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Impact of mining boom on the quality of public goods in Sub-Saharan Africa

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Impact of mining boom on the quality of public goods in Sub-Saharan Africa

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Abstract

In this paper, we investigate the impact of public mining revenues on perception indicators of public goods quality in five mining countries that have recently experienced a boom in their government revenues: Burkina Faso, Ghana, D.R. Congo, Tanzania, and Zambia. The effect of the tax revenue boom is identified using a difference-in-differences estimation strategy. Our estimations indicate that people living in mining regions as having a sense of structural disadvantage in terms of the provision of public goods; however, this perception is pro-cyclical in the presence of resource booms/busts. Our results hold even after taking account of the possible endogeneity of our measure of resource revenue.

JEL classification: I31, O13, O55, Q33

Keywords: mining; resource boom; public goods; mining areas; Sub-Saharan Africa

1. Introduction

In many African countries with limited tax-raising capacities, mineral revenue has become a major source of total government revenue. However, tax receipts from mining fluctuate widely according to commodity prices and investments. In this regard, during the period ranging from the late 2000s to 2014 many African mining countries witnessed a significant boom in their revenues following a steep increase in the price of certain minerals. For some of these countries, the share of mining tax receipts has exceeded 30 per cent (e.g., Zambia and the Democratic Republic of Congo, or DRC). In this context, an abundant literature has been devoted to the economic mechanisms that explain why mining rent may become a curse (see Mosley 2017 for an overview).

The present paper focuses on the local welfare effect of mining. To this end, we estimate the impact of public mining revenues on perception indicators of public goods quality in five mining countries

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that have recently experienced a well-characterized boom in their government revenues: Burkina-Faso, Ghana, DRC, Tanzania, and Zambia.

Previous contributions identify three channels through which mining activity or mining revenues can impact local living conditions. The first channel involves the positive effect of local or central public spending on productive public goods—roads, water, education, and hospitals, among others. Our work focuses on these potential impacts. A second channel revolves around spillovers positively impacting employment and the level of infrastructure. Following long international pressure, an increasing number of new mining codes include clauses that aim to encourage local development and the sharing of infrastructure between mining companies and local people (Africa Mining Vision 2009, Collier and Ireland 2018). Finally, the third channel concerns negative effects such as pollution, corruption, and conflicts.

Our paper contributes to this growing empirical literature by building on an identification strategy based on a counterfactual. We rely on the observation of regions affected by the boom in mining revenue during the early 2010s compared to non-affected regions, our control group. There are a number of related studies relying on the opening and closing dates of mines (or oil exploitation) to identify the impact of mining activity on living standard indicators in mining areas. In Aragón and Rud (2013), the authors explore the effects of a large mines in Peru and find poverty-reducing effects, but only in conjunction with policies for local procurement. Also in Peru, at the district level Loayza et al. (2013) find a positive relationship between mining production and measures of living standards (e.g., poverty, corruption). Following the same methodology, akin to a quasi-natural experiment three recent papers explore the local or regional socioeconomic effects of gold mining in Sub-Saharan Africa. Chuhan-Pole et al. (2017) exploit the geographic identification of observations from existing household surveys in relation to mine locations in Ghana, Mali, and Tanzania. They find a decline in agricultural employment while non-farm occupations are rising, especially for women. The results for child health are mixed from one country to another. Finally, the improvement in access to infrastructure does not appear to be significant. In a similar study based on difference-in-differences estimations for mining and non-mining areas of Ghana, Benshaul-Tolonen et al. (2019) show that women in mining areas may be more likely to gain from indirect employment opportunities. The same authors also highlight significantly decreasing infant mortality rates in mining communities. The results of Zabsonné et al. (2018) in Ghana indicate that areas hosting gold extraction have better living standards than areas without a gold mine but that gold exploitation has increased local inequality and child labor. In the same vein, Vicente (2010) in Sao Tome and Principe and Knutsen et al. (2017) for a sample of Sub-Saharan areas have both unearthed a positive impact of, respectively, oil and mineral extraction on perceived corruption at the regional level. Very close to our research question, Konte and Vicente (2020) investigate the effects of mining on the quality of public services in Africa. Their results indicate that citizens living near an active mine are less likely to approve of government performance in key public goods and services. These recent contributions, based on the openings of mines, rely on the hypothesis that mining exploitation mechanically increases mining revenues, which misses part of the story as tax revenues are highly dependent on commodity prices and tax mobilization. Our study is thus complementary to these papers.

In the non-mineral natural resource literature, one can cite a number of contributions exploiting an unexpected boom or bust in commodity prices to identify socioeconomic consequences on local populations. Marchand (2012) measures the impacts of an oil boom on local labor markets with and without energy resources in Western Canada. Cogneau and Jedwab (2012) base their identification strategy on the drastic cut in administered cocoa producer prices in 1990 in Côte d'Ivoire. They use household surveys conducted before and after the shock and find that the cocoa crisis negatively affected the education of cocoa producers' children. In the same vein, Asfaw (2018) uncovers a significant impact of coffee price decreases on the school dropout rates of children in rural Ethiopia.

In our work, we exploit the event of a mining boom followed by a bust in five Sub-Saharan countries, characterized by a sudden and massive increase in government receipts from mining. Rather than focusing on the implementation of large public investments (which may take years to be completed), we surmise that an increase in mining revenues can improve the functioning of public services in the short run. Complementary to studies on the local impacts of mining in Sub-Saharan Africa, we use individual perception indicators of the quality of public goods and welfare from the Gallup World Poll, rather than living standard surveys.

In Burkina-Faso, Ghana, and Tanzania, the boom in gold prices in the early 2010s clearly benefited government mining revenues. According to EITI[3] data, these government receipts were multiplied by 9.5 (Burkina), 6.5 (Ghana), and 3.4 (Tanzania) between 2009 and 2011. Over the same period, the government receipts of Zambia originating from copper extraction multiplied by 3.8. In DRC, government revenues from mining were multiplied by 5 between 2009 and 2011. These five producer countries effectively experienced a government revenue shock.

For every mining country, mining regions are identified by the presence of active mines over the period under scrutiny, as retrieved from the Mining Intelligence database.[4] Individual data on perception are provided by the Gallup World Poll database, which provides 1,000 observations per year per country. The location of every individual interviewee allows us to determine whether he/she is in a mining area or not. For the five countries under consideration, repeated annual surveys provide 55,000 observations over the period spanning from 2008 to 2019, which includes the 2010–2014 revenue boom.

Our dependent variables are individuals' answers regarding the perceived quality of public goods and well-being, namely of public transportation systems, roads, and the education system or schools, and many individual variables control for demographic characteristics, household composition and income, and location, among others.

Considering inhabitants in a mining area as the treatment group and those from non-mining areas as the control group, the effect of the tax revenue boom (after 2010) is identified using a difference-in-differences estimation strategy with continuous treatment.

Our results tend to confirm that individuals located in mining regions perceive having a lower quality of public services, on average. However, a boom in resource revenues improves this perception more than in non-mining regions. These results are confirmed when the endogeneity of the resource income variable is controlled for by using the metal price index as an instrument.

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[3] Extractive Industries Transparency Initiative (EITI). The data collected by this organization may differ from those of the International Monetary Fund (IMF Government Finance Statistics, GFS), but they are more complete for recent years.

[4] Mining Intelligence is a private company offering data application for mining companies and their properties, including for financial, production, reserves, ownership, and geographic aspects, among others. In particular, thousands of mines are geolocated, allowing us to link mining activity to administrative regions in our analysis. URL: https://www.miningintelligence.com/

Section 2 briefly describes mining in the five countries under investigation. The data are presented in Section 3. Section 4 exposes the empirical method. Results are discussed in Section 5, and Section 6 offers some concluding remarks.

2. Mining in Africa: the case of Burkina Faso, Ghana, Tanzania, DRC, and Zambia

For many African countries, mineral exploitation constitutes a significant part of the economy and remains key to their economic development. Although the five countries under scrutiny in the present study are not in similar situations in terms of economic development or the quantity, diversity, and dependence on mineral production, they are all highly reliant on revenues from mineral extraction and are thereby representative of many other Sub-Saharan African countries.

Burkina Faso, Ghana, and Tanzania are among the top 5 African gold producers, with South Africa and Mali. Unlike Burkina Faso and Tanzania, Ghana (formerly the Gold Coast) has a long historical tradition and with substantial reserves and is the largest gold producer in Africa. Its production has sharply increased since the mid-1990s. In Burkina Faso, the development of gold production is much more recent. Since its expansion in the early 2000s, the mining sector in Burkina Faso has been considered one of the most dynamic in West Africa. Production development began during the same period in Tanzania, which is endowed with a variety of mineral resources. The contribution of gold mining to GDP in all three countries is modest: 14 percent of GDP in Burkina Faso, 6 percent in Ghana, and 5 percent in Tanzania in 2018. However, gold is a substantial component of their exports: 68 percent in Burkina Faso, 35 percent in Ghana, and 37 percent in Tanzania in 2018. While Mali presents similar mining characteristics and data is available, we nonetheless did not include it in our study as it has been significantly affected by conflict and political troubles in the contemporary period.

Zambia is another typical case of a mineral-dependent economy and has been so ever since the discovery of rich underground reserves of copper in 1926 (Mosley 2017). In 2018, the country was the world's 7th largest producer of copper. According to the latest EITI reporting (2018), Zambia's mining sector directly accounts for 10.7 percent of GDP and 78.4 percent of total exports.

The Democratic Republic of Congo (DRC) is the African mining giant. The region of Katanga, the main mineral provider in DRC, is often referred to as a "geological scandal".[5] DRC is the world's fifth largest copper producer and produces some sixty percent of the global output of cobalt. In addition, DRC extracts large quantities of diamonds, gold, oil, tin, tantalum, tungsten, and zinc. The contribution of the extractive sector in 2018 amounted to 25 percent of GDP, while mining resources accounted for 95 percent of export earnings in 2018. Copper has accounted for over half of export earnings to date, followed by cobalt, which accounts for about a third.

Mining regions

For the definition of mining and non-mining regions, we refer to political or administrative units. We locate the main industrial mines (69) collected from the Mining Intelligence database in the five countries and define a region to be "mining" if it had an active mine with production on its territory during the 2009–2019 period. An alternative method that has been adopted in other studies is to use the geocoded positions of mines to define a buffer around this point, thereby defining the mining region. We do not adopt this approach for several reasons. First, the Gallup database

[5] The paternity of the expression "geological scandal" is traditionally attributed to the Belgian geologist Jules Cornet during an expedition to Katanga in 1892.

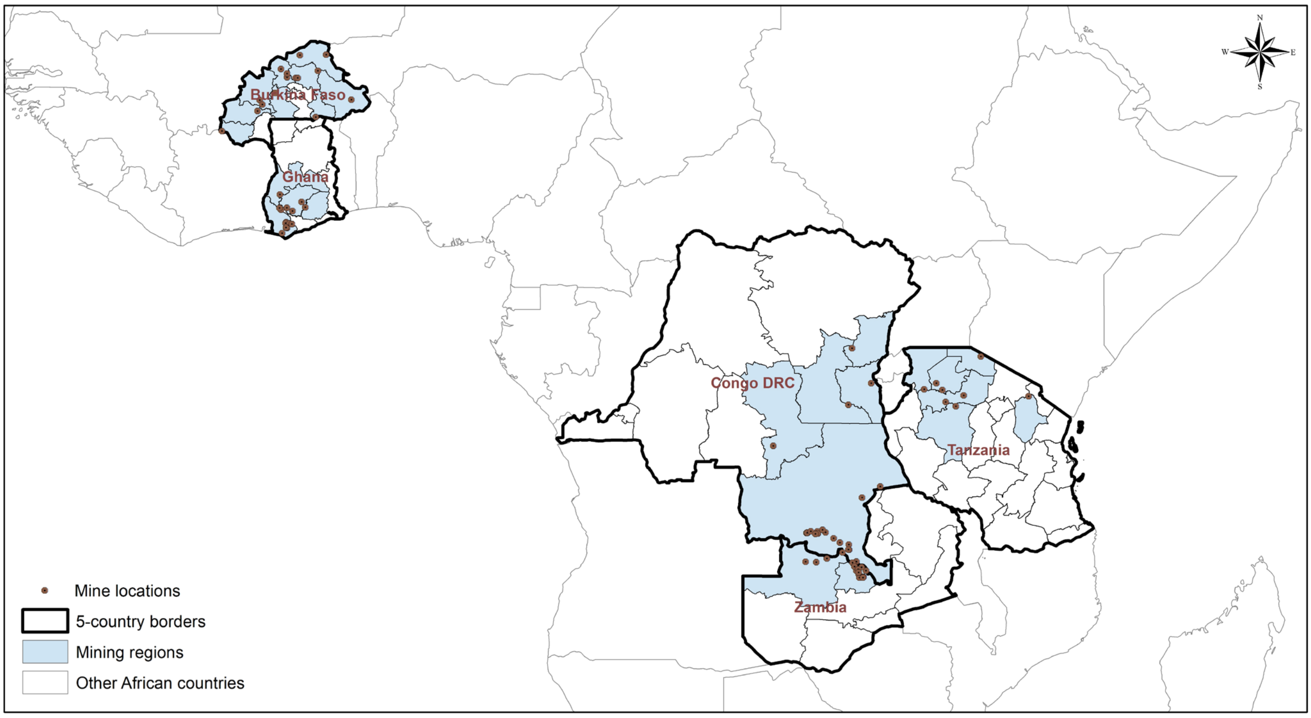
provides the location of interviewees by region but not their geocoded location—hence the impossibility of accurately linking a person to a mining buffer. Second, given that the focus of our study is on public services, administrative regions are more relevant to us because they generally constitute the space for public policy intervention at both the local and national levels.

Among our five countries, the geographic granularity differs to some extent. For Burkina Faso, we have a much finer level of regions (45 regions) than in DRC (11 regions) or Zambia (10 regions). Another concern for locating mines is that specialized international databases do not consider artisanal and small-scale mining (ASM). This informal production is estimated to be approximately 20 percent of total gold production for Burkina Faso and 10 percent for Tanzania (EITI reports 2017). While their share of production is fairly limited, they are labor-intensive and their impact on employment is significant (Hilson 2021). For obvious geological reasons, ASM is generally located in the same regions as industrial mines.

3. Data

Mining regions are displayed on Map 1. Burkina Faso is the only country in our sample that has relatively scattered mine locations, with a higher density in the northern regions. Fortunately, the detailed level of observation at the regional level in this country allows us to clearly define mining regions. In Ghana, mines are essentially found only in two mining regions: Ashanti and the Western Region.

Map 1: Mining in Africa: Burkina Faso, Ghana, Tanzania, RDC and Zambia



In Tanzania, the distribution of gold mines is concentrated in the northwestern districts: Shinyang, Geita, North Mara, and Tabora. In Zambia, copper production is very concentrated in the "Copperbelt Province" that bears its name well (comprising 14 of the 17 major Zambian mines) and the others are located in the northwestern province, considered the "New Copperbelt". In DRC, the famous mining region of Katanga hosts 26 of the 29 large mines listed in our data. It is in this region that we find the large production of copper and cobalt. The other mines are located in North and South Kivu.

Mining revenues

As reported by Chuhan-Pole et al. (2017, p. 27), "In many countries in Africa, most benefits from extractives will clearly be fiscal and national, because the government is the conduit of the benefits to the rest of the economy". In addition to mining tax revenue, which is our main indicator, the recent African mining codes must include clauses that are in line with the "African Mining Vision".[6] In terms of local development, mining companies must commit to promoting local employment, the local procurement of goods, and infrastructure expansion. This includes promoting the development of resource infrastructure to open up access to other users. So far, these non-binding international pacts are seen primarily as means of improving the public image of mining companies (Besada and Martin 2013).

Mining revenues are largely collected and budgeted by the central government. Nevertheless, fiscal arrangements between the central government and local authorities or other transfer mechanisms may have an impact on the benefits obtained by a mining region. The degree and modality of fiscal decentralization is very different across the five countries. Burkina Faso has established a Local Development Mining Fund earmarked to finance regional development plans. This fund is endowed, on the one hand, by the government's contribution of 20 percent of the royalties collected and, on the other hand, by the mining license-holders for 1 percent of their monthly turnover. In 2016, Ghana adopted a new policy of decentralization whereby metropolitan, municipal, and district assemblies administer and collect property rates from mining companies operating in their jurisdictional areas. Tanzania has a more centralized system, with all mining revenues collected by the central government. Transfers to local governments are allocated according to criteria and priorities unrelated to the location of mines or the source of the funds (Chuhan-Pole et al. 2017). In Zambia, a 2008 reform imposed a windfall profit tax of 25 percent on gross proceeds. Of the revenue from the windfall tax, 40 percent is earmarked for specific target groups, half for education and health in low-income communities, and half for local councils (Mosley 2017). In DRC, the 2018 Mining Code stipulates that the central government retains 50 percent of royalties, 25 percent go to the provincial administration where the project is located, 15 percent to the area where the mining takes place, and the remaining 10 percent to a mineral fund for future generations. The revenue has to be paid directly to provinces.

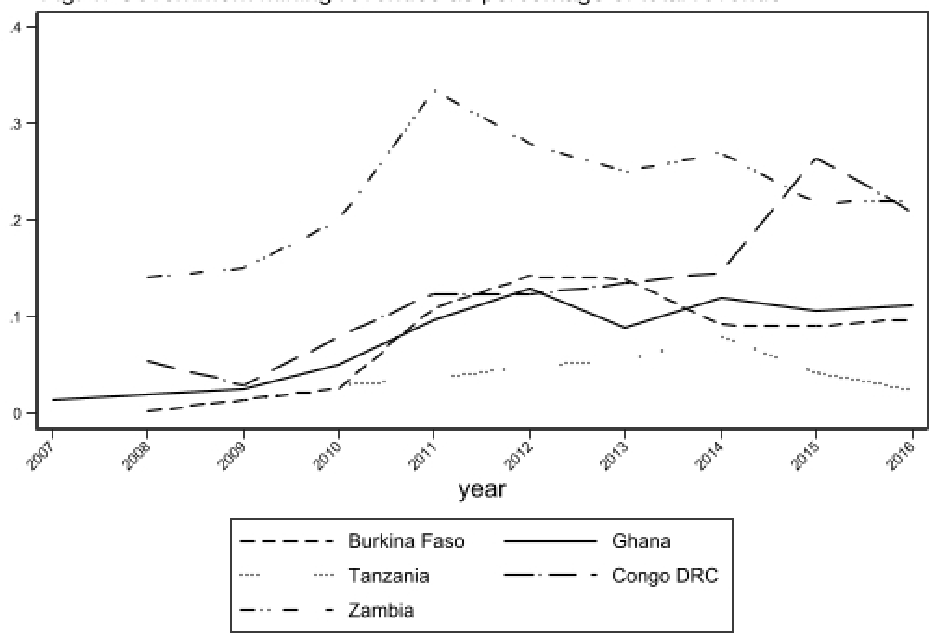
The taxation of extractive resources is essentially based on two instruments, namely mineral royalties and corporate income tax, and also includes a large number of other tax levies: mineral rights, ground rents, permit fees, and environmental fees, among others. The mining codes of each country document the rates and terms of these levies and allow us to observe the evolution of fiscal policy on extractive resources. African producer countries have raised their royalty rates over the

[6] Adopted by African heads of state at the February 2009 African Union summit, the Africa Mining Vision outlines Africa's long-term and broad development objectives for the continent's mineral sector. https://www.a-mla.org/

last decade, in parallel with the steady decline in the corporate tax rate. The codes do not accurately reflect what is actually collected by the tax authorities, however, because of different exemptions, ad-hoc deals, and stability clauses. Fortunately, reports from the Extractive Industries Transparency Initiative (EITI) have provided access to comprehensive and reliable data on government revenues from mining for more than a decade. Relying on this database, we build our main indicator of mineral resource revenues for the countries in our sample. This data collection is complicated, given the considerable number of different taxes related to mining activity. Even the data provided by the IMF (GFS) is often incomplete. For those years and countries where data is available from the IMF and ICTD databases,[7] the comparisons did not reveal any major differences.

Government mining revenues can be considered a fundamental determinant of the perception of the quality of public goods. This relationship is the major channel through which mining affects living conditions in mining regions and countries. We have included all government tax and non-tax revenues from mining activity, excluding oil and gas revenues. The trends in the government mining revenues indicator are built using the EITI database from 2009 to 2019 and are displayed in Figure 1.

Fig. 1: Government mining revenues as percentage of total revenue



Source: Authors' calculations using EITI data

The evolution of government mining revenues is highly dependent on the price of the extractive resource considered. Burkina Faso, Ghana, and to a lesser extent Tanzania (the three gold producers) present fairly similar revenue profiles with the gold price boom in 2012. Similarly, the price of copper has a strong impact on the evolution of Zambian government revenues. However, the quantities produced, the various tax measures, and tax mobilization efforts are also factors determining revenues.

[7] International Centre for Tax and Development (ICTD)—The ICTD Government Revenue Dataset

As can be seen in Figure 1, government mining revenues in each country experienced a boom followed by a bust, which we rely on to construct our identification strategy.

Perception of the quality of public goods

Our analysis of the perception of public goods quality is positioned as complementary to those based on living standard surveys (Cogneau and Jedwab 2012; Chuhan-Pole et al. 2017; Ouoba 2017, Zabsonré et al. 2018). While perception is subjective by nature, perception indicators offer a different, more qualitative perspective compared to more traditional/aggregate indicators, e.g., the rate of school enrolment, access to electricity, access to sanitation and water systems.

The quantitative analysis is based on the Gallup World Poll. This database is a largescale repeated cross-sectional survey covering more than 150 countries. Representative samples of the resident population aged 15 and older consist of 1,000 people interviewed in each country-year.

The annual regularity is an advantage over living standard surveys or the Afrobarometer, which are implemented at irregular time intervals. In addition, the Gallup survey includes DRC, the mining giant, which is not covered in other datasets. The interviewees are not geolocalized, but their region and the urban or rural character of their residence are carefully documented.

We define dichotomous *dependent variables* based on questions about the perceived quality of public transportation systems, roads, and the education system or schools. The respondents were asked (1)"Are you satisfied or dissatisfied with the public transportation systems in the city or area where you live?"; (2)"Are you satisfied or dissatisfied with the roads and highways in the city or area where you live?"; (3) "Are you satisfied or dissatisfied with the education system or schools in the city or area where you live?" The data is coded as satisfied (1) and dissatisfied (0). Other subjective well-being data indicators are available but not related to public goods and services.

Our *control variables* comprise standard individual and household socio-demographic characteristics, and more specifically, the respondent's age, gender, education, marital status, household size, urban or rural location, and household income.

Descriptive statistics

In Table 1, basic descriptive statistics are presented. Subscripts refer to the level of observation. While the share of resource revenues over total revenues can be 0 in some rare cases (less than 5 percent of the observations for the years 2017 and 2018 only), it reaches an average level of 11.5 percent. Individual income (measured in per capita annual income in international dollars) is $1,236, on average, with a large standard deviation. We therefore log-transformed the income (and age) variable in our regressions. About a third of the interviewees were located in mining regions, and the same share of interviewees declared living in urban areas. The sample is gender balanced.

Among our perception variables, between 35 and 52 percent of the interviewees perceived public goods favorably, with the education system scoring the highest percentage.

Table 1: Descriptive statistics

	mean	min.	max.
Continuous variables (37,793 obs.)			
Share Res. Rev.$_{ct}$ [%]	0.115	0	0.335
Income$_i$ [$]	1,236	0	230,519
Age$_i$	33.2	15	100
Metal price index [base=2016]	127.6	99.7	170
Dichotomous variables	Obs.	% of 1	
Perception indicators			
Public transportation$_i$	37,603	0.41	
Roads and highways$_i$	37,793	0.35	
Educational system / schools$_i$	37,504	0.52	
Mining$_r$	37,793	0.32	
Urban$_i$	37,793	0.29	
Women$_i$	37,793	0.48	

Note: Subscripts denote the level of observation (*i=individual, c=country, r=region, t=time[year]*)

4. Empirical specification

To identify the effects of mining revenue shocks on the perception of the quality of public goods, our identification strategy relies on a difference-in-differences approach with continuous treatment (Black et al. 2005; Marchand 2012, Bonilla-Mejía 2020). The continuous treatment is achieved through the use of relative mining revenue. This method has the advantage of not having to define a boom period in a discrete (and arbitrary) manner. Unlike other studies, in the present case several extractive resources are involved, for which the shocks are not completely synchronous.[8]

The treatment group consists of individuals located in mining regions (see Map 1), defined by the presence of at least one producing mine that was active during the period under consideration. Our hypothesis is that mining regions benefit from a positive mining revenue shock. The control group includes individuals located in non-mining regions. The appraisals of the individuals in the two groups are compared in order to produce an estimate for the effects of a boom and bust, according to region.

In order to measure the impact of public mining revenues on the propensity to perceive the quality of public goods positively, we estimate the following specification, relying on a logit estimator given the binary nature of the dependent variable:

$$P(Y_{icrt} = 1) = \Omega\ (\beta_0 + \beta_1\ Mine_r \times RessRev_{ct} + \beta_2\ Mine_r + X_{it} \cdot \Psi + \lambda_c \cdot \delta_t + \varepsilon_{irt})\ , \qquad (1)$$

where the dependent variable Y_{icrt} is the binary answer of an individual i who lives in region r, country c, in year t, related to her perception of the quality of public goods. Ω is the logistic

[8] In Cogneau and Jedwab (2012), a sudden drop in the administered price of cocoa is modelled as a discrete treatment.

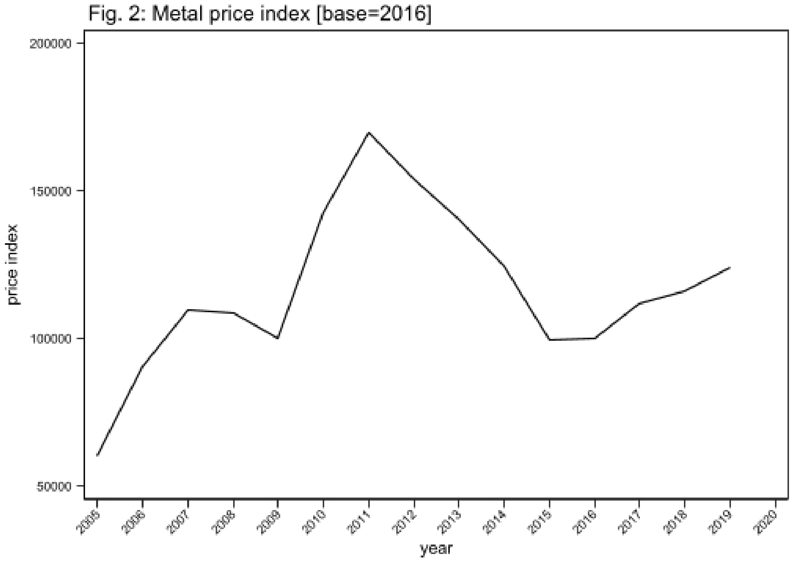
distribution. Our main coefficient of interest is β_1, which captures how individuals' perceptions of the quality of public goods are affected by changes in relative mining revenue.

Our estimations include country-year fixed effects ($\lambda_c \cdot \delta_t$) that control for observed and unobserved characteristics, including resource specialization of the country, the country-level business cycle, and geographic and climatic characteristics, as well as any other country-specific time-varying variable that might affect individuals' perceptions of the quality of public goods. Individual-level controls are captured by vector X_{it}, e.g., age, gender, household composition, urban/rural location, household income.

One possible issue related to specification (1) comes from the estimation of β_1, which may be biased as a result of mismeasurement and simultaneity due to omitted variables. First, mismeasurement error may plague public mining revenues as official statistics may be distorted due to corruption and fraud. Furthermore, public mining revenue may be a poor approximation of the resources devoted to infrastructure for public goods in mining regions as artisanal and small scale (ASM) mining extraction may account for a non-negligible share of total extraction, resulting in public infrastructure development that is not captured by official public revenue figures (Ouoba 2017). A second potential source of bias could result from the unobservability of factors affecting both the perception of the quality of public infrastructure and the public resources resulting from mining activity. For instance, an increase in political or social instability can affect both mining activity (and therefore the public resources it generates) as well as the perception of the quality of infrastructure, which can be damaged or rendered inoperative due to instability and conflict.

To address this issue, we (i) make use of a combination of fixed effects (i.e., time-varying country fixed effects) to address potential biases from omitted variables, and we (ii) rely on an instrumental variable to model mining revenues. In particular, following Bonilla-Mejía (2020) we make use of the exogeneity of international extractive-resource price indices, which should impact mining regions. As can be seen in Figure 2, metal prices[9] boomed until 2012 and then fell quite sharply. We make use of this important variation to instrument our resource revenue variable.

Fig. 2: Metal price index [base=2016]



Source: IMF, commodity prices

[9] Metal prices are represented by monthly statistics collected from IMF's Primary Commodity Prices database, which we have annualized. We specifically rely on the "Base Metals and Precious Metals Index". URL: https://www.imf.org/en/Research/commodity-prices

5. Results

Basic specification

In Table 2, we display the results of specification (1). In the three first columns, besides the mining dummy and its interaction with the resource revenue variable, we control (i) at the individual level for income, age, and gender, and (ii) at the regional level for the urban/rural status of the interviewees' residence. As can be seen from the first two rows, the coefficient of the mining dummy is negative while our interaction term between the mining dummy and relative resource revenue is always positive and significant. While people living in mining regions have a less favorable perception of the quality of public infrastructure, on average, a boom in resource revenues improves their satisfaction more than in non-mining regions. This is consistent with results in Sub-Saharan Africa from Chuhan-Pole et al. 2017, Zabsonné et al. (2018), and Benshaul-Tolonen et al. (2019), who rely on alternative methods and indicators. The effect is strongest for public transportation and road quality, and slightly less strong for education, which does not only involve infrastructure. Even if educational public expenditure increased during resource booms, the perceptible effects of this expenditure may take more time to manifest themselves than for transport infrastructure. Our control variables display standard signs: women and persons with higher income have a slightly more favorable perception of public goods, on average, while age does not seem to play a significant role. Lastly, looking at the regional level, people living in urban areas have a significantly higher perception of public infrastructure. This comes as no surprise given the well-known bias of public spending towards cities.

In columns (4) to (6), we further explore the urban/rural divide of public goods and investigate whether resource booms also disproportionately favor urban areas. To do so, we interact our urban dummy with a mining dummy. While urban dwellers continue to perceive public goods significantly more favorably than rural ones (except for educational spending), the same is true also during resource booms, i.e., during resource revenue booms, public goods are perceived more favorably in urban than in rural areas. Results on our coefficient of interest β_1 remain unchanged in terms of significance and magnitude.

Finally, in the last three columns of Table 3 we exclude the Democratic Republic of Congo (DRC) in columns (1) to (3) and Ghana in columns (4) to (6). DRC is probably one of the most resource-rich countries, to the point that it is often referred to as a "geological scandal". But at the same time, its population is one of the poorest on the continent and the country has been plagued by persistent insecurity and conflict in the last decades. Given the atypical nature of DRC's resource situation and its hypertrophied resource curse, we reran our estimation dropping interviewees from DRC and focusing on the same specifications as in the three first columns. As can be seen, the results unearthed so far seem not to be driven by the DRC case. Mining regions, on average, remain seen as disfavored in terms of public goods by their inhabitants. A resource boom improves this perception, however, and the magnitude of this improvement is narrow among the three public goods measures considered here (i.e., the difference between the estimated coefficients is smaller when the DRC is not part of the sample). We also exclude Ghana, given that it is not only considered a mineral-resource-rich country but is also a major producer of cocoa (about 10 percent of agricultural GDP) and oil (which amounts to 3 to 5 percent of GDP). If prices of commodities are correlated, this would bias our results. However, the results in columns (4) to (6) do not qualitatively change compared to their counterparts in columns (1) to (3) in Table 2.

Overall, our results lend themselves to an interpretation in which mining regions are, on average, structurally lagging in terms of public goods supply, as perceived by inhabitants. However, this perception tends to be pro-cyclical during booms and busts of mining revenues.

Instrumenting resource revenues

In Table 4, we present a two-stage approach to estimate the impact of resource revenues on the quality of public goods provision, correcting for potential endogeneity. More particularly, we rely on a linear-logistic control function approach where we first estimate the model of the endogenous regressor (i.e., resource revenues in mining regions) as a function of instruments (i.e., a price index of metals) and including all other controls of Eq. (1), using OLS. We then recover our residuals, which we use as a supplementary regressor in the second step of our regression, using a logit estimator. Standard errors are obtained through nonparametric bootstrapping.

Except for our third variable of interest, i.e., the perceived quality of the education system or schools, the results remain qualitatively similar although larger in magnitude. While mining regions are perceived to have a lower quality of public services, on average, a boom in resource revenues improves this perception more than in non-mining regions.

Table 2: Basic specification

	(1)	(2)	(3)	(4)	(5)	(6)
	public transportation	roads and highways	education system / schools	public transportation	roads and highways	education system / schools
	Basic spec.			**Urban+mining interact.**		
Mining*Share Res. Rev.	3.1583	2.1998	1.6956	3.0479	2.0818	1.3985
	*(0.3189)****	*(0.3094)****	*(0.3087)****	*(0.3213)****	*(0.3123)****	*(0.3113)****
Mining	-0.1621	-0.2208	-0.2105	-0.1955	-0.2588	-0.2919
	*(0.0414)****	*(0.0420)****	*(0.0399)****	*(0.0430)****	*(0.0440)****	*(0.0415)****
Income	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	*(0.0000)****	*(0.0000)****	*(0.0000)*	*(0.0000)****	*(0.0000)****	*(0.0000)*
Age	0.0012	0.0002	0.0027	0.0012	0.0002	0.0027
	(0.0008)	*(0.0008)*	*(0.0007)****	*(0.0008)*	*(0.0008)*	*(0.0007)****
Woman	0.1168	0.1343	0.1780	0.1170	0.1344	0.1788
	*(0.0219)****	*(0.0222)****	*(0.0213)****	*(0.0219)****	*(0.0222)****	*(0.0214)****
Urban	0.4244	0.4899	0.1606	0.3791	0.4420	0.0443
	*(0.0246)****	*(0.0246)****	*(0.0242)****	*(0.0293)****	*(0.0293)****	*(0.0287)*
Urban*Mining				0.1469	0.1556	0.3828
				*(0.0517)****	*(0.0518)****	*(0.0512)****
Const.	-0.6374	-1.4049	-0.4809	-0.6204	-1.3855	-0.4381
	*(0.1166)****	*(0.1191)****	*(0.1157)****	*(0.1168)****	*(0.1193)****	*(0.1159)****
Country*Year dum.	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Pseudo-R^2	0.0512	0.0345	0.0313	0.0514	0.0346	0.0324
Log-likelihood	-24,178.799	-23,624.177	-25,165.227	-24,174.754	-23,619.662	-25,137.219
Observations	37,603	37,793	37,504	37,603	37,793	37,504

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 3: Excluding DRC and Ghana

	(1)	(2)	(3)	(4)	(5)	(6)
	public transporta-tion	roads and highways	education system / schools	public transporta-tion	roads and highways	education system / schools
	No DRC			**No Ghana**		
Mining*Share Res. Rev.	2.2836	2.2836	2.2836	3.3272	2.8187	1.9412
	*(0.3306)****	*(0.3306)****	*(0.3306)****	*(0.3305)****	*(0.3223)****	*(0.3180)****
Mining	-0.3412	-0.3412	-0.3412	-0.2017	-0.3705	-0.2770
	*(0.0426)****	*(0.0426)****	*(0.0426)****	*(0.0463)****	*(0.0477)****	*(0.0442)****
Income	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	(0.0000)	*(0.0000)*	*(0.0000)*	*(0.0000)****	*(0.0000)****	*(0.0000)*
Age	0.0021	0.0021	0.0021	0.0019	0.0008	0.0030
	*(0.0008)****	*(0.0008)****	*(0.0008)****	*(0.0009)***	*(0.0009)*	*(0.0008)****
Woman	0.1096	0.1096	0.1096	0.1303	0.1499	0.1815
	*(0.0238)****	*(0.0238)****	*(0.0238)****	*(0.0245)****	*(0.0249)****	*(0.0237)****
Urban	0.3138	0.3138	0.3138	0.4362	0.4771	0.1094
	*(0.0271)****	*(0.0271)****	*(0.0271)****	*(0.0282)****	*(0.0282)****	*(0.0277)****
Const.	-0.5891	-0.5891	-0.5891	-0.6586	-1.4017	-0.4746
	*(0.1165)****	*(0.1165)****	*(0.1165)****	*(0.1176)****	*(0.1200)****	*(0.1165)****
Country*Year dum.	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Pseudo-R^2	0.0341	0.0341	0.0341	0.0564	0.0387	0.0344
Log-likelihood	-20,322.623	-20,322.623	-20,322.623	-19,473.558	-19,042.139	-20,475.958
Observations	30,660	30,660	30,660	30,627	30,817	30,597

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 4: Instrumenting resource revenues with the mineral price index

	(1)	(2)	(3)
VARIABLES	public transportation	roads and highways	education system / schools
		Control function: mineral prices	
Mining*Share Res .Rev.	7.5468	6.3454	-1.3652
	*(1.7822)****	*(1.8245)****	*(1.6701)*
Mining	-0.6253	-0.6594	0.1131
	*(0.1904)****	*(0.1953)****	*(0.1773)*
Income	0.0000	0.0000	0.0000
	*(0.0000)***	*(0.0000)***	*(0.0000)*
Age	0.0012	0.0002	0.0027
	(0.0008)	*(0.0008)*	*(0.0007)****
Women	0.1193	0.1367	0.1763
	*(0.0216)****	*(0.0220)****	*(0.0208)****
Urban	0.3825	0.4504	0.1900
	*(0.0293)****	*(0.0307)****	*(0.0294)****
Const.	-0.5810	-1.3524	-0.5198
	*(0.1195)****	*(0.1227)****	*(0.1185)****
Residual 1st step	-4.4943	-4.2575	3.1554
	*(1.7908)***	*(1.8398)***	*(1.7160)**
Country*Year dum.	Yes	Yes	Yes
Pseudo-R^2	0.0513	0.0346	0.0314
Log-likelihood	-24,175.612	-23,621.392	-25,163.582
Observations	37,603	37,793	37,504

Bootstrapped standard errors in parentheses (1000 rep.); *** p<0.01, ** p<0.05, * p<0

6. Conclusion

Although many African countries are endowed with abundant mineral resources, an ample literature has shown that populations have generally benefited little from the exploitation of this wealth. In light of this well-known evidence, there is pressure on extractive companies to contribute to the development of public goods and services (Africa Mining Vision 2009). The improvement can also come from a better allocation of mining revenues towards public goods, social services, and development goals more generally. Initiatives for more transparency, such as the Extractive Industries Transparency Initiative (EITI), can contribute to this process.

The objective of this study is to assess to what extent resources extracted from mining industries have had a perceivable impact on local populations, the main assumption being that increased mining revenues should improve the maintenance and performance of public goods. To do so, we focus our analysis on five major mining nations and take advantage of a natural experiment setting to unearth the perceptions of local populations. In particular, we focus our analysis on three indicators of the perception of the quality of public goods, namely of public transportation, roads and highways, and education systems. Our study complements other studies conducted in Sub-Saharan Africa by exploiting the effects of a boom on mining resources and by using perception indicators measured annually.

While our results do not allow us to disentangle the channels through which mining impacts perception indicators of public goods quality, our main conclusions tend to indicate that people in mining regions perceive these areas to be structurally disadvantaged in terms of public goods, on average, but this perception is pro-cyclical in the presence of resource booms/busts.

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