Follow the money: Does the financial sector intermediate natural resource windfalls?

Thorsten Beck *
(Cass Business School, City, University of London; and CEPR)

Steven Poelhekke **
(Vrije Universiteit Amsterdam; De Nederlandsche Bank; Tinbergen Institute)

This version: 16 February 2018

Abstract:
We explore the role of the financial sector in absorbing and intermediating natural resource windfall gains. Using within-country variation over time and dynamic models, we find a relative decline in both financial sector deposits and private sector lending in countries that experience an unexpected natural resource windfall as measured by shocks to exogenous world prices. This effect is driven by countries with repressed financial systems and weak governance structures. The smaller role for the financial sector is accompanied by a stronger role of governments in channeling financial capital into the economy. This evidence is consistent with a financial resource curse by limiting funding for the development of the financial sector.

JEL codes: E20, F41, G20, O10, Q32, Q33
Keywords: natural resources, financial development, banking

* Cass Business School, City University London, CEPR, and CESifo. Contact information: Cass Business School, 106 Bunhill Row, London EC1Y 8TZ, UK. Email: TBeck@city.ac.uk.
** Vrije Universiteit Amsterdam, Tinbergen Institute, CESifo, and De Nederlandsche Bank. Contact information: Vrije Universiteit Amsterdam, Faculty of Economics and Business Administration, De Boelelaan 1105, 1081 HV Amsterdam, The Netherlands. Email: steven.poelhekke@vu.nl. We are grateful for comments by Rabah Arezki, Charles Bos, Rick van der Ploeg, Ragnar Torvik, Samuel Wills and seminar and conference participants at the Bank of Algeria conference on Natural Resources, Finance and Growth, the University of East Anglia, the European Economic Association (EEA) 2017 meeting in Lisbon, and the 2017 Annual CEBRA Meeting at the Bank of Canada. Views expressed are those of the authors and do not necessarily reflect official positions of De Nederlandsche Bank nor of the Eurosystem of central banks.

1. Introduction

An extensive literature has not only shown that natural resources can exacerbate challenges of macroeconomic management, but points to a fundamental problem faced by producers of natural resources: how to transform subsoil wealth into productive assets such as financial, human and physical capital (van der Ploeg and Venables, 2012). While the need to absorb windfalls gains and macroeconomic tools to manage them appropriately have been discussed extensively by academics and policy makers alike, this paper focuses on the role of the financial system in this process of absorbing and intermediating natural resource windfall gains.

The literature documenting the importance of the financial system for economic development has shown its critical role of intermediating savings into investment. The financial system should thus serve as an important absorption tool for windfall gains, such as arising from natural resource rents. In turn, resource rents channeled through the financial system should help develop the financial system by providing resources and increase demand for lending and non-lending services. While a recent literature has explored the importance of financial development for fiscal policy space[1], monetary policy transmission[2] and exchange rate choice[3], there is a limited literature on the effectiveness of the financial system in absorbing and intermediating natural resource rents. This may be especially relevant in the many capital-scarce developing countries that specialize in natural resource extraction, which also tend to have small financial sectors and weaker governance structures.

This paper gauges whether natural resource windfalls are associated with changes in financial sector deposits and lending, using a panel dataset of over 150 developed and developing countries over the period 1970 to 2008, covering a period of high commodity price volatility. While previous papers have shown a negative relationship between natural resource abundance and financial sector development (Beck, 2011) and between initial endowments and financial development (Beck et al., 2003), endogeneity challenges have prevented researchers from drawing causal inferences and identifying the mechanism through which such a relationship works. We address endogeneity by relating changes in domestic sector lending and deposit taking by the financial system to exogenous changes in natural resource rents. Specifically, we develop a novel methodology to isolate windfalls arising from unexpected and exogenous world price changes that affect a country's effective natural resource export price

---

[1] See Caballero and Krishnamurthy (2004).
[2] See Mishra et al. (2012)
[3] See Aghion et al. (2006)

from those arising from increased production or from reduced unit production costs. By focusing on unexpected changes in prices and applying structural VAR methods, we address identification concerns related to cross-country explorations of the relationship between natural resources and financial development. Specifically, by observing on an annual basis the adjustment of financial system indicators to changes in a country's natural resource rents, it is easier to control for other unobserved country-level factors. Similarly, by focusing on the price component in the resource change, we better control for endogeneity, as price changes are all but outside the control of individual countries.

Broad-based economic growth typically leads to financial deepening as firms and households make deposits and take out more loans. However, for natural resource-rich countries theory makes contradictory predictions on the relationship between changes in GDP per capita due to natural resource windfall gains and the development and efficiency of its financial system.

On the one hand, the *resource absorption hypothesis* argues that natural resource wealth provides a broader funding basis for financial institutions and markets and increases demand for financial services. For example, Mansoorian (1991) and Manzano and Rigobon (2007) show that natural resource booms lower constraints to international borrowing by increasing collateral and raising public demand for loans. Similarly, higher resources entering the financial sector can result in a higher supply of loans to enterprises and households. More generally, the higher wealth accruing from such windfall gains, can increase the demand for financial services even if the rents themselves are saved in sovereign wealth funds. Sectors related to the mineral sector will experience an economic upswing and rising profits and wages will feed into more financial system deposits. The standard Dutch disease reallocation of factors of production to the most productive sectors (Corden and Neary, 1982) is income and welfare improving (at least in the short run) and would also increase the demand for financial services.[4] The *resource absorption hypothesis* thus posits that both the supply of and demand for financial services increase with windfall gains from natural resources.

On the other hand, the *financial resource curse hypothesis* argues that natural resource abundance undermines financial sector development if resource-related wealth is shifted out of

[4] The traded non-resource sector shrinks but the non-traded sector typically expands, as does the economy as a whole. Just as with Manzano and Rogobon (2007)'s debt overhang, financial openness may exacerbate this process by stimulating short run demand for non-traded goods and imports after a commodity-driven reduction in foreign financing constraints and thus eventually contribute to slower growth if technological progress is concentrated in the shrinking traded sector (Alberola and Benigno, 2017). Our focus in on the effects on the development of the domestic financial system as this may stimulate entrepreneurship and have positive long-run growth effects, but we will also examine the degree of liberalization of the financial system.

the domestic financial system, either into foreign investment conduits and offshore sovereign wealth funds (Andersen et al., *forthcoming*), or into non-financial wealth, such as real estate. Lower savings rates in resource abundant countries might further reduce the intermediation capacity of the financial system by limiting the available domestic funding base (Van der Ploeg and Venables, 2012).[5] In addition to facing higher funding constraints, the intermediation efficiency might also be lower in resource-rich countries, due to lower levels of contractual efficiency, rule of law and control of corruption, also referred to as the institutional aspect of the resource curse. An extensive literature has documented the institutional resource curse, i.e. resource-abundant countries being less likely to develop the institutional framework that also underpins the financial system (Engerman and Sokoloff 1997, 2000; Sala-i-Martin and Subramanian, 2013; Bulte et al., 2005; Beck and Laeven, 2006). The *financial resource curse hypothesis* thus predicts a negative effect of resource windfall gains on financial sector development.

Finally, the effect of natural resource windfalls might vary across countries with different levels of institutional development, different regulatory frameworks or different market structures of the financial system. This *modified financial resource curse hypothesis* posits that the capacity of financial systems to absorb and intermediate natural resource windfall gains might depend on the ability of banks to easily set prices and compete with each other, the ability of new entrants – both domestic and foreign – to enter the market and sufficient liquidity in capital market to support the banking system in allocating resources to their best uses and to more sectors of the economy.[6] Another important criterion (often related to political structure and institutional framework in a country) is the organizational, ownership and governance structure of the natural resource sector, which determines who takes decisions on the distribution and use of windfall gains.

While these theories focus on the long-run relationship between natural resource wealth and financial sector development, our identification strategy considers the short-term relationship between windfall gains from changes in natural resource prices and changes in financial sector deposits and loans. This identification strategy also implies that we abstract

---

[5] The normative approach to how a country should consume or invest a resource windfall is described in detail in van der Ploeg and Venables (2012, 2013). Based on the permanent income hypothesis, they conclude that windfall revenue should be saved abroad at a level that smooths consumption over time. If future revenues are uncertain then additional savings in a stabilization or sovereign wealth fund are warranted. However, capital scarce developing countries should consider public investment, a reduction in distortionary taxation, and using windfall revenue to relax foreign borrowing constraints and thus saving less abroad.

[6] This hypothesis is similar to recent findings in the capital account liberalization literature that has shown a threshold of institutional and financial development below which countries do not experience any positive growth effect from capital account liberalization (Kose et al., 2009)

from other determinants of financial sector development, including the macro-economic and institutional framework and focus on the funding constraints for financial system development (which in turn might depend on the institutional framework). Specifically, we gauge whether exogenous changes in resource rents related to price changes are associated with changes in financial sector deposits and loans. Our analysis of short-term effects of windfall gains on financial sector deposits and loans is related to the long-term relationship between natural resource wealth and financial sector development, as financial sector deepening (the process of developing an efficient financial system) can be seen as the accumulation of positive funding and demand-side shocks over time in interaction with the underlying institutional and macroeconomic framework. While in the long-run there are important interaction and feedback effects – a broader and growing funding base might help increase intermediation efficiency and demand for institutional reforms – we focus on the short-term dynamics of additional resource revenues and the growth of financial sector deposits and loans, effectively comparing the extent to which GDP changes in non-resource-based economies compare to resource rent induced changes in GDP in their effect of financial sector deposits and loans. However, in our analysis we condition on the level of financial and institutional development and interact with specific financial sector policies and institutional conditions that might impact the relationship between resource rents and changes in financial sector deposits and loans.

To illustrate our approach, consider the following framework where changes in natural resource wealth *NW* are converted into changes in financial sector deposits or loans *F* and the overall level of financial sector deposits and lending is captured by $FD_{it} = \sum_{j=t-T}^{t-1} \Delta F_{ij}$

$$\Delta F_{it} = \alpha_1 \Delta NW_{it} + \alpha_2 \Delta NW_{it} * Institutions_{it} \qquad (1)$$

As indicated above, the conversion of natural resource wealth into financial sector resources, might depend on the institutional framework in a country. Importantly, there might be feedback effects over time. Finally, windfall gains or losses may have asymmetric effects on the financial system, for which we also test.

Using a large cross-country sample over 35 years and controlling for the level of financial development, inflation, GDP growth and country fixed-effects, we find a relative decline in the volume of financial sector deposits in countries that experience an unexpected natural resource windfall. While we find that financial system deposits tend to increase following the windfall – which is the optimal response to a transitory shock - comparing countries with similarly booming economies as captured by total GDP growth, we find that those countries where the boom is induced by an unexpected positive shock to the exogenous world price of its basket of natural resources experience a relative *decline* in private financial sector deposits. Moreover, we find that the relative volume of private sector lending also declines, although the decline in lending is mostly due to the decrease in deposits.[7] Our findings are driven by non-OECD countries and countries with repressed financial systems and weak institutional frameworks. These country-level results hold across different types of deposits, they are confirmed with bank-level regressions and independently of bank characteristics, are robust to controlling for news about natural resource discoveries, to dropping major mineral exporters, to the existence of sovereign wealth funds, and to controlling for the ownership structure of mines. In addition, we find evidence that foreign assets and government deposits with commercial and central banks increase following a natural resource price shock. We also find that the higher government deposits with commercial and central banks result in higher government consumption, but this in turn does not lead to more private sector lending by banks. Our results are not only statistically but also economically significant. Compared to the counterfactual of a country growing at similar speed, a doubling of commodity price inflation induces a relative decline of deposit growth by 3.4% but increases relative growth of foreign assets by 9.6% and government deposits with central banks by 19.3%, which in turn raises government consumption but not private sector lending by banks. Overall, our findings are consistent with the negative long-term relationship between the reliance of a country on natural resources and financial sector development as well as the government as major beneficiary of natural resource booms while at the same time undermining the financial intermediation process.

Our paper adds to several literatures. First, we add to the literature on finance and growth. An expansive literature has shown the positive relationship between financial development and economic growth (see Levine, 2005, for an overview). There is also evidence that countries with better developed financial systems suffer less economic volatility and that well-developed financial systems can mitigate the impact of real sector shocks (Beck et al., 2006). While the recent literature has shown the non-linearity between financial development and economic growth (e.g. Arcand et al., 2015), there is evidence that natural resource based economies benefit at least as much from a well-developed financial system as non-resource economies (Beck, 2011). We add to this literature by focusing on the effect of exogenous changes in natural resource rents on changes in financial system lending and deposits. Our results show the limited role that domestic financial sectors play in absorbing and

[7] Starting from the view that loans create deposits, rather than the other way around, we find similar results.

intermediating windfall gains from natural resource rents in countries with repressed financial system and restrictive regulatory frameworks.

Second, we add to the literature on the determinants of financial development. While a large literature has focused on macroeconomic stability and the institutional framework underpinning financial transactions, using regression analysis with data averaged over longer time periods, we focus on the short-term association of variation of financial system lending and funding with short-term variation in natural resource rents.[8] Our paper adds to this literature by showing that windfall gains from natural resource rents rather than non-resource income are associated with relative reductions in deposit-taking and lending by banks and thus undermine financial sector development in natural resource rich societies.

Third, we add to the literature on natural resource rents (see van der Ploeg, 2011, for a recent survey). Mostly, this literature has focused on the relationship between natural resource dependence and national income growth and the reasons behind poor outcomes. For example, van der Ploeg and Poelhekke (2009ab) and Bhattacharya and Hodler (2014) find respectively that natural resource dependence can be a drag on economic growth by increasing macroeconomic volatility, which can be mitigated by more developed financial systems, but that low financial development itself may be a result of poor contract enforcement in resource-rich countries with weak political institutions. Furthermore, van der Ploeg and Venables (2012) explore several reasons why most countries are unable to turn natural resource wealth into optimal investment strategies.[9] However, they discuss the domestic financial sector mostly indirectly and only in so far as private saving decisions are altered.[10] This paper adds to this literature by investigating how windfall income affects the funding of banks and their lending behavior. Adverse effects of nature resource production induced windfall income on the ability of the financial sector to intermediate capital may seriously constrain countries in their goal of

[8] This is also different from Bhattacharya and Hodler (2014) who relate the level of natural resource rents as a share of GDP to the level of financial development (private credit over GDP), with both averaged over five-year periods. They instrument rents over GDP with a country-specific price index of commodities. However, in our view, prices have direct effects on the financial system, for example by changing the value of collateral and the net present value of investment opportunities. When measuring financial development as bank deposits over GDP as a robustness exercise, they find a negative relationship significant at the 10% confidence level.

[9] Van der Ploeg and Venables highlight issues of political economy such as weak fiscal discipline in combination with powerful lobbying for public funds leading to unproductive public spending (Tornell and Lane, 1999) and expropriation by incumbent rulers (Acemoglu et al., 2004); macroeconomic volatility and boom-bust cycles (van der Ploeg and Poelhekke, 2009a) which calls for making more use of hedging, stabilization funds, and better macroeconomic management. There is also evidence that corruption increases after sudden windfalls (Svensson, 2000; Vincente, 2010) and that natural resource wealth can undermine institutional development (Beck and Laeven, 2006).

[10] These may change if resource wealth reaches citizens through handouts, subsidies or tax reductions; if the government reduces domestic debt or lends directly to the private sector through development banks; or if expectations on future taxes are changed.

achieving sustainable growth, while unrestrained direct spending by governments all too often leads to unproductive projects, especially in developing countries with lower quality governance (Bates, 1981; Robinson and Torvik, 2005; Afonso et al., 2010).

The remainder of the paper is organized as follows. The next section presents our indicators of natural resource rents and financial sector development. Section 3 discusses the methodology and section 4 presents the main results. Section 5 offers a series of robustness tests and section 6 concludes.

2. Data

To test the relationship between financial deepening and natural resource windfalls and the different hypotheses discussed above, we use data for a broad cross-section of countries over the period 1971 to 2008, covering a period of high commodity price volatility (Jacks, 2013).[11] This section describes the different data sources and variables. Appendix Table A1 reports descriptive statistics, definition, and source, for each of the variables.

2.1. Natural resource rents

The literature has used different indicators to measure the reliance of economies on natural resources, ranging from the export share of natural resources in total exports to the importance of sub-soil wealth in a country's total wealth and giant oil field discoveries. In cross-country growth regressions on the long run impact of natural resource wealth these have been criticized for their lack of exogeneity as they are based not only on exogenous geology, but also on exploration effort, technology and extraction costs (and thus growth and institutions) that determine the degree of economic recoverability of resources (see for example the discussion in van der Ploeg and Poelhekke, 2010). Recently, also the likelihood of giant oil and gas field discoveries have been shown to depend on the quality of institutions, because exploration effort relies on the quality of institutions (Tsui, 2011; Arezki et al., 2016).

To credibly isolate an exogenous shock, we need to disentangle windfalls due to exogenous world price shocks from changes in natural resource revenues due to less exogenous changes in quantities produced or extraction costs. Our main variable to test the effect of natural resource windfalls on an economy is therefore based on the World Bank (2011) data set on resource rents, which is defined as revenue net of extraction costs for the total of metals and mineral produced (including oil, gas, coal, bauxite, copper, lead, nickel, phosphate, tin, zinc,

[11] Our sample period is constrained by the availability of data on natural resource windfalls as discussed below.

gold, silver, and iron ore) and is available up to 2008.[12] It is computed as total production times the world price net of unit cost of production.[13] There is a wide variation in our sample for total natural resource rents, ranging from zero to 116.5% of GDP. The log changes in total rents range from -627% to 546%, with a mean of 12%, suggesting substantial shocks to these economies. However, to identify the relationship between natural resource windfalls and changes in financial sector deposits and lending, we introduce a novel methodology to the natural resource literature and split the resource rents into its components.

Specifically, we split the log change of resource revenues into (i) the log change in the Paasche price index[14] of metals and minerals, with base year 1970, to capture windfalls due to exogenous world price shocks, (ii) the log change in metal and minerals revenue (value of production) divided by the Paasche price index of metals and minerals[15], which indexes windfalls due to changes in production, and (iii) the log change in Paasche unit production cost index of metals and minerals, with base year 1970. Most closely related to the concept of a windfall is the change in the country- and year-specific price index. A change in the world price of, for example oil, will only translate into a substantial windfall in those countries that produce a lot of oil. This is captured by the country-year-specific price index, which allows for mineral weights that are different for each country-year. By keeping changes in quantities and unit costs constant in the regressions, we can isolate the exogenous effect of a natural resource windfall induced by world price shocks. A windfall may also occur for given prices if new discoveries come into production. This is captured by the quantity index, although this source of windfall gain is less unexpected than a price-driven windfall and may be factored into fiscal

---

[12] Available here: http://siteresources.worldbank.org/EXTEEI/Resources/Metals_and_Minerals_Rents.xls; http://siteresources.worldbank.org/EXTEEI/Resources/oil_and_gas_rents.xls; http://siteresources.worldbank.org/EXTEEI/Resources/Hard_Coal_and_Lignite_Rents.xls. More recent versions of the data no longer split minerals and no longer separate prices from production and unit costs.

[13] The unit cost estimates are best for major producers, but partly imputed for other countries. If data for a single year was available, it was assumed that production costs remained constant in real terms using the US GDP deflator. Missing data between two different years with data were linearly interpolated. If no data was available then geographic proximity and similarity between the ratios of offshore active drilling rigs to total active drilling rigs between the two countries were used. See Bolt et al. (2002) for more details on the construction of unit costs. For this reason, we will always control for (changes in) unit costs but we do not interpret its coefficients.

[14] The Paasche price index for several different minerals c is defined as

$$P = \sum_c p_{ct} q_{ct} / \sum_c p_{c,t=0} q_{ct} .$$

The log first difference of this index for one good c is equivalent to the rate of inflation in good c. For multiple goods, it tracks the overall export price level faced by a country that produces a basket of goods. We choose the Paasche price index instead of a Laspeyres index that relies on base year quantities, because base year prices of all resources are known, while not all resources are produced in each country in base year 1970. In Table 11 we experiment with alternative chained indices with lagged weights and show that our results are robust.

[15] We do not include quantities produced directly to facilitate summation over various units such as barrels of oil, cubic feet of natural gas and tons of metals.

policy and behavior of financial institutions. Also, a change in quantity produced may be the direct result of historical or expected price changes. Lastly, a windfall may occur through a drop in the production costs of resources. The average price shock is 7.7% of GDP, while quantities change on average by 2.8% per country-year.[16] The average change in cost is 5.8%. Appendix Table A2 shows the correlation between changes in mineral rents and its components. We see that price shocks are by far the most important component as an one percentage point change in prices leads to more than twice as high a change in rents as an one percentage point increase in quantity and almost four times as high a change in rents as an one percentage point reduction in costs. Focusing on price changes thus not only allows us to isolate the exogenous component of changes in rents but also captures the economically most important component.

Figure 1 shows the development of the natural resource price index across our sample period. Specifically, we show the average and one- and two-standard deviation dispersion around the mean, which reflects the dispersion in mineral extraction across countries. While the early 1970s and late 1970s saw two spikes in resource prices (driven by the first and second oil price shock), there were other large price movements, including a big drop in 1986/7 and a boom from the mid-2000s that coincides with the growth of China.

Figure 2 shows that natural resource price shocks are not persistent, which allows us to test for the short-term effects of windfall gains on financial sector deposits and lending. Here we plot the persistence of a shock of 100% in year 0 to the log change of the commodity price index. Point estimates for years 1 to 4 are obtained by fitting an AR(4) model with a trend. While lags 1 to 3 are significantly different from zero at 99% confidence level, their economic significant is miniscule compared to the initial shock.

2.2. Financial development indicators

We use several standard indicators of financial sector development, used by the financial development literature over the past two decades. Other than this literature, however, we do not normalize by GDP and we use data in current US dollars rather than in local currency

[16] Others have also used price indices to measure natural resource shocks such as Deaton and Miller (1996), Bazzi and Blattman (2014) and Harding and Venables (2016). However, they have used as weights the export volume by resource and country, with export shares often fixed to one base year. We believe however that the volume of production is more relevant since trade shares will underestimate resource booms that are (partly) consumed domestically, such as the recent shale gas boom in the United States. Moreover, we control for the change in quantity produced to separate relatively endogenous quantity-induced windfalls from exogenous price-induced windfalls. Finally, using only one base year will miss booms occurring through discoveries made after the base year.

to thus control for the effect of depreciations or appreciations, especially due to changes in natural resource prices. First, we use several indicators of deposits in the financial system, all taken from the IMF's International Financial Statistics, unless stated otherwise. Specifically, we focus on deposits by the (i) total financial system, including banks and non-bank financial institutions and (ii) banking system deposits. We also consider different sources of deposits. Specifically, we distinguish between (i) government deposits with central banks and (ii) government deposits with commercial banks[17] to investigate whether additional resource revenues result in more net savings by the government in the form of banking system deposits. Following previous research, we also use offshore bank deposits, i.e. the amount of deposits held outside the economy, based on data from the BIS. Previous research has shown a relationship between resource rents and off-shore bank deposits, especially in tax havens (Andersen et al., 2017). We also use net foreign assets by commercial banks to test whether changes in resource rents are associated with higher funding of banks from abroad or higher investment by banks abroad.

Second, we use an indicator of domestic sector lending, notably total credit to the private sector, a standard indicator of total lending by financial institutions to non-financial domestic private households and enterprises. We also use an indicator of bank lending to central and local governments and to state-owned enterprises. Natural resource rents might lead to an easing on funding pressures by governments and government-owned enterprises if they can rely on the higher income stemming from natural resource revenues. Alternatively, the pressure on banks to lend to governments and their enterprises might increase if higher natural resource revenues translate into higher political power.

In addition to aggregate indicators of financial development, we also use bank-level data from Bureau van Dijk's BankScope data set. Unlike the aggregate cross-country data, the timespan for these data is limited to 1987 to 2008. We use loan growth and deposit growth of banks and control for several bank characteristics in our analysis. We also interact changes in natural resource rents with specific bank characteristics to explore whether the relationship varies across banks.

2.3. Macro-indicators

[17] We use the name "commercial bank" synonymous with the term "deposit money bank" as used by the International Financial Statistics.

In addition to financial system and bank indicators, we also explore the relationship between changes in natural resource rents and macroeconomic aggregates, including consumption and savings, taken from the World Bank's World Development Indicators, and gross assets and liabilities form Lane and Milesi-Ferretti (2007). Specifically, we consider the relationship between changes in natural resource rents and changes in gross domestic savings, household and non-household financial consumption and central government consumption. In robustness tests, we also control for the level of institutional development, with data from the International Country Risk Guide (ICRG) and the financial liberalization database put together by Abiad et al. (2008), and for the private versus state and foreign ownership of mines using mine-level data from Gu (2014).

3. Methodology

To test the different hypotheses proposed by theory, we relate changes in the three components of natural resource rents to changes in financial sector deposits and loans in dynamic panel regressions that use annual observations over the period 1971 to 2008 for up to 156 countries. Specifically, we use the following regression set-up to test our different hypothesis on the relationship between natural resource windfall gains and growth in financial sector deposits and loans.

$$\Delta F_{it} = \alpha \Delta F_{i,t-1} + \beta_1 \Delta P_{it} + \beta_2 \Delta Q_{it} + \beta_3 \Delta UC_{it} + \gamma \Delta X_{it} + \delta Z_{it} + c_i + \varepsilon_{it} \qquad (1)$$

where F is one of our financial development indicators or macro-aggregates, P is the natural resource price index, Q the natural resource quantity index, UC the natural resource unit cost index, ΔX and Z are arrays of control variables, i denotes country and t year. We include country fixed effects (c_i), so that our coefficient estimates thus capture within-country variation: rather than focusing on cross-country relationships, we gauge how a change in natural resource rents within a country relates to changes in financial sector deposits and loans within this country. Fixed effects control for important unobserved time-invariant characteristics of the institutional and regulatory framework of both the financial and the natural resource sectors. As changes in financial sector deposits and loans might be persistent, we include the lagged dependent variable and cluster standard errors on the country-level, thus allowing for arbitrary heteroskedasticity and correlations of error terms within but not across countries.[18] First differencing also ensures that the model is stationary. The matrix *X* always includes the rate of inflation since all variables are measured in nominal terms. In matrix Z we also control for initial (predetermined) financial development. In time-series terminology, this model is an autoregressive-distributed lag representation of an infinite distributed lag model, and assumes that the weights on additional lags decline at the same rate for each variable. In other words, ΔF_{it} reacts equally quickly (but with different magnitude) to each right-hand-side variable. The short run effect of each variable is its coefficient, while the long run cumulative effect of a permanent shock is the coefficient divided by one minus the coefficient of the lagged dependent variable, α.[19] Our focus will be on β_1. A positive coefficient would be evidence in favor of the *resource absorption hypothesis*, while a negative coefficient, would be evidence in favor of the *financial resource curse hypothesis*. Interacting ΔP_{it} with indicators of the institutional and regulatory framework will allow us to test for the *modified financial resource curse hypothesis*.

In most of our regressions, we use a structural VAR model, which allows us to (i) relax the assumption of a common decline rate and (ii) take into account interactions between different macroeconomic variables. Specifically, we start out with a 'rational autoregressive-distributed lag model', which includes a lagged dependent variable and lags of right-hand-side variables and estimate a fully dynamic reduced-form vector autoregressive (VAR) model (Lütkepohl, 2006):

$$\begin{aligned}\Delta Y_{it} = A^{-1}B_{01}\Delta Y_{it-1} + \sum_{j=0}^{4} A^{-1}B_{1j}\Delta P_{it-j} + \sum_{j=0}^{4} A^{-1}B_{2j}\Delta Q_{it-j} + \\ \sum_{j=0}^{4} A^{-1}B_{3j}\Delta UC_{it-j} + A^{-1}DZ_{it-5} + A^{-1}C_i + A^{-1}\varepsilon_{it}\end{aligned} \tag{2}$$

where $\Delta Y_{it} = (\Delta F_{it}, \Delta GDP_{it}, \pi_{it})'$. $A^{-1}B_{01}$, $A^{-1}B_{kj}$, $k \in [1,2,3]$, and $A^{-1}D$ are 3x3 matrices of parameters to be estimated. Motivated by the fact that shocks dissipate quickly (as shown in Figure 1) we include up to four lags initially, which we will later reduce to a more parsimonious

[18] Results are robust to allowing for two-way clustering on both countries and years, which includes arbitrary cross-sectional spatial dependence.

[19] In short panels, the correlation between the fixed effects and the error term introduces a downward bias in the parameter α, and an upward bias if the fixed effects are excluded. However, the bias goes to zero as the time dimension approaches infinity, see Nickell (1981). In our case, T typically equals 38, which, in combination with the fact that the estimate of α with and without fixed effects is very close suggests that the bias is minor (Bond, 2002). We perform Arellano-Bond GMM estimates as a robustness check (Arellano and Bond, 1991).

model based on dropping insignificant lags and AIC and BIC criteria. GDP is taken from the World Bank's World Development Indicators and π is the log difference of its deflator. We then multiply the above model by a matrix A. As is standard in the VAR literature, this model can be estimated and identified by assuming a causal ordering of the three endogenous variables included in ΔY_{it}. We assume that $A = \begin{bmatrix} 1 & \cdot & \cdot \\ 0 & 1 & \cdot \\ 0 & 0 & 1 \end{bmatrix}$, where the $[\cdot]$ are parameters to be estimated. This means that both GDP and inflation are allowed to influence deposits contemporaneously, to ensure that we estimate the effect of a windfall on a measure of financial development relative to GDP's effect on the demand for financial services. Inflation may also move nominal GDP simultaneously, but we assume that deposits affect GDP and inflation only with a delay. Since deposits are equal to income saved for future spending, we believe this assumption is justified.[20]

We estimate the structural VAR with iterated seemingly unrelated regression (based on feasible generalized least squares) to allow the error terms to be correlated and perform a bootstrap to generate standard errors, where we resample from within each country. However, because the models are nested the estimates collapse to OLS and we can also cluster the standard errors by country. As a robustness check we perform Arellano-Bond GMM estimates which instrument the endogenous variables with their lagged levels (Arellano and Bond, 1991). The baseline specification is thus:

$$\Delta F_{it} = \alpha_1 \Delta F_{i,t-1} + \sum_{j=0}^{4} \beta_{1j} \Delta P_{it-j} + \sum_{j=0}^{4} \beta_{2j} \Delta Q_{it-j} + \sum_{j=0}^{4} \beta_{3j} \Delta UC_{it-j}$$
$$+ \Gamma_0 \Delta X_{it} + \Gamma_1 \Delta X_{i,t-1} + \delta Z_{it-5} + c_i + \varepsilon_{it} \qquad (3)$$

where $\Delta X_{it} = (\Delta GDP_{it}, \pi_{it})'$ and Γ_j are 1x2 matrices of parameters.

Our main parameters of interest are the β_{1j}. The short run elasticity of each variable is its coefficient, while the long run cumulative effect of a permanent shock is the (sum of the lagged) coefficient(s) divided by one minus the coefficient of the lagged dependent variable. For example, a one unit permanent increase in ΔP leads to a $\left(\sum_{j=0}^{4} \beta_{1j}\right)/(1-\alpha_1)$ unit change

[20] Because matrix A is lower-triangular this is equivalent to a recursive VAR and we do not overidentify the SVAR.

in ΔF. However, because real commodity prices trend upwards in levels (Jacks, 2013) we first difference the data to make them stationary and focus on the short run effects of a shock to the annual *change* in natural resource prices, which tend to be relatively transitory. We run similar regressions for different measures of deposits. When the left-hand-side is a measure of lending, we include deposits as a fourth endogenous variable and add lending to the front of the causal ordering.[21]

We also estimate this relationship at the bank-level, where the dependent variable is loan growth or deposit growth by bank j in country i and year t. In these regressions, we also interact the changes in natural resource shocks with bank characteristics to gauge whether the relationship between resource shocks and lending growth varies across banks with different characteristics. We will describe the regression set-up below.

4. Results

We start our empirical analysis with a regression of the level of natural resource rents on the level of financial system deposits and lending as well as present some regressions of macroeconomic variables on natural resource windfall gains to replicate results that were previously established in the literature. We then turn to our main regressions of changes in financial sector deposits and loans on natural windfall gains. In addition to exploring different types of deposits and loans, we offer an array of robustness tests, which include bank-level regressions.

4.1. Natural resources, financial development and macroeconomic effects

To introduce our data and novel measurement of natural resource windfall shocks we start by replicating several main findings from the literature. The results in Table A3 confirm previous results that higher natural resource rents are associated with lower levels of financial development, even when controlling for the level of GDP per capita and an indicator of institutional development. The regressions control for country and year fixed effects, with standard errors clustered on the country level; thus, we are exploiting within-country and within-year variation in natural resource rents and financial development. The results hold for both the lending side of financial development (columns 1 and 2) as for the deposit-taking side (column 3). We also find a negative relationship between natural resource rents and the loan-deposit ratio in the banking system (column 4). The effects are not only statistically significant,

[21] In Section 4.3 we explore the robustness to an alternative ordering.

but also economically meaningful. A one standard deviation in resource rents explains 8.6 percentage points different in Private Credit to GDP, 4.9 percentage points difference in Bank Deposits to GDP and 14.8 percentage points difference in the loan-deposit ratio, even after controlling for GDP per capita.

While these results are consistent with the previous literature, they do not control for endogeneity, as the share of mineral rents in GDP is not exogenous. We therefore split resource rents into its components and investigate year to year changes from now on. Before doing so, however, we first assess the relationship between changes in the components of natural resource rents and macroeconomic aggregates, to establish the effects of windfall gains on macroeconomic aggregates as backdrop for the role of the financial sector in such aggregate effects.

The results in Table A4 show that a sudden windfall as measured by a year to year *change* in the value of the mineral price index is positively associated with growth in total foreign gross assets (column 1), aggregate savings (column 2), household and non-household consumption (columns 3 and 4) and government consumption (column 5). Specifically, a 1% windfall leads to a 0.1% increase in foreign gross assets,[22] a 0.4 % increase in gross domestic savings, a 0.1% increase in household and in non-household consumption and a 0.1% increase in the volume of government consumption. These findings are in line with the theoretical optimal response to an unexpected windfall increase in income, as they are partially saved to smooth consumption (Van der Ploeg and Venables, 2012). As we include the lagged dependent variable, we are able to also compute the long-term effects of shocks to natural resource rents, by considering the ratio of the coefficient on price shocks and one minus the coefficient on the lagged dependent variable. Because the lagged dependent variable coefficients are close to zero, we do not find that the long-term effect is much different from the short-term effect in most cases, i.e., not only are the price shocks not very persistent as already shown above in Figure 2, but their effects also dissipate rapidly.

4.2. Natural resource windfalls, financial sector deposits and private sector lending

We now turn to our main results. The regressions in Table 1 show that windfall gains from natural resource rents are associated with reductions in financial system deposits and – as consequence of the decline in deposits – reductions in private sector credit. The results in

[22] This effect is net of revaluation of the dollar value of local currency assets induced by an appreciation of the real exchange rate. Real appreciation is measured as an increase in the log change in the price level of GDP relative to the US price level of GDP, with base year 2005, taken from the Penn World Tables 8.1.

columns (1) to (3) show that compared to a non-resource-related GDP shock, natural resource windfalls result in a relative decline in financial sector deposits. Starting with column (1), we find that a year to year change in the value of the mineral price index is associated with an *increase* in the volume of financial system deposits. However, when we add non-mineral GDP in column (2), the coefficient on natural resource price changes and turns insignificant, while the coefficient on non-mineral GDP is positive and significant. When we finally add the change in total GDP in column (3) we find that price induced windfalls predict a relative *decline* in financial system deposits. The results suggest that an increase in GDP leads to more deposits, but when comparing the effect of an average change in GDP to the effect of a similarly sized change in GDP that is due to an unexpected mineral windfall, we find that windfalls predict a relative crowding out of financial system deposits. This is a novel finding in the literature, which we will explore further in the following. While the short-term effect of a 1% price shock is a -0.06% relative decline in financial system deposits, the long-term effect is -0.08%, thus somewhat stronger. The effect of an average price shock, as observed within this sample of 7.7%, is thus a 0.6% decrease in deposits.

The negative relationship between changes in natural resource rents and deposits is mostly driven by price changes. While the change in natural resource quantity (due to a new discovery or expansion of production) enters negatively and significantly once we control for changes in non-mineral GDP or overall GDP, we find that a change in unit cost is positively associated with deposit volume, but significantly only as long as we do not control for GDP changes. We do not report these coefficients to save space, although they are always included.

The results in columns (4a) to (4c) confirm our findings with a structural VAR (SVAR) model, imposing the assumption that both GDP and inflation can influence deposits contemporaneously, that inflation may also move nominal GDP simultaneously, but that deposits affect GDP and inflation only with a delay. In terms of equation (2), we assume that matrix A is lower triangular and that $\Delta Y_{it} = (\Delta F_{it}, \Delta GDP_{it}, \pi_{it})'$. The regressions confirm that a positive price shock results in a relative decrease in the volume of deposits (column 4a) and an increase in GDP and inflation (columns 4b and 4c).[23] We also find a strong positive contemporaneous relationship between GDP growth and growth in financial systems deposits, confirming that higher GDP growth also increases growth in financial system deposits, unless higher GDP growth is caused by a natural resource price shock. Compared to the counterfactual

[23] We confirm the negative coefficient on financial system deposits when dropping several lagged values of the mineral price, quantity and costs variables that do not enter significantly, as well when using the Arrellano and Bond (1991) difference GMM estimator.

of a country growing at similar speed, a doubling of commodity price inflation induces a relative decline of deposit growth by 3.4%. We also tested, but rejected, asymmetric effects by splitting price shocks into positive and negative shocks. Positive and negative shocks were never of significant different magnitude (results not reported to save space, but available on request).

Figure 3 illustrates the effect of windfall gains under three different scenarios of the evolution of financial sector deposits and GDP growth after a shock in $t = 0$, averaged across countries. Estimates are obtained by using model (2) of Appendix Table A5 five periods ahead, where we first drop insignificant lags in the baseline model of Table 1, and second limit the sample to a balanced panel.[24] The baseline shows the no-shock scenario (assuming that Δ log mineral price index remains zero in all periods) with the consequence that growth in GDP and financial deposits co-move over the four subsequent periods. Scenario 1 shows the effect of a doubling of Δ log mineral price index; while we see a jump in GDP growth after the shock, the increase in financial system deposits is less than half that of the increase in GDP, while in subsequent periods the growth of both variables converges and then co-moves. Again, we can see that the effect of the shock dissipates quickly. Scenario 2, finally, imposes a shock to GDP growth that is equal to the response of GDP growth to the mineral price shock of Scenario 1 but imposing that Δ log mineral price index remains zero in all periods, thus showing a scenario of an equivalent shock to GDP growth in a non-resource based economy: both GDP and deposit growth jump by the same amount, with the effect dissipating over the subsequent periods, but both series co-moving. Figure 4 compares the two scenarios and shows that following a GDP growth shock the growth in deposits is almost three times as high in a non-resource based economy as it is in a resource-based economy.

The structural VAR in columns (5a) to (5d) of Table 1 shows that the consequent relative reduction in financial sector lending following a positive shock to natural resource windfall gains is due to the relative reduction in deposit funding. Here, we run a structural VAR model with private sector lending, financial sector deposits, GDP, and inflation. We impose the same structural assumption as before and in addition assume that growth in financial system deposits, GDP growth and inflation can impact private sector lending growth, while private sector lending growth cannot impact any of the other three variables contemporaneously, but

[24] Dropping insignificant lags in Table 1 could potentially result in dropping too many lags in 5% of cases. Formally testing the SVAR systems in Table 1 with BIC and AIC criteria yields the same conclusion: In columns 4a-c the AIC and BIC both conclude a lag length of 0 for the windfall shock. In columns 5a-d both also suggest 0 lags. Re-estimating those models with the reduced lag length yields the same contemporaneous results.

only through lags. In terms of equation (2), we again assume that matrix A is lower triangular but *4x4* and that $\Delta Y_{it} = (\Delta Lending_{it}, \Delta Deposits_{it}, \Delta GDP_{it}, \pi_{it})'$. We find no significant impact of natural resource price shocks on private sector lending growth, positive and significant effects on GDP growth and inflation and (on impact) a negative and significant effect on growth in financial system deposits. A doubling of commodity price inflation reduces deposit growth by 3.7% and thus indirectly lending growth by 0.037*0.254 = 0.9%. We also find a positive and significant contemporaneous impact of growth in financial system deposits and GDP growth on private sector lending growth and a negative contemporaneous effect of inflation. Similar to the effect on deposits, we thus find that when comparing countries with similarly booming economies as captured by total GDP growth, that those countries where the boom is induced by an unexpected positive shock to the exogenous world price of its basket of minerals do not experience an increase in lending and, if at all, a decrease. We conclude that an increase in natural resource wealth appears to crowd out financial intermediation by banks, mainly by reducing deposits.

In Appendix Table A6, we impose an alternative structural assumption on the SVAR. Specifically, in line with the view that it is lending that creates deposits, we assume that lending growth, GDP growth and inflation can impact growth in financial sector deposits, while growth in financial sector deposits can impact any of the other three only through lags but not contemporaneously.[25] Our results are very similar to the results in Panel A, with a negative contemporaneous effect of price shocks on deposits and a positive lagged effect. There is no significant effect of price changes on private sector lending, except for a positive effect in the fourth lag. As before, we find positive relationships between deposit and lending growth. Overall, imposing an alternative structural assumption does not change our main conclusion of a crowding out of financial intermediation by banks following an exogenous increase in natural resource wealth.

The results in Table 2 confirm our results across different sample splits and show that they are mainly driven by less developed economies. We run again structural VARs but only show the results for the financial sector variables. In columns (1) and (5) we drop from the sample the top producer for each commodity.[26] The results are consistent with the findings in

[25] This is consistent with recent research by the Bank of England that lending is the primary channel through which money is created. Any loan automatically creates an off-setting deposit in a bank's balance sheet and through multiplier effect further deposits (McLeay et al., 2014). We thus define: $\Delta Y_{it} = (\Delta Deposits_{it}, \Delta Lending_{it}, \Delta GDP_{it}, \pi_{it})'$.

[26] Although we observe 15 metals and minerals we drop 9 countries because some countries are the largest producer in multiple commodities. We drop Australia, Canada, Chile, China, Germany, Mexico, Saudi Arabia, South Africa, and the United States. We also tried dropping all OPEC members, but this did not change the results.

Table 1 – a negative and significant drop in financial system deposits and a negative but insignificant drop in credit. Conversely, when limiting the sample to the most resource dependent countries (columns 2 and 6), we find even stronger effects, with the negative effect on private sector lending now turning significant. The larger the degree of natural resource dependence (the average share of total resource rents in GDP) of an economy, the more adversely affected is thus the financial sector. Finally, in columns (3/4) and (7/8), we find that our findings are largely driven by less developed economies. While natural resource windfall gains do not enter significantly for the sub-sample of the OECD countries, they enter negatively and significantly for the non-OECD countries. In the following, we will dig deeper to understand this cross-country heterogeneity in the relationship between windfall gains and financial sector deposits and loans.[27]

The results in Table 3 show that our finding of a negative impact of natural resource windfalls are driven by financially repressive systems. As our sample contains natural resource rich countries at very different levels of financial development, here we allow the relationship between price changes in natural resources and financial sector deposits to vary across countries with different degrees of financial liberalization and institutional development. Specifically, we interact the price change in natural resources with seven different indicators of a country's legal system: the rule of law, and dummy variables for the absence of credit controls, directed credit, interest rate controls, state ownership, restrictions on capital account transactions, and an overall financial reform index, based on the previous five dummy variables (with all variables four periods lagged), obtained from Abiad et al. (2008). We lag these such that they measure a country's initial liberalization score before the price shock hits. While most of the coefficients on the concurrent and lagged changes in natural resource prices continue to enter negatively and significantly, some of the interactions enter positively and significantly, partly off-setting the effect of the main effect of windfall gains. Specifically, we find positive interaction terms of contemporaneous and/or lagged windfalls gains with the absence of interest rate controls and state ownership in the banking system as well as with the financial sector reform index. In Appendix Table A7, we present similar regressions with changes in private sector credit. While windfall gains themselves do not enter significantly, we find that lagged price changes have a positive effect in countries with higher levels of rule of law

[27] Recent advancements in panel data econometrics allow for dynamic panel heterogeneity in coefficient estimates (Chudik and Pesaran, 2015). However, these methods augment the regressions with lagged cross-sectional averages of all right-hand-side variables. The dimensions of our model and availability of data quickly result in more variables than data points. For this reason, we only explore explicit heterogeneity by using interactions and sample-splits.

(column 1) and more liberalized financial system (as proxied by limited or no credit controls or directed credit, interest rate controls, government ownership or restrictions on capital account liberalization), as can be seen in columns (2) – (6). We also find that lagged price changes have a positive effect on private sector lending in countries with higher indices of financial reforms (column 7), an effect that holds even without controlling for deposits and GDP changes (column 8). These findings suggest that the negative and significant relationship between resource windfall gains and financial sector deposits is driven by financially repressed countries, while the insignificant relationships that we documented above between price changes and private sector lending is driven by financially repressed countries and countries with a poor contractual framework. This can also be interpreted as suggesting that many natural resource countries have limited absorption capacity in their financial systems due to financial repression and the lack of a conducive institutional framework.

In summary, our results showing a relative decline in deposit growth after natural resource windfall gains, which in turn results in lower lending growth, in countries with weak institutional frameworks and repressive regulatory frameworks are not consistent with the *resource absorption hypothesis*, but rather provide evidence in favor of the *modified financial resource curse hypothesis*.

4.3. Where do the resource windfall gains go?

The results so far have shown a relative decline in financial system deposits after a resource windfall gain (compared to what a comparable shock in a non-resource based economy would cause), which in turn explains a similar relative decline in private sector lending. In the following we will explore different types of deposits as well as other asset positions of banks to gain a more granular view of where natural resource rents flow to and how they are being used if they end up in the financial system. The results are presented in Table 4.

In column (1) we confirm our previous findings using the more narrow measure of bank deposits (rather than total financial system deposits). For conciseness, and to preserve sample size, we drop insignificant trailing lags. The results in column (2) show that unlike domestic deposits, offshore deposits do not experience a relative decline after a resource windfall gain. The column (3) regression shows that banks increase their net foreign asset holding. The results in columns (4) and (5) finally show that while government deposits with commercial banks do not increase after a resource windfall gain, government's deposit with the central bank do increase significantly. When considering (in columns 6 to 8) lending to the central government, state and local governments, and public companies, we find no significant effects, although these samples are also much smaller. The results thus far thus suggest an increase in foreign asset positions of banks and an increase in claims of the government on central banks, suggesting that part of the windfall gains find their way abroad and into central bank rather than commercial bank coffers.

In Table 5, we focus on the government as apparent recipient of resource windfall gains and document that higher government deposits following resource windfall gains are associated with higher government consumption. Specifically, we regress the growth in government consumption and in private sector lending on contemporaneous and lagged growth in government deposits with commercial and central banks, on contemporaneous and lagged growth foreign asset holding, on contemporaneous and lagged growth in private sector deposits (only in column 2), the lagged dependent variable, financial development, contemporaneous and lagged inflation and (in column 2) contemporaneous and lagged growth. We find a strongly positive and significant relationship between growth in government deposits with commercial and central banks and growth in government consumption and a contemporaneous (though smaller) relationship between growth in government deposits with commercial banks and growth in private sector lending. We also find (not surprising) a positive relationship between contemporaneous and lagged growth in private sector deposits and growth in private sector lending, but no significant relationship between growth in foreign assets holding and either growth in government consumption or private sector lending.

To test how the regulatory and fiscal treatment of natural resources matters we would ideally use data on the direct tax receipts of governments and the profits of (foreign) extraction companies over time, but this data is to the best of our knowledge not available. These often do not appear in government accounts, as the Extractive Industries Transparency Initiative (EITI.org) underscores. Also, tax rates are unknown and can vary by country, mineral and over time, and can involve production sharing and in-kind payments (Otto et al., 2006). Finally, the government may own extraction companies directly.[28]

In the absence of better data, we construct a proxy, which uses mine-level data on the direct owners of over 1500 mines producing 31 different metals and minerals, but unfortunately does not cover oil and gas. The proprietary source is SNL Metals and Mining's predecessor

[28] Countries vary widely in this regard. Norway extracts most of its oil and gas through a majority state-owned company (Statoil), as do Saudi Arabia (Saudi Aramco) and Brazil (Petrobras). In other countries most extraction is done by domestic private companies (such as in the United States), while many developing countries rely on foreign companies.

RMG.[29] For these mines we know the owner by type (state, private, domestic, foreign) and the ownership share. We use four variables that estimate for each country the average share of mines that is domestic and private owned, domestic state owned, foreign private owned and foreign state owned.[30] We hypothesize that if the domestic state ownership share of mines is higher, than a larger share of profits would go to the government directly, which will exacerbate the relative decline in deposits.

Starting from our baseline dynamic model of Table 1 we interact the price shock with our proxies, where the excluded category is the domestic state-owned share.[31] The result is summarized in Figure 5. It shows the marginal effect of a shock to natural resource prices on the relative change in log private sector deposits, for varying levels of a country's average domestic private ownership share of mines. The solid line, with a slope of 0.099 that is significant at 10% level, tracks the marginal effect. The confidence bands show that the marginal effect becomes insignificant beyond the 85th percentile of its distribution. For most countries, with a mean domestic private ownership share of only 27%, we still find a negative and significant relative decline in deposits. Foreign ownership matter less, although it reduces the direct effect of the windfall on GDP growth, most likely because more of the windfall is channeled to offshore accounts. Appendix Table A8 also shows that none of the interactions is significant for the effect on lending. In summary and in line with the *financial resource curse hypothesis*, natural windfall gains seem to go into off-shore accounts and government coffers, being ultimately channeled into higher government consumption, except for the few countries where extraction is done by private domestic companies and in which also the tax burden on the natural resource sector may be lower.

4.4. **Bank-level evidence of the effect of natural resource windfalls**

We next turn to bank-level data to explore the robustness of our findings so far to the use of micro- rather than aggregate data. We have data available for almost 20,000 banks across 132 countries over the period 1986 to 2008. After conditioning on observables and dropping

[29] We are grateful to Yuan Gu for sharing her aggregate data.

[30] Specifically, if a country has two mines, one 100% domestic state-owned and one 50% domestic state-owned, the average share is ((1+0.5)/2=) 0.75. Because the coverage of mines with ownership information increases over time, we take the time-average for each country. Moreover, in only 3% of country-years do we observe a change from majority state to or from majority private ownership.

[31] See Appendix Table A8, columns 1a-c, for the underlying regression results. As advised by both the BIC and the AIC we drop lags of the index shocks to economize on degrees of freedom.

large clusters we are left with 1,601 banks in 105 countries between 1991 and 2008.[32] We include bank dummies, which also absorb country dummies. We modify the baseline model to include bank-level units of observation and regress:

$$\Delta F_{ibt} = \beta_1 \Delta P_{it} + \beta_2 \Delta Q_{it} + \beta_3 \Delta UC_{it} + \gamma_1 \Delta X_{it} + \gamma_2 \Delta Z_{ibt} + c_b + \varepsilon_{ibt}$$

where *F* is a bank-year level observation on the log of total deposits and short-term borrowing or log gross loans, *P* is the natural resource price index, *Q* the natural resource quantity index, *UC* the natural resource unit cost index, X is an array of control variables at the country-year level including initial financial development, the rate of inflation and GDP growth, Z is an array of standard bank-year level characteristics including log total assets (size of the bank), net loans over total assets, and the non-interest share of total operating income, *i* denotes country, *b* bank, and *t* year. We include bank (c_b) fixed effects and cluster standard errors at the country level. We also test for the differential effect of resource rent shocks on banks of different ownership. Specifically, we conjecture that foreign-owned banks might be less susceptible to the effects of natural resource rents, given their possible reliance on parent bank funding and lower susceptibility to government's moral suasion.

The results in Table 6 show that changes in resource prices significantly reduce the bank-level volume of deposits for countries that otherwise experience similar growth rates, supporting our earlier findings at the country level. The coefficients in the bank-level regressions are of similar size as the regressions on the country-level. Specifically, a 10% increase in natural resource prices results in a 1.3% reduction in deposits. These regressions control for bank-fixed effects and the global growth in deposits. When exploring differences across banks of different ownership (column 2), we find no significant difference between domestic and foreign-owned banks.[33]

The bank-level regressions also show a negative, though not significant impact of natural resource price shocks on private sector lending growth as the aggregate regressions in Table 1. As before, we find no differential effect across banks of different ownership.

Finally, the results in columns (5) and (6) show a significant positive relationship between resource price shocks and banks' investment into government securities.

[32] We drop large countries with many banks (Germany and the United States) because simulations have shown that cluster-robust standard errors can be biased downwards if the clusters are unbalanced in size. Rogers (1994) suggests that no cluster should contain more than five per cent of the data.

[33] We also explored the level of institutions for differential effects among banks, but neither affected the results.

Specifically, a 10% positive shock to natural resource prices results in a 2.4% increase in banks' government holding (column 5), unless the bank is foreign-owned, in which case the effect is a negative one if one adds up contemporaneous and lagged effects.

In summary, the bank-level regressions confirm our aggregate regressions in that natural resource price shocks result in lower growth in financial system deposits and no significant impact on bank lending. At the same time, banks hold more government securities following a natural resource price shock. As in the case of the aggregate regressions, it is important to note that these results are effectively comparing a positive growth shock due to natural resource rents with a positive growth not due to natural resource rent changes. While there is some evidence for bank-level variation, such as foreign banks not increasing their government security holdings after a natural resource rent shock, overall this evidence points again to a process of dis-intermediation following exogenous natural resource rent increases, consistent with the overall story of a natural resource curse in the financial sector documented in the literature.

5. Robustness tests

In this section, we subject our baseline regressions of changes in deposits and private sector lending to a series of additional robustness tests. First, we test the sensitivity of our findings to the use of different price indices. Second, we control for giant oil and gas field discoveries as additional exogenous source of variation in natural resource rents. Third, we consider the differential effects of windfall gains from natural resources across countries with and without sovereign wealth funds.

5.1.Varying price index methodologies

The results in Table 7 shows the robustness of our findings to the use of different price indices. We have so far used the Paasche price index with base year 1970, but another commonly used index is the Laspeyres chained index, where we allow the base year to change over time. Specifically, we allow for the index to be chained to weights lagged three or five years. Table 7 shows that these choices do not affect the main result that deposits decline significantly with a natural resource price shocks while there is a negative but insignificant effect on private sector lending.

5.2. Controlling for giant oil and gas field discoveries

The literature has recently started to use discoveries of giant oil and gas fields to identify the effects of natural resources. For example, Arezki et al. (2015) use a dataset from Horn (2003) on giant oil discoveries (i.e., at least 500 million ultimately recoverable barrels) to isolate the precise timing when expectations change and find that the investment ratio turns positive and the ratio of the current account to GDP turns negative for the first few years after a giant oil discovery while the current account becomes positive after five to seven years - when production on average starts. Our focus is on the short run effects of an increase in natural resource revenue, rather than anticipation effects of discoveries which may happen long before the revenue starts flowing. Nevertheless, to see if such giant discoveries affect our results, we use the same data base and include lagged effects of discoveries in our baseline model. First, we use dummies equal to 1 in any year between 1960 and 2003 that a country discovers at least one oil or gas field with a size of at least 500 millions of barrels of oil equivalent (MMBOE) ultimately recoverable reserves, zero otherwise.[34] Second, we measure discoveries as the log of field size in terms of ultimately recoverable reserves discovered.

The results in Table 8 show that these discoveries do not affect our main results, nor when we limit ourselves to shocks to producers of hydrocarbons (coal, oil and gas). We still find a relative decline in bank deposits following a resource price shock. Similarly, we find no significant impact of natural resource price shocks on private sector lending. The discoveries themselves tend to decrease deposits with a delay of 6 years and private sector lending with a delay of 2 years, but the effects are small.[35] However, reinterpreting discoveries of oil and gas field as an even more exogenous measure for increases in natural resource wealth confirms our finding of a crowding out of financial intermediation by banks following an increase in natural resource wealth.

5.3. Sovereign wealth funds

Natural resource rich countries have different regulatory frameworks that govern the way in which the government's natural resource income is saved, invested or consumed. While a

[34] A factor of 1/.006 is applied to convert gas in trillions of cubic feet to equivalent million barrels of oil.

[35] In Arezki et al. (2015), the effect on the savings rate enters with 10% confidence in lags 8 and 9. Partly, this could reflect that we include all oil, gas and coal production and thus include many more and smaller fields, such that we combine the effect of new production from fields and declining production from existing fields. However, by measuring production of hydrocarbons directly, we also allow for new technology to increase production in existing fields, while Arezki et al. (2016) assume that fields decrease production over time by a power law since geological pressure declines over time. That is true of any well, but it is not necessarily true of a field, in which additional wells may be drilled to increase production (see also Anderson et al., 2017). In fact, we find nearly zero correlation between lags of discovery and changes in country level oil and gas production.

detailed analysis of these differences is beyond the scope of this paper, we focus on one specific element in this framework, sovereign wealth funds.

Countries with sovereign wealth funds might be better able to smooth external shocks by keeping resource revenues in offshore accounts rather than letting all of them flow into the domestic economy. Norway for example, invests oil revenue directly abroad and only consumes the annual return on investment. We attempt to control for this possibility by constructing an indicator equal to 1 for each country-year in which a country has a natural resource based sovereign wealth fund. This is admittedly a crude measure because there is wide variation in the size of funds, their political independence and their management.[36] With this caveat in mind, our regressions presented in Table 9 show significantly stronger negative effects in both the short and the long run (adding up all the coefficients of the lags) on both deposits and lending for countries with a sovereign wealth fund. However, this effect is due to major oil exporters having sovereign wealth funds, such as Saudi Arabia. Deposits, but not lending, actually grow for non-OPEC member countries with sovereign wealth funds (-0.036 + 0.086 = +0.05), which fits the experience of Norway, and points to the possibility that sectors related to extraction may boom even when the windfall is saved abroad. The differences in the way in which SWFs are run thus matters for the degree of intermediation by the private sector of windfall resource revenue.

6. Conclusion

This paper tests opposing hypotheses on the effect of natural resource windfall gains on financial sector development. The *resource absorption hypothesis* posits a positive impact of additional income and wealth from windfall gains on financial sector deposits and loans and thus financial sector deepening. The *financial resource curse hypothesis* argues that additional resources do not enter the financial sector, but rather go into government coffers and off-shore accounts, while at the same time intermediation efficiency is negatively impact by the resource reliance of an economy; this ultimately points to a negative impact of resource windfall gains on financial sector deepening. A *modified financial resource curse hypothesis* argues that this

[36] See for example Bernstein et al. (2013). Countries with a natural resource based sovereign wealth fund are: Algeria, Azerbaijan, Botswana, Brunei Darussalam, Chile, Equatorial Guinea, Gabon, Iraq, Kazakhstan, Kiribati, Kuwait, Libya, Mauritania, Mexico, Norway, Oman, Qatar, Russian Federation, Saudi Arabia, Trinidad and Tobago, Turkmenistan, United Arab Emirates, United States, Venezuela.

is more likely to hold in countries with weak institutional and repressive regulatory frameworks.

Our results show that the financial system plays a limited if any role in absorbing windfall gains, especially in country with less conducive institutional frameworks and repressed financial systems and are thus in line with the *modified financial recourse curse hypothesis*. Specifically, controlling for the level of financial development, inflation, GDP growth and country fixed-effects, we find a relative decline in the volume of financial sector deposits in countries that experience an unexpected natural resource windfall. Compared to the counterfactual of a country growing at similar speed, a doubling of commodity price inflation induces a relative decline of deposit growth by 3.4% but increases relative growth of foreign assets by 9.6% and government deposits with central banks by 19.3%, which in turn raises government consumption but not private lending. Moreover, we find that the relative volume of loans at the bank level also declines, although the decline in lending at the aggregate level is mostly due to the decrease in deposits.

Our results thus stress the importance of financial system development for economic growth, including in resource-rich countries. Strengthening financial institutions and financial reform is essential to turn future windfall natural resource income into more productive investment. Future work requiring substantial data collection would benefit from more detailed analysis of how governments tax and spend natural resource income.

References

Abiad, A., E. Detragiache and T. Tressel.2008. A New Database of Financial Reforms, IMF Working Paper No. 08/266.

Acemoglu D, Robinson JA, Verdier T. 2004. Kleptocracy and divide-and-rule: a theory of personal rule. J. Eur. Econ. Assoc. 2:162–92

Afonso, António, Ludger Schuknecht, and Vito Tanzi, 2010. Public Sector Efficiency: Evidence for New EU Member States and Emerging Markets, Applied Economics, Vol. 42, No.17, pp. 2147–64.

Aghion, P., P. Bacchetta, R. Ranciere, and K. Rogoff, 2006, Exchange Rate Volatility and Productivity Growth: The Role of Financial Development, Journal of Monetary Economics 56, 494-513.

Alberola, E. and G. Benigno, 2017. Revisiting the commodity curse: A financial perspective, Journal of International Economics 108(1) 87-106.

Andersen, Jorgen Juel, Niels Johannesen, David Dreyer Lassen and Elena Paltseva. 2017. Petro Rents, Political Institutions and Hidden Wealth: Evidence from Offshore Bank Accounts, Journal of the European Economic Association, forthcoming.

Anderson, S.T. & Ryan Kellogg & Stephen W. Salant, 2017. Hotelling Under Pressure, Journal of Political Economy, forthcoming.

Arcand, Jean Louis, Enrico Berkes, Ugo Panizza 2015. Too much finance? Journal of Economic Growth 20(2) 105-148.

Arellano, M. and S.R. Bond, 1991. Some specification tests for panel data: Monte Carlo evidence and an application to employment equations, Review of Economic Studies 58, 277-298.

Arezki, R., F. van der Ploeg and F. Toscani, 2016. Shifting Frontiers in Global Resource Wealth: The Role of Policies and Institutions, OxCarre Research Paper 180.

Arezki, R, Valerie A. Ramey amd Liugang Sheng, 2017. News Shocks in Open Economies: Evidence from Giant Oil Discoveries, Quarterly Journal of Economics, forthcoming.

Bates, R.H., 1981. Markets and States in Tropical Africa. University of California Press, Berkeley.

Bazzi, Samuel and Christopher Blattman. 2014. Economic Shocks and Conflict: Evidence from Commodity Prices, American Economic Journal: Macroeconomics, 6(4): 1–38.

Beck, Thorsten, 2011. Finance and Oil Is There a Natural Resource Curse in Financial Development? In: Rabah Arezki, Thorvaldur Gylfason and Amadou Sy (Eds.): *Beyond the Curse: Policies to Harness the Power of Natural Resources,* Washington DC: IMF, 81-106

Beck, T., A. Demirguc-Kunt, and R. Levine (2003). Law, endowments, and finance. Journal of Financial Economics, 70, 137-181.

Beck, Thorsten & Luc Laeven, 2006. Institution building and growth in transition economies, Journal of Economic Growth, 11(2), 157-186 .

Bernstein, S., J. Lerner, and A. Schoar. 2013. The Investment Strategies of Sovereign Wealth Funds, Journal of Economic Perspectives, Volume 27, Number 2, 219–238.

Bhattacharyya, Sambit and Roland Hodler, 2014. Do Natural Resource Revenues Hinder Financial Development? The Role of Political Institutions, World Development 57 101-113.

Bolt, Katharine, Mampite Matete and Michael Clemens, 2002. Manual for Calculating Adjusted Net Savings, Environment Department, World Bank, September.

Bond, S.R., 2002. Dynamic Panel Data Models: A Guide to Micro Data Methods and Practice, IFS WP CWP09/02.

Bulte, Erwin, Damania, Richard and Deacon, Robert, (2005), Resource intensity, institutions, and development, World Development, 33, issue 7, p. 1029-1044

Caballero, R. J., and A. Krishnamurthy, 2004, Fiscal Policy and Financial Depth, NBER Working Paper No. 10532 (Cambridge, Massachusetts: National Bureau of Economic Research).

Chudik, Alexander and Pesaran, M. Hashem, (2015), Common correlated effects estimation of heterogeneous dynamic panel data models with weakly exogenous regressors, Journal of Econometrics, 188(2) 393-420.

Corden, W. Max and J. Peter Neary, 1982. Booming Sector and De-Industrialisation in a Small Open Economy, The Economic Journal 92, No. 368, 825-848.

Deaton, Angus & Miller, Ron, 1996. International Commodity Prices, Macroeconomic Performance and Politics in Sub-Saharan Africa, Journal of African Economies, Centre for the Study of African Economies (CSAE) 5(3), 99-191.

Engerman, S., and K. Sokoloff (1997). "Factor Endowments: Institutions, and Differential Paths of Growth among New World Economies," in S.H. Haber (ed), How Latin America Fell Behind, Stanford University Press, Stanford.

Feenstra, Robert C., Robert Inklaar and Marcel P. Timmer 2015. The Next Generation of the Penn World Table" forthcoming American Economic Review.

Gu, Y., 2014. How does ownership risk affect individual mine production—a mine-level empirical study, MPhil thesis, Tinbergen Institute, Amsterdam.

Harding, T. and A.J. Venables, 2016. The implications of natural resource exports for non-resource trade, IMF Economic Review 64(2), pages 268-302.

Horn, M.K. 2003. Giant Fields 1868-2003 (CD-ROM) in Halbouty, M.K., ed., Giant Oil and Gas Fields of the Decade, 1990-1999, Houston, AAPG Memoir 78.

Jacks, D.S., 2013. A Typology of Real Commodity Prices in the Long Run, NBER Working Paper No. 18874.

Kose, Ayhan, Eswar Prasad, Kenneth Rogoff and Shang-Jin Wei (2009) Financial Globalization: A Reappraisal. IMF Staff Papers 56, 8-62.

Lane, P. and G.M. Milesi-Ferretti, 2007. The External Wealth of Nations Mark II: Revised and Extended Estimates of Foreign Assets and Liability, 1970-2004. Journal of International Economics 73, 223-50.

Lütkepohl, H. 2006. New Introduction to Multiple Time Series Analysis. Springer Berlin Heidelberg. pp764

Mansoorian A. 1991. Resource discoveries and 'excessive' external borrowing. Economic Journal 101:1497–509

McLeay, M., A. Radia and R. Thomas. 2014. Money creation in the modern economy. Bank of England Quarterly Bulletin Q1, 1014.

Manzano O, Rigobon R. 2007. Resource curse or debt overhang. In Natural Resources: Neither Curse nor Destiny, ed. D Lederman, WF Maloney, pp. 41–70. Washington, DC: World Bank

Mishra, P., Montiel, P. & Spilimbergo, A. 2012, Monetary Transmission in Low-Income Countries: Effectiveness and Policy Implications IMF Economic Review 60, 270-302.

Nickell, Stephen J, 1981. Biases in Dynamic Models with Fixed Effects, Econometrica 49(6), 1417-26, November.

Otto, J., C. Andrews, F. Cawood, M. Doggett, P. Guj, F. Stermole, J. Stermole and J. Tilton, 2006. Mining royalties : a global study of their impact on investors, government, and civil society. Directions in development ; energy and mining. Washington, DC : World Bank Group.

Ploeg F. van der and S. Poelhekke. 2009a. Volatility and the natural resource curse. Oxford Economic Papers 61, 727–60

Ploeg, F. van der and S. Poelhekke, 2009b. The Volatility Curse: Revisiting the Paradox of Plenty, CESifo Working Paper 2616.

Ploeg F. van der and S. Poelhekke, 2010. The pungent smell of 'red herrings': Subsoil assets, rents, volatility and the resource curse Journal of Environmental Economics and Management 60(1) 44-55.

Ploeg, F. van der and A.J. Venables, 2012. Natural Resource Wealth: The Challenge of Managing a Windfall, Annual Review of Economics 4 315-337.

Ploeg, F. van der and A.J. Venables, 2013. Absorbing a windfall of foreign exchange: Dutch disease dynamics, Journal of Development Economics 103 229-243.

Robinson, James A., and Ragnar Torvik. 2005. White Elephants. Journal of Public Economics, 89(2–3):197–210.

Rogers, W. 1994. Regression standard errors in clustered samples, Stata Technical Bulletin, vol. 3, issue 13.

Sala-i-Martin, Xavier & Arvind Subramanian, 2013. "Addressing the Natural Resource Curse: An Illustration from Nigeria," Journal of African Economies, 22(4), 570-615.

Svensson, Jakob. 2000. Foreign aid and rent-seeking. Journal of International Economics 51(2) 437-461.

Tornell A, Lane PR. 1999. The voracity effect. American Economic Review 89:22–46

Tsui, K., 2011. More Oil, Less Democracy: Evidence from Worldwide Crude Oil Discoveries, Economic Journal, Royal Economic Society 121(551), 89-115.

Vicente, P.C. 2010. Does oil corrupt? Evidence from a natural experiment in West Africa. Journal of Development Economics 92, 28–38.

World Bank. 2011. The Changing Wealth of Nations : Measuring Sustainable Development in the New Millennium. Environment and Development. World Bank.

Table 1
Natural resource windfalls and the relative decline in private sector deposits

Dependent variable →	Δ log financial system deposits			Δ log financial system deposits	Δ log GDP	Rate of inflation	Δ log private credit	Δ log financial system deposits	Δ log GDP	Rate of inflation
Method →	*OLS*			*SUR SVAR ordering: no contemporaneous effect of deposits on GDP, on inflation*			*SUR SVAR ordering: no contemporaneous effect of lending on deposits, on GDP, on inflation*			
	[1]	[2]	[3]	[4a]	[4b]	[4c]	[5a]	[5b]	[5c]	[5d]
Δ log mineral price index	0.066***	0.023	-0.063***	-0.034**	0.148***	0.066***	-0.012	-0.037**	0.147***	0.061***
	(0.013)	(0.016)	(0.012)	(0.014)	(0.019)	(0.013)	(0.017)	(0.015)	(0.019)	(0.013)
Δ log mineral price index (t-1)				0.033***	0.036**	-0.014	0.000	0.033***	0.036**	-0.013
				(0.012)	(0.018)	(0.014)	(0.019)	(0.012)	(0.018)	(0.014)
Δ log mineral price index (t-2)				0.022	0.023	-0.006	0.027	0.020	0.022	-0.008
				(0.014)	(0.016)	(0.010)	(0.020)	(0.014)	(0.017)	(0.010)
Δ log mineral price index (t-3)				0.017	0.032**	0.003	-0.016	0.014	0.032**	-0.001
				(0.011)	(0.013)	(0.014)	(0.013)	(0.011)	(0.013)	(0.014)
Δ log mineral price index (t-4)				0.008	0.006	-0.002	0.028**	0.010	0.006	0.000
				(0.012)	(0.014)	(0.009)	(0.014)	(0.012)	(0.014)	(0.008)
Lagged dependent variable	0.294***	0.216***	0.186***	0.313***	0.110**	0.563***	0.013	0.256***	0.111**	0.577***
	(0.034)	(0.034)	(0.033)	(0.065)	(0.051)	(0.043)	(0.039)	(0.063)	(0.054)	(0.044)
Rate of inflation	-0.070	-0.096**	-0.150***	-0.247***	-0.004		-0.300***	-0.265***	-0.002	
	(0.051)	(0.043)	(0.048)	(0.060)	(0.099)		(0.094)	(0.058)	(0.100)	
Rate of inflation (t-1)				0.177***	0.035		0.059	0.199***	0.035	
				(0.044)	(0.095)		(0.094)	(0.042)	(0.098)	
Δ log non-mineral GDP		0.571***								
		(0.061)								
Δ log GDP			0.880***	0.868***		0	0.760***	0.868***		0
			(0.031)	(0.026)			(0.128)	(0.026)		
Δ log GDP (t-1)				-0.209***		-0.221***	0.078	-0.259***		-0.297***
				(0.049)		(0.043)	(0.084)	(0.051)		(0.045)
Δ log financial system deposits					0	0	0.254*		0	0
							(0.144)			
Δ log financial system deposits (t-1)					0.056**	0.030	0.087		0.059**	-0.043
					(0.026)	(0.033)	(0.080)		(0.029)	(0.030)
Δ log private credit								0	0	0
Δ log private credit (t-1)								0.101***	-0.006	0.148***
								(0.024)	(0.019)	(0.021)
Financial development (t-(s+1))	-0.001***	-0.000***	-0.000*	-0.000***	-0.000***	-0.000	-0.001***	-0.000***	-0.000***	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Controls for quantity and unit cost index, lags 0-s	Yes	Yes	Yes		Yes			Yes		
Country FE	Yes	Yes	Yes		Yes			Yes		
Observations	2,975	2,975	2,975		2,559			2,541		
Number of countries	122	122	122		115			121		
Years	1975-2008	1975-2008	1975-2008		1975-2008			1975-2008		
R-squared	0.124	0.366	0.458	0.485	0.162	0.519	0.551	0.489	0.161	0.529

Notes: This table shows OLS estimates in columns 1 to 3 and SVAR estimates in columns 4 and 5 to estimate the effect of unexpected and exogenous windfall in natural resource revenue based on world prices (*Δ log mineral price index*) on financial system deposits and private credit. The SVAR in 4a-4c assumes the following ordering: no contemporaneous effect of deposits on GDP, on inflation. The SVAR in 5a-5d assumes the following ordering: no contemporaneous effect of lending on deposits, on GDP, on inflation. These identifying assumptions are denoted by 0s in the table. Columns 4 and 5 are estimated using Seemingly Unrelated Regression (SUR), where the Breusch-Pagan test rejects the H0 of independence of the equations. See Section 3 for more details. *s* is the maximum included lag length of the windfall shock. By controlling for total GDP growth we estimate the differential effect of a windfall on countries that experience similar booms or busts but who experience them for different reasons. Robust standard errors are clustered by country shown in parentheses in 1-3, and block (country) bootstrapped in 4 and 5. A constant and country fixed effects are included but not shown. ***, **, * correspond to the 1%, 5%, and 10% level of significance, respectively.

Table 2
Heterogeneous effects: sample splits

Dependent variable →	Δ log financial system deposits				Δ log private credit			
Sample →	*Price takers: Excluding each mineral's largest producer*	*Including only top quartile of countries by natural resource dependence*	*OECD*	*non-OECD*	*Price takers: Excluding each mineral's largest producer*	*Including only top quartile of countries by natural resource dependence*	*OECD*	*non-OECD*
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Δ log mineral price index	-0.034***	-0.043**	-0.014	-0.029**	-0.010	-0.080***	0.027	-0.044**
	(0.011)	(0.016)	(0.015)	(0.014)	(0.017)	(0.024)	(0.024)	(0.018)
Δ log mineral price index (t-1)	0.029**	0.028	0.011	0.040***	-0.001	-0.018	0.046*	-0.024
	(0.012)	(0.021)	(0.014)	(0.013)	(0.015)	(0.025)	(0.024)	(0.015)
Δ log mineral price index (t-2)	0.024*	0.041***	0.000	0.027	0.034**	0.045**	0.010	0.020
	(0.014)	(0.014)	(0.011)	(0.016)	(0.014)	(0.021)	(0.020)	(0.014)
Δ log mineral price index (t-3)		0.039**	0.003	0.024*	-0.012			
		(0.015)	(0.010)	(0.013)	(0.014)			
Δ log mineral price index (t-4)					0.027**			
					(0.011)			
Lagged dependent variable	0.331***	0.246***	0.383***	0.259***	-0.009	-0.017	-0.198*	0.011
	(0.052)	(0.034)	(0.067)	(0.027)	(0.044)	(0.041)	(0.107)	(0.038)
Rate of inflation	-0.289***	-0.484***	-0.454***	-0.310***	-0.140**	-0.088	-0.441***	-0.136**
	(0.056)	(0.053)	(0.043)	(0.062)	(0.060)	(0.056)	(0.094)	(0.055)
Rate of inflation (t-1)	0.170***	0.267***	0.358***	0.190***				
	(0.044)	(0.042)	(0.049)	(0.044)				
Δ log GDP	0.882***	0.880***	0.927***	0.854***	0.699***	0.569***	0.408**	0.706***
	(0.026)	(0.042)	(0.042)	(0.035)	(0.111)	(0.107)	(0.162)	(0.105)
Δ log GDP (t-1)	-0.234***	-0.141***	-0.280***	-0.175***	0.238***	0.112	0.265*	0.199***
	(0.055)	(0.039)	(0.069)	(0.040)	(0.059)	(0.083)	(0.132)	(0.061)
Δ log financial system deposits					0.275**	0.469***	0.638***	0.270**
					(0.116)	(0.104)	(0.170)	(0.106)
Financial development (t-(s+1))	-0.000***	-0.001***	0.000	-0.001***	-0.001***	-0.002**		
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)		
Controls for quantity and unit cost index, lags 0-s	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,508	867	766	1,901	2,314	906	792	2,011
Number of countries	114	41	28	99	113	41	28	99
R-squared	0.472	0.714	0.772	0.451	0.491	0.566	0.553	0.516

Notes: This table shows SVAR estimates of the effect of unexpected and exogenous windfall in natural resource revenue based on world prices (Δ *log mineral price index*) on deposit and credit growth, where we restrict the sample first to countries with no market power in any mineral (columns 1 and 5), and to only the most natural resource dependent countries (columns 2 and 6). Finally, we split the sample in OECD and non-OECD members. Insignificant trailing lags of the windfall shock are dropped. *s* is the maximum included lag length of the windfall shock. Robust standard errors are clustered by country shown in parentheses. A constant and country fixed effects are included but not shown. ***, **, * correspond to the 1%, 5%, and 10% level of significance, respectively.

Table 3
Heterogeneous effects: relative decline of credit in financially restrictive countries

	Dependent variable →	Δ log private credit							
	Interaction variable →	*rule of law e[0,6]*	*Degree of liberalization of e[0,3]:*					*financial reform index e[0,1]*	
			credit controls	*directed credit*	*interest rate controls*	*ownership of banks (privatization*	*capital account transactions*		
		[1]	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ log mineral price index		-0.087	-0.011	0.003	-0.024	-0.015	-0.057	-0.054	0.021
		(0.074)	(0.036)	(0.035)	(0.032)	(0.031)	(0.036)	(0.045)	(0.045)
Δ log mineral price index (t-1)		-0.073	-0.089**	-0.072*	-0.052	-0.045	-0.095***	-0.116***	-0.036
		(0.058)	(0.039)	(0.038)	(0.034)	(0.033)	(0.035)	(0.041)	(0.054)
Δ log mineral price index (t-2)		0.072	-0.069*	-0.054	-0.086**	-0.036	-0.088**	-0.111***	-0.082
		(0.070)	(0.038)	(0.036)	(0.036)	(0.031)	(0.041)	(0.042)	(0.056)
Δ log mineral price index (t-3)		-0.133**	-0.107**	-0.099**	-0.102***	-0.063**	-0.068**	-0.116***	-0.084**
		(0.061)	(0.041)	(0.040)	(0.034)	(0.025)	(0.029)	(0.038)	(0.040)
Direct effect of interaction variable		-0.006	0.010*	0.009*	0.014***	0.004	0.011**	0.064***	0.050
		(0.006)	(0.005)	(0.005)	(0.005)	(0.006)	(0.005)	(0.023)	(0.037)
Δ log mineral price index	* Interaction variable (t-4)	0.019	-0.003	-0.011	0.005	0.007	0.027	0.060	0.103
		(0.019)	(0.016)	(0.015)	(0.014)	(0.018)	(0.019)	(0.080)	(0.080)
Δ log mineral price index (t-1)	* Interaction variable (t-4)	0.029**	0.058***	0.049***	0.032*	0.035*	0.056***	0.230***	0.271***
		(0.014)	(0.019)	(0.018)	(0.016)	(0.018)	(0.016)	(0.067)	(0.089)
Δ log mineral price index (t-2)	* Interaction variable (t-4)	-0.007	0.026	0.020	0.036**	0.021	0.045**	0.161***	0.195**
		(0.016)	(0.018)	(0.017)	(0.015)	(0.015)	(0.019)	(0.061)	(0.081)
Δ log mineral price index (t-3)	* Interaction variable (t-4)	0.037***	0.052**	0.047**	0.049***	0.027**	0.022*	0.187***	0.248***
		(0.014)	(0.020)	(0.020)	(0.015)	(0.013)	(0.012)	(0.057)	(0.061)
Lagged dependent variable		0.004	-0.036	-0.035	-0.046	-0.033	-0.048	-0.051	0.068
		(0.049)	(0.056)	(0.056)	(0.055)	(0.056)	(0.055)	(0.055)	(0.069)
Rate of inflation		-0.169**	-0.084	-0.085	-0.078	-0.093*	-0.085*	-0.077	-0.089**
		(0.073)	(0.051)	(0.052)	(0.051)	(0.051)	(0.051)	(0.051)	(0.040)
Δ log GDP		0.728***	0.596***	0.597***	0.606***	0.608***	0.606***	0.600***	
		(0.154)	(0.107)	(0.107)	(0.110)	(0.110)	(0.108)	(0.108)	
Δ log GDP (t-1)		0.233***	0.267***	0.266***	0.274***	0.258***	0.276***	0.277***	
		(0.079)	(0.086)	(0.085)	(0.085)	(0.085)	(0.085)	(0.085)	
Δ log financial system deposits		0.281*	0.428***	0.429***	0.421***	0.420***	0.425***	0.421***	
		(0.143)	(0.100)	(0.100)	(0.103)	(0.103)	(0.101)	(0.101)	
Financial development (t-4)		-0.002***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.002***	-0.002***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Controls for quantity and unit cost index, lags 0-s		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations		1,593	1,783	1,783	1,783	1,783	1,783	1,783	1,783
Number of countries		104	76	76	76	76	76	76	76
R-squared		0.490	0.526	0.525	0.527	0.520	0.526	0.529	0.529

Notes: This table shows SVAR estimates the effect of unexpected and exogenous windfall in natural resource revenue based on world prices *(Δ log mineral price index*) on private credit growth, where we control for various measures of institutions and components of financial sector liberalization, and their interaction with the windfall. Robust standard errors are clustered by country shown in parentheses. A constant and country fixed effects are included but not shown. ***, **, * correspond to the 1%, 5%, and 10% level of significance, respectively.

Table 4
Sub-categories of deposits and credit

	Sub-categories of Δ *log financial system deposits*					Sub-categories of Δ *log private credit*			Oher aggregate borrowing		
Dependent variable →	Δ log bank deposits	Δ log offshore bank deposits	Δ log foreign assets (banking institutions)	Δ log government deposits with banks	Δ log government deposits with central bank	Δ log claims on central government	Δ log claims on state and local governments	Δ log claims on public non-financial corp.	Δ log gross total national liabilities	Δ log national gross debt liabilities	Δ net foreign borrowing by banks over GDP ((liabilities-assets)/GDP)
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]
Δ log mineral price index	-0.035***	-0.078	0.096**	0.056	0.193**	-0.044	-0.006	-0.036	-0.032*	-0.044**	-0.001
	(0.011)	(0.052)	(0.046)	(0.047)	(0.077)	(0.067)	(0.184)	(0.085)	(0.018)	(0.020)	(0.003)
Δ log mineral price index (t-1)	0.029**	0.008		0.024					0.002	-0.016	
	(0.012)	(0.062)		(0.045)					(0.020)	(0.023)	
Δ log mineral price index (t-2)	0.024*	0.096*							0.043**	0.047*	
	(0.013)	(0.058)							(0.017)	(0.026)	
Δ log mineral price index (t-3)		0.246***							0.054**	0.077***	
		(0.060)							(0.021)	(0.028)	
Δ log mineral price index (t-4)		0.197***							0.017	0.025	
		(0.053)							(0.013)	(0.017)	
Lagged dependent variable	0.336***	-0.347***	-0.218***	-0.167***	-0.176***	-0.242***	-0.229***	-0.238	0.068	0.099	-0.226
	(0.048)	(0.069)	(0.044)	(0.026)	(0.057)	(0.092)	(0.074)	(0.146)	(0.047)	(0.061)	(0.184)
Rate of inflation	-0.303***	0.187**	0.137**	-0.164***	0.000	-0.278*	-0.351*	-0.588**	-0.002	0.008	-0.001
	(0.056)	(0.080)	(0.058)	(0.054)	(0.062)	(0.162)	(0.195)	(0.266)	(0.009)	(0.011)	(0.007)
Rate of inflation (t-1)	0.182***		-0.168***								
	(0.043)		(0.058)								
Δ log GDP	0.873***	0.149	0.279***	0.825***	0.694***	0.190	1.257***	0.464**	0.011	0.016	0.034**
	(0.029)	(0.096)	(0.077)	(0.095)	(0.131)	(0.269)	(0.233)	(0.225)	(0.054)	(0.053)	(0.016)
Δ log GDP (t-1)	-0.233***	0.129*	0.354***	0.265***							0.030**
	(0.050)	(0.070)	(0.098)	(0.096)							(0.014)
Δ log financial system deposits						0.446**	-0.192*	0.220	0.062*	0.054*	-0.016
						(0.195)	(0.101)	(0.173)	(0.033)	(0.031)	(0.011)
Δ log financial system deposits (t-1)							1.142***				
							(0.227)				
Financial development (t-(s+1))	-0.000***	0.001***	0.000	0.000	0.000	-0.001	-0.002	0.003	-0.001***	-0.001***	-0.000**
	(0.000)	(0.001)	(0.000)	(0.001)	(0.001)	(0.000)	(0.002)	(0.002)	(0.000)	(0.000)	(0.000)
Δ log real exchange rate									0.208***	0.163***	
									(0.049)	(0.053)	
Controls for quantity and unit cost index, lags 0-s	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,783	1,083	3,031	2,726	2,889	2,576	828	1,145	2,470	2,470	2,546
Number of countries	122	111	126	123	129	116	51	68	114	114	113
Years	1973-2008	1997-2008	1971-2008	1972-2008	1971-2008	1971-2008	1971-2008	1971-2008	1975-2008	1975-2008	1971-2008
R-squared	0.486	0.186	0.072	0.092	0.060	0.094	0.102	0.097	0.096	0.083	0.061

Notes: This table shows SVAR estimates to estimate the effect of unexpected and exogenous windfall in natural resource revenue based on world prices *(Δ log mineral price index*) on sub-categories of financial system deposits and credit. Insignificant trailing lags of the windfall shock are dropped in 1-11. *s* is the maximum included lag length of the windfall shock. By controlling for total GDP growth we estimate the differential effect of a windfall on countries that experience similar booms or busts but who experience them for different reasons. Robust standard errors are clustered by country shown in parentheses. A constant and country fixed effects are included but not shown. ***, **, * correspond to the 1%, 5%, and 10% level of significance, respectively.

Table 5
Do government deposits lead to spending or to lending?

	Δ log central government consumption expenditure	Δ log private credit
	[1]	[2]
Δ log government deposits with central bank	0.016***	0.003
	(0.005)	(0.004)
Δ log government deposits with central bank (t-1)	0.017***	0.002
	(0.004)	(0.004)
Δ log government deposits with central bank (t-2)	0.012***	0.001
	(0.004)	(0.002)
Δ log government deposits with central bank (t-3)	0.004	
	(0.003)	
Δ log government deposits with banks	0.051***	0.021***
	(0.010)	(0.006)
Δ log government deposits with banks (t-1)	0.021**	0.004
	(0.009)	(0.007)
Δ log government deposits with banks (t-2)	0.013*	0.002
	(0.007)	(0.005)
Δ log government deposits with banks (t-3)	0.007	
	(0.007)	
Δ log foreign assets (banking institutions)	0.007	0.001
	(0.009)	(0.008)
Δ log foreign assets (banking institutions) (t-1)	0.008	-0.001
	(0.006)	(0.007)
Δ log foreign assets (banking institutions) (t-2)	0.007	0.004
	(0.008)	(0.007)
Δ log foreign assets (banking institutions) (t-3)	0.001	
	(0.006)	
Δ log private-sector deposits with banks		0.196***
		(0.038)
Δ log private-sector deposits with banks (t-1)		0.087***
		(0.029)
Δ log private-sector deposits with banks (t-2)		0.042**
		(0.019)
Lagged dependent variable	0.060**	-0.023
	(0.030)	(0.026)
Rate of inflation	-0.119***	-0.429***
	(0.031)	(0.063)
Rate of inflation (t-1)	0.089**	
	(0.043)	
Δ log GDP		0.721***
		(0.045)
Δ log GDP (t-1)		0.166***
		(0.045)
Financial development (t-s)	-0.001***	-0.002***
	(0.000)	(0.000)
Country FE	Yes	Yes
Observations	3,205	2,870
Number of countries	150	140
Years	1964-2008	1963-2008
R-squared	0.079	0.526

Notes: This table shows OLS regressions to estimate the effect of government deposit growth on government consumption and private lending. Robust standard errors are clustered by country shown in parentheses. A constant and country fixed effects are included but not shown. ***, **, * correspond to the 1%, 5%, and 10% level of significance, respectively.

Table 6
Bank-level analysis: Natural resource windfalls and the relative decline in deposits

	Dependent variable →	Δ log total deposits and short-term borrowing		Δ log gross loans		Δ log government securities	
	Interaction with ↓	[1]	[2]	[3]	[4]	[5]	[6]
Δ log mineral price index		-0.131***	-0.097**	-0.035	-0.033	0.321**	0.460***
		(0.042)	(0.048)	(0.026)	(0.033)	(0.130)	(0.133)
Δ log mineral price index (t-1)		0.074	0.071	0.075**	0.112**	0.013	0.187
		(0.057)	(0.071)	(0.034)	(0.046)	(0.125)	(0.163)
Δ log mineral price index (t-2)		-0.025	0.032	0.044	0.044	0.123	0.182
		(0.058)	(0.055)	(0.031)	(0.031)	(0.180)	(0.155)
Δ log mineral price index (t-3)		0.046	0.034	0.069**	0.034	0.175	0.259*
		(0.049)	(0.060)	(0.031)	(0.037)	(0.150)	(0.145)
Lagged dependent variable		-0.129***	-0.142***	-0.140***	-0.151***	-0.225***	-0.225***
		(0.023)	(0.031)	(0.048)	(0.050)	(0.023)	(0.022)
Rate of inflation		0.000	-0.169	-0.038	-0.154**	0.624***	1.008***
		(0.088)	(0.126)	(0.034)	(0.063)	(0.133)	(0.390)
Δ log GDP		0.917***	0.987***	0.595***	0.620***	-1.120***	-1.033***
		(0.163)	(0.140)	(0.081)	(0.085)	(0.254)	(0.207)
Δ log GDP (t-1)				0.156***	0.143**	-0.363**	-0.367**
				(0.056)	(0.068)	(0.143)	(0.150)
Δ log deposit				0.398***	0.390***	0.428***	0.430***
				(0.028)	(0.034)	(0.106)	(0.103)
Δ log deposit (t-1)				0.094**	0.124***	0.106**	0.140**
				(0.042)	(0.034)	(0.051)	(0.058)
Financial development (t-4)		0.001	0.001	0.000	-0.000	-0.000	-0.000
		(0.000)	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)
Bank's log tot assets (t-4)		-0.031**	-0.059***	-0.027**	-0.027	0.001	-0.021
		(0.015)	(0.016)	(0.013)	(0.019)	(0.027)	(0.033)
Bank's Net Loans / Tot Assets (t-4)		0.000	0.001	-0.002***	-0.002***	0.003*	0.002
		(0.001)	(0.000)	(0.001)	(0.000)	(0.002)	(0.002)
Bank's Non-interest share of		-0.000*	-0.000	0.000	-0.000	0.002	0.003
total operating income (t-4)		(0.000)	(0.000)	(0.000)	(0.000)	(0.002)	(0.002)
Δ log global deposit		0.322***	0.574***				
		(0.073)	(0.134)				
Δ log mineral price index	* Bank foreign owned (t-4)		-0.025		0.050		-0.486*
			(0.091)		(0.053)		(0.269)
Δ log mineral price index (t-1)	* Bank foreign owned (t-4)		0.140		-0.080		-0.610**
			(0.106)		(0.069)		(0.243)
Δ log mineral price index (t-2)	* Bank foreign owned (t-4)		-0.060		0.076		0.325
			(0.082)		(0.086)		(0.351)
Δ log mineral price index (t-3)	* Bank foreign owned (t-4)		0.020		0.140*		-0.255
			(0.083)		(0.082)		(0.200)
Bank foreign owned (t-4)			-0.033**		-0.036***		0.130**
			(0.017)		(0.013)		(0.064)
Controls for quantity and unit cost index, lags 0-s		Yes	Yes	Yes	Yes	Yes	Yes
Bank FE		Yes	Yes	Yes	Yes	Yes	Yes
Observations		9,906	7,217	9,864	7,184	5,283	3,951

Notes: This table shows OLS regressions to estimate the effect of unexpected and exogenous windfall in natural resource revenue based on world prices *(Δ log mineral price index*) on deposit growth, loan growth, and investment in government securities, at the bank level. We drop large clusters (Germany and the United States) because simulations have shown that cluster-robust standard errors can be biased downwards if the clusters are unbalanced in size. Rogers (1994) suggests that no cluster should contain more than five per cent of the data. We control for bank-level characteristics, which are interacted with the windfall. Robust standard errors are clustered by country shown in parentheses. A constant and bank fixed effects are included but not shown. ***, **, * correspond to the 1%, 5%, and 10% level of significance, respectively.

Table 7
Robustness: Price shocks based on unchained (baseline) versus chained price indices

Dependent variable →	Δ log total deposits and short-term borrowing			Δ log private credit		
Price index →	*Baseline: Paasche, base year 1970*	*Laspeyres chained to t-3*	*Laspeyres chained to t-5*	*Baseline: Paasche, base year 1970*	*Laspeyres chained to t-3*	*Laspeyres chained to t-5*
	[1]	[2]	[3]	[4]	[5]	[6]
Δ log mineral price index	-0.034***	-0.032***	-0.026**	-0.013	0.011	-0.004
	(0.011)	(0.008)	(0.011)	(0.016)	(0.012)	(0.014)
Δ log mineral price index (t-1)	0.030**	0.013	0.009	-0.008	-0.018*	0.000
	(0.012)	(0.010)	(0.018)	(0.015)	(0.010)	(0.015)
Δ log mineral price index (t-2)	0.025*	-0.004	0.007	0.036***	0.028***	0.011
	(0.013)	(0.010)	(0.008)	(0.014)	(0.010)	(0.011)
Δ log mineral price index (t-3)			-0.013	-0.014		0.004
			(0.013)	(0.015)		(0.012)
Δ log mineral price index (t-4)			-0.003	0.026**		0.024*
			(0.008)	(0.011)		(0.012)
Lagged dependent variable	0.333***	0.297***	0.323***	-0.003	-0.010	0.007
	(0.049)	(0.028)	(0.026)	(0.044)	(0.042)	(0.042)
Rate of inflation	-0.302***	-0.294***	-0.274***	-0.126**	-0.135**	-0.134**
	(0.056)	(0.056)	(0.066)	(0.056)	(0.057)	(0.058)
Rate of inflation (t-1)	0.181***	0.184***	0.179***			
	(0.043)	(0.043)	(0.049)			
Δ log GDP	0.872***	0.890***	0.890***	0.696***	0.706***	0.723***
	(0.028)	(0.023)	(0.023)	(0.115)	(0.123)	(0.119)
Δ log GDP (t-1)	-0.228***	-0.196***	-0.208***	0.204***	0.210***	0.223***
	(0.051)	(0.037)	(0.036)	(0.059)	(0.058)	(0.062)
Δ log financial system deposits				0.294**	0.309**	0.268**
				(0.120)	(0.127)	(0.123)
Financial development (t-(s+1))	-0.000***	-0.000***	-0.000**	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Controls for quantity and unit cost index, lags 0-s	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,784	2,597	2,215	2,579	2,611	2,230
Number of countries	122	120	119	121	120	119
Years	1973-2008	1976-2008	1980-2008	1975-2008	1976-2008	1980-2008
R-squared	0.484	0.489	0.481	0.499	0.510	0.508

Notes: This table shows OLS regressions to estimate the effect of unexpected and exogenous windfall in natural resource revenue based on world prices *(Δ log mineral price index, Paasche base year 1970*) on deposit and credit growth. *s* is the maximum included lag length of the windfall shock. Δ *log mineral price index, Laspeyres chained to t-1* allows the base year to vary but sets the base year for time t at year t-1. Δ *log mineral price index, Laspeyres chained to t-1* allows the base year to vary but sets the base year for time t at year t-2. Δ *log mineral price index, Laspeyres chained to t-1* allows the base year to vary but sets the base year for time t at year t-3. Robust standard errors are clustered by country shown in parentheses. A constant and country fixed effects are included but not shown. ***, **, * correspond to the 1%, 5%, and 10% level of significance, respectively.

Table 8
Robustness: Controlling for giant oil and gas field discoveries

Dependent variable →	Δ log financial system deposits		Δ log private credit	
Discovery measured as →	*Giant oil and gas field discovery dummy*		*log giant oil and gas field ultimately recoverable reserves discovered*	
Resource measured as →	*all minerals*	*hydrocarbons only*	*all minerals*	*hydrocarbons only*
	[1]	[2]	[3]	[4]
Δ log resource price index	-0.034***	-0.033***	-0.012	-0.013
	(0.011)	(0.011)	(0.016)	(0.016)
Δ log resource price index (t-1)	0.032***	0.032***	-0.006	-0.006
	(0.012)	(0.012)	(0.015)	(0.015)
Δ log resource price index (t-2)	0.027**	0.026**	0.039***	0.038***
	(0.013)	(0.013)	(0.014)	(0.014)
Δ log resource price index (t-3)			-0.014	-0.014
			(0.015)	(0.015)
Δ log resource price index (t-4)			0.027**	0.027**
			(0.011)	(0.011)
Lagged dependent variable	0.335***	0.335***	-0.007	-0.008
	(0.049)	(0.049)	(0.044)	(0.044)
Rate of inflation	-0.298***	-0.297***	-0.126**	-0.126**
	(0.056)	(0.056)	(0.055)	(0.055)
Rate of inflation (t-1)	0.181***	0.180***		
	(0.043)	(0.043)		
Δ log GDP	0.871***	0.871***	0.695***	0.695***
	(0.028)	(0.028)	(0.114)	(0.114)
Δ log GDP (t-1)	-0.229***	-0.229***	0.208***	0.208***
	(0.050)	(0.050)	(0.059)	(0.059)
Δ log financial system deposits			0.291**	0.291**
			(0.119)	(0.120)
Financial development (t-(s+1))	-0.000***	-0.000***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
Discovery	0.009	0.002	0.042*	0.006*
	(0.010)	(0.001)	(0.022)	(0.003)
Discovery (t-1)	-0.021*	-0.003*	-0.024*	-0.003*
	(0.011)	(0.002)	(0.012)	(0.002)
Discovery (t-2)	0.003	0.001	-0.029**	-0.004**
	(0.010)	(0.001)	(0.013)	(0.002)
Discovery (t-3)	0.011	0.001	-0.024*	-0.003*
	(0.009)	(0.001)	(0.012)	(0.002)
Discovery (t-4)	0.014	0.002	0.009	0.001
	(0.011)	(0.002)	(0.015)	(0.002)
Discovery (t-5)	-0.015*	-0.002*	-0.023	-0.003
	(0.008)	(0.001)	(0.018)	(0.003)
Discovery (t-6)	-0.028**	-0.004**	-0.019*	-0.002
	(0.011)	(0.002)	(0.011)	(0.002)
Discovery (t-7)	0.008	0.001	-0.005	-0.001
	(0.011)	(0.002)	(0.015)	(0.002)
Discovery (t-8)	0.010	0.001	0.002	0.000
	(0.010)	(0.001)	(0.012)	(0.002)
Discovery (t-9)	-0.009	-0.001	0.024*	0.003*
	(0.009)	(0.001)	(0.013)	(0.002)
Discovery (t-10)	-0.005	-0.001	-0.017	-0.002
	(0.008)	(0.001)	(0.012)	(0.002)
Controls for quantity and unit cost index, lags 0-s	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes
Observations	2,784	2,784	2,579	2,579
Number of countries	122	122	121	121
R-squared	0.486	0.486	0.504	0.504

Notes: This table shows OLS regressions to estimate the effect of unexpected and exogenous windfall in natural resource revenue based on world prices (*Δ log mineral price index*) on measures of deposit and credit growth, controlling for two measures of oil and gas field discovery. Insignificant trailing lags of the windfall shock are dropped. *s* is the maximum included lag length of the windfall shock. Hydrocarbons include oil, natural gas and coal. Robust standard errors are clustered by country shown in parentheses. A constant and country fixed effects are included but not shown. ***, **, * correspond to the 1%, 5%, and 10% level of significance, respectively.

Table 9
Robustness: OPEC countries' SWFs amplify the relative credit cycle

Dependent variable →		Δ log deposits			Δ log private credit		
	Interaction variable →	*SWF dummy*	*non-OPEC SWFs*	*OPEC SWFs*	*SWF dummy*	*non-OPEC SWFs*	*OPEC SWFs*
		[1]	[2]	[3]	[1]	[2]	[3]
Δ log mineral price index		-0.028**	-0.036***	-0.028**	-0.006	-0.010	-0.010
		(0.011)	(0.011)	(0.011)	(0.017)	(0.017)	(0.016)
Δ log mineral price index (t-1)		0.029**	0.032***	0.027**	-0.005	-0.008	-0.006
		(0.012)	(0.012)	(0.012)	(0.016)	(0.016)	(0.015)
Δ log mineral price index (t-2)		0.022	0.023*	0.024*	0.025*	0.037**	0.025*
		(0.014)	(0.013)	(0.014)	(0.014)	(0.014)	(0.013)
Δ log mineral price index (t-3)					-0.019	-0.014	-0.019
					(0.015)	(0.016)	(0.014)
Δ log mineral price index (t-4)					0.026**	0.030***	0.021*
					(0.011)	(0.011)	(0.011)
Direct effect of interaction variable		0.018	-0.004	0.057***	0.008	0.020	0.039
		(0.013)	(0.013)	(0.009)	(0.023)	(0.018)	(0.026)
Δ log mineral price index	* Interaction variable (t-4)	-0.098*	0.086**	-0.193***	-0.107**	-0.069	-0.167**
		(0.059)	(0.041)	(0.043)	(0.049)	(0.056)	(0.076)
Δ log mineral price index (t-1)	* Interaction variable (t-4)	0.006	-0.053	0.090***	-0.055	0.033	-0.067
		(0.034)	(0.039)	(0.029)	(0.034)	(0.031)	(0.049)
Δ log mineral price index (t-2)	* Interaction variable (t-4)	0.025	0.067**	0.028	0.123**	0.004	0.218***
		(0.030)	(0.030)	(0.047)	(0.052)	(0.052)	(0.036)
Δ log mineral price index (t-3)	* Interaction variable (t-4)				0.052	0.018	0.106**
					(0.042)	(0.052)	(0.052)
Δ log mineral price index (t-4)	* Interaction variable (t-4)				0.015	-0.071	0.074
					(0.046)	(0.069)	(0.045)
Lagged dependent variable		0.330***	0.333***	0.332***	-0.007	-0.003	-0.011
		(0.050)	(0.049)	(0.050)	(0.044)	(0.044)	(0.043)
Rate of inflation		-0.294***	-0.301***	-0.289***	-0.125**	-0.126**	-0.126**
		(0.055)	(0.056)	(0.055)	(0.056)	(0.056)	(0.056)
Rate of inflation (t-1)		0.176***	0.181***	0.172***			
		(0.044)	(0.043)	(0.044)			
Δ log GDP		0.883***	0.873***	0.888***	0.714***	0.696***	0.714***
		(0.025)	(0.028)	(0.025)	(0.114)	(0.116)	(0.114)
Δ log GDP (t-1)		-0.226***	-0.228***	-0.233***	0.217***	0.205***	0.222***
		(0.053)	(0.051)	(0.053)	(0.060)	(0.060)	(0.061)
Δ log financial system deposits					0.285**	0.295**	0.282**
					(0.118)	(0.121)	(0.118)
Financial development (t-(s+1))		-0.000***	-0.000***	-0.000***	-0.001***	-0.001***	-0.001***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Controls for quantity and unit cost index, lags 0-s		Yes	Yes	Yes	Yes	Yes	Yes
Country FE		Yes	Yes	Yes	Yes	Yes	Yes
Observations		2,784	2,784	2,784	2,579	2,579	2,579
Number of countries		122	122	122	121	121	121
R-squared		0.488	0.485	0.491	0.505	0.501	0.507

Notes: This table shows OLS regressions to estimate the effect of unexpected and exogenous windfall in natural resource revenue based on world (Δ *log mineral price index*) on credit growth. *s* is the maximum included lag length of the windfall shock. We interact the windfall with a dummy equal to 1 for years in which, respectively, a country has a sovereign wealth fund (SWF), a non-OPEC country has an SWF, and an OPEC member has an SWF. Insignificant trailing lags of the windfall shock are dropped. Robust standard errors are clustered by country shown in parentheses. A constant and country fixed effects are included but not shown. ***, **, * correspond to the 1%, 5%, and 10% level of significance, respectively.

Figure 1
Dispersion in mineral price booms and busts

This graph plots the country-average and dispersion of the change in the log mineral price index between 1970 and 2008.

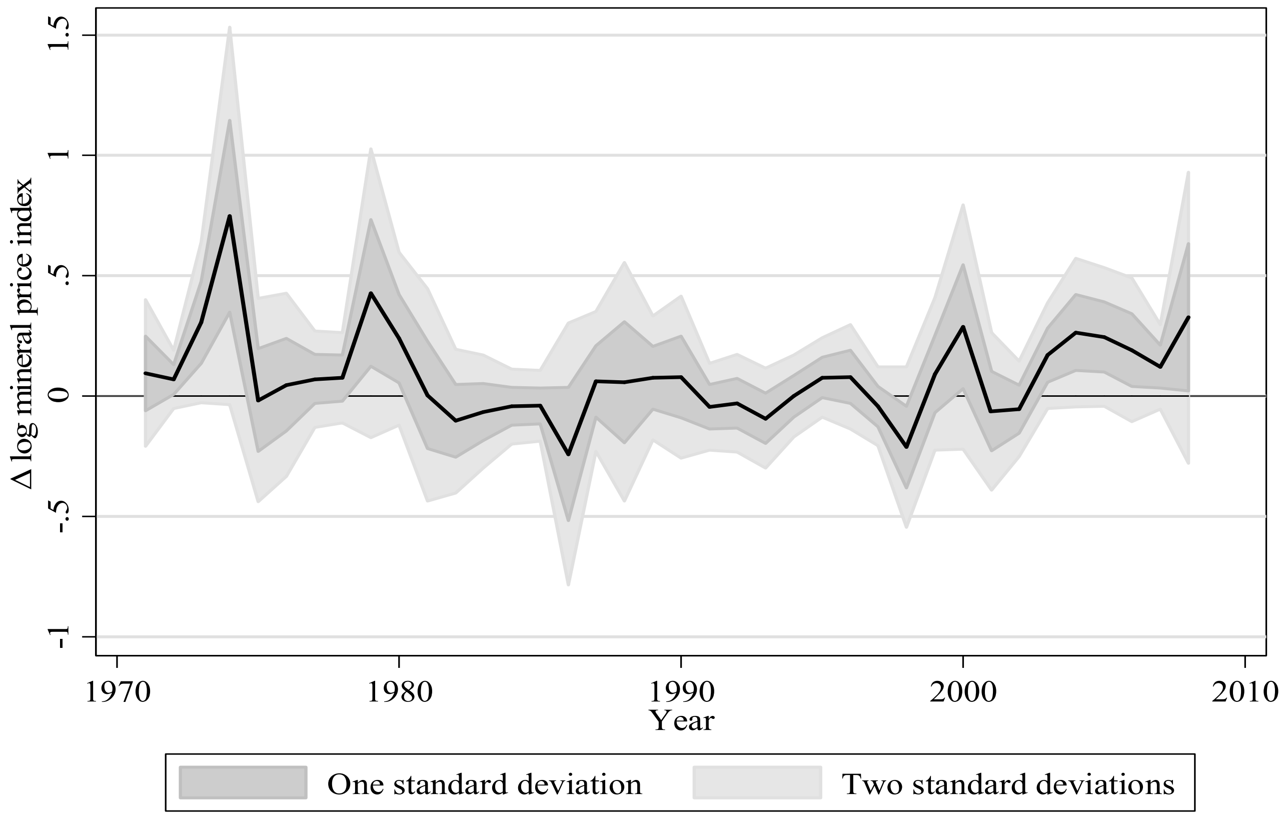

Figure 2

Persistence of a shock to the mineral price index

This graph plots the persistence of a shock of 100% in year 0 to the log change of the commodity price index. Point estimates at years 1 to 4 are obtained by fitting an AR(4) model with a trend. Lags 1 to 3 are signigficantly different from zero at 99% confidence.

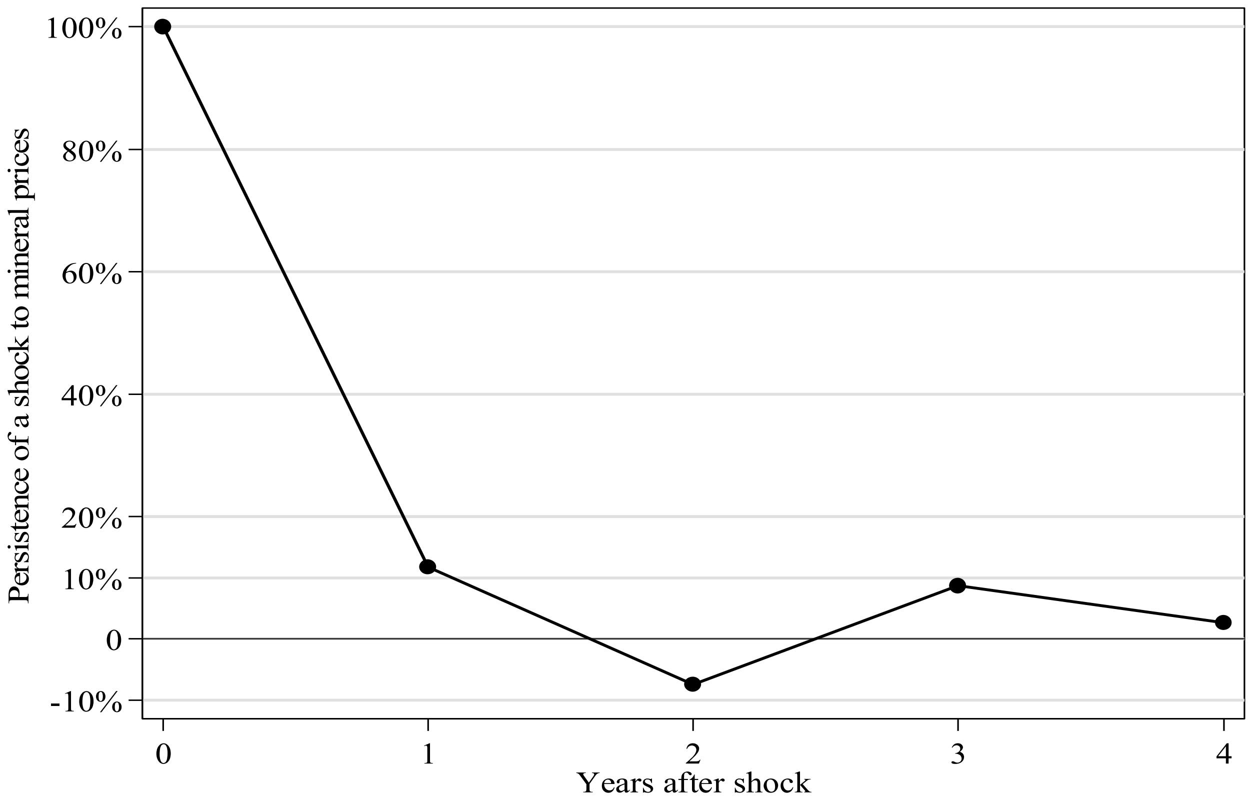

Figure 3

Three dynamic forecast scenarios for private sector deposits and GDP

This graph plots three scenarios of the evolution of private sector deposits and GDP growth after a shock in $t = 0$, averaged across countries. The baseline scenario assumes that Δ log mineral price index remains zero in all periods. Scenario 1 imposes a shock to Δ log mineral price index as in Figure 2. Scenario 2 imposes a shock to GDP growth that is equal to the respons to GDP growth to the mineral price shock of Scenario 1 but assumes that Δ log mineral price index remains zero in all periods. Estimates are obtained by forecasting model 2 of Appendix Table 5 five periods ahead.

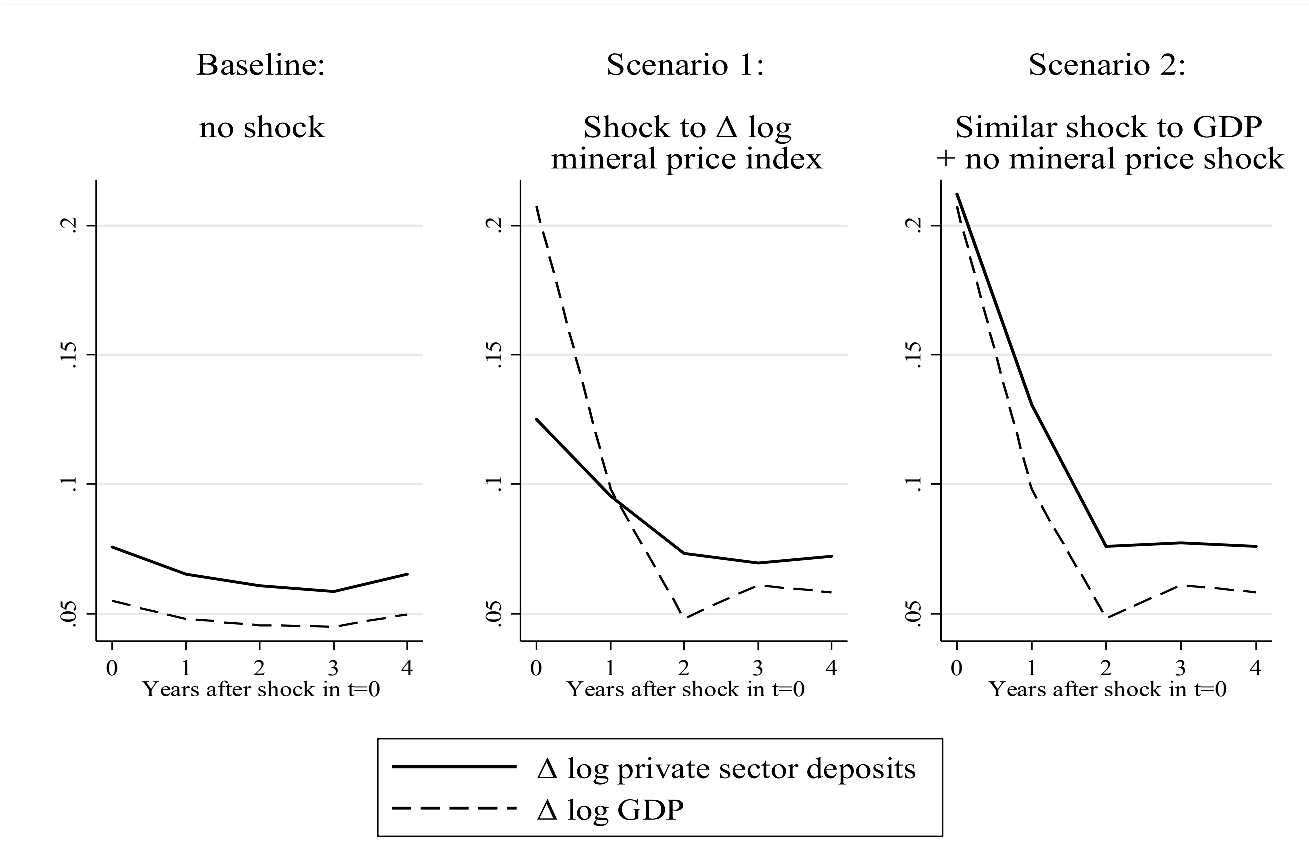

Figure 4

Relative change in Δ log private sector deposits

This graph plots the relative change in log private sector deposits between the scenarios of Figure 3. The solid line represents the rate of change from Scenario 1 (the mineral price shock) over and above what would happen under the baseline scenario of no shock. The dashed line represents the rate of change from Scenario 2 (the pure GDP shock) over and above what would happen under the baseline scenario of no shock. The pure GDP shock is equal in magnitude to the response of GDP to the mineral price shock in Scenario 1. The graph shows that the response of private sector deposits after a natural resource boom is much less than under a similarly-sized GDP shock that happens for other exogenous reasons.

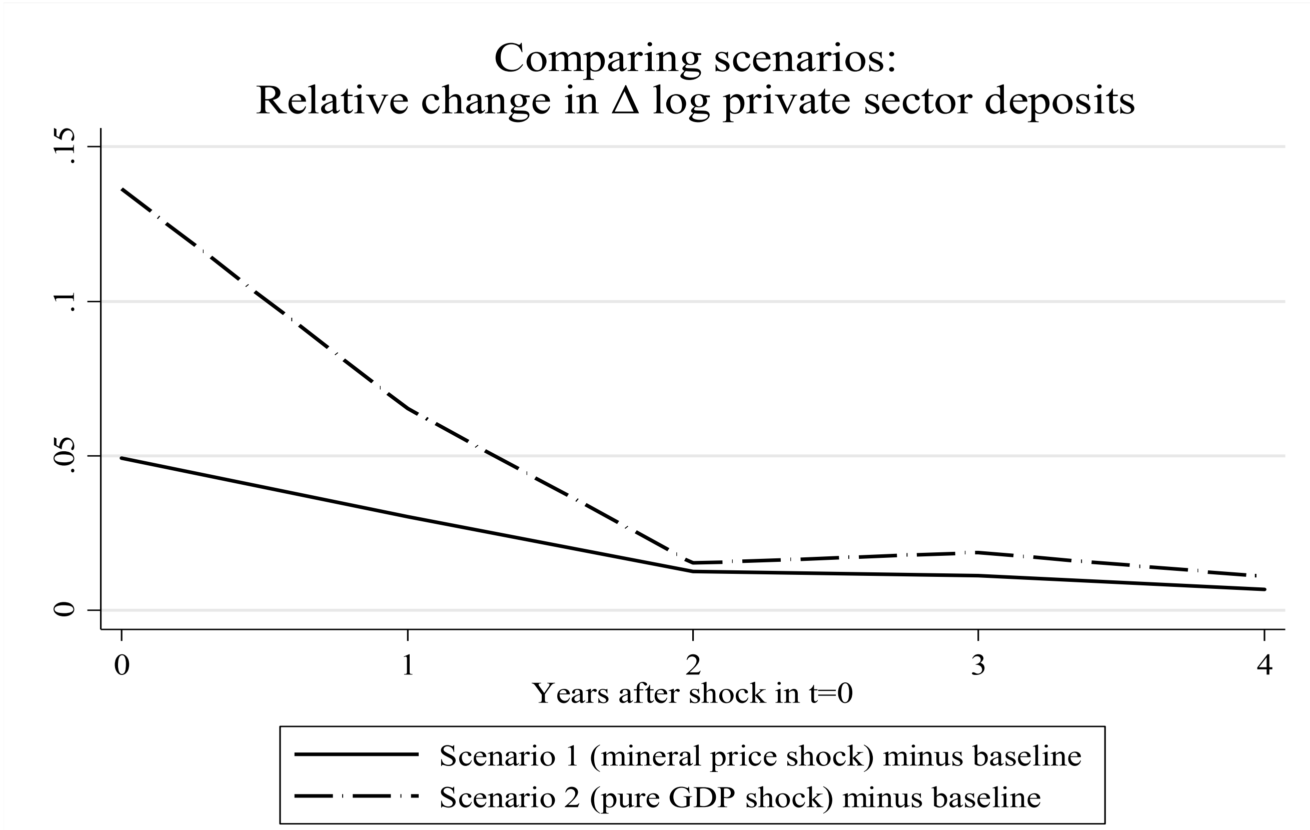

Figure 5

Ownership structure and the marginal effect of a price shock on deposits

This graph plots the marginal effect of a shock to natural resource prices on the relative change in log private sector deposits, for varying levels of a country's average domestic private ownership share of mines. The solid line, with a slope of 0.099, tracks the marginal effect. The dashed line represents the 95% confidence bands of the marginal effect and the asterisks show the 90% confidence range. Domestic private ownership share is defined as the country-average of the share of mines that is owned by domestic private companies. In the sample, its mean is 0.27, its median 0.12 and the marginal effect becomes insignificant beyond the 85th percentile of its distribution. See Appendix Table A8, columns 1a-c, for the underlying regression results.

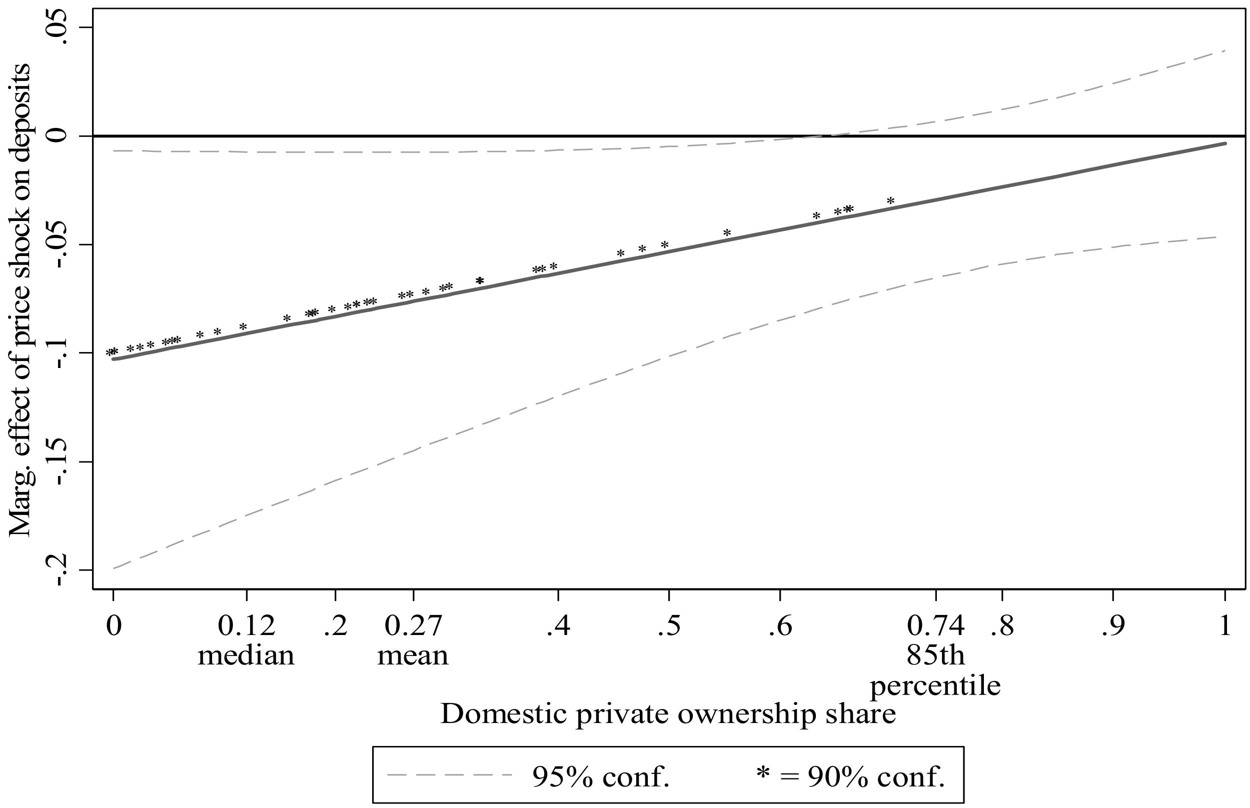

Table A1
Variable definitions and data sources

	N	mean	s.d.	min	max	Definition	Source
Dependent variables:							
Private credit/GDP	4,522	0.407	0.366	0.001	2.698	% Private credit of GDP	Beck et al.
Bank deposits over GDP	4,532	0.410	0.369	0.001	4.292	% bank deposits of GDP	Beck et al.
Δ gross domestic savings (% of GDP)	3,535	0.064	5.416	-49.93	72.555	change in gross domestic savings (% of GDP)	World Bank
Δ log gross domestic savings	3,323	0.089	0.433	-4.21	3.779	log difference of gross domestic savings (current US$)	World Bank
Δ log household final consumption expenditure	3,465	0.08	0.157	-1.343	1.205	log difference of household final consumption expenditure (current US$)	World Bank
Δ log final consumption expenditure minus household final consumption expenditure	3,080	0.079	0.227	-4.904	5.078	log difference of final consumption expenditure (current US$) minus household final consumption expenditure (current US$)	World Bank
Δ log financial system deposits	3,042	0.112	0.194	-4.432	1.154	log difference of financial system deposits (current US$)	Beck et al.
Deposit rate						IFS line 60L__ZF, deposit rate	IMF
Δ log bank deposits	3,041	0.112	0.194	-4.432	1.154	log difference of bank deposits (current US$)	Beck et al.
Δ log offshore bank deposits	1,280	0.111	0.314	-2.208	3.046	log difference of offshore bank deposits (current US$)	Beck et al.
Δ log foreign assets (banking institutionsitutions)	2,555	0.129	0.447	-6.425	4.154	log difference of foreign assets (IFS line 21) (current US$)	IMF
Δ log government deposits with central bank	2,482	0.102	1.037	-7.613	28.065	log difference of central government deposits with cent (current US$)ral bank (IFS line 16D)	IMF
Δ log government deposits with banks	2,420	0.091	0.546	-4.339	7.686	log difference of central government deposits with banks (IFS line 26D__ZF) (current US$)	IMF
Δ log private credit	3,033	0.111	0.224	-1.864	2.041	log difference of private credit (current US$)	World Bank
Δ log claims on central government	2,592	0.112	0.694	-10.04	8.794	log difference of claims on central government (IFS line 22A) (current US$)	IMF
Δ log claims on state and local governments	907	0.080	1.050	-6.630	8.109	log difference of claims on state and local governments (IFS line 22B) (current US$)	IMF
Δ log claims on public non-financial corp.	1,198	0.076	0.715	-5.807	8.881	log difference of claims on public non-financial corporations (IFS line 22C) (current US$)	IMF
Δ net foreign borrowing over GDP ((liabilities-assets)/GDP)	3,111	0	0.062	-1.822	1.588	change in net foreign borrowing over GDP (IFS line 26C (liabilities) minus 21 (assets) divided by GDP)	IMF
Δ log total assets	5,684	0.127	0.123	-1.541	2.583	log difference of total assets in millions (current US$). Equals the sum of Portfolio equity assets (stock), FDI assets (stock), Debt assets (stock), financial derivatives (assets), and FX Reserves minus gold.	updated and extended version of dataset constructed by Lane and Milesi-Ferretti (2007)
Δ log total liabilities	5,691	0.120	0.103	-1.242	4.231	log difference of total liabilities in millions (current US$)	idem
Δ log gross debt liabilities	5,723	0.111	0.088	-1.668	10.206	log difference of debt liabilities in millions (current US$)	idem
Δ log Bank's total deposits and short-term borrowing	9,906	0.0939	0.4605	-7.29	7.25	log difference of Total Customer Deposits + Other Deposits and Short-term Borrowings (data2031+data2033) (current US$)	Bankscope
Δ log Bank's gross loans	9,874	0.1059	0.4539	-7.861	6.3968	log difference of gross loans (data2001) (current US$)	Bankscope
Δ Bank's nonperfoming loans to total gross loans (%)	508	-1.096	-0.5	-25	20.1	log difference of bank nonperfoming loans to total gross loans (%)	World Bank
Independent variables:							
Resource rents over GDP	4,522	0.054	0.123	0	1.165	% Total metals and mineral rents of GDP. production * (price-unit production cost) of oil, gas, coal, bauxite, copper, lead, nickel, phosphate, tin, zinc, gold, silver, iron ore. Missing observations are counted as zero.	World Bank
log GDP per capita	4,522	7.713	1.575	4.4	10.936	log GDP per capita (current US$)	World Bank
Institutions	1,680	24.614	6.016	5	38.29	Sum of corruption, rule of law, government stability, investment profile and bureacratic quality	ICRG
Δ log resource price index	3,042	0.077	0.237	-0.929	1.584	log difference in Paasche price index of metals and minerals, with base year 1970	World Bank

Δ log resource quantity index	3,042	0.028	0.364	-5.118	4.886	log difference in metals and minerals revenue divided by Paasche price index of metals and minerals, with base year 1970	World Bank
Δ log resource unit cost index	3,042	0.058	0.12	-0.758	1.701	log difference in Paasche unit production cost index of metals and minerals, with base year 1970	World Bank
Financial development	3,042	43.7	38.923	0.683	231.08	private credit over GDP	World Bank
rate of inflation	3,042	0.116	0.233	-0.297	4.823	rate of inflation (based on GDP deflator)	World Bank
Δ log GDP	3,042	0.085	0.135	-0.968	1.136	log difference of GDP (current US$)	World Bank
Δ log non-mineral GDP						log difference of GDP net of ores, metals and fuel exports (current US$)	World Bank
Δ log real exchange rate	6,893	0.0407	0.0414	-1.116	2.541	log difference of the price level of GDP, price level of USA GDP in 2005=1	Feenstra et al. (2015)
Bank's log total assets	9,906	8.0741	2.4247	-0.087	17.966	log total assets (data2025) (current US$)	Bankscope
Bank's Net Loans / Tot Assets	9,906	50.092	20.218	-0.26	99.95	Net Loans / Tot Assets (Net Loans / Tot Assets)	Bankscope
Δ log global deposits	9,906	0.1221	0.1029	-0.012	0.4894	log difference of global sum of deposits (data2025) (current US$)	Bankscope
Bank foreign owned	8,076	0.2697	0.4438	0	1	=1 if bank is foreign owned in year t	Claessen and van Horen
Bank's non-interest share of total operating income	9,906	-0.686	15.083	-407.8	854	non-interest share of total operating income ((data6640-data6510)/data6640)	Bankscope
Interest rate controls (t-1)	2,638	1.782	2	0	3	0 to 3 in integer steps from fully repressed to fully liberalized based on government control over deposit and lending rates.	Abiad et al.
International capital controls (t-1)	2,638	1.671	2	0	3	0 to 3 in integer steps from fully repressed to fully liberalized based on Is the exchange rate system unified?, Does a country set restrictions on capital inflow?, Does a country set restrictions on capital outflow?	Abiad et al.
Financial reform index [0,1] (t-1)	2,638	0.494	0.512	0	1	0 to 1, continuous. Based on sum of indices of liberalization in Banking Sector Supervision, Securities Markets, Privatization, Capital Account Transactions, Banking Sector Entry, Interest Rate Liberalization, Aggregate Credit Ceilings, Credit Controls and Reserve Requirements, normalized to [0,1]	Abiad et al.
Credit controls (t-1)	2,638	1.602	1.5	0	3	0 to 3 in steps of 0.25 to fully liberalized based on Are reserve requirements restrictive?, Are there minimum amounts of credit that must be channeled to certain sectors?, Are there any credits supplied to certain sectors at subsidized rates?	Abiad et al.
Credit ceilings (t-1)	1,567	0.642	1	0	1	0 or 1 to fully liberalized based on whether restrictions exist on the expansion of bank credit	Abiad et al.
Directed credit (t-1)	2,638	1.552	1	0	3	0 to 3 in integer to fully liberalized based on Are there minimum amounts of credit that must be channeled to certain sectors?, Are there any credits supplied to certain sectors at subsidized rates?	Abiad et al.
Δ log hydrocarbon price index	2,416	0.086	0.246	-0.675	1.647	log difference in Paasche price index of hydrocarbons, with base year 1970	World Bank
Δ log hydrocarbon quantity index	2,416	0.036	0.393	-6.942	3.823	log difference in metals and minerals revenu divided by Paasche price index of hydrocarbons, with base year 1970	World Bank
Δ log hydrocarbon unit cost index	2,416	0.077	0.15	-0.924	1.598	log difference in Paasche unit production cost index of hydrocarbons, with base year 1970	World Bank
Domestic state ownership share	2,180	0.242	0.328	0	1	the country-average of the share of mines that is owned by domestic state-owned companies	Gu (2014)
Domestic private ownership share	2,180	0.269	0.336	0	1	the country-average of the share of mines that is owned by domestic private companies	Gu (2014)
Foreign state ownership share	2,180	0.013	0.067	0	0.55	the country-average of the share of mines that is owned by foreign state-owned companies	Gu (2014)
Foreign private ownership share	2,180	0.477	0.367	0	1	the country-average of the share of mines that is owned by foreign private companies	Gu (2014)
Giant oil and gas field discovery dummy	2,784	0.048	0.214	0	1	=1 if a giant oil or gas field is discovered in year t of at least 500 million of barrels of oil equivalent (MMBOE) ultimately recoverable reserves.	Horn (2003)
log giant oil and gas field ultimately recoverable reserves discov	2,784	0.342	1.531	0	9.486	log of sum of total MMBOE ultimately recoverable reserves discovered in year t	Horn (2003)

Sovereign wealth fund dummy	3,042	0.068	0.252	0	1	=1 if country has a commodity based sovereign wealth fund in year t. http://www.swfinstitute.org/fund-rankings/	SWF Institute

Notes: This table gives the definition, source and unit for each of the variables used in the analysis.

Table A2
Growth in natural resource rents and its components

	Δ Total mineral rents
	[1]
Δ log mineral price index	1.174***
	(0.042)
Δ log mineral quantity index	0.555***
	(0.058)
Δ log mineral unit cost index	-0.297**
	(0.119)
Country FE	Yes
Observations	4,603
Number of countries	146
R-squared	0.578

Notes: This table shows an OLS regressions to estimate the relationship between growth in total mineral rents and the separate effect of shocks to prices, quantities and unit costs. An F-test rejects that the sum of the coefficients is different from 1. Robust standard errors are clustered by country shown in parentheses. A constant and country fixed effects are included but not shown. ***, **, * correspond to the 1%, 5%, and 10% level of significance, respectively.

Table A3
Natural resource-rich countries have small financial sectors

	Private credit/GDP		Bank deposits over GDP	Private credit over bank deposits
	[1]	[2]	[3]	[4]
Total mineral rents over GDP (t-1)	-0.643***	-0.697***	-0.397***	-1.204***
	(0.111)	(0.159)	(0.091)	(0.396)
log GDP per capita (t-1)	0.314***	0.412***	0.223***	0.384***
	(0.044)	(0.061)	(0.048)	(0.081)
Institutions (t-1)		0.001		
		(0.002)		
Country FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	4,446	2,465	4,454	4,439
Number of countries	156	122	156	156
Years	1971-2008	1985-2008	1971-2008	1971-2008
R-squared	0.367	0.259	0.387	0.093

Notes: This table shows OLS regressions to estimate the correlation between countries' dependence on natural resource production (*Total mineral rents over GDP*) and the size of their financial sector. *Total mineral rents over GDP (t-1)* is the value of mineral production net of extraction costs, where minerals include oil, gas, coal, bauxite, copper, lead, nickel, phosphate, tin, zinc, gold, silver and iron ore. The the size of their financial sector is measured as the volume of private credit over GDP in columns 1 and 2, and as the volume of bank deposits over GDP in column 3. *Institutions* are the sum of sum of corruption, rule of law, government stability, investment profile and bureacratic quality. Robust standard errors are clustered by country shown in parentheses. A constant, country and year fixed effects are included but not shown. ***, **, * correspond to the 1%, 5%, and 10% level of significance, respectively.

Table A4
The effect of natural resource windfalls on macroeconomic aggregates

	Δ log gross total foreign assets	Δ log gross domestic savings	Δ log household final consumption expenditure	Δ log non-household final consumption expenditure	Δ log central government consumption expenditure
	[1]	[2]	[3]	[4]	[5]
Δ log mineral price index	0.125***	0.387***	0.097***	0.097***	0.100***
	(0.032)	(0.049)	(0.011)	(0.018)	(0.015)
Δ log mineral quantity index	0.040***	0.047	0.010	0.032**	0.020**
	(0.012)	(0.037)	(0.007)	(0.016)	(0.009)
Δ log mineral unit cost index	0.003	0.065	0.193***	0.289***	0.193***
	(0.045)	(0.052)	(0.032)	(0.067)	(0.033)
Lagged dependent variable	-0.053	-0.197***	0.066**	-0.125	0.068**
	(0.043)	(0.036)	(0.026)	(0.134)	(0.028)
Rate of inflation	0.021	-0.026	-0.034**	-0.131***	-0.096***
	(0.017)	(0.032)	(0.016)	(0.032)	(0.023)
log GDP per capita (t-1)	0.027	-0.077***	0.025	0.024	0.024
	(0.023)	(0.028)	(0.017)	(0.025)	(0.019)
Financial development (t-1)	-0.001***	-0.000*	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Δ log real exchange rate	0.269***				
	(0.041)				
Country FE	Yes	Yes	Yes	Yes	Yes
Observations	3,323	3,265	3,446	3,064	3,495
Number of countries	126	130	131	110	132
R-squared	0.060	0.088	0.083	0.073	0.091

Notes: This table shows OLS regressions to estimate the effect of unexpected and exogenous windfall in natural resource revenue based on world prices (Δ *log mineral price index*) on aggregate savings, investment and consumption behavior. Robust standard errors are clustered by country shown in parentheses. A constant and country fixed effects are included but not shown. ***, **, * correspond to the 1%, 5%, and 10% level of significance, respectively.

Table A5
Effect on deposits: balanced sample

Dependent variable →	Δ log financial system deposits	Δ log GDP	Rate of inflation	Δ log financial system deposits	Δ log GDP	Rate of inflation
Method →	*SUR SVAR ordering: no contemporaneous effect of deposits on GDP, on inflation*			*SUR SVAR ordering: no contemporaneous effect of deposits on GDP, on inflation*		
	[1a]	[1b]	[1c]	[2a]	[2b]	[2c]
Δ log mineral price index	-0.035**	0.144***	0.073***	-0.048***	0.155***	0.086***
	(0.015)	(0.032)	(0.020)	(0.016)	(0.034)	(0.022)
Δ log mineral price index (t-1)	0.020	0.020	-0.030			
	(0.018)	(0.030)	(0.024)			
Δ log mineral price index (t-2)	0.022	0.011	-0.006			
	(0.020)	(0.022)	(0.013)			
Δ log mineral price index (t-3)	0.005	0.013	0.006			
	(0.012)	(0.019)	(0.020)			
Δ log mineral price index (t-4)	0.021	-0.005	-0.016			
	(0.014)	(0.020)	(0.011)			
Lagged dependent variable	0.362***	0.031	0.520***	0.342***	0.082	0.497***
	(0.033)	(0.074)	(0.072)	(0.042)	(0.064)	(0.071)
Rate of inflation	-0.468***	0.008		-0.455***	-0.032	
	(0.053)	(0.167)		(0.054)	(0.169)	
Rate of inflation (t-1)	0.311***	0.155		0.273***	0.207	
	(0.043)	(0.134)		(0.053)	(0.127)	
Δ log GDP	0.897***		0	0.894***		0
	(0.038)			(0.034)		
Δ log GDP (t-1)	-0.197***		-0.125**	-0.202***		-0.087
	(0.050)		(0.060)	(0.051)		(0.064)
Δ log financial system deposits		0	0		0	0
Δ log financial system deposits (t-1)		0.119***	0.041		0.064*	0.024
		(0.040)	(0.038)		(0.032)	(0.031)
Financial development (t-5)	-0.000***	-0.000**	-0.000***	-0.000***	-0.000*	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Controls for quantity and unit cost index,		Yes			Yes	
Country FE		Yes			Yes	
Observations		1,054		868	868	868
Number of countries		31			31	
Years		1975-2008			1976-2003	
R-squared	0.739	0.190	0.308	0.725	0.162	0.283

Notes: This table shows SVAR estimates to estimate the effect of unexpected and exogenous windfall in natural resource revenue based on world prices (Δ *log mineral price index*) on financial system deposits. The SVARs assume the following ordering: no contemporaneous effect of lending on deposits, on GDP, on inflation. Estimates based on seemingly unrelated regression, where the Breusch-Pagan test rejects the H0 of independence of the three equations. See Section 3 for more details. By controlling for total GDP growth we estimate the differential effect of a windfall on countries that experience similar booms or busts but who experience them for different reasons. Robust standard errors in perentheses are block (country) bootstrapped and estimates are obtained by seamingly unrelated regression. A constant and country fixed effects are included but not shown. ***, **, * correspond to the 1%, 5%, and 10% level of significance, respectively.
Included countries are: Australia, Canada, Denmark, Dominican Republic, Ecuador, Egypt, Finland, Gabon, Greece, Guatemala, Honduras, India, Ireland, Italy, Jamaica Japan, Korea, Malaysia, Mexico, New Zealand, Nigeria, Pakistan, Philippines, Saudi Arabia, Spain, Sweden, Thailand, Trinidad and Tobago, United Kingdom, United States, and Venezuela.

Table A6
Effect on private credit: SVAR with different ordering

Dependent variable →	Δ log financial system deposits	Δ log private credit	Δ log GDP	Rate of inflation
Method →	*SUR* *SVAR ordering: no contemporaneous effect of deposits on lending, on GDP, on inflation*			
	[1a]	[1b]	[1c]	[1d]
Δ log mineral price index	-0.033**	-0.022	0.147***	0.061***
	(0.014)	(0.017)	(0.019)	(0.013)
Δ log mineral price index (t-1)	0.031***	0.008	0.036**	-0.013
	(0.012)	(0.019)	(0.018)	(0.014)
Δ log mineral price index (t-2)	0.013	0.032*	0.022	-0.008
	(0.015)	(0.019)	(0.017)	(0.010)
Δ log mineral price index (t-3)	0.016	-0.012	0.032**	-0.001
	(0.011)	(0.013)	(0.013)	(0.014)
Δ log mineral price index (t-4)	0.004	0.031**	0.006	0.000
	(0.011)	(0.015)	(0.014)	(0.008)
Lagged dependent variable	0.224***	0.038	0.111**	0.577***
	(0.065)	(0.035)	(0.054)	(0.044)
Rate of inflation	-0.189***	-0.367***	-0.002	
	(0.055)	(0.081)	(0.100)	
Rate of inflation (t-1)	0.177***	0.109	0.035	
	(0.040)	(0.079)	(0.098)	
Δ log GDP	0.665***	0.981***		0
	(0.060)	(0.037)		
Δ log GDP (t-1)	-0.261***	0.012		-0.297***
	(0.050)	(0.066)		(0.045)
Δ log financial system deposits		0	0	0
Δ log financial system deposits (t-1)		0.152***	0.059**	-0.043
		(0.057)	(0.029)	(0.030)
Δ log private credit	0.207***		0	
	(0.045)			
Δ log private credit (t-1)	0.094***		-0.006	0.148***
	(0.023)		(0.019)	(0.021)
Financial development (t-5)	-0.000	-0.001***	-0.000***	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Controls for quantity and unit cost	Yes			
Country FE	Yes			
Observations	2,541			
Number of countries	115			
Years	1975-2008			
R-squared	0.515	0.526	0.161	0.529

Notes: This table shows SVAR estimates of the effect of unexpected and exogenous windfall in natural resource revenue based on world prices *(Δ log mineral price index*) on financial system deposits and credit. The SVAR assumes no contemporaneous effect of deposits, which has no immediate effetc on lending, which in turn does not affect GDP contemporaneously, which in turn does not affect inflation immediately. Estimated are based on seemingly unrelated regression, where the Breusch-Pagan test rejects the H0 of independence of the four equations. See Section 3 for more details. By controlling for total GDP growth we estimate the differential effect of a windfall on countries that experience similar booms or busts but who experience them for different reasons. Robust standard errors in perentheses are block (country) bootstrapped and estimates are obtained by seamingly unrelated regression. A constant and country fixed effects are included but not shown. ***, **, * correspond to the 1%, 5%, and 10% level

Table A7
Heterogeneous effects: relative decline of deposits in financially restrictive countries

	Dependent variable →	Δ log financial system deposits							
	Interaction variable →	*rule of law e[0,6]*	*Degree of liberalization of e[0,3]:*					*financial reform index e[0,1]*	
			credit controls	*directed credit*	*interest rate controls*	*ownership of banks (privatization*	*capital account transactions*		
		[1]	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ log mineral price index		0.009	-0.047**	-0.051**	-0.053**	-0.057***	-0.052**	-0.067***	-0.004
		(0.065)	(0.023)	(0.022)	(0.021)	(0.016)	(0.024)	(0.023)	(0.043)
Δ log mineral price index (t-1)		0.019	0.015	0.015	-0.002	-0.003	0.023	-0.003	-0.005
		(0.063)	(0.025)	(0.023)	(0.019)	(0.019)	(0.022)	(0.023)	(0.045)
Δ log mineral price index (t-2)		-0.083	0.054	0.052	0.025	0.007	0.027	0.036	-0.026
		(0.093)	(0.045)	(0.043)	(0.023)	(0.015)	(0.037)	(0.038)	(0.052)
Δ log mineral price index (t-3)		-0.042	-0.007	-0.007	-0.004	-0.009	-0.014	-0.014	-0.023
		(0.089)	(0.021)	(0.021)	(0.015)	(0.014)	(0.015)	(0.019)	(0.030)
Direct effect of interaction variable		0.000	0.003	0.003	0.006***	0.006*	0.005	0.019	0.011
		(0.004)	(0.003)	(0.003)	(0.002)	(0.003)	(0.004)	(0.012)	(0.020)
Δ log mineral price index	* Interaction variable (t-4)	-0.005	0.012	0.015	0.015*	0.021***	0.014	0.077**	0.100*
		(0.013)	(0.010)	(0.010)	(0.009)	(0.007)	(0.011)	(0.033)	(0.055)
Δ log mineral price index (t-1)	* Interaction variable (t-4)	0.001	0.007	0.007	0.012	0.019*	0.001	0.051	0.127*
		(0.015)	(0.013)	(0.012)	(0.009)	(0.011)	(0.011)	(0.040)	(0.066)
Δ log mineral price index (t-2)	* Interaction variable (t-4)	0.025	-0.015	-0.014	0.001	0.014	0.001	-0.014	0.093
		(0.019)	(0.019)	(0.018)	(0.009)	(0.008)	(0.016)	(0.050)	(0.073)
Δ log mineral price index (t-3)	* Interaction variable (t-4)	0.010	0.004	0.004	0.002	0.006	0.008	0.025	0.121**
		(0.019)	(0.011)	(0.010)	(0.007)	(0.008)	(0.007)	(0.030)	(0.046)
Lagged dependent variable		0.343***	0.325***	0.324***	0.322***	0.324***	0.330***	0.323***	0.294***
		(0.028)	(0.035)	(0.035)	(0.035)	(0.034)	(0.033)	(0.034)	(0.036)
Rate of inflation		-0.293***	-0.227***	-0.226***	-0.223***	-0.228***	-0.225***	-0.224***	-0.033
		(0.075)	(0.064)	(0.064)	(0.063)	(0.064)	(0.065)	(0.063)	(0.053)
Rate of inflation (t-1)		0.154***	0.150**	0.149**	0.151***	0.151***	0.151***	0.150***	
		(0.050)	(0.057)	(0.057)	(0.056)	(0.056)	(0.056)	(0.056)	
Δ log GDP		0.884***	0.920***	0.920***	0.917***	0.914***	0.919***	0.918***	
		(0.039)	(0.030)	(0.030)	(0.029)	(0.030)	(0.029)	(0.030)	
Δ log GDP (t-1)		-0.237***	-0.207***	-0.207***	-0.204***	-0.210***	-0.209***	-0.206***	
		(0.050)	(0.046)	(0.046)	(0.045)	(0.045)	(0.044)	(0.045)	
Financial development (t-4)		-0.000**	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.001***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Controls for quantity and unit cost index, lags 0-s		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations									
Number of countries									
R-squared									

Notes: This table shows OLS regressions to estimate the effect of unexpected and exogenous windfall in natural resource revenue based on world prices (*Δ log mineral price index*) on private credit growth, where we control for various measures of institutions and components of financial sector liberalization, and their interaction with the windfall. Robust standard errors are clustered by country shown in parentheses. A constant and country fixed effects are included but not shown. ***, **, * correspond to the 1%, 5%, and 10% level of significance, respectively.

Table A8
Ownership structure and the marginal effect of a price shock on deposits and lending

Dependent variable →	Δ log financial system deposits	Δ log GDP	Rate of inflation	Δ log private credit	Δ log financial system deposits	Δ log GDP	Rate of inflation
Method →	*SUR SVAR ordering: no contemporaneous effect of deposits on GDP, on inflation*			*SUR SVAR ordering: no contemporaneous effect of lending on deposits on GDP, on inflation*			
	[1a]	[1b]	[1c]	[2a]	[2b]	[2c]	[2d]
Δ log mineral price index	-0.103**	0.265***	0.150***	-0.006	-0.116**	0.284***	0.164***
	(0.049)	(0.075)	(0.050)	(0.043)	(0.053)	(0.072)	(0.052)
Δ log mineral price index * Average domestic private ownership share	0.099*	-0.117	-0.124**	-0.009	0.120*	-0.134*	-0.142**
	(0.058)	(0.084)	(0.054)	(0.049)	(0.063)	(0.078)	(0.057)
Δ log mineral price index * Average foreign state ownership share	-0.068	0.091	-0.270	-0.044	-0.011	-0.030	-0.219
	(0.370)	(0.798)	(0.428)	(0.592)	(0.302)	(0.667)	(0.411)
Δ log mineral price index * Average foreign private ownership share	0.081	-0.175**	-0.088	-0.039	0.093*	-0.198**	-0.105*
	(0.050)	(0.086)	(0.054)	(0.057)	(0.055)	(0.082)	(0.057)
Lagged dependent variable	0.358***	0.106***	0.536***	0.017	0.274***	0.119***	0.569***
	(0.051)	(0.036)	(0.060)	(0.056)	(0.055)	(0.039)	(0.053)
Rate of inflation	-0.240***	-0.031		-0.316***	-0.266***	-0.029	
	(0.059)	(0.042)		(0.119)	(0.064)	(0.046)	
Rate of inflation (t-1)	0.166***	0.059*		0.059	0.201***	0.055	
	(0.058)	(0.036)		(0.087)	(0.058)	(0.038)	
Δ log GDP	0.875***		0	0.780***	0.877***		0
	(0.026)			(0.122)	(0.027)		
Δ log GDP (t-1)	-0.252***		-0.264***	0.086	-0.268***		-0.256***
	(0.049)		(0.061)	(0.089)	(0.048)		(0.085)
Δ log financial system deposits		0	0	0.224*		0	0
				(0.131)			
Δ log financial system deposits (t-1)		0.061***	0.101**	0.104		0.060**	-0.072
		(0.020)	(0.048)	(0.072)		(0.025)	(0.068)
Δ log private credit					0	0	0
Δ log priate credit (t-1)					0.095**	-0.009	0.150*
					(0.038)	(0.020)	(0.080)
Financial development (t-2)	-0.000***	-0.000***	-0.000**	-0.001***	-0.000***	-0.000***	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Controls for quantity and unit cost index, lags 0-s		Yes			Yes		
Country FE		Yes			Yes		
Observations	2,180	2,180	2,180	2,118	2,118	2,118	2,118
Number of countries		80			80		
Years		1971-2008			1971-2008		
R-squared	0.462	0.176	0.500	0.567	0.463	0.186	0.533

Notes: This table shows SVAR estimates to estimate the effect of unexpected and exogenous windfall in natural resource revenue based on world prices *(Δ log mineral price index*) on financial system deposits. The SVARs assume the following ordering: no contemporaneous effect of (lending on) deposits, on GDP, on inflation. Estimates based on seemingly unrelated regression, where the Breusch-Pagan test rejects the H0 of independence of the three equations. See Section 3 for more details. By controlling for total GDP growth we estimate the differential effect of a windfall on countries that experience similar booms or busts but who experience them for different reasons. Robust standard errors in perentheses are block (country) bootstrapped and estimates are obtained by seamingly unrelated regression. A constant and country fixed effects are included but not shown. ***, **, * correspond to the 1%, 5%, and 10% level of significance, respectively.
BIC and AIC lag selection criteria concluded that no lags of the price index should be included. The price index is interacted with proxies for the degree of private versus state and foreign versus domestic ownership of mineral producing sites