WP/17/XX

IMF Working Paper

Commodity Price Shocks and Financial Development

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INTERNATIONAL MONETARY FUND

 WP/17/xx

IMF Working Paper

African Department

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January 2017

Abstract

Why do commodity-dependent developing countries have typically lower levels of financial development than their peers? The literature has proposed many possible explanations, but it typically does not dwell on the deep mechanisms that drive such an outcome. We propose a theoretical explanation based on a partial equilibrium behavior of a representative bank firm. We test the model on 70 countries over the period 1980-2014, and we find strong evidence of the financial development resource curse through the channel of commodity price shocks, after controlling for other explanations found in the literature. The findings are robust to the different types of commodities, nature of the shocks, and various indicators of financial development. We also show how the impact of these shocks can be mitigated.

JEL Classification Numbers: E30, E44, G38.

Keywords: Commodity price shocks, financial sector development.

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Contents

Tables

I. INTRODUCTION

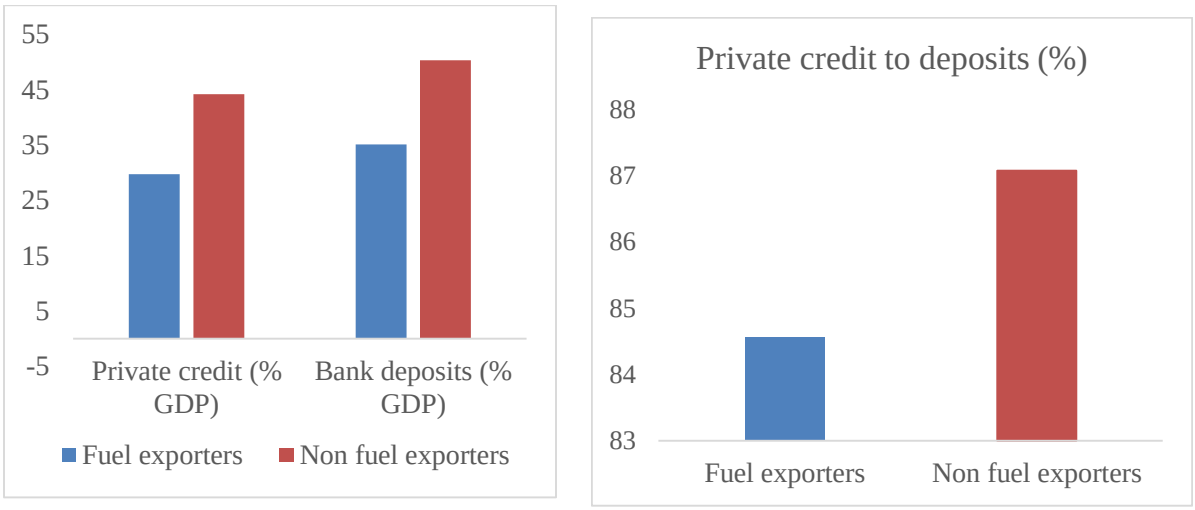
It has been well-established in the literature that resource-abundant economies typically suffer from lower financial development (e.g., Bhattacharrya and Holder, 2013; Beck, 2010). This is particularly the case in fuel exporters (Figure 1). Several hypotheses have been advanced for this outcome, e.g., lack of integration of commodity sector to the rest of the economy, poor governance, especially the higher levels of mismanagement of financial and human resources in commodity-rich countries (including prevalence of rent-seeking behavior).[1]

This paper contributes to this literature by analyzing another channel that has not been sufficiently explored. This is the channel through which resource-abundance can impede financial development, namely the impact of commodity price shocks., We draw on Kinda *et al.* (2016) who established that commodity price shocks often lead to financial sector fragility, and sometimes even financial crises. They find strong evidence that commodity price shocks weaken the financial sector notably by increasing non-performing loans (NPLs), reducing provisions to bank non-performing loans, lowering bank liquidity and reducing bank profits. They show that these effects operate through the reduction in growth rates, government revenue, and savings, and the increase in unemployment, debt in foreign currency and fiscal deficits.

In this paper, we hypothesize that commodity price shocks lead to weak financial development[2]. To do this, we start by building a small theoretical model based on a partial equilibrium behavior of a representative bank firm based on work by Alessandri and Nelson (2012) and Hülsewig et al. (2004) to elucidate the potential channels of transmission. Second, we conduct an empirical study based on a sample of 70 commodity-rich countries over the period 1980-2014. We use the GMM estimator to deal with the endogeneity issues of all right-hand variables.

[1] In line with the tradition, this paper's approach to financial sector development is limited to the banking sector. Specifically, we use four indicators to measure the development of the financial sector: domestic credit to the private sector over GDP, bank deposits over GDP, liquid liabilities over GDP and domestic credit to the private sector to bank deposits. More recent approaches, such as in Sahay *et al. (*2015), take a more comprehensive view of financial sector development and develop a broad-based index. Unfortunately, the coverage of the index in terms of countries and duration does not allow us to have a sufficiently large sample of commodity-rich countries.

Figure 1: Financial Development in Non-fuel and Fuel Exporting Countries



Source: FinStat and Authors' calculations

The main findings of this paper are the following. First, we find additional robust evidence of the financial development resource curse through the channel of commodity price shocks. The effect of commodity price shocks—whatever their nature—on the various indicators of the financial sector development is always negative. This implies that commodity price shocks tend to undermine the development of the financial sector. Second, we show that the impact of these shocks can be mitigated. Countries with more democratic governments tend to avoid the financial curse as they are able to ensure better law enforcement and limit the misuse of the commodity windfalls.

The remainder of the paper is organized as follows. The next section presents a summary review of related literature. Section III develops a simple theoretical model on the effects of commodity price shocks on bank credit, which is the main indicator for financial development used in the literature. Section IV describes the dataset and the empirical methodology. Section V presents and discusses the results of the econometric model. The last section provides concluding remarks.

II. Related Literature

It is well-documented in the literature that resource-rich countries generally have lower levels of financial development, all things being equal. This is quite contrary to what might be expected, as Bhattacharyya and Hodler (2013) argue, since these countries have high levels of liquidity from export revenues.

So what could explain this state of affairs? A number of theoretical and empirical explanations have been advanced for this version of the resource curse. First, drawing on

Hausman and Rigobon (2002), Hattendorff (2014) argues that the concentrated structure of resource-rich economies renders them more vulnerable to terms-of-trade shocks. Consequently, banks need higher levels of interest rates as a risk premium. As a result, higher interest rates lead to lower overall credit and investment, and thus lower financial development. The paper by Hattendorff (2014) shows empirically that export concentration tends to weaken private credit to GDP, based on cross-sectional and panel data from 93 countries for the period 1970-2007.

Relatedly, natural resource sectors tend to be enclaves in the way they operate. In the oil sector for instance, multinational companies generally depend on internal finance for their operations, and, to a lesser extent, on international capital markets. As a result, they have little need to have recourse to the local banking system, especially given that most of their costs, e.g., equipment, expatriate salaries, etc. are paid abroad (Beck 2010). Using a large sample of 104 developing countries over the period 1960-2007, Beck (2010) provides strong evidence of the existence of a natural resource curse in financial development, which falls more on enterprises than on households.

An interesting angle of the financial resource curse is explored by Benigno and Fornato (2013). They develop a theoretical model in which resource-rich countries' easy access to foreign capital can lead to lower productivity growth due to the Dutch disease effect. The capital inflows trigger a consumption boom, leading to a shift of productive resources toward the nontradable sector, thus lowering productivity growth, and thus reducing the need for financial resources from the financial sector. The existence of a small tradable sector in turn also leads to less support for more liberal financial development policies (Yuxiang and Chen 2001).

Some authors argue that the resource curse evidence is strongly linked to the way natural resource countries use their windfalls. Indeed, resource-rich countries may use the revenues from their resources for consumption smoothing, which weakens the incentive to build an effective financial system to serve as a buffer to smooth consumption over the business cycle (Gylfason 2004). On the other hand, higher investment in the natural resource sector can lead to lower investment in the financial sector and draw away skills from the financial system (Beck 2010). Therefore, the financial system might be less important as growth depends less on finance-intensive sectors but investments in mining activities and public consumption. In the same vein, Nili and Rastad (2007) argue that the government is often heavily involved in investment, thus weakening the private sector and private lending. The lack of demand for broader financial services weaken the financial sector.

Perhaps the most frequently used argument for lower financial development in resource-rich countries is that these countries tend to have inadequate institutions for contract enforcement. The literature has documented that contract enforcement is a key ingredient for well-

functioning financial systems. In the absence of contract enforcement, debtors have little incentive to repay their debts (Bhattarharyya and Hodler, 2013), thereby undermining the vary basis of financial development. This is so because in these countries elites can thrive on rent-seeking activities and can use these proceeds to pay off political competitors.

The resulting uncompetitive nature of politics reduces the incentives for fostering contract enforcement, and often fosters corruption. The two authors confirmed empirically their theoretical predictions by employing panel data covering the period 1970 to 2005 and 133 countries. Likewise, Yuxiang and Chen (2011) argue that the enforcement and reliability of financial sector reforms requires high government credibility, which might be eroded by the rent-seeking and corruption that are typical of resource-based economies. The rent-seeking behavior can decrease the activity and credit demand of entrepreneurs, thereby lowering domestic credit and the potential for financial sector development.

Another theoretical channel advanced is that of lower levels of education in resource-rich countries. Sarmidi *et al.* (2012) posit that the easy availability of financial resources to individuals reduces the incentives for higher education and the quest for excellence. This in turn lowers social capital and lowers overall levels of institutional and financial development. Yuxiang and Chen (2011) add that if resource abundance is believed to weaken human capital, it might also reduce a society's general level of trust and thus the reliability of financial contracts. Using a sample of 33 middle-income countries over the period 1999-2009 and an endogenous panel threshold model, Sarmidi *et al.* (2012) find clear evidence that low human development economies experience negative contribution of natural resources to financial development, while this relationship is not valid for high human development economies.

In this paper, we augment the previous literature and provide another potential cause of the weak financial development in resource-rich countries. We hypothesize that commodity price shocks weaken financial sector development in commodity-dependent countries through many channels. First, booms and busts in commodity prices increase the vulnerability of resource rich countries, which in turn reduce the prospects of growth and thereby impede the construction of a solid financial system. Kurronen (2012) finds that the macroeconomic volatility caused by fluctuations in commodity prices may generally weaken financial development. In addition, several studies have showed that macroeconomic uncertainty shocks such as commodity price shocks negatively affect economic activity, which in turn could lower domestic credit and bank deposits ((Bernanke, 1983; Kimball, 1990).

Second, the shocks in commodity prices can lead to financial fragility and banking crises, thereby weakening the financial sector. Using a large sample of 71 resource rich-countries

over the period 1997-2013, Kinda, Mlachila and Ouedraogo (2016) find strong evidence that commodity price shocks weaken the financial sector by not only increasing bank non-performing loan and the occurrence of banking crises, but also reducing provisions to bank non-performing loans, bank liquidity and bank profits (return on assets and return on equity). The authors show that these effects operate through the reduction in growth rates, government revenue, and savings, and the increase in unemployment, debt in foreign currency and fiscal deficits.

Our analysis aims to show that on the whole commodity price shocks lead to weaker financial development. To do this, we start by building a small theoretical model to elucidate the potential channels of transmission. Second, we conduct an empirical study based on a sample of 70 countries over the period 1980-2014.

III. THEORETICAL MODEL

One of the most obvious linkages between commodity prices shocks and financial development is the effect commodity price fluctuations might have on credit and deposits. When facing an external shock, the banking system may behave in a manner to maximize its net income. If the initial level of commodity prices is high, there is chance that the banking system will be motivated to increase lending. At some point the banks may realize that it is unlikely that some borrowers will be able to repay their debts, thereby raising the probability of credit default. This means that they will refuse to lend any more money to the agents, or at least demand a very high interest rate, so that the agents in practice are unable to borrow. Without access to credit the agents will no longer be able to invest, thereby freezing their profits and potential money to deposit into their accounts.

This issue even becomes more serious when prices turn down. In that case, GDP growth is slowing and bank non-performing loans are increasing as many borrowers lose their jobs and are now unable to payback their debts (Kinda, Mlachila and Ouedraogo 2016). What is evident is that the decline in bank deposits as economic activity is reduced. The banking system will be also more reluctant to give loans.

In this section we develop a theoretical model explaining how commodity price shocks lead to low credit and thereby weaken financial sector development. We consider a partial equilibrium model of a representative banking firm based on Alessandri and Nelson (2012), and Hülsewig e*t al.* (2004). We assume that the representative bank $i \in [0; 1]$ operates in a monopolistic market, a common approach in the literature. Bank loans are differentiated according to the bank specialization and then banks compete on the loan rate. Specialization can refer to a type of borrower, sector or to a geographical area (Carletti *et al*., 2007). For instance, some banks may provide credit mostly to oil companies and workers while others do not. We also suppose that the representative bank faces an exogenous business cycle

represented here by commodity price shocks. In addition, we consider a strict backward-looking provisioning system in which loan loss provisions are only made up of specific provisions (Bouvatier and Lepetit 2008, 2012). We aim to show how the commodity price shocks (exogenous shocks below) can reduce domestic credit and thereby undermine financial development.

Activities of the bank and profit

We consider a bank *i* that has a traditional intermediation activity. For simplicity, we assume that its asset side is made up exclusively of loans ($L_{i,t}$). As the loan portfolio contains expected credit losses, loan loss reserves ($LR_{i,t}$) are deducted from assets. The asset side is represented by net loans (loans minus loan loss reserves) while the liability side is made up of deposits ($D_{i,t}$) and capital or equity ($K_{i,t}$). The bank balance sheet identity is:

$$L_{i,t} - LR_{i,t} = D_{i,t} + K_{it,} \quad (1)$$

We assume that the business cycle is a function of the commodity price index as follows:

$$y_t(p_t) = \emptyset p_t + (1 - \emptyset)ב_t, \quad (2)$$

Where $\emptyset$<1, p_t represents the commodity price index and $ב_t$ is the error term. This assumption is motivated by the fact that growth patterns in commodity dependent countries are typically closely tied to the evolution in commodity prices. Several studies have documented that GDP growth are significantly reduced by negative commodity price shocks, while positive price shocks tend to lead to higher growth rates in resource-rich countries (see Deaton 1999, Dehn 2000, Bruckner and Antonion Ciccone 2010). This is particularly true in the current area of low prices where many commodity-dependent countries are suffering from low growth or are in recession (Nigeria, Venezuela, Russia, and so on). As a result, bank non-performing loans and charged-off loans are all functions of commodity prices. Moreover, Kinda and others (2016) showed that bank non-performing loans increase when commodity prices collapse and decline during boom times in commodity prices.

The net after-tax profit of the bank $i(\pi_{i,t})$ is related to its traditional intermediation activity:

$$\pi_{i,t} = r_{i,t}^{L} L_{i,t}\big(1 - NPL(p_t) - F(p_t)\big) - r_t^d D_{i,t} - LP_{i,t} - \delta L_{i,t} F(p_t) - T_{i,t} \quad (3)$$

Where $r_{i,t}^{L}$ is the interest rate on loans, r_t^{d} is the interest rate on deposits, p_t is the index of commodity prices, functions $NPL(p_t)$ and $F(p_t)$ stand for respectively the fraction of non-performing loans and the fraction of charged-off loans, $LP_{i,t}$ represents

loan loss provisions, $\delta L_{i,t}F(p_t)$ represents unanticipated charge-offs (i.e., charge-offs for which the bank did not set aside loan loss reserves) and $T_{i,t}$ are taxes.

Charged-off loans occur when the bank decides that some loans or some portion of loans will not be collected. The fraction of non-performing loans and of charged-off loans are defined by:

$$NPL(p_t) = npl_0(\frac{p_t}{p})^{-w} z_t \quad (4)$$

$$F(p_t) = f_0(\frac{p_t}{p})^{-\theta} v_t \quad (5)$$

Where npl_0 and f_0 represent the steady state fraction (or average fraction over a whole business cycle) of non-performing loans and of charged-off loans per period. $\frac{p_t}{p}$ stands for the growth rate in the commodity price index, $\theta > 0$ and $w > 0$ are the elasticity with respect to the commodity price index, and z_t and v_t represent shocks with mean one and standard deviation σ_z and σ_v.

The partial derivatives of $NPL(p_t)$ and $F(p_t)$ are negative. Indeed, the change in commodity prices reflecting the financial situation of firms and households affects negatively the fraction of non-performing loans and of charged-off loans. When commodity prices are increasing, bank non-performing loans and charged-off loans are lower, and inversely (see Kinda and others 2016). The shocks z_t and v_t underline that non-performing loans and charged-off loans are not fully predictable.

We assume that profits are shared between retained earnings ($K_{i,t+1} - K_{i,t}$) used to modify the bank capitalization and dividends paid out to shareholders ($\Delta_{i,t}$). This can be written as:

$$\pi_{i,t} = K_{i,t+1} - K_{i,t} + \Delta_{i,t} \quad (6)$$

Negative dividends operate as equity issuing and retained earnings are used to meet the risk-based capital requirement which is given by:

$$K_{i,t+1} \geq k_0 L_{i,t+1} \quad (7)$$

Where k_0 is the regulatory threshold (the tier 1 requirement is 8 percent under Basel III). To simplify, we assume that this regulatory constraint (equation (7)) is always

binding. It means that banks hold the minimum of capital required by the regulator.[3] This simplification allows us to focus on the bank provisioning behavior.

Loan loss reserves and loan loss provisions

Loan loss reserves represent the portion of a bank's cash or cash equivalents holdings set aside to cover estimated potential losses in its loan portfolio. They adjust the loan portfolio for expected losses. The law of motion of loan loss reserves is given by:

$$LR_{i,t} = LR_{i,t-1} + LP_{i,t-1} - L_{i,t-1}F(p_{t-1}) + \delta L_{i,t-1}F(p_{t-1}) \quad (8)$$

Charged-off loans ($L_{i,t-1}F(p_{t-1})$) are removed from loan loss reserves since they represent recognized losses. However, charged-off loans had not been fully provisioned over prior periods. Unanticipated charged-off loans $\delta L_{i,t-1}F(p_{t-1})$ (subtracted from earnings in equation (3)) are therefore added to loan loss reserves in order to maintain loan loss reserves at a level sufficient to absorb expected losses (Walter, 1991). Loan loss provisions $LP_{i,t-1}$ are also added as they are charged against earnings to increase loan loss reserves. The loan loss provision is a balance sheet account that represents a bank's best estimate of future loan losses.

In a strict backward-looking provisioning system as considered here, loan loss provisions are made up of specific provisions $H^s(L_{i,t}, p_t)$ which are driven by non-performing loans. Loan loss reserves fit therefore identified problem loans rather than expected credit losses. Loan loss provisions are defined by:

$$LP_{i,t} = H^s(L_{i,t}, p_t) = h_0 L_{i,t} NPL(p_t) \quad (9)$$

Where h_0 is the steady state fraction (or average fraction over a whole business cycle) of non-performing loans ($L_{i,t}NPL(p_t)$) which are covered by loan loss provisions during a period.

This specification ensures a contra-cyclical evolution of loan loss provisions which is the main stylized fact in a backward-looking provisioning system (see Clerc *et al.*, 2001; Arpa et al., 2001; Fernandez de Lis *et al.*, 2001; and Pain, 2003). Identified problem loans underestimate expected credit losses during an economic expansion and then the bank has to

[3] However, it could also be interesting in a further development to take into account cautiously the effects of the capital requirement on the bank lending behavior.

charge numerous loan loss provisions during the downturn. This system has therefore a pro-cyclical effect on bank profits.

Taxes

We assume that tax is levied on the profit, and not on the intermediate transactions. In addition, the taxation rate is unique and does not depend on the size of the profit made by each bank. The bank income tax can be written as:

$$T_t = \tau\left[r_{i,t}^L L_{i,t}\left(1 - NPL(p_t) - F(p_t)\right) - r_t^d D_{i,t} - H^s\left(L_{i,t}, p_t\right) - \delta L_{i,t} F(p_t)\right], \qquad (10)$$

Where τ is the taxation rate and the term within the brackets is the profit.

Loan demand

The demand for loan is described by the inverse demand function taking into account that bank operates on a monopolistic economy. It provides the interest rate borrowers are willing to pay for a given amount of loans L and a given interest rate (Hülsewig *et al.* 2006, Henzel et al. 2007). In this case, banks offer differentiated loans and then each bank faces a specific demand for loans given by:

$$L_{i,t} = \left(\frac{r_{i,t}^L}{r_t^L}\right)^{-\lambda} L_t \qquad (11)$$

$L_{i,t}$ is the aggregated quantity of loans, r_t^L is the average economy-wide interest rate on loans and λ is the elasticity of $L_{i,t}$ with respect to the interest rate on loans. The parameter λ is the elasticity of substitution and represents therefore the monopolistic power of the bank.

The bank maximization behavior

The objective of each bank is to choose its loan rate $\left(r_{i,t}^L\right)$ to maximize its present discounted value of future dividends. The maximization problem is defined by:

$$\max_{\{r_{i,t}^L\}|_{t=0}^{\infty}} E_t \sum_{t=0}^{\infty} \beta^t \Delta_t, \qquad (12)$$

Where $\Delta_t = r_{i,t}^L L_{i,t}\left(1 - NPL(p_t) - F(p_t)\right) - r_t^d D_{i,t} - LP_{i,t} - \delta L_{i,t} F(p_t) - T_{i,t} + K_{i,t} - K_{i,t+1}$, (13)

β is the standard discount factor or the bank's rate of time preference.

Optimal interest rate on loans

The first order condition gives the optimal interest rate on loans (see Appendix I for more details).

$$r_{i,t}^{L}\big(1 - NPL(p_t) - F(p_t)\big) = \frac{\lambda}{\lambda-1}\{r_t^d(1-k_0) + \beta r_{t+1}^d\big((1-\delta)F(p_t) - h_0 NPL(p_t)\big) + h_0 NPL(p_t) + \delta F(p_t) + \frac{{k_0}/{\beta} - k_0}{1-\tau}\} \quad (14)$$

The left-hand of equation (14) represents the marginal return on loans. It shows what the bank earns after taking into account the non-performing loans and the charged-off loans $(1 - NPL(p_t) - F(p_t))$. The right-hand side of equation (14) presents the different factors influencing the bank when setting up the loan interest rate. More precisely, the bank applies a mark-up $(\frac{\lambda}{\lambda-1})$ on the marginal cost of its lending activity.

The marginal cost of the bank lending activity is composed of five components:

- The cost of the deposits $(r_t^d(1-k_0))$,
- The extra cost of deposits involves by a change in loan loss reserves $(\beta r_{t+1}^d\big((1-\delta)F(p_t) - h_0 NPL(p_t)\big))$,
- The provisioning cost $(h_0 NPL(p_t))$,
- The unanticipated charge-offs cost $(\delta F(p_t))$ and
- The cost related to the capital requirement $(\frac{{k_0}/{\beta} - k_0}{1-\tau})$.

Since anticipated recognized losses had been provisioned over prior periods, they do not affect the current profit. In addition, loan loss provisions depend mainly on problem loans and then the provision cost is negatively affected by the business cycle.

Business cycle and credit market

In a symmetric equilibrium of the steady state $\big(r_{i,t}^{L} = r_t^{L}\big)$, the interest rate on loans is given by:

$$r^L(1 - npl_0 - f_0) = \frac{\lambda}{\lambda-1}\left\{r^d(1-k_0) + \delta f_0 + h_0 npl_0 + \frac{\frac{k_0}{\beta} - k_0}{1-\tau}\right\}, \quad (15)$$

Where r^L and r^d represent the steady state value of the loan interest rate and of the interest rate on deposits, respectively.

In order to incorporate the dynamics of the loan market, we define the aggregate loan demand as follows (Calza *et al.* 2003, 2006; Hülsewig et al. 2004):

$$\hat{L}_t = \emptyset_y \hat{p}_t - \emptyset_{r^L}(\hat{r}_t^L - E_t\{\hat{\omega}_{t+1}\}), \quad (16)$$

Where ω_t is the inflation rate. The variables $\hat{L}_t$, $\hat{r}_t^L$, $\hat{p}_t$ and $\hat{\omega}_{t+1}$ represent the percentage deviations of the variables L_t, r_t^L, p_t and ω_t from their steady-state values, L, r^L, p and ω, respectively.

As described, the aggregate loan demand is positively and negatively associated with the output and the interest rate, respectively. These two conditions simply derive from the fact that higher interest rates on loans during economic downturn imply lower loan demand. In other words, the aggregate loan demand is growing when the output increases and falls when the real loan rate increases.

The log-linearization of the equation (14) is given by (see the appendix for details):

$$\varphi_0 \hat{r}_t^L = \varphi_1 \hat{r}_t^d + \varphi_2 \hat{z}_t + \varphi_3 \hat{v}_t - \varphi_4 \hat{p}_t \quad (17)$$

Where:

$\varphi_0 = r^L(1 - npl_0 - f_0)$, $\varphi_1 = Zr^d(1 - k_0)$, $\varphi_2 = r^L npl_0 + Zh_0 npl_0 - Z\beta r^d h_0 npl_0$, $\varphi_3 = r^L f_0 + Z\delta f_0 + Z\beta r^d(1-\delta)f_0$, $\varphi_4 = w\varphi_2 + \theta\varphi_3$, and $Z = \lambda/(\lambda - 1)$. The parameter φ_i, $i = 0, \ldots, 4$ are positive.

The main predictions of the model are therefore the following:

- First, shocks on problem loans ($\hat{z}_t$) and on charged-off loans ($\hat{v}_t$) positively affect ($\hat{r}_t^L$). In the case of positive shocks to commodity prices, there is an increase in credit risk exposure, thereby leading to an increase in the price of loans. As a result, equation (16) shows that there is a decrease in loans.

- Second, commodity prices ($\hat{p}_t$) negatively affect the loan rate $\hat{r}_t^L$. This effect is measured by the parameter $\varphi_4 = w\varphi_2 + \theta\varphi_3$. Commodity prices affect the bank's behavior through its impact on the levels of non-performing loans and of charged-off loans. A decline in commodity prices implies an increase in problem loans and charged-off loans, leading to an increase in the loan rate and a decline in loans. This reinforces the direct effect of commodity prices on loans, measured by the parameter $\emptyset_y$ in the equation (16).

Proposition: ***Commodity price shocks may harm the development of the financial sector in resource rich countries as the level of credit is declining regardless of the nature of the shock. Positive commodity price shocks are associated with high credit risk, which in turn leads to an increase in interest rates and thereby lower credit levels. Negative commodity price shocks are associated with economic downturns and high problem loans, leading to a decline in domestic credit.***

IV. DATA AND METHODOLOGY

Having showed theoretically that commodity price shocks may weaken the financial sector mainly by reducing domestic credit, we then test an empirical model to seek support for our predictions. Our analysis will focus on a large sample of 70 resource rich-countries over the period 1980-2014. Before proceeding, we briefly explain the approach of the empirical study. First, our analysis will include additional indicators of financial sector development including bank deposits, bank liquid liabilities and the ratio of private credit to bank deposits. All of these variables measure the depth of the financial sector. Second, we undertake the stationarity tests for each series to make sure that it does not contain a unit root. The failure of this hypothesis leads us to use the different variables in their first differences. Third, we explore the non-linearity of the effect of commodity price shocks on the financial sector according to the level of democracy. This exercise is not part of the theoretical model, but is highly important regarding the previous literature advocating that the quality of governance matters.

A. Methodology

We use a dynamic specification given the strong inertia of the indicators of financial sector development. More specifically, we estimate the following equation:

$$FinSD_{i,t} = \propto + \delta FinSD_{i,t-1} + \beta PriceShocks_{i,t} + \theta X'_{i,t} + v_i + \varphi_t + \varepsilon_{i,t} \qquad (17)$$

Where $FinSD_{i,t}$ stands for financial sector development indicator for country i in time t, $PriceShocks_{i,t}$ is commodity price shocks. We include v_i to control for unobserved time-invariant country-level characteristics that are potentially correlated with financial development indicator and φ_t to control for time-varying shocks that affect all resource rich countries. $\varepsilon_{i,t}$ is a standard error term. $X'_{i,t}$ stands for other

explanatory variables including GDP per capita, inflation rate, trade openness, rule of law, FDI and financial openness (*kaopen*).[4]

Financial development indicators typically have a certain inertia in their evolution, and thus do not vary so much from year to year. In order to take into account this characteristic we employ a dynamic model that estimates the level of financial development on its lagged value and a set of control variables including commodity price shocks. This empirical model may suffer from endogeneity because of the lagged dependent variable, some unobservable variables and the reverse causality of all right hand variables (Aggarval, Demirgüç-Kunt, and Martínez Pería 2010), except the commodity price shock indices. For instance, if the unobservable variable is the innate skills of the labor force, high resource countries may be more likely to face large price shocks and also more likely to have liquid and solid banks--biasing the effect of commodity price shocks towards zero. Therefore, OLS estimation of such equation will lead to biased and inconsistent results.

Moreover, a number of authors have been concerned with the presence of endogeneity, and therefore the need to have a valid instrumental variable. As argued in Hattendorff (2014), the direction of causality is a major concern. Indeed, the level of financial development itself can shape the trade structure. In other words, in a case of reverse causality, weak financial systems themselves may actually favor industries that do not rely heavily on external finance. A common way is to use gravity equations to predict the intensity of international trade and indirectly export concentration using geographical explanatory variables. Our modeling strategy suffers relatively less from this kind of endogeneity bias. Our main explanatory variable, commodity price shocks is quite exogenous since most countries have little control over international commodity prices. However, a reverse causality may exist between the dependent variable and the other independent variables.

To deal with the endogeneity issues arising from simultaneity bias and omitted variables, we use GMM estimators which are more suited for dynamic panel data. Furthermore, GMM estimators allow us to correct for endogeneity of all right-hand side variables. This method is appropriate as some of the explanatory variables, $X'_{i,t}$, may themselves be a function of the dependent variable and because dynamic panel estimation in the presence of country fixed effects generally yields biased estimates (Nickel, 1981; Wooldridge, 2002).

There are two GMM estimators commonly used: the difference-GMM estimator (Arellano and Bond, 1991) and the system-GMM estimator (Arellano and Bover, 1995; Blundell and

[4] In principle, one could also directly control whether export diversification helps improve financial development. The empirical tests show that this variable is not statistically significant. This is likely due to the fact that commodity dependence is *de facto* orthogonal to export diversification.

Bond, 1998). For the difference-GMM estimator, equation (17) is differenced in first order in order to remove country fixed effects, and the first differenced variables are instrumented by the lagged values of the variables in level. As for the system-GMM estimator, both equations in levels and in first differences are used in a system that allows the use of lagged differences and lagged levels of the explanatory variables as instruments.

Therefore, system-GMM estimator is an extension of the difference-GMM estimator. In this paper, our preferred estimator is the system-GMM because it has been highlighted in the literature that the lagged values of variables in levels as it is done with the difference-GMM estimator are sometimes poor instruments for variables in first differences. Moreover, we limit the instrument set to one lag in order to avoid the well-known problems associated with too many instruments (Roodman, 2009). To check the validity of the instruments, we use the Sargan test for over-identifying restrictions and Arellano and Bond's test that investigates that there is no second-order serial correlation in the first-differenced residuals. We also perform several robustness checks using alternative econometric method and different sample of commodities.

B. Data

The study covers 70 commodity exporter countries over the period 1980-2014. The list of countries is included in Appendix A2. We extracted data from several sources including IMF's *WEO*, World Bank datasets and United Nation's *Comtrade*. The *Comtrade* dataset serves as a source for data on exports and imports by commodity and country during the base year (1996).[5] To be included in the sample, each country and commodity should meet the following conditions: (i) the country should be a net exporter of the given commodity during the base year (1996); and (ii) the commodity must represent at least 10 percent of the country's total exports during the base year. The aim of the latter threshold is to include a maximum of countries. Apart from these criteria, only data availability restricted our sample.

The data on the financial development are from *Global Financial Development Database* of the World Bank. We extracted bank credit to the private sector, bank deposits, bank liquid liabilities and the ratio of bank credit to private credit to bank deposits. We thereby follow previous studies which have also used these variables as financial development indicators. All of these dependent variables are taken in their differences as they are not stationary in level (see Section IV-C). As for the commodity price shock indices, we followed the measures used in Kinda, Mlachila and Ouedraogo (2016). Shocks are measured as the estimated residuals of an econometric model of the logarithm of commodity price regressed

[5] We rely on SITC1 system to extract dollar values of exports and imports of the different commodities.

on its lagged values (up to three) and quadratic time trend as follows. Once estimated the commodity price shock indices, we then standardize them in order to bring them together.

Regarding the independent variables, we included GDP per capita at 2005 constant prices to measure the level of development, inflation rate, foreign direct investment and trade openness defined as the ratio imports plus exports over GDP. These variables are extracted from the World Bank's *World Development Indicators*. The variables GDP per capita and trade openness are taken in the first differences as they are not stationary in level. We also included the variable law and order to capture the quality of governance, retrieved from *International Country Risk Guide*. Finally, data providing a measure of financial openness (Kaopen) is collected from Chinn and Ito (2006).

C. Stationarity Tests

We examine the stationarity properties of each series. We begin by computing both Levin, Lin and Chu (LLC hereafter) and Im, Pesaran and Shin (IPS hereafter) tests for unit roots, including a constant and time trend in the test specifications to reflect the trending nature of the time series. We undertake the test for all variables in level and first differences. The LLC unit root test assumes common unit root processes, while IPS assumes individual unit root processes.

The results, reported in Table 1, show that all the financial development variables including bank credit to the private sector, bank deposits, bank liquid liabilities and the ratio of credit to bank deposits contain unit roots when the variables are taken in level. However, when these variables are expressed in first difference, the hypothesis of non-stationarity is rejected at 1 percent level. Moreover, we found that the level of development and trade openness are also stationary in first difference. Therefore, these variables will be taken in their first differences in the empirical model.

Table 1: Stationarity Tests

	LLC		IPS		Result
	Level	First difference	Level	First difference	
FDI	-5.31 (0.00)***	-20.41 (0.00)***	-7.30 (0.00)***	-30.36 (0.00)***	I(0)
GDPPC	-2.69 (0.00)***	-13.42 (0.00)***	2.40 (0.99)	-16.02 (0.00)***	I(1)
Liquid liabilities	-2.70 (0.35)	-12.17 (0.00)***	-2.20 (0.14)	-11.01 (0.00)***	I(1)
Bank deposits	-1.16 (0.12)	-10.94 (0.00)***	-0.82 (0.20)	-10.73 (0.00)***	I(1)
Inflation	-353.82 (0.00)***	-151.52 (0.00)***	-73.60 (0.00)***	-67.24 (0.00)***	I(0)
Kaopen	1.73 (0.01)***	29.81 (0.00)***	-0.81 (0.00)***	-16.87 (0.00)***	I(0)
Rule of law	-0.26 (0.00)***	-14.86 (0.00)***	0.74 (0.01)***	-12.80 (0.00)***	I(0)
Trade	-3.63 (0.27)	-19.84 (0.00)***	-4.44 (0.12)	-25.77 (0.00)***	I(1)
Polity2	-12.53 (0.00)***	-33.52 (0.00)***	-4.26 (0.00)***	-20.49 (0.00)***	I(0)
Priv. Credit	1.13 (0.87)	-15.09 (0.00)***	2.14 (0.98)	-17.91 (0.00)***	I(1)
Priv. Credit to deposits	-1.67 (0.47)	-13.91 (0.00)***	-1.61 (0.53)	-17.42(0.00)***	I(1)

*** denotes it is significant at 1%

V. EMPIRICAL RESULTS

A. Baseline Results

In this section we try to analyze how commodity price shocks can potentially weaken the development of the financial sector. The baseline results are reported in Tables 2 and 3. The results for all commodities and all types of shocks are reported in Table 2, while the estimates for only positive and negative shocks are reported in Table 3. Statistical tests do not invalidate the econometric method. In other words, the null hypothesis of the *Sargan* and the *AR* (*2*) tests are not rejected. Moreover, the significance in the coefficients associated the lagged dependent variables highlights an inertia effect that legitimates the dynamic panel specification.

The empirical evidence supports our theoretical priors. We find that commodity price shocks strongly undermine the development of the financial sector in resource-dependent countries. Indeed, as expected, the coefficients associated with commodity price shocks are negative and strongly significant at 1 percent level in Table 1, columns [1-3]. Thus, commodity price shocks reduce the level of bank credit to the private sector, bank deposits, bank liquid liabilities and the ratio of private credit to bank deposits. More precisely, a one standard deviation increase in commodity price shocks leads to a decline in bank credit to the private sector by 0.844 percent of GDP[6], bank deposits by 0.74 percent of GDP and 1.08 percent of

[6] This number is obtained by multiplying the coefficient estimate by the mean of credit to the private sector, and then dividing by the standard deviation of credit to the private sector. This applies to the other figures of this section.

GDP for bank liquid liabilities. As a result of the higher reduction in private credit than bank deposits, the ratio of private credit to deposit decline by 0.86 percent of GDP.

Table 2. Baseline Results: All Commodities

	(1)	(2)	(3)	(4)
Variables	**Priv. credit**	**Bank deposits**	**Liq. Liabilities**	**Priv. Credit to deposit**
Dep. Variable (-1)	0.1200***	0.1590***	-0.1160***	0.0870***
	(0.0111)	(0.0138)	(0.0142)	(0.0142)
Price_Shocks	-0.6430***	-0.5550***	-0.6710***	-0.3540*
	(0.0852)	(0.0713)	(0.0904)	(0.194)
$\Delta(GDPPC)$	0.0012***	0.0020***	0.0009***	0.0014
	(0.0002)	(0.0001)	(0.0001)	(0.0009)
Inflation	-0.0009*	-0.0002**	-0.0002***	-0.0014***
	(0.0005)	(0.0001)	(0.0001)	(0.0004)
$\Delta(Trade)$	0.0231***	-0.0083	-0.0142	0.0896***
	(0.0088)	(0.0074)	(0.0091)	(0.0298)
Rule of law	1.1580***	0.4220***	0.7650***	2.4990***
	(0.1940)	(0.1390)	(0.1840)	(0.799)
FDI	0.0793**	-0.0018	-0.0103	0.0650
	(0.0321)	(0.0193)	(0.0253)	(0.1270)
Kaopen	0.3430**	0.2900***	0.1110	0.2610
	(0.1670)	(0.0941)	(0.1390)	(0.5460)
Constant	-3.3260***	-0.7950*	-1.5110***	-8.2020***
	(0.6390)	(0.4500)	(0.5810)	(2.5370)
Observations	1,499	1,383	1,383	1,489
Number of countries	68	68	68	69
Sargan	0.331	0.0715	0.0333	0.8113
AR(1)	0.0077	0.0209	0.1583	0
AR(2)	0.295	0.7536	0.6974	0.5826
Number of instruments	35	35	35	35

Robust standard errors in parentheses. *** p<0.01, significant at 1%,
** p<0.05 significant at 5%, * p<0.1 significant at 10%

Moreover, the results are clear and compelling both for positive and negative price shocks (Table 3). The coefficients associated with commodity price shocks are negative and significant in all columns, except column (8). In addition, the impact on domestic credit to the private sector is clearly stronger during positive shocks than during negative shocks. Indeed, a one standard deviation increase in positive commodity price shocks reduces credit to the private sector by 0.9 percent of GDP, against 0.71 percent of GDP when it comes to

negative commodity price shocks. On the contrary, the harmful effects of commodity price shocks on bank deposits and bank liquid liabilities are higher in the cases of negative shocks than the positive ones. A one standard deviation increase in price shocks reduce bank deposits by 0.76 percent of GDP and 1.27 percent of GDP for bank liquid liabilities during negative commodities price shocks, against 0.57 percent of GDP and 0.8 percent of GDP during positive shocks, respectively.

However, the decline in the ratio of private credit to bank deposits following commodity price shocks occurs only during the positive ones. The coefficient associated with commodity price shocks is negative and strongly at 1 percent level in column (4), while it is not significant in column (8). A one standard deviation increase in positive price shocks leads to a decline of 0.241 percent of GDP in the ratio of bank credit to the private sector to bank deposits, higher than the average one (column 4, Table 2). Our findings are consistent with the theory of resource curse in financial development according to which resource-rich countries are likely to have a low level of financial development (Beck, 2010; Hattendorff, 2014).

Turning now to the control variables, we found that they are all consistent with the empirical literature. On the one hand, the results show that the level of development, trade openness, rule of law, FDI and financial openness (*kaopen*) are all positively associated with the different financial development variables. On the other hand, the coefficient associated with inflation is negative and statistically significant in all columns of Table 1.

Table 3: Baseline Results: Positive and Negative Shocks

	Positive shocks				Negative shocks			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	Priv. credit	Bank deposit	Liq. Liabilities	Priv. credit to deposits	Priv. credit	Bank deposit	Liq. Liabilities	Priv. credit to deposits
Dep. Variable (-1)	0.1820***	0.1840***	-0.1430***	0.0088	-0.2410***	-0.0456***	-0.2430***	0.1160***
	(0.0083)	(0.0180)	(0.0301)	(0.0306)	(0.0091)	(0.0115)	(0.0186)	(0.0220)
Price_Shocks	-0.6500***	-0.4640***	-0.6200***	-0.9860***	-0.5750***	-0.5690***	-0.7940***	0.2540
	(0.114)	(0.0980)	(0.0881)	(0.2940)	(0.0906)	(0.0621)	(0.0872)	(0.2380)
$\Delta(GDPPC)$	0.001***	0.0022***	0.0013***	0.0008	0.0028***	0.0014***	0.0001	0.0063***
	(0.0001)	(0.0001)	(0.0002)	(0.0007)	(0.0004)	(0.0005)	(0.0006)	(0.0023)
Inflation	-0.0020*	-4.37e-05	-0.0002	0.0018	2.78e-05	-8.73e-05	-0.0003***	-0.0012***
	(0.0012)	(0.0003)	(0.0002)	(0.0011)	(0.0002)	(9.21e-05)	(0.0001)	(0.0003)
$\Delta(Trade)$	0.0193	-0.0166*	-0.0088	0.1660***	0.0207***	-0.0053	-0.0265***	0.0631*
	(0.0198)	(0.0086)	(0.0107)	(0.0517)	(0.0075)	(0.0059)	(0.0088)	(0.0352)
Rule of law	2.5730***	-0.3110	0.1130	1.8390	0.9330***	0.6960***	1.2010***	2.4610***
	(0.5090)	(0.2330)	(0.2480)	(1.1380)	(0.1590)	(0.1890)	(0.2080)	(0.8820)
FDI	0.1050*	0.1040***	0.1210***	-0.4830***	0.0681***	-0.0752***	-0.1900***	0.3130***
	(0.0580)	(0.0296)	(0.0329)	(0.1700)	(0.0237)	(0.0257)	(0.0303)	(0.1070)
Kaopen	0.4750*	0.6910***	0.8390***	1.4390*	0.1500	0.0572	-0.1160	-0.0059
	(0.2640)	(0.2350)	(0.2380)	(0.7590)	(0.2300)	(0.1460)	(0.2020)	(0.8380)
Constant	-6.9050***	1.1760*	0.2250	-3.8900	-2.7850***	-1.4720**	-2.5930***	-9.2460***
	(1.5810)	(0.6850)	(0.7580)	(3.6060)	(0.5390)	(0.6250)	(0.6800)	(2.8520)
Observations	735	681	680	727	764	702	703	762
Number of countries	68	68	68	69	68	68	68	69
Sargan	0.3577	0.1888	0.5687	0.197	0.2187	0.1754	0.0484	0.8312
AR(1)	0.0932	0.0665	0.2433	0.0001	0.0408	0.0319	0.1597	0
AR(2)	0.3259	0.1575	0.1357	0.9645	0.1856	0.3373	0.4822	0.8434
Number of instruments	35	35	35	35	35	35	35	34

Robust standard errors in parentheses. *** p<0.01, significant at 1%, ** p<0.05 significant at 5%, * p<0.1 significant at 10%

B. Democracy Matters

In this section we estimate whether the degree of democracy matters. Previous studies argue that the natural resource rents undermine financial development only in countries with poor quality of governance. For instance, Bhattacharyya and Roland Hodler (2010) even showed theoretically and empirically that resource revenues hinder financial development in countries with poor political institutions, but not in countries with comparatively better political institutions. Democratic governments may suffer less from macroeconomic instability because leaders of democratic governments are limited by the risk-averse citizens in their choices and they are able to ensure better law enforcement. We then explore this hypothesis by generating an interactive variable between the indices of commodity price shocks and the degree of democracy. We use the variable Polity extracted from Polity IV (Marshall et al., 2011). This variable is the difference between a democracy index (0 to 10) and an autocracy index (0 to 10), with higher values representing better quality of governance or better democracy. For instance, in our sample Saudi Arabia and Qatar have the

lowest values, meaning that they represent the most autocratic regimes, while Mauritius and Chile stand for higher levels of democracy.

Table 4: Role of Democracy

	(1)	(2)	(3)	(4)
Variables	**Priv. credit**	**Bank deposits**	**Liq. Liabilities**	**Priv. credit to deposits**
Dep. Variable (-1)	0.167***	0.128***	-0.161***	0.0984***
	-0.0078	(0.0105)	(0.0110)	(0.0144)
Price_Shocks	-0.490***	-0.428***	-0.578***	-0.404*
	(0.0674)	(0.0579)	(0.0761)	(0.216)
Price Shocks*Polity2	0.0451***	0.0157*	0.0312***	0.0486
	(0.0113)	(0.00829)	(0.0111)	(0.0406)
Polity2	0.160***	0.0658**	0.0831**	0.465**
	(0.0428)	(0.0273)	(0.0335)	(0.191)
$\Delta(GDPPC)$	0.0011***	0.00195***	0.0009***	0.0015
	-0.0002	(7.81e-05)	(9.61e-05)	-0.0012
Inflation	-0.000534	-9.49e-05	-0.000131***	-0.000312
	-0.0004	(6.62e-05)	(4.75e-05)	-0.0002
$\Delta(Trade)$	0.00943	-0.0107*	-0.0176**	0.0970***
	-0.0077	-0.0059	-0.0081	(0.0258)
Rule of law	0.810***	0.249**	0.607***	1.486*
	(0.174)	(0.127)	(0.149)	(0.794)
FDI	0.0598**	0.0136	0.00423	0.125
	(0.0249)	(0.0176)	(0.0245)	(0.131)
Kaopen	0.529***	0.389***	0.258*	0.948
	(0.111)	(0.0971)	(0.137)	(0.619)
Constant	-2.207***	-0.376	-1.198***	-5.841**
	(0.597)	(0.437)	(0.464)	(2.532)
Observations	1,320	1,219	1,219	1,314
Number of countries	57	57	57	58
Sargan	0.4383	0.2587	0.0761	0.2631
AR(1)	0.0263	0.0421	0.1894	0
AR(2)	0.2586	0.8559	0.6748	0.7572
Number of instruments	37	37	37	37

Robust standard errors in parentheses. *** p<0.01, significant at 1%,
** p<0.05 significant at 5%, * p<0.1 significant at 10%

Results are reported in Table 4. We found that the coefficient associated with the interactive variable is positive and strongly significant in all columns. This finding highlights that the harmful effect of commodity price shocks on the financial sector development is dampened in countries with higher level of democracy. In order words, quality of governance matters. Not only are shock-related weakness in domestic credit mitigated in countries with better democracy (column 1), but also the levels of deposits and bank liquid liabilities are higher in these countries (Columns 2 and 3). Our results then confirm those in previous studies (Bhattacharyya and Hodler, 2010).

C. Robustness checks

We now check the robustness of our results. To that end, we undertake three exercises.

First, we use another measure of commodity price shocks by employing the first method explained in Kinda, Mlachila and Ouedraogo (2016). This approach uses the change in price as a metric for shocks (Arezki and Brückner, 2010; Brückner and Ciccone, 2010). The results are reported in Table 5. They are consistent with our hypothesis according to which commodity price shocks undermine the level of financial development. The coefficient associated with commodity price shocks are negative and statistically different from zero in all columns.

Table 5: Robustness Tests: Alternative measure of price shock indices

	(1)	(2)	(3)	(4)
Variables	**Priv. credit**	**Bank deposit**	**Liq. Liabilities**	**Priv. credit to deposits**
Dep. Variable (-1)	0.0817***	0.0845***	-0.183***	0.0633***
	(0.00449)	(0.00621)	(0.00717)	(0.0138)
Price_Shocks	-0.0726***	-0.103***	-0.129***	-0.0300*
	(0.0156)	(0.0101)	(0.0118)	(0.0180)
$\Delta(GDPPC)$	0.0011***	0.0017***	0.0008***	0.0015*
	-0.0001	(7.75e-05)	(6.21e-05)	-0.0008
Inflation	-0.00158***	-0.000231***	-0.000234***	0.000195
	-0.0005	(7.36e-05)	(5.89e-05)	-0.0009
$\Delta(Trade)$	0.0244***	-0.00611	-0.00434	0.0532**
	-0.0089	-0.0058	-0.0096	(0.0268)
Rule of law	1.343***	0.363***	0.837***	2.030**
	(0.260)	(0.122)	(0.181)	(0.838)
FDI	0.0646***	0.0024	-0.0019	0.105
	(0.0242)	(0.0162)	(0.0189)	(0.116)
Kaopen	0.447***	0.0438	-0.0660	0.641
	(0.116)	(0.0952)	(0.118)	(0.445)
Constant	-3.695***	-0.322	-1.420**	-6.961**
	(0.836)	(0.378)	(0.552)	(2.734)
Observations	1,026	943	943	1,023
Number of countries	48	48	48	49
Sargan	0.3607	0.2381	0.2576	0.4834
AR(1)	0.0248	0.0431	0.1914	0
AR(2)	0.2785	0.7798	0.6852	0.4326
Number of instruments	35	35	35	35

Robust standard errors in parentheses. *** p<0.01, significant at 1%,
** p<0.05 significant at 5%, * p<0.1 significant at 10%

Second, we perform the estimates on two groups of commodities: one group containing oil and metal commodities and the second group for food commodities. The results reported in Table 6 confirm our previous findings. Moreover, we found that the coefficients associated i^{th} commodity price shocks in columns [1-4], Table 6 are higher than those of columns [5-8] and Table 2. This finding means that the harmful effects of price shocks are greater in oil and metal exporter countries.

Table 6: Robustness Tests: Varieties of Commodities

	Oil and Metal commodities				Food commodities			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	Priv. credit	Bank deposits	Liq. Liabilities	Priv. credit to deposits	Priv. credit	Bank deposits	Liq. Liabilities	Priv. credit to deposits
Dep. Variable (-1)	0.0921***	0.0908***	-0.1770***	0.0619***	0.0912***	0.147***	-0.187***	0.0624***
	(0.0050)	(0.0073)	(0.0085)	(0.0139)	(0.00814)	(0.0103)	(0.00945)	(0.0115)
Price_Shocks	-0.6510***	-0.9170***	-1.0270***	-0.1120	-0.406***	-0.187***	-0.125*	-0.0598
	(0.1260)	(0.0811)	(0.0948)	(0.1970)	(0.0673)	(0.0470)	(0.0659)	(0.183)
$\Delta(GDPPC)$	0.0011***	0.0017***	0.0008***	0.0015*	0.00217***	0.00252***	0.00141***	0.00671***
	(0.0001)	(7.30e-05)	(6.23e-05)	(0.0008)	-0.0006	-0.0006	-0.0005	-0.0022
Inflation	-0.0016***	-0.0001*	-0.0002***	0.0002	-0.00104**	-0.0002**	-0.0003***	-0.0011***
	(0.0005)	(7.75e-05)	(4.56e-05)	(0.0009)	-0.0004	(8.70e-05)	(8.34e-05)	-0.0003
$\Delta(Trade)$	0.0180*	-0.0069	-0.0035	0.0504*	0.0246***	-0.0177***	-0.0280***	0.105***
	(0.0099)	(0.0058)	(0.0103)	(0.0264)	(0.00729)	-0.005	-0.0065	(0.0238)
Rule of law	1.2720***	0.4000***	0.8290***	2.0040**	1.085***	0.300**	0.684***	1.924**
	(0.2590)	(0.1210)	(0.2090)	(0.8070)	(0.223)	(0.121)	(0.137)	(0.784)
FDI	0.0628**	0.0093	0.0028	0.1060	0.0821***	-0.0313*	-0.0484**	0.182
	(0.0305)	(0.0154)	(0.0195)	(0.1110)	(0.0232)	(0.0163)	(0.0214)	(0.142)
Kaopen	0.4440***	0.2420**	0.1250	0.6860	0.218	0.280***	0.135	0.435
	(0.1400)	(0.1030)	(0.1150)	(0.4510)	(0.151)	(0.104)	(0.159)	(0.535)
Constant	-3.7950***	-0.7910**	-1.7890***	-6.9850***	-2.905***	-0.286	-1.091**	-6.725***
	(0.8620)	(0.3930)	(0.6430)	(2.6540)	(0.678)	(0.378)	(0.431)	(2.379)
Observations	1,024	941	941	1,021	1,285	1,219	1,219	1,271
Number of countries	48	48	48	49	56	57	57	57
Sargan	0.3702	0.2141	0.2542	0.464	0.2561	0.114	0.0264	0.8227
AR(1)	0.0212	0.0352	0.1787	0	0.0152	0.0382	0.2036	0
AR(2)	0.2754	0.7704	0.7039	0.4341	0.2887	0.8865	0.7457	0.9682
Number of instruments	35	35	35	35	35	35	35	35

Robust standard errors in parentheses. *** p<0.01, significant at 1%, ** p<0.05 significant at 5%, * p<0.1 significant at 10%

Third, we use an alternative measure of indicator of financial development. We aim to generate a composite index based on the four variables used so far. To do so, we employ the principal component analysis (PCA) which is increasingly used in several studies (e.g., David *et al.*, 2015). With the PCA a new variable is created as linear combinations of the original set of four variables. PCA identifies how the 4 indicators may be summarized in a simple way to give a new meaningful measure of financial development (see in appendix the results for PCA). Having computed the new variable, we estimate equation (17) for the different samples performed above. Results are reported in Table (7). They are all consistent with our hypothesis according to which commodity price shocks weaken the financial sector. The coefficients associated with commodity price shocks are all negative and strongly significant in all columns. Moreover, we still find that the impacts are dampened in countries with high level of democracy.

Table 7: Robustness Tests: Alternative dependent variable

	All commodities	Positive shocks	Negative shocks	Oil and metals	Food	All commodities
Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Dep. Variable (-1)	0.0668***	0.210***	-0.130***	-0.00780	0.0411***	0.0432***
	(0.0142)	(0.0213)	(0.0160)	-0.0076	(0.0146)	(0.0122)
Price Shocks	-0.226***	-0.167***	-0.251***	-0.358***	-0.0516**	-0.183***
	(0.0357)	(0.0371)	(0.0335)	(0.0370)	(0.0238)	(0.0306)
Price shocks*Polity2						0.0072*
						-0.0041
Polity2						0.0450***
						(0.0132)
$\Delta(GDPPC)$	0.00062***	0.0008***	0.0007***	0.0005***	0.0012***	0.0006***
	(3.25e-05)	(3.85e-05)	(0.000173)	(2.11e-05)	-0.0002	(3.22e-05)
Inflation	-0.0007	-0.0065***	-5.28e-05	-0.0005**	-0.0009**	-0.0006*
	-0.0004	-0.0002	-0.0001	-0.0002	-0.0004	-0.0003
$\Delta(Trade)$	-0.0019	-0.0018	0.0032	-0.0002	-0.0031	-0.0031
	-0.003	-0.0039	-0.0026	(0.0033	(0.0027	-0.0022
Rule of law	0.285***	0.106	0.380***	0.440***	0.232***	0.222***
	(0.0697)	(0.0971)	(0.0540)	(0.0585)	(0.0600)	(0.0437)
FDI	0.00743	0.0349***	-0.0121	0.0140**	0.00190	0.0111
	-0.007	(0.0122)	-0.0085	-0.007	-0.0064	-0.0071
Kaopen	0.114***	0.177*	-0.0349	0.145***	0.164***	0.197***
	(0.0406)	(0.103)	(0.0646)	(0.0377)	(0.0357)	(0.0343)
Constant	-0.920***	-0.342	-1.330***	-1.432***	-0.716***	-0.820***
	(0.227)	(0.297)	(0.182)	(0.193)	(0.191)	(0.150)
Observations	1,319	647	672	883	1,151	1,166
Number of countries	66	66	66	46	55	55
Sargan	0.10	0.2788	0.5507	0.1701	0.1864	0.1727
AR(1)	0.0408	0.1301	0.0843	0.0635	0.0608	0.0775
AR(2)	0.8516	0.2573	0.5041	0.7672	0.8975	0.8872
Number of instruments	35	35	35	35	35	37

Robust standard errors in parentheses. *** p<0.01, significant at 1%,
** p<0.05 significant at 5%, * p<0.1 significant at 10%

VI. CONCLUDING REMARKS

In this paper we have provided a novel theoretical and empirical characterization of the financial curse in resource rich-countries. Our study illustrates how fluctuations in commodity prices undermine the development of the financial sector. To do so, we have developed a simple backward-looking provisioning theoretical model in which we showed that commodity price shocks may weaken the financial sector by reducing the level of credit to the economy. We then explored empirically the extent to which actual data confirm our theoretical predictions. We used a large sample of 70 resource rich-countries over the period 1980-2014 and employed the dynamic panel GMM method to perform our analysis. The econometric part of this paper studies the link between commodity price shocks and financial sector development using a comprehensive set of financial development indicators, including bank credit to the private sector, bank deposits, bank liquid liabilities and the ratio private credit to bank deposits.

Drawing on the priors of the theoretical model, our empirical results can be interpreted in the following manner. First, the evidence is consistent with the idea of financial curse in resource-rich countries. The effect of commodity price shocks—whatever their nature—on the various indicators of the financial sector development is always negative. This implies that commodity price shocks tend to undermine the development of the financial sector. However, this is not a *fait accompli*. Second, the level of democracy matters. Countries with more democratic governments tend to avoid the financial curse as they are able to ensure better law enforcement and limit the misuse of the commodity windfalls.

Our results raise several policy issues as booms and busts in commodity prices are recurrent. The ideas that commodity price shocks may matter in weakening the financial sector and that democracy is important in policy-making were simply not well-established so far. Mitigating the effects of fluctuations in commodity prices can reduce their negative impact on financial sector development. This could be done, for instance, by maintaining sufficient fiscal buffers, e.g., through the establishment of a sovereign wealth fund. Second, and in the same vein, developing counter-cyclical capital buffers can reduce the impact of commodity price shocks on bank balance sheets. Finally, the role of good governance is particularly important in resource-rich countries. Democratic governments may not only be able to ensure a better enforcement of law related to financial services but also they could reduce the misallocation of natural resource windfalls.

Appendix I

The maximization program

The maximization problem is written as:

$$\max_{\{r_{i,t}^L\}|_{t=0}^{\infty}} E_t \sum_{t=0}^{\infty} \beta^t \Delta_t, \qquad (12)$$

With $\Delta_t = (1-\tau)[r_{i,t}^L L_{i,t}\left(1 - npl_0\left(\frac{p_t}{p}\right)^{-w} z_t - f_0\left(\frac{p_t}{p}\right)^{-\theta} v_t\right) - r_t^d D_{i,t} -$

$h_0 L_{i,t} npl_0\left(\frac{p_t}{p}\right)^{-w} z_t - \delta L_{i,t} f_0\left(\frac{p_t}{p}\right)^{-\theta} v_t\Big] + k_0 L_{i,t} - k_0 L_{i,t+1},$

Under the constraints

$$D_{it,} = L_{i,t} - LR_{i,t-1} - h_0 L_{i,t-1} npl_0\left(\frac{p_t}{p}\right)^{-w} z_{t-1} + (1-\delta) L_{i,t-1} f_0\left(\frac{p_t}{p}\right)^{-\theta} v_{t-1} - k_0 L_{i,t},$$

And $L_{i,t} = \left(\frac{r_{i,t}^L}{r_t^L}\right)^{-\lambda} L_t$.

The first order condition (FOC) on the loan rate ($(r_{i,t}^L)$ is given by

$$\begin{aligned} 0 = (1-\tau)\{&(1-\lambda)\left(r_{i,t}^L\right)^{-\lambda}(r_t^L)^{\lambda} L_t (1 - npl_0\left(\frac{p_t}{p}\right)^{-w} z_t - f_0\left(\frac{p_t}{p}\right)^{-\theta} v_t \\ &+ r_t^d (1-k_0)\lambda\left(r_{i,t}^L\right)^{-\lambda-1}(r_t^L)^{\lambda} L_t \\ &+ \beta r_{t+1}^d \lambda\left(r_{i,t}^L\right)^{-\lambda-1}(r_t^L)^{\lambda} L_t((1-\delta) f_0\left(\frac{p_t}{p}\right)^{-\theta} v_t - h_0 npl_0\left(\frac{p_t}{p}\right)^{-w} z_t \\ &+ \lambda h_0\left(r_{i,t}^L\right)^{-\lambda-1}(r_t^L)^{\lambda} L_t npl_0\left(\frac{p_t}{p}\right)^{-w} z_t + \lambda\delta\left(r_{i,t}^L\right)^{-\lambda-1}(r_t^L)^{\lambda} L_t f_0\left(\frac{p_t}{p}\right)^{-\theta} v_t \\ &- \left(k_0 - \frac{k_0}{\beta}\right)\lambda\left(r_{i,t}^L\right)^{-\lambda-1}(r_i^L)^{\lambda} L_t, \end{aligned}$$

Which is equivalent to

$$\begin{aligned} r_{i,t}^L\left(1 - NPL(p_t) - F(p_t)\right) = \frac{\lambda}{\lambda-1}\{&r_t^d(1-k_0) + \beta r_{t+1}^d\left((1-\delta)F(p_t) - h_0 NPL(p_t)\right) \\ &+ h_0 NPL(p_t) + \delta F(p_t) + \frac{\frac{k_0}{\beta} - k_0}{1-\tau}\} \end{aligned}$$

Log-linearization

The log-linearization of the first order on the loan rate is given by:

$$\hat{r}_t^L[r^L][1 - npl_0 - f_0]$$
$$= \hat{r}_t^M[r^d][(\lambda/(\lambda-1))(1-k_0)] + \hat{p}_t\,[p][-r^L(1/p)(wnpl_0 + \theta f_0)$$
$$- (\lambda/(\lambda-1))(wh_0\, npl_0(1/p) + \theta(1/p)\delta f_0$$
$$- (\lambda/(\lambda-1))\beta r^d\,(\theta(1/p)(1-\delta)f_0 - w(1/p)h_0 npl_0)]$$
$$+ \hat{z}_t[r^L npl_0 + (\lambda/\lambda-1))(h_0\, npl_0 - \beta r^d h_0 npl_0)] + \hat{v}_t[r^L f_0$$
$$+ (\lambda/\lambda-1))(\delta\, f_0 + \beta r^d(1-\delta)f_0),$$

Which is equivalent to:

$$\hat{r}_t^L[r^L][1 - npl_0 - f_0] = \hat{r}_t^d[r^d]Z(1-k_0)] - \hat{p}_t[r^L(wnpl_0 + \theta f_0)$$
$$+(wh_0 npl_0 + \theta\delta f_0) + Z\beta r^d(\theta(1-\delta)f_0 - wh_0 npl_0)] + \hat{z}_t[r^L npl_0 + Z(h_0 npl_0$$
$$- \beta r^d h_0 npl_0)] + \hat{v}_t[r^L npl_0 + Z(\delta f_0 + \beta r^d(1-\delta)f_0)],$$

With $Z = \lambda/(\lambda-1)$.

The log-linearization of equation (14) can be written as:

$$\varphi_0 \hat{r}_t^L = \varphi_1 \hat{r}_t^d + \varphi_2 \hat{z}_t + \varphi_3 \hat{v}_t - \varphi_4 \hat{p}_t,$$

With

$\varphi_0 = r^L(1 - npl_0 - f_0)$,

$\varphi_1 = r^d(1 - k_0)$,

$\varphi_2 = r^L npl_0 + Z(h_0 npl_0 - \beta r^d h_0 npl_0)$,

$\varphi_3 = r^L f_0 + Z(\delta_0 - \beta r^d(1-\delta)f_0)$,

$\varphi_4 = r^L(wnpl_0 + \theta f_0) + Z(wh_0 npl_0 + \theta\delta f_0) + Z\beta r^d(\theta(1-\delta)f_0) - wh_0 npl_0$,

$= w\varphi_2 + \theta\varphi_3$,

Appendix II

Table A 1: Principal component analysis

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	2.18595	.934934	0.5465	0.5465
Comp2	1.25101	.76139	0.3128	0.8592
Comp3	.489623	.416205	0.1224	0.9816
Comp4	.0734184	.	0.0184	1.0000

Principal components (eigenvectors)				
Variable	Comp1	Comp2	Comp3	Comp4
Priv. Credit	0.4356	0.5008	-0.7441	-0.0761
Bank deposits	0.6405	-0.2037	0.1640	0.7221
Liquid liabilities	0.6306	-0.2026	0.3029	-0.6852
Priv. Credit to deposits	0.0491	0.8165	0.5724	0.0568

Table A 2: Sample

Albania	Indonesia	Peru
Argentina	India	Philippines
Azerbaijan	Jamaica	Paraguay
Burkina Faso	Kazakhstan	Qatar
Bangladesh	Kenya	Russian Federation
Bulgaria	Kuwait	Saudi Arabia
Bolivia	Libya	Sudan
Botswana	Lithuania	Senegal
Brazil	Latvia	El Salvador
Chile	Morocco	Suriname
Cote d'Ivoire	Moldova	Syrian Arab Republic
Cameroon	Madagascar	Togo
Colombia	Mexico	Thailand
Costa Rica	Mali	Trinidad and Tobago
Dominican Republic	Mongolia	Tunisia
Algeria	Mozambique	Turkey
Ecuador	Malawi	Uganda
Egypt. Arab Rep.	Malaysia	Ukraine
Gabon	Nigeria	Uruguay
Ghana	Nicaragua	Venezuela. RB
Guinea	Oman	Yemen. Rep.
Guatemala	Pakistan	South Africa
Honduras	Panama	Zambia
Croatia		

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