WPS6366

Policy Research Working Paper 6366

# Poverty, Inequality, and the Local Natural Resource Curse

*Norman Loayza*
*Alfredo Mier y Teran*
*Jamele Rigolini*

The World Bank
Latin America and the Caribbean Region
Office of the Chief Economist
&
Development Economics
February 2013

Policy Research Working Paper 6366

## Abstract

The extent to which local communities benefit from commodity booms has been subject to wide but inconclusive investigations. This paper draws from a new district-level database to investigate the local impact on socioeconomic outcomes of mining activity in Peru, which grew almost twentyfold in the last two decades. The authors find evidence that producing districts have better average living standards than otherwise similar districts: larger household consumption, lower poverty rate, and higher literacy. However, the positive impacts from mining decrease significantly with administrative and geographic distance from the mine, while district-level consumption inequality increases in all districts belonging to a producing province. The inequalizing impact of mining activity, both across and within districts, may explain part of the current social discontent with mining activities in the country, even despite its enormous revenues.

This paper is a product of the office of the Chief Economist, Latin America and the Caribbean Region; and Development Economics. It is part of a larger effort by the World Bank to provide open access to its research and make a contribution to development policy discussions around the world. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The author may be contacted at jrigolini@worldbank.org.

# Poverty, Inequality, and the Local Natural Resource Curse

Norman Loayza
World Bank

Alfredo Mier y Teran
UCLA

Jamele Rigolini [1]
World Bank and IZA

JEL: D7, H7, O1, Q3

Keywords: Natural resource curse, Poverty, Inequality, Living standards

[1] We would like to thank Laura Chioda, Emanuela Galasso, Renos Vakis, Tomoko Wada, and Cynthia van der Werf for their help and feedback. All remaining errors are our own. The findings, interpretations, and conclusions expressed in this paper are entirely those of the authors. They do not necessarily represent the views of the International Bank for Reconstruction and Development/World Bank and its affiliated organizations, or those of the Executive Directors of the World Bank or the governments they represent.

## I. Introduction

To what extent do local communities benefit from commodity booms? The question of high policy relevance given rising commodity prices has been subject to wide but inconclusive investigations. This paper utilizes new data on mining activity and government transfers in Peru to investigate the effect of mining and resource windfalls on socioeconomic outcomes at the district level, the lowest administrative unit in the country.[2]

Peru is entering its second decade of an impressive mining boom. After decades of relative stability, the value of mining exports more than doubled between 1993 to 2000, to 3.2 billion US dollars, and by 2010 exports rose again sevenfold to 21.7 billion US dollars, or 14 percent of the country's GDP. Local governments are benefitting generously from mining activities: the central government transfers to local authorities in mining departments a large share of the taxes levied on mining companies, in the context of an agreement that is commonly referred to as the *Canon Minero*. In 2007, the year of our analysis, the overall budget envelope of the *Canon* amounted to 5.1 billion soles (approximately 1.6 billion US dollars).

Yet, despite these generous transfers, the dramatic expansion of mining activities has been accompanied by rising societal tensions, which have grown to become a major concern for policy makers. In 2009, the *Defensoría del Pueblo* (Ombudsman's office) reported 268 social conflicts in Peru, of which 38 percent were related to mining activities. Major confrontations involved violence and the use of firearms, leading to death and injuries among both protesters and police (Taylor, 2011). While many protesters cite environmental concerns, case studies suggest that the underlying reasons are often more complex, involving revenue sharing disputes between mining companies, local authorities, and local populations (Arellano-Yanguas, 2011). Poor management of the *Canon* also appears to add to the discontent (Hinojosa, 2011).

In this paper we use variation in mining across Peruvian districts to investigate the impact of mining activity and government transfers on local socioeconomic outcomes. The analysis uses a unique, district level dataset that merges administrative data on local mining production, transfers from central to local government, and census and survey-based measures of households' average consumption, poverty, and inequality.

Our empirical approach improves upon the existing literature in two related aspects. First, since we are able to identify the location where the mineral is extracted down to the lowest administrative

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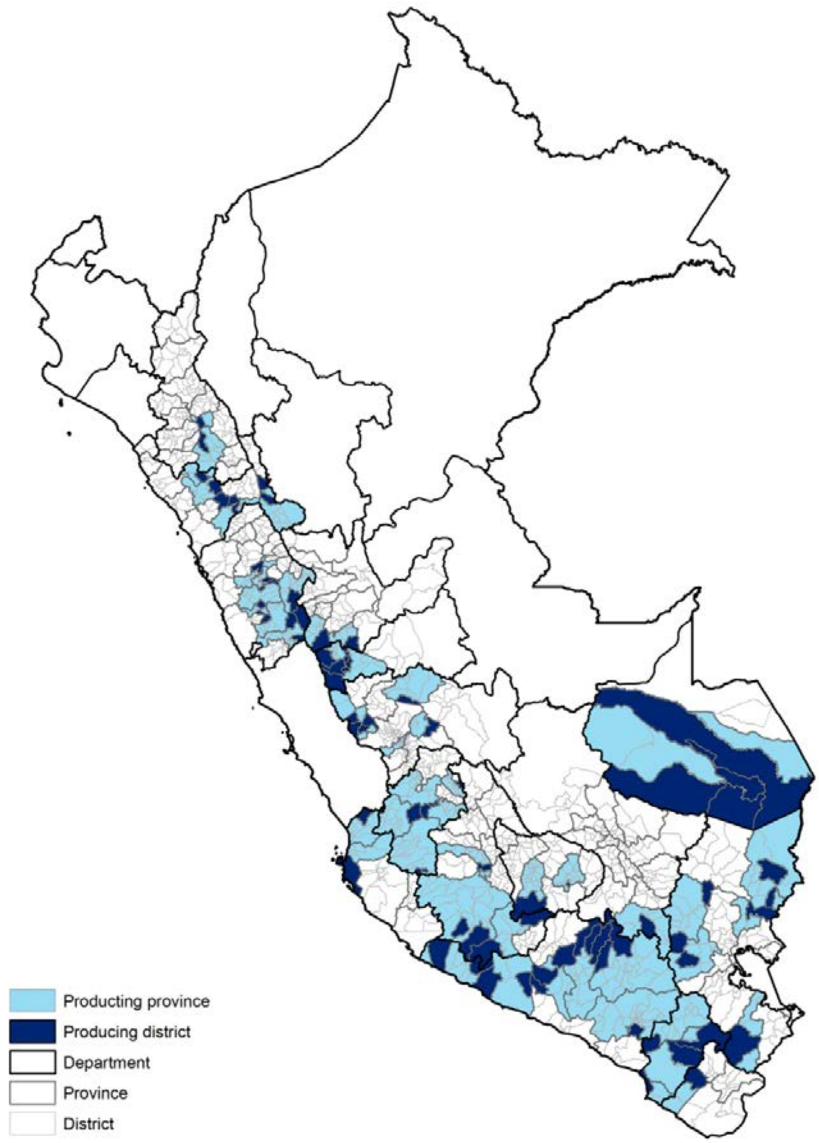
[2] In Peru, sub-national administrative units are called departments, provinces, and districts, in decreasing order of size.

level, we can estimate mining effects on socio-economic outcomes with greater local accuracy and specificity. Second, the precise identification of the location of mines allows us to conduct a thorough study of how far geographically the impacts of mining activity can be observed. This represents an improvement with respect to related studies, which have focused mainly on the aggregate impact over large regions of revenue windfalls derived from oil extraction. In contrast with mines, oil fields and oil wells tend to be spread over several local administrations, making it necessary to conduct impact analyses at higher levels of aggregation (Michaels, 2010). This runs the risk of missing some of the specific local effects and suffers from aggregation bias and greater measurement error (Caselli and Michaels, 2009).

Our identification strategy is based on comparing socioeconomic outcomes in districts where mines are located, with outcomes in neighboring or nearby districts of similar characteristics. Our premise is that, while economic and political factors may influence broad geographical patterns of mining activity, at lower administrative and geographic levels the location of a mine is primarily dictated by geological factors. By comparing neighboring or nearby districts we can therefore minimize omitted variables biases related to endogenous location decisions. Figure 1 reports the location of mining districts and provinces across the Peruvian territory. It shows that mining is concentrated in the Andean region and in the Amazon basin. To reduce potential omitted variable biases, we restrict therefore the analysis to departments that report mining activity and, given how much the capital differs from the rest of the country, we exclude the department of Lima from the sample. Our base sample consists, therefore, of 87 producing districts and 1,195 non-producing districts spread over 142 provinces and 16 departments, with an average of 9 districts per province.

Several findings emerge. In 2007, the year of our analysis, average per capita expenditure in producing districts was around 10 percent higher than in non-producing districts of the same province. Producing districts also faced around 2.5 percentage points lower rates of extreme poverty, and had 2.5 percentage points fewer households with basic needs uncovered. Illiteracy was also lower. When compared to non-producing districts in *other* provinces, impacts are larger: per capita expenditure in producing districts is 14 percent higher, and poverty rate is between three and four percentage points lower. We concentrate our analysis on 2007 because this is when the most recent census was conducted. The previous census had been done in 1993, that is, prior to the mining boom. When we use data corresponding to 1993, we find that mining districts did not exhibit any statistically significant difference with respect to otherwise similar districts, which reinforces the causal interpretation of the impacts of mining activity.

Figure 1: Mineral production in Peru (excluding Lima), 2007




The benefits of mining activity, however, appear to be unevenly distributed. Consumption inequality, as captured by the Gini coefficient, increases in all districts of mining provinces and particularly in those where mining takes place. Moreover, benefits from mining appear to lead to higher inequality *across* districts, as its benefits are substantially higher in producing than in non-producing districts, even those located in the same province.

Next, we conduct a series of alternative analyses to check robustness and enrich the interpretation of our basic results. First, to fully correct for differences in time invariant and 1993 characteristics between districts, we match samples of producing and non-producing districts by means of a propensity score, and test for differences in socioeconomic outcomes using a kernel matching estimator. The results are almost the same as in the benchmark specification. Second, we test the extent to which the magnitude (and not only the presence) of mining activity, measured by the log of the value of mineral production, affects socioeconomic outcomes. We find that larger mines have a stronger impact, both on welfare and inequalities.

Third, to investigate further the geographic impact of mining activity, we refine the spatial analysis and consider the *geographic* proximity of districts, as an alternative to the *administrative* (provincial) proximity in the benchmark specification. We use mapping software to identify direct neighbors of mining districts, as well as their second neighbors. Our findings remain basically unaffected: the positive impacts of mining activity decrease rapidly with (geographic) distance, while income inequality increases in both producing and non-producing districts.

Fourth, the localized impact of mining activity calls for an investigation of the impacts of mining revenues (i.e. the *Canon Minero*) that, to varying degrees, are distributed to all districts in mining departments (the highest subnational administrative level). Because producing districts also receive a higher share of the *Canon*, the specifications described up so far do not distinguish between the impacts from direct mining activity and the effects associated with higher local government revenues through the *Canon*. To overcome this issue, we exploit exogenous variation in the allocation rule of the *Canon* between producing districts, districts in producing provinces, and in non-producing provinces. Then, we control for socioeconomic characteristics that may affect the allocation of the *Canon* by instrumenting each district's mining revenues with the value of mining production at the district, province, and department levels. Once department fixed effects are accounted for, we do not find any significant impact from the *Canon*. This lack of impact is in line with some of the findings from oil extraction studies (Caselli and Michaels, 2009), and calls into question the usefulness of local revenue sharing agreements without accompanying them with strong monitoring and capacity building efforts (Bardhan and Mookherjee, 2006; Loayza, Rigolini and Calvo-Gonzalez, 2011).

Our findings add to an emerging literature that investigates the local impacts of commodities' extraction. How natural resources affect living standards has been subject to wide but inconclusive investigations. Early cross-country studies based on cross-sectional analyses (Sachs and Warner, 1995 and 2001) tend to find a negative association between natural resource abundance and economic growth, but studies exploiting both cross-sectional and times series variation find no effect, or even a positive one (Manzano and Rigobon, 2006; Raddatz, 2007). Institutional differences and the time span of the investigations (short vs. longer term) may explain in part these differences (Mehlum, Moene and Torvik, 2006; Collier and Goderis, 2007; van der Ploeg, 2011). Notwithstanding their contribution, cross-country studies have suffered from uneven data quality and limited treatment of omitted variables that may correlate with resource abundance.

More recent studies have attempted to solve some of these pitfalls by exploiting variation of commodity production within national boundaries. These studies have mostly focused on oil extraction. A pattern partly consistent with cross-country evidence is beginning to emerge. Michaels (2010) studies the impact of oil abundance in Southern US counties on long term development. He finds oil abundance to increase local employment, population growth, per capita income and quality of infrastructure.[3] In developing countries with inferior institutional settings, however, the picture seems to reverse. Caselli and Michaels (2009) look at the impact of backward linkages and revenue windfalls from oil production across municipalities of similar characteristics in Brazil. They find no impact on GDP, and despite higher reported municipal spending on a range of budgetary items, they find little impact on social transfers, public good provision, infrastructure, and household income. Moreover, Dube and Vargas (2006) find that higher oil prices in Colombia boost conflict over the ownership of resource production. Thanks to a greater ability to determine the location of mining activity and the use of different socioeconomic outcomes, our analysis considers the nuanced ability of commodity extraction to benefit local communities at large.

Our findings also put in perspective the analysis of Aragon and Rud (2011), who observe a geographically widespread positive impact of the Yanacocha gold mine in Peru, the second largest in the world. The Yanacocha mine may represent a best case scenario for two reasons. First, its sheer size may extend its impact. Second, as Aragon and Rud (2011) observe, local living standards improved only after international shareholders put pressure on the mine to expand local procurement of its inputs, which calls again for accompanying revenue sharing agreements with institutional building.

Our analysis is also consistent with an emerging literature finding that local officials may handle revenues from commodity extraction differently than other transfers from the central government, which do seem to positively affect human capital and reduce poverty (Litschig, 2008), even if they may foster corruption (Brollo et al., 2010). These differences may stem from a greater ability of local officials

[3] At a higher level of aggregation, however, Papyrakis and Gerlagh (2007) find a negative US state-level correlation between resource extraction and growth.

to capture commodity-related revenues, which may be particularly pronounced when citizens have little knowledge about their magnitude (Monteiro and Ferraz, 2009).

In conclusion, we find that mining activity has a positive effect on the average living standards of producing districts. Against this positive effect, however, we also find that the beneficial impact is accompanied by rising inequality both within and across districts, and that government transfers associated to mining revenues (i.e., the *Canon*) have little effect on poverty alleviation. This nuanced impact may well be at the center of the current social discontent regarding mining activities in the country. Solving this discontent may require a broader discussion and overarching institutional reforms that reach to the current decentralization structure, of which mining revenues are only one component (Loayza, Rigolini and Calvo-Gonzalez, 2011). We leave this discussion to further research.

The paper is organized as follows. Section 2 discusses in greater details the Peruvian mining panorama and the structure of the *Canon Minero*. Section 3 presents the data and empirical methodology. Section 4 presents the results, and Section 5 concludes.

## II. Context

The Peruvian mining sector is experiencing a prolonged boom, with the value of mining-related exports having grown sevenfold in the period between 2001 and 2010, from 3,205 to 21,723 million US dollars. As of 2010, Peru was among the five largest producers of silver, zinc, tin, lead, copper, gold, and mercury in the world. In the same year, mineral exports accounted for 61 percent of total exports.

Mining has become an important source of government income. In an effort to decentralize these windfalls, Peru implemented a sharing scheme called the *Canon Minero*, by which the central government shares 50 percent of all mining companies’ corporate tax revenues with local governments in producing departments. This sharing agreement has been developed in the context of a broader decentralization process, which began in 2002 with the Constitutional reform. To avoid the fiscal crises that had plagued earlier episodes of decentralization in Latin America, decentralization in Peru was heavily anchored around fiscal neutrality (World Bank, 2003). The ability to borrow of sub-national governments (which include department, province and district governments) was strictly limited by law, and the central government imposed strong fiduciary requirements for spending (such as the need to submit proposals and receive clearance from the central government for large capital investments). For districts, a law on participatory budgeting was also passed requiring local authorities, who are elected every four years, to consult each year with their constituency and civil society in planning the budget.

All districts in mining regions have limited ability to raise their own taxes. Thus, their investments in infrastructure and poverty alleviation programs depend on revenues transferred from the central government. The main ones are the *Fondo de Compensación Municipal (FONCOMUN)*, and, since 2002, the *Canon Minero*. While the allocation rule of *FONCOMUN* favors remote and poor districts, the *Canon* is mainly allocated on the basis of mining production value. The *Canon'*s rule is as follows: 50 percent of mining tax revenues are distributed back to subnational governments; of this amount, 10 percent goes directly to the corresponding producing district; 25 percent is distributed among all districts in a producing province; 40 percent is distributed among all districts in a producing department; and the remaining 25 percent is transferred to departmental governments and universities.[4] Apart from the 10 percent transferred directly to producing districts, the allocation of the Canon across all (producing and non-producing districts) also depends on district characteristics that include socioeconomic conditions.

Before the implementation of the *Canon*, *FONCOMUN* represented the main sources of revenues for most districts. However, as a result of Peru's mining boom, the *Canon* has grown substantially, particularly for districts in producing regions. In 2007, the year of our analysis, *FONCOMUN* represented 32.9 percent of districts' budget and the *Canon* 21.4 percent (excluding the Department of Lima). The correlation between the amount of FONCOMUN received from the start of decentralization until the years of our analysis (2002-2006), and being a mining district, is statistically insignificant, hence there may be little crowding out of other government transfers from the *Canon*. Accordingly, we shall find that controlling for additional transfers from the central government does not affect the results.

## III. Data and Methodology

Our outcome variables are a set of district-level living standards measurements for 2007: average per capita expenditure, the poverty and extreme poverty headcount indexes, a measure of uncovered basic necessities, the illiteracy rate, and the Gini coefficient of consumption inequality.

We collect living standard measurements that are representative at the district level by drawing directly from the 1993 and 2007 Censuses and from a poverty map developed by the Peruvian Statistical Institute that combines data from the 2007 Census with 2007 household survey data from the *Encuesta Nacional de Hogares sobre Condiciones de Vida* (INEI, 2009). The advantage of using districts as our unit

[4] Districts are the smallest administrative entity in Peru. A group of districts forms a province and a group of provinces forms a Department. Peru is divided in 25 Departments, 195 Provinces, and 1841 districts.

of analysis is that they are also the smallest administrative unit where the location of a mine can be identified.

In the analysis, we introduce two sets of explanatory variables: variables related to the location and magnitude of mining activity, and control variables. In line with the distribution formula of the *Canon*, and using plant-level mining data from the Peruvian Ministry of Energy and Mining, we distinguish between three types of districts within mining departments:[5] *producing districts*, which hosted a mining facility during 2004-2006; *non-producing districts in producing provinces*, which, despite not hosting any mining activity, receive a larger share of the *Canon* than districts in provinces where there is no mining production; and *non-producing districts in non-producing provinces*, which still receive a share, albeit the smallest, of the *Canon* because they are located in a producing department. Our final sample consists of 87 producing districts, 453 non-producing districts in producing provinces, and 742 non-producing districts in non-producing provinces (Table 2).

For all districts, we use information about the amount of *Canon* they received during 2002-2006; the amount of other government transfers during 2002-06; and the value of mineral production at the district and province level during the same period.[6] In addition, we also use in the analysis time invariant district characteristics such as altitude, area, and the location of provincial capitals, and district socioeconomic characteristics from the 1993 Census, prior to the mining boom (for more details, see Table 1).

Table 2 presents summary statistics of these three groups of districts. Of interest are the two socioeconomic outcomes for which we have information in both 1993 and 2007: illiteracy and basic necessities uncovered. Overall, in 1993, producing districts seemed to display a slightly higher literacy rate than-non producing districts; however this difference disappears once we control for basic district characteristics (Table 3). And there are no significant differences regarding the index of basic necessities uncovered between producing and non-producing districts.  Of the control variables, the only major difference between producing and non-producing districts is regarding geographic area: on average, producing districts have twice the square kilometers than their non-producing counterparts. While at first sight the difference can appear surprising, the selection of larger districts is consistent with random location of mineral abundance across the provincial territory, as larger districts have a higher probability

[5] We exclude from the analysis the department of Lima and departments where no mining activity has taken place during 2002-06.

[6] The value of production at the district level is the log of (one plus the) accumulated dollar value of mineral production by all mining facilities within the district, as reported by the Ministry of Energy and Mining (MINEM) for the period 2002-2006. The mineral prices used are the average annual prices per mineral reported by MINEM for the same period.

of including a mine. Nevertheless, since size may correlate with potential unobserved district characteristics, in the analysis we control for it.

## Methodology

Our identification relies upon comparing producing and non-producing districts that are spatially close and institutionally similar. We do so by means of several exercises. Our baseline case considers all districts from departments with mining activity (excluding the department of Lima), and compares socioeconomic outcomes of producing districts with, in turn, outcomes of non-producing districts in non-producing provinces and outcomes of non-producing districts in the same province of each mining district. We use information from the 1993 Census to control for district characteristics in 1993, prior to the mining boom, so that our baseline regression is as follows:

$$y_{pd} = \alpha + \beta_0 \mathbb{I}_{pd}[PD] + \beta_1 \mathbb{I}_{pd}[NPDPP] + \beta_2 X_{pd} + \nu_d + \nu_p + \varepsilon_{pd} \qquad (1)$$

where, *p* denotes the province, *d* the district, $\mathbb{I}_{pd}[PD]$ a binary variable that takes a value of one if the district is producing, $\mathbb{I}_{pd}[NPDPP]$ a binary variable that takes a value of one if the district is non-producing in a producing province, $X_{pd}$ a set of time invariant and 1993 district characteristics, and $\nu_d, \nu_p, \varepsilon_{pd}$ department, province, and district error terms.

Under this specification, we consider two types of "treatment" districts: producing districts and non-producing districts in producing provinces; and one type of "control districts": non-producing districts in non-producing provinces. Therefore, without province fixed effects, the estimates of $\beta_0$ and $\beta_1$ refer to the respective impacts on the two types of treatment districts with respect to control districts. When we introduce province fixed effects, however, the dummy $\mathbb{I}_{pd}[NPDPP]$ (associated with $\beta_1$) drops out, and the estimate of $\beta_0$ refers to the additional impact on producing districts with respect to non-producing districts in the same province.

Using the specification in (1), we first perform a diagnostic analysis to check the possibility of pre-treatment differences. Drawing from the 1993 Census, we use the 1993 district averages of illiteracy rate and index of basic necessities uncovered (the two dependent variables for which information is available for 1993) and test whether, everything else being equal, the two treatment and one control sets of districts had statistically different levels before the mining boom. Then, we perform a set of exercises to evaluate the impact of the treatment. In the benchmark exercise, we estimate regression (1) by Ordinary Least Squares (OLS) using outcome variables corresponding to 2007.

Next, as an alternative to correct for differences in observed characteristics between mining and non-mining districts, we use a matching procedure based on time invariant and 1993 characteristics (which precede the mining boom). Specifically, we match producing districts with various subsamples of non-producing districts of similar characteristics using a propensity score built upon a probit regression (Table 5). The matching variables are, at the district level, the percentage of households without electricity in 1993; the illiteracy rate in 1993; the log of population in 1993; the percentage of urban population in 1993; the log of the area in square kilometers; and department dummies. We then estimate the Average effect of Treatment on the Treated (ATT) using an Epanechnikov Kernel with a bandwidth of 0.2. We obtain standard errors through bootstrapping, using 100 repetitions.

We then extend the analysis along three important dimensions. First, we go beyond average effects by exploring whether varying magnitudes of mining activity affect socioeconomic indicators differently. We do so by substituting $\mathbb{I}_{pd}[PD]$ in Equation (1) with the log of (one plus) the cumulated value of mineral production in each district between 2002 and 2006. Similarly, we substitute $\mathbb{I}_{pd}[NPDPP]$ with the log of (one plus) the value of mineral production in other districts of the corresponding province between 2002 and 2006.

Second, we refine the spatial analysis by considering the *geographic* proximity between districts, instead of *administrative* proximity (determined by whether districts belong to the same province). Specifically, we use mapping software to identify direct neighbors of mining districts, as well as their second and higher order neighbors. We then run the following regression specification:

$$y_{pd} = \alpha + \beta_0 \mathbb{I}_{pd}[PD] + \beta_1 \mathbb{I}_{pd}[First\ Neighbor] + \beta_2 X_{pd} + \nu_d + \nu_p + \varepsilon_{pd} \qquad (2)$$

where, $\mathbb{I}_{pd}[First\ Neighbor]$ is a dummy variable that takes the value of one if a non-producing district shares a border with a producing district. Under this specification, the omitted districts (the control group) are the second and higher order neighbors (i.e., non-producing districts that are not first neighbors). This approach can be useful in two aspects. One, by focusing attention on districts that share borders and are thus more likely to be similar, it helps addressing further potential omitted variable biases. Two, it allows exploring how much geographic proximity, as opposed to administrative proximity, matters for reaping the benefits of a mine. Specifically, while under specification (1) all non-producing districts in producing provinces are treated as equals, specification (2) distinguishes between first and higher order neighbors, treating them differently even when province fixed effects are introduced.

Finally, we conclude the analysis by attempting to isolate the impact of the *Canon* from the direct effect of the mining activity. For that purpose, we run the following specification:

$$y_{pd} = \alpha + \beta_0 \mathbb{I}_{pd}[PD] + \beta_1 \mathbb{I}_{pd}[NPDPP] + \qquad (3)$$

$$+\beta_2 \text{Log}(Canon_{pd}) + \beta_3 X_{pd} + \nu_d + \nu_p + \varepsilon_{pd}$$

where, $Canon_{pd}$ represents the government transfers related to mining revenue received by each district during 2002-2006. Because the Canon's attribution rule does factor in socioeconomic indicators for the provincial and departmental allocations, we instrument the amount of Canon received by each district with three variables: the log of (one plus) the value of the mineral extracted in each district, province and department between 2002 and 2006.

## IV. Results

We begin the analysis by considering the possibility of preexisting differences between producing and non-producing districts. In particular, we test whether socioeconomic outcomes in 1993 differ between districts where a mine was active during 2002-2006 and districts with no mining activity. The socioeconomic outcomes under consideration are the illiteracy rate and the index of basic necessities uncovered, the two variables for which we have information for 1993.

Results are shown in Table 3. The results corresponding to each outcome variable are organized by rows, with columns assigned to different regression specifications and comparison groups. The comparison groups are defined according to whether or not we include in the regressions department and province dummies. In regression (1), the comparison group consists of all non-producing districts in non-producing provinces. In regression (2), the comparison group is restricted to non-producing districts in non-producing provinces within the same producing department. Finally, in regression (3), we compare producing and non-producing districts in the same province. In all cases, we control for time-invariant district characteristics (provincial capital, log of area, and log of altitude), and district characteristics obtained from the 1993 Census (log of total population, share of rural population, and share of households without electricity).[7] Results are encouraging. While there are differences in the

[7] Observe that, when we look at 1993 outcomes, the analysis may suffer from reverse causality biases. We shall however not devote efforts to attempt to correct for these biases since the core of our analysis deals with

1993 raw means between producing and non-producing districts, once we introduce department fixed effects, all differences disappear except one. The only statistically significant difference that remains is among non-producing districts, where the ones located in producing provinces seem to display lower levels of basic necessities uncovered than those in non-producing provinces. However, once we add province fixed effects, comparing producing and non-producing districts in the same province, all differences disappear. Overall, results in Table 3 suggest that in 1993, prior to the mining boom, producing and non-producing districts did not differ in a statistically significant manner (conditional on the same controls used for the 2007 analysis).

With these results in hand, we move to analyzing whether the mining boom had any impact on mining districts, and how that impact may have trickled down to neighboring districts. In Table 4 we repeat the analysis of Table 3 except that now we use 2007 outcome variables and control for all 1993 variables (including district averages of the illiteracy rate and the index of basic necessities uncovered). In some specifications we also control for the amount of government transfers other than the *Canon* (in logs, accumulated during 2002-06). This is to account for potential transfers aimed at compensating districts that are not favored by the distribution formula of the *Canon*. It turns out that in all regressions the inclusion of other government transfers makes virtually no difference on the outcome variables, and therefore we will devote little time to discussing it.

Regression (1) in Table 4 suggests that in 2007 all districts in producing provinces had better socioeconomic outcomes than their counterparts in non-producing provinces: $\beta_0$ is always significantly different from zero, and $\beta_1$ in all but two cases. The signs of these coefficients indicate that districts in mining provinces show higher average per capita expenditures; lower rates of poverty and extreme poverty (the latter for producing districts only); fewer households with basic necessities uncovered; and lower illiteracy rates (producing districts only). At the same time, districts in producing provinces exhibit higher consumption inequality, as measured by a higher Gini coefficient.

When we refine the control group and introduce department fixed effects (regression (2)), the differences between producing districts and districts in non-producing provinces ($\beta_0$) remain large and significant: on average, households in producing districts display 14 percent higher per capita expenditures, poverty rates are between 3 and 4 percentage points lower, there are 4 percentage points fewer households with basic necessities uncovered, and illiteracy rates are 1.6 percentage points lower.[8] These beneficial impacts contrast with those regarding consumption inequality: the Gini coefficient in

outcomes in 2007, where a clear causal relation can be asserted. Moreover, to correct for such biases we would need to use data on district characteristics prior to 1993, which are unavailable.

[8] Observe that the last two estimates show the net impact after controlling for their 1993 levels.

producing districts is higher by 1 percentage point than in districts of non-producing provinces. Note that controlling for other government transfers, in regression (3), has almost no effect on the coefficients.

Controlling for department fixed effects does change however the results regarding the comparison between non-producing districts ($\beta_1$). Non-producing districts in producing provinces do not exhibit anymore a difference with respect to districts in non-producing provinces of the same department. The only difference that remains significant is regarding consumption inequality, which is higher by 0.7 percentage points of the Gini. Again, controlling for other government transfers, in regression (3), does not change the picture.

In regressions (4) and (5) we compare producing districts with non-producing districts *in the same province* by introducing province fixed effects. While such a comparison minimizes omitted variables biases, it also changes the nature of the comparison because, by introducing province fixed effects, we drop the control group and evaluate the differential impact of mining activity between the two treatment groups. The results show marked differences in the impact of mining activity even within producing provinces: producing districts display better socioeconomic outcomes along all the dimensions we explore, but also higher consumption inequality (differences in the Gini coefficient, however, are now significant only at the 10 percent level).

The results tell a clear and consistent story. First, mining activity has a positive and statistically significant impact on socioeconomic outcomes. The impacts are substantially larger in producing districts than in their neighbors, however. Spillovers beyond the producing districts may occur but not enough to equalize the impact; in fact, socioeconomic outcomes between non-producing districts in producing and non-producing provinces differ only slightly. Second, mining activity, while improving welfare and reducing poverty, also brings higher inequality, both within districts *and* across districts in the same province and department. Finally, considering government transfers other than the *Canon* (i.e., *Foncomun*) does not seem to affect the impact of mining and related transfers, which suggests that these other transfers do not compensate for the advantaged condition of producing districts.

The remainder of the paper deals with the robustness of these results, and expands the analysis along some important dimensions. In Table 5, we adopt an alternative approach to fixed effects to cope with omitted variables biases and test if our results hold under propensity score matching techniques.[9] With small differences, all our findings hold through: when we use the full sample of 1,282 districts

[9] We use department dummies as one of the variables on which we base the propensity score – see Table 5. To avoid sample selection biases, we estimate differences in means using the full sample of districts, but the results are almost identical if we restrict the analysis to the common support.

(comparison 3), producing districts display higher socioeconomic outcomes than non-producing districts, but also display higher inequality. However, when we only select sub-samples of these districts for the comparison, small differences emerge. In columns (1) and (2), we compare producers with non-producers in non-producing provinces and in the same province, respectively. In both cases results weaken for poverty and extreme poverty. Moreover, when we compare producers with non-producers in the same province (comparison 2), the inequality differences are no longer significant. Finally, in column (4) we restrict the analysis to non-producing districts only. In accordance with the OLS results, no differences subsist between districts in producing and those in non-producing provinces *except* for higher inequality.

In Table 6, we go beyond average mining effects and study whether the *magnitude* of mining activity affects socioeconomic outcomes. We measure the magnitude of mining activity in a given district as (the log of one plus) the value of mining production in the district between 2002 and 2006; similarly, we measure mining activity in a province as (the log of one plus) the value of mining production in the province between 2002 and 2006.[10] We then replace the dummies in Equation (1) with these two variables.

Results in Table 6 look almost identical than under average effects. However, their interpretation remains more nuanced, since the *magnitude* of mining activity now matters. In regressions (2) and (3), with department dummies, an increase in district-level mining activity leads to better socioeconomic outcomes, even when correcting for other government transfers per capita. At the same time, higher mining activity also leads to higher inequality. On the other hand, similarly to the results reported in Table 4, for a non-producing district the value of production in other districts in the province does *not* affect any socioeconomic outcome apart from raising inequality. Such a result may come as a surprise since higher production in a province is associated with higher *Canon* transferred to all districts in that province, and suggests a rather weak effect of the *Canon* – something that we explore below in greater details. In regressions (4) and (5) we compare districts within provinces. The results are similar but somewhat weaker than in the regressions with average effects of Table 4. While higher values of production affect positively socioeconomic outcomes (and, again, also lead to higher inequality), the estimates for poverty and extreme poverty, while keeping the correct sign, are now statistically insignificant.

[10] To avoid double counting, for each district we subtract from this last variable the value of production in the district itself.

In Tables 7 to 9 we refine the analysis along the geographical dimension, following Equation (2). Using mapping software, we identify direct (i.e. first) neighbors of producing districts, as well as higher-order neighbors (i.e., districts that are not direct neighbors of producing districts). We then study the extent to which socioeconomic outcomes vary with geographic distance, as opposed to administrative location. This approach allows us to compare, among other things, producing districts with their first and higher-order neighbors *within producing provinces*, reducing further the possibility of omitted variable biases.

Table 7 reports differences in socioeconomic outcomes between producing districts and their higher-order neighbors. The picture that emerges, as well as the magnitude of the estimates, remains very similar to the analysis in Table 4. Along all the dimensions we analyze, producing districts show better socioeconomic outcomes but display also higher consumption inequality. When we introduce province fixed effects, the estimate of extreme poverty loses significance, but all other estimates remain significant.

Table 8 reports differences between first and higher-order neighbors of producing districts. Here as well, in full similarity with the administrative analysis, there are no significant differences in socioeconomic outcomes. First neighbors seem to display a lower proportion of people with basic necessities uncovered, but the difference becomes insignificant once we add province fixed effects. The main difference with the administrative analysis of Table 4 is that we do not observe differences in inequality between first and higher-order neighbors.

Finally, Table 9 compares, by means of a Wald test on $(\beta_0 - \beta_1)$, differences in socioeconomic outcomes between producing districts and their first neighbors. Because of its novelty with respect to the analysis in Table 4, we focus the description on regressions (4) and (5), where we introduce province fixed effects. Even within provinces, producing districts display higher average per capita expenditures, lower rates of extreme poverty, lower illiteracy rates, and higher inequality than their first neighbors. The geographic analysis confirms therefore that the benefits of mining activity accrue substantially more in producing districts, and that mining tends to increase inequalities within and across districts.

To conclude, in Table 10 we attempt to isolate the impact of the *Canon* from the direct effect of mining activities. We correct for direct effects unrelated to the *Canon* by introducing dummies for producing districts and non-producing districts in producing provinces. We then add separately the (log of) the *Canon*, as per Equation (3). To account with the fact that part of the *Canon* is allocated based on socioeconomic outcomes, we instrument it using (the log of one plus) the value of production at the district, province, and department levels. Once we introduce department dummies, we find that the

*Canon* raises average per capita expenditure but has no significant impact on other socioeconomic outcomes. The limited impact of the *Canon* is consistent with the observed challenges districts are facing to manage large transfers from the central government, which have been scaled up in the context of the 2002 decentralization process (Loayza, Rigolini and Calvo-Gonzalez, 2011). This apparent shortcoming calls for reforming the way in which producing regions should share the benefits from mining activity.

## V. Conclusions

Mining activity has had a positive impact on local communities. Mining has brought higher levels of average income, lower poverty, fewer households with basic necessities uncovered, and lower illiteracy rates. The high level of disaggregation of our analysis, and the various checks we perform, indicate that these effects can be interpreted causally. Why, then, is mining creating so much discontent and conflict?

Our analysis highlights several aspects of mining that may counteract its benefits, and which may be at the source of the observed societal tensions. First, the positive impact of mining activity appears to differ between producing districts, and their neighbors. Our analysis consistently points out that districts where the mines are located have substantially better socioeconomic outcomes than their neighbors do. This is the case even with respect to districts located in the same province, which in principle should also strongly benefit from mining through positive spillovers and generous transfers through the *Canon*. Second, mining is not only generating higher inequalities across districts (with producing districts benefitting the most), but is also generating an increase in district-level inequality that extends beyond producing districts, and reaches their non-producing neighbors. Not everybody is thus benefitting as much from mining. Finally, despite their generosity, and reflecting a trend that is emerging in many countries (Caselli and Michaels, 2009), the redistributive arrangements that have been put in place to share the revenues from mining with local communities have had only a limited impact on social outcomes, increasing average expenditures but having a weaker impact on poverty alleviation.

While our analysis provides a comprehensive picture of the local social effects of mining activity, it remains however incomplete regarding their mechanisms. One aspect that deserves further attention is the extent to which migration of people in and out of mining areas is affecting socioeconomic outcomes. Our findings, for instance, are consistent with mining attracting more skilled workers, who may help improving socioeconomic outcomes, but at the same time may also raise inequality. General equilibrium price effects could also drive the poorest households out of mining districts, thus leading to the same measured result. We leave the exploration of these issues for future research.

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## TABLE 1. VARIABLES DEFINITIONS AND SOURCES

| | *Origin* | *Source* |
|---|---|---|
| ***Outcome Variables*** | | |
| *Average Per Capita Monthly Expenditures in 2007 (Soles)* | *2007 Poverty Map* | INEI (2009) |
| *% Population under Poverty Line in 2007*<br>The poverty line is the minimal amount of money needed by an individual to buy goods and services to satisfy basic needs The poverty line varies by Department and urban/rural geographic areas. | *2007 Poverty Map* | INEI (2009) |
| *% Population under Extreme Poverty Line in 2007*<br>The extreme poverty line is the minimal amount of money needed by an individual to satisfy basic food needs The extreme poverty line varies by Department and urban/rural geographic areas. | *2007 Poverty Map* | INEI (2009) |
| *% Population with Basic Needs Uncovered in 2007*<br>A household is deemed to have basic needs uncovered if at least one of the following holds: inadequate or excessively crowded housing, lack of sewage, at least one school aged child does not attend school, unskilled household head with high dependency ratio. | *2007 Census* | National Statistical Institute (INEI) |
| *Illiteracy in 2007 (% of population older than 15 years old)* | *2007 Census* | INEI |
| *Expenditure Gini Coefficient in 2007* | *2007 Poverty Map* | INEI (2009) |
| *Population in 2007* | *2007 Census* | INEI |
| ***Control Variables*** | | |
| *1993 Control Variables* | *2003 Census* | INEI |
| *Producing Districts*<br>Dummy variable that takes the value of one for all districts where there was production of any tax paying mineral (mainly copper, gold, and silver) between 2002 and 2006 | *Administrative Data* | Peruvian Ministry of Energy and Mining (MINEM) |
| *Non-Producers in Producing Provinces*<br>Dummy variable that takes the value of one for Non-Producing Districts in a province where there is at least one Producing District. | *Administrative Data* | MINEM |
| *Non-Producers in Non-Producing Provinces*<br>Dummy variable that takes the value of one for Non-Producing Districts in a Non-Producing Province in a Department where there is at least one Producing District. | *Administrative Data* | MINEM |
| *Value of Mineral Production in a Producing District*<br>Accumulated dollar value of mineral production by all mining facilities within a district as reported by the Ministry of Energy and Mining (MINEM) for the period 2002-2006. The mineral prices used are the average annual prices per mineral reported by MINEM for the same period. | *Administrative Data* | MINEM |
| *Value of Mineral Production in Producing Provinces*<br>For each district it is the sum of the value of production between 2002-2006 at the province level, excluding (if applicable) the value of mineral production realized within a district's own boundaries. | *Administrative Data* | MINEM |
| *Canon Minero*<br>Accumulated per capita revenues from the *Canon Minero* between 2002-2006 in soles. | *Administrative Data* | Peruvian Ministry of Economy and Finance (MEF) |

**TABLE 2. SUMMARY STATISTICS**

MEAN COMPARISON OF OUTCOME AND CONTROL VARIABLES BY GROUPS

| | (1) | (2) | (3) |
|---|---|---|---|
| | *Producers* | *Non-Producers in Producing Provinces* | *Non-Producers in Non-Producing Provinces* |
| **Outcome Variables** | | | |
| *Average Per Capita Monthly Expenditures in 2007 (Soles)* | 346.32 | 285.36 | 213.6 |
| | (504.49) | (1228.86) | (111.00) |
| *% Pop. under Poverty Line in 2007* | 54.22 | 62.3 | 63.9 |
| | (23.09) | (21.48) | (21.93) |
| *% Pop under Extreme Poverty Line in 2007* | 24.50 | 31.3 | 31.4 |
| | (19.49) | (21.03) | (19.73) |
| *% Pop with Basic Necessities Uncovered in 2007* | 25.33 | 29.0 | 31.2 |
| | (9.55) | (13.18) | (12.09) |
| *Illiteracy in 2007 (% of population older than 15 years old)* | 11.66 | 15.4 | 16.5 |
| | (8.43) | (8.68) | (8.85) |
| *Gini in 2007* | 0.30 | 0.3 | 0.3 |
| | (0.04) | (0.04) | (0.04) |
| **Control Variables** | | | |
| *Altitude (meters)* | 2868.13 | 2902.90 | 2,600.0 |
| | (1185.08) | (930.15) | (1210.33) |
| *Area(square kilometers)* | 1039.42 | 422.7 | 437.5 |
| | (2697.44) | (769.39) | (1147.47) |
| *Provincial Capital Dummy* | 0.11 | 0.09 | 0.13 |
| | (0.32) | (0.28) | (0.33) |
| *Population Density in 1993(population per square kilometer)* | 98.74 | 86.74 | 122.05 |
| | (513.37) | (540.85) | (845.21) |
| *% of Rural Population in 1993* | 57.93 | 60.00 | 63.03 |
| | (31.09) | (30.69) | (37.24) |
| *% Pop with Basic Necessities Uncovered in 1993* | 79.88 | 82.73 | 81.48 |
| | (19.45) | (18.32) | (18.48) |
| *% of Households without Electricity in 1993* | 67.24 | 76.6 | 75.1 |
| | (30.26) | (28.03) | (29.02) |
| *Illiteracy in 1993 (% of population older than 15 years old)* | 21.56 | 25.3 | 26.4 |
| | (12.45) | (13.20) | (13.60) |
| *Accumulated Other Gov. Transfers per capita in soles (2002-2006)* | 1146.45 | 1337.79 | 1092.78 |
| | (1084.13) | (1271.60) | (859.17) |
| *Accumulated Canon Minero per capita in soles (2002-2006)* | 715.60 | 434.9 | 182.2 |
| | (1976.69) | (1345.44) | (320.72) |
| **Observations** | 87 | 453 | 742 |

Note: the sample consists of all districts in producing departments excluding districts of the department of Lima. Standard deviations are reported in parentheses below each mean.

**TABLE 3. OLS: SAMPLE OF ALL DISTRICTS IN PRODUCING DEPARTMENTS EXCLUDING LIMA**

IMPACT OF PRODUCING DISTRICTS AND NON-PRODUCING DISTRICTS IN PRODUCING PROVINCES

| | *Producers vs Non-Producers in Non-Producing Provinces ( $\beta_0$)* | | *Non-Producers in Producing Provinces vs Non-Producers in Non-Producing Provinces ( $\beta_1$)* | | *Producers vs Non-Producers in the same Province( $\beta_0$)* |
|---|---|---|---|---|---|
| | (1) | (2) | (1) | (2) | (3) |
| *Dependent Variable* | | | | | |
| *A) % Pop with Basic Necessities Uncovered in 1993* | -1.81 | -0.63 | -2.19*** | -1.31* | -0.86 |
| | (1.37) | (1.33) | (0.78) | (0.76) | (1.24) |
| *B) Illiteracy (% of Population) in 1993* | -3.76*** | -1.90 | -1.91*** | -1.02 | -0.79 |
| | (1.31) | (1.33) | (0.69) | (0.70) | (1.23) |
| *Controls* | | | | | |
| *Provincial Capital Dummies, Log of Area, and Log of Altitude* | YES | YES | YES | YES | YES |
| *Log of Population in 1993* | YES | YES | YES | YES | YES |
| *% of Rural Population in 1993* | YES | YES | YES | YES | YES |
| *% of Households without Electricity in 1993* | YES | YES | YES | YES | YES |
| *Department Dummies* | - | YES | - | YES | - |
| *Provincial Dummies* | - | - | - | - | YES |
| *Observations* | 1282 | 1282 | 1282 | 1282 | 1282 |

Note: Each row in the table reports the coefficients $\beta_0$ and $\beta_1$ of Equation (1) for different dependent variables. The numbers above each column characterize a specific regression that varies in the set of controls included. In this model $\beta_0$ reports the impact of producing districts against the omitted category, and $\beta_1$ reports the impact of non-producing districts in producing provinces. The omitted category is non-producing districts in non-producing provinces for regressions (1) and (2), and non-producing districts in producing provinces for regression (3). Robust Standard Errors are reported in parentheses below each coefficient. *** p<0.01, ** p<0.05, * p<0.1.

**TABLE 4. OLS: SAMPLE OF ALL DISTRICTS IN PRODUCING DEPARTMENTS EXCLUDING LIMA**

IMPACT OF PRODUCING DISTRICTS AND NON-PRODUCING DISTRICTS IN PRODUCING PROVINCES

| | *Producers vs Non-Producers in Non-Producing Provinces ( $\beta_0$)* | | | *Non-Producers in Producing Provinces vs Non-Producers in Non-Producing Provinces ( $\beta_1$)* | | | *Producers vs Non-Producers in the same Province( $\beta_0$)* | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (1) | (2) | (3) | (4) | (5) |
| *Dependent Variable* | | | | | | | | |
| *A) Log of Average Per Capita Expenditures in 2007* | 0.199*** | 0.140*** | 0.138*** | 0.055*** | 0.009 | 0.008 | 0.108*** | 0.109*** |
| | (0.046) | (0.043) | (0.042) | (0.020) | (0.014) | (0.014) | (0.041) | (0.041) |
| *B) % Pop. under Poverty Line in 2007* | -6.406*** | -3.993*** | -3.808*** | -2.282*** | -0.547 | -0.483 | -2.529* | -2.685* |
| | (1.778) | (1.516) | (1.511) | (0.861) | (0.738) | (0.731) | (1.478) | (1.454) |
| *C) % Pop under Extreme Poverty Line in 2007* | -3.748** | -3.252*** | -3.108*** | -0.388 | -0.382 | -0.332 | -2.318* | -2.450* |
| | (1.779) | (1.374) | (1.384) | (0.925) | (0.790) | (0.784) | (1.344) | (1.330) |
| *D) % Pop with Basic Necessities Uncovered in 2007* | -4.972*** | -4.193*** | -4.267*** | -2.092*** | -0.98 | -1.005 | -2.422* | -2.371* |
| | (1.199) | (1.302) | (1.308) | (0.771) | (0.823) | (0.826) | (1.362) | (1.360) |
| *E) Illiteracy in 2007 (% of population older than 15 years old)* | -2.05*** | -1.584*** | -1.556*** | -0.349 | 0.1580 | 0.168 | -1.588*** | -1.615*** |
| | (0.475) | (0.492) | (0.499) | (0.282) | (0.300) | (0.300) | (0.549) | (0.550) |
| *F) Gini in 2007* | 0.017*** | 0.009*** | 0.009*** | 0.01*** | 0.007*** | 0.007*** | 0.006* | 0.006* |
| | (0.004) | (0.003) | (0.003) | (0.002) | (0.001) | (0.001) | (0.003) | (0.003) |
| *Controls* | | | | | | | | |
| *Provincial Capital Dummies, Log of Area, and Log of Altitude* | YES | YES | YES | YES | YES | YES | YES | YES |
| *Log of Population in 1993* | YES | YES | YES | YES | YES | YES | YES | YES |
| *% of Rural Population in 1993* | YES | YES | YES | YES | YES | YES | YES | YES |
| *% Pop with Basic Necessities Uncovered in 1993* | YES | YES | YES | YES | YES | YES | YES | YES |
| *% of Households without Electricity in 1993* | YES | YES | YES | YES | YES | YES | YES | YES |
| *Illiteracy (% of Population) in 1993* | YES | YES | YES | YES | YES | YES | YES | YES |
| *Department Dummies* | - | YES | YES | - | YES | YES | - | - |
| *Provincial Dummies* | - | - | - | - | - | - | YES | YES |
| *Log of Accumulated Other Gov. Transfers per capita in soles (2002-2006)* | - | - | YES | - | - | YES | - | YES |
| *Observations* | 1282 | 1282 | 1282 | 1282 | 1282 | 1282 | 1282 | 1282 |

Note: Each row in the table reports the coefficients $\beta_0$ and $\beta_1$ of Equation (1) for different dependent variables. The numbers above each column characterize a specific regression that varies in the set of controls included. In this model $\beta_0$ reports the impact of producing districts against the omitted category, and $\beta_1$ reports the impact of non-producing districts in producing provinces. The omitted category is non-producing districts in non-producing provinces for regressions (1), (2) and (3), and non-producing districts in producing provinces for regressions (4) and (5). Robust Standard Errors are reported in parentheses below each coefficient. *** p<0.01, ** p<0.05, * p<0.1.

**TABLE 5. PROPENSITY SCORE MATCHING: SUBSAMPLE OF ALL DISTRICTS IN PRODUCING DEPARTMENTS EXLUDING LIMA**

IMPACT OF PRODUCING DISTRICTS AND NON-PRODUCING DISTRICTS IN PRODUCING PROVINCES

| | *Producers vs Non-Producers in Non-Producing Provinces* | *Producers vs Non-Producers in the same Province* | *Producers vs All Non-Producers* | *Non-Producers in Producing Provinces vs Non-Producers in Non-Producing Provinces* |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| *Dependent Variable* | | | | |
| *A) Log of Average Per Capita Expenditures in 2007* | 0.108*** | 0.153** | 0.200*** | 0.010 |
| | (0.044) | (0.073) | (0.064) | (0.030) |
| *B) % Pop. under Poverty Line in 2007* | -2.701 | -4.704* | -6.209*** | -0.788 |
| | (2.631) | (2.761) | (2.359) | (1.703) |
| *C) % Pop under Extreme Poverty Line in 2007* | -2.655 | -3.817* | -4.906*** | -0.675 |
| | (2.248) | (2.274) | (2.110) | (1.551) |
| *D) % Pop with Basic Necessities Uncovered in 2007* | -4.033*** | -3.103*** | -4.451*** | -1.080 |
| | (1.039) | (1.192) | (1.039) | (0.853) |
| *E) Illiteracy (% of population) in 2007* | -2.302** | -2.770*** | -3.327*** | -0.429 |
| | (1.140) | (0.889) | (0.912) | (0.600) |
| *F) Gini in 2007* | 0.009** | 0.006 | 0.010*** | 0.006*** |
| | (0.004) | (0.005) | (0.004) | (0.002) |
| *Observations* | 829 | 540 | 1282 | 1195 |

Note: Results are divided in four columns each containing the estimates of the Average effect of Treatment on the Treated (ATT) for a different set of treatment and control groups. The propensity score is built via a probit where we regress each treatment group on the percentage of households with Basic Necessities Uncovered in 1993, percentage of households with electricity in 1993, illiteracy in 1993, log of population in 1993, percentage of urban population in 1993, log of area, and department dummies. The ATT is estimated using the full sample. Matching is done using an Epanechnikov Kernel with a bandwidth of 0.2. Balancing: Observations are divided in six blocks where all covariates are balanced, except for one department dummy for one block in column 2, and percentage of urban population and three department dummies for one block in column 4. Standard Errors are obtained by bootstrapping (100 repetitions), and are reported in parentheses below each coefficient*** p<0.01, ** p<0.05, * p<0.1.

## TABLE 6. CONTINOUS TREATMENT: SAMPLE OF ALL DISTRICTS IN PRODUCING DEPARTMENTS EXLUDING LIMA

IMPACT OF ACCUMULATED VALUE OF MINERAL PRODUCTION, 2002-2006

| | *Log(1+value of production in the district) No province fixed effects* | | | *Log(1+value of production in the province - value of production in the district) No province fixed effects* | | | *Log(1+value of production in the district) With province fixed effects* | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (1) | (2) | (3) | (4) | (5) |
| *Dependent Variable* | | | | | | | | |
| *A) Log of Average Per Capita Expenditures in 2007* | 0.0049*** | 0.0041*** | 0.0041*** | 0.0010 | 0.0005 | 0.0006 | 0.0037*** | 0.0037*** |
| | (0.0017) | (0.0014) | (0.0014) | (0.0007) | (0.0005) | (0.0005) | (0.0013) | (0.0013) |
| *B) % Pop. under Poverty Line in 2007* | -0.1705*** | -0.0984* | -0.0928* | -0.0370 | -0.0126 | -0.0149 | -0.0647 | -0.0656 |
| | (0.0681) | (0.0523) | (0.0524) | (0.0319) | (0.0253) | (0.0250) | (0.0524) | (0.0513) |
| *C) % Pop under Extreme Poverty Line in 2007* | -0.1457** | -0.1069** | -0.1030** | 0.03094 | 0.00977 | 0.00821 | -0.0791 | -0.0798 |
| | (0.0699) | (0.0493) | (0.0496) | (0.0342) | (0.0278) | (0.0277) | (0.0506) | (0.0500) |
| *D) % Pop with Basic Necessities Uncovered in 2007* | -0.1520*** | -0.1290*** | -0.1287*** | -0.0614** | -0.0282 | -0.0283 | -0.0860* | -0.0859* |
| | (0.0470) | (0.0472) | (0.0472) | (0.0276) | (0.0285) | (0.0284) | (0.0519) | (0.0519) |
| *E) Illiteracy in 2007 (% of population older than 15 years old)* | -0.0594*** | -0.0655*** | -0.0647*** | 0.0022 | 0.0032 | 0.0029 | -0.0609*** | -0.0610*** |
| | (0.0193) | (0.0187) | (0.0188) | (0.0090) | (0.0090) | (0.0090) | (0.0203) | (0.0203) |
| *F) Gini in 2007* | 0.0004*** | 0.0002*** | 0.0002*** | 0.0003*** | 0.0001*** | 0.0001*** | 0.0002*** | 0.0002*** |
| | (0.0002) | (0.0001) | (0.0001) | (0.0001) | (0.0001) | (0.0001) | (0.0001) | (0.0001) |
| *Controls* | | | | | | | | |
| *Provincial Capital Dummies, Log of Area, and Log of Altitude* | YES | YES | YES | YES | YES | YES | YES | YES |
| *Log of Population in 1993* | YES | YES | YES | YES | YES | YES | YES | YES |
| *% of Rural Population in 1993* | YES | YES | YES | YES | YES | YES | YES | YES |
| *% Pop with Basic Necessities Uncovered in 1993* | YES | YES | YES | YES | YES | YES | YES | YES |
| *% of Households without Electricity in 1993* | YES | YES | YES | YES | YES | YES | YES | YES |
| *Illiteracy (% of Population) in 1993* | YES | YES | YES | YES | YES | YES | YES | YES |
| *Department Dummies* | - | YES | YES | - | YES | YES | - | - |
| *Provincial Dummies* | - | - | - | - | - | - | YES | YES |
| *Log of Accumulated Other Gov. Transfers per capita in soles (2002-2006)* | - | - | YES | - | - | YES | - | YES |
| *Observations* | 1282 | 1282 | 1282 | 1282 | 1282 | 1282 | 1282 | 1282 |

Note: Each row in the table reports the coefficients of Equation (1) for different dependent variables. The numbers above each column characterize a specific regression that varies in the set of controls included. Average effects in Equation (1) have been substituted with the log of value of production. Robust Standard Errors are reported in parentheses below each coefficient. *** p<0.01, ** p<0.05, * p<0.1.

**TABLE 7. OLS WITH NEIGHBORS: SAMPLE OF ALL DISTRICTS IN PRODUCING DEPARTMENTS EXCLUDING LIMA**

IMPACT OF PRODUCING DISTRICTS ON SECOND NEIGHBORS

| | *Producers vs Second Neighbors Non-Producers ( $\beta_0$)* | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| *Dependent Variable* | | | | | |
| *A) Log of Average Per Capita Expenditures in 2007* | 0.188*** | 0.135*** | 0.133*** | 0.097*** | 0.099*** |
| | (0.047) | (0.043) | (0.042) | (0.043) | (0.043) |
| *B) % Pop. under Poverty Line in 2007* | -6.000*** | -3.698*** | -3.535*** | -2.467* | -2.793* |
| | (1.779) | (1.405) | (1.401) | (1.467) | (1.435) |
| *C) % Pop under Extreme Poverty Line in 2007* | -3.604** | -2.999*** | -2.868*** | -1.858 | -2.141 |
| | (1.771) | (1.246) | (1.254) | (1.355) | (1.334) |
| *D) % Pop with Basic Necessities Uncovered in 2007* | -4.877*** | -4.236*** | -4.310*** | -2.596* | -2.485* |
| | (1.174) | (1.199) | (1.201) | (1.440) | (1.437) |
| *E) Illiteracy in 2007 (% of population older than 15 years old)* | -1.999*** | -1.857*** | -1.825*** | -1.847*** | -1.91*** |
| | (0.467) | (0.470) | (0.478) | (0.563) | (0.563) |
| *F) Gini in 2007* | 0.014*** | 0.006** | 0.006** | 0.006** | 0.006** |
| | (0.004) | (0.003) | (0.003) | (0.003) | (0.003) |
| *Controls* | | | | | |
| *Provincial Capital Dummies, Log of Area, and Log of Altitude* | YES | YES | YES | YES | YES |
| *Log of Population in 1993* | YES | YES | YES | YES | YES |
| *% of Rural Population in 1993* | YES | YES | YES | YES | YES |
| *% Pop with Basic Necessities Uncovered in 1993* | YES | YES | YES | YES | YES |
| *% of Households without Electricity in 1993* | YES | YES | YES | YES | YES |
| *Illiteracy (% of Population) in 1993* | YES | YES | YES | YES | YES |
| *Department Dummies* | - | YES | YES | - | - |
| *Provincial Dummies* | - | - | - | YES | YES |
| *Log of Accumulated Other Gov. Transfers per capita in soles (2002-2006)* | - | - | YES | - | YES |
| *Observations* | 1282 | 1282 | 1282 | 1282 | 1282 |

Note: Each row in the table reports the coefficient $\beta_0$ of Equation (2) for different dependent variables. The numbers above each column characterize a specific regression that varies in the set of controls included. Robust Standard Errors are reported in parenthesis below each coefficient. *** p<0.01, ** p<0.05, * p<0.1.

**TABLE 8. OLS WITH NEIGHBORS: SAMPLE OF ALL DISTRICTS IN PRODUCING DEPARTMENTS EXCLUDING LIMA**

IMPACT OF FIRST NEIGHBORS OF PRODUCING DISTRICTS ON SECOND NEIGHBORS

| | *First Neighbors Non-Producers vs Second Neighbors Non-Producers ( $\beta_1$)* | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| *Dependent Variable* | | | | | |
| *A) Log of Average Per Capita Expenditures in 2007* | 0.047** | 0.010 | 0.010 | -0.016 | -0.015 |
| | (0.023) | (0.023) | (0.023) | (0.024) | (0.024) |
| *B) % Pop. under Poverty Line in 2007* | -2.035** | -0.555 | -0.481 | -0.386 | -0.608 |
| | (1.028) | (0.779) | (0.769) | (0.799) | (0.787) |
| *C) % Pop under Extreme Poverty Line in 2007* | -0.060 | 0.300 | 0.359 | 0.405 | 0.213 |
| | (1.111) | (0.843) | (0.840) | (0.873) | (0.868) |
| *D) % Pop with Basic Necessities Uncovered in 2007* | -2.926*** | -2.276*** | -2.309*** | -0.7400 | -0.665 |
| | (0.837) | (0.858) | (0.860) | (1.014) | (1.018) |
| *E) Illiteracy in 2007 (% of population older than 15 years old)* | -0.355 | -0.100 | -0.085 | -0.324 | -0.367 |
| | (0.278) | (0.267) | (0.267) | (0.290) | (0.288) |
| *F) Gini in 2007* | 0.006** | 0.002 | 0.002 | 0.001 | 0.001 |
| | (0.003) | (0.002) | (0.002) | (0.002) | (0.002) |
| *Controls* | | | | | |
| *Provincial Capital Dummies, Log of Area, and Log of Altitude* | YES | YES | YES | YES | YES |
| *Log of Population in 1993* | YES | YES | YES | YES | YES |
| *% of Rural Population in 1993* | YES | YES | YES | YES | YES |
| *% Pop with Basic Necessities Uncovered in 1993* | YES | YES | YES | YES | YES |
| *% of Households without Electricity in 1993* | YES | YES | YES | YES | YES |
| *Illiteracy (% of Population) in 1993* | YES | YES | YES | YES | YES |
| *Department Dummies* | - | YES | YES | - | - |
| *Provincial Dummies* | - | - | - | YES | YES |
| *Log of Accumulated Other Gov. Transfers per capita in soles (2002-2006)* | - | - | YES | - | YES |
| *Observations* | 1282 | 1282 | 1282 | 1282 | 1282 |

Note: Each row in the table reports the coefficient $\beta_1$ of Equation (2) for different dependent variables. The numbers above each column characterize a specific regression that varies in the set of controls included. Robust Standard Errors are reported in parenthesis below each coefficient. *** p<0.01, ** p<0.05, * p<0.1.

**TABLE 9. OLS WITH NEIGHBORS: SAMPLE OF ALL DISTRICTS IN PRODUCING DEPARTMENTS EXCLUDING LIMA**

IMPACT OF PRODUCING DISTRICTS ON FIRST NEIGHBORS (WALD TEST $\beta_0 - \beta_1$)

| | *Producers vs First Neighbors Non-Producers (Wald test $\beta_0$- $\beta_1$)* | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| *Dependent Variable* | | | | | |
| *A) Log of Average Per Capita Expenditures in 2007* | 0.142*** | 0.124*** | 0.123*** | 0.114*** | 0.114*** |
| *B) % Pop. under Poverty Line in 2007* | -3.964** | -3.143** | -3.054** | -2.081 | -2.185 |
| *C) % Pop under Extreme Poverty Line in 2007* | -3.544* | -3.299** | -3.228** | -2.263* | -2.353* |
| *D) % Pop with Basic Necessities Uncovered in 2007* | -1.951 | -1.960 | -2.000 | -1.856 | -1.820 |
| *E) Illiteracy in 2007 (% of population older than 15 years old)* | -1.644*** | -1.757*** | -1.740*** | -1.523*** | -1.543*** |
| *F) Gini in 2007* | 0.008* | 0.004 | 0.004 | 0.005* | 0.005* |
| *Controls* | | | | | |
| *Provincial Capital Dummies, Log of Area, and Log of Altitude* | YES | YES | YES | YES | YES |
| *Log of Population in 1993* | YES | YES | YES | YES | YES |
| *% of Rural Population in 1993* | YES | YES | YES | YES | YES |
| *% Pop with Basic Necessities Uncovered in 1993* | YES | YES | YES | YES | YES |
| *% of Households without Electricity in 1993* | YES | YES | YES | YES | YES |
| *Illiteracy (% of Population) in 1993* | YES | YES | YES | YES | YES |
| *Department Dummies* | - | YES | YES | - | - |
| *Provincial Dummies* | - | - | - | YES | YES |
| *Log of Accumulated Other Gov. Transfers per capita in soles (2002-2006)* | - | - | YES | - | YES |
| *Observations* | 1282 | 1282 | 1282 | 1282 | 1282 |

Note: Each row in the table reports the coefficient ($\beta_0 - \beta_1$) of Equation (2) for different dependent variables, where significance has been estimated by means of a Wald test. The numbers above each column characterize a specific regression that varies in the set of controls included. Robust Standard Errors are reported in parenthesis below each coefficient. *** p<0.01, ** p<0.05, * p<0.1.

**TABLE 10. INSTRUMENTAL VARIABLES: SAMPLE OF ALL DISTRICTS IN PRODUCING DEPARTMENTS EXCLUDING LIMA**

IMPACT OF ACCUMULATED CANON MINERO, 2002-2006

| | | *Log(1+Canon minero)* | | |
|---|---|---|---|---|
| | | (1) | (2) | (3) |
| *Dependent Variable* | | | | |
| *A)* | *Log of Average Per Capita Expenditures in 2007* | 0.0186*** | 0.0975** | 0.0948* |
| | | (0.0080) | (0.0482) | (0.0485) |
| *B)* | *% Pop. under Poverty Line in 2007* | -2.1073*** | -0.4141 | -0.2287 |
| | | (0.4393) | (1.9461) | (1.9793) |
| *C)* | *% Pop under Extreme Poverty Line in 2007* | -0.7837** | 1.752 | 1.9814 |
| | | (0.4008) | (2.0306) | (2.0696) |
| *D)* | *% Pop with Basic Necessities Uncovered in 2007* | 0.5315 | -1.0074 | -1.0549 |
| | | (0.3312) | (1.8702) | (1.8936) |
| *E)* | *Illiteracy (% of population) in 2007* | 0.3343*** | 0.0575 | 0.1094 |
| | | (0.1458) | (0.8652) | (0.8863) |
| *F)* | *Gini in 2007* | 0.0156*** | -0.0027 | -0.0025 |
| | | (0.0015) | (0.0036) | (0.0037) |
| *Controls* | | | | |
| *Producing District Dummies* | | YES | YES | YES |
| *Non Producing District in Producing Province Dummies* | | YES | YES | YES |
| *Provincial Capital Dummies, Log of Area, and Log of Altitude* | | YES | YES | YES |
| *Log of Population in 1993* | | YES | YES | YES |
| *% of Urban Population in 1993* | | YES | YES | YES |
| *% Pop with Basic Necessities Uncovered in 1993* | | | | |
| *% of Households without Electricity in 1993* | | YES | YES | YES |
| *Illiteracy (% of Population) in 1993* | | YES | YES | YES |
| *Department Dummies* | | - | YES | YES |
| *Log of Accumulated Other Gov. Transfers per capita in soles (2002-2006)* | | - | - | YES |
| *Observations* | | 1282 | 1282 | 1282 |

Note: Each row in the table reports the coefficient $\beta_2$ of Equation (3) for different dependent variables. The numbers above each column characterize a specific regression that varies in the set of controls included. The *Canon* is instrumented with the log of (one plus) the accumulated value of mineral production at the district, province and department levels for the same period. Robust Standard Errors are reported in parentheses below each coefficient. *** p<0.01, ** p<0.05, * p<0.1.