Table A9. Metal commodity price shock and the banking sector.

Dependent Variable: Credit Risk			
	Overall	**Positive**	**Negative**
Commodity price shock	0.324 *	1.109 **	0.372
	(0.174)	(0.455)	(0.478)
Capital adequacy	0.025 ***	0.034 ***	0.012 *
	(0.004)	(0.005)	(0.007)
Profitability	−0.742 ***	−1.484 ***	−0.375 **
	(0.093)	(0.163)	(0.188)
Liquidity	0.087 ***	0.120 ***	0.063 ***
	(0.011)	(0.015)	(0.015)
Real economic growth	−0.021	−0.048 *	0.052 **
	(0.013)	(0.028)	(0.023)
Inflation	0.004	−0.011	−0.011
	(0.016)	(0.028)	(0.030)
Unemployment	−0.012	0.099 ***	−0.104 **
	(0.023)	(0.031)	(0.041)
Government revenue	−0.039 **	−0.100 **	0.047
	(0.020)	(0.041)	(0.047)
Lending rate	0.013	−0.032	−0.001
	(0.040)	(0.053)	(0.061)
M2 and reserves	−0.681 ***	−0.657 ***	−0.654 ***
	(0.029)	(0.043)	(0.047)
Exchange rate	−0.031 ***	−0.041 ***	−0.023 *
	(0.006)	(0.009)	(0.012)
Savings	0.134 ***	0.227 ***	0.080 **
	(0.025)	(0.033)	(0.038)
Constant	6.248 ***	5.462 ***	6.912 ***
	(0.937)	(1.378)	(1.365)
Observations	10,847	5608	5239
R-squared	0.114	0.162	0.103
Number of newid	2154	1862	1888

Robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. **Source**: Author computations.

Table A10. Chemical commodity price shock and the banking sector.

Dependent Variable: Credit Risk			
	Overall	**Positive**	**Negative**
Commodity price shock	0.375	2.332 ***	−0.449
	(0.232)	(0.746)	(0.674)
Capital adequacy	0.063 ***	0.053 ***	0.085 ***
	(0.004)	(0.008)	(0.009)
Profitability	−0.431 ***	0.065	−1.191 ***
	(0.155)	(0.249)	(0.277)
Liquidity	0.324 ***	0.352 ***	0.300 ***
	(0.028)	(0.040)	(0.037)
Real economic growth	−0.223 ***	−0.404 ***	−0.070
	(0.033)	(0.064)	(0.064)
Inflation	0.033 **	0.003	0.105 ***
	(0.016)	(0.028)	(0.041)
Unemployment	0.276 ***	0.256 ***	0.363 ***
	(0.037)	(0.051)	(0.076)
Government revenue	−0.089 *	−0.013	−0.219 **
	(0.048)	(0.073)	(0.102)
Lending rate	−0.169 ***	−0.250 ***	−0.136 **
	(0.047)	(0.066)	(0.066)
M2 and reserves	−0.456 ***	−0.316 ***	−0.602 ***
	(0.052)	(0.090)	(0.086)

Table A10. *Cont.*

Dependent Variable: Credit Risk			
	Overall	**Positive**	**Negative**
Exchange rate	−0.059 ***	−0.023 **	−0.093 ***
	(0.007)	(0.011)	(0.013)
Savings	0.487 ***	0.593 ***	0.495 ***
	(0.049)	(0.062)	(0.084)
Constant	−7.477 ***	−10.660 ***	−5.887 **
	(2.126)	(3.044)	(2.976)
Observations	8028	4284	3744
R-squared	0.245	0.244	0.304
Number of newid	1705	1441	1476

Robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. **Source**: Author computations.

Table A11. The impact of agricultural price shocks on credit extension.

Dependent Variable: Domestic Credit Extension			
	Overall	**Positive**	**Negative**
Commodity price shock	0.074	0.019	−0.562
	(0.117)	(0.390)	(0.440)
Real economic growth	0.233 ***	0.219 ***	0.258 ***
	(0.015)	(0.020)	(0.023)
Unemployment	−0.610 ***	−0.645 ***	−0.611 ***
	(0.033)	(0.041)	(0.041)
Savings	−0.976 ***	−0.934 ***	−1.042 ***
	(0.034)	(0.040)	(0.040)
Lending rate	−0.034	−0.019	−0.023
	(0.021)	(0.026)	(0.025)
Constant	63.688 ***	63.701 ***	63.965 ***
	(0.791)	(0.990)	(0.963)
Observations	25,381	13,553	11,828
R-squared	0.168	0.158	0.184
Number of newid	3442	3083	3103

Robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. **Source**: Author computations.

Table A12. The impact of mineral and fuel price shocks on credit extension.

Dependent Variable: Domestic Credit Extension			
	Overall	**Positive**	**Negative**
Commodity price shock	0.094	2.145 ***	−2.176 **
	(0.226)	(0.751)	(0.917)
Real economic growth	0.324 ***	0.308 ***	0.360 ***
	(0.027)	(0.038)	(0.040)
Unemployment	−0.539 ***	−0.540 ***	−0.563 ***
	(0.057)	(0.066)	(0.072)
Savings	−0.717 ***	−0.667 ***	−0.834 ***
	(0.068)	(0.078)	(0.086)
Lending rate	0.026	−0.005	0.068
	(0.039)	(0.043)	(0.047)
Constant	58.570 ***	58.569 ***	58.823 ***
	(1.524)	(1.740)	(1.971)
Observations	6443	3430	3013
R-squared	0.118	0.114	0.142
Number of newid	954	853	832

Robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. **Source**: Author computations.

Table A13. The impact of metal price shocks on credit extension.

Dependent Variable: Domestic Credit Extension	**Overall**	**Positive**	**Negative**
Commodity price shock	−0.167	1.396 ***	−0.849 *
	(0.137)	(0.458)	(0.503)
Real economic growth	0.326 ***	0.326 ***	0.356 ***
	(0.019)	(0.026)	(0.030)
Unemployment	−0.533 ***	−0.504 ***	−0.589 ***
	(0.031)	(0.038)	(0.041)
Savings	−0.894 ***	−0.940 ***	−0.850 ***
	(0.040)	(0.043)	(0.052)
Lending rate	−0.157 ***	−0.118 ***	−0.182 ***
	(0.025)	(0.028)	(0.032)
Constant	66.725 ***	65.841 ***	67.323 ***
	(0.887)	(1.034)	(1.152)
Observations	17,063	8930	8133
R-squared	0.194	0.199	0.189
Number of newid	2540	2201	2240

Robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. **Source**: Author computations.

Table A14. The impact of chemical price shocks on credit extension.

Dependent Variable: Domestic Credit Extension	**Overall**	**Positive**	**Negative**
Commodity price shock	−0.377 **	−0.063	−1.205 *
	(0.185)	(0.612)	(0.636)
Real economic growth	0.348 ***	0.309 ***	0.406 ***
	(0.027)	(0.037)	(0.045)
Unemployment	−1.192 ***	−1.295 ***	−1.251 ***
	(0.072)	(0.097)	(0.094)
Savings	−0.662 ***	−0.693 ***	−0.611 ***
	(0.038)	(0.043)	(0.048)
Lending rate	−0.365 ***	−0.390 ***	−0.373 ***
	(0.049)	(0.060)	(0.062)
Constant	87.218 ***	89.746 ***	87.698 ***
	(1.791)	(2.327)	(2.395)
Observations	13,453	7162	6291
R-squared	0.225	0.248	0.217
Number of newid	2084	1767	1782

Robust standard errors in parentheses; *** $p < 0.01$, ** p < 0.05, * $p < 0.1$. **Source**: Author computations.

Notes

1 This increase represents the magnitude of the shock. This is a shock that does not distinguish between a negative or positive shock.
2 Credit extension to the private sector and bank lending are used interchangeably.
3 A shock in one institution or economy that spreads and impacts other institutions or economies.
4 Competitiveness of companies that depend on government contracts is compromised.
5 Run on a bank occurs when a large number of depositors, fearing that their bank will be unable to repay their deposits in full and on time, simultaneously try to withdraw their funds immediately.
6 Capital adequacy, asset quality, earnings, profitability, liquidity, and sensitivity to market risk (IMF 2006).
7 Breusch-Pagan Lagrangian multiplier and Hausman tests further motivated the use of the panel fixed effects model for the study.
8 Sargan's test of over-identified instruments tests the overall validity of the instruments used in the estimation process.
9 Represents the number of days in a year.
10 Akaike's information criterion (AIC), Schwarz's Bayesian information criterion (SBIC) and Hannan and Quinn's Information Criterion (HQIC) tests were computed per country to determine the most appropriate lag length.
11 Therefore, the study has three various shocks: a CPS (1), a positive CPS, and a negative CPS.
12 Basel 3 regulations require banks to maintain a minimum capital adequacy ratio of only 8% (Bank for International Settlements 2010).

[13] The study is not exactly related to banking sector, but the fact that the measure used obtained similar results is important for this study. Further, agriculture makes up a significantly large portion of the dataset.

[14] The minerals and fuels commodity group had the smallest sample in the study. This may have contributed to the insignificance.

[15] African economies import chemicals.

[16] While this study did not solely focus on the agricultural sector, it constituted the largest portion of the dataset.

[17] That can be built during periods of commodity price booms.

References

Addison, Tony, Atanu Ghoshray, and Michalis P. Stamatogiannis. 2016. Agricultural Commodity Price Shocks and Their Effect on Growth in Sub-Saharan Africa. *Journal of Agricultural Economics* 67: 47–61. [CrossRef]

Agarwal, Isha, Rupa Duttagupta, and Andrea F Presbitero. 2017. *International Commodity Prices and Domestic Bank Lending in Developing Countries*. IMF Working Paper, 17/279. Washington, DC: International Monetary Fund.

Al-Khazali, Osamah M., and Ali Mirzaei. 2017. The Impact of Oil Price Movements on Bank Non-Performing Loans: Global Evidence from Oil-Exporting Countries. *Emerging Markets Review* 31: 193–208. [CrossRef]

Allen, Craig R., Joseph J. Fontaine, Kevin L. Pope, and Ahjond S. Garmestani. 2011. Adaptive management for a turbu-lent future. *Journal of Environmental Management* 92: 1339–1345. [CrossRef]

Alesina, Alberto, Filipe R. Campante, and Guido Tabellini. 2008. Why Is Fiscal Policy Often Procyclical? *Journal of the European Economic Association* 6: 1006–36. [CrossRef]

Alodayni, Saleh. 2016. Oil Prices, Credit Risks in Banking Systems, and Macro-Financial Linkages across GCC Oil Exporters. *International Journal of Financial Studies* 4: 23. [CrossRef]

Arellano, Manuel, and Olympia Bover. 1995. Another Look at the Instrumental Variable Estimation of Erro-Components Model. *Journal of Econometrics* 68: 29–51. [CrossRef]

Bangara, Bertha Chipo, and John Paul Dunne. 2018. Macroeconomic Effects of Commodity Price Shocks in a Low-Income Economy: The Case of Tobacco in Malawi. *South African Journal of Economics* 86: 53–75. [CrossRef]

Bank for International Settlements. 2010. A Global Regulatory Framework for More Resilient Banks and Banking Systems, Basel Committee on Banking Supervision. Available online: http://www.bis.org/publ/bcbs189.htm (accessed on 19 December 2016).

Bems, Rudolfs, and Irineu De Carvalho Filho. 2011. Current Account and Precautionary Savings for Exporters of Exhaustible Resources. *Journal of International Economics* 84: 48–64. [CrossRef]

Bernanke, Ben S., Mark Gertler, and Simon Gilchrist. 1999. The financial accelerator in a quantitative business cycle framework. In *Handbook of Macroeconomics*. Amsterdam: Elsevier Science B.V., pp. 1341–93. [CrossRef]

Blanchard, Olivier J., and Jordi Gal. 2008. *The Macroeconomic Effects of Oil Price Shocks: Why Are the 2000s So Different from the 1970s*? National Bureau of Economic Re-search Working Paper, 13368. Available online: https://www.nber.org/system/files/working_papers/w13368/w13368.pdf (accessed on 22 January 2017).

Bruckner, Markus, and Antonio Ciccone. 2010. International commodity prices, growth and the outbreak of civil war in sub-saharan africa. *The Economic Journal* 120: 519–34. [CrossRef]

Caggiano, Giovanni, Pietro Calice, Leone Leonida, Steve Kayizzi-mugerwa, and C. John. 2013. Early Warning Systems and Systemic Banking Crises in Low Income Countries: A Multinomial Logit Approach. *African Development Bank Group* 47: 258–69. [CrossRef]

Cashin, Paul, and John McDermott. 2002. The Long-Run Behavior of Commodity Prices: Small Trends and Big Variability. *IMF Staff Papers* 49: 175–99. [CrossRef]

Chironga, Mutsa, Luis Cunha, Hilary De Grandis, and Mayowa Kuyoro. 2018. Roaring to Life: Growth and Innovation in African Retail Banking. Available online: https://www.mckinsey.com/~/media/McKinsey/Industries/FinancialServices/OurInsights/Africanretailbankingsnextgrowthfrontier/Roaring-to-life-growth-and-innovation-in-African-retail-banking-web-final.ashx (accessed on 22 January 2017).

Christensen, Benedicte Vibe. 2016. *Challenges of Low Commodity Prices for Africa*. Basel: Bank for International Settlements, pp. 1–12.

Deaton, Angus, and Ronald I. Miller. 1995. *International Commodity Prices, Macroeconomic Performance, and Politics in Sub-Saharan Africa*. Princeton Studies in International Finance. 79. Princeton: International Finance Section, Department of Economics, Princeton University. Available online: https://d1wqtxts1xzle7.cloudfront.net/4082210/international_commodity_prices_and_macroeconomic_performance_in_subsaharan_africa-with-cover-page-v2.pdf?Expires=1649160432&Signature=FfwhgjFuLEEc4m9tav0WMN11paUOXciXCoDnCoHuNo9cCF7oSvQrT3-PENe-BwroY1a8R1MF5gwZFLp9lznolfzE5QDLP336AD2dPov2rnwBRnv8Gk9wrvxI1lyjXjiOesmWL7-yhcRQZp~yrwSjSZHJ1Ydd1z6OT6wNGXqBTbMTQhiWUg40bArIO8EcOjD-x9~AFlZCNCateUvnbjnq-7v4Yh3CDOYX4inzsDmvekSxFXaJ8LkwLh6RmqbOjpCDP4UMwpEtMw7BiNiBvWc6i2SmVxzBAJsAcaxBwWlQQpiCrb9NGh~32cwAzakj2hQhamxPH6P1DxtJ202Xe7K9ww__&Key-Pair-Id=APKAJLOHF5GGSLRBV4ZA (accessed on 19 December 2016).

Dehn, Jan. 2000. *Commodity Price Uncertainty and Shocks: Implications for Economic Growth*. WPS/2000-10. Available online: https://invenio.unidep.org/invenio/record/11811/files/wps2000-10.pdf (accessed on 19 May 2017).

Dietrich, Andreas, and Gabrielle Wanzenried. 2014. The determinants of commercial banking profitability in low-, middle-, and high-income countries. *Quarterly Review of Economics and Finance* 54: 337–54. [CrossRef]

Doumenis, Yianni, Javad Izadi, Pradeep Dhamdhere, Epameinondas Katsikas, and Dimitrios Koufopoulos. 2021. A critical analysis of volatility surprise in Bitcoin cryptocurrency and other financial assets. *Risks* 9: 207. [CrossRef]

Eberhardt, Markus, and Andrea Presbitero. 2018. *Commodity Price Movements and Banking Crises*. IMF Working Paper, 153. Washington, DC: International Monetary Fund.

Farzanegan, Mohammad Reza, and Gunther Markwardt. 2009. The effects of oil price shocks on the Iranian economy. *Energy Economics* 31: 134–51. [CrossRef]

Flamini, Valentina, Calvin A. McDonald, and Liliana B. Schumacher. 2009. The Determinants of Commercial Bank Profitability in Sub-Saharan Africa. Available online: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1356442 (accessed on 28 December 2016).

Ftiti, Zied, Sandrine Kablan, and Khaled Guesmi. 2016. What can we learn about commodity and credit cycles? Evidence from African commodity-exporting countries. *Energy Economics* 60: 313–24. [CrossRef]

Greenwald, Bruce, and Joseph E. Stiglitz. 1991. Towards a Reformulation of Monetary Theory: Competitive Banking. *Economic and Social Review* 23: 1–34. [CrossRef]

Greenwald, Bruce, and Joseph E Stiglitz. 2003. *Towards a New Paradigm for Monetary Economics*. Cambridge: Cambridge University Press, pp. 1–199. [CrossRef]

Greenwald, Bruce, Joseph E. Stiglitz, and Andrew Weiss. 1984. Information Imperfections on the Capital Market and Macro-economic Fluctuations. *American Economic Review* 74: 194–99. [CrossRef]

Hamilton, James D. 1983. Oil and the Macroeconomy since World War II. *Journal of Political Economy* 91: 228–48. Available online: http://www.jstor.org/stable/18 (accessed on 22 February 2017). [CrossRef]

Hamilton, James D. 2009. *Causes and Consequences of the Oil Shock of 2007–2008*. (No. w15002). National Bureau of Economic Research. vol. 40, pp. 215–83. Available online: https://www.brookings.edu/wp-content/uploads/2016/07/2009a_bpea_hamilton-1.pdf (accessed on 22 December 2016).

Hammond, John L. 2011. The Resource Curse and Oil Revenues in Angola and Venezuela. *Science & Society* 75: 348–78.

Ighobor, Kingsley. 2016. Commodity Prices Crash Hits Africa, Africa Renewal. Available online: http://www.un.org/africarenewal/magazine/december-2016-march-2017/commodity-prices-crash-hits-africa (accessed on 22 June 2017).

IMF. 2006. *Indicators*. Washington, DC: International Monetary. Available online: https://www.imf.org/external/pubs/ft/fsi/guide/2006/index.htm (accessed on 24 April 2016).

IMF. 2017. *Macroeconomic Developments and Prospects*. IMF Staff Paper, 17/07. Washington, DC: International Monetary. Available online: https://www.imf.org/en/Publications/Policy-Papers/Issues/2017/01/13/PP5086-Macroeconomic-Developments-and-Prospects-in-Low-Income-Developing-Countries-2016 (accessed on 22 May 2017).

Kablan, Sandrine, Zied Ftiti, and Khaled Guesmi. 2017. Commodity price cycles and financial pres-sures in African commodities exporters. *Emerging Markets Review* 30: 215–31. [CrossRef]

Kaminsky, Graciela L., and Carmen M. Reinhart. 1999. The Twin Crises: The Causes of Banking and Balance-Of-Payments Problems. *The American Economic Association* 89: 473–500. [CrossRef]

Karl, Terry Lynn. 2004. Oil-Led Development: Social, Political, and Economic Consequences. *Encyclopedia of Energy* 4: 661–72.

Kilian, Lutz, Alessandro Rebucci, and Nikola Spatafora. 2009. Oil shocks and external balances. *Journal of International Economics* 77: 181–94. [CrossRef]

Kinda, Tidiane, Montfort Mlachila, and Rasmané Ouedraogo. 2016. *Commodity Price Shocks and Financial Sector Fragility*. IMF Working Paper, 16/12. Washington, DC: International Monetary. Available online: https://www.imf.org/external/pubs/ft/wp/2016/wp1612.pdf (accessed on 22 January 2017).

Kooros, Syrous K, and Marjorie Semetesy. 2016. *The Impact of Oil Prices on the Banking System in the GCC*. IMF Working Paper, 16/161. Washington, DC: International Monetary. Available online: https://www.imf.org/external/pubs/ft/wp/2016/wp16161.pdf (accessed on 25 February 2017).

Lescaroux, François, and Valérie Mignon. 2008. On the Influence of Oil Prices on Economic Activity and Other Macroeconomic and Financial Variables. *OPEC Energy Review* 32: 267–380. [CrossRef]

Magnus, M., J. Deslandes, and C. Dias. 2017. Non-Performing Loans in the Banking Union. Available online: https://ellinofreneianet.gr/wp-content/uploads/2018/10/IPOL_BRI2018614491_EN.pdf (accessed on 17 April 2019).

Makri, Vasiliki, Athanasios Tsagkanos, and Athanasios Bellas. 2014. Determinants of non-performing loans: The case of Eurozone. *Panoeconomicus* 61: 193–206. [CrossRef]

Miyajima, By Ken. 2016. *An Empirical Investigation of Oil-Macro-Financial Linkages in Saudi Arabia*. IMF Working Paper, 16/22. Washington, DC: International Monetary. Available online: https://www.elibrary.imf.org/view/journals/001/2016/022/001.2016.issue-022-en.xml (accessed on 25 February 2017).

Montfort, Mlachila, and Rasmane Ouedraogo. 2017. *Financial Development Resource Curse in Resource-Rich Countries: The Role of Commodity Price Shocks*. IMF Working Paper, 17/163. Washington, DC: International Monetary. Available online: https://www.elibrary.imf.org/view/journals/001/2017/163/article-A001-en.xml (accessed on 20 July 2017).

Mork, Knut Anton. 1989. Oil and the Macroeconomy When Prices Go Up and Down. *Journal of Political Economy* 97: 740–44. [CrossRef]

Mpofu, Trust R., and Eftychia Nikolaidou. 2018. Determinants of Credit Risk in the Banking system in Sub-Saharan Afric. *Review of Development Finance* 7: 52–63.

Oduor, Jacob, Kethi Ngoka, and Maureen Odongo. 2017. Capital requirement, bank competition and stability in Africa. *Review of Development Finance* 7: 45–51. [CrossRef]
Phillips, Peter C. B. 1987. Time Series Regression with a Unit Root. *The Econometric Society* 55: 277–301. Available online: http://www.jstor.org/stable/1913237 (accessed on 1 July 2017). [CrossRef]
Phillips, Peter, and Pierre Perron. 1988. Testing for a unit root in time series regression. *Biometrika* 75: 335–46. [CrossRef]
Poghosyan, Tigran, and Heiko Hesse. 2009. *Oil Prices and Bank Profitability: Evidence from Major Oil-Exporting Countries in the Middle East and North Africa*. IMF Working Papers, 09/220. Washington, DC: International Monetary. Available online: https://www.elibrary.imf.org/view/journals/001/2009/220/001.2009.issue-220-en.xml (accessed on 1 July 2017).
Rafiq, Shudhasattwa, Pasquale Sgro, and Nicholas Apergis. 2016. Asymmetric oil shocks and external balances of major oil exporting and importing countries. *Energy Economics* 56: 42–50. [CrossRef]
Rudolf, Karl Oton, Samer Ajour El Zein, and Nicola Jackman Lansdowne. 2021. Bitcoin as an Investment and Hedge Alternative. A DCC MGARCH Model Analysis. *Risks* 9: 154. [CrossRef]
Sami, Mina, and Wael Abdallah. 2022. Does Cryptocurrency Hurt African Firms? *Risks* 10: 53. [CrossRef]
Spatafora, Nicola, and Issouf Samake. 2012. *Commodity Price Shocks and Fiscal Outcomes*. IMF Working Paper, 12/112. International Monetary Fund. Washington, DC: International Monetary. Available online: https://www.elibrary.imf.org/view/journals/001/2012/112/article-A001-en.xml (accessed on 2 June 2017).
Stiglitz, Joseph E. 2016. *The Theory of Credit and Macro-Economic Stability*. NBER Working Paper, 22837. National Bureau of Economic Research. Available online: https://www.nber.org/papers/w22837 (accessed on 2 May 2017).
UNDP. 2015. African Economic Outlook, UNDP. Available online: https://www.afdb.org/fileadmin/uploads/afdb/Documents/Publications/AEO2015_EN.pdf (accessed on 2 May 2017).
UNDP. 2016. Primary Commodity Booms and Busts 2016. Available online: https://www.africa.undp.org/content/rba/en/home/library/reports/primary-commodity-booms-and-busts.html (accessed on 2 April 2017).
Varangis, P. 2018. *Agriculture Finance & Agriculture Insurance*. Washington, DC: World Bank Group.