Journal of Comparative Economics xxx (xxxx) xxx

Contents lists available at ScienceDirect

Journal of Comparative Economics

journal homepage: www.elsevier.com/locate/jce

Firms' access to finance in resource-based countries and the financial resource curse

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ARTICLE INFO

JEL codes:
E44
G20
O13
O16
F30

Keywords:
Financial resource curse
Firms' access to finance
Resource rents
Financial development

ABSTRACT

Using a panel of more than 156 000 firms surveyed in 140 countries over the 2003–2019 period, this paper addresses the issue of the financial resource curse through a new channel that thus far has not been accounted for in the literature, namely, firms' access to finance. To do this, our econometric analysis is based on an original approach combining microeconomic level data on firms' access to finance and macroeconomic level data on countries' level of natural resource rents, with a focus on energy rents (oil, gas and coal). By doing so, we are able to investigate in a more precise and disaggregated way the mechanisms explaining why resource-based countries are associated with less developed financial systems. Using panel regressions, we find significant and robust evidence that firms operating in countries characterized by a high level of natural resource rents suffer from less access to external financing. Moreover, depending on two important transmission channels, namely, the quality of institutions and the extent of supply constraints, we find heterogeneities in the relationship between firms' access to finance and countries' level of natural resource rents. In addition, we show that the countries' level of natural resource rents has a significant and negative correlation with firms' access to finance only for firms that do not operate in the natural resource sector. This provides new evidence of the Dutch disease phenomenon, since the lack of firms' financing can also be an explanation for the atrophy of sectors unrelated to the natural resource sector.

1. Introduction

A vast body of literature has tried to answer whether natural resources are a "curse" or a "blessing" (van der Ploeg, 2011; Frankel, 2012). This question is even more important and topical in the current period regarding the recent surge in commodity prices – especially oil and gas ones – due to the Covid-19 crisis, the Ukraine-Russian war and the ongoing energy and ecological transition process engaged by most of the countries in the world. If the negative consequences of surging commodity prices for resources and energy importers are well debated, it is less the case for exporters. However, the question about the impact of such changes in the so-called resource-based countries is also crucial. Indeed, energy and oil exports are expected to strongly decrease in a near future, leading to less windfalls but increasing volatility for resource-based countries. Less windfalls might relax the overweight of the natural resource sector, but at the same time, less revenues imply a deep structural change for resource-based economies and can hamper

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https://doi.org/10.1016/j.jce.2023.04.004
Received 7 March 2022; Received in revised form 16 April 2023; Accepted 24 April 2023

financing access for firms. More uncertainty and volatility might also occur and reinforce constraints on firm's access to finance if the resource revenues continue to be allocated in an inefficient manner. It is difficult to forecast what the net effects of the energy transition will be from a resource curse perspective, but we can expect that they will be conditional on the nature of the resources – energy or minerals? – and to the attitude of countries facing the energy transition. As a result, the question about the relationship between natural resources and economic development is still active and the role of the financial sector is a crucial channel. Financial instability, limited credit supply and/or presence of constraints in the firm's access to finance could hamper the development of resource-based countries.

Over the past decade, there has been a renewal in the resource curse literature (Badeeb et al., 2017), with an emphasis on the role played by the financial sector, leading to the so-called "financial resource curse". According to the seminal work of Beck (2011), the financial resource curse can be viewed as a financial intermediation problem. Beck (2011) explains that banks in resource-based countries are better capitalized and more profitable but distribute fewer loans to firms. This results in a less developed financial system in resource-based countries, which could be an explanation to the resource curse itself. In other words, countries with less developed financial system are associated to lower economic growth rates ceteris paribus.

1.1. Financial resource curse channels

Thus, following Beck (2011)'s pioneering work, several authors have started to empirically investigate how this financial resource curse occurs in the financial system and what its characteristics are. Overall, thus far, the literature has emphasized three main channels explaining the finance resource curse: the quality of institutions, the fragility of the banking system, and some supply constraints.

As for institutions, Bhattacharyya and Holder (2014) find that the abundance of natural resources only hinders financial development when institutions are weak. Indeed, going from the works of La Porta et al. (1997, 1998), Acemoglu and Johnson (2005) and Djankov et al. (2007), they show that when contracts are not respected and there is corruption (in the form of wage embezzlement), citizens have little savings to invest through banks. This leads to a low level of financial intermediation, which in turn hampers financial development. In the same vein, several authors, stress the role played by the quality of institutions in the occurrence of a financial resource curse. Indeed, Kassouri et al. (2020), Beck and Poelhekke (2023), and Dwumfour and Ntow-Gyamfi (2018) find that the financial resource curse (resulting in low financial development) occurs when regulatory institutions are weak. Besides, Kinda et al. (2016), Mlachilda and Ouedraogo (2019), as well as Jarrett et al. (2019) corroborate this thesis, showing that countries with stronger institutions are less prone to (severe) financial crises related to commodity price shocks. Therefore, the proper development of their financial system mitigates the resource curse occurrence (Chang et al., 2022).

Secondly, some authors stress the impact of commodity price shocks in weakening the financial system of resource-based countries. As explained by Deaton (1999); Dehn (2000); Brückner and Ciccone (2010) and Blanchard and Gali (2010), negative shocks on commodity prices lead to a fall in GDP growth, resulting in business failures and an increase in unemployment. This in turn weakens the solvability of the banking system since banks suffer from a surge in nonperforming loans on their balance sheets which ultimately lead to a contraction in the credit supply (Bems and Carvalho, 2011; Cherif and Hasanov, 2012). Following these studies, several authors have brought empirical evidence of the link between commodity price fluctuations and banks'risks indicators and even banking crises (Eberhardt and Presbitero, 2021; Dwumfour and Ntow-Gyamfi, 2018; Beck and Poelhekke, 2023).

Thirdly, supply constraints may explain the financial resource curse. Indeed, the literature mentions that in resource-based countries, the levels of savings and investment could be very low (Atkinson and Hamilton, 2003; Van der Ploeg, 2010; Davis and Tilton, 2005). Especially, resource windfalls are diverted towards the smoothing of government and household consumption expenditures (Arezki and van der Ploeg, 2011; Venables, 2016). Again, resource windfalls are mainly allocated to the natural resources sector and do not necessarily pass through the financial system, limiting its ability to provide external sources of financing to the economy. This, in the end, leads to a lower level of financial development (Gylfasson, 2004; Beck, 2011; Bhattacharyya and Holder, 2014). Furthermore, Sarmidi et al., (2012), Gylfasson (2001) and Ebeke et al., (2015) emphasize the negative impact of massive financial windfalls coming from the exploitation of natural resources, since they can reduce individuals' incentives to acquire a high level of education or to search for excellence in work. This ultimately results in lower social capital and less well-trained human capital, which in turn penalizes financial institutions and may explain the lower levels of financial development observed in resource-based economies.

1.2. From a supply to a demand-side perspective of the financial resource curse

One limitation of previous studies is that they have considered the financial resource curse only through the lens of the banking sector. Another limitation is that they have been conducted mainly at a macroeconomic level. To the best of our knowledge, few articles have recently used microeconomic data to study the financial resource curse. In addition, these papers focus on bank-level data and are based only on a subset of key indicators: banks' liquidity, efficiency or credit supply (Beck, 2011; Beck and Poelhekke, 2023; Adetutu et al., 2020). The financial resource curse may certainly be perceived at the banking system level, which is associated with poor financial intermediation. However, the financial resource curse may also be considered at the firms' level, since in resource-based countries, firms have difficulties in accessing bank financing, which in turn would negatively impact their ability to invest and expand their business. As a result, firms operating in countries subject to the financial resource curse would have access to fewer external sources of funding to finance their investment projects, especially less bank credit. Moreover, since resource-based economies are much more fragile, due to their exposure to commodity-price volatility, the risk premium that banks charge on their credit to firms is

much higher, which reduces credit distribution and causes more severe credit rationing issues. Finally, as Beck (2011) and Beck & Poelhekke (2023) previously highlighted, credit rationing to the private sector is increased through the strong involvement of the government in investment in resource-based countries.

Therefore, one important implication of the limitations of the existing literature we surveyed above concerns the role played by firms' access to finance in resource-based economies to explain the emergence of a financial resource curse phenomenon. In other words, how does the abundance of natural resources at the macroeconomic level in resource-based countries adversely influences firms' access to finance at a microeconomic level? To date, this firms' access to finance channel has not been investigated to explain the financial resource curse. Moreover, since the financing of firms and their activity are at the heart of the growth process, this research question also aims to provide further explanations of the Dutch disease phenomenon, i.e., a resource curse coming from a decline in domestic competitiveness. Indeed, the lack of firms' financing can also represent an explanation for the atrophy of sectors unrelated to the natural resource sector.

1.3. Highlighting a new firms' access to finance channel

In this paper, our goal is therefore to assess whether firms operating in countries characterized by a high level of natural resource rents suffer from less access to external financing. Hence, we switch from the supply-side view of the financial resource curse previously adopted in the literature to an original demand side perspective. By doing so, we aim to test a new microeconomic channel, namely, firms' access to finance, which could explain why resource-based countries are associated with less developed financial systems. To do this, we develop an original approach combining microeconomic level data on firms' access to finance and macroeconomic level data on countries' level of natural resource rents for more than 156 000 firms surveyed in 140 countries over the 2003–2019 period. Microeconomic level data on firms' access to finance are based on the World Bank's Enterprise Surveys database, which includes detailed information on a large panel of firms surveyed all around the world. Macroeconomic level data on countries' level of natural resource rents come from the World Bank's World Development Indicators database. Our baseline estimates primarily focus on energy-abundant countries, due to their prominent role in explaining the financial resource curse and because of their specific economic features (high volatility of energy resources, which is at the heart of the resource curse, see Frankel, 2012). This choice also enables us to remain consistent with the previous empirical literature on the financial resource curse, since energy rent countries are the most concerned with this issue (see Nigeria's famous example by Sala-i-Martin and Subramanian, 2003). We thus hypothesize that focusing on energy rent countries allows for a more precise identification of the drivers explaining the financial resource curse. However, for robustness checks, we also account for other types of natural resource rents, such as mineral rents.

1.4. A new micro-macro dataset with resource and non-resource-based countries

Contrary to most of the previous studies that investigated the financial resource curse from a macroeconomic perspective only, using aggregated indicators of financial development such as *banks' credit to the private sector/GDP*, our approach combines both microeconomic and macroeconomic level data. This enables us to investigate the mechanisms that explain why resource-based countries are associated with less developed financial systems in a more precise and disaggregated way. This paper thus contributes to the existing literature by focusing on the firms' access to finance channel using both microeconomic and macroeconomic data. In terms of sample composition, our empirical approach is in line with Bhattacharrya and Hodler (2014). Indeed, unlike most of the papers, which only focus on samples of resource-based countries, we use a large sample of both resource-based and non-resource-based countries to limit sample selection bias issues. In this way, we assess the relationship between countries' level of natural resource rents and firms' access to finance in resource-based economies while controlling for the counterfactual dynamics in firms' access to finance in non-resource-based economies. Therefore, this approach helps us better identify how the financial resource curse is associated with more constraints on firms' access to finance in resource-based economies.

1.5. Main results and contribution

Based on panel fixed-effects regressions, our results are consistent with a financial resource curse hypothesis and thus corroborate, at a firm level from a new demand-side perspective, the results obtained thus far in the empirical literature at a macroeconomic level. Indeed, we find significant and robust evidence that firms operating in countries characterized by a high level of natural resource rents suffer from less access to external financing. This result is robust to a broad range of alternative specifications, such as considering firm-level data and sector-level data, accounting for country, time, sector and regional fixed effects, including a large number of microeconomic and macroeconomic controls, using alternative measures of firms' access to finance and resource rents, accounting for outliers and alternative sample compositions, as well as using instrumental (IV) panel regressions to explicitly account for endogeneity issues. All in all, our analysis has carefully considered several potential sources of bias associated with our baseline estimates, such as, omitted variables, simultaneity, measurement errors, sample selection and outliers. We also outline heterogeneities related to the effects of the quality of institutions and the extent of supply constraints. Furthermore, we show that the countries' level of natural resource rents has a significant and negative correlation with firms' access to finance only for firms that do not operate in the natural resource sector. This provides new evidence of the Dutch disease phenomenon, since the lack of firms' financing can also be an explanation for the atrophy of sectors unrelated to the natural resource sector.

Overall, the value added of this paper regarding the previous financial resource curse literature can be summarized as follows: by building a new micro-macro database with more than 156 000 firms, we offer a new disaggregated and more precise analysis of the

financial resource curse channels and switch from a '*supply side*' approach based on the banking sector to a '*demand side*' one based on firms' access to finance. We thus outline the financial constraints experienced by firms in terms of access to external financing in resources-based countries, especially for firms that do not belong to the natural resources sectors. A channel that has not been yet explored in the previous literature. This approach is even more relevant since it enables us to make a bridge between the *finance resource curse* and the broader *Dutch disease* issue. Indeed, the lack of external financing in resource-based countries could explain the atrophy of sectors unrelated to the natural resource sector.

The rest of the paper is organized as follows. Sections 2 and 3 describe the data and the econometric methodology. Section 4 presents our main results. Section 5 checks the robustness of our findings. Section 6 discusses potential sources of heterogeneity in the relationship between firms' access to finance and countries' level of resource rents. Section 7 accounts for some potential transmission channels that could explain our results, and Section 8 concludes the paper.

2. Data

2.1. Construction of the micro-macro dataset

Our study addresses the issue of the financial resource curse based on an original approach combining microeconomic level data on firms' access to finance and macroeconomic level data on countries' level of natural resource rents, with a focus on energy rents (oil, gas and coal rents). As a result, we build a dataset that matches firms' characteristics at a microeconomic level from the World Bank's Enterprise Surveys (WBES) database, with data at a macroeconomic level on countries' level of natural resource rents from the World Bank's World Development Indicators (WDI) database. To better identify how the financial resource curse is associated with more constraints on firms' access to finance in resource-based economies, we follow Bhattacharrya and Hodler (2014) and consider a large sample including both resource-based and non-resource-based countries. This allows controlling for the counterfactual dynamics in firms' access to finance in non-resource-based economies.

Five steps were followed to obtain the final dataset. In the first step, we started from the microeconomic level data coming from the WBES database. It includes detailed information on a large panel of firms surveyed all around the world, including resource-based and non-resource-based countries ranging from low to high income levels. The WBES includes different waves of surveys that took place in different pools of countries throughout the world from 2006 to 2020. More precisely, for each country surveyed in a given year, the WBES includes a representative sample of small, medium and large firms operating in the non-agricultural formal private sector. Firms from a large number of sectors are included in these surveys, from basic metal and metal products, chemical products, construction and food to manufacturing, retail, services and textiles, for instance, apart from firms operating in sectors such as public utilities, government services, health care and financial services. Table A2 in the Online Appendix (OA) displays the list of sectors included in the WBES.

Moreover, it is important to note that, despite this database covering the 2006–2020 period, observations at the firm level in a given country are only available for the years where surveys took place in that country. For instance, Argentina was surveyed in 2006, 2010 and 2017. Thus, we have data at the firm level for this country only for these three specific years over the 2006–2020 period. Depending on countries, one to four waves of surveys occurred, which means that we have between one and four years of observations at the firm level for each country in our sample. As a result, data included in the WBES are not panel data observed at an annual frequency over the 2006–2020 period but data observed at specific years depending on the country considered.

In a second step, we matched the countries and years available in the WBES database with the macroeconomic level data on countries' level of natural resource rents extracted from the WDI database. As previously mentioned, due to their prominent role in explaining the financial resource curse and because of their specific economic features, our baseline estimates focus first on energy rent countries (oil, gas and coal rents). This choice also enables us to remain consistent with the empirical literature on the financial resource curse, since energy rent countries are among the most widely used countries to investigate this issue. Therefore, the variables *oil rents/GDP, natural gas rents/GDP* and *coal rents/GDP* have been extracted from the WDI database, and we kept only countries which have at least one year of survey in the WBES. Since these resource rent variables were available only until 2019, this prevented us from accounting for the countries surveyed in 2020 in the WBES. This explains why our sample ends in 2019.

There is a debate about the measurement of natural resources, especially between resource abundance variables measured by total subsoil assets or by proven reserves (see, e.g., Brunnschweiler and Bulte, 2008) and resource dependence variables that consist of computing, in most cases, the primary exports over GDP ratio (see, e.g., Sachs and Warner, 1995; Beck, 2011). Beyond the nature of the proxies, this measurement choice impacts the potential endogeneity of the resource's measures (Badeeb et al., 2017). We decided to consider energy rent data expressed in terms of GDP for three main reasons. First, it enables us to proxy in a relevant way for the economic weight that energy rents represent in each country included in our sample. Second, it allows us to remain consistent with previous empirical studies dealing with the financial resource curse, since energy rent data expressed in terms of GDP are commonly used to assess the amount of resource rents at the country level. Third, these data are available for a large number of countries and periods.

At the end of this second step, the matching procedure between the microeconomic level data from the WBES and the macroeconomic level data from the WDI enabled us to derive a precise list of countries and years to be included in our sample. Table A1 in the OA displays the surveyed countries included in our database, with their years of survey and the number of firms surveyed. It is important to note that due to data availability constraints, some Middle Eastern countries, such as Algeria, Bahrain, Iran, Kuwait, Libya, Oman, Qatar, Saudi Arabia, Syria and the United Arab Emirates, do not appear in our database. These countries were never surveyed and thus are not included in the WBES database. However, some countries from this region, such as Egypt, Iraq and Tunisia,

are included in the WBES, as well as other countries characterized by an economy heavily based on the exploitation of natural resources, such as Venezuela, Brazil and Kazakhstan.

In a third step, to more closely match microeconomic and macroeconomic level data while accounting at the same time for the potential lagged effect of resource rents on firms' access to finance, we define for each country-survey-year observation a four-year window starting the third year preceding the survey (*t-3*) and ending the year of the survey (*t*). In this way, we are able to keep the values of the resource rents variables for the year of each survey (*t*) and the three years preceding each survey (*t-1, t-2* and *t-3*), as well as to compute the average of the resource rents variables over different periods preceding each survey (from *t-3* to *t-1* for instance). With this approach, we can thus merge the microeconomic and macroeconomic level data to investigate, for instance, how the level of resource rents observed in *t-1* impacts firms' access to finance in *t*. Since the first wave of surveys included in the WBES was in 2006, our four-year window entails keeping observations for the resource rents variables back to 2003 for countries that were surveyed in 2006. This explains why our sample covers the 2003–2019 period.

This four-year window around each country-survey-year observation was chosen to avoid overlapping issues as much as possible. Indeed, considering a larger window, such as a six-year window (from *t* to *t-5*), for instance, would entail an overlapping of the time window associated with the surveyed years for many countries. This, in the end, prevents us from clearly identifying the lagged effect of resource rents on firms' access to finance surveyed in a given year. For example, a country such as Colombia was surveyed in 2006, 2010 and 2017. In this case, considering a six-year window would lead to including the survey-year 2006 in the time window associated with the survey-year 2010. This would prevent us from clearly isolating the time window associated with each of these two surveys and the specific level of resource rents associated with each of them.

At the end of this third step, we obtain a database combining microeconomic and macroeconomic level data and covering more than 156 000 firms surveyed in 140 countries over the 2003–2019 period.

After defining the precise structure of our database, the fourth step was dedicated to the choice of the precise variables that we will then use in our econometric analysis to assess firms' access to finance at a microeconomic level and energy rents at a macroeconomic level. Regarding firms' access to finance, we mentioned in Section 1 that one critical factor that enables firms to invest and expand their business activities is to have access to credit granted by financial institutions, especially banks. As a result, since our goal in this paper is to assess whether firms operating in countries characterized by a high level of natural resource rents suffer from less access to external financing, we have to consider a variable that proxies in a relevant way for firms' access to credit. Following Chauvet and Jacolin (2017), the variable in the WBES that is the most closely related to this issue is the *Credit line* variable, which takes the value 1 if the surveyed firm declares having a line of credit or a loan from a bank or another financial institution and the value 0 otherwise.[1]

As for resource rents at the country level, we previously mentioned that our paper focuses on energy rents, i.e., oil, gas and coal rents. Therefore, to keep a parsimonious specification of our econometric model, while accounting at the same time for the overall effect of the level of energy rents, regardless of its type, on firms' access to finance, we computed the variable *Energy rents* corresponding to the unweighted sum of *oil rents/GDP, natural gas rents/GDP* and *coal rents/GDP* for a given year. This *Energy rents* variable corresponds to the baseline resource rents variable that we will use in our econometric analysis.[2]

Finally, in a fifth step, to account for financing constraints that are not driven by firms' idiosyncratic characteristics but instead are representative of the precise business sector in which they operate, for each country and year of survey included in our sample, we compute the average value of the *Credit line* variable by business sector. Indeed, as explained by Rajan and Zingales (1998), the business sector in which firms operate represents a structural factor determining their ability to access external sources of financing. By focusing on a measure of firms' access to finance at the sector level, we are thus able to capture more representative financing constraints associated with firms included in the WBES to more clearly assess how the financial resource curse may occur in resource-based countries through the channel of firms' access to finance. As a result, our baseline estimates rely on sector-level data, and the *Credit line* variable corresponds, for each country and year surveyed, to the percentage of firms in each sector that declare having a line of credit or a loan from a bank or another financial institution.[3]

Compared with the original business sector classification from the WBES that includes 52 business sectors, we decided to group some sectors to have a more representative and precise classification of firms depending on their business activity. Indeed, among the 52 sectors included in the WBES, many of them include a very limited number of firms and can easily be grouped with an already existing broader sector category (see Table A2 in the OA). As a result, the sector classification we use for our baseline estimates includes 25 business sectors (see Table A3 in the OA).[4]

To summarize, based on the WBES and WDI databases, we use a sample combining microeconomic and macroeconomic level data that includes more than 156 000 firms operating in 25 business sectors in 140 countries over the 2003–2019 period to estimate how energy rents impact firms' access to finance at the sector level.

2.2. *A first look at the relationship between energy rents and firms' access to finance*

In this section, we provide a preliminary overview of the relationship between firms' access to finance and energy rents variables. In

[1] All the other values of the *Credit line* variable have been treated as missing values, since in the WBES, this variable can also take the value -9 for firms answering, "*Don't Know spontaneously*".

[2] For the sake of robustness, we will consider alternative measures of firms' access to finance and resource rents. See Section V.

[3] In Section V, we show that our baseline results obtained at the sector-level are robust when considering the *Credit line* variable at the firm-level.

[4] In Section V, we show that our baseline results are robust when considering the original 52 business sectors classification from the WBES.

line with the econometric methodology presented in Section 3, we focus on energy rent variables evaluated one year before each surveyed year to account for a potential lagged effect that the level of energy rents may have on firms' access to finance.[5]

In Table 1, we carry out a *t*-test on the equality of means of the *Credit line* variable according to different thresholds values of the *Energy rents* variable. Resource-based countries are those with a value of *Energy rents* greater than or equal to 5% of GDP in the first test and 10% of GDP in the second test. In both cases, countries below those thresholds are considered non-resource-based countries. Whatever the threshold considered, resource-based countries are significantly associated with lower firms' access to credit than non-resource-based countries. This suggests a negative effect of the level of energy rents on firms' access to finance. Another salient point is that the magnitude of this negative effect increases with the energy rents: 27% vs. 39% in the 5% threshold case and 25% vs. 38% in the 10% threshold case.

Fig. 1 graphically confirms the negative correlation between firms' access to finance and energy rents. This suggests that firms' access to finance could represent a potential channel explaining the financial resource curse phenomenon observed in resource-based countries at the microeconomic level.[6] Starting from these preliminary findings, we carry out a more detailed econometric analysis in the rest of the paper.

3. Econometric methodology

3.1. Model specification

As previously explained, our database combined microeconomic level data on firms' access to finance and macroeconomic level data on countries' level of energy rents. It is important to note that due to constraints on data coming from the WBES database, our sample does not include annual frequency observations at the country level, contrary to a usual panel database. Indeed, the number of observations associated with each country in the time dimension corresponds to the number of surveys that took place in this country. For instance, as shown by Table A1 in the OA, the number of surveys listed for Argentina is equal to $T = 3$ (2006, 2010 and 2017). Likewise, for Cameroon, $T = 2$ (surveys in 2009 and 2016), and for Brazil, $T = 1$ (survey in 2009). Thus, the number of available observations in the time dimension is not the same across countries, and the duration between two observations is heterogeneous. In addition, from one survey to another in a given country, the composition of firms surveyed may change, which prevents us from using firm fixed effects in our econometric model. This gives more credit to our focus on firms' access to finance at the sector level to derive a more representative picture of firms' financing constraints in resource-based countries.

Due to the unusual structure of our panel database and contrary to most previous empirical analyses (e.g., Mlachila and Ouedraogo, 2019) that explicitly take into account endogeneity issues such as reverse causality between credit and energy rents and omitted variables bias, we are not able to estimate the relationship between energy rents and firms' access to finance by using a dynamic panel fixed-effects model, such as the Diff-GMM from Arellano and Bond (1991) or the System-GMM from Richard and Stephen (1998). Indeed, assuming a one-period lag of our dependent variable (*Credit line*) is not relevant in our case since some countries have been surveyed only once ($T = 1$). In addition, for countries with at least two surveys ($T \geq 2$), the duration between each survey is not the same.

Because of the constraints imposed by the structure of our micro-macro panel database, we carefully specify our econometric model to avoid reverse causality and omitted variables bias. As a result, our assessment of the relationship between lagged energy rents and firms' access to finance relies on an econometric model estimated with the Ordinary Least Squares (OLS) estimator including a large set of time, sector and country fixed effects. This enables us to control, as much as possible, for different sources of unobserved heterogeneity that could bias the estimated effect of energy rents on firms' access to finance. Time fixed effects are included to control for unobserved shocks that could impact all countries surveyed in a given year. They also account for the fact that countries are surveyed at different periods. Sector fixed effects are included to control for unobserved characteristics specific to each sector that may influence both firms' access to finance and firms' sensitivity to variation in the level of energy rents at the macroeconomic level. Finally, country fixed effects are included to control for unobserved countries' characteristics that may influence their dependence on energy rents, as well as the extent of firms' financing constraints.[7]

Taken together, these three different sets of fixed effects enable us to evaluate the relationship between energy rents and firms' access to finance by controlling for the most important sources of unobserved heterogeneity that might bias our estimates. In Section 3.2., we detail the additional macroeconomic and microeconomic control variables included in our econometric model to account for important countries' and firms' characteristics that are not constant over time and that may influence both firms' access to finance and the level of energy rents.

[5] In the OA, Table A4 provides descriptive statistics of the *Credit line* and energy rents variables.

[6] In the OA, Figure A and Table A5 support, at the macroeconomic level, the significant and negative correlation between energy rents and the level of financial development (*banks' credit to the private sector/GDP*) derived from the previous literature (note that only countries and survey years included in our sample have been considered).

[7] Since several countries in our sample belong to regions that exhibit characteristics of resource-based economies, we also account in one specification of our econometric model for regional fixed-effects to control for unobserved regional features that could impact both the level of energy rents at the macroeconomic level and firms' access to finance at the microeconomic level. However, due to multicollinearity issues, we are not able to include in the same model both country and regional fixed-effects. This is why, we prefer to account for country fixed-effects in our baseline econometric model, but we also present results for an alternative model including regional fixed-effects.

Table 1
Mean comparison test of firms' access to finance according to energy rents.

Mean of *credit line*		
Energy rents (t-1) ≥ 5% GDP	Energy rents (t-1) < 5% GDP	*t*-test p-value
27.63	39.19	0.00
Energy rents (t-1) ≥ 10% GDP	Energy rents (t-1) < 10% GDP	*t*-test p-value
25.14	38.61	0.00

Note: *Credit line* is measured at the sector-level for each country-year surveyed. The *Energy rents* thresholds (5% and 10%) are computed at the country level one year before each surveyed year.

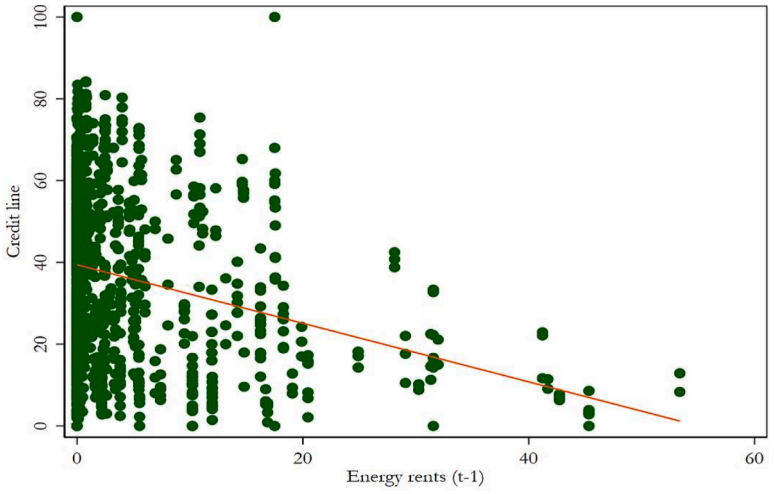

Fig. 1. Energy rents and firms' access to finance.
Note: *Credit line* is measured at the sector-level for each country-year surveyed. The *Energy rents* variable is measured at the country level one year before each surveyed year.

To evaluate how the level of energy rents may influence firms' access to finance, we consider the following baseline econometric model assuming sector-level heterogeneity:

$$Creditline_{j,i,t} = \alpha_0 + \alpha_1 Energyrents_{i,t-1} + \sum_{t=1}^{T} \alpha_{2t} TD + \sum_{j=1}^{J} \alpha_{3j} SD + \sum_{i=1}^{I} \alpha_{4i} CD + \sum_{k=1}^{K} \alpha_{5k} Z_{k,j,t} + \sum_{p=1}^{P} \alpha_{6p} X_{p,i,t-1} + \varepsilon_{j,i,t}$$

with

- *Credit line*$_{i,j,t}$: the percentage of firms in sector *j* from country *i* that declare having a line of credit or a loan from a bank or another financial institution in survey year *t*.
- *Energy rents*$_{i,t-1}$: the level of energy rents as a percentage of GDP in country *i* at year *t-1* preceding the survey.
- $Z_{k,j,t}$: microeconomic control variable *k* for sector *j* in survey year *t*.
- $X_{p,i,t-1}$: macroeconomic control variable *p* for country *i* at year *t-1* preceding the survey.
- *TD*: time dummies[8]
- *SD*: sector dummies
- *CD*: country dummies
- $\varepsilon_{j,i,t}$: error term for sector *j* in country *i* in survey year *t*.

Energy rents are observed at year *t-1*, i.e., the year preceding the survey. This enables us to account for a potential lagged effect from a variation in energy rents at the macroeconomic level on firms' access to finance. In addition, by considering such a lagged effect for

[8] Our cross-country data structure allows us to include time dummies (*TD*) when estimating the relationship between energy rents and firms' access to finance. This would not be the case in a single-country set up where all firms would face the same level of country-specific energy rents in a given period, leading to a perfect multicollinearity issue between time dummies and the *Energy rents* variable, such as the coefficient associated with this macro variable would be unidentifiable. See Huang *et al.* (2022) for a discussion regarding the econometric issues associated with the combination of micro (firm-level) panel data and macro (country-level) time series data in empirical studies focusing on only one country.

Energy rents, we avoid any potential simultaneity problem between the level of energy rents and firms' access to finance. Indeed, in resource-based countries, business sectors associated with the exploitation of natural resources have an important economic weight. If these firms obtain better access to finance, they could generate higher benefits and thus be more prone to invest in the exploitation of energy rents, which in turn could influence the amount of energy rents observed in a given year.[9]

Finally, to illustrate our econometric methodology, we consider the case of Argentina. For this country, the percentage of firms in sector *j* that declare having a line of credit or a loan from a bank or another financial institution at survey year *t* (e.g., 2017) is regressed on Argentina's level of energy rents and macroeconomic control variables at year *t-1* preceding the survey (e.g., 2016), on microeconomic control variables for sector *j* at survey year *t* (e.g., 2017), and on time, sector and country fixed effects.

3.2. Microeconomic and macroeconomic control variables

Although the different sets of fixed effects included in our econometric model allow us to control for different sources of unobserved heterogeneity at the temporal, sectoral and country levels, we also account for key macroeconomic and microeconomic control variables that are time-varying and may influence both firms' access to finance and energy rent levels.[10]

At the macroeconomic level, we follow the literature on the financial resource curse and account for variables that are important determinants of the level of financial development, namely, GDP per capita, population, trade openness (ratio of imports plus exports over GDP), and terms of trade (i.e., net barter terms of trade). All these variables come from the WDI database and are evaluated in the same way as *Energy rents*, that is, at year *t-1* preceding each survey. To account for potential outlier values, each of these variables is expressed in logarithmic form. GDP per capita controls for the level of economic development, which is an important determinant of financial development at both the banking sector and financial markets levels (Beck, 2011). We control for the population at the country level, since financial institutions operating in countries with an important population benefit from a larger credit market and face a higher demand for financial services, which in turn may favor financial development and a better access of firms to external sources of finance (Huang, 2010). By increasing the demand for financial services from exporting firms and allowing more technological transfers, trade openness plays an important role in the development of financial systems (Rajan and Zingales, 1998).[11] Finally, terms of trade are added as a control variable to capture Dutch Disease effects (Bhattacharyya and Holder, 2014).[12]

At the microeconomic level, we account for three key control variables that are likely to influence firms' access to external finance, namely, firms' size, age, and ability to export their production (Beck et al., 2005; De la Torre et al., 2010). All these variables come from the WBES database and are evaluated in the same way as the *Credit line* variable, i.e., at survey year *t* and averaged at the sector level. Firm size plays a critical role in the decision process of financial institutions to grant credits, since small and medium-sized firms generally encounter more difficulties in accessing credit than large firms. Firms' age also represents an important factor driving firms' access to finance, as older firms benefit from more experience in their field of activity and are thus considered less risky for financial institutions. Finally, since resource-based economies rely heavily on revenues generated by the export of commodities, exporting firms operating in the resource sector may benefit from better access to finance. In addition, exporting firms have access to larger markets to sell their production, which increases their revenues and may improve their access to finance.[13]

4. Main results

Table 2 displays the main econometric results going from a simple pooling model without any fixed effects (1) to a model incorporating time, country and sector fixed effects and significant controls (9). These nine estimated models enable us to control for a large variety of unobservable and observable sources of heterogeneity.

Overall, the predictive power of the model is important and strongly increases when incorporating country fixed effects in specifications (5) – (9). Hence, a large part of the variance of the endogenous variable is explained by our set of explanatory variables (84% and more), attesting to the robustness of our results.

More precisely, three main salient points can be derived from Table 2. First, the *Credit line* variable is significantly and negatively correlated with *Energy rents* regardless of the model considered. Thus, firms operating in high energy rent countries are likely to encounter difficulties in obtaining access to external financing, suggesting the presence of a financial resource curse. Second, the value of the coefficient associated with *Energy rents* is lower when country fixed effects are accounted for. It is thus necessary to consider unobservable heterogeneity at the country level to avoid overestimating the financial resource curse effect. The coefficient's value of *Energy rents* is, however, very stable in regressions (5) – (9), when microeconomic and macroeconomic control variables are added to the set of explanatory variables. Among the set of control variables, only the firms' size variable is significant. Country fixed effects are

[9] In Section V, we show that our baseline results are robust when considering alternative lagged effects for the *Energy rents* variable, as well as alternative ways to combine oil, gas and coal rents.

[10] In the OA, Table B1 provides more details regarding the definition of each of these variables and Table B2 gives their descriptive statistics.

[11] Trade openness also plays a key role in resource-based countries since their economies rely heavily on the exports of commodities (Mlachilda and Ouedraogo, 2019).

[12] In addition, favourable terms of trade induce an increase in net financial inflows due to international trade that can benefit the financial sector and improve firms' access to finance.

[13] Since firms' belonging to the public sector are not included in the WBES database (only private sector firms are accounted for), we do not include in our baseline model a control variable distinguishing between firms operating in the public sector or in the private sector.

Table 2
Energy rents and firms' access to finance.

	Energy rents & credit line (sector-level data)								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Energy rents (t-1)	−0.716***	−0.746***	−0.745***	−0.717***	−0.474*	−0.476**	−0.495**	−0.496**	−0.485**
	[0.129]	[0.122]	[0.115]	[0.104]	[0.241]	[0.238]	[0.237]	[0.240]	[0.233]
log GDP per capita (t-1)						0.105		−1.599	
						[10.10]		[9.037]	
log Population (t-1)						0.525		−1.350	
						[11.49]		[11.09]	
log Trade openness (t-1)						0.815		−0.785	
						[3.487]		[2.938]	
log Term trade (t-1)						4.470		3.868	
						[6.988]		[6.379]	
Firm size (t)							16.67***	16.47***	16.73***
							[2.879]	[2.838]	[2.099]
Firm age (t)							0.123	0.0934	
							[0.208]	[0.215]	
Firm export (t)							−0.0216	−0.0222	
							[0.0575]	[0.0600]	
Time fixed effects	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector fixed effects	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regional fixed effects	No	No	No	Yes	No	No	No	No	No
Country fixed effects	No	No	No	No	Yes	Yes	Yes	Yes	Yes
Observations	1213	1213	1213	1213	1213	1155	1213	1155	1213
Country	140	140	140	140	140	128	140	128	140
R-squared	0.08	0.25	0.30	0.52	0.84	0.84	0.86	0.86	0.86

Note: coefficients displayed are marginal effects. Standard errors robust to within-country correlations are reported in brackets. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

thus likely to capture most of the information included in the macroeconomic control variables. The same occurs for microeconomic control variables due to their strong association with sector fixed effects. Given that model (9), including only the significant control variables, is both parsimonious and informative, it will be considered as the baseline specification in the rest of the paper. Third, we notice that, broadly speaking, an increase in the energy rents of 1 percentage point leads to a decline of firms' access to credit of 0.5 percentage point, which represents a sizeable effect.

To summarize, the results displayed in Table 2 are consistent with the financial resource curse hypothesis and corroborate, at the firm level from a new demand-side channel, the results obtained thus far at a macroeconomic level. We find significant evidence that firms operating in countries characterized by a high level of natural resource rents suffer from less access to external financing, especially less bank credit. Since resource-based economies are much more fragile, due to their exposure to commodity-price volatility, the risk premium that banks charge on their credit to firms is much higher, which reduces credit distribution and causes more severe credit rationing issues. As Beck (2011) and Beck & Poelhekke (2023) previously highlighted, credit rationing to the private sector is increased through the strong involvement of the government in investment in resource-based countries. However, the role played by firms' access to finance in resource-based economies to explain the emergence of a financial resource curse phenomenon has not been explored. By more explaining the behavior of the firms, we provide further explanations of the Dutch disease phenomenon, i.e., a resource curse coming from a decline in domestic competitiveness. Indeed, the lack of firms' financing can also represent an explanation for the atrophy of sectors unrelated to the natural resource sector.

In the following section, we deepen these baseline estimates by considering several robustness checks and by assessing potential sources of heterogeneity and transmission channels that could drive these results.

5. Robustness

We check the robustness of the previous results by accounting for additional macroeconomic and microeconomic control variables (5.1), by estimating the effect of the level of energy rents on firms' access to finance based on firm-level data (5.2), by using alternative variables to proxy firms' access to finance and energy rents (5.3), by considering several potential statistical issues (5.4), such as, sample composition, presence of outliers and causality (placebo test) and by dealing explicitly with potential endogeneity issues using external instruments for the *Energy rents* variable (5.5). All these robustness checks are implemented in order to carefully ensure that our baseline results are not influenced by (i) omitted variables, (ii) simultaneity bias, (iii) measurement errors, (iv) sample composition bias, (v) outliers.

5.1. Accounting for additional macroeconomic and microeconomic control variables

Fifteen additional macroeconomic and microeconomic variables likely to impact the energy rents-firms' access to finance relationship have been sequentially included in our baseline model. The definitions and sources of these variables are listed in Table C1 in the OA, whereas Table C2 displays their descriptive statistics.

Overall, as shown by Tables C3 and C4 in the OA, our results regarding the *Energy rents* variable are largely robust, both in terms of significance and magnitude of the estimated coefficients, to changes in the set of control variables. Concerning macroeconomic control variables, only *GDP per capita growth* and *FDI* are significantly correlated with the *Credit line* variable. Regarding microeconomic control variables, only *Firm foreign ownership* (percentage of firms owned by foreign investors in each sector/country at survey year *t)* significantly and negatively impacts firms' access to finance. In this case, (Column (4) in Table C4), the energy rents effect is slightly less important. The same result is derived when inflation is accounted for (Column (8) in Table C3).

5.2. Firm-level estimates

Although we previously focused on sector-level estimates, in Table 3, we challenge our baseline results of the energy rents-firms' access to finance relationship by considering firm-level estimates. Based on binary probit and logit models, our goal is to assess the effect of *Energy rents* on the probability of firms' access to external sources of financing. To this end, we consider the following specification of our econometric model:

$$P\left(Creditline_{f,j,i,t}=1\right)=\alpha_0+\alpha_1 Energyrents_{i,t-1}+\sum_{t=1}^{T}\alpha_{2t}TD+\sum_{j=1}^{J}\alpha_{3j}SD+\sum_{i=1}^{I}\alpha_{4i}CD+\alpha_5 Firmsize_{f,j,i,t}+\varepsilon_{f,j,i,t}$$

with

- *Credit line*$_{f,j,i,t}$: a binary variable taking the value 1 if the firm *f* operating in sector *j* from country *i* declares having a line of credit or a loan from a bank or another financial institution at the survey year *t* and 0 otherwise.
- *Energy rents*$_{i,t-1}$: the level of energy rents as a percentage of GDP in country *i* at year *t-1* preceding the survey.
- *TD, SD* and *CD*: time, sector, and country dummies.[14]
- *Firm size* $_{f,j,i,t}$: a categorical variable indicating the size category (small, medium, large) of firm *f* operating in sector *j* from country *i* in survey year *t*.
- $\varepsilon_{f,j,i,t}$: an error term for firm *f* operating in sector *j* from country *i* in survey year *t*. This error term follows a Gaussian distribution in the probit model and a logistic distribution in the logit model.

Both probit and logit models are estimated using the maximum likelihood estimator.

Firm fixed effects are not included for three main reasons. First, given the very large number of firms in our sample (more than 156 000), accounting for firm fixed effects would dramatically decrease the number of degrees of freedom of our econometric model. Second, we do not include firm fixed effects to avoid potential multicollinearity issues with other fixed effects we account for. Third, remember that for some countries in our sample, only one round of survey is available in the WBES. In addition, for countries with multiple available surveys, the composition of firms surveyed in a given country may change from one round to another. Therefore, these three limitations prevent us from using firm fixed effects.

Note that the estimated coefficients displayed in Table 3 are marginal effects computed at the mean value of the explanatory variables (*Energy rents* and *Firm size*). This implies that the magnitude of the estimated coefficients cannot be compared with those from Table 2. Overall, regardless of the model considered, the results from Table 3 are qualitatively similar to previous estimates. An increase in the level of energy rents is associated with a significant decrease in firms' access to finance: on average, a one percentage point increase in the level of energy rents leads to a 0.006 point decline in the probability of firms' access to external sources of financing. In line with our baseline results from Table 2, firms operating in high energy rent countries are likely to face more difficulties in obtaining access to external financing, giving additional support for the presence of a financial resource curse.

5.3. Alternative measures for dependent and interest variables

Regarding the choice of an alternative dependent variable, due to data constraints in the WBES on the availability of a relevant proxy for firms' access to finance, our baseline *Credit line* variable is now replaced by the *Fixed assets internal* variable. This latter variable corresponds for firm *f* operating in sector *j* from country *i* at survey year *t* to the share of its fixed-assets investments finance through internal fundings (internal funds or retained earnings).[15] Thus, for sector-level estimates, we consider the average value of *Fixed assets internal* for each sector *j* from country *i* at survey year *t*. For the shake of comparability with previous results, our estimates using *Fixed assets internal* as an alternative dependent variable are carried out at both the sector and firm levels and include either regional or country fixed effects.

Note that to support the presence of a financial resource curse, the estimated coefficient associated with the *Energy rents* variable

[14] In the vein of Table 2, regional fixed-effects have been included. However, due to multicollinearity concern, we are not able to include both country and regional fixed-effects in the same model. Thus, in Table 3, country and regional fixed-effects have been accounted for in separate specifications of our probit and logit models.

[15] Compared with the *Credit line* variable, which is a dummy variable, the *Fixed assets internal* variable is a quantitative variable. In this case, for estimates at the firm-level, our econometric model including different sets of fixed-effects is now estimated using the OLS estimator.

Table 3
Energy rents and firms' access to finance: firms-level data.

	Energy rents & credit line (firm-level data)			
	Probit	Logit	Probit	Logit
	(1)	(2)	(3)	(4)
Energy rents (t-1)	−0.00803***	−0.00823***	−0.00379*	−0.00386*
	[0.00106]	[0.00116]	[0.00228]	[0.00233]
Firm size	0.117***	0.116***	0.110***	0.110***
	[0.00503]	[0.00489]	[0.00509]	[0.00508]
Time fixed effects	Yes	Yes	Yes	Yes
Sector fixed effects	Yes	Yes	Yes	Yes
Region fixed effects	Yes	Yes	No	No
Country fixed effects	No	No	Yes	Yes
Observations	156,804	156,804	156,804	156,804
Country	140	140	140	140
Pseudo R-squared	0.11	0.11	0.15	0.15

Note: coefficients displayed are marginal effects. Standard errors reported in brackets are robust to within-country correlations. Pseudo-R2 is proxied by the ratio $(|LL_0| - |LL_1|)/|LL_0|$, where LL_0 and LL_1 denote the absolute value of the log likelihood in a model with only a constant term and the full model, respectively. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

must be positive. Since an increase in the level of energy rents is associated with a significant decrease in firms' access to external funding, this should translate into a significant *increase* in the share of firms financing their investments through internal funding. The results from Table C5 in the OA confirm this hypothesis. Regardless of the specification considered, we notice that an increase in the level of energy rents is positively correlated with the share of firms financing their investments through internal fundings. This confirms that a financial resource curse is likely to occur through a reduction in firms' access to external finance.

For robustness purposes, we also account for four alternative measures of energy rents. The first two variables aim to consider a larger time window before each year of the survey to measure energy rents from a more medium-term perspective. The last two variables aim at accounting more precisely for the economic weight associated with each of the three energy rents we consider for countries included in our sample. These four alternative measures of energy rents are as follows:

- *Energy rents (mean t-2 to t-1)*: for each country *i*, it corresponds to the average value of energy rents during the two years preceding survey year *t*.
- *Energy rents (mean t-3 to t-1)*: for each country *i*, it corresponds to the average value of energy rents during the three years preceding survey year *t*.
- *Energy rents (t-1 time-varying weights)*: for country *i*, it corresponds to the weighted average of *oil rents/GDP, natural gas rents/GDP* and *coal rents/GDP* for the year preceding survey year *t*. For each country *i*, the weight associated with each commodity corresponds to its share of the total energy rents (oil, gas and coal) for the year preceding survey year *t*.
- *Energy rents (t-1 fixed weights)*: for country *i*, it corresponds to the weighted average of *oil rents/GDP, natural gas rents/GDP* and *coal rents/GDP* for the year preceding survey year *t*. For each country *i*, the weight associated with each commodity corresponds to its average share in the total energy rents from 2003 to 2019 (the period covered by our sample).

As shown by Table C6 in the OA, our baseline results are robust when accounting for these four alternative measures of energy rents. The level of energy rents is significantly and negatively correlated with firms' access to finance, with estimated coefficients very close to those displayed in Table 2.

5.4. Accounting for alternative samples, outliers and placebo test

We implement several robustness tests of the baseline results displayed in Table 2 when accounting for alternative samples, outliers and a placebo test (see Table C7 in the OA).

5.4.1. Alternative samples

Column (1) presents the results with only countries surveyed twice at a minimum over the 2006–2019 period. The results from Column (2) show estimates with the usual (untransformed) WBES classification: 52 business sectors are considered instead of 25 in our previous estimates (see Table A3 in the OA). Our baseline results are corroborated.

5.4.2. Outliers

Column (3) displays estimates with the logarithm of the *Energy rents* variable instead of its level. Column (4) (resp. (5)) presents estimates when removing from our sample observations of the *Energy rents* variable above 50% (resp. 40%) of GDP the year preceding

survey year *t*. Column (6) shows estimates when removing from our sample observations of the *Credit line* variable equal to 100%, whereas Column (7) outlines the results of a *Robust Regression* model based on the Weighted Least Squares (WLS) estimator.[16] In all specifications, the effect of energy rents on firms' access to finance is significant and negative.

5.4.3. Placebo test

Although our baseline results seem to be robust to a large variety of alternative specifications, we also re-estimate our model with only non-resource-based countries. In this way, we want to check if our baseline estimates of the energy rents-firms' access to finance relationship are not subject to a spurious correlation problem. In Column (8) (resp. (9)), only observations with *Energy rents* below 3% (resp. 5%) of GDP are considered. As expected, the *Energy rents* variable is no longer significant when only non-resource-based countries are considered in our sample.

5.5. Accounting for endogeneity with IV panel regressions

Although we already control for potential endogeneity issues by several other means, we also perform additional estimates based on external instruments for the *Energy rents* variable. To this end, we carry out panel IV regressions using commodity prices (oil, gas and coal) as instruments. Our goal is to use international oil, gas and coal prices to derive a composite energy price index that is then employed as instrument for the *Energy rents* variable. Based on the IMF's *Primary Commodity Prices* database, we first compute the yearly average of international oil, gas and coal prices (in USD).[17] Then, based on these averaged yearly price series for oil, gas and coal, we compute a yearly composite index of energy prices accounting for the economic weight associated with oil, gas and coal rents for each country in our sample. The objective is to derive an energy price index that is able to explain in a relevant way the dynamics of energy rents for countries included in our sample. For robustness purpose, we define the energy price index in two different ways. The first one corresponds to the yearly weighted average of oil, gas and coal prices for each country *i* and year *t*, where the weights associated with each commodity price corresponds to its share of the total energy rents (oil, gas and coal) in year *t*. The second one corresponds to the yearly weighted average of oil, gas and coal prices for each country *i* and year *t*, where the weights associated with each commodity price corresponds to its average share in the total energy rents from 2003 to 2019 (the period covered by our sample).[18] We then match these two yearly composite energy price series with each country-survey-year observations included in our sample. Finally, to account for potential lagged effects in international commodity prices on domestic energy rents, the *Energy rents (t-1)* variable is instrumented with the *t-1* to *t-3* values of the composite energy price index. Therefore, we carry out two IV panel estimates: the first one with the time-varying weights energy price index and the second one with the fixed-weights energy price index.

Because we use a weighted average of energy prices based on the economic weight associated with each energy rents, our IV panel estimates account only for countries with strictly positive values of oil, gas or coal rents. As a result, these IV estimates are carried out on a smaller panel compared with our baseline estimates.[19] To ensure comparability with our main results, while limiting potential statistical issues due to the reduced degrees of freedom of these two IV panel estimates, estimations associated with each of these two sets of instrumental variables are based on the baseline specification of our econometric model (column (9) in Table 1) with and without country fixed-effects.

The detailed results can be found in Table C8 of the OA. Although the magnitude of the estimated coefficients associated with the *Energy rents* variable slightly differs, the results are qualitatively similar to previous estimates and thus confirm the robustness of our baseline findings to endogeneity issues. The validity of the external instruments has been controlled for by the Hansen test, which confirms in most cases the relevance of our instrumental variables identification strategy.[20] Note that the increase in the estimated negative effect of the *Energy rents* variable on firms' access to finance when using panel IV estimates does not come from the smaller sample size due to the use of the composite energy price indexes. Indeed, in Table C9 of the OA, we have re-estimated our baseline econometric specification from column (9) in Table 2 (with and without country fixed effects to ensure comparability) based only on the sample observations used in the IV panel estimates. In this case, the estimated coefficients associated with the *Energy rents* variable are very similar to our main findings, confirming that the panel IV results are not reflecting a potential sample composition bias.

[16] In this case, observations are weighted according to the absolute value of the predicted standardized errors taken from our model.

[17] Yearly oil prices correspond to the unweighted average of the price series associated with Brent, Dubai and West Texas Intermediate (WTI) crude oil prices. Yearly gas prices correspond to the unweighted average of the price series associated with Indonesian Liquefied Natural Gas in Japan, Netherlands TTF Natural Gas Forward Day Ahead and Natural Gas spot price at the Henry Hub Terminal in Louisiana. Yearly coal prices correspond to the unweighted average of the price series associated with Australian thermal coal and South African export price.

[18] The first composite energy price index with time-varying weights thus aims at accounting for international energy prices based on a short-term assessment of the economic weight associated with oil, gas and coal rents, while the second composite energy price index with fixed-weights aims at accounting for international energy prices based on a more long-term assessment of the economic weight associated with the three energy rents variables.

[19] 91 countries are included on average in the IV panel estimates compared with the 140 countries we account for in our baseline estimates displayed in Table 2.

[20] We use the Hansen test of exogeneity for the instrumental variables instead of the Sargan one, since it is robust to heteroskedastic errors.

6. Heterogeneity

In this section, we look at a potential nonlinearity in the energy rents-firms' access to finance relationship and at possible heterogeneities related to the type of resource rents and business sector considered.

6.1. Accounting for nonlinearity in the effect of energy rents

In Column (1) of Table 4, we check in a simple way for a potential nonlinearity in the energy rents-firms' access to finance relationship by adding a quadratic term (*Energy rents*^{2}) in our baseline model. Considering that some countries in our sample have no energy rents, in Column (2), we re-estimate the specification from Column (1) with only countries for which the *Energy rents* variable is strictly positive. In Column (3) of Table 4, we split the *Energy rents* variable into two: *Bottom 50% energy rents* (resp. *Top 50% energy rents*) equals *Energy rents* for observations below or equal to (resp. above) its sample median, and 0 otherwise. In Column (4), the same methodology is applied with terciles of the *Energy rents* variable. Overall, the results from Table 4 do not reveal nonlinear patterns but confirm that high energy rent countries mainly drive the negative impact of energy rents on firms' access to finance.

6.2. Accounting for mineral rents and disaggregated effects of energy rents

In Column (1) of Table 5, to assess the robustness of our baseline results to a broader definition of resource rents, mineral rents as a percentage of GDP from the WDI dataset are now added to energy rents. The results show that the negative effect of resource rents on firms' access to finance remains significant. In Columns (2) – (4) of Table 5, we account for the disaggregated effects of energy rents on firms' access to finance by considering *oil rents/GDP, natural gas rents/GDP* and *coal rents/*GDP separately. Our results show that only oil rents and natural gas rents have a significant and negative correlation with firms' access to finance. Natural gas rents are associated with the most significant negative effect on firms' access to finance, while the magnitude of the oil rent's coefficient (-0.43) is very close to the one associated with the *Energy rents* variable in our baseline estimates.

6.3. Accounting for sectorial differences in the effect of energy rents

In Table 6, we test the assumption that firms' access to finance may be different across sectors (resource versus non-resource sectors). Relying on the Dutch disease hypothesis, we assume that in resource-based countries, firms operating in the non-resource sector are more likely to experience difficulties in accessing external sources of financing. To test this assumption, we split the 25 business sectors associated with our baseline results into two categories by differentiating between resource and non-resource sectors (see Table A3 in the OA). Then, the following two energy rents variables are computed:

- *Energy rents (t-1) non-resource sector only* equals *Energy rents* if sector *j* from country *i* in survey year *t* belongs to the non-resource sector and 0 otherwise.
- *Energy rents (t-1) resource sector only* equals *Energy rents* if sector *j* from country *i* at survey year *t* belongs to the resource sector and 0 otherwise.

Both sector-level (Column (1)) and firm-level (Column (2)) estimates have been performed.[21] We find that energy rents have a significant and negative effect on firms' access to finance only for firms operating in the non-resource sector. This result holds at both the sector level and the firm level. We also notice that the magnitude of the estimated coefficients associated with the *Energy rents (t-1) non-resource sector only* variable is very close to the results displayed in Tables 2 and 3. This suggests that in resource-based countries, it is primarily firms operating in the non-resource sector that experience constraints in accessing external sources of financing, which gives additional support for the presence of a financial resource curse. This result is in line with the Dutch disease theory since the lack of firms' financing can also be an explanation for the decline in the production and export of sectors unrelated to the natural resource sector in resource-based countries.

7. Transmission channels

Our results suggest the presence of a robust financial resource curse effect. In Table 7, we now try to investigate the transmission channels behind this result by focusing on the three main channels previously discussed in Section 1: the quality of the institutions, the supply constraints and the fragility of the banking sector. To this end, we re-estimate our baseline econometric model at the sector level based on the following subsamples. The quality of political institutions is investigated based on the *Polity2* variable from the *Polity 5* dataset. In Column (1) (resp. Column (2)), the model is estimated only for countries with a value of the *Polity2* variable below or equal (resp. above) its sample median the year preceding survey year *t*. The same methodology applies when considering the supply constraints and the fragility of the banking sector. In Columns (3) and (4), the supply constraints are proxied through the overall index of financial development (*FD index*) coming from the IMF's *Financial Development Index Database*. In Columns (5) and (6), the fragility of

[21] To save space, only probit estimates are presented. Logit estimates lead to very similar conclusions and are available upon request. Due to multicollinearity concerns, sector- and firm-level estimates do not account for sector fixed effects.

Table 4
Nonlinearity in the effect of energy rents.

	Energy rents & credit line (sector-level data)			
	(1)	(2)	(3)	(4)
Energy rents (t-1)	−0.822*	−0.961*		
	[0.466]	[0.519]		
Energy rents^2 (t-1)	0.00838	0.0134		
	[0.00961]	[0.0103]		
Bottom 50% energy rents (t-1)			1.583	
			[4.138]	
Top 50% energy rents (t-1)			−0.489**	
			[0.233]	
Low energy rents (t-1)				14.32
				[56.09]
Middle energy rents (t-1)				−0.0137
				[1.250]
High energy rents (t-1)				−0.482*
				[0.244]
Firm size (t)	16.78***	13.60***	16.71***	16.72***
	[2.106]	[1.823]	[2.103]	[2.088]
Time fixed effects	Yes	Yes	Yes	Yes
Sector fixed effects	Yes	Yes	Yes	Yes
Regional fixed effects	No	No	No	No
Country fixed effects	Yes	Yes	Yes	Yes
Observations	1213	902	1213	1213
Country	140	90	140	140
R-squared	0.86	0.89	0.86	0.86

Note: in Column (2), only countries with *Energy rents* > 0 are considered. Coefficients displayed are marginal effects. Standard errors robust to within-country correlations are reported in brackets. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Table 5
Adding mineral rents and disaggregated effects of energy rents.

	Energy rents & credit line (sector-level data)			
	(1)	(2)	(3)	(4)
Energy & mineral rents (t-1)	−0.384*			
	[0.202]			
Oil rents (t-1)		−0.433*		
		[0.232]		
Gas rents (t-1)			−1.880**	
			[0.896]	
Coal rents (t-1)				−0.823
				[1.127]
Firm size (t)	16.78***	16.46***	16.70***	16.74***
	[2.100]	[2.085]	[2.076]	[2.111]
Time fixed effects	Yes	Yes	Yes	Yes
Sector fixed effects	Yes	Yes	Yes	Yes
Regional fixed effects	No	No	No	No
Country fixed effects	Yes	Yes	Yes	Yes
Observations	1213	1221	1221	1213
Country	140	141	141	140
R-squared	0.86	0.86	0.86	0.86

Note: coefficients displayed are marginal effects. Standard errors robust to within-country correlations are reported in brackets. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

the banking sector is assessed with the banking sector's distance-to-default (z-score) variable coming from the World Bank's *Global Financial Development Database*.[22]

The results in Table 7 suggest that the quality of institutions and supply constraints are two channels at work that explain how energy rents may hamper firms' access to finance in resource-based countries. Indeed, we notice that the *Energy rents* variable is significantly and negatively correlated with firms' access to finance only for countries where the quality of institutions (Column (1)) and the level of financial development (Column (3)) are low. Thus, together with our previous estimates, these results indicate that, from a microeconomic perspective, the financial resource curse is likely to arise in resource-based countries through a decline in firms' access to finance; this effect is even more pronounced when countries suffer from low institutional quality and a low level of financial

[22] Definitions and descriptive statistics of these three variables are reported in Tables D1 and D2 of the OA.

Table 6
Sectorial differences in the effect of energy rents.

	Energy rents & credit line Sector-level data (1)	Firm-level data (Probit estimates) (2)
Energy rents (t-1) non-resource sector only	−0.486**	−0.0038*
	[0.240]	[0.0023]
Energy rents (t-1) resource sector only	−0.361	−0.0027
	[0.232]	[0.0024]
Firm size (t)	18.30***	0.1515***
	[1.608]	[0.0133]
Time fixed effects	Yes	Yes
Sector fixed effects	No	No
Regional fixed effects	No	No
Country fixed effects	Yes	Yes
Observations	1213	156,804
Country	140	140
R-squared	0.85	
Pseudo R-squared		0.12

Note: coefficients displayed are marginal effects. Standard errors robust to within-country correlations are reported in brackets. Pseudo-R2 is proxied by the ratio $(|LL_0| - |LL_1|)/|LL_0|$, where LL_0 and LL_1 denote the absolute value of the log likelihood in a model with only a constant term and the full model, respectively. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Table 7
Transmission channels.

	Energy rents & credit line (sector-level data)					
	Quality of institutions		Supply constraints		Financial fragility	
	Bottom 50% of polity2 (1)	Top 50% of polity2 (2)	Bottom 50% of financial development (3)	Top 50% of financial development (4)	Bottom 50% of bank z-score (5)	Top 50% of bank z-score (6)
Energy rents (t-1)	−0.559**	−1.491	−0.552***	−0.52	−0.414	−0.269
	[0.251]	[1.057]	[0.197]	[0.839]	[0.292]	[0.455]
Firm size (t)	17.51***	13.67***	20.39***	10.12***	22.45***	13.36***
	[2.830]	[3.434]	[3.195]	[2.674]	[3.359]	[2.703]
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Sector fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Regional fixed effects	No	No	No	No	No	No
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	650	492	579	573	511	522
Country	77	51	81	60	70	70
R-squared	0.85	0.80	0.86	0.86	0.88	0.89

Note: coefficients displayed are marginal effects. Standard errors robust to within-country correlations are reported in brackets. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

development. These results are in line with the previous literature on the financial resource curse; however, they bring further insights into one precise microeconomic mechanism, namely, firms' access to finance, which can give rise to this curse.

8. Conclusion

Combining microeconomic level data on firms' access to finance and macroeconomic level data on countries' level of natural resource rents, with a focus on energy (oil, gas and coal) rents, we have carried out an original approach to the study of the financial resource curse and, more generally, to the issue of the natural resource curse. This way, we have been able to deal with the issue of the financial resource curse through a new channel that has thus far not been accounted for in the literature, namely, firms' access to finance. Based on a panel of more than 156 000 firms surveyed in 140 countries over the 2003–2019 period, we have shown the presence of a robust financial resource curse effect at the microeconomic level that arises from reduced access for firms to external sources of financing. Broadly speaking, our baseline estimates suggest that an increase in the level of energy rents of 1 percentage point leads to a decline in firms' access to finance of 0.5 percentage points. This result holds when considering firm-level data and sector-level data, accounting for country, time, sector and regional fixed effects, including a large number of additional microeconomic and macroeconomic controls, using alternative measures of firms' access to finance and resource rents, accounting for outliers and alternative sample compositions, as well as using instrumental (IV) panel regressions to explicitly account for endogeneity issues. All in

all, our results hold when carefully accounting for several potential sources of bias associated with our baseline estimates, such as, omitted variables, simultaneity, measurement errors, sample selection and outliers.

As a result, firms' access to finance is a robust channel through which the financial resource curse may arise. In the previous literature, this question has only been addressed by looking at the behavior of banks and other financial intermediaries, i.e., through the lens of the financial sector (a supply-side view), from both macroeconomic and microeconomic perspectives. This study adds interesting results to this literature by focusing on firms' access to finance (a demand-side view) and shows, from a microeconomic perspective, that the importance of natural resource rents is a key factor in explaining the difficulties that firms face in accessing external sources of financing.

Moreover, we show that the countries' level of natural resource rents is negatively and significantly correlated with firms' access to finance only for firms that do not operate in the natural resource sector. This result provides additional insights into the channels that may explain the Dutch disease phenomenon, since it allows us to explain why some business sectors are insufficiently developed in resource-rich countries. Indeed, in resource-based countries, it is more secure for banks to lend money to firms operating in the natural resource sector, as this sector is considered less risky than firms operating in the non-resource sector. This in turn may explain the atrophy of the non-resource sector, since companies belonging to this sector experience more constraints in accessing external sources of funding. This leads to lower levels of investment, especially for small firms that suffer the most from credit constraints, which in the end penalize the production of the non-resource sector.

We have tried to discuss the relationship between energy rents and firms' access to finance in light of the main theoretical channels mentioned in the financial resource curse literature. For two out of these three channels, our results are significant and consistent with what the literature predicts. Indeed, our results suggest that the quality of institutions and the supply constraints channels are at work to explain the energy rents-firms' access to finance relationship, contrary to the banking sector fragility channel. Firms operating in resource-based countries with low institutional quality and low financial development are more prone to encounter difficulties in accessing external sources of funding. The quality of institutions plays a preponderant role in firms' access to financing. Supply constraints also play a crucial role, which can arise from the fact that windfall resources are diverted from the financial sector and invested in the natural resource sector or in non-productive expenditures. This hampers the intermediation function of the financial sector and thus leads to a lower level of financial development.

Finally, the value added of this paper can be summarized as follows. First, in contrast to most of previous macroeconomic studies, by relying on a new micro-macro database with more than 156 000 firms, our firm's focus enables us to offer a more detailed and precise analysis of the finance resource curse patterns in resource-based countries. Second, contrary to previous studies considering the finance resource curse according to a supply-side approach based on the banking sector, our demand-side analysis based on firms' behaviors enable us to better highlight the *Dutch disease* patterns in the resource-based countries and thus reveal the major role of the external financing constraints in the atrophy of sectors unrelated to the natural resource sector.

In terms of policy recommendations, it is necessary to improve contract enforcement in accordance with La Porta et al. (1998), Djankov et al., (2007) and Bhattacharyya and Holder (2014). Indeed, improving trust between citizens and regulatory institutions enables optimization of the financial intermediation function of the financial system and facilitates the access of firms to finance. Regarding supply constraints, a solution, which is often mentioned in the literature, relies on sovereign wealth funds. In line with the three stabilization funds discussed by Arezki et al., (2018), part of these sovereign wealth funds could be used as a special fund for banks of resource-rich countries devoted to the financing of small and medium-sized enterprises that operate in sectors not related to natural resources. This could reduce the problems faced by the firms of these sectors to access external sources of funding, which in turn would enable them to expand their production. Coupled with this measure, a credit-reporting system could be implemented for small and medium-sized firms to reduce the information asymmetry faced by banks, which makes them reluctant to lend to firms in sectors not related to natural resources.

What about the financial resource curse in the future? The effects of natural resources on firms' access to finance analysed in this paper are likely to be deeply challenged by the energy transition in the near future. Indeed, energy and oil exports are expected to strongly decrease, leading to less windfalls for resource-based countries. It is difficult to forecast what the net effects of the energy transition will be from a financial resource curse perspective, but we can expect that they will be conditional on the nature of the resources – energy or minerals? – and to the attitude of countries facing the energy transition. The case of Russia, one of the largest oil and gas exporters in the world, would likely follow a 'Kodak moment'. In contrast, the low carbon energy transition also increases the use of metals, especially scarce metals for renewable materials such as batteries (lithium, cobalt, nickel, etc.) and could be beneficial for countries such as the Democratic Republic of Congo. In other words, the countries and hence the sector and the firms currently the most concerned by the financial resource curse could not be the same in the future according to the nature of resources and their role in the new low carbon economy. One potential direction for future research would be to further investigate the link between the energy transition and the financial resource curse.

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