Commodity Prices and Bank Lending*

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Abstract: We analyze the transmission of changes in commodity prices to bank lending in developing countries. Identification relies on a bank-specific time-varying measure of bank sensitivity to changes in commodity prices, based on daily data on bank stock prices. We find that a fall in commodity prices reduces bank lending, and this effect is stronger for commodity exporters and driven by commodity price busts. We complement this bank-level analysis with loan-level data from a credit register, which allows us to identify the effect of a commodity price shock on the supply of credit at the extensive margin, controlling for borrower-specific time-varying unobserved factors that could drive borrowers' demand for credit. Results show that banks with relatively lower deposits and poor asset quality transmit the changes in commodity prices more aggressively, indicating that commodity prices swings affect credit supply.

JEL Codes: F30; F34; G21; Q02.

Keywords: Bank lending channel; Commodity prices; Credit register; Credit supply; Shock Transmission.

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1 Introduction

As the size of the financial sector increases with economic growth in developing countries, macro-financial linkages can play an increasingly important role in the transmission of shocks, both domestic and external, to economic activity. While there is no dearth of studies on the international transmission of shocks through the banking sector in the context of advanced and emerging market economies (Cetorelli and Goldberg, 2011; Schnabl, 2012; De Haas and Van Horen, 2013; Ivashina, Scharfstein and Stein, 2015; Ongena, Peydró and Van Horen, 2015; Morais, Peydro and Ruiz, 2018), there is little evidence on the role of banks in the transmission of global shocks to developing countries, possibly because of low levels of global financial integration of banks in these countries. However, the transmission of international shocks through bank lending could have important effects on the real economy in developing countries, where equity and bond markets are underdeveloped and banks are an important source of finance for domestic firms. Bank credit is often a key driver of firm growth and entrepreneurship, with significant welfare implications through employment creation and poverty alleviation (Burgess and Pande, 2005; Beck and Demirguc-Kunt, 2006; Karlan and Zinman, 2010; Banerjee and Duflo, 2014; Bruhn and Love, 2014).

We contribute to the literature by providing the first formal evidence on the bank lending channel of commodity price shocks in developing countries. Developing countries have typically been extremely vulnerable to adverse external shocks, with severe impact on output growth and macroeconomic and political stability (Deaton, 1999; Loayza, Rancière, Servén and Ventura, 2007; Raddatz, 2007; Brückner and Ciccone, 2010; Dabla-Norris and Bal Gunduz, 2014; Bazzi and Blattman, 2014). Among external shocks, terms of trade ones tend to be particularly important, given the high reliance of most developing countries on commodity exports. While changes in commodity prices can be expected to directly affect earnings of firms and government revenues, and thereby economic activity, the role of banking sector in propagating these shocks to the real economy is less clear. Our analysis disentangles a bank lending channel in transmitting commodity price shocks through lower credit supply in developing countries.

To understand how commodity price shocks affect bank lending, we explore whether the funding and capital structure of banks plays a role, whether bank ownership (foreign vs domestic) matters, and whether there are asymmetries across episodes of commodity prices increases versus declines. To this end, we first use detailed balance sheet data for a large sample of banks and provide evidence of the transmission of commodity prices to bank lending in developing countries. We then complement this cross-country, bank-level evidence with granular

loan-level data from a credit register, which allows us to identify—for the first time—the effect of commodity prices on the supply of credit. We use loan-level data for Uganda, a country representative of developing countries in terms of financial development, economic structure and institutional weaknesses, and that experienced a sharp fall in terms of trade in 2010-2011.

Changes in commodity prices can affect bank lending through a credit and a supply channel. On the one hand, commodity price swings can impact real activity directly by affecting margins of exporters—a fall in commodity net export prices would have a negative impact on the profits of exporters, likely inducing a scale back in employment or postponement of investment. To the extent that some of the economic activity was financed through bank credit, the shock will also result in a lower *demand* for credit for banks that are more exposed to the commodity sector. On the other hand, changes in commodity prices could also dampen the *supply* of bank credit through a funding shock or a deterioration of bank health (see Figure 1). For instance, lower deposits due to slower economic activity could generate a funding shock to domestic banks. Insofar as banks cannot easily substitute deposit funding with wholesale funding (which is typically the case in developing countries), they would respond by curtailing credit (Kashyap and Stein, 2000; Jayaratne and Morgan, 2000; Khwaja and Mian, 2008). The funding shock may end up affecting the credit supply of banks with lower deposits-to-assets ratios (Gatev and Strahan, 2006; Ivashina and Scharfstein, 2010), a channel that could be stronger in developing countries, where banks heavily rely on retail funding. Moreover, government arrears and weak revenue growth of commodity dependent firms may render them unable to service their loans, thereby worsening bank asset quality and eroding capital of banks highly exposed to the commodity sector. The diminished ability of banks to raise market funding would be particularly binding for banks starting with already relatively high levels of non-performing loans, which could be induced to reduce bank lending to the economy even further (Gambacorta and Shin, 2016).[1]

Our analysis focuses on uncovering the bank lending channel through which international commodity price changes can induce changes in the supply of credit, using bank- and loan-level data. Loan-level data are best suited for identification purposes, as we can better separate demand and supply of credit. Bank-level data, instead, have the advantage of providing evidence on a large sample of countries, mitigating concerns about generalized conclusions about developing countries arising from the analysis of bank lending in Uganda.

In the first part of the paper, we use a large sample of almost 600 banks headquartered in 40

[1]Consistent with these conjectures, we show that in response to a fall of commodity price, banks more exposed to commodity prices experience a larger fall in deposits and a larger increase of non-performing loans. We also find that that after the two large negative commodity price shocks in Uganda, bank deposits decreased and asset quality worsened significantly.

developing countries to estimate the effect of international commodity prices on domestic bank lending over the period 2004-2015. This period is characterized by large swings in commodity prices and our identification strategy hinges on differential exposure of individual banks to variations in country-specific commodity net export prices. In the spirit of Acharya and Steffen (2015) and Beck, De Jonghe and Mulier (2017), we construct a time-varying, bank-specific measure of exposure or sensitivity for each listed bank in our sample using factor loadings from a regression of daily bank stock prices on the broad market index and commodity prices. In particular, we are interested in the heterogeneous response of banks to commodity net export prices, depending on their sensitivity to the commodity sector.

Our baseline results confirm that banks which are more exposed to the commodity sector (i.e. banks whose stock prices show a higher co-movement with commodity prices) reduce lending more in response to lower international commodity prices, even after controlling for bank specific characteristics and macroeconomic factors. The transmission of commodity price shocks to the banking sector is asymmetric, as the positive relationship between commodity net export prices and loan growth observed in the overall sample is driven by periods of declining commodity prices. A one standard deviation (SD) decline in the commodity net export price index (which amounts to about 10 percent decline in the commodity net export price for a median economy) is associated with a 1.1 percentage points decline in lending by a bank weakly exposed to the commodity sector and with a 1.8 percentage points decline for a highly exposed bank.[2] We also find that this effect is stronger for banks located in commodity exporting countries. For instance, a decline in net export prices similar to that experienced by Nigeria between 2009 and 2010 leads to a 4.9 percentage points contraction in lending by banks highly exposed to the commodity sector. When looking at bank ownership, instead, we do not find any significant difference in the response of foreign banks and domestic banks to fluctuations in commodity prices. This finding can be explained by the prevalence of 'regional' foreign banks in low-income countries, or the fact that foreign banks are locally incorporated and reliant on retail funding, different from 'global' foreign banks in advanced economies, so that they are less able exploit geographical diversification to limit the vulnerability to external shocks.[3]

While we control for a set macroeconomic variables which likely affect the demand for credit (mainly GDP growth and interest rates), and saturate the model with bank, country, and

[2] A one standard deviation decline in the commodity net export price index in our sample broadly corresponds to the average decline between 2010 and 2013. We define banks as weakly (highly) exposed to the commodity sector if they are at the 10^{th} (90^{th}) percentile of the sensitivity measure, as defined below in Section 2.

[3] Our results are robust to a number of additional exercises which (i) use alternative sensitivity measures and country-specific commodity price indexes, (ii) expand the set of macroeconomic variables to control for the credit demand channel, and (iii) use different model specifications.

time fixed effects[4], we cannot absorb bank-specific time-varying shifts in credit demand. Thus, our baseline bank-level analysis cannot establish if the response of credit to commodity prices is due to a credit supply or a credit demand channel.

To disentangle these two channels, we proceed in two steps. First, using bank-level data for the sample of developing countries, we exploit the heterogeneity in bank balance sheet characteristics to look at the differential effect of commodity price shocks on banks with different balance sheet characteristics. Second, we use granular data on the universe of loan applications in Uganda, which allows us to better control for credit demand with time-varying borrower fixed effects. In this case we are able to compare the same firm (or borrowers in the same district-industry cluster) when it applies to at least two banks in the same year (or quarter) with different *ex-ante* levels of deposits or NPLs.

Both approaches suggest that the deposits-to-assets ratio and asset quality (as measured by the ratio of NPLs to gross loans) are important factors driving how aggressively a bank responds to changes in commodity prices. Banks with low deposits-to-assets ratio and with high non-performing loans (in percent of gross loans) reduce lending more in the event of a decline in commodity prices, supporting the presence of a credit supply channel. In terms of economic magnitude, the bank-level analysis shows that a bank at the 90th percentile of our sensitivity measure, and with low (high) deposits, contracts lending by 4.1 (1.6) percentage points in response to a one SD decline in the commodity net export price index. When looking at loan applications, we find that the differential effect in rejection rate between high and low deposit banks (first vs. third quartile) in response to a one SD fall in the commodity price index is 1.2 percentage points, a relatively sizable effect in light of an average rejection rate of 16.3%.

Our paper speaks to the literature on the economic effects of commodity price changes in developing countries and makes a contribution on several fronts. We expand on the literature on the international transmission of macroeconomic shocks through the bank lending channel (Peek and Rosengren, 1997; Cetorelli and Goldberg, 2011; Schnabl, 2012; Ivashina *et al.*, 2015; Ongena *et al.*, 2015; Baskaya, di Giovanni, Kalemli-Ozcan and Ulu, 2017; Morais *et al.*, 2018) by focusing on commodity prices. We bring to this literature unique administrative data on the universe of loan applications for a developing country. The loan-level data allows us to control for borrower-specific time-varying unobserved factors, including credit demand, and to provide unique evidence on how external shocks could be transmitted to the local economy in developing countries through the bank lending channel. Examining the strength of spillovers from global shocks to developing countries through the lens of global commodity

[4]While there is not enough variation in our data to include country $\times$ year fixed effects, we are able to add to the model country $\times$ bi-annual fixed effects to proxy for time-varying country-specific changes in demand.

price changes is ideal for three main reasons. First, many developing countries are highly reliant on commodities and fluctuations in commodity prices are often a major source of economic volatility.[5] Second, the last 15 years are characterized by ample swings in countries' idiosyncratic terms of trade, which provide enough variability in the data to look at the effect of international commodity price changes on bank lending. Finally, international commodity prices—and their changes—could be considered exogenous to bank lending behavior (see Bazzi and Blattman, 2014, for a comprehensive discussion of commodity price shocks in a developing country setting).[6]

Understanding the role of banks in the transmission of international commodity prices could provide novel insights, given that the banking sector in developing countries differs along a number of features compared to more advanced economies—bank size and efficiency, funding and capital structure, and foreign ownership (Beck, Demirguc-Kunt and Levine, 2010; Allen, Carletti, Cull, Qian, Senbet and Valenzuela, 2014; Claessens and Van Horen, 2014). Indeed, the lack of evidence of any specific role for foreign banks in amplifying or dampening the transmission of shocks is unique to the experience of low-income countries, and can be explained by the prevalence of regional banks, the strong reliance on retail funding also of foreign banks, and the ineffectiveness of internal capital market funding. Further, a strong transmission for banks with low deposits indicates that banks' ability to tap other sources of funding is limited, consistent with a lower share of wholesale funding in developing countries. While the analysis focuses on bank-specific effects, the aggregate country-specific effects would also clearly be higher for countries that are more dependent on commodity exports and, hence, are host to banks that are more sensitive to commodity prices.

Then, we quantify the role of the bank lending channel in the transmission of commodity price shocks on real activity, which has been often overlooked by the development literature (Mendoza, 1997; Deaton, 1999; Bleaney and Greenaway, 2001; Raddatz, 2007). Our results suggest that a fall in commodity prices could have a second-round effect on economic activity through a contraction in credit supply, and this effect could be economically significant, given

[5] Fernández, Schmitt-Grohé and Uribe (2017), for instance, estimate that over a third of the variance of output, consumption, and investment in developing countries is accounted for by fluctuations in commodity prices and the world interest rate. Similarly, Raddatz (2007) shows that even if most of the variance in real per capita GDP in low-income countries is explained by domestic factors, the effect of external shocks is economically meaningful and, among external shocks, changes in commodity prices are the most important sources of output fluctuations.

[6] A possible concern is that some countries are not 'price-takers': for those countries, if growth collapses for a different reason, the recession could affect both international prices and bank lending—via lower demand—generating a spurious correlation between the two variables. However, demand for credit should affect all banks equally in this case, while our identification relies on differential bank exposure to the commodity sector, and in particular, on the deterioration of bank credit quality. In addition, since our commodity net export price index considers exports and *imports* of a comprehensive basket of 45 commodities, we argue that the possible effect of one commodity would be partially washed out by other commodity prices for which the country is 'price-taker'. Finally, as a robustness check, we exclude countries that depend on a single commodity (see Section 4).

the heavy reliance of several developing countries on the traditional banking sector.[7]

Finally, we provide new evidence on the asymmetric effect of commodity prices and on the importance of bank balance sheet strength and macroeconomic fundamentals for the transmission of the shock to domestic credit, which can guide the current debate on macroprudential policies in developing countries (Jones and Zeitz, 2017; Jones, Beck and Knaack, 2018a,b).

The rest of the paper is organized as follows: Section 2 presents the measure of country-specific commodity net export prices. Section 3 introduces the bank-level analysis, discussing the bank-specific sensitivity to commodity prices, the empirical strategy, the baseline results, and a number of extensions. Section 4 discusses the main robustness checks. Section 5 introduces the credit register data and shows the main results of the effects of commodity price shocks on credit supply in Uganda. Section 6 concludes.

2 A country-specific commodity net export price index

In the spirit of Deaton and Miller (1995) and Bazzi and Blattman (2014), we consider a country-specific measure of commodity prices based on 45 commodities. More specifically, we use the commodity net export price ($CNEP$) index constructed by Gruss (2014), using monthly data, as follows:

$$CNEP_{i,t} = \sum_{j=1}^{J} P_{j,\tau}\omega_{i,j,t} \tag{1}$$

where, $P_{j,\tau}$ is the logarithm of the relative price of commodity j in period (month) τ within year t (in U.S. dollars and divided by the IMF's unit value index for manufactured exports), and the weights are pre-determined and calculated as a three-year average:

$$\omega_{i,j,t} = \frac{1}{3}\sum_{s=1}^{3} \frac{x_{i,j,t-s} - m_{i,j,t-s}}{\sum_{j=1}^{J} x_{i,j,t-s} + \sum_{j=1}^{J} m_{i,j,t-s}} \tag{2}$$

where, $x_{i,j,t-s}$ is the export value (in USD) of commodity j from country i in year $t-s$, and $m_{i,j,t-s}$ is the import value (in USD) of commodity j by country i in year $t-s$. Hence, the weights reflect the net-export of each commodity as a share of total trade (sum of exports and imports of all commodities) in a given country.

[7] To the best of our knowledge, few papers have investigated the effects of commodity prices on the financial sector in developing countries. Kinda, Mlachila and Ouedraogo (2018) look at the effect of commodity prices on financial fragility in a sample of emerging and developing countries and show that negative commodity price shocks are associated with higher non-performing loans, lower profitability, and a higher likelihood of banking crises. Eberhardt and Presbitero (2018) also show that commodity prices are a key driver of the likelihood of banking crises in low-income countries. Ftiti, Kablan and Guesmi (2016) look at the relationship between commodity prices and credit to the private sector in three African commodity exporters—Burkina Faso, Niger and Ivory Coast—and show a strong association between fluctuations in commodity prices and private credit. Moreover, in another recent contribution, Caggiano, Calice and Leonida (2014) focus on low-income countries to identify the drivers of banking crises, but they do not explicitly take into consideration the role of commodity prices.

The key advantage of such a measure, compared to a more standard commodity price index is that being country-specific, it can take into account the fact that prices of different commodities have been moving quite differently in past years, so that not all countries have been equally hit by the slowdown in commodity prices.[8] Also, having predetermined weights, rather than fixed ones, it takes into consideration the rapid change in the composition of export products in several developing countries.

3 Bank-level analysis

3.1 Bank balance sheet data data

We use bank-level data from Bankscope, a global database of banks' financial statements which covers about 90 percent of the total assets of the banking system in each country. The sample is constrained by the availability of bank-level data in Bankscope. In particular, we limit our analysis to developing countries with data for more than 5 active banks in any year and we retain banks which have at least 2 observations with non-missing values for the key bank-level variables used in the baseline model. As a result, our sample consists of 40 developing countries with 584 active banks for the time period 2004-2015.[9] We use the following bank-level variables from Bankscope: the growth rate of total loans (measured in real USD), the ratio of equity over assets, the ratio of deposits over assets, liquidity (defined as the ratio of liquid assets over deposit and short term funding), size (as the log of total assets), return on assets (ROA), and the ratio of non-performing loans to gross loans.[10] Daily data on stock prices for listed banks in our sample is from Datastream and Bloomberg and data on stock market index in each country is from Bloomberg.

Table 1 presents the summary statistics for loan growth and the key bank characteristics. It is important to note that there is significant variation across banks in terms of balance sheet characteristics, a feature that we will exploit in our analysis of the transmission of commodity prices on lending across different banks. In particular, average (median) loan growth in the sample is 15.8 (9.5) percent, but there is large variation across banks. While there is almost no

[8] This indicator also shows an improvement in the country-specific terms of trade for commodity-importing countries when commodity prices decline.

[9] The initial choice of the countries is based on the IMF definition of low-income developing countries. The original sample consists of 917 banks. We eventually end up with 584 banks because of the restriction imposed to focus on banks which have at least 2 consecutive observations with non-missing values for the key bank-level variables used in the baseline model. Finally, out of this sample, 81 banks are listed. Those banks cover, on average, more than 70 percent of total credit to the private sector in the country, as measured by comparable statistics from the World Development Indicators. See Appendix Table B1 for the list of countries and the number of banks (and listed banks) included in the sample.

[10] Total loans include credit extended to all sectors of the economy and we are not able to distinguish between private and public sector lending. The definition of each variable is in Table B2; all variables are winsorized at the 5^{th} and 95^{th} percentile to remove outliers.

difference in loan growth across ownership (domestic vs foreign banks), interesting differences in loan growth emerge across other bank characteristics. Banks with low deposit funding and low NPL ratios shows much higher loan growth, on average, than banks with relatively higher deposits and NPL ratios. Loan growth tends to be sensitive to commodity prices, especially in countries with a high share of commodity exports to GDP. A simple plot of the data illustrates the positive correlation between loan growth and the $CNEP$ index (Figure 2).

3.2 Bank sensitivity to commodity prices

Our empirical strategy relies on the differential sensitivity of banks to variations in commodity prices. The ideal method to compute sensitivity of banks to commodity prices would be to directly observe the balance sheets of these banks and look for the share of loans to commodity exporters in total lending. However, we are restricted by our data from doing so. Balance sheet data for banks in developing countries do not allow us to compute a precise measure of sensitivity using loans to commodity exporters. Instead, we use a novel methodology to construct our measure of bank-level sensitivity, motivated from the observation that stock prices of banks that are strongly exposed to the commodity sector tend to move together with commodity prices. Figure 3, for instance, shows a strong correlation between bank stock returns and the commodity price index between 2011 and 2017 for two large Nigerian banks—First Bank of Nigeria and Skye Bank—which are particularly exposed to the energy sector.[11] Following Acharya and Steffen (2015) and Beck *et al.* (2017), we compute a time-varying sensitivity measure for each listed bank in our sample by estimating the following regression on a one-year rolling window for each year and each listed bank:

$$\ln(P)_{bd} = \alpha + \beta \ln(COMMODITY\ PRICE)_d + \gamma \ln(MARKET\ INDEX)_d \tag{3}$$

where, $\ln(P)_{bd}$ is the log of daily stock price of bank b on day d, $\ln(COMMODITY\ PRICE)_d$ is the log of commodity price index on day d and $\ln(MARKET\ INDEX)_d$ is the log of stock market index of the country where the bank is located.[12] To get the sensitivity measure of a bank b to commodity prices for year t, we estimate equation (3) using daily data in the period $t-1$ to t and use the coefficient β as our sensitivity measure.[13] Figure 4 shows the distribution of our bank-level measure of sensitivity to commodity prices, calculated for the 81 listed banks in our sample and illustrates that the estimated β are normally distributed.

[11] See a recent article on Vanguard (2015) for a recent overview of the effects of energy prices on the financial sector in Nigeria.

[12] Both indexes are taken from Bloomberg. In particular, we use the BCOM Index for commodity prices.

[13] To the best of our knowledge, this is the first paper which computes sensitivity of banks to commodity prices using this methodology.

Since about 15 percent of the banks in our sample are listed, to maintain enough degrees of freedom, we impute the sensitivity measure for the unlisted banks in two steps: first, for a given country-year pair, we impute the sensitivity measure for unlisted banks as the average bank-level sensitivity measure of listed banks in that country and for that year. For those countries in our sample without listed banks, we use the share of commodity exports in the country's GDP as our measure of sensitivity. This choice ensures that we do not exclude countries with underdeveloped financial markets from the analysis. In doing so, we assume that banks located in commodity-dependent countries are more affected by commodity price shocks than the ones located in countries with low dependence on commodity exports, and that all banks in the country are equally exposed to the commodity sector.[14]

3.3 Loan growth and commodity prices

We look at the response of bank lending to changes in commodity prices by estimating the following model, based on the traditional specifications used to estimate the reaction of bank lending to monetary policy shocks (Kashyap and Stein, 1995; Gambacorta and Mistrulli, 2004; Gambacorta, 2005; Gambacorta and Marques-Ibanez, 2011; Aiyar, Calomiris and Wieladek, 2016):

$$\begin{aligned} \Delta LOANS_{bct} &= \alpha_1 CNEP_{ct-1} \times SENS_{bct-1} + \alpha_2 CNEP_{ct-1} + \alpha_3 SENS_{bct-1} + \\ &+ \mathbf{COUNTRY}_{ct-1} + \mathbf{BANK}_{bct-1} + \delta_b + \tau_t + \epsilon_{bct} \end{aligned} \tag{4}$$

where $\Delta LOANS_{bct}$ is the growth rate of outstanding loans (in real USD) of bank b, located in country c, in year t; $CNEP_{ct-1}$ is the country-specific commodity price index presented in equation (1) for country c in the previous year $(t-1)$; $SENS_{bct-1}$ is the lagged sensitivity measure of bank b to commodity prices, as discussed above; $\mathbf{COUNTRY}_{ct-1}$ is a set of country-specific control variables including real GDP growth and the logarithm of domestic interest rates;[15] $\mathbf{BANK}_{bct-1}$ is a set of time-varying bank-specific controls, lagged one period, including measures of liquidity, size, capitalization, and deposits to asset ratio; δ_b and τ_t are bank and year fixed effects; and ϵ_{bct} is the standard error term.[16] Since the sensitivity measure varies

[14] Since these are indeed quite strong assumptions, in Section 4.1 we show that our results do not depend on this choice and are robust to the use of the restricted sample of listed banks. Figure B1 shows that there is a substantial variation in the share of commodity exports over GDP across banks. For the bank in the median country, the share of commodity exports to GDP is around 6 percent, but the share varies substantially across banks—the third quartile is above 15 percent and, on average, commodity exports account for more than 20 percent of GDP in a number of countries in the sample (e.g., Bolivia, Congo, Mauritania, Mongolia, Nigeria, Tajikistan, Vietnam, Yemen and Zambia).

[15] Data on GDP and interest rates are from the IMF's World Economic Outlook and International Financial Statistics Databases. See Table B2 for variable definitions and data sources.

[16] Compared to the traditional literature cited above, our data are at annual frequency, rather than quarterly, so that we simply take all the explanatory variables lagged one year, rather than including a more complex lag

at the bank level, standard errors are also clustered at the bank level to allow for intra-bank autocorrelation of the residuals within banks. The coefficient of interest is α_1, which identifies the extent to which changes in commodity prices affect bank lending, exploiting the differential sensitivity of banks to the commodity sector.

A key challenge when estimating the effect of commodity prices on bank lending is disentangling the credit demand from the credit supply channels. While the baseline estimation is silent on which channel is driving the result, we will try to tackle this issue in several ways.

The inclusion of year fixed effects absorb global shocks that may change the demand for credit (i.e., the global financial crisis), while GDP growth and the level of interest rate absorb part of the country-specific demand for credit.[17] To control for country-specific unobserved heterogeneity in credit demand, we include country fixed effects and, as a robustness exercise, we also include time-varying country fixed effects to absorb differential shifts in credit demand over time and across countries (see Section 4). However, even though time-varying country fixed effects may be able to capture cross-country unobserved heterogeneity in credit demand, they do not allow us to capture bank-specific heterogeneity in credit demand.

In this respect, bank fixed effects control for the possibility that a systematic matching between banks and firms confounds the identification of the effect of commodity prices. For instance, there is a consistent literature showing that large banks often lend to large firms (Berger and Udell, 2002) and that the latter are more likely to be exporters (see, for instance, Rankin, Söderbom and Teal, 2006, for evidence on Africa) and affected by commodity prices. In that case, the change in prices would affect the demand for credit, rather than the supply. Controlling for bank fixed effects enables us to get around this issue to some extent.

As none of these additional controls allow us to get a clean identification of the credit supply channel, we extend the baseline analysis with additional evidence on the transmission mechanism in Section 3.5, and we complement the bank-level analysis using loan-level data on Uganda in Section 5 to better isolate the credit supply channel.

3.4 Baseline results

Table 2 presents the results from our baseline model, estimated on a sample of 584 banks in 40 countries. We start by documenting the relationship between international commodity prices and bank lending. The first two columns include sequentially year, country and bank fixed effects, while column 4 adds bank-level controls, and column 5 further augments the model with country-level controls. Results indicate a positive, *unconditional*, association between commod-

structure.

[17] Results are robust to the inclusion of several other macroeconomic variables, see Section 4.

ity prices and bank lending in developing countries. The coefficient on commodity net export prices is positive and precisely estimated and, in the specifications with all controls and fixed effects, indicates that one standard deviation in the commodity net export prices index—which in our sample broadly corresponds to the average decline between 2010 and 2013—is associated with a contraction of 1.5 percentage points in bank lending one year ahead. The coefficients on bank liquidity and size have the expected sign and are significant, as loan growth is faster for more liquid and smaller banks. By contrast, bank capital and the deposits-to-assets ratio are not significantly associated with loan growth. Bank lending is also stronger in countries that grow faster (the effect decreases comparing contemporaneous and lagged growth), and it slows down in response to a (contemporaneous) increase in interest rates.

To identify the effect of commodity prices on the domestic economy through the financial intermediation channel, in column 6 we exploit the cross sectional variation of bank sensitivity to the commodity sector. Once we introduce the interaction term between the lagged value of the commodity net export price index and the measure of sensitivity to fluctuations in commodity prices of the country in which the bank is located, we find that the effect of commodity prices on loan growth depends on the intensity of bank sensitivity to the commodity sector. The positive and significant coefficient on the interaction term $CNEP \times SENS$ implies that banks which are more sensitive to commodity price shocks curtail lending more when commodity prices are lower. In terms of economic magnitude, one standard deviation decline of the commodity net export price index is associated with a contraction of loan growth of 1.8 percentage points for banks highly exposed to the commodity sector (i.e., those with $SENS$ at the 90^{th} percentile of the sample distribution), and with a 1.1 percentage points reduction for weakly exposed banks (those with $SENS$ at the 10^{th} percentile of the sample distribution.

3.5 Heterogeneity across banks

Our baseline results suggest that in periods of lower commodity prices, banks with a high exposure to the commodity sector reduce lending more relative to banks with low exposure. This result is agnostic of the distinction between credit supply and credit demand channel. Changes in commodity prices can, in fact, affect bank lending through the credit demand or the credit supply channel. As commodity prices fall, banks which are more exposed to commodities can see a larger decline in lending relative to weakly exposed banks if exporters postpone their investment and reduce their demand for credit. This is the credit demand channel of commodity prices. If, however, highly exposed banks experience a funding shock—as deposits fall due to a decline of commodity prices—they will be more likely to curtail lending, as retail

deposits is typically the dominant source of funding for banks in developing countries. This is the credit supply channel of commodity prices. This channel can also operate through a deterioration in bank asset quality, as exporters find it unable to service their loan repayments, leading to an increase in non-performing loans of the highly exposed banks. If the demand channel is explaining the positive correlation between commodity prices and bank lending seen in the baseline results, the transmission mechanism should not depend on funding and balance sheet strength of banks. However, if the transmission mechanism is working through the credit supply channel, it should be stronger for banks with weak deposit-to-assets ratio and worse asset quality (measured by the ratio of non-performing loans to total loans).

Thus, to uncover the mechanisms behind the transmission of commodity prices to credit growth and provide evidence supporting the credit supply channel, we focus on two measures of bank balance sheet strength—bank deposits and non-performing loans—dividing the banks into *high* and *low* groups, where *low* refers to the banks in the lowest decile of the sample distribution of the bank-characteristic in question, while *high* refers to the remaining banks. We enrich the model in equation (4) by splitting the coefficient on the interaction term $CNEP \times SENS$ between the two groups of banks (low and high ratios of deposits-to-assets and NPLs-to-gross loans), as follows:

$$\begin{aligned} \Delta LOANS_{bct} \quad = \quad & \gamma_1 CNEP_{ct-1} + \gamma_2 SENS_{bct-1} \\ & + \gamma_h CNEP_{ct-1} \times SENS_{bct-1} \times BANK^{HIGH}_{bct-1} \\ & + \gamma_l CNEP_{ct-1} \times SENS_{bct-1} \times BANK^{LOW}_{bct-1} \\ & + \mathbf{COUNTRY}_{ct-1} + \mathbf{BANK}_{bct-1} + \delta_b + \tau_t + \epsilon_{bct} \end{aligned} \tag{5}$$

In this model, we are interested in the coefficients γ_h and γ_l, which quantify the differential effect of commodity prices on lending across bank characteristics. Then, we consider bank ownership (foreign vs domestic) to test whether foreign banks could mitigate or amplify the effects of external shocks.[18] All specifications include the standard set of bank and country-level controls and bank, year, and country fixed effects.

Table 3 summarizes the results. In columns 1 and 2 we show the estimates for banks with low and high deposits and NPLs, respectively. The results unveil interesting heterogeneities in the transmission process. Banks with a low deposits-to-assets ratio (column 1) and high non-performing loans to gross loans (column 2) are those which exhibit a stronger transmission of commodity price shocks to loan growth. The p-values reported at the bottom of Table 3 show

[18] We classify a bank as a foreign bank if the country code of the global ultimate owner of the bank is different from the country code where the bank operates.

that the difference between high and low categories is statistically significant. These findings suggest that the transmission of the external shock to loan growth may work through the credit supply channel. The exposure to commodity prices affects only the supply of credit of banks whose deposit base dries up, leading to a contraction in their lending capacity. Similarly, when commodity net export prices go down, non-performing loans start to accumulate as exporters suffer losses and government arrears grow. This negative effect on bank asset quality will impair bank ability to raise market funding and force them to reduce lending.

The results are also economically relevant: in response to a one standard deviation decline of the commodity net export price index, a bank with high exposure (at the 90^{th} percentile of the sample distribution) and low-deposit contracts lending by 4.1 percentage points. This effect is not trivial, given that the median loan growth for banks with low deposits to asset ratio is 19.8 percent. By contrast, the credit contraction for a bank with high deposits is only 1.1 percentage points. The effect for banks with relatively higher NPLs is smaller, as a one standard deviation decline in $CNEP$ leads to a 1.7 percentage points lower credit growth (for those banks the median growth is 15.6 percent).

In column 3 we test for a differential effect across domestic and foreign banks. Contrary to the existing evidence pointing to foreign banks as a channel of transmission of financial shocks across borders (Cetorelli and Goldberg, 2012; Cull and Martinez Peria, 2010; De Haas and Van Lelyveld, 2014; Ongena *et al.*, 2015), we do not find any significant difference in the transmission behavior of foreign and domestic banks and the point estimates are extremely close. One possible reason behind the common effect across bank ownership is the similarity of business models between domestic and foreign banks that operate in low-income countries, which could limit the capacity of foreign banks to take advantage of a geographical diversification to mitigate their vulnerability to external shocks. Many banks in low-income countries are regional banks (e.g., 'Pan-African' banks, see International Monetary Fund, 2015) that are locally incorporated and share a similar business model to many domestic banks and differ from large international banks (Claessens and Van Horen, 2014). In our sample, foreign banks rely on retail funding as much as domestic banks, and their access to wholesale funding is much smaller than that of foreign banks headquartered in emerging economies.[19] Hence, if the home country of the foreign bank is simultaneously hit by a similar commodity price shock, the parent bank is unable to provide a protective liquidity buffer to its subsidiary in the host country. For instance, a Nigerian foreign bank in Ghana may not be able to source funding from its

[19]For banks located in low-income countries, retail funding is equal to 85 percent of total funding for the average foreign bank and 83 percent for the average domestic bank. By contrast, in emerging markets the average share of retail funding for foreign banks is 61 percent.

home country (Nigeria) as commodity price busts affect all commodity exporters (Nigeria and Ghana in this example) simultaneously.

Even though we do not find evidence that bank ownership matters for the transmission, we further rule out the possibility that our results are driven by the presence of foreign banks, some of which may have access to alternative sources of funding via internal capital markets, by replicating our analysis in the sub-sample of domestic banks. The results, presented in columns 4 and 5, indicate that the deposits-to-assets ratio and non-performing loans are the key channels for the transmission of commodity prices to bank lending.[20]

3.6 Commodity prices and bank balance sheet strength

The results discussed in the previous section suggest that changes in commodity prices could affect bank credit in developing countries through a funding shock and worsening of asset quality. In this section we conduct a direct test to validate the mechanisms behind the transmission of the international commodity price shock to domestic lending. To formally assess the impact of commodity prices on the health of the banking system, we estimate a set of simple panel regressions in which a set of bank health indicators—the return on assets, non-performing loans to gross loans, and deposits over assets—are function of the lagged price changes ($CNEP$) and its interaction with the measure of bank sensitivity to commodity price changes ($SENS$). As in the loan growth equation, we include macroeconomic controls, and country, bank and year fixed effects to absorb bank-specific and country-specific unobserved heterogeneity and the effect of global shocks on bank performance.

Our results show that commodity net export prices indeed affect bank deposits and NPLs. Banks that are more sensitive to fluctuations in commodity prices experience a reduction of deposit funding and an increase in NPLs in response to a fall in commodity net export prices (Table 4, columns 1 and 2). This evidence is in line with that found for the lending equation and provides further support to the credit supply channel, according to which banks more exposed to the commodity sector are more likely to experience a funding shock and a deterioration of asset quality, leading to a slowdown in the supply of credit. By contrast, there is no significant correlation with bank profitability, even though the coefficients have the expected signs (column 3).

[20] One may still wonder if our results are picking up something else. In particular, the one related to a funding shock could be related to bank size, as smaller (independent) banks tend to rely more on retail deposits, while larger banks have an easier access to other liabilities (Kashyap and Stein, 2000; Campello, 2002). However, when we divide banks between small and large we do find that the effect of commodity prices on lending is similar across the two groups (results available upon request).

3.7 Country heterogeneity and asymmetry

The effect of commodity prices on bank lending could also depend on the characteristics of the countries where banks are located. We look at the transmission of commodity prices to bank lending in countries with high and low dependence on commodity exports, by splitting the sample at a level of commodity exports equal to 5 percent of GDP, which approximately corresponds to the median of the sample distribution of exports to GDP ratio. We find that only lending by banks in countries with high dependence on commodity exports is significantly affected by fluctuations in commodity prices, and the effect is stronger than in the overall sample: for a highly-exposed bank, one standard deviation decline in $CNEP$ (amounting to about 10 percent decline) leads to a 4 percentage points fall in lending. By contrast, the coefficient on the interaction term for banks in more diversified exporters is smaller and not statistically significant (Table 5, columns 1 and 2).

Since the macroeconomic effects of commodity prices can be non-linear (see, for instance, Hamilton, 2003, on oil shocks), we investigate the presence of an asymmetric effect of commodity price changes. While it is intuitive to see that a fall in commodity prices would affect bank health negatively and hamper credit growth, it is not obvious how an increase in commodity prices will immediately lead to an improvement in bank health. With declining commodity prices, exporting firms suffer losses and are unable to service loan repayments. This trend would manifest itself as a funding shock and a deterioration of bank credit quality, which can potentially lead to a fall in lending as banks' balance sheets worsen. A commodity boom, however, may not affect bank lending as greater profits of commodity exporters and government may end up being spent on more consumption rather than increasing the deposit base of the banking system via more savings. To the extent the commodity sector is financed by foreign direct investment instead of domestic borrowing, one can also expect banks to not see an increase in lending during commodity price increases.

To understand the transmission mechanism more clearly, in Table 5 we look separately at the effect of positive and negative commodity price changes on bank lending. We find that the positive correlation between commodity prices and loan growth is driven by negative price changes and in this case the coefficient is more than twice as large as in the baseline (column 4), while there is no response of loan growth to a positive change in commodity prices (column 3). This result is in line with the evidence provided by Beck and Poelhekke (2017), who show that natural resource windfalls are not intermediated by the banking system, but are rather channeled to the economy through higher government consumption.[21]

[21] In the same spirit, Mlachila and Ouedraogo (2017) document a financial development resource curse in com-

4 Robustness exercises

In this section, we test the robustness of our key results from the bank-level analysis to the sub-sample of listed banks, an alternative measure of sensitivity, additional variables, and model specifications.[22]

4.1 Listed banks and an alternative measure of sensitivity

To be able to run our model on a sufficiently large sample of banks, we have constructed the sensitivity measure by merging bank- as well as country-level exposure to the commodity sector (Section 3.2). In order to address the concern that the country-level measure of exposure could be less precise and introduce measurement error in the $SENS$ variable, as we assume that all non-listed banks in a country are equally exposed to commodity prices, our first key robustness exercise restricts the sample to listed banks, so that the measure of sensitivity varies only at the bank level.

Our main results, re-estimated using the sample of listed banks, are presented in Table 6. The first column shows that, notwithstanding the significant drop in sample size (from over 584 to 81 banks), the coefficient on the interaction term $CNEP \times SENS$ retains its statistical significance, and is very close in magnitude to that estimated on the whole sample (Table 2, column 6). Columns 2 and 3 show the results for the sample split between positive and negative price changes and confirm that the overall positive correlation between commodity price and loan growth is driven by negative price changes. Then, columns 4 and 5 replicate the key results for bank-level heterogeneity and show that banks with lower deposits-to-assets ratio and higher levels of non-performing loans show a stronger transmission from international commodity prices to loan growth. These results, based on a much smaller sample composed by larger, listed banks, confirm the presence of a bank lending channel for the transmission of international commodity prices to domestic credit.

Finally, to make sure our findings are not driven by the way we define our sensitivity measure, we construct an alternative measure of sensitivity to commodity prices— an index of specialization in the commodities sector, based on Beck *et al.* (2017). The intuition is as follows: if a bank is well-diversified, its stock price should highly co-move with the broad stock market index, which moves in response to macroeconomic or system-wide news. Hence, for a well-diversified bank, a regression of daily bank stock prices on the broad market index should be

modity exporters, according to which bank deposits and credit to the private sector fall not only in downturns, but also during commodity booms, when the commodity sector catalyze existing resources.

[22] Annex A discusses a set of additional robustness exercises which deal with the clustering of standard errors, alternative samples, and definitions of the sensitivity measure (see Table A1).

able to explain most of the variation in its stock price. However, if a bank is more exposed to certain sectors, like commodities, its stock price should respond more to news specific to the commodities sector, after controlling for the macroeconomic impact that this sector-specific news may have. In this case, a model that regresses the bank's stock price on the broad stock market index alone may not be able to capture large part of the variation in the bank's stock price. Adding the commodity price index to the model should increase its explanatory power.

To compute the measure of specialization in commodities for each listed bank, we first estimate a model with the bank's daily stock price as the dependent variable and the broad market index as the independent variable:

$$\ln(P)_{bd} = \alpha + \beta \ln(MARKET\ INDEX)_d \tag{6}$$

Next, we include the daily commodity price index as an additional regressor:

$$\ln(P)_{bd} = \alpha + \beta \ln(COMMODITY\ PRICE)_d + \gamma \ln(MARKET\ INDEX)_d \tag{7}$$

Similar to equation (3), the above two equations are estimated in a one-year rolling window for each year. Our measure of specialization ($SPEC$) is given by the difference in R-squared from the two regressions: $R^2[7] - R^2[6]$. This measure varies between 0 and 1 and it is close to zero for banks whose portfolios are not concentrated in commodities.[23] Taking the bank-specific specialization in commodities to measure the exposure to international prices does not affect our results, as the coefficient on the interaction term $CNEP \times SPEC$ is significant and positive.

4.2 Additional macroeconomic variables and controlling for credit demand

Next, we test whether our results are robust to controlling for other macroeconomic factors which could potentially explain the positive relationship between loan growth and commodity prices (Table 7). For instance, one concern is that countries which see a fall in commodity prices are also likely to experience volatility in their exchange rate, which could have an impact on the credit supply. Since our identification strategy exploits variation in exposure to commodity prices at the bank-level, changes in exchange rates would confound our identification strategy only if the banks which are more exposed to commodity prices are also the ones which are more exposed to exchange rates, which is not necessarily the case. Nevertheless, in column 1 we control for exchange rates at the country-level and find that our key result is robust: the coefficient on the interaction term between commodity prices and sensitivity remains positive and significant and with a magnitude very close to that of the baseline (Table 2, col-

[23] Figure B2 shows the distribution of our specialization measure, which has a mean value of 0.15 and a standard deviation of 0.17.

umn 7). Another concern could be that countries with open capital account could see capital outflows during periods of commodity busts and capital inflows during periods of commodity booms, which could explain the positive relationship between lending and commodity prices. To address this concern, we include an index of *de jure* capital account openness (Chinn and Ito, 2006) and we find that our baseline results remain robust, while financial openness does not contribute to explain the variation in loan growth (column 2).[24]

To better control for credit demand, we run additional tests. We start by augmenting the baseline model with: 1) the one-period ahead GDP growth forecast, to capture changes in demand for bank credit due to expectations and changes in investment (column 3), and 2) the ratio of credit to the private sector over GDP, as more financially developed countries could have a higher demand for loans (column 4). In both cases the coefficient on the interaction term $CNEP \times SENS$ remains precisely estimated. Interestingly, we find that the coefficient on the private credit-to-GDP ratio is negative and significant, suggesting that credit demand maybe stronger in countries with less developed credit markets, because of financial deepening.

Then, to further allay concerns that our results are driven by credit demand rather than credit supply, we include country$\times$bi-annual fixed effects, which should be a reasonably good proxy for changes in demand at the country-level. We do not include country$\times$year fixed effects since in our data there is not enough variation, given that the main variable of interest, $CNEP$, varies at the country-year level. We believe that the next best alternative is to use bi-annual fixed effects. Results, reported in column 5, show that the interaction term, albeit somewhat smaller in magnitude than that of the baseline, remains significant at 5 percent and, strengthening our hypothesis that at least part of the estimated effect could be due to the credit supply channel.

5 Loan-level analysis in Uganda

The bank-level evidence showing that banks with a lower deposits-to-assets ratio and higher non-performing loans are those that respond more to changes in commodity prices is suggestive of the presence of the credit supply channel in the transmission of commodity price shocks. However, bank-level data do not allow to fully control for credit demand: if there is an endogenous sorting between banks with weaker balance sheet (e.g., more sensitive to commodity prices) and weak firms, our results could still reflect a demand effect.

To tackle this issue and identify the credit supply channel we rely on granular loan-level

[24] Data on exchange rates and credit to the private sector are from the IMF's World Economic Outlook Database, and the World Bank's World Development Indicators, while the index of capital account openness is taken from Chinn and Ito (2006). See Table B2 for variable definitions and data sources.

data from a single country which experienced a significant fall in terms of trade. We focus on Uganda for three main reasons. First, Uganda experienced a large commodity price shock in 2010-2011, which increased inflation from 0.3% in 2010:Q3 to 28.4% in 2011:Q3, before declining to around 5 percent—the inflation targeting set by Bank of Uganda—since 2012:Q3. In correspondence to the commodity price shock, which is visible also in the pattern of the CNEP index, credit growth slowed down significantly and contracted in mid-2012, and real GDP growth declined from double-digit at the end of 2010 to 0.7% in 2012:Q3 (Figure 5).

Second, Uganda set up a fully functional and comprehensive credit register in 2008, which collects loan-level data on the universe of loans based on monthly reports from all commercial banks, microfinance deposit-taking institutions, and other credit institutions. These data make it possible to control for changes in loan demand at a more granular level than in the bank-level analysis as well as in other studies, and hence enable us to more credibly to isolate credit supply from demand effects.

Finally, we argue that Uganda is representative not only for the region but also for other developing countries where weaknesses in institutions, and market incompleteness aggravate informational frictions in lending, resulting in low intermediation ratios and impairing the potency of the bank lending channel. Financial development gaps are a common feature throughout Sub-Saharan Africa and low bank presence is a key contributing factor (Allen, Carletti, Cull, Qian, Senbet and Valenzuela, 2014). As in other developing countries, banks are the main source of external finance for firms and bank financing is an important driver of entrepreneurship and firm growth (Banerjee and Duflo, 2014; Giannetti, 2003). Over the past decade, the financial system has experienced rapid growth and diversification and the country has become increasingly integrated with regional and global capital markets.[25]

5.1 Loan-level data from the credit register

Data on loan application in Uganda come from the credit register, which is maintained by the private credit bureau Compuscan Uganda CRB Ltd. under the supervision of the Bank of Uganda. The coverage of the register continuously improved over time and the data became representative by mid-2010, at the time of the commodity price shock. Thus, our analysis covers the period 2010:Q3—2014:Q2 and is based on data for the largest 15 banks, which account for 95% of total banking assets, and for which we have detailed quarterly balance sheet data, essential to measure the exposure to the commodity price shock.

[25]The domestic credit-to-GDP ratio, a measure of financial development, increased from 5.5 percent in 2007 to 23.4 percent in 2016, close to the average of low-income countries (26.8%) and not too far from the average of 38% in the sample of least developed countries (data from the World Bank's World Development Indicators).

We use data on the universe loan applications (with accept/reject decision) to non-financial firms, with no restriction on the minimum size of the loan. We have information on the currency, size and type (overdrafts, secured and unsecured loans, mortgages, etc.) of the loan application. To have a relatively homogeneous sample, we focus on local currency loans (in Ugandan shillings), which represent almost 90% of all loan applications, and we limit our sample to applications that were approved or rejected and exclude any records with pending or withdrawn status (34% and 0.2% of observations, respectively). The final sample has 16,784 (accepted/rejected) loan applications made by 6,209 firms between 2010:Q3 and 2014:Q2. For each borrowing firm, we also have information on its location (in one of 66 districts) and sector of activity (9 industries), but there is no information on firm balance sheets. The data show that in Uganda, there is a prevalence of single firm-bank relationships: over the full sample period 83% of firms apply for a loan to only one bank, 13% to two banks, and the rest to 3 or more banks.[26]

We merge the loan-level data with bank balance sheet variables, the CNEP index, and macroeconomic time series (e.g., GDP growth, inflation) at a quarterly frequency from the Bank of Uganda.

5.2 Loan applications and commodity prices

Data on loan applications from the credit register allows us to look at the supply of credit at the extensive margin, controlling for unobserved time-varying heterogeneity with borrower fixed effects. In particular, in the spirit of Jiménez, Ongena, Peydró and Saurina (2012), we estimate the following equation with data at the firm-bank-quarter level:

$$APPLICATION_{ibt} = \gamma_1 \Delta CNEP_t + \sum_{j=2}^{n} \gamma_j MACRO_t^j + \sum_{k=1}^{m} \delta_k BANK_{bt-1}^k + \sum_{l=1}^{p} \delta_l LOAN_{ibt}^l + \quad (8)$$
$$+\beta_1 EXPOSURE_b \times \Delta CNEP_t + \sum_{j=2}^{n} \beta_j EXPOSURE_b \times \Delta MACRO_t^j + \eta_i + \delta_b + \epsilon_{ibt}$$

where the dependent variable takes value 1 if a loan application by firm i to bank b during quarter t has been accepted and 0 if it was rejected. We employ the same measure of commodity prices ($CNEP$) used in the bank-level analysis and we control for the macroeconomic conditions that can drive credit demand including real economic growth and inflation ($MACRO$). At the bank level, we absorb unobserved bank heterogeneity with bank fixed effects (δ_b), but

[26] See Abuka, Alinda, Minoiu, Peydró and Presbitero (2017) for a detailed discussion of these data and their use in the context of the bank lending channel in Uganda. We focus our analysis exclusively on loan applications, as these data are more granular and allow for a better identification of the supply effect. As discussed by Abuka, Alinda, Minoiu, Peydró and Presbitero (2017), the presence of a very limited number of multiple bank relationships in the loan originations dataset prevent a firm-level analysis, in favor of a more aggregate approach that treats all firms in the same district and industry as one borrower.

we also control for time-varying key bank balance sheet characteristics which are likely to affect their lending capacity: the ratio of regulatory capital to risk-weighted assets, the ratio of liquid assets to total deposits, and the return on assets ($BANK$). We also control for the size of the loan application (taking the logarithm of the volume in shillings) and for a set of dummies capturing the type of loan application ($LOAN$). In line with the bank-level analysis, we allow the effect of commodity prices on bank lending to depend, alternatively, on two measures of bank balance sheet strength: 1) the reliance on retail deposits—measured by the ratio of deposits over total assets; and 2) asset quality—measured by the ratio of non-performing loans to gross loans. We take the value of the exposure variables before the commodity price shock, as of 2010:Q1 ($EXPOSURE$).[27]

The choice of bank deposits and NPLs as measures of exposure to the shock is motivated by the fact that: i) changes in commodity prices impact bank NPLs and deposits, and ii) the bank lending channel of commodity prices is stronger for high-NPLs and low-deposit banks (see Sections 3.5 and 3.6). To corroborate these arguments in the context of Uganda, Figure 6 plots the evolution of the deposits-to-assets (panel a) and non-performing loans-to-gross loans (panel b) ratios for the overall banking system, together with the CNEP index. The charts clearly show that bank deposits decreased and asset quality worsened after the two major negative commodity price shocks experienced in Uganda in 2007 and in 2010-2011. Thus, we expect that banks that start from a lower deposit base and a higher level of NPLs to be more severely affected by the negative commodity price shock.[28] A funding shock and a further accumulation of non-performing loans, by reducing the banks' ability to raise market funding, will impair their lending capacity and result in a contraction of the supply of credit.

5.3 Commodity prices and credit supply in Uganda

The estimated results from equation (8) are reported in Table 6. We present three specifications that control for credit demand with a different set of variables and fixed effects. First, we start with firm fixed effects, to absorb firm-specific constant factors that can drive demand for credit, and real GDP growth and inflation, as ways to control for common macroeconomic shocks that can affect all firms in the same way (columns 1, 4 and 7). Second, we control for time-varying unobserved heterogeneity across borrowers. As there are only very few firms

[27] The standalone effect of deposits and NPLs cannot be estimated since it is absorbed by the bank fixed effects. In the loan-level regressions we cannot use the bank-specific measure of sensitivity (see equation (3)) because only 3 banks are listed, see Table B1. The use of balance sheet characteristics as measure of exposure to the shock allow us to estimate equation (8) for all banks in Uganda.

[28] The argument about the importance of deposits to deal with a shock is similar to the evidence provided by Ivashina and Scharfstein (2010), who show banks with a larger deposits-to-assets ratio cut lending by less during the 2008 financial crisis.

applying more than once in a given quarter, we pool all firms in any given district-industry pair and add district-industry×year-quarter fixed effects. In this way, under the assumption that all firms in the same district-industry pair face similar unobserved shocks that can affect their credit demand in any quarter, we can absorb the effect of all macroeconomic shocks on credit demand. With this approach, we identify the differential effect of commodity prices on the supply of credit comparing the same borrower applying in the same quarter to banks with different exposures (columns 2, 5 and 8). Finally, we combine these two approaches and we maintain firm fixed effects allowing them to vary across years. In this case, we allow for firm-specific unobserved shocks which vary at a yearly frequency (columns 3, 6 and 9).

The results from the first specification, with only bank and firm fixed effects allow for the estimation of the level effect of commodity prices on the extensive margin of lending and indicate that, on average, there is no significant association between commodity price changes and acceptance rates. However, all specifications show that the probability that a loan application is accepted in response to a negative shock to commodity prices significantly depends on the degree of bank exposure to the shock, with low deposits and high NPLs banks having significantly lower loan acceptance rates.

If we focus on the two more demanding specifications with time-varying borrower fixed effects, we see that the coefficient of the interaction term between the change in CNEP and the deposits-to-assets ratio is negative and statistically significant, so that banks with relatively lower deposits-to-assets ratio before the commodity price shock contracted lending more than banks with a better funding position (higher deposits-to-assets ratio). The point estimate of column 2 indicates that the differential effect of a drop in CNEP by one SD (2.5%) between high and low deposit banks (75th vs. 25th percentile) is 1.2 percentage points, a relatively large effect given that the average rejection rate in the sample is 16.3%. In the similar way, the positive coefficient of the interaction term $NPL/ASSETS \times \Delta CNEP$ in column 5 implies that banks with an *ex-ante* higher level of non-performing loans reduce credit supply at the extensive margin relatively more than banks lower NPLs in 2010:Q1. In economic terms, the differential effect of a one SD fall in CNEP between banks with high and low NPLs (75th vs. 25th percentile) is 1 percentage point. These effects are of the same order of magnitude and statistically significant when comparing the *same firm* applying for loans in the *same year* from at least two different banks, notwithstanding the sharp drop in the number of observations (columns 3 and 6).

These results are confirmed even when we jointly include the interaction terms between the change in CNEP and the deposits-to-assets and the NPL-to-assets ratios (columns 7-9)—even

though when saturating the model with firm×year fixed effects the coefficient on the interaction term $DEPOSITS/ASSETS \times \Delta CNEP$ is less precisely estimated (column 9).[29] Overall, the analysis of loan applications in Uganda confirms the main findings from the bank-level analysis, as we observe a bank lending channel in the transmission of commodity prices to the domestic economy. More important, the availability of granular loan-level data allows for a more convincing identification of the credit supply channel, given that banks with less deposits and worse asset quality are those that react more to a negative shock in commodity prices reducing the supply of credit at the extensive margin.

6 Conclusions

This paper explores the role of bank lending channel in the transmission of international commodity prices to the domestic economy. We show that bank credit reacts to fluctuations in commodity prices and we document that the bank lending channel is stronger for countries more dependent on commodity exports and is driven by commodity price busts.

Our identification strategy exploits variation in exposure to commodity prices at the bank-level and tries to absorb the credit demand channel through a number of macroeconomic controls and fixed effects. Baseline results show that lending by banks that are more exposed to the commodity sector reacts more to changes in commodity prices. In addition, banks with lower deposits-to-assets ratios and higher non-performing loans reduce loan growth relatively more in periods of low commodity prices.

We complement this evidence with unique administrative data on loan applications in Uganda during 2010-2014, a period that includes a large negative shocks in terms of trade. The granularity of this data allows us to identify the credit supply channel of changes in commodity prices by absorbing borrower-specific time-varying heterogeneity through a large set of fixed effects. Results using this approach are consistent with the cross-country evidence using bank-level data, mitigating possible external validity concerns related to the experience of Uganda. In particular, we observe that banks that entered the commodity price shock with higher NPLs and lower deposits contracted credit supply at the extensive margin more than banks that had stronger asset quality and a larger deposit base.

[29] Our results are robust to a number of additional exercises. In particular, clustering the standard errors at the district and bank level does not wash out the statistical significance of the key interaction terms (Table C2). Our sample period is also characterized by large swings in the monetary policy stance and by the transition from a traditional monetary targeting framework to inflation targeting (Abuka, Alinda, Minoiu, Peydró and Presbitero, 2017; Berg and Portillo, 2018). Hence, we also control for monetary policy including the change in the 7-day interbank rate, which is the closest proxy to the policy rate—which is not available before the introduction of inflation targeting in July 2011 (see Abuka, Alinda, Minoiu, Peydró and Presbitero, 2017, for additional details). Results are robust to the inclusion of the change in the 7-day interbank rate and its interaction with the two exposure variables (Table C3).

Overall, our results indicate that the bank lending channel increases the vulnerability of the domestic economy to international shocks and could reinforce the direct effect of commodity price shocks on economic activity, which operates through a decline in export earnings, firm profitability, and government revenue, further constraining firm growth and investment. Moreover, the potency of bank lending channel of commodity prices is larger for banks which have lower deposits-to-assets ratios and higher non-performing loans. These findings underscore the importance to put in place strong financial regulation and macroprudential polices in developing countries, to strengthen the resilience of banking systems to commodity price shocks.

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Figures

Figure 1: Commodity prices and bank lending: transmission channels

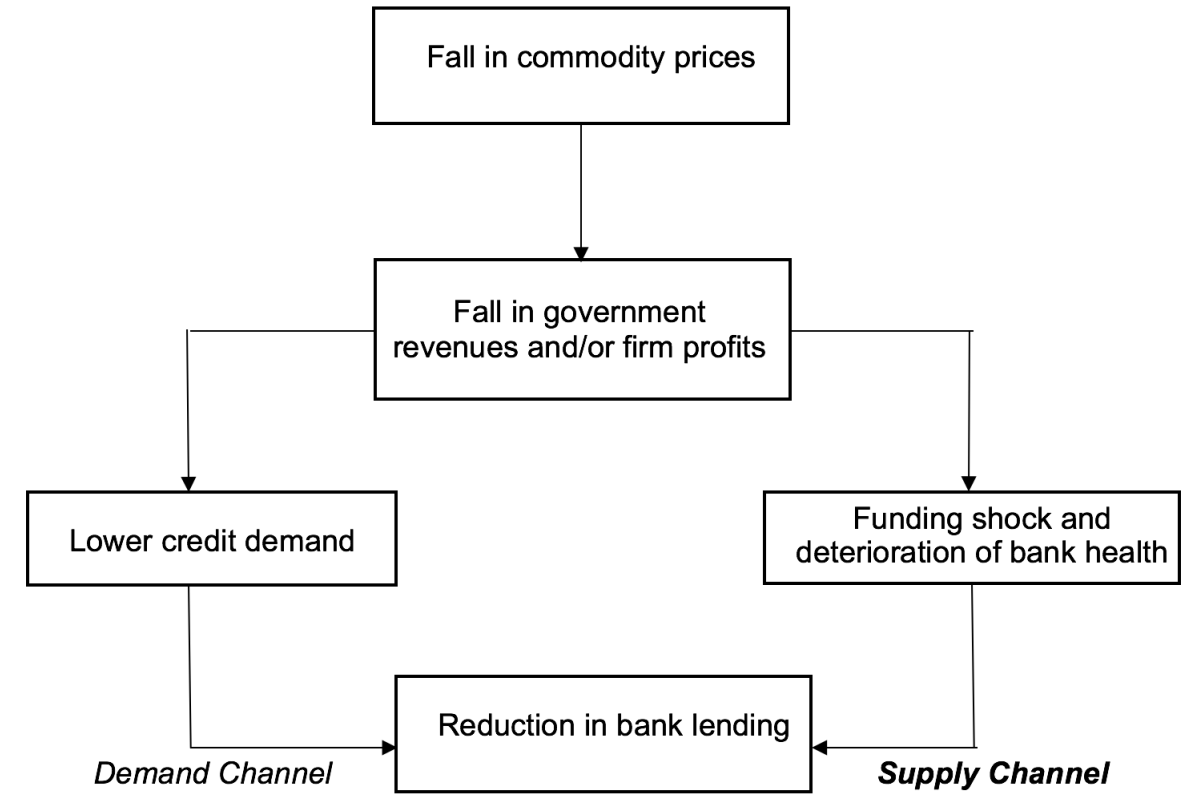
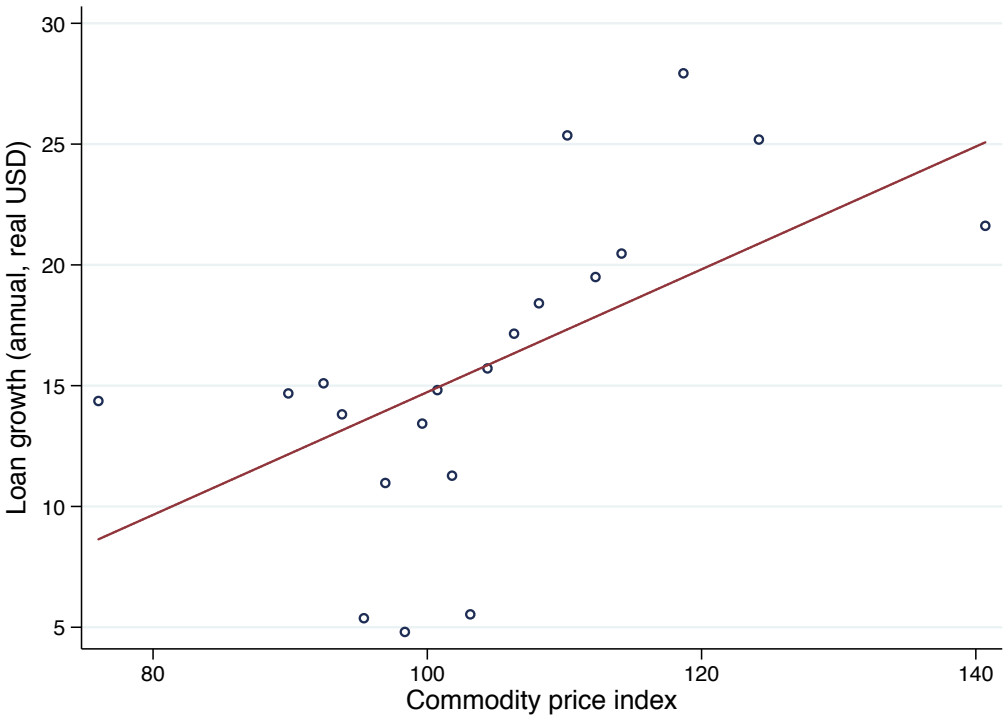
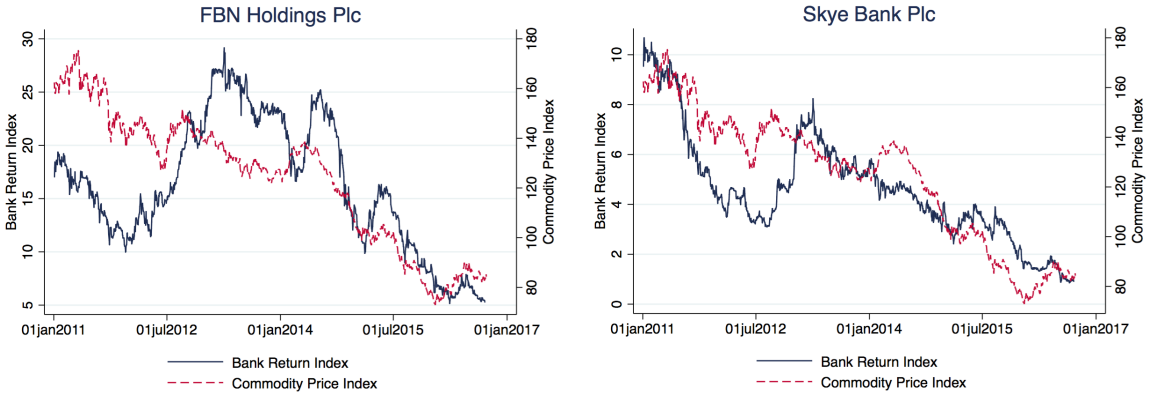


Figure 2: Commodity prices and loan growth



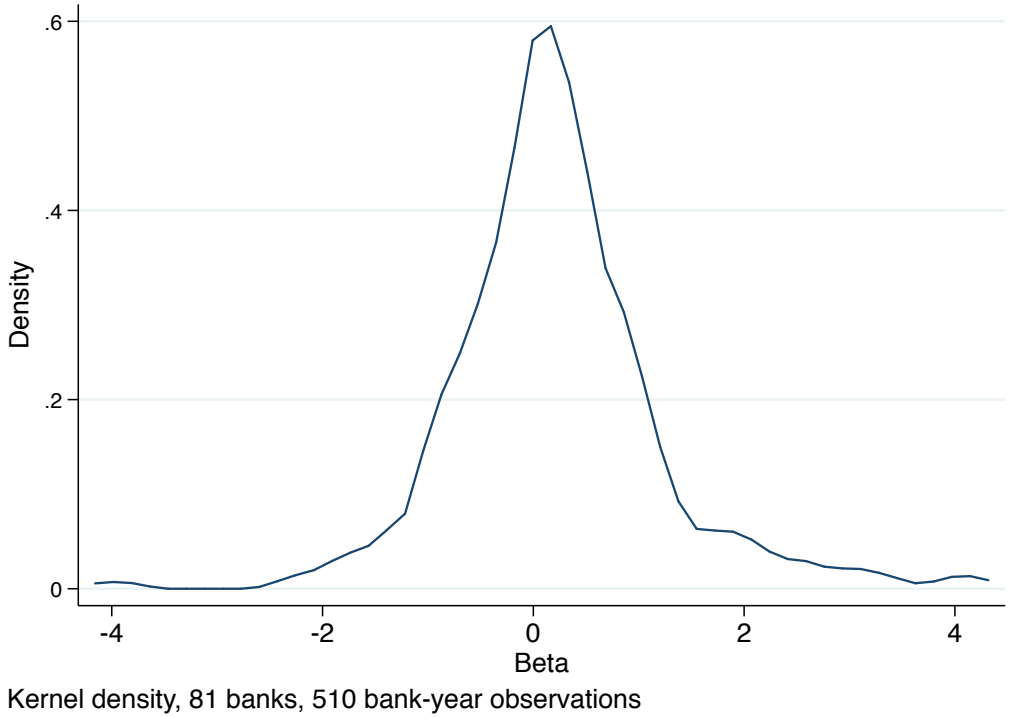
Notes: The figure shows a binned scatterplot of loan growth (defined as yearly percentage change in outstanding loans, in real USD) and the commodity net export price index ($CNEP$, as defined in equation (1)). To generate the binned scatterplot, starting from the regression sample (see Table 2, column 1), $CNEP$ is grouped into 20 equal-sized bins, then the chart plots, for each bin, the mean of $CNEP$ and loan growth within each bin. Data on loan growth are from Bankscope.

Figure 3: Commodity prices and bank returns



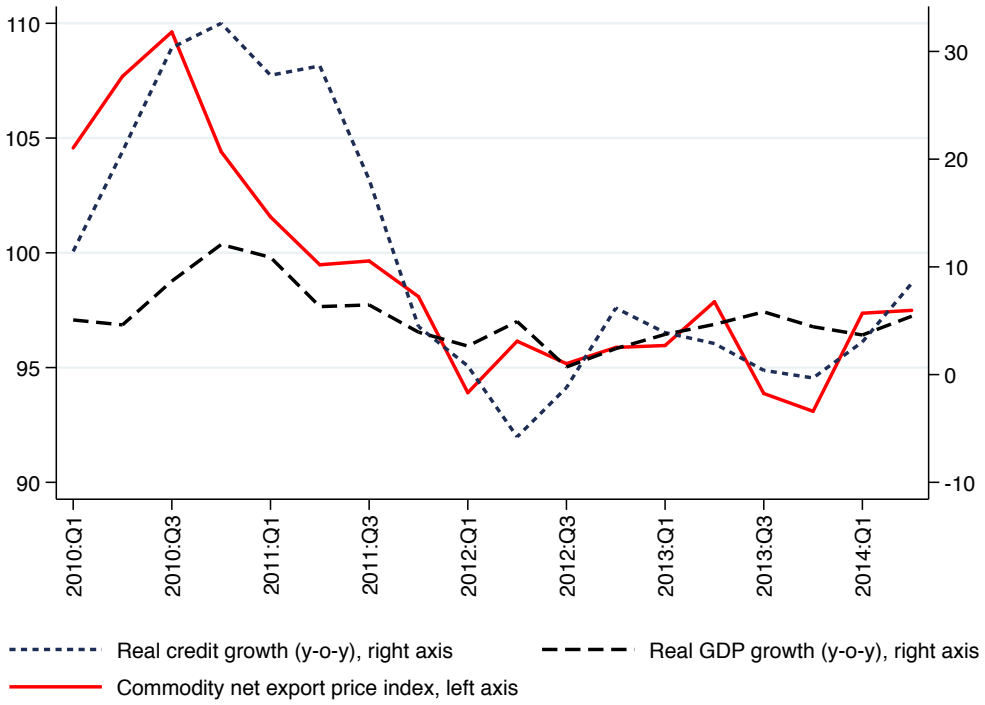
Notes: The commodity price index in the figure is the BCOM Index from Bloomberg. Data on stock returns for FBN Holdings and Skye Bank are from Datastream.

Figure 4: Distribution of the bank-specific sensitivity measure to commodity prices



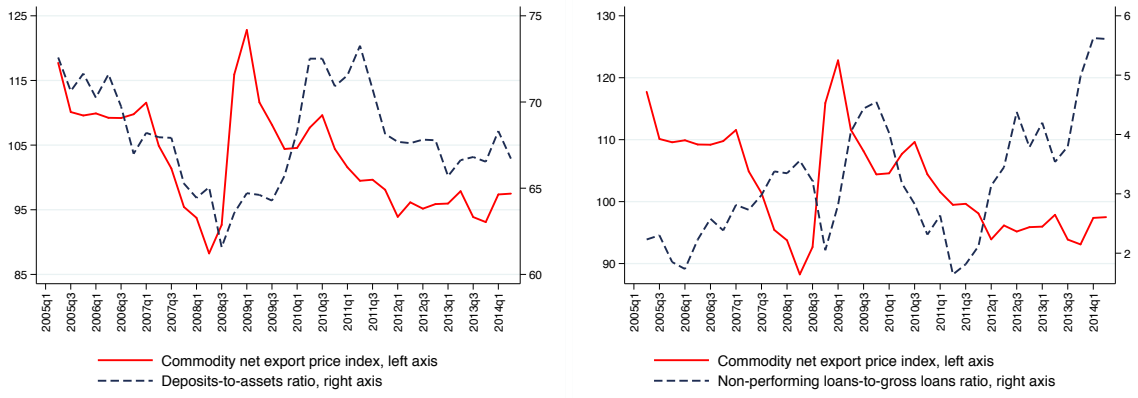
Notes: The bank-specific sensitivity to commodity prices for each listed bank is measured as the factor loadings from a regression of daily bank stock prices on the commodity price index, over a one-year rolling window, after controlling for the overall stock market index (equation (3)).

Figure 5: Commodity prices, credit and growth in Uganda



Notes: The commodity net export price index (*CNEP*) is defined in equation (1). Data on real credit and real GDP annual growth rates are from Bank of Uganda.

Figure 6: Bank exposure to commodity prices in Uganda



(a) Deposits-to-assets

(b) Non-performing loans-to-gross loans

Notes: The charts report the evolution of the commodity net export price index (*CNEP*) for Uganda, as defined in equation (1), together with the ratio of bank deposits over total assets (panel a) and the ratio of non-performing loans over gross loans (panel b). Bank variables are computed as weighted averages over each quarter, using total assets as weight. Data on bank balance sheet variables are from Bank of Uganda.

Tables

Table 1: Summary Statistics: Loan growth by bank characteristics

This table shows the summary statistics for the bank-characteristics; statistics for loan growth ($\Delta LOAN$) are shown also for the sub-sample of banks used in the bank heterogeneity regressions (see Table 3). Dummies for low bank characteristics are constructed considering the banks in the bottom decile of the sample distribution. All other banks are grouped in the high characteristic dummy.

	Obs	Mean	S.D.	25^{th}	Median	75^{th}
$\Delta LOAN_t$:						
All banks	3,547	15.81	33.89	-5.24	9.5	27.94
Domestic banks	2,228	15.95	34.23	-4.86	9.43	27.81
Foreign banks	1,319	15.59	33.32	-5.63	9.76	28.06
Low deposit banks (lowest decile)	353	30.39	47.28	-5.49	17.35	63.78
Other banks	3,194	14.2	31.67	-5.23	9.16	25.76
Low NPLs banks (lowest decile)	241	22.65	35.72	0.64	16.05	36.66
Other banks	3,306	15.31	33.71	-5.63	9.17	27.02
$LIQUIDITY$	3,547	37.7	24.31	19.63	31.17	48.93
$SIZE$	3,547	12.62	1.55	11.5	12.57	13.65
$EQUITY$	3,547	14.56	9.86	8.43	11.75	16.74
$DEPOSITS/ASSETS$	3,547	67.03	17.52	59.46	71.53	79.82
$NPLs$	2,409	7.05	7.95	1.84	4.25	8.99

Table 2: Baseline results

This table reports the estimates of equation (4) over the period 2004-2015 using annual data. The dependent variable is loan growth, defined as yearly change in real USD outstanding loans. The main independent variable are the commodity net export price index ($CNEP$, lagged one period) and its interaction with a measure of bank specific sensitivity to the commodity sector ($SENS$). Columns (1) to (3) include only the commodity net export price index and a different set of fixed effects; columns (4) and (5) add bank-level and country-level control variables, respectively. Column (6) includes the main variable of interest—the interaction of commodity price index with the sensitivity measure. All bank-level variables are lagged by one year. The set of fixed effects included in each columns is reported at the bottom. Standard errors, clustered at the bank level, are in parentheses.. *** p<0.01, ** p<0.05, * p<0.1.

Dep. Var.: $\Delta LOAN_t$	(1)	(2)	(3)	(4)	(5)	(6)
$CNEP_{t-1}$	0.1289***	0.1008*	0.1444***	0.0711	0.0124	-0.0280
	(0.048)	(0.054)	(0.053)	(0.050)	(0.052)	(0.056)
$CNEP_{t-1} \times SENS_{t-1}$						0.3068**
						(0.120)
$SENS_{t-1}$						-31.481***
						(11.974)
$LIQUIDITY_{t-1}$				0.3509***	0.3569***	0.3580***
				(0.049)	(0.048)	(0.048)
$SIZE_{t-1}$				-26.132***	-26.240***	-26.232***
				(2.739)	(2.711)	(2.708)
$EQUITY_{t-1}$				0.0907	0.0680	0.0707
				(0.211)	(0.209)	(0.209)
$DEPOSITS/ASSETS_{t-1}$				0.0035	-0.0129	-0.0140
				(0.077)	(0.078)	(0.078)
$GROWTH_t$					1.1862***	1.1840***
					(0.198)	(0.197)
$GROWTH_{t-1}$					0.3662	0.3809*
					(0.227)	(0.227)
IR_t					-16.887***	-17.264***
					(3.536)	(3.547)
IR_{t-1}					6.5104**	6.8067**
					(2.728)	(2.726)
Observations	3,547	3,547	3,547	3,547	3,547	3,547
Number of banks	584	584	584	584	584	584
R^2	0.081	0.133	0.410	0.493	0.511	0.512
Bank fixed effects	No	No	Yes	Yes	Yes	Yes
Country fixed effects	No	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Table 3: Heterogeneous effects across bank characteristics

This table reports the estimates of equation (5) over the period 2004-2015 using annual data. The dependent variable is loan growth, defined as yearly change in real USD outstanding loans. In column (1), the interaction term between the commodity net export price index ($CNEP$) and the sensitivity measure ($SENS$) is split into banks with high and low ratios of deposits to assets. Column (2) splits the interaction term between banks with high and low NPL ratios. Dummies for low bank characteristics (deposits, and NPLs) are constructed considering the banks in the bottom 10% of the sample distribution. All other banks are grouped in the high characteristic dummy. Column (3) splits the interaction term between banks domestic and foreign banks. A bank is defined as a foreign bank if the country code of global ultimate owner of the bank is different from the country code of the bank. The p-value for the test in the difference of coefficients of high and low bank characteristics is also reported in the table. Columns (1), (2) and (3) report the results for the whole sample. Columns (4) and (5) replicate the exercise for deposits and NPLs for the sub-sample of only domestic banks in low-income countries. All columns include bank- and country-level controls and bank, country, and time fixed effects. Standard errors, clustered at the bank level, are in parentheses.. *** p<0.01, ** p<0.05, * p<0.1.

Dep. Var.: $\Delta LOAN_t$	(1)	(2)	(3)	(4)	(5)
$CNEP_{t-1}$	-0.0315	-0.0343	-0.0277	-0.0026	-0.0180
	(0.055)	(0.070)	(0.056)	(0.072)	(0.089)
$CNEP_{t-1} \times SENS_{t-1}$, high deposits	0.2900**			0.2829**	
	(0.120)			(0.141)	
$CNEP_{t-1} \times SENS_{t-1}$, low deposits	0.7657***			0.7719***	
	(0.251)			(0.275)	
$CNEP_{t-1} \times SENS_{t-1}$, high NPLs		0.2652**			0.2612*
		(0.121)			(0.142)
$CNEP_{t-1} \times SENS_{t-1}$, low NPLs		0.1177			0.1362
		(0.121)			(0.139)
$CNEP_{t-1} \times SENS_{t-1}$, domestic banks			0.2966**		
			(0.124)		
$CNEP_{t-1} \times SENS_{t-1}$, foreign banks			0.3096***		
			(0.118)		
Observations	3,547	2,375	3,547	2,229	1,498
Number of banks	584	435	584	390	280
R^2	0.513	0.510	0.512	0.532	0.526
T-test (p-value)	0.069	0.000	0.544	0.088	0.000
Bank controls	Yes	Yes	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Sample	All banks			Domestic Banks	

Table 4: Commodity prices and bank health

This table reports the estimates of a set of regressions in which the dependent variables are: the ratio of deposits over assets (column (1)), the ratio of non-performing loans to gross loans (column (2)), and the return on assets (column (3)). The main independent variable are the commodity net export price index ($CNEP$, lagged one period) and its interaction with a measure of bank specific sensitivity to the commodity sector ($SENS$). All columns include macroeconomic controls, as in the baseline (see Table 2, columns (5) and (6)), and bank, country, and year fixed effects. Standard errors, clustered at the bank level, are in parentheses.. *** p<0.01, ** p<0.05, * p<0.1.

Dep. Var.:	(1) Deposits/Assets	(2) NPLs/Gross loans	(3) ROA
$CNEP_{t-1}$	-0.0003	-0.0007	0.0050
	(0.000)	(0.016)	(0.003)
$CNEP_{t-1} \times SENS_{t-1}$	0.0007*	-0.0556**	0.0003
	(0.000)	(0.022)	(0.005)
$SENS_{t-1}$	-0.0649*	5.7019***	0.0046
	(0.036)	(2.139)	(0.469)
Observations	3,534	2,490	3,535
Number of banks	580	445	583
R^2	0.808	0.682	0.618
Macro controls	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes

Table 5: Asymmetric effects and cross-country heterogeneity

This table reports the estimates of equation (4) over the period 2004-2015, using annual data. The dependent variable is loan growth, defined as yearly change in real USD outstanding loans. The main independent variable are the commodity net export price index ($CNEP$, lagged one period) and its interaction with a measure of bank specific sensitivity to the commodity sector ($SENS$). Column (1) and (2) show the results for sub-samples of countries with high and low levels of country exports to GDP ratio. A country is grouped into high category if the ratio of exports to GDP exceeds 5 percent (about the median of the sample distribution). Column (3) and (4) report the results for sub-samples of positive and negative changes in the commodity price index. All columns include bank- and country-level control variables as in the baseline regressions, in addition to bank, country and year fixed effects. Standard errors, clustered at the bank level, are in parentheses.. *** p<0.01, ** p<0.05, * p<0.1.

	Country Exports/GDP		**Asymmetry**($\Delta CNEP_{t-1}$)	
	High	Low	Positive	Negative
$CNEP_{t-1}$	-0.1158	0.1999*	0.0015	-0.0978
	(0.086)	(0.116)	(0.143)	(0.089)
$CNEP_{t-1} \times SENS_{t-1}$	0.5202***	0.2189*	-0.0288	0.8475***
	(0.177)	(0.125)	(0.193)	(0.141)
$SENS_{t-1}$	-55.1444***	-21.5754*	3.9758	-86.5621***
	(18.537)	(12.130)	(19.519)	(13.738)
$LIQUIDITY_{t-1}$	0.4118***	0.3319***	0.3541***	0.3170***
	(0.063)	(0.074)	(0.077)	(0.061)
$SIZE_{t-1}$	-24.7703***	-26.9700***	-28.1223***	-23.2330***
	(3.628)	(3.498)	(4.185)	(3.249)
$EQUITY_{t-1}$	0.1373	-0.0832	-0.1621	0.1927
	(0.276)	(0.281)	(0.336)	(0.272)
$DEPOSITS/ASSETS_{t-1}$	0.0407	-0.1560	0.0416	-0.0178
	(0.094)	(0.132)	(0.121)	(0.114)
$GROWTH_t$	1.0842***	1.3420***	1.1761***	1.2954***
	(0.269)	(0.322)	(0.400)	(0.284)
$GROWTH_{t-1}$	0.2037	0.3787	-0.0189	0.4593
	(0.263)	(0.385)	(0.386)	(0.311)
IR_t	-34.5046***	-1.1102	-16.9001***	-13.8271***
	(4.627)	(3.889)	(6.031)	(4.638)
IR_{t-1}	7.4236*	1.9308	4.5092	3.2489
	(4.326)	(3.416)	(5.505)	(3.468)
Observations	1,836	1,711	1,281	2,057
Number of banks	297	287	389	462
R^2	0.532	0.523	0.632	0.536
Bank fixed effects	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes

Table 6: Robustness: Only listed banks

This table reports the estimates of equation (4) over the period 2004-2015 using annual data and restricting the sample to only listed banks. The dependent variable is loan growth, defined as yearly change in real USD outstanding loans. Column (1) replicates the main specification, as reported in Table 2, column (6). Column (2) and (3) replicate the asymmetry results for positive and negative commodity price changes. Column (4) and (5) replicate the bank heterogeneity results for deposits and NPLs. In columns (1)-(5), the main independent variable are the commodity net export price index ($CNEP$, lagged one period) and its interaction with a measure of bank specific sensitivity to the commodity sector ($SENS$). In column (6), the main independent variable is the interaction between $CNEP$ and the alternative measure of bank specific sensitivity to commodity prices—specialization, $SPEC$—as defined in equations (6) and (7). All columns include country-level control variables as in the baseline specification (Table 2, column (6)), in addition to bank, country, and year fixed effects. Standard errors, clustered at the bank level, are in parentheses.. *** p<0.01, ** p<0.05, * p<0.1.

Dep. Var.: $\Delta LOAN_t$	Baseline	Asymmetry ($\Delta CNEP_{t-1}$)		Bank heterogeneity		Specialization
		Positive	Negative			
	(1)	(2)	(3)	(4)	(5)	(6)
$CNEP_{t-1}$	-0.0398	-0.1662	0.0985	-0.0024	0.1584	-0.4267*
	(0.134)	(0.353)	(0.300)	(0.136)	(0.145)	(0.232)
$CNEP_{t-1} \times SENS_{t-1}$	0.3408***	0.0213	0.9097***			3.0272***
	(0.113)	(0.171)	(0.131)			(1.138)
$SENS_{t-1}$	-35.2026***	-0.6953	-89.6623***	-34.2112***	-30.3517***	-314.2361***
	(11.131)	(17.538)	(12.513)	(11.184)	(11.254)	(115.222)
$CNEP_{t-1} \times SENS_{t-1}$, high deposits				0.3299***		
				(0.114)		
$CNEP_{t-1} \times SENS_{t-1}$, low deposits				0.7147***		
				(0.168)		
$CNEP_{t-1} \times SENS_{t-1}$, high NPLs					0.2957**	
					(0.114)	
$CNEP_{t-1} \times SENS_{t-1}$, low NPLs					0.1727	
					(0.115)	
$LIQUIDITY_{t-1}$	0.1827*	0.0133	0.0891	0.1510	0.1916	0.1373
	(0.107)	(0.172)	(0.171)	(0.103)	(0.121)	(0.109)
$SIZE_{t-1}$	-23.9302***	-30.6237***	-16.7423*	-23.9081***	-25.2170***	-22.4752***
	(4.506)	(5.980)	(8.375)	(4.758)	(5.112)	(4.682)
$EQUITY_{t-1}$	0.6777	-0.0204	0.6375	0.7992	0.6319	0.7033
	(0.598)	(0.949)	(0.706)	(0.575)	(0.719)	(0.604)
$DEPOSITS/ASSETS_{t-1}$	-0.1101	-0.1579	-0.2059		-0.0396	-0.1295
	(0.185)	(0.311)	(0.232)		(0.191)	(0.183)
Observations	510	261	235	510	459	510
Number of banks	81	75	57	81	78	81
R^2	0.593	0.770	0.633	0.598	0.632	0.596
T-test (p-value)				0.0017	0.0002	
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes	Yes	Yes	Yes

Table 7: Robustness: Macroeconomic variables and controlling for credit demand

This table reports the estimates of equation (4) over the period 2004-2015 using annual data and expanding the list of macroeconomic control variables. The dependent variable is loan growth, defined as yearly change in real USD outstanding loans. The main independent variable are the commodity net export price index ($CNEP$, lagged one period) and its interaction with a measure of bank specific sensitivity to the commodity sector ($SENS$). Column (1) estimates the baseline regression with the addition of exchange rates; column (2) adds capital account openness; column (3) adds the one period ahead GDP forecast; column (4) adds the ratio of credit to GDP. Column (5) adds country $\times$ bi-annual fixed effects to the baseline model. Columns (1) - (4) include bank, country, and year fixed effects. Standard errors, clustered at the bank level, are in parentheses.. *** p<0.01, ** p<0.05, * p<0.1.

Dep. Var.: $\Delta LOAN_t$	(1)	(2)	(3)	(4)	(5)
$CNEP_{t-1}$	-0.0186	-0.1139**	-0.0218	-0.0335	0.3075***
	(0.059)	(0.058)	(0.056)	(0.056)	(0.108)
$CNEP_{t-1} \times SENS_{t-1}$	0.2857**	0.3702**	0.3236***	0.3174***	0.1969**
	(0.115)	(0.169)	(0.118)	(0.114)	(0.093)
$SENS_{t-1}$	-28.7938**	-38.0164**	-33.2086***	-32.4991***	-20.8424**
	(11.320)	(17.287)	(11.752)	(11.334)	(9.278)
$LIQUIDITY_{t-1}$	0.3188***	0.3790***	0.3588***	0.3498***	0.3794***
	(0.052)	(0.054)	(0.048)	(0.048)	(0.053)
$SIZE_{t-1}$	-26.1540***	-29.5214***	-26.2077***	-25.1070***	-26.8786***
	(2.850)	(3.545)	(2.702)	(2.799)	(2.781)
$EQUITY_{t-1}$	-0.0656	0.1612	0.0797	0.0594	0.0828
	(0.227)	(0.246)	(0.208)	(0.212)	(0.198)
$DEPOSITS/ASSETS_{t-1}$	-0.0595	0.0087	-0.0095	-0.0253	-0.0200
	(0.090)	(0.098)	(0.077)	(0.077)	(0.087)
$GROWTH_t$	1.3127***	0.9883***	1.0879***	1.1921***	1.2810***
	(0.213)	(0.226)	(0.214)	(0.204)	(0.271)
$GROWTH_{t-1}$	0.4808**	0.4424*	0.3549	0.4334*	0.5747*
	(0.219)	(0.233)	(0.227)	(0.233)	(0.300)
IR_t	-18.0699***	-23.8944***	-17.4245***	-15.8554***	-20.0644***
	(3.969)	(3.971)	(3.544)	(3.620)	(5.448)
IR_{t-1}	7.9818**	8.6614***	6.6183**	6.6987**	2.3413
	(3.135)	(3.093)	(2.711)	(2.697)	(3.762)
$EXCHANGE\ RATE_{t-1}$	0.0739				
	(0.095)				
$KA\ OPENNESS_t$		2.9800			
		(11.560)			
$GROWTH_{t+1}$			0.4316		
			(0.266)		
$CREDIT/GDP_{t-1}$				-0.2401**	
				(0.118)	
Observations	3,069	2,796	3,547	3,475	3,536
Number of banks	509	518	584	576	583
R^2	0.509	0.509	0.512	0.516	0.587
Bank fixed effects	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	-
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Country $\times$ bi-annual fixed effects	No	No	No	No	Yes

Table 8: Commodity prices and loan applications

This table reports the estimates of equation (8) over the period 2010:Q3-2014:Q2. Data are quarterly. The dependent variable is a dummy equal to 1 if the loan application has been accepted and 0 otherwise (*APPLICATION*). The main independent variables are the interaction between the change of the commodity net export price index ($\Delta CNEP$) and the two measures of bank exposure to commodity prices: 1) the deposits-to-assets ratio (*DEPOSITS/ASSETS*); and 2) the ratio of non-performing loans to gross loans (*NPL/LOANS*), both measured in 2010:Q1. Bank-level control variables include the ratio of regulatory capital to risk-weighted assets (*CAPITAL*), the ratio of liquid assets to total deposits (*LIQUIDITY*, and the return on assets (*ROA*). The size of the loan application is measured by the logarithm of the loan volume in shillings (*APPLICATION SIZE*). The set of additional controls and fixed effects is reported at the bottom of the table. *MACRO* controls include real GDP growth and inflation. Standard errors, clustered at the district level, are in parentheses.. *** p<0.01, ** p<0.05, * p<0.1.

Dep. Var.: *APPLICATION* (0/1)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
DEPOSITS/ASSETS × $\Delta CNEP$	-0.0201***	-0.0233***	-0.0187*				-0.0204***	-0.0156***	-0.0097
	(0.007)	(0.004)	(0.010)				(0.007)	(0.004)	(0.010)
NPL/LOANS × $\Delta CNEP$				0.0160	0.1038***	0.1051***	-0.0054	0.0869**	0.0923**
				(0.020)	(0.035)	(0.035)	(0.019)	(0.034)	(0.035)
$\Delta CNEP$	1.3371**			-0.1262			1.3801**		
	(0.557)			(0.131)			(0.591)		
CAPITAL	1.0029***	0.3463***	0.6617***	1.0161***	0.3642***	0.5971***	1.0080***	0.3481***	0.6724***
	(0.154)	(0.072)	(0.164)	(0.166)	(0.106)	(0.148)	(0.150)	(0.084)	(0.173)
LIQUIDITY	0.3797***	0.3676***	0.2829***	0.3419***	0.3002***	0.2811***	0.3782***	0.3580***	0.2854***
	(0.108)	(0.045)	(0.052)	(0.101)	(0.044)	(0.053)	(0.105)	(0.044)	(0.053)
ROA	0.7932***	0.6991***	0.8210	0.9341***	0.6662***	0.8191	0.8251***	0.5596**	0.7425
	(0.249)	(0.174)	(0.824)	(0.247)	(0.214)	(0.800)	(0.239)	(0.226)	(0.793)
APPLICATION SIZE	-0.8154***	-0.3137	-1.1155***	-0.8536***	-0.3233	-1.1251***	-0.8264***	-0.3106	-1.1191***
	(0.160)	(0.381)	(0.191)	(0.151)	(0.382)	(0.193)	(0.156)	(0.381)	(0.188)
Average partial effect of $\Delta CNEP$	-0.0596			-0.0706			-0.0594		
p-value	0.6629			0.5875			0.6633		
Observations	13,765	15,714	9,895	13,765	15,714	9,895	13,765	15,714	9,895
R^2	0.415	0.279	0.530	0.413	0.277	0.529	0.415	0.279	0.530
MACRO controls	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes
EXPOSURE × *MACRO* controls	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes
Firm fixed effects	Yes	No	-	Yes	No	-	Yes	No	-
Bank fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-quarter fixed effects	No	-	Yes	No	-	Yes	No	-	Yes
District-industry × year-q fixed effects	No	Yes	No	No	Yes	No	No	Yes	No
Firm × year fixed effects	No	No	Yes	No	No	Yes	No	No	Yes

Online Appendix

A Bank-level analysis: Other robustness checks

In this annex, we report a set of tests to ensure that our results are robust to changes in model specification, sample, and variable definitions (Table A1). We begin by conducting robustness tests on alternative specifications of our baseline regression (see equation (4)). We start by estimating the model by excluding bank fixed effects, since the differential exposure of banks to commodity prices could be a function of the bank-specific business model. Including bank fixed effects would absorb significant variation in differential exposure to commodities and could weaken our results. We find that our results do not change if we exclude bank fixed effects (column 1).

In column 2, we make sure that the significance of our findings is not driven by the choice of clustering the standard errors at the bank level. Since we use also the share of commodity exports over GDP to construct the measure of sensitivity (i.e., for banks headquartered in countries without listed banks), we replicate the baseline regression by clustering the standard errors at the country level. Even though the standard errors are somewhat larger than in the baseline, the key estimated coefficients remain significant at least at the 5 percent level.

An additional exercise deals with the possibility that large events in some countries can affect global commodity prices even if these countries are not 'price makers' for those commodities (for example, large supply shock that shuts down all coal or copper mines in one country could temporarily affect world commodity prices for coal or copper). In that case, fluctuation in international commodity prices could be endogenous to local economic conditions. This possibility should not weaken our identification, since a negative shocks that affect the economy and international prices would have the same effect across all domestic banks, while our identification hinges on different bank exposure to the commodity sector. However, to fully address any remaining concern, we exclude from the sample banks headquartered in countries where a single commodity has a significant weight in the basket of exports. Formally, we calculate the average weight ($\omega_{i,j}$ in equation (1)) for each country-commodity pair over the sample period and, for each country, we select the highest weight. Then, we exclude all countries with the highest weight greater than 5 percent, assuming that those countries will be able to influence international prices for that commodity.[30] Our results are robust to this exercise (column 3).

In the last three columns we introduce alternative measures for our key variables. In column 4 we replace our measure of sensitivity with one obtained estimating the beta coefficients running a set of bank-level regressions (see equation (3)) on daily stock prices on a two-year rolling window. Then, as an alternative measure to the country-specific commodity price index used so far, we introduce a measure of commodity export prices (CEP), which is defined as follows:

$$CEP_{i,t}^{alt} = \sum_{j=1}^{J} P_{j,\tau} \hat{\omega}_{i,j,t} \tag{9}$$

[30] These countries are Cote d'Ivoire, The Gambia, Mauritania, Niger, Tajikistan and Zambia.

where, $P_{j,\tau}$ is the logarithm of the relative price of commodity j in period t within year t (in U.S. dollars and divided by the IMF's unit value index for manufactured exports); the weights are pre-determined and calculated as a three-year average:

$$\hat{\omega}_{i,j,t} = \frac{1}{3}\sum_{s=1}^{3}\frac{x_{i,j,t-s}}{\sum_{j=1}^{J} x_{i,j,t-s}} \tag{10}$$

where, $x_{i,j,t-s}$ is the export of commodity j from country i in year $t-s$. Hence, the weights reflect the share of each commodity in total commodity exports of country i. This measure takes into account only the exports side and, hence, it could better capture the possibility that in some countries, what really matters for the transmission of the shock to banking sector health is a decline in export revenues. We estimate the baseline model using this measure and find that the positive relationship between commodity prices and loan growth is again significant (column 5).

Finally, in column 6 we explore the possibility that the effect of a variation in commodity prices on loan growth is contemporaneous. Replacing the lagged value of the commodity net export price index with its value at time t does not affect the significance of the interaction term, even though the point estimate becomes smaller. This would suggest that, even if there is an immediate effects of changes in commodity prices on lending, this effect is likely to carry over to the following year, providing a justification for the lagged structure used in the baseline.[31]

[31] In addition, we run a model controlling jointly for the contemporaneous and the lagged values of commodity prices, finding that only the coefficient on the lagged variable is significant, and with a similar point estimate as in the baseline.

Table A1: Robustness: Model specification, sample, and variable definition

This table reports the results of a set of additional robustness exercises, including different model specifications, samples, and alternative variable definitions. The results are based on the estimations of equation (4) over the period 2004-2015, using annual data. The dependent variable is loan growth, defined as yearly change in real USD outstanding loans. The baseline model is estimated excluding bank fixed effects (column (1)), and clustering the standard errors at the country level (column (2)). In column (3) the sample excludes potentially non 'price-taker' countries, those for which the average share of exports in one commodity over GDP (calculated over the sample period) exceeds 5 percent (those countries are Cote d'Ivoire, The Gambia, Mauritania, Niger, Tajikistan and Zambia). In column (4), the sensitivity measure ($SENS$) is calculated by estimating the β coefficients in equation (3) on a two-year rolling window. In column (5) the variable $CNEP$ is replaced with the commodity export price index (CEP, as defined in equation (9)). In column (6) the commodity net export price index ($CNEP$) is measured at time t rather than $t-1$. Standard errors, clustered at the bank level (except that in column (3), where they are cluster at the country level), are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Dep. Var.: $\Delta LOAN_t$	(1)	(2)	(3)	(4)	(5)	(6)
$CNEP_{t-1}$	-0.0199	-0.0280	0.0066	-0.0264		
	(0.059)	(0.082)	(0.063)	(0.056)		
$CNEP_{t-1} \times SENS_{t-1}$	0.2818***	0.3068**	0.3193***	0.2318**		
	(0.106)	(0.140)	(0.114)	(0.109)		
$SENS_{t-1}$	-29.043***	-31.481**	-32.913***	-23.387**	-15.380*	-20.606***
	(10.685)	(14.572)	(11.260)	(11.105)	(7.875)	(7.204)
$LIQUIDITY_{t-1}$	0.1567***	0.3580***	0.3496***	0.3665***	0.3565***	0.3589***
	(0.039)	(0.054)	(0.051)	(0.049)	(0.048)	(0.048)
$SIZE_{t-1}$	-6.3154***	-26.232***	-25.355***	-26.232***	-26.233***	-26.402***
	(0.749)	(3.199)	(2.858)	(2.761)	(2.714)	(2.711)
$EQUITY_{t-1}$	0.2247*	0.0707	0.0405	0.0824	0.0680	0.0783
	(0.126)	(0.226)	(0.224)	(0.208)	(0.209)	(0.210)
$DEPOSITS/ASSETS_{t-1}$	-0.0008	-0.0140	-0.0260	0.0043	-0.0144	-0.0106
	(0.057)	(0.083)	(0.080)	(0.079)	(0.078)	(0.078)
$GROWTH_t$	1.2067***	1.1840***	1.4092***	1.1971***	1.1959***	1.2129***
	(0.208)	(0.260)	(0.231)	(0.197)	(0.197)	(0.198)
$GROWTH_{t-1}$	0.2152	0.3809*	0.4000	0.3702	0.3891*	0.3784*
	(0.233)	(0.194)	(0.272)	(0.227)	(0.224)	(0.223)
IR_t	-17.227***	-17.264*	-17.063***	-16.928***	-17.159***	-17.350***
	(3.535)	(9.040)	(3.643)	(3.537)	(3.420)	(3.497)
IR_{t-1}	6.3275**	6.8067*	6.0429**	7.0087**	6.7534**	6.7917**
	(2.696)	(3.834)	(2.749)	(2.749)	(2.718)	(2.742)
CEP_{t-1}					0.0206	
					(0.045)	
$CEP_{t-1} \times SENS_{t-1}$					0.1411*	
					(0.075)	
$CNEP_t$						-0.0744
						(0.052)
$CNEP_t \times SENS_{t-1}$						0.1802***
						(0.063)
Observations	3,547	3,547	3,177	3,544	3,547	3,547
Number of banks	584	584	526	583	584	584
R^2	0.237	0.512	0.510	0.509	0.511	0.512
Bank fixed effects	No	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	Bank	Country	Bank	Bank	Bank	Bank
Sample	All	All	Restricted	All	All	All

B Additional tables and figures—Bank-level analysis

Table B1: Bank-level analysis: Countries and number of banks in the sample

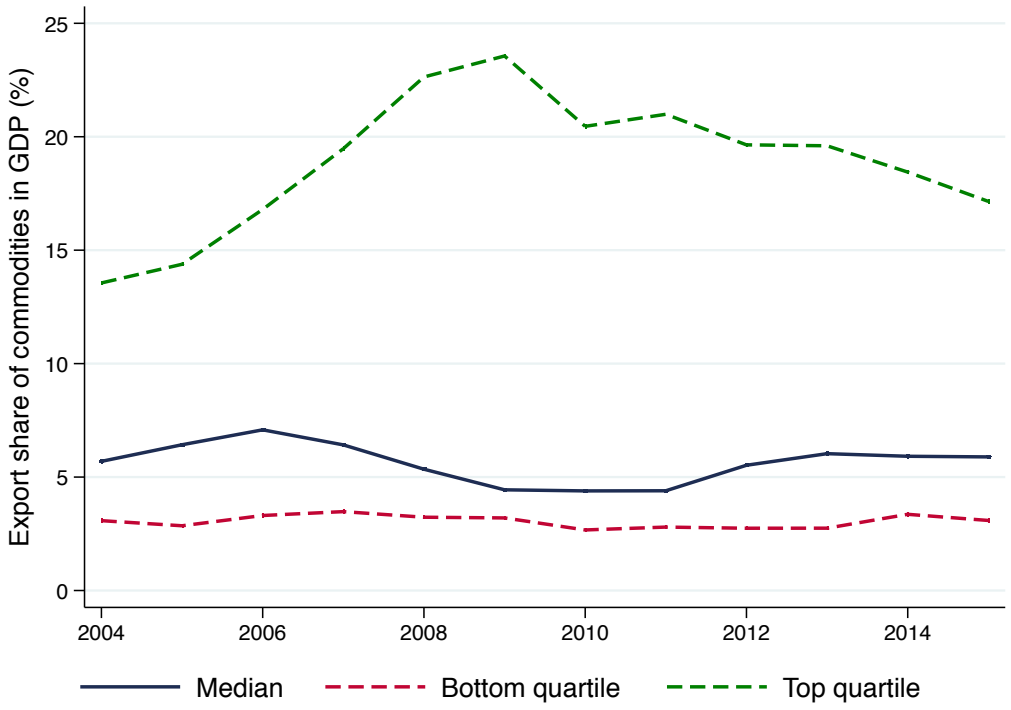
This table lists the total number of banks and that of listed banks in each country in the sample. There are 584 banks in 40 countries, out of which 81 banks are listed.

Country	Banks	Listed	Country	Banks	Listed
AFGHANISTAN	9	0	MALAWI	13	3
BANGLADESH	49	28	MALI	9	0
BENIN	8	0	MAURITANIA	8	0
BOLIVIA	15	0	MONGOLIA	9	0
BURKINA FASO	9	1	MOZAMBIQUE	14	0
BURUNDI	6	0	MYANMAR	4	0
CAMBODIA	27	0	NEPAL	22	0
CAMEROON	14	0	NIGER	5	0
CONGO	5	0	NIGERIA	30	14
COTE D'IVOIRE	13	0	MOLDOVA	13	0
DJIBOUTI	5	0	RWANDA	10	1
ETHIOPIA	8	0	SENEGAL	11	0
GAMBIA	3	0	SIERRA LEONE	8	0
GHANA	32	6	TAJIKISTAN	9	0
GUINEA	3	0	TOGO	9	0
HAITI	5	0	UGANDA	24	3
HONDURAS	20	0	TANZANIA	34	3
KENYA	41	10	VIETNAM	44	9
LAO PDR	1	0	YEMEN	8	0
MADAGASCAR	7	0	ZAMBIA	20	3

Table B2: Bank-level analysis: Variable definitions and data sources

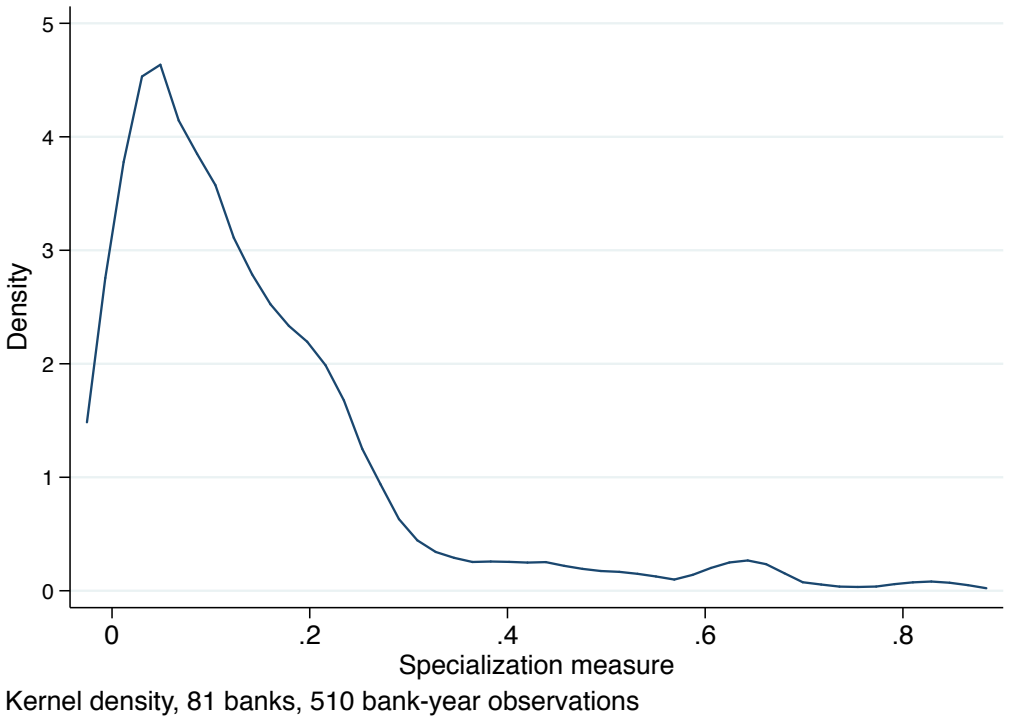
Variable	Definition	Source
Loan Growth	Growth of gross loans in real USD (%)	Bankscope
Size	Logarithm of total assets	Bankscope
NPL	Ratio of non-performing loans to gross loans	Bankscope
Deposits/Assets	Ratio of customer deposits to total assets	Bankscope
Equity	Total equity to assets ratio	Bankscope
Liquidity	Liquid assets to deposits and short-term funding	Bankscope
ROA	Return on assets	Bankscope
Price index	Country-specific commodity price index	Gruss (2014)
Exposure	Ratio of commodity exports to GDP (three-year moving average)	Gruss (2014) and authors' calculations
Growth	Growth rate of real GDP	World Economic Outlook (IMF)
IR	log of domestic interest rates	International Financial Statistics (IMF) and World Development Indicators (World Bank)
Private Credit/GDP	Credit to the private sector over GDP	International Financial Statistics (IMF) and World Development Indicators (World Bank)
ER	Exchange Rate	International Financial Statistics (IMF)
Growth Forecast	One period ahead forecast of GDP growth	World Economic Outlook (IMF), different vintages
KA Open	Dummy for capital account openness	Chinn and Ito (2006), updated

Figure B1: Share of commodity exports over GDP, sample distribution



Notes: The chart report the sample distribution of the share of commodity exports over GDP (calculated at the country-year level), across banks.

Figure B2: Distribution of the bank-specific specialization in commodities



Notes: The bank-specific specialization measure for each listed bank is computed as the difference in R-squared of the regression of daily bank stock prices on commodity price index, with and without the broad stock market index (equation (6) and equation (7)).

C Additional tables—Loan-level analysis

Table C1: Commodity prices and loan application: Summary statistics

This table reports the summary statistics of the variables used in the loan-level analysis. $APPLICATION$ is a dummy variable equal to 1 if the loan application has been accepted and 0 otherwise. $APPLICATION\ SIZE$ measures the size of the loan application, taking the logarithm of the loan volume in shillings. The macroeconomic variables are the change of the commodity net export price index ($\Delta CNEP$); real GDP growth, quarterly (ΔGDP); quarterly inflation, as change in consumer prices (ΔCPI) and the the change in the 7-day interbank rate (ΔIR). The two measures of bank-specific exposure to commodity prices: 1) the deposits-to-assets ratio ($DEPOSITS/ASSETS$); and 2) the ratio of non-performing loans to gross loans ($NPL/LOANS$), both measured in 2010:Q1. Bank-level control variables are measured quarterly and include: the ratio of regulatory capital to risk-weighted assets ($CAPITAL$); the ratio of liquid assets to total deposits ($LIQUIDITY$); and the return on assets (ROA).

	Obs.	Mean	S.D.	Min.	Max.
Loan-level variables					
$APPLICATION$	16,688	83.701	36.937	0	100
$APPLICATION\ SIZE$	16,688	17.535	1.733	13.816	21.416
Macroeconomic variables					
$\Delta CNEP$	16,688	-0.806	2.518	-5.217	4.275
ΔGDP	16,688	1.360	1.694	-1.736	4.402
ΔCPI	16,688	2.937	3.479	-0.940	12.290
ΔIR	16,688	0.999	3.592	-4.314	8.130
Bank-level variables					
$DEPOSITS/ASSETS$	16,688	69.605	12.338	19.644	88.248
$NPL/LOANS$	16,688	3.618	3.758	0.313	22.224
$CAPITAL$	16,688	20.489	6.251	11.802	51.739
$LIQUIDITY$	16,688	37.142	9.263	20.422	92.529
ROA	16,688	3.422	2.427	-14.417	8.467

Table C2: Commodity prices and loan application: Alternative clustering

This table reports the estimates of equation (8) over the period 2010:Q3-2014:Q2. Data are quarterly. The dependent variable is a dummy equal to 1 if the loan application has been accepted and 0 otherwise ($APPLICATION$). The main independent variables are the interaction between the change of the commodity net export price index ($\Delta CNEP$) and the two measures of bank exposure to commodity prices: 1) the deposits-to-assets ratio ($DEPOSITS/ASSETS$); and 2) the ratio of non-performing loans to gross loans ($NPL/LOANS$), both measured in 2010:Q1. Bank-level control variables include the ratio of regulatory capital to risk-weighted assets ($CAPITAL$), the ratio of liquid assets to total deposits ($LIQUIDITY$), and the return on assets (ROA). The size of the loan application is measured by the logarithm of the loan volume in shillings ($APPLICATION\ SIZE$). The set of additional controls and fixed effects is reported at the bottom of the table. $MACRO$ controls include real GDP growth and inflation. Standard errors, clustered at the bank and district level, are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Dep. Var.: $APPLICATION\ (0/1)$	(1)	(2)	(3)
$DEPOSITS/ASSETS \times \Delta CNEP$	-0.0233**		-0.0156
	(0.011)		(0.011)
$NPL/LOANS \times \Delta CNEP$		0.1038***	0.0869***
		(0.030)	(0.029)
$CAPITAL$	0.3463*	0.3642*	0.3481*
	(0.200)	(0.211)	(0.205)
$LIQUIDITY$	0.3676**	0.3002*	0.3580**
	(0.162)	(0.179)	(0.163)
ROA	0.6991**	0.6662**	0.5596*
	(0.281)	(0.291)	(0.310)
$APPLICATION\ SIZE$	-0.3137	-0.3233	-0.3106
	(0.412)	(0.409)	(0.409)
Observations	15,714	15,714	15,714
R^2	0.279	0.277	0.279
$EXPOSURE \times MACRO$ controls	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes
District-industry × quarter fixed effects	Yes	Yes	Yes

Table C3: Commodity prices and loan application: Controlling for monetary policy

This table reports the estimates of equation (8) over the period 2010:Q3-2014:Q2. Data are quarterly. The dependent variable is a dummy equal to 1 if the loan application has been accepted and 0 otherwise ($APPLICATION$). The main independent variables are the interaction between the change of the commodity net export price index ($\Delta CNEP$) and the two measures of bank exposure to commodity prices: 1) the deposits-to-assets ratio ($DEPOSITS/ASSETS$); and 2) the ratio of non-performing loans to gross loans ($NPL/LOANS$), both measured in 2010:Q1. ΔIR is the change in the 7-day interbank rate. Bank-level control variables include the ratio of regulatory capital to risk-weighted assets ($CAPITAL$), the ratio of liquid assets to total deposits ($LIQUIDITY$), and the return on assets (ROA). The size of the loan application is measured by the logarithm of the loan volume in shillings ($APPLICATION\ SIZE$). The set of additional controls and fixed effects is reported at the bottom of the table. $MACRO$ controls include real GDP growth and inflation. Standard errors, clustered at the district level, are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Dep. Var.: $APPLICATION\ (0/1)$	(1)	(2)	(3)
$DEPOSITS/ASSETS \times \Delta CNEP$	-0.0218***		-0.0130***
	(0.004)		(0.004)
$DEPOSITS/ASSETS \times \Delta IR$	0.0092***		0.0178***
	(0.003)		(0.005)
$NPL/LOANS \times \Delta CNEP$		0.1128***	0.0975**
		(0.039)	(0.039)
$NPL/ASSETS \times \Delta IR$		0.0777*	0.0907*
		(0.042)	(0.046)
$CAPITAL$	0.3558***	0.3355***	0.3349***
	(0.074)	(0.093)	(0.078)
$LIQUIDITY$	0.3748***	0.3067***	0.3803***
	(0.045)	(0.046)	(0.048)
ROA	0.7023***	0.7262***	0.6299***
	(0.170)	(0.180)	(0.179)
$APPLICATION\ SIZE$	-0.3181	-0.3170	-0.3121
	(0.380)	(0.376)	(0.375)
Observations	15,714	15,714	15,714
R^2	0.279	0.277	0.280
$MACRO$ controls	Yes	Yes	Yes
$EXPOSURE \times MACRO$ controls	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes
District-industry × quarter fixed effects	Yes	Yes	Yes