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Oil price collapse and firm leverage in resource-dependent countries

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Contents

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Abstract

This study examines the financial channel between oil price volatility and the resource curse using firm-level data. A collapse in oil prices adversely affects firm borrowing in resource-dependent countries. However, unlike in non-resource-dependent countries where just the resource sector is harmed, both resource and non-resource firms are affected in resource-dependent countries in an oil price collapse. We also find evidence of a flight to quality in lending, implying that the decline in leverage can partly be attributed to a reduction in the credit supply. Our results suggest that oil price volatility operates via the financial channel to impede economic diversification in resource-dependent countries.

Keywords: resources and development, resource rich, capital structure, commodity prices, panel data
JEL classification: Q32, O13, G32, Q02, G21

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1 Introduction

Economic development can be inhibited by commodity price volatility. Indeed, Rick van der Ploeg and Steven Poelhekke (2009) argue that the volatility is the *main* reason for underdevelopment in resource-dependent economies. In this paper, we examine evidence of the financial channel through which two recent oil price declines slowed the growth of firm leverage in dozens of countries. We specifically consider the oil price collapse in 2008 tied to the global financial crisis, and the 2014 oil price collapse associated with multiple factors related to oil supply and demand. Both episodes had profound effects on countries dependent on production and export of mineral resources.

Oil price changes lead to costly resource reallocation (Gilbert & Mork, 1986) that may be particularly harmful for the non-resource related sectors in resource-dependent economies and thus enhance resource curse effects. Along with the rest of the economy, the financial sector in resource-dependent countries typically comes under stress following a drop in commodity prices.

Bengt Holmstrom and Jean Tirole (1997) further demonstrate that credit crunches, collateral squeezes and savings squeezes all lead to a *flight to quality* in lending. We have at least two types of tightening of capital in our observation period. The global financial crisis of 2008–2009 caused a global credit crunch. The fall in oil prices in 2008 and 2014 exposed resource firms to a collateral squeeze, and the entire banking sectors of countries with large resource sectors were exposed to stress. Borrowers facing significant agency costs in borrowing are likely to bear the brunt of an economic downturn (Bernanke et al., 1996). In practice, smaller, younger and less capitalized firms are the first to suffer from a credit crunch. This flight to quality is associated with a reduction in overall economic activity (Lang & Nakamura, 1995).

We therefore expect that crunched and squeezed firms will gradually reduce their investments and borrowing as the end product prices of commodity producers decline. Lower commodity prices should also make resource firms riskier for lenders. The paradox confronting banks in a commodity price collapse is that even if they want to shift to other borrower groups and support non-resource sectors in the economy, large and tangible resource firms may still be their safest borrowers during an episode of financial distress. Thus, we address the empirical issue of whether the flight-to-quality effect dominates under such conditions.

Based on the above-described theoretical and empirical literature, we present two hypotheses:

1) *A sharp decline in commodity prices has an adverse effect on the borrowing of resource firms in all countries.*

2) *A collapse in oil prices causes a significant collateral squeeze in the banking sectors of resource-dependent countries. This leads to a flight to quality in lending, adversely affecting the borrowing of firms in non-resource sectors as well.*

We test our hypotheses empirically using annual firm-level data from 70 countries over the period 2005 to 2016. Our sample includes over 3,000 non-financial firms.

To the best of our knowledge, this is the first paper to provide firm-level empirical evidence on changes in firm borrowing in the wake of an oil price collapse. We present evidence that the fall in outstanding debt is more pronounced for firms in resource-dependent countries following a major decline in oil prices. Further, we show that the decline in borrowing growth is not entirely attributable to demand, i.e. the supply of credit also plays a role. Our results suggest that oil price volatility hinders economic diversification in resource-dependent countries through this financial channel, thereby exacerbating the resource curse.

The remainder of this paper consists of four sections. Section 2 introduces the related literature. Section 3 discusses the data and methodology. Section 4 presents the empirical results. Section 5 concludes.

2 Literature on oil price volatility and the financial channel

There is an extensive branch of empirical literature showing the adverse effects of oil price on economic growth, equity returns and industry growth (e.g. Hamilton, 1983; Lee & Ni, 2002; Nandha & Faff, 2008; Scholtens & Yurtsever, 2012; Zind, 1999). Although the relationship is positive for resource firms and commodity-producing countries, the negative effect on other industries and countries outweighs the benefits to oil producers from a global perspective (IEA, 2016). Gupta (2016) presents firm-level evidence that oil price shocks affect the stock returns of oil and gas firms more if such firms are located in countries where oil production is the dominant industry. Asymmetry in the reaction to oil price has been detected by Mork (1989), showing that the negative effects of a rise in oil price are greater than the positive effects followed by a decline in price. While price movements up and down have opposite and symmetric effects on the production possibility frontier, Gilbert and Mork (1986) suggest that any substantial oil price change causes costly resource reallocation.

Countries dependent on mineral extraction tend to grow more slowly than their resource-poor counterparts (Badeeb, Lean, & Clark, 2017). Moradbeigi and Law (2017) show that higher level of financial development dampens the negative impact of oil abundance on economic growth. However, there is both cross-country and within-country evidence that financial sectors tend to be less developed in resource-rich regions (Kurronen, 2015; Yuxiang & Chen, 2011). Van der Ploeg and Poelhekke (2009) argue that the resource curse and development failures of resource-abundant countries are caused by volatility in commodity prices. Controlling for the volatility, they show that resource wealth supports growth and that a developed financial sector can mitigate price shocks. Applying this finding to the firm level, we consider whether a rapid fall in commodity prices causes a detectable reallocation of financial resources.

Khwaja and Mian (2008) present empirical evidence from an emerging market that large firms are twice hedged from liquidity shocks in the financial sector: i.e. large firms see less reduction in their bank lending than smaller firms, and large firms enjoy access to alternative borrowing channels. Notably, a global credit crunch creates an environment where alternative sources of financing are likely to be limited for large firms as well. Examining evidence from syndicated loans, a flight home effect reduces the availability of loans even for high-quality borrowers as banks retreat to their home markets (Giannetti & Laeven, 2012). Using evidence from Russia, Fungacova et al. (2013) show that foreign-owned banks reduced lending more than other banks during the 2008–2009 financial crisis. Lemmon and Roberts (2010) show that even large firms with access to public credit markets are susceptible to fluctuations in the supply of capital. As investor sentiment deteriorates, it becomes harder for firms to stage bond issues. Soured investor sentiment may also reduce availability of bank loans as banks find it harder to securitize debt (Shleifer & Vishny, 2010).

The classic *trade-off theory* of capital structure choice argues that firms balance between equity and debt to maximize firm value. Firms facing volatility in the financial value of their assets face higher costs from financial distress and may be expected to cut back on their borrowing (Myers, 1984). This may indeed be the case for resource firms, which typically have lower leverage ratios than firms in other industries (Kurronen, 2016). On the other hand, the *pecking order theory* challenges this view, positing that firms prefer internal financing due to information asymmetry. Only when internal resources are insufficient do firms resort to issuing debt. As well summarized by Zeitun et al. (2016), the theories often give contradictory prognoses on firm leverage and indicate the capital structure debate is far from settled.

Contrary to the classic assumption of Modigliani and Miller (1958), firms do not always choose debt levels optimal to their needs. For example, supply frictions distort capital structures from those demanded by the firms (Faulkender & Petersen, 2006). Beck (2011) makes a similar assertion

based on survey data of firms in resource-dependent countries. Using empirical evidence from Gulf Cooperation Council (GCC) countries, Zeitun et al. (2016) argue that corporate capital structure prior to the 2008 financial crisis was determined by demand, whereas after the crisis the supply side, i.e. banks, has increased in importance. Considering the GCC countries as well, Khandelwal et al. (2016) show that changes in oil prices affect bank balance sheets and asset prices. A recent study of Al-Khazali and Mirzaei (2017) finds that a fall in oil prices is associated with an increase in non-performing loans in oil-exporting countries.

There is a rapidly emerging strand of literature on the effects of the 2008 global financial crisis on firm capital structure. Using US data, Harrison and Widjaja (2014) show that the role of asset tangibility increased after the financial crisis as a determinant for leverage. Using data from Western Europe, Iqbal and Kume (2014) show that firm leverage ratios increased during the financial crisis, and decreased after the crisis. As a general observation, the effects of the recent financial crisis on resource-dependent countries has received limited attention.

3 Data and methodology

3.1 Data

We take our firm data from Bloomberg, gathering financial data on companies included in the main equity indices of 73 countries during our 2005–2016 observation period. These equity indices are listed in Appendix 1. For the United States, we use firms included in the S&P500 index. We limit the data to non-financial firms, and remove firms with missing values on debt or assets. We also eliminate observations from countries that do not have information on their fuel and metal exports for any of the years in our sample as we are unable to determine their resource dependence. Country-specific variables are taken from the World Bank Group's World DataBank.

As our interest variable, we use the annual real change in the amount of outstanding short- and long-term interest-bearing debt of the firm relative to the previous period's total assets. We use consumer price inflation (CPI) to deflate the nominal change in the debt amount. While CPI is admittedly an imperfect measure of changes in price levels, it is the most available. In line with the observation of Lemmon and Roberts (2010) that debt levels do not react strongly to changes in the supply of capital as firms tend to reduce investments accordingly, we use the change in the amount of debt rather than debt level. Similarly, using current period assets in debt ratios does not yield meaningful results as the value of current period assets for resource firms changes due to the oil price drop and the effects on the amount of debt are not visible.

We use firm-specific variables that previous literature has shown to be important for firm leverage as our controls (Rajan & Zingales, 1995; Titman & Wessels, 1988). Specifically, we use the ratio of the firm's property, plant and equipment to total assets as a measure of the firm's tangibility. We use the market-to-book ratio as our control for growth opportunities. Firm size is measured by the logarithm of total assets in US dollars and profitability by cash from operations to total assets as this describes the firm's ability to generate cash to finance investments. Book leverage and maturity structure are used to control for the characteristics of existing debt and capital expenditure to indicate investment intensity.

We trim the firm variables, removing observations that are more than four median absolute deviations from the median.[1] While this only removes clear outliers, it reduces the risk of outliers or errors in the data driving the results. More importantly, it does not systematically eliminate the tails of the distribution that might contain valuable information.

Using the Global Industry Classification Standard (GICS), we define resource firms as firms with the sector name "Energy" or the industry name "Metals & Mining." We exclude the sub-industry "Oil & Gas Refining & Marketing" from the energy sector based on the observation of Lee and Ni (2002) that the refining uses oil as an input, so it is adversely affected by the rise in oil prices. Following Nili and Rastad (2007), we use the export share of minerals (fuels and metals) in total exports as the indicator for resource dependence. Countries with their average share of mineral exports to total exports during our sample period are described in Figure 1.

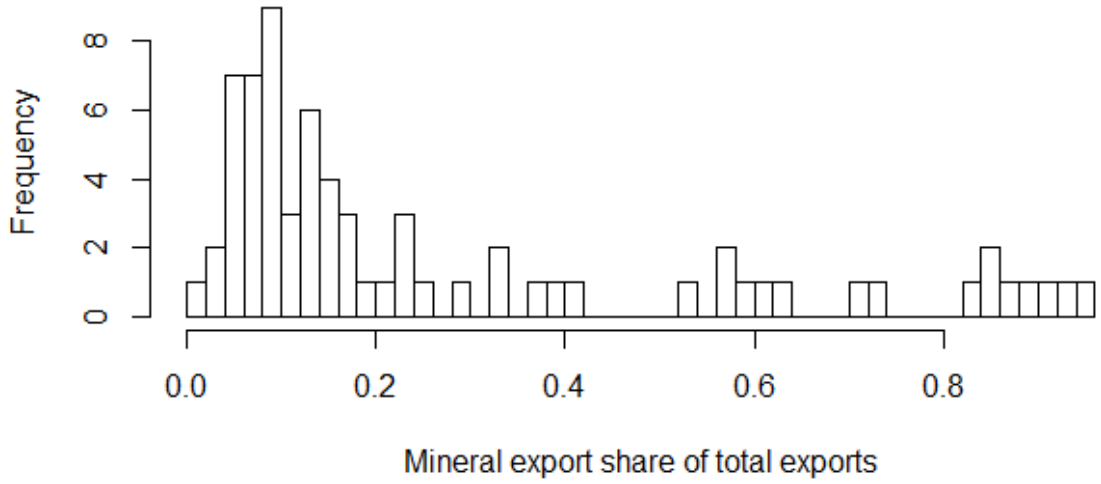
To illustrate firm characteristics in the most resource-dependent countries, we assign as "resource-dependent" those countries in which the mineral export share exceeds 50%. By the same token, "non-resource" countries are those where less than 50% of exports consist of energy and minerals.[2]

To improve confidence in our findings, we also test alternative thresholds to verify our results in later regressions. As country-specific control variables we use dummy variable "developed" to indicate that a country was a high-income country (World Bank classification) in 2008, domestic credit to private sector to control for the financial sector development level and non-performing loans to total gross loans to control for banking sector health. In addition to year dummies, we use the S&P Goldman Sachs Commodity Index (GSCI) to control for commodity prices. Descriptive statistics of

[1] We limit the maximum amount of trimmed observations to 1.5% for each variable. Consequently, for the real change in debt we increase the multiplier from 4 to 8, as it has a peaked distribution.
[2] Countries in our sample where minerals account for more than half of total exports include Australia, Bahrain, Chile, Colombia, Kazakhstan, Kuwait, Nigeria, Norway, Oman, Peru, Qatar, Russia, Saudi Arabia, United Arab Emirates and Venezuela.

key variables and their correlation matrix are presented in Table 1. Our variables are described in detail in Appendix 2 .

Figure 1 Histogram of countries by their average mineral export share of total exports during 2005–2016



Oil price developments for 2005–2016 are depicted in Figure 2. Two major price falls occurred during the sample period; the first in the second half of 2008 and the second in late 2014. The reasons behind the price declines are quite distinct, however. The 2008 collapse was a response to a deteriorating global growth outlook. The oil price slide accelerated in September on the Lehmann Brothers failure, a major triggering event for the global financial crisis. In contrast, no major recession was in sight in 2014. Oil supplies had built up due to US shale oil investments, the reentry of Iran to the market and the return of stability to Libya. Demand for oil in 2014 was subdued, mostly due to slowing growth in China. Consequently, as the supply of oil consistently exceeded demand (IEA, 2016), with OPEC and other big producers doing little to curb supplies until late 2016, oil price dropped. Metal prices in this period declined at a much more moderate pace than the oil price, indicating that supply issues were largely responsible for the 2014 oil price decline (Baumeister & Kilian, 2016). The drop in oil prices in 2014 improved the global economic outlook overall as low energy prices support economic growth in most countries. As the price falls were so large and rapid in our sample period, the “normal” time periods consist mostly of rising or relatively stable prices. That should amplify the effect we find following a sudden price shock.

While our study focuses on the effects of changes in the oil price, our use a broader definition of resources (energy and metals) is warranted by the strong co-movement of oil with other commodities. Prices of both energy and industrial commodities react to global business cycles (Barsky &

Kilian, 2002). Ohashi and Okimoto (2016) note the increasing trend of excess co-movement in commodities since 2000 caused by financialization. Reboredo and Ugolini (2016) present evidence that spillovers from oil to metals prices have strengthened since the 2008 global financial crisis.

Table 1 Descriptive statistics

Descriptive statitistics	N	Mean	St. Dev.	Min	Median	Max
Real change in debt	30,615	0,01	0,09	-0,42	0	0,42
Size	37,936	6,60	2,70	-4,70	6,86	13,59
Capex	37,286	0,24	0,18	0	0,23	1,02
Book leverage	37,086	0,06	0,05	0,001	0,04	0,29
Profitability	37,489	0,09	0,1	-0,3	0,08	0,47
Tangibility	33,658	0,35	0,24	0	0,31	1
Market-to-book	34,376	0,15	0,65	-2,3	0,07	2,45
Maturity	37,401	0,51	0,37	0	0,58	1
GDP/cap USD	36,796	22093	21802	442	9709	102910
Private credit	32,565	1,02	0,59	0,08	1,06	2,5
NPL	33,256	3,65	3,74	0,10	2,45	37,30
Mineral exports	34,774	0,25	0,26	0,01	0,12	0,98
Resource rents	33,989	0,07	0,11	0	0,03	0,61

Correlation matrix	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1 Real change in debt		0,00	0,00	0,00	0,00	0,87	0,00	0,00	0,27	0,64	0,00	0,00	0,94	0,57
2 Size	0,07		0,00	0,00	0,00	0,35	0,00	0,00	0,00	0,00	0,00	0,14	0,00	0,00
3 Book leverage	0,20	0,14		0,00	0,00	0,00	0,00	0,00	0,92	0,00	0,00	0,00	0,00	0,00
4 Capex	0,20	0,02	0,04		0,00	0,00	0,00	0,00	0,00	0,00	0,58	0,00	0,00	0,69
5 Profitability	-0,22	0,09	-0,24	0,22		0,00	0,00	0,00	0,00	0,00	0,67	0,05	0,23	0,01
6 Tangibility	0,00	0,01	0,20	0,43	0,11		0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
7 Market-to-book	0,06	0,07	-0,10	0,15	0,36	-0,05		0,04	0,00	0,00	0,00	0,46	0,00	0,00
8 Maturity	0,07	0,43	0,34	0,11	0,07	0,22	0,01		0,00	0,00	0,00	0,00	0,00	0,00
9 GDP/cap USD	-0,01	0,53	0,00	-0,04	0,10	-0,10	0,12	0,40		0,00	0,00	0,00	0,00	0,17
10 Private credit	0,00	0,52	0,03	-0,07	0,06	-0,17	0,12	0,27	0,62		0,00	0,70	0,00	0,00
11 NPL	-0,07	-0,23	-0,04	0,00	0,00	0,08	-0,15	-0,18	-0,33	-0,34		0,00	0,00	0,00
12 Resource firm	0,02	0,01	-0,03	0,19	0,01	0,19	0,00	0,05	0,08	0,00	-0,08		0,00	0,00
13 Mineral exports	0,00	-0,21	-0,07	0,04	0,01	0,10	0,03	-0,04	0,08	-0,46	0,06	0,07		0,00
14 Resource rents	0,00	-0,19	-0,06	0,00	-0,02	0,04	0,04	-0,16	-0,01	-0,39	0,06	-0,03	0,78	

Notes: Pearson correlation coefficient in lower triangle and corresponding p-values in the upper triangle.Variables: “Real change in debt”: Real annual change in short and long term interest bearing debt divided by the start of the period assets;“Size”: Natural logarithm of assets in US dollars, millions; “Book leverage”: Total long and short term interest bearing debt to total assets; "Capex": Capital expenditure to total assets; “Profitability”: Cash from operations to total assets; “Tangibility”: Fixed assets to total assets; “Market-to-book”: Market value to total assets; "Maturity": Long-term debt to total debt; “GDP/cap USD”: GDP per capita in US dollars; “Private credit”: Domestic bank credit to private sector to GDP; "NPL": Non-performing loans to total loans, %; "Resource firm": Binary variable for 1=resource firm; "Mineral exports": Mineral export share of total exports; "Resource rents": Natural resource rents to GDP, %.

Figure 2 Brent crude oil price, 2005–2016

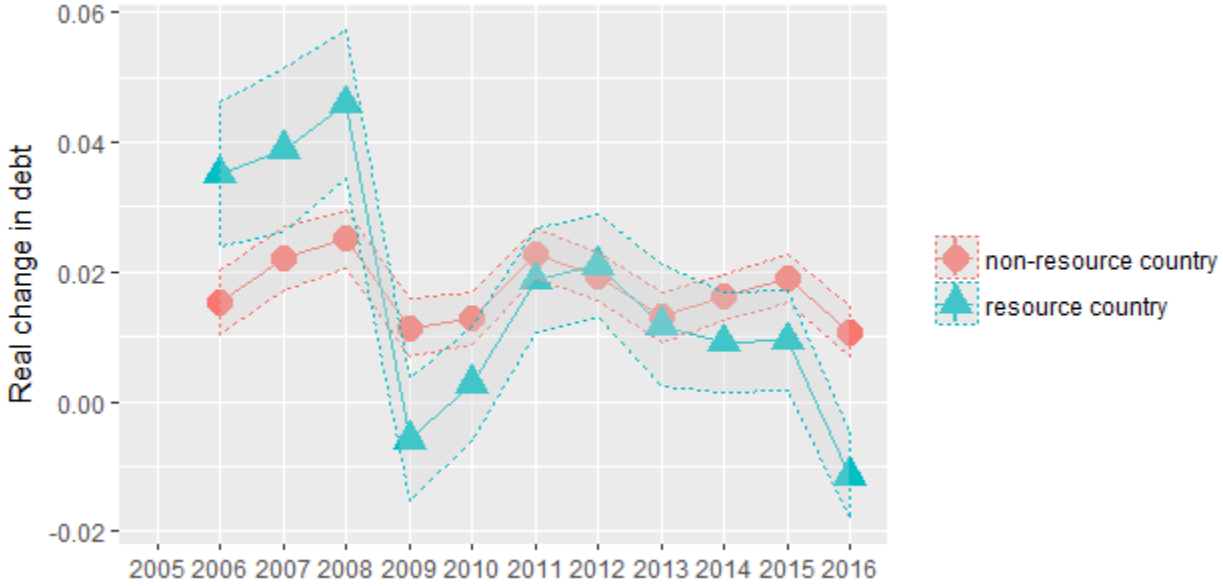
Source:EIA

Data limitations are a familiar issue in empirical studies on liquidity shocks. As Khwaja and Mian (2008) discuss, due to the lack of data linking banks and individual firms over time, there are difficulties of separating the effect of a shock on bank lending from the impact on firm borrowing. Moreover, our annual data makes detailed analysis of changes in firm leverage very challenging. Immediately after the start of the global financial crisis, for example, firms may have used existing credit facilities to insure their liquidity even without an actual need to take on debt. Ivashina and Scharfstein (2010) show evidence of such behavior by US firms during late 2008.

In any case, data limitations compel us to narrow our focus to what happened over the 1–2 years following a drop in oil prices. As shown by Gertler and Gilchrist (1994), firms need time to adjust their borrowing after a downturn. This fact is also highlighted by Iqbal and Kume (2014), who use data on Western European countries around the time of the 2008–2009 financial crisis. Based on a large sample of empirical studies, Jones et al. (2004) also show the largest impacts of oil prices on output tend to occur in the following third and fourth quarters (though sometimes a bit later). Thus, our choice of a one-to-two-year lag should yield reasonable results.

The averages of the dependent variable, real change in debt, are depicted in Figure 3 for firms in resource and non-resource-dependent countries with a 95% confidence interval. It seems that the reaction in 2009 was much stronger for firms in resource-dependent countries than in other countries. The same applies for the shock in 2014, when firms in non-resource countries barely reacted to the shock. This is expected based on previous knowledge about the effects of oil price fluctuations.

Figure 3 Real change in debt and 95% confidence intervals shown for firms in resource-dependent and other countries



3.2 Methodology

The regression equation becomes

$$Y_{ijkt} = \beta_1 mexport_{jt-1} * I(year \in 2009{,}2010) + \beta_2 mexport_{jt-1} * I(year \in 2015{,}2016) + \beta_3 rfirm_{ijk} * I(year \in 2009{,}2010) + \beta_4 rfirm_{ijk} * I(year \in 2015{,}2016) + \beta_5 rfirm_{ijk} + \beta_6 mexport_{jt-1} + \vartheta X_{ijkt-1} + GSCI_t + \varphi_j + \gamma_k + \delta_t + \varepsilon_{ijkt}, \quad (1)$$

where *i*,*j*,*k* and *t* are the indexes of firm, country, industry and year, respectively. Y_{ijkt} is the real change in debt of firm *i*, country *j*, industry *k* and year *t*. $rfirm_{ijk}$ is the dummy variable indicating whether a firm is a resource firm, $mexport_{jt}$ is the mineral export share of the country's exports and $I(year \in 2009{,}2010)$ receives value 1 if the year is the indicated shock year and 0 otherwise. ϑX_{ijt-1} presents the firm and country specific one-period lagged control variables and GSCI is the control for commodity prices. We use lagged values of control variables to reduce the risk for contemporaneous correlation between the independent variables and the error term. φ_j, γ_k and δ_t are the country, industry and year dummies, respectively. ε_{ijt} is the random disturbance. Due to our time-invariant resource-firm indicator, a fixed effects estimator is not feasible. Instead, we use a random firm effects estimator. This approach is preferable to the alternative, a pooled model based on Breusch-Pagan Lagrange multiplier test.

Our choice for using two years to indicate the post-shock period after the beginning of the financial crisis is data-driven. The negative effect also seems to persist even in 2010 despite the oil

price recovery. Nevertheless, we also test the regressions while limiting the post-crisis years to 2009 and 2015 and obtain similar results.

4 Results

4.1 Oil price collapse and firm leverage

We start by estimating how firm leverage growth was affected by commonly used firm control variables with the addition of resource firm dummy and control for country, industry and year. Our results for the final sample of 70 countries are presented in column (1) in Table 2. Resource firms seem to have slower leverage growth than other firms. This result is in line with Kurronen (2016), who finds that resource firms globally tend to have lower leverage levels than other firms. The remaining firm variables are mostly as expected based on the previous literature. Larger firms with good growth opportunities, high investment intensity and longer maturity debt have higher real debt growth rates, whereas more profitable firms and firms with a higher debt level have slower growth in debt.

The negative coefficient on firm tangibility is predicted by the pecking order theory as tangibility reduces cost of equity, but empirical evidence, although mixed, tends to support more positive relation for tangibility and leverage (Frank & Goyal, 2009. See Joeveer, 2013 for an opposite result). However, Harrison and Widjaja (2014) and Halling et al. (2016) show that the effect of firm tangibility is more positive on leverage during recessions, so we also test later to determine the role tangibility played during the crisis years. Norden and van Kampen (2013) show that tangible assets are more important for firms dependent on private credit and less so for firms with access to public capital markets. Our sample of listed firms can be considered financially less constrained.

Next, we add four country variables in column (2). The results show that firms in mineral exporting countries have faster leverage growth than firms in other countries. As most of our time period is characterized by rising oil prices or a sustained high oil price, resource-dependent countries may have experienced a credit boom. The period 2006–2008 shows particularly strong firm leverage growth in resource-dependent countries (Figure 3). Firms in high-income countries have higher leverage growth. However, a developed financial sector is associated with lower leverage growth, which is in line with the results of Fan et al. (2012) for developed countries. Financial depth is also found to correlate positively with financial sector stress during the global financial crisis, suggesting that a developed financial sector may be an indicator of overextended debt (Claessens et al., 2010). As expected, higher level of non-performing loans in the country's financial sector coincides with lower firm leverage growth.

In column (3) in Table 2, we add crisis dummies and their interaction terms with resource firm and resource country indicators. The coefficient for interaction term of crisis and country resource-dependence is negative and significant in both crisis periods. This indicates a boom-bust development for firms in mineral exporting countries, supporting the volatility hypothesis of resource curse. Resource firms globally seem to have faced a larger negative shock to their leverage growth than other firms only in the latter crisis, when the oil price drop was not accompanied by a global economic downturn.

Following the global financial crisis, resource firms did not slow down their borrowing growth like other firms. That could be interpreted as an indication that resource firms remained quality borrowers in the eyes of lenders. Such firms tend to be large and more tangible than other firms (Kurronen, 2016). Alternatively, this result could be driven by higher demand for debt as extraction investments tend to be bulky (Berglof & Lehmann, 2009).

After the oil price drop in 2014, resource firms experience lower credit growth than other firms. This may reflect a lack of good investment opportunities that led to lower credit demand or that lenders perceive resource firms as riskier than before. While our model captures only a relatively small part of the variance in leverage growth, this is typical for leverage regressions on large firm data (see e.g. Lemmon & Roberts, 2010).

The fact that an oil price collapse adversely affects firms in resource-dependent countries could indicate that most firms in those countries operate in a resource sector or industries closely related to resources. To determine whether non-resource related firms are also affected, we estimate the regression for two subgroups: non-resource firms in Table 2, column (4) and consumer firms in Table 2, column (5). Consumer firms consist of two sectors: Consumer Staples and Consumer Discretionary. Whereas non-resource firms in resource-dependent countries might still be closely linked to resource extraction (e.g. transportation or manufacturing), we expect firms in consumer sectors to be less linked to the resource sector as they do not play crucial roles in the supply chain of mineral extraction. Moreover, the resource sector is typically not a major employer (see Kurronen, 2016). This subgroup is still sufficiently large, however, and the result holds, i.e. an oil price collapse seems to be harsher on the balance sheets of non-resource firms and consumer sector firms in mineral exporting countries than elsewhere.

Table 2 Random effects regression results. Dependent variable: Real change in total debt

	All firms			Non-resource firms	Consumer firms
	(1)	(2)	(3)	(4)	(5)
oilcrisis0910*Mineral exports			-0.029***	-0.029***	-0.030***
			(0,006)	*(0,006)*	*(0,009)*
oilcrisis1516*Mineral exports			-0.017***	-0.021***	-0.032***
			(0,006)	*(0,006)*	*(0,010)*
oilcrisis0910*Resource firm			0.012***		
			(0,004)		
oilcrisis1516*Resource firm			-0.013***		
			(0,004)		
Resource firm	-0.005***	-0.022***	-0.022***		
	(0,002)	*(0,005)*	*(0,005)*		
Size	0.002***	0.001***	0.001***	0.001***	0,0003
	(0,000)	*(0,000)*	*(0,000)*	*(0,000)*	*(0,001)*
Book leverage	-0.089***	-0.093***	-0.093***	-0.092***	-0.080***
	(0,005)	*(0,005)*	*(0,005)*	*(0,005)*	*(0,009)*
Capex	0.253***	0.261***	0.261***	0.304***	0.273***
	(0,015)	*(0,016)*	*(0,016)*	*(0,018)*	*(0,029)*
Profitability	-0.047***	-0.046***	-0.044***	-0.043***	-0.046***
	(0,009)	*(0,009)*	*(0,009)*	*(0,010)*	*(0,017)*
Tangibility	-0.018***	-0.019***	-0.019***	-0.023***	-0.018**
	(0,003)	*(0,004)*	*(0,004)*	*(0,005)*	*(0,007)*
Market-to-book	0.013***	0.014***	0.014***	0.013***	0.013***
	(0,001)	*(0,001)*	*(0,001)*	*(0,001)*	*(0,002)*
Maturity	0.016***	0.016***	0.016***	0.015***	0.017***
	(0,002)	*(0,002)*	*(0,002)*	*(0,002)*	*(0,004)*
Mineral exports		0.058***	0.058***	0.058***	0.071***
		(0,018)	*(0,018)*	*(0,020)*	*(0,026)*
Developed		0.063***	0.061***	0.078***	-0.060***
		(0,018)	*(0,018)*	*(0,028)*	*(0,015)*
Private credit		-0.026***	-0.024***	-0.027***	-0.021***
		(0,005)	*(0,004)*	*(0,005)*	*(0,008)*
NPLs		-0.007***	-0.007***	-0.007***	-0.009***
		(0,001)	*(0,001)*	*(0,001)*	*(0,002)*
oilcrisis0910			-0.011*	-0,009	-0,01
			(0,006)	*(0,006)*	*(0,011)*
oilcrisis1516			0.026***	0.025***	0.033***
			(0,006)	*(0,006)*	*(0,011)*
gsci			0.0002***	0.0002***	0.0002**
			(0,000)	*(0,000)*	*(0,000)*
Observations	28,95	26,699	26,699	23,132	8,296
R2	0,06	0,07	0,08	0,08	0,08

Notes: *p<0.1; **p<0.05; ***p<0.01. Country, year and industry dummies included in all regressions. All time variant firm and country regressors are lagged by one period. Robust standard errors clustered by firm below coefficient in parenthesis. Variables: “Real change in debt”: Real annual change in short and long term interest bearing debt divided by the previous period assets;"Resource firm": Binary variable for 1=resource firm; “Size”: Natural logarithm of assets in US dollars, millions; “Book leverage”: Total long and short term interest bearing debt to total assets; "Capex": Capital expenditure to total assets; “Profitability”: Cash from operations to total assets; “Tangibility”: Fixed assets to total assets; “Market-to-book”: Market value to total assets; "Maturity": Long-term debt to total debt; “Developed”: Binary variable where 1=high income country in 2008; “Private credit”: Domestic bank credit to private sector to GDP; "NPL": Non-performing loans to total loans, %; "Oilcrisis0910": Binary variable where 1= years 2009 and 2010; "Oilcrisis1516": Binary variable where 1= years 2015 and 2016; "Mineral exports": Mineral export share of total exports; "gsci": GSCI commodity price index.

4.2 Robustness tests

To verify these results, we conduct several robustness tests. Given that choice of indicator for resource-dependence has been extensively discussed in the previous literature (Alexeev & Conrad, 2011), our robustness tests use two alternative indicators of resource dependence: resource rents to GDP from the World DataBank and subsoil assets to GDP in 2000 (World Bank, 2006). Rather than energy and metals in our main regressions, we consider a narrower group of resource firms in our robustness test – oil firms only (GSCI sector "Energy"). Our results are not sensitive to the choice of resource indicators (Appendix 3).

In the second robustness check, we use real growth in long- and short-term debt separately as dependent variables to see if the crisis affected long- and short-term debt differently. Previous literature has shown, for example, that after the eruption of global financial crisis, firms turned to existing credit facilities that tended to be shorter maturity debt (Ivashina & Scharfstein, 2010). Large differences may also indicate that banks, which usually provide shorter term debt, and capital markets, which provide longer maturity debt, reacted differently to the shocks (Demirguc-Kunt & Maksimovic, 2002). The results are similar on our data when using total debt as the leverage indicator (Appendix 4).

As the third robustness test, we use a fixed effect estimator. It is more consistent than the random effects estimator based on a Hausmann test, but, as mentioned above, not feasible in our main regressions. We are able to use it by splitting the data into resource firms and other firms. Again, the results remain robust (Appendix 4).

As the fourth robustness test, we only use the years 2009 and 2015 as the crisis indicator instead of the two-year periods and these results are robust as well.[3]

The fifth robustness test considers the challenge of foreign exchange rate fluctuations. If some firms, e.g. mineral extraction firms are using foreign currency, most likely USD denominated debt issues, a weakening in the domestic exchange rate increases the amount of outstanding debt (USD-denominated debt reported in domestic currency) even though the firm does not issue new debt. Such a finding, however, should reinforce our results. We lack information on the issue currency of the firm debt, so we tackle this challenge by repeating the main regression using change in debt in USD terms divided by previous period assets in USD terms as the dependent variable. This approach should turn the results upside down if foreign currency debt issues and exchange rate depreciation play major roles. We do not need to change the currency of control variables as they are all ratios or already in USD terms (firm size). The results in Appendix 4, column (5) are similar, but interestingly

[3] These results are available on request

the coefficient for the term interacting resource firm and years 2015 and 2016 falls deeper into negative territory. This could suggest that resource firms issue USD-denominated debt and the depreciation of domestic exchange rate mitigates the fall in the leverage growth of the main regressions. However, the model performance is clearly worse in capturing the variation for change in debt in USD terms, warranting caution in the interpretation of the results. Weaker explanatory power should be expected though, as firm control variables are not likely to be associated with foreign exchange rate fluctuations now more included in the dependent variable assuming that most debt issues are in the domestic currency.

Overall, the results for a decline in leverage growth after an oil price collapse for firms in resource-dependent countries seems robust. Based on these results, we cannot, however, tell whether the resource firms and firms in resource dependent countries merely reduce their demand for debt due to the worsened growth opportunities or whether the supply of debt also plays a role.

4.3 The role of banks

To detect whether the supply of finance plays a role in resource-dependent countries, we must tackle tough identification problems. As we cannot directly observe whether lower leverage growth is due to lower demand or a diminishing supply of financing, we look, as suggested by Bernanke et al. (1996), at cross-sectional implications of the crisis.

Our sample consists only of listed firms, so all are expected to be less constrained in their access to finance than firms in general. However, firms without a bond rating are expected to have poorer access to international capital markets than rated firms (Chava & Purnanandam, 2011). Thus, we choose firms in resource-dependent countries which did not have a bond rating by Moody's, Standard & Poor's or Fitch at the end of 2007 or 2013 but had some debt. This classification yields 386 firms (out of 512) in the earlier period, and 435 (out of 608) in the later period, which we classify as bank-dependent. The reaction of these bank-dependent firms could reveal whether the domestic banking sector fared worse than international capital markets in post-crisis periods.

Based on theoretical and empirical evidence, adverse macroeconomic shocks can cause flight to quality in lending (Bernanke et al., 1996; Holmstrom & Tirole, 1997). In practice, larger firms with strong balance sheets are more resilient to shocks, so we use asset tangibility as an indicator of the quality of firm's balance sheet (Titman & Wessels, 1988). We interact these two variables, bank-dependent dummy and firm tangibility with the crisis-year indicators for the subsample of resource-dependent countries, which are all the countries where mineral export share of total exports

exceeds 50% (the results are robust if we use 25% as the threshold level). We also test if the credit growth of resource firms or oil firms was significantly different from other firms in these countries.

The results in Table 3, column (1) show that firms we classify as bank-dependent reduced their borrowing more than other firms after the oil price collapse in 2009. Unfortunately, firms with missing observations on bank-dependence seem to be different in the two pre-crisis periods. This reduces sample size. We thus test the results of Table 3, column (1) also by splitting the sample into two sample periods separately (2005–2010 and 2011–2016) to avoid loss of observations. Here, the result holds.[4]

Similarly, we find some evidence of flight to quality in 2009-2010 (column 2) as more tangible firms had higher leverage growth than other firms. This result is in line with the theoretical underpinning that flight to quality leads to reallocation of financial resources in the event of a credit crunch. This favors firms with a strong balance sheet and gives results similar to the empirical results from the global financial crisis (Harrison & Widjaja, 2014; Zeitun et al., 2016). We also find evidence that oil producing firms had higher leverage growth rates after the global financial crisis than other firms in resource-dependent countries (column 4). However, we find no significant difference for bank-dependent firms, tangible firms or oil firms from other firms during 2015–2016. This may indicate that an oil price collapse in the absence of a global credit crunch does not distort the supply of credit in the same way.

Finally, from column 5 we note that firms located in a country with more developed financial sector did better after the second crisis. This supports the macro-level finding of van der Ploeg and Poelhekke (2009) that a developed financial sector may mitigate commodity price shocks.

We conduct the same regressions as in Table 3 for a control group of countries where the average mineral export share of total exports is below the sample median and the results are presented in Appendix 5. Three notable differences emerge. First, we find no evidence from the full sample that firm tangibility played a role in the aftermath of the global financial crisis, but in the latter crisis the interaction term between crisis and tangibility is negative and significant indicating a flight *from* quality in lending. Of course, the 2014 oil price drop was not followed by a global economic downturn, so it was not really a crisis for other than commodity producers, i.e. firms that tend to be more tangible than other firms (Kurronen, 2016). Second, resource firms and oil firms had significantly lower credit growth after the 2014 oil price collapse. This is an expected result, but it does not show up the subsample of resource-dependent countries. Third, level of financial development does not seem to play a role during the crisis years.

[4] The results are available on request.

Table 3 Random effects regressions, the role of banks in resource-dependent countries. Dependent variable

Dependent variable	Real change in total debt				
	Bank dependent	Tangible	Resource firms	Oil firms	Banking sector size
	(1)	(2)	(3)	(4)	(5)
oilcrisis0910*bankdependent2007	-0.028***				
	(0,008)				
oilcrisis1516*bankdependent2013	-0,009				
	(0,007)				
oilcrisis0910*lagtangibility		0.039**			
		(0,016)			
oilcrisis1516*lagtangibility		0,0004			
		(0,013)			
oilcrisis0910*Resource firms			0,008		
			(0,010)		
oilcrisis1516*Resource firms			0,006		
			(0,008)		
oilcrisis0910* Oil firms				0.031**	
				(0,014)	
oilcrisis1516*Oil firms				0,004	
				(0,011)	
oilcrisis0910 * Private credit					-0,006
					(0,010)
oilcrisis1516 * Private credit					0.014*
					(0,008)
Size	0.007***	0.004***	0.004***	0.004***	0.004***
	(0,001)	(0,001)	(0,001)	(0,001)	(0,001)
Book leverage	-0.133***	-0.117***	-0.120***	-0.119***	-0.116***
	(0,018)	(0,014)	(0,014)	(0,014)	(0,014)
Capex	0.229***	0.214***	0.226***	0.227***	0.220***
	(0,042)	(0,032)	(0,033)	(0,032)	(0,032)
Profitability	-0.044*	-0.054***	-0.056***	-0.056***	-0.055***
	(0,023)	(0,019)	(0,019)	(0,019)	(0,019)
Tangibility	-0.017*	-0.016*	-0,009	-0,009	-0,009
	(0,010)	(0,010)	(0,009)	(0,009)	(0,009)
Market-to-book	0.015***	0.015***	0.015***	0.015***	0.016***
	(0,004)	(0,003)	(0,003)	(0,003)	(0,003)
Maturity	0.013*	0.016***	0.017***	0.017***	0.016***
	(0,007)	(0,006)	(0,005)	(0,005)	(0,006)
Developed	0.066*	0,04	0,034	0,034	0.045*
	(0,036)	(0,026)	(0,026)	(0,026)	(0,026)
Private credit	-0.067**	-0.047**	-0.040*	-0.040*	-0.053**
	(0,033)	(0,021)	(0,021)	(0,021)	(0,022)
NPLs	-0,009	-0.008*	-0.009**	-0.009**	-0.009**
	(0,006)	(0,004)	(0,004)	(0,004)	(0,004)
oilcrisis0910	-0,024	-0.065***	-0.054***	-0.055***	-0.047***
	(0,022)	(0,017)	(0,016)	(0,016)	(0,018)
bankdependent2007	0,008				
	(0,005)				
oilcrisis1516	0.031*	0.033**	0.032**	0.033**	0.027*
	(0,018)	(0,015)	(0,015)	(0,015)	(0,015)
bankdependent2013	0.014**				
	(0,006)				
Resource firms			-0.024*		
			(0,013)		
Oil firms				-0.028**	
				(0,014)	
gsci	0.0004**	0.001***	0.001***	0.001***	0.001***
	(0,000)	(0,000)	(0,000)	(0,000)	(0,000)
Observations	3,011	4,386	4,386	4,386	4,386
R^2	0,121	0,104	0,103	0,105	0,103

Notes: *p<0.1; **p<0.05; ***p<0.01. Country, year and industry dummies included in all regressions. All time variant firm and country regressors are lagged by one period. Robust standard errors clustered by firm below coefficient in parenthesis. Variables: “Real change in debt”: Real annual change in short and long term interest bearing debt divided by the previous period assets;"Bank dependent": Binary variable, where 1=Firms which had no credit rating in the given year but had some debt, 0=otherwise;"Resource firm": Binary variable for 1=resource firm; "Oil firm": Binary variable for 1=oil firm; “Size”: Natural logarithm of assets in US dollars, millions; “Book leverage”: Total long and short term interest bearing debt to total assets; "Capex": Capital expenditure to total assets; “Profitability”: Cash from operations to total assets; “Tangibility”: Fixed assets to total assets; “Market-to-book”: Market value to total assets; "Maturity": Long-term debt to total debt; “Developed”: Binary variable where 1=high income country in 2008; “Private credit”: Domestic

bank credit to private sector to GDP; "NPL": Non-performing loans to total loans, %; "Oilcrisis0910": Binary variable where 1= years 2009 and 2010; "Oilcrisis1516": Binary variable where 1= years 2015 and 2016; "Mineral exports": Mineral export share of total exports; "Resource rents": Mineral and forest rents to GDP; "Subsoil assets": Subsoil assets to GDP in 2000; "gsci": GSCI commodity price index.

Theoretical and empirical work as well as surveys give support to our results that supply frictions play a role in the contraction of firm borrowing after the oil price shocks in resource-dependent countries and that this reaction cannot be entirely attributed to demand factors. Beck (2011) uses survey data to argue that the availability of financing is an obstacle for firms in resource-dependent countries. Examining GCC countries, Zeitun et al. (2016) show credit supply constraints were evident after the 2008–2009 financial crisis.

Our data also strongly imply bank distress after the beginning of the financial crisis in 2008. This supports our hypothesis that the credit supply was more limited in resource-dependent countries than elsewhere. The upper left corner chart in Figure 4 shows the share of non-performing loans for resource and non-resource countries weighted by the number of firms in each country in our sample. Non-performing loans increased (upper left chart), whereas net margin (lower left chart) and return on equity (lower right chart) squeezed in the resource-dependent countries in 2009. The oil price collapse in 2014 alone does not seem to have caused similar shock to non-performing loans than the one that coincided with the global financial crisis, which could indicate that the banking sector was stronger or that the crisis was milder. However, the oil price only bottomed in early 2016 and data for 2016 is not yet available.

There is also a possibility that the regressions are biased due to endogeneity. We use firm random effects and control for country, industry and year to reduce the risk of endogeneity rising from omitted variables. Still our model captures only a fraction of the variation in leverage growth and even though robustness tests with firm fixed effects reduce this challenge, there is still many unobserved factors driving firm leverage. Oil price shocks, especially of this magnitude, can be considered exogenous to individual countries and not driven by firm leverage growth.

Figure 4 Distress of financial sector before, during and after 2008-2009 financial crisis in resource-dependent countries (Source: World DataBank).

Our sample consists only of firms included in the main equity index of each country. It could be the case that large listed firms are all considered quality borrowers in each economy, i.e. that the firms hurt by the flight-to-quality phenomenon tend to be smaller and unlisted. However, the volatility of the oil price seems to affect the leverage of listed firms in resource-dependent countries even in the absence of a large-scale credit crunch. We also find some evidence that a developed financial sector could mitigate the shock at the firm level. As the financial sector tends to be less developed in resource-dependent regions (Kurronen, 2015; Yuxiang & Chen, 2011) securing a well-functioning financial sector in the environment of macroeconomic volatility remains a major challenge for resource-dependent countries.

5 Conclusions

We present the hypothesis that an oil price collapse hinders not only resource firms but also other firms in resource-dependent countries through a financial channel. We presume that the stress in the financial sector following a drop in resource firms' asset values leads to reduced lending by banks and flight to quality in lending.

Using an extensive micro-level dataset, we showed that, indeed, following the two recent collapses in oil price in 2008 and 2014, both resource and non-resource firms in resource-dependent countries experienced slowdowns in borrowing growth. Further, we identified evidence that the supply of financing played a role; bank-dependent firms were more affected in 2009–2010. Flight to quality also seems to have played its part in resource-dependent countries; firms with strong balance sheets had higher credit growth than other firms after the oil price collapse in the 2008 financial crisis. In contrast, we find no evidence of flight to quality with our sample firms after the oil price drop in 2014, which was not accompanied by a global financial crisis. While the 2014 crisis was largely limited to the resource sector, we find no evidence that it hindered growth in leverage of resource firms any more than that of other firms in resource-dependent countries.

Overall, both oil price drops in this study appeared to cause lower firm leverage growth in resource-dependent countries for resource firms and other firms in our sample. As leverage growth was stronger in these countries than elsewhere during non-crisis years, a boom-bust effect seems to be present in firm leverage in resource-dependent countries. This finding supports the notion of a *volatility curse* (van der Ploeg & Poelhekke, 2009), as well as bolsters the view that the financial sector works as a channel from macroeconomic shock to microeconomic agents.

Due to data limitations, we cannot determine the extent to which the negative change in debt by non-resource firms in resource-dependent countries is attributable to credit supply and demand. However, our results clearly support the volatility hypothesis underlying the resource curse, suggesting that focus on macroprudential policies are well-warranted in resource-dependent countries. Our results are hardly exhaustive and leave open many paths for future research. For example, the consequences of an oil price collapse may be quite different for small unlisted firms or state-owned enterprises.

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Appendix 1 Equity indices

	Country	Index in Bloomberg		Country	Index in Bloomberg
1	Argentina	Argent Merval	37	Malaysia	FTSE Malay KLCI
2	Australia	ASX200	38	Mexico	MEX IPC
3	Austria	ATX Austria Trd	39	Mongolia	MSE top 20
4	Bahrain	Bahrain All Share	40	Namibia	FTSE/Namibia
5	Belgium	BEL 20 index	41	Netherlands	AEX-index
6	Botswana	Botswana Gab	42	New Zealand	NZX 50
7	Brazil	IBOVESPA	43	Nigeria	Nigeria SE All
8	Bulgaria	BSE Sofix	44	Norway	OBX Stock
9	Canada	TSX	45	Oman	Muscat SM 30
10	Chile	Chile SM Select	46	Pakistan	KARACHI 100
11	China	CSI300	47	Peru	Peru Lima Gen
12	Colombia	Colom COLCAP	48	Philippines	PSEi Philippine
13	Croatia	Zagreb CROBEX	49	Poland	WIG 20
14	Czech Republic	Prague SE index	50	Portugal	PSI General POR
15	Denmark	OMX Copenhagen 20	51	Quatar	QE index
16	Egypt	Egypt Hermes	52	Romania	Bucharest BET
17	Estonia	OMX Tallinn index	53	Russia	RTS Index
18	Finland	OMX Helsinki 25	54	Saudi Arabia	Tadawull
19	France	CAC 40 Index	55	Singapore	FTSE Straits Tim
20	Germany	DAX Index	56	Slovakia	Slovak Share Index
21	Ghana	GSE Comp	57	Slovenia	Slovenia Blue Chip
22	Greece	Athex Composite	58	South Africa	FTSE/JSE Africa Top 40
23	Hong Kong	Hang Seng	59	South Korea	KRX 100
24	Hungary	Budapest SE index	60	Spain	IBEX35 ESP
25	India	S&P BSE SENSEX 30	61	Sweden	OMX STKH30
26	Indonesia	Jakarta Comp	62	Switzerland	Swiss Market Index
27	Ireland	ISEQ Overall	63	Taiwan	Taiwan TAIEX
28	Israel	Tel Aviv 25	64	Tanzania	Tanzania all sh
29	Italy	FTSE MIB ITA	65	Thailand	SE Thai Index
30	Japan	Nikkei 225	66	Tunisia	Tunis SE
31	Kazakhstan	KASE	67	Turkey	BIST 100 Index
32	Kenya	Nairobi SE 20	68	Ukraine	PFTS Index
33	Kuwait	Kuwait SE Weighted	69	United Arab Emirates	DFM General Index
34	Latvia	OMX Riga index	70	United Kingdon	FTSE 100 Index
35	Lithuania	OMX Vilnius index	71	United States	S&P500
36	Luxembourg	LuxX	72	Venezuela	Venezuela SM
			73	Vietnam	Ho Chi Minh Stk

Index compositions as of November 2013

Appendix 2 Variable descriptions

Firm variables	**Description**	**Source**	**Bloomberg code**
Sector	Global Industry Classification Standard (GICS) by MSCI and Standard & Poor's including	Bloomberg	GICS_SECTOR_NAME
Industry	10 sectors, 67 industries and 156 sub-industries	Bloomberg	GICS_INDUSTRY_NAME
Sub-industry		Bloomberg	GICS_SUB_INDUSTRY_NAME
Country	Country of domicile	Bloomberg	COUNTRY_OF_DOMICILE
Assets	Total assets	Bloomberg	BS_TOT_ASSET
Market capitalization	Market capitalization	Bloomberg	HISTORICAL_MARKET_CAP
Long term debt	All interest-bearing financial obligations that are not current	Bloomberg	BS_LT_BORROW
Short term debt	Includes bank overdrafts, short-term debts and borrowings, repurchase agreements	Bloomberg	BS_ST_BORROW
Cash From Operations	Cash From Operations	Bloomberg	CF_CASH_FROM_OPER
Capex	Capital Expenditures	Bloomberg	CAPITAL_EXPEND
Fixed assets	Property, plant and equipment	Bloomberg	ARD_PROPERTY_PLANT_EQUIP_NET
Value	Market capitalization + long and short term debt + preferred equity and minority interest	Bloomberg	
Market-to-book	Value/Total assets	Bloomberg	
Size	Natural logarithm of Total asset in USD	Bloomberg/World Databank	
Profitability	Cash From Operations/Total assets	Bloomberg	
Tangibility	Property, plant and equipment/Total assets	Bloomberg	
Book leverage	Total debt/Total assets		
Maturity	Long term debt/total debt		
Real change in debt	((Long and short term debt(t)/(100+CPI(t)))-Long and short term debt(t-1))/Total assets (t-1)		
Change in USD debt	(Long and short term debt(t)/Exchange rate(t)-Long and short term debt(t-1)/		
	Exchange rate(t-1))/Total assets(t-1)/Exchange rate(t-1)		
Country variables	**Description**	**Source**	
CPI	Annual change in consumer price index, %	World databank	
Exchange rate	Exchange rate USD per local currency	World databank	
Fuel exports	Fuel exports, % of merchandise exports	World databank	
Metal exports	Ores and metals exports, % of merchandise exports	World databank	
Resource rents	Sum of oil rents, natural gas rents, coal rents and mineral rents to GDP	World databank	
Subsoil assets	Value of subsoil assets to GDP in 2000	World Bank 2006	
Private credit	Domestic credit to private sector, % of GDP	World databank	
NPL	Non-performing loans to gross loans	World databank	
GDP per capita	Gross domestic product in US dollars per capita	World databank	
Developed	Binary variable with 1 indicating developed economy by the World Bank country rank in 2008	The World Bank country income classification	
Global financial markets	**Description**	**Source**	
GSCI	S&P GSCI, average value for each year. Index composition: Energy 78.65%, Metals 7.93%, Other: 13.43%. Annual average.	Bloomberg	SPGSCI Index

Appendix 3 Regression results with alternative indicators for resource-dependence

	Real change in total debt		
Dependent variable	(1)	(2)	Oil firms (3)
oilcrisis0910* Resource rents	-0.029**		
	(0,014)		
oilcrisis0910 * Subsoil assets		-0.002**	
		(0,001)	
oilcrisis0910* Mineral exports			-0.029***
			(0,006)
oilcrisis0910: Resource/oil firms	0.010**	0,006	0.017***
	(0,004)	(0,005)	(0,006)
oilcrisis1516* Resource rents	-0,002		
	(0,014)		
oilcrisis1516 * Subsoil assets		-0.002**	
		(0,001)	
oilcrisis1516* Mineral exports			-0.017***
			(0,006)
oilcrisis1516* Resource/oil firms	-0.013***	-0.013***	-0.008*
	(0,004)	(0,004)	(0,004)
Resource firms	-0.023***	-0.022***	
	(0,005)	(0,005)	
Oil firms			-0.025***
			(0,005)
oilcrisis0910	0,002	0,001	0.006**
	(0,003)	(0,003)	(0,003)
oilcrisis1516	0,003	0,002	0,004
	(0,003)	(0,003)	(0,003)
Size	0.002***	0.001***	0.001***
	(0,000)	(0,000)	(0,000)
Book leverage	-0.093***	-0.089***	-0.094***
	(0,005)	(0,005)	(0,005)
Capex	0.260***	0.251***	0.260***
	(0,015)	(0,016)	(0,016)
Profitability	-0.042***	-0.038***	-0.044***
	(0,009)	(0,010)	(0,009)
Tangibility	-0.005***	-0.005***	-0.004***
	(0,001)	(0,001)	(0,001)
Market-to-book	0.014***	0.013***	0.014***
	(0,001)	(0,001)	(0,001)
Maturity	0.015***	0.015***	0.016***
	(0,002)	(0,002)	(0,002)
Mineral exports			0.059***
			(0,018)
Resource rents	0.074***		
	(0,023)		
Private credit	-0.021***	-0.016***	-0.025***
	(0,005)	(0,006)	(0,005)
NPLs	-0.006***	-0.006***	-0.007***
	(0,001)	(0,001)	(0,001)
Observations	26,967	21,862	26,699
R^2	0,07	0,08	0,08

Notes: *p<0.1; **p<0.05; ***p<0.01. Country, year and industry dummies included in all regressions. All time variant firm and country regressors are lagged by one period. Robust standard errors clustered by firm below coefficient in parenthesis. Variables: “Real change in debt”: Real annual change in short and long term interest bearing debt divided by the previous period assets;"Resource firm": Binary variable for 1=resource firm; “Size”: Natural logarithm of assets in US dollars, millions; “Book leverage”: Total long and short term interest bearing debt to total assets; "Capex": Capital expenditure to total assets; “Profitability”: Cash from operations to total assets; “Tangibility”: Fixed assets to total assets; “Market-to-book”: Market value to total assets; "Maturity": Long-term debt to total debt; “Developed”: Binary variable where 1=high income country in 2008; “Private credit”: Domestic bank credit to private sector to GDP; "NPL": Non-performing loans to total loans, %; "Oilcrisis0910": Binary variable where 1= years 2009 and 2010; "Oilcrisis1516": Binary variable where 1= years 2015 and 2016; "Mineral exports": Mineral export share of total exports; "Resource rents": Mineral and forest rents to GDP; "Subsoil assets": Subsoil assets to GDP in 2000; "gsci": GSCI commodity price index.

Appendix 4 Robustness test using fixed effects estimator, real change in long- and short-term debt separately and change in debt in USD terms

	Fixed effects estimator		Random effects estimator		
Dependent variable	Real change in total debt Resource firms	Real change in total debt Non-resource firms	Real change in long-term debt	Real change in short-term debt	Change in debt in USD terms
	(1)	(2)	(3)	(4)	(5)
oilcrisis0910*Mineral exports	-0.028*	-0.028***	-0.015***	-0.012***	-0.031***
	-0,017	-0,006	-0,004	-0,004	-0,01
oilcrisis1516*Mineral exports	0,002	-0.015**	-0.013***	-0,004	-0.028***
	-0,014	-0,007	-0,004	-0,004	-0,01
oilcrisis0910*Resource firm			0,003	0,004	0,024
			-0,003	-0,003	-0,022
oilcrisis1516*Resource firm			-0.007***	-0.004*	-0.029***
			-0,003	-0,002	-0,007
Resource firm			-0.009**	-0.008**	-0,007
			-0,003	-0,004	-0,01
oilcrisis0910	0,007	0,009	-0.011**	0,006	0.042***
	-0,014	-0,006	-0,005	-0,004	-0,011
oilcrisis1516	0.043***	0.036***	0.028***	-0,004	-0.051***
	-0,016	-0,007	-0,005	-0,004	-0,013
Size	-0.016**	-0.017***	0.002***	-0.001***	-0.004**
	-0,007	-0,003	0	0	-0,002
Book leverage	-0.392***	-0.374***	-0.019***	-0.045***	-0.074***
	-0,031	-0,013	-0,003	-0,003	-0,009
Capex	0.151***	0.274***	0.171***	0.076***	0.270***
	-0,043	-0,022	-0,012	-0,009	-0,038
Profitability	0,024	-0.026**	-0.026***	-0.017***	-0.115***
	-0,028	-0,012	-0,005	-0,006	-0,03
Tangibility	-0,009	0,016	-0.006**	-0.015***	-0.051***
	-0,024	-0,012	-0,003	-0,002	-0,011
Market-to-book	0.023***	0.022***	0.006***	0.005***	0.033***
	-0,005	-0,002	-0,001	-0,001	-0,007
Maturity	0.023***	0.027***	-0.035***	0.046***	0.018***
	-0,008	-0,004	-0,002	-0,002	-0,005
Mineral exports	0,0001	0.088***	0,004	0.035***	0.086*
	-0,059	-0,021	-0,014	-0,011	-0,051
Developed			0.051***	0,003	-0,029
			-0,012	-0,007	-0,135
Private credit	-0,007	-0.024***	-0.011***	-0.008***	-0.044***
	-0,013	-0,006	-0,003	-0,003	-0,009
NPLs	-0,005	-0.007***	-0.003***	-0.002***	-0.006*
	-0,004	-0,001	-0,001	-0,001	-0,003
gsci	0,0002	0,0001	0.0002***	-0,00004	-0.0005***
	0	0	0	0	0
Observations	4,234	22,465	26,495	26,875	27,234
R^2	0,17	0,17	0,07	0,07	0,04

Notes: *p<0.1; **p<0.05; ***p<0.01. Country, year and industry dummies included in all regressions. All time variant firm and country regressors are lagged by one period. Robust standard errors clustered by firm below coefficient in parenthesis. Variables: “Real change in debt”: Real annual change in short and long term interest bearing debt divided by the previous period assets;"Resource firm": Binary variable for 1=resource firm; “Size”: Natural logarithm of assets in US dollars, millions; “Book leverage”: Total long and short term interest bearing debt to total assets; "Capex": Capital expenditure to total assets; “Profitability”: Cash from operations to total assets; “Tangibility”: Fixed assets to total assets; “Market-to-book”: Market value to total assets; "Maturity": Long-term debt to total debt; “Developed”: Binary variable where 1=high income country in 2008; “Private credit”: Domestic bank credit to private sector to GDP; "NPL": Non-performing loans to total loans, %; "Oilcrisis0910": Binary variable where 1= years 2009 and 2010; "Oilcrisis1516": Binary variable where 1= years 2015 and 2016; "Mineral exports": Mineral export share of total exports; "gsci": GSCI commodity price index.

Appendix 5 Role of banks in countries where average mineral export share of total exports is below sample median

	Real change in total debt				
Dependent variable	Bank Dependent	Tangible	Resource firms	Oil firms	Banking sector size
	(1)	(2)	(3)	(4)	(5)
oilcrisis0910*bankdependent2007	-0.007**				
	-0,003				
oilcrisis1516*bankdependent2013	-0,002				
	-0,004				
oilcrisis0910*lagtangibility		0,002			
		-0,007			
oilcrisis1516*lagtangibility		-0.016**			
		-0,007			
oilcrisis0910*Resource firms			0.018***		
			-0,006		
oilcrisis1516*Resource firms			-0.019***		
			-0,004		
oilcrisis0910* Oil firms				0.020***	
				-0,006	
oilcrisis1516*Oil firms				-0.011**	
				-0,005	
oilcrisis0910 * Private credit					0,003
					-0,003
oilcrisis1516 * Private credit					0,001
					-0,003
Size	0.002**	0.002**	0.002**	0.002**	0.002**
	-0,001	-0,001	-0,001	-0,001	-0,001
Book leverage	-0.086***	-0.094***	-0.094***	-0.094***	-0.094***
	-0,007	-0,006	-0,006	-0,006	-0,006
Capex	0.298***	0.282***	0.285***	0.286***	0.283***
	-0,026	-0,022	-0,022	-0,022	-0,022
Profitability	-0.044***	-0.044***	-0.043***	-0.043***	-0.044***
	-0,013	-0,012	-0,012	-0,012	-0,012
Tangibility	-0.028***	-0.024***	-0.024***	-0.024***	-0.027***
	-0,006	-0,006	-0,005	-0,005	-0,005
Market-to-book	0.014***	0.015***	0.015***	0.015***	0.015***
	-0,002	-0,002	-0,002	-0,002	-0,002
Maturity	0.015***	0.015***	0.015***	0.015***	0.015***
	-0,003	-0,003	-0,003	-0,003	-0,003
Developed	0.069***	0.061***	0.063***	0.062***	0.062***
	-0,02	-0,019	-0,019	-0,019	-0,019
Private credit	-0.030***	-0.025***	-0.026***	-0.026***	-0.027***
	-0,006	-0,006	-0,005	-0,005	-0,006
NPLs	-0.008***	-0.007***	-0.007***	-0.007***	-0.007***
	-0,002	-0,002	-0,002	-0,002	-0,002
oilcrisis0910	-0,0001	-0,003	-0,01	-0,008	-0,008
	-0,042	-0,038	-0,038	-0,038	-0,038
bankdependent2007	0,004				
	-0,003				
oilcrisis1516	0.017***	0.020***	0.018***	0.016***	0.015**
	-0,005	-0,005	-0,004	-0,004	-0,007
bankdependent2013	0,001				
	-0,003				
Resource firms			-0.023***		
			-0,006		
Oil firms				-0.025***	
				-0,006	
gsci	0,0001	0,0001	0,0001	0,0001	0,0001
	0	0	0	0	0
Observations	14,505	17,252	17,252	17,252	17,252
R^2	0,075	0,071	0,073	0,072	0,071

Notes: *p<0.1; **p<0.05; ***p<0.01. Country, year and industry dummies included in all regressions. All time variant firm and country regressors are lagged by one period. Robust standard errors clustered by firm below coefficient in parenthesis. Variables: “Real change in debt”: Real annual change in short and long term interest bearing debt divided by the previous period assets;"Bank dependent": Binary variable, where 1=Firms which had no credit rating in the given year but had some debt, 0=otherwise;"Resource firm": Binary variable for 1=resource firm; "Oil firm": Binary variable for 1=oil firm; “Size”: Natural logarithm of assets in US dollars, millions; “Book leverage”: Total long and short term interest bearing debt to total assets; "Capex": Capital expenditure to total assets; “Profitability”: Cash from operations to total assets; “Tangibility”: Fixed assets to total assets; “Market-to-book”: Market value to total assets; "Maturity": Long-term debt to total debt; “Developed”: Binary variable where 1=high income country in 2008; “Private credit”: Domestic bank credit to private sector to GDP; "NPL": Non-performing loans to total loans, %; "Oilcrisis0910": Binary variable where 1= years 2009 and 2010; "Oilcrisis1516": Binary variable where 1= years 2015 and 2016; "Mineral exports": Mineral export share of total exports; "Resource rents": Mineral and forest rents to GDP; "Subsoil assets": Subsoil assets to GDP in 2000; "gsci": GSCI commodity price index.

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