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Inequality: Evidence from the Commodity Boom in  
Peru**

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# The Local Impact of Mining on Poverty and Inequality: Evidence from the Commodity Boom in Peru\*

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## Abstract

This paper studies the impact of mining activity on socioeconomic outcomes in local communities in Peru. In the 1990s and 2000s, the value of Peruvian mining exports grew by fifteen times; and since early 2000s, one-half of fiscal revenues from mining have been devolved to local governments. Has this boom benefitted people in local communities? We present preliminary evidence to answer this question. Mining districts have larger consumption per capita and lower poverty rates than otherwise similar districts. However, these positive impacts decrease drastically with administrative and geographic distance from mining centers. Moreover, consumption inequality within mining districts is higher than in comparable nonproducing districts. This dual effect of mining is partially accounted for by the better educated immigrants required and attracted by mining activity. The inequalizing impact of mining, both across and within districts, may help explain the social discontent with mining in Peru, despite its enormous revenues.

JEL: H7, I3, O1, Q3, R5

Keywords: Natural resources, Mining, Poverty, Inequality, Commodity Boom, Peru

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## 1. Introduction

To which extent do local communities benefit from extractive natural resources and commodity booms? The question has been subject to wide but inconclusive research. 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.<sup>1</sup>

For two decades, Peru enjoyed an impressive mining boom. After decades of relative stagnation, the value of mining exports doubled in the 1990s and then rose by more than seven times in the following decade. By the early 2010s, the value of Peru's mining exports averaged nearly 25 billion US dollars, or 14% of GDP and over 50% of total exports. At the beginning of the current decade, Peru was among the five largest producers of silver, zinc, tin, lead, copper, gold, and mercury in the world. The mining boom occurred while the country experienced high and sustained economic growth, which contributed to a remarkable fall in poverty: between 2004 and 2007 alone, national poverty rates dropped by more than 15 percentage points, dropping by a further 20 percentage points – to 22.7 percent – by 2014.

Local Governments in producing regions have obtained large rents derived from mining activity. The central Government transfers 50% of the taxes levied on mining companies to local governments in mining regions. This sharing scheme, called the *Mining Canon*, has been implemented to decentralize resource windfalls; it allocates funds to district, province, and regional governments according to a distribution rule that favors producing localities. The sharing agreement was developed in the context of a broader decentralization process that began in 2002.<sup>2</sup> The Mining Canon's distribution rule is dictated and revised by national law.<sup>3</sup> In 2007, the year of our analysis, the overall budget envelope of the Canon amounted to approximately 1.6 billion US dollars.

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<sup>1</sup> In Peru, sub-national administrative units are called regions, provinces, and districts, where a region is composed of several provinces and, in turn, a province is composed of several districts.

<sup>2</sup> 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 of sub-national Governments to borrow 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.

<sup>3</sup> 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 region; and the remaining 25 percent is transferred to regional Governments and universities. Apart from the 10 percent transferred directly to producing districts, the allocation of the Canon across all (producing and non-producing districts) depends on district characteristics that include population size and socioeconomic conditions.

Yet, despite a substantial decline in poverty – both in urban and rural areas – and generous fiscal transfers, the expansion of mining production has been accompanied by rising social tensions. In 2009, the Office of the Ombudsman (*Defensoría del Pueblo*) 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 protesters and the police (Taylor, 2011). These social tensions are a major concern for policy makers, not least because they have halted or prevented large mining ventures: It is estimated that by 2014 mining investment lost due to social conflicts amounted to \$8-12 billion (4-6% of GDP).<sup>4</sup> While many protesters cite environmental concerns – and limited local participation in environmental assessments may be an important factor behind conflicts (Jaskoski, 2014) – research 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, and Haslam and Tanimoune, 2016).

In this paper we use variation in mining production across Peruvian districts to investigate the impact of mining activity on local socioeconomic outcomes. The analysis uses a unique, district-level dataset that merges administrative data (on local mining production and transfers from central to local governments) with census and survey-based data (on average consumption, poverty, and inequality). The main year of observation is 2007, when the latest national census took place.

Our identification strategy is based on comparing socioeconomic outcomes in mining producing districts with outcomes in neighboring nonproducing districts of otherwise similar characteristics. Our premise is that, while economic and political factors may influence international patterns of mining activity, at lower administrative and geographic levels the location of mining production is primarily dictated by geological factors. By comparing neighboring or nearby districts and controlling for initial conditions, we can reduce biases related to endogenous location decisions.<sup>5</sup>

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 the analysis to regions that report mining activity, and we exclude the province of Lima (where the influential and populous national capital is located). Our sample consists of

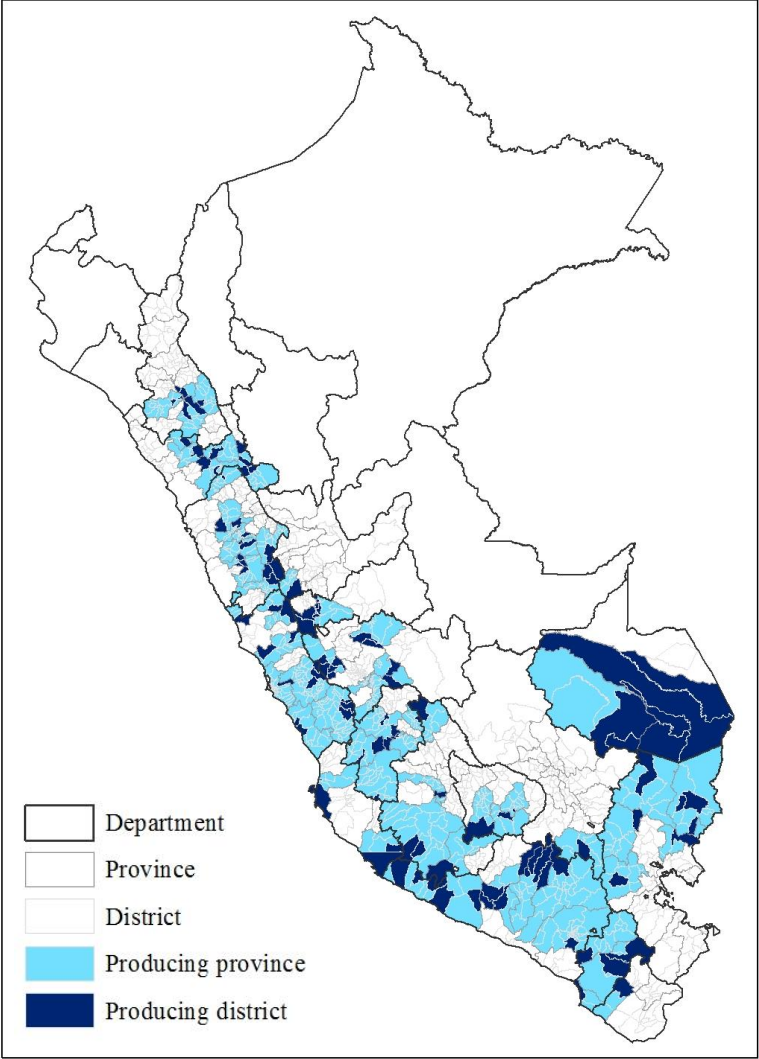
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<sup>4</sup> The figures on investment lost due to conflicts are based on Abusada (2014) and own calculations using information from the Ministry of Energy and Mining (MINEM).

<sup>5</sup> As the recent opposition to the large *Conga* mine exemplifies, *regional* politics within a country can also affect the location of mining activity. That's why we emphasize the within region and province variation when we discuss the results.

104 mining producing districts and 1260 nonproducing districts spread over 140 provinces and 17 regions in Peru.

Figure 1: Mineral production in Peru, 2007



Since we are able to identify the location where the mineral is extracted down to the lowest administrative level, we can estimate mining effects on socioeconomic outcomes with local accuracy and specificity. We can also study the extent to which local mining effects vary with the geographic and administrative distance between producing and nonproducing districts. This represents an improvement with respect to studies that have focused on the aggregate impact of oil-related windfalls over large regions. In contrast with mineral 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 risks of missing some of the specific local effects and suffering from aggregation bias (Caselli and Michaels, 2013).

Several preliminary findings emerge from our analysis. Mining activity appears to be beneficial for districts where production takes place, resulting in higher consumption per capita and lower poverty and extreme poverty rates than in comparable nonproducing districts. The benefits of mining activity, however, seem to be unevenly distributed: Consumption inequality, as captured by the Gini coefficient, is higher in districts of mining provinces and particularly in producing districts. Moreover, the benefits of mining activity are localized to producing districts, with no discernable spillovers to other districts in the same province, not even to close geographic neighbors. Therefore, mining appears to lead also to higher inequality *across* districts.

After conducting a few robustness exercises, which confirm the basic results, we turn our attention to assessing the impact of the Mining Canon itself and to understanding the mechanisms behind the dual effect of mining activity. Regarding the Mining Canon, we use an instrumental variable procedure to deal with its endogeneity and evaluate its impact.<sup>6</sup> We construct an instrument based on a revenue distribution rule that accounts for the district's jurisdictional location and population but abstracts from other socioeconomic characteristics. Once instrumented, the Canon does not seem to have a detrimental effect on districts' per capita consumption, poverty, or inequality.<sup>7</sup> However, it does not appear to have a beneficial effect either. This lack of impact is in line with some of the findings from studies focusing on oil exploitation (Caselli and Michaels, 2013). It calls into question the impact of the current revenue sharing design, in particular in the absence of strong monitoring and capacity building for subnational governments (Bardhan and Mookherjee, 2006; Loayza, Rigolini and Calvo-Gonzalez, 2014).

In order to understand the mechanisms behind the positive (average) and negative (distributional) effects of mining activity, we consider the differences between migrant and native populations. Producing districts have a larger immigrant population than non-producing districts in the same province or in other, non-producing, provinces. Producing districts have better educational indicators than nonproducing districts, but alas, not because of differences across native populations but because of their better-educated immigrants (arguably drawn by mining-related opportunities). On the positive side, native populations in producing districts do have a larger share of salaried workers than native populations in nonproducing districts. These results suggest that the better *average* outcomes

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<sup>6</sup> The Mining Canon distribution rule assigns larger allocations to poorer and less developed districts.

<sup>7</sup> The OLS results show that a larger Mining Canon transfer is associated with *lower* consumption per capita and *higher* poverty index.

enjoyed by producing districts are, in part, explained by the better-educated (and presumably better-paid) immigrants that mining activities require and attract and, only to some extent, explained by the jobs that some natives (presumably the more qualified) are able to get. This may not only explain the better *average* effects, but also the worse *distributional* outcomes regarding higher inequality.

Our findings add to a rich literature that investigates the impact of natural resource exploitation. 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. However, studies exploiting both cross-sectional and time-series variation find no effect or even a positive one (Manzano and Rigobon, 2006; Raddatz, 2007). Differences in institutional settings and time horizons (short vs. longer term) may explain in part these contrasting results (Mehlum, Moene and Torvik, 2006; Collier and Goderis, 2008; van der Ploeg, 2011; Boschini, Pettersson and Roine, 2013). 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 natural resource exploitation within national boundaries. These studies have mostly focused on oil extraction. Michaels (2010) studies the impact of oil abundance in Southern U.S. counties on their long term development. It finds that oil abundance increases local employment, population growth, per capita income, and quality of infrastructure.<sup>8</sup> In developing countries with inferior institutional capacity, however, the picture seems to reverse. Caselli and Michaels (2013) looks at the impact of backward linkages and revenue windfalls from oil production across municipalities of similar characteristics in Brazil. It finds no impact on GDP; and despite higher reported municipal spending on a range of budgetary items, the paper finds little impact on social transfers, public good provision, infrastructure, and household income. Moreover, Dube and Vargas (2006) finds 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 can measure local effects with more precision and make progress in understand their mechanisms.

Our cross-district analysis also complements and builds upon existing studies of the local impacts of mining on social and political outcomes. Sociological studies have found mining to play a fundamental role in shaping rural development, as a product of the interaction between communities, mining companies, and the State (Bebbington et al., 2008). An active literature has described a relationship

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<sup>8</sup> At a higher level of aggregation, however, Papyrakis and Gerlagh (2007) find a negative US state-level correlation between resource extraction and growth.

between mining exploitation and social conflict, rooted not only on environmental concerns but also on competition for land resources, distribution of fiscal rents, and characteristics of the mining company and concession site (Haslam and Tanimoune, 2016). A link between resource development and local inequality in indigenous societies has also been postulated (O’Faircheallaigh, 1998), but existing research has remained for the most part conceptual. A decentralized setting may add a layer of complexity. A study of mining in the Philippines, for instance, finds that decentralized control over mineral resource wealth have resulted in a highly ambiguous institutional arena, wherein heterogeneous actor coalitions attempt to influence the associated distribution of mineral wealth (Verbrugge, 2015). This echoes the struggle surrounding the management of the Mining Canon in the Peruvian context (Hinojosa, 2011).

Our findings complement and put in perspective existing econometric studies on mining in Peru. Aragon and Rud (2013) study the effects of the Yanacocha gold mine in Peru, the second largest in the world, and find a geographically widespread positive impact. The Yanacocha mine may, however, represent a best-case scenario for two reasons: first, its sheer size may extend its impact beyond its location; and, second, local living standards improved only after international shareholders put pressure on Yanacocha’s management to expand local input procurement. Our findings are consistent with the results of Zegarra, Orihuela and Paredes (2007) and Ticci and Escobal (2015), who, using a propensity score matching methodology, look at the impacts of mining on poverty, migration, and labor-market outcomes. Our econometric specification allows us to expand the analysis to spatial effects, to consider the impact on inequality both within and across districts, and to isolate the effect of fiscal transfers (i.e. the Mining Canon).

Finally, our analysis contributes, albeit tangentially, to an emerging literature on the political economy of fiscal transfers and their use (Brollo et al., 2013). Studying local financing in Brazilian municipalities, Litschig (2012) finds that local officials handle revenues derived from natural resources differently than they do other transfers from the central Government: Only the latter seems to contribute to human capital accumulation and poverty alleviation. These differences may stem from a greater ability of local officials to capture commodity-related revenues, which is particularly pronounced when citizens have little knowledge about their magnitude (Monteiro and Ferraz, 2010).

The paper is organized as follows. Section 2 presents the conceptual framework guiding our empirical analysis, as well as the corresponding data and methodology. Section 3 shows and discusses the results. Section 4 concludes.



## 2. Conceptual Framework, Data and Methodology

### 2.1 Conceptual Framework

There are several channels through which mining activity can affect socioeconomic outcomes. Given the spatial and distributional focus of our analysis, in what follows we discuss the various channels through these two lenses. These mechanisms can be divided into three broad categories. The first is *direct impacts and spillovers of mining on the local economy*. Direct impacts on socioeconomic outcomes happen to a large extent through the labor market, as a consequence of both direct hiring and increased local economic activity.

By impacting local economic activity and offering better paid jobs, mining should have a positive impact on local poverty rates. Nevertheless, the impacts on the native population remain *a priori* unclear. Poverty rates can drop because mining offers better jobs to locals, but also because mining may attract better paid immigrants, so that in relative terms there are fewer poor people. Likewise, the impacts on inequality remain *a priori* ambiguous: depending on whether mining activity benefits skilled more than unskilled workers or attracts a more skilled mix of workers, inequality could increase. It is therefore possible to observe mining both *reducing* poverty and *increasing* inequality.

The second channel through which mining may affect local socioeconomic outcomes is *financial transfers to local municipalities, provinces, and regions* stemming from mining revenues (i.e. the Mining Canon). Such transfers can have an ambiguous impact on both poverty and inequality. First, there is evidence that many municipalities have trouble just managing to spend these additional revenues (Loayza, Rigolini, and Calvo-Gonzalez, 2014). Second, depending on the type of investments, the Mining Canon may have a distributional impact that favors the better-off. Third, some of these rents may be misappropriated through corruption of politicians and people in power.

The third channel are *direct investments of mining companies in producing districts*. Mines, especially large ones, often invest in infrastructure improvements, such as the quality of the road network, that benefit both their own activities and the population at large. It is also the case that large mines contribute directly to local development projects (see Ticci and Escobal, 2015). On average, these direct investments should have a positive effect on poverty – albeit confined to districts close to the mining center – while, here as well, the impact on inequality will depend on the type of investments.

The conceptual framework predicts that mining should have a positive impact on poverty. However, the impact of inequality is *a priori* ambiguous. It would depend on whether mining induces immigration of skilled workers and better employment opportunities for local workers, whether the Mining Canon is used to benefit particular groups of the population, whether the public and private

investment projects have a distributional impact, and whether these labor and capital effects are geographically limited or widely dispersed. Given this conceptual motivation, we begin the empirical analysis by looking at the overall impacts of mining on poverty and inequality depending on administrative and geographic proximity; we then consider the impact of the Mining Canon. To conclude, we examine whether native and immigrant populations are different regarding education and employment, in order to suggest the mechanisms underlying our results.

## 2.2 Data

The unit of observation and analysis is the district, which is the smallest administrative unit in the country. In Peru, a group of districts forms a province, and a group of provinces forms a region. The boundaries between them are based on historical and political jurisdictions and revised only rarely.<sup>9</sup> The advantage of using district-level analysis is that it allows the most precise identification of local effects resulting from mining activity. We only work with districts belonging to regions where some mining production took place in the five years prior to the year of observation, 2007, and we exclude districts in the province of Lima, where the country's capital is located (which makes the province an outlier in most respects). The resulting sample consists of 1364 districts in 140 provinces and 17 regions. Appendix Table A1 provides information on definitions and sources of all variables used in the paper, and Appendix Table A2 presents some summary statistics across groups of districts.

As dependent variables, we consider a set of socioeconomic outcome indicators (at the district level). For purposes of this paper, the most important of them are derived from the country's "poverty map" for 2007: average per capita consumption, poverty and extreme poverty headcount indexes, and the Gini coefficient of consumption inequality. The poverty map was developed by the Peruvian Statistical Institute, combining data from the 2007 Census and the 2007 National Household Survey (INEI, 2009) and following a methodology based on Hentschel, Lanjouw, Lanjouw, and Poggi (2000). In some applications, we also use indicators directly obtained from the National Censuses of 2007 and 1993: illiteracy rate, average years of education of the adult population, immigration rate, employment rate, and public and private infrastructure measures.

Admittedly, by using 2007 as our measurement year, we miss the part of the mining bonanza that happened subsequently. Nevertheless, between 1993 and 2007, an impressive mining boom that multiplied the value of mining exports by about 10 times had already occurred (and just during the preceding five years, 2002-07, mining exports increased by a factor of 5). At any rate, 2007 is the date of

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<sup>9</sup> Peru is divided into 25 regions, 195 provinces, and 1841 districts.

the last Census and poverty map, and it is the last period for which reliable district-level poverty and inequality information can be obtained.

We use two sets of explanatory variables. The first and most important are indicators of the location and magnitude of mining activity, as well as measures of fiscal revenues accruing to districts according to the Mining Canon Law; the second one is a set of control variables chosen to account for initial differences across districts. Using plant-level mining data from the Peruvian Ministry of Energy and Mining (MINEM), we distinguish three types of districts within mining regions: *Producing districts*, which host a mining facility with some mineral production during 2002-2006 and receive the largest share of the Canon; *non-producing districts in producing provinces*, which, despite not having a mining facility, receive a portion of the Canon and could be under the economic influence of mining districts; and *non-producing districts in non-producing provinces*, which receive the lowest share of the Canon and are the least affected by mining activity in the sample. Our sample contains 104 producing districts, 563 non-producing districts in producing provinces, and 697 non-producing districts in non-producing provinces.

Apart from these categorical variables (that is, dummy variables corresponding to the three types of districts), we also use information on the magnitude of mining production and related fiscal revenues. The magnitude of mining activity at the district level is measured as the accumulated value of mineral production by all mining facilities within the district for the period 2002-2006. We obtain the value of mineral production by combining data on production quantities by type of mineral with international prices per mineral, both reported by the Ministry of Energy and Mining (MINEM).<sup>10</sup> Similarly, Mining Canon revenue at the district level is the accumulated value of fiscal transfers received by each district during 2002-2006, as reported by the Ministry of Economy and Finance (MEF).

The second set of explanatory variables consists of control variables, which account for differences across districts other than mining activity or its revenues. First, we include time-invariant district characteristics, such as surface area, altitude, and a binary variable indicating whether the district is a provincial capital. Second, we include district-specific initial conditions, taken from the 1993 Census, such as total population, percentage of rural population, percentage of households with access to clean water and sanitation, percentage of households with electricity, the illiteracy rate, and the percentage of the working-age population with paid work. In addition, to control for remaining characteristics as perceived by the central government, we include the transfers from the central to district governments

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<sup>10</sup> MINEM's production data are disaggregated by type of mineral. We consider the eight minerals whose production accounts for nearly 100% of mining production in the country. They are, gold, silver, copper, zinc, lead, tin, iron and molybdenum.

to fund public services and goods. These transfers, grouped under the program *Foncomun*, are separate from the mining-related transfers of the *Canon*. Our measure consists of the accumulated *Foncomun* transfers received by each district during 2002-2006, as reported by the Ministry of Economy and Finance.

### 2.3 Methodology

Our identification strategy relies upon comparing localities that are spatially close and institutionally similar but differ regarding mining activity. In order to work with similar localities, we use the administrative demarcation of localities into districts, provinces, and regions, focusing on the comparisons between districts belonging to the same region or province. We conduct these comparisons by means of several exercises, which are explained in detail in the following section. Using terms from experimental design, we can consider having two treatment groups --producing districts and nonproducing districts in producing provinces-- and a control group --districts in nonproducing provinces. The comparisons of interest are between each of the treatment groups with the control group, and between the treatment groups with each other.

The basic, benchmark regression equation is the following,

$$Y_d = \beta_0 + \beta_1 \mathbb{I}_d[PD] + \beta_2 \mathbb{I}_d[NPDPP] + \beta_3 D_d + \beta_4 X_d + \nu_R + \nu_p + \varepsilon_d \quad (1)$$

Where,  $d$  denotes district,  $Y_d$  represents a given outcome variable,  $\mathbb{I}_d[PD]$  is a binary variable that takes the value of 1 if the district is producing and 0 otherwise,  $\mathbb{I}_d[NPDPP]$  is a binary variable that takes the value of 1 if the district is non-producing in a producing province and 0 otherwise,  $X_d$  is a set of initial conditions,  $D_d$  is a set of time-invariant district characteristics,  $\nu_R$  is a region fixed effect,  $\nu_p$  is a province fixed effect, and  $\varepsilon_d$  is an error term.

Note that the interpretation of the coefficients of interest,  $\beta_1$  and  $\beta_2$ , depends on whether region and/or province fixed effects are included. When neither region nor province fixed effects are included,  $\beta_1$  estimates the difference in means between producing districts (treatment 1) and districts in nonproducing provinces (control) in any region; and  $\beta_2$  estimates the difference in means between nonproducing districts in producing provinces (treatment 2) and districts in nonproducing provinces (control) in any region. In the tables presented in the paper, these estimates are given under the heading "Across and Within Regions." When region fixed effects are included but not province fixed effects, the meaning of  $\beta_1$  and  $\beta_2$  is similar as above but the comparison is restricted to districts within the same region. In the tables, these estimates are presented under the heading "Within Region." Finally, when province fixed effects are included,  $\mathbb{I}_d[NPDPP]$  drops out, and  $\beta_1$  estimates the difference in means between producing districts (treatment 1) and nonproducing districts in the same province (treatment

2).<sup>11</sup> These estimates are presented under the heading “Within Province.”

The quality of the identification strategy depends on whether treatment and control districts were similar before the “treatment” started, that is, before the mining boom. As mentioned previously, mining activity picked up in Peru in the 1990s and 2000s, with the international commodity boom and the propitious macroeconomic and business conditions in the country. However, mining has been historically important for Peru, and there has always been some mining in certain areas of the country. There are, therefore, reasons to believe that producing and nonproducing districts were not initially similar.

Ideally, we would have liked to have a baseline with information on the outcome variables of interest (income, poverty, and inequality) at an initial period. Then, we could have conducted a difference-in-difference type of comparison. Unfortunately, however, a poverty map before the mining boom is unavailable and cannot be constructed: The previous census, conducted in 1993, was not accompanied by a household survey that would provide income or consumption information.

Nevertheless, we are able to check for some initial differences across districts, prior to the mining boom, using information from the 1993 Census. We consider district-level initial conditions regarding population, education, work, and infrastructure. We conduct the comparison across treatment and control groups by applying the following regression:

$$X_d = \alpha_0 + \alpha_1 \mathbb{I}_d[PD] + \alpha_2 \mathbb{I}_d[NPDPP] + \alpha_3 D_d + \nu_R + \nu_p + \mu_d \quad (2)$$

Where,  $X_d$  represents a given initial condition, and all other variables are as in equation (1).

The results in Table 1 indicate that as of 1993 there were differences between producing and nonproducing districts and, in general, between treatment and control groups. Moreover, with the exception of the proportion of households with electricity, these differences were rather in favor of districts in producing provinces, especially those where mining took place. These differences are reduced when we compare districts within the same region and province but do not fully disappear. The results highlight the importance of controlling for region and province effects and suggest the need to include controls for initial and time-invariant district characteristics, specifically those listed above.

### 3. Results

Using the sample and data outlined above, we conduct the following empirical exercises. First, we present the basic results of comparing the treatment and control groups. Second, we conduct some variations of the basic specification to check for the robustness of the results. Third, we study to what

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<sup>11</sup> Naturally, when province fixed effects are included, region fixed effects become redundant.

extent the effects of mining activity are localized geographically, in the sense of applying only to producing districts without spillovers to their neighbors. Fourth, we consider whether the Mining Canon has an effect on its own and whether it affects the basic results of mining activity. And fifth, we examine a likely mechanism by contrasting outcomes from the overall district population with outcomes from its native population.

### **3.1 Basic results**

Our basic, benchmark results are obtained from estimating regression equation (1), presented above. That is, we estimate the difference in means between treatment and control groups for four outcome variables at the district level: Average per capita consumption, the poverty headcount index, the extreme poverty headcount index, and the Gini coefficient of consumption inequality across households. As mentioned in the previous section, these variables are obtained from the Peru Poverty Map corresponding to 2007. The results are presented in Table 2.

Producing districts (treatment 1) have larger consumption per capita and lower poverty and extreme poverty indexes than non-producing districts, whether the latter are in the same province (treatment 2) or in a non-producing province (control). At the same time, however, producing districts have larger income inequality than non-producing districts. The differences between non-producing districts in a producing province and non-producing districts elsewhere in the same region are not significant, except for income inequality. Therefore, mining activity appears to be related to increased inequality both within producing districts and across districts in the same or other provinces.

The differences in means tend to be larger in size and more statistically significant when comparisons are not limited to the same region or province (first two columns, labeled “Across and Within Regions”). The quality of the identification strategy improves when comparisons are restricted to districts in the same region (intermediate columns, labeled “Within Region”). Although the size and significance of the effects decline, they are arguably more reliable. The sharpest comparison is between the two treatment groups, when we restrict the comparisons to districts within the same province (last column, labeled “Within Province”). Focusing on the last set of results, producing districts have about 9 percent larger per capita consumption than nonproducing districts and 2.6 percentage points less poor and extreme poor population. On the negative side, the Gini coefficient of (consumption) inequality is 0.6 percentage points larger in producing than nonproducing districts.

### **3.2 Robustness**

To check the robustness of the results, we extend the analysis along three dimensions. First, we use propensity score matching to select comparable districts among our sample, as an alternative to

controlling for initial conditions via multiple regression analysis. Second, we take into account the magnitude of mineral production, as an alternative to using a binary, dummy variable approach to characterizing districts in producing provinces. Third, we consider different samples and additional control variables.

#### *Propensity score matching*

As an alternative to using control variables in a regression setting, we use a matching procedure to select comparable producing and nonproducing districts. Specifically, we match producing districts with various subsamples of non-producing districts of similar characteristics using a propensity score built upon a probit regression. With the exception of accumulated Foncomun transfers, the matching variables are the same time-invariant characteristics and initial (1993) conditions used as controls in the basic regression<sup>12</sup>. In addition, to obtain the “Within Region” results, we restrict matches to districts in the same region and then perform the match based on the propensity scores; and we follow an analogous procedure to obtain the “Within Province” results. (Obviously, for the “Across and Within Regions” results, we exclude region and province restrictions and match districts solely on their propensity scores.) 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. The results are presented in Table 3.

The propensity score matching approach is supportive of the basic regression results. Producing districts have higher average per capita consumption and lower poverty and extreme poverty headcount indexes than non-producing districts. These results are uniformly statistically significant when comparing districts across and within regions (first column) and within the same province (last column). The results carry the same signs but are not statistically significant when restricting the comparison to the same region (third column). Also as in the benchmark case, producing districts suffer from higher inequality than any other group of districts, and this result is always statistically significant. Non-producing districts in producing provinces also suffer from higher inequality than districts in nonproducing provinces that are in the same region (fourth column). Focusing on the within province results, the mean differences between producing and nonproducing districts in the same province are larger in magnitude than those obtained under the basic regression.

#### *Magnitude of production*

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<sup>12</sup> As described in Caliendo and Kopeinig (2005), covariates should only be included in the propensity score model if they are either fixed over time or measured before participation in the treatment (i.e. being a producing district). For this reason, Log of Accumulated Foncomun Transfers Per Capita in Soles for 2002-2006 is not included.

Producing districts do vary regarding the value of their mining production. The basic specification does not take into account this variation, and we now check whether accounting for the value of production affects the main results. For this purpose, regression equation (1) is transformed into the following,

$$Y_d = \beta_0 + \beta_1 \mathbb{I}_d[PD] * Prod_d + \beta_2 \mathbb{I}_d[NPDPP] * Prod_p + \beta_3 D_d + \beta_4 X_d + \nu_R + \nu_p + \varepsilon_d \quad (3)$$

Where,  $Prod_d$  is the (log of 1 plus the) accumulated value of mineral production per capita in the district between 2002 and 2006, and  $Prod_p$  is the (log of 1 plus the) accumulated value of mineral production per capita in the corresponding province over the same period.<sup>13</sup> The results are presented in Table 4.

The estimation results that take into account the value of mining production confirm those of the basic specification in all relevant respects. The interpretation of the coefficients, however, is somewhat different since in this case the magnitude of mining activity matters. Larger values of mineral production in a district are related to higher average per capita consumption, lower poverty and extreme poverty indexes, and higher inequality. The coefficient sizes tend to get smaller as region and then province fixed effects are included, remaining however statistically significant. (As in the basic results, the exception is the regression for the index of extreme poverty: there, the coefficient on the value of production becomes larger and statistically significant when comparing across districts in the same region or in the same province.) For non-producing districts, the value of production in their province seems to be related to higher average per capita consumption and higher inequality, with no clear effect regarding poverty rates.

#### *Other Robustness Checks*

We conduct three other robustness checks. The first one expands the set of producing districts by including, in addition, those whose jurisdiction had been divided into two or more districts after 1993 and those that have been identified as mining districts by both Ticci and Escobal (2015) and Zegarra, Orihuela, and Paredes (2007). The number of producing districts then increases from 104 to 116. The second robustness check restricts the sample of districts to those located in the highlands of the country (*Sierra*). This region includes the most traditional mining areas in the country and arguably comprises a more homogenous sample (than in the benchmark regression). The third robustness check adds two additional control variables: An “index of unsatisfied basic needs” generated by the Peruvian Government and based on household characteristics regarding living conditions, access to public infrastructure, education, and earning capacity, using information from the 1993 Census. From the same source, we also add the

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<sup>13</sup> The indicator variable  $\mathbb{I}_d[PD]$  in equation (3) is redundant. We include it for clarity purposes.



percentage of households in the district that are headed by a female. This attempts to take into account the impact of the 1980s civil conflict that affected a considerable portion of Peruvian districts, particularly in the highlands. The results of the three robustness checks are presented in respective panels of Table 5.

The results using the extended set of producing districts are similar to those of the benchmark regression. The estimated coefficients when using the extended sample have the same sign but are slightly smaller and no longer significant in the case of extreme poverty. These changes are to be expected given the imprecision introduced by relaxing the selection of “treatment” districts. In contrast, when the sample is restricted to districts in the highlands, the coefficients not only maintain their sign but are also larger than in the benchmark specification, in absolute terms and relative to their respective standard errors. This implies strengthening the statistical significance of the estimated effects. This is particularly true for poverty and extreme poverty. Finally, when the additional controls on unsatisfied basic needs and female-headed households are added, the results are almost the same as in the benchmark regression, regarding sign, size, and significance of the coefficients, especially when region- and province-specific effects are taken into account.

All in all, we can conclude that, with specific nuances, the basic results are quite robust: mining districts have larger average consumption, lower poverty rates, and higher inequality than non-mining districts, whether in the same province or not; likewise, non-mining districts in producing provinces are similar in all respects to other non-mining districts, except that those in mining provinces have higher inequality.

### 3.3 Localized effects

We now study to what extent the effects of mining activity are localized; that is, whether they apply only to producing districts without spillovers to their geographic neighbors. For this purpose, in addition to using administrative jurisdictions to identify treatment and control groups, we employ a criterion based on geographic proximity. Specifically, we use mapping software to identify first-order and second and higher-order neighbors of mining districts. First neighbors share a border with producing districts, second neighbors share a border with first neighbors, and so on. (Producing districts are identified as such, and not as neighbors of other producing districts.) For this extension, regression equation (1) is transformed into the following,

$$Y_d = \beta_0 + \beta_1 \mathbb{I}_d[PD] + \beta_2 \mathbb{I}_d[First\ Neighbor] + \beta_3 D_d + \beta_4 X_d + \nu_R + \nu_p + \varepsilon_d \quad (4)$$

Under this specification, first neighbors belong to treatment 2, and second and higher-order neighbors correspond to the control group. Note that in this case,  $\mathbb{I}_d[First\ Neighbor]$  is not dropped

when province dummies are included, and, therefore,  $\beta_1$  and  $\beta_2$  can both be estimated within provinces. This approach can be useful in two aspects. First, by focusing attention on districts that share borders and are more likely to be similar, this exercise may help address further potential omitted variable biases. Second, it allows exploration of how much geographic proximity, beyond purely administrative jurisdiction, matters for identifying the effects of mining activity. In particular, while under the basic specification all non-producing districts in producing provinces are treated as equals, the specification in equation (4) allows us to distinguish between first and higher-order neighbors within the same province. The results are presented in Table 6, focusing only on the within-province comparisons.

The comparisons based on geographic proximity confirm the results of the basic specification, with support for the notion of localized effects. Producing districts have larger average per capita consumption and lower poverty rates than neighboring districts. On the other hand, producing districts also present larger inequality than neighboring districts. Regarding the positive effects (i.e., larger average consumption and lower poverty rates), producing districts are almost as different from first neighbors as they are from second (and higher-order) neighbors: the sizes of the coefficients measuring the mean difference between producing districts and the rest are around the same as in the basic regression. For consumption and poverty rates, the estimated differences between first and second (and higher-order) neighbors are not statistically significant. Regarding the negative effects (i.e., larger Gini coefficient), producing districts have more inequality than first neighbors, and they, in turn, feature larger inequality than second (and higher-order) neighbors. These results suggest that the positive effects of mining are confined to producing districts.

### 3.4 The Canon

We now turn to analyzing the Mining Canon, with the dual purpose of evaluating its effect on poverty and inequality and checking whether including it affects the basic results of mining activity. For this purpose, regression equation (3) is augmented as follows,

$$Y_d = \beta_0 + \beta_1 Prod_d + \beta_2 \mathbb{I}_d[NPDPP] * Prod_p + \beta_3 D_d + \beta_4 X_d + \beta_5 * Canon_d + v_R + v_p + \varepsilon_d \quad (5)$$

Where,  $Canon_d$  is the (log of 1 plus) the accumulated value of government transfers during 2002-2006, made in accordance to the Mining Canon Law of 2002 and its addendums. Arguably, regression equation (5) should not be estimated directly by OLS because Canon transfers are jointly endogenous with the dependent variables. In fact, the Mining Canon's distribution rule (for district, province and region allocations) factors in socioeconomic indicators that are closely connected with income, poverty, and inequality measures.

We use an instrumental variable (IV) procedure to deal with the endogeneity of the Canon. We construct an instrument based on a revenue distribution rule that takes into account the district's jurisdictional location and population, while abstracting from other socioeconomic characteristics. Thus, the instrument considers the revenue shares mandated by law according to the location of production (district, province, and region) and population weights. Since 2002, there have been 3 revenue distribution regimes (corresponding to the original canon law and its 2 subsequent modifications). They respectively apply to: 2002-03, 2004, and 2005-present. The instrument is built by following the specific rules of the corresponding regime per year and then accumulating for the period 2002-06. This is done both in total and per capita terms, resulting in 2 instruments. Since only overall revenues at the regional level could be obtained directly from the data, we use the assumption that province and district revenues are proportional to their respective value of mining production. Table 7 presents the results obtained with instrumental variables (through a GMM estimator), and the OLS results for comparison purposes. We focus on the within-province exercise.

Taken at face value, the OLS results suggest a significant association between larger Canon transfers and worse socioeconomic conditions: lower average per capita consumption and higher poverty headcount index. This likely reflects the fact that the Canon allocation is larger for districts that are more in need. In fact, the IV results confirm that the negative OLS results are due to reverse causation: Once instrumented, the Canon does not seem to have a (statistically significant) detrimental effect on districts' per capita consumption and poverty rate. However, it does not appear to have a beneficial impact either. This is an interesting and important topic and deserves further research study.

Finally, the coefficients on the value of mining production retain their sign and significance after the Canon transfer is included. This, together with the lack of a significant Canon effect, suggests that the socioeconomic impact of mining is related to the economic activity itself, rather than the fiscal revenues it generates.

### **3.5 The mechanism: migrants or natives?**

Our analysis uses the district as the unit of observation. This is not only due to data limitations but also to our concern for understanding outcomes at the community level. Districts are not, however, homogenous entities, and aggregate local effects may mask differing impacts on the population. Of particular interest to understand the mechanism of mining effects is the difference between migrant and native populations. The poverty map does not have information at the household level, so that studying the disaggregated effects on consumption and poverty by groups within a district is not feasible. Census data can, however, shed light on our results.

The 2007 Census allows distinguishing between native and immigrant populations. It reports whether the mother of a respondent living in a district was a resident of the same district when the respondent was born. If this is the case, we identify the person as native, and otherwise as immigrant.<sup>14</sup> Then, the first question to address is whether there are significant differences across districts regarding immigration. The results are reported at the bottom of Table 2. Producing districts have larger immigrant populations than non-producing districts in the same province or in other, non-producing, provinces. In fact, the share of immigrants in the total population is over 6 percentage points higher in producing than nonproducing districts.

This raises the question as to whether the better consumption and poverty outcomes observed for mining districts are due to their having wealthier and more educated immigrants. To address this question we compare educational and labor indicators for total and native populations. We present only the mean differences between producing and nonproducing districts in the same province (for which identification is arguably the most precise).<sup>15</sup> The results, presented in Table 8, are remarkable. The educational differences observed for the whole population are driven by immigrants' characteristics: Producing districts have better educational indicators than nonproducing districts because of their well-educated immigrants, not because of differences across native populations. On the positive side, native populations in producing districts do have a larger share of salaried workers than native populations in nonproducing districts.

These results suggest that the better *average* outcomes enjoyed by producing districts are in part explained by the well-educated (and presumably well-paid) immigrants that mining activities require and attract. To some extent, this may explain not only the better outcomes regarding consumption per capita and poverty headcount index but also the worse outcomes regarding inequality. We should not, however, ignore the positive impact of mining on the salaried employment of natives: some of them, presumably the more qualified, seem to get jobs in mining and related economic activities.

#### 4. Conclusions

Mining has a dual impact on local communities in Peru: It has a positive *average* effect but a negative *distributional* effect. On the positive side, producing districts have 9 percent larger per capita consumption than comparable nonproducing districts and 2.6 percentage points less poor and extreme

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<sup>14</sup> The results are robust to other criteria for identifying native population; for instance, whether the head of household has lived in the district for more than five years.

<sup>15</sup> The results are similar for comparisons between producing districts and districts in nonproducing provinces (treatment 1 vs. control).

poor population. On the negative side, the Gini coefficient of inequality is 0.6 percentage points larger in producing than nonproducing districts. Moreover, the positive average benefits are limited to producing districts, with no discernable spillovers to other districts even in the same province. Mining, therefore, appears to lead to higher inequality both within and across local communities.

Mining's dual effect is partly explained by the well-educated (and surely well-paid) immigrants that mining activities require and attract to producing localities. It is also explained by the jobs that some community natives (likely the more qualified) are able to get in industries and services related to mining activity. The distributional impact of mining may explain, at least in part, the social discontent regarding mining activities in the country.

The paper highlights some areas for future research. The first has to do with a better understanding of the connection between social conflict and natural resource extraction. We have underscored the importance of economic distributional effects. Other literature has also highlighted the capture of rents by local politicians, concerns about environmental damage, and cultural alienation of native populations, to name a few. Understanding how these factors influence on their own and interact with each other may elucidate communities' perceptions on the benefits and damages stemming from mining activity, as well as the changes needed for mining to be accepted by local populations.

The second area for future research is regarding the usefulness of fiscal transfers to local governments. In principle these transfers can fund public goods and services that increase welfare in local communities and counteract any possible negative impacts derived from mining activity. We find neither a detrimental nor a beneficial effect from the Mining Canon in Peru. One possibility is that by 2007 it was too soon to obtain any significant effects from a decentralization program that had been working for 5 years. Another possibility is that decentralization in Peru is rather flawed and must be restructured, decreasing the incentives for capture of local governments and improving their managerial and implementation capacity.

Solving the social discontent with mining and allowing mining to reach its full potential on local communities will require a broader discussion and overarching institutional reforms encompassing fiscal, governance, and productive aspects. Should people in local communities be made co-owners of mining companies, by distributing among them stockholder rights and dividends? Should the management of mining revenues be only one component, albeit important, in a comprehensive reform of fiscal decentralization in Peru and other countries facing similar issues?

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**TABLE 1. INITIAL CONDITIONS IN 1993**  
**OLS: SAMPLE OF ALL DISTRICTS IN PRODUCING REGIONS**

<i>Dependent Variable</i>	<i>Across and Within Regions</i>		<i>Within Region</i>		<i>Within Province</i>
	<i>Producing Districts vs Districts in Nonproducing Provinces ( <math>\alpha_1</math> )</i>	<i>Non-Producing Districts in Producing Provinces vs Non-Producers in Non-Producing Provinces ( <math>\alpha_2</math> )</i>	<i>Producing Districts vs Districts in Non-Producing Provinces ( <math>a_1</math> )</i>	<i>Nonproducing Districts in Producing Provinces vs Districts in Non-Producing Provinces ( <math>a_2</math> )</i>	<i>Producing Districts vs Nonproducing districts in the same Province( <math>a_1</math> )</i>
A) <i>Log of Population in 1993</i>	-0.0332 (0.111)	-0.523*** (0.0554)	0.214** (0.106)	-0.211*** (0.0559)	0.497*** (0.0974)
B) <i>% of Rural Population in 1993</i>	-16.91*** (3.015)	-9.549*** (1.432)	-11.28*** (2.678)	-5.179*** (1.446)	-6.384** (2.491)
C) <i>Illiteracy (% of Population) in 1993</i>	-7.316*** (1.331)	-4.818*** (0.705)	-3.808*** (1.244)	-2.483*** (0.687)	-1.295 (1.080)
D) <i>% of Population with Paid Work at the Time of Census in 1993</i>	2.226*** (0.781)	2.269*** (0.446)	0.769 (0.834)	0.587 (0.455)	0.618 (0.850)
E) <i>% of Household with Water Supply</i>	8.150*** (1.968)	4.422*** (1.054)	4.801** (1.888)	2.138** (1.067)	3.131 (1.914)
F) <i>% of Households with Electricity in 1993</i>	-16.04*** (3.007)	-1.444 (1.344)	-14.83*** (2.782)	-2.809** (1.186)	-10.40*** (2.946)
<i>Controls</i>					
<i>Provincial Capital Dummies, Log of Area, and Log of Altitude</i>	YES	YES	YES	YES	YES
<i>Region Dummies</i>	-	-	YES	YES	-
<i>Province Dummies</i>	-	-	-	-	YES
<i>Observations</i>	1,364	1,364	1,364	1,364	1,364

\*\*\* p<0.01; \*\* p<0.05; \* p<0.1.



**TABLE 2. IMPACT OF MINING ACTIVITY BY 2007: BENCHMARK RESULTS**  
**OLS: SAMPLE OF ALL DISTRICTS IN PRODUCING REGIONS**

<i>Dependent Variable</i>	<i>Across and Within Regions</i>		<i>Within Region</i>		<i>Within Province</i>
	<i>Producing Districts vs Districts in Nonproducing Provinces ( b<sub>1</sub> )</i>	<i>Nonproducing Districts in Producing Provinces vs Districts in Nonproducing Provinces ( b<sub>2</sub> )</i>	<i>Producing Districts vs Districts in Nonproducing Provinces ( b<sub>1</sub> )</i>	<i>Nonproducing Districts in Producing Provinces vs Districts in Nonproducing Provinces ( b<sub>2</sub> )</i>	<i>Producing Districts vs Nonproducing districts in the same Province( b<sub>1</sub> )</i>
<b>2007 Poverty Map</b>					
A) <i>Log of Average Per Capita Expenditures</i>	0.156*** (0.0397)	0.0401** (0.0186)	0.116*** (0.0354)	0.0145 (0.0141)	0.0865** (0.0339)
B) <i>% of Population under Poverty Line</i>	-4.840*** (1.606)	-1.098 (0.860)	-2.686* (1.375)	0.215 (0.749)	-2.595** (1.308)
C) <i>% of Population under Extreme Poverty Line</i>	-2.434 (1.628)	0.577 (0.900)	-2.386* (1.251)	0.381 (0.788)	-2.685** (1.219)
D) <i>Gini Coefficient(%)</i>	1.349*** (0.374)	0.609*** (0.218)	0.815*** (0.241)	0.466*** (0.136)	0.556** (0.233)
<b>2007 Census</b>					
E) <i>% Immigrant Population</i>	5.711*** (1.373)	-0.504 (0.578)	6.528*** (1.348)	0.278 (0.599)	6.226*** (1.331)
<i>Controls*</i>					
<i>Region Dummies</i>	-	-	YES	YES	-
<i>Province Dummies</i>	-	-	-	-	YES
<i>Observations</i>	1,364	1,364	1,364	1,364	1,364

\*All regressions include the following control variables: Provincial Capital Dummies; Log of Area; Log of Altitude; Log of Population in 1993; % of Rural Population in 1993; % of Household with Water Supply in 1993; % of Household with Electricity in 1993; % of Illiteracy in 1993 (population older than 15 years old); % of Population with Paid Work at the Time of Census in 1993; Log of Accumulated Foncomun Transfers Per Capita in Soles (2002-2006). Robust standard errors are reported in parentheses below each coefficient.

\*\*\* p<0.01; \*\* p<0.05; \* p<0.1.

**TABLE 2. IMPACT OF MINING ACTIVITY BY 2007: BENCHMARK RESULTS**  
**OLS: SAMPLE OF ALL DISTRICTS IN PRODUCING REGIONS**

<i>Dependent Variable</i>	<i>Across and Within Regions</i>		<i>Within Region</i>		<i>Within Province</i>
	<i>Producing Districts vs Districts in Nonproducing Provinces ( b<sub>1</sub> )</i>	<i>Nonproducing Districts in Producing Provinces vs Districts in Nonproducing Provinces ( b<sub>2</sub> )</i>	<i>Producing Districts vs Districts in Nonproducing Provinces ( b<sub>1</sub> )</i>	<i>Nonproducing Districts in Producing Provinces vs Districts in Nonproducing Provinces ( b<sub>2</sub> )</i>	<i>Producing Districts vs Nonproducing districts in the same Province( b<sub>1</sub> )</i>
<b>2007 Poverty Map</b>					
A) <i>Log of Average Per Capita Expenditures</i>	0.164*** (0.040)	0.0407** (0.019)	0.118*** (0.035)	0.012 (0.014)	0.0938*** (0.034)
B) <i>% of Population under Poverty Line</i>	-5.114*** (1.612)	-1.157** (0.857)	-2.642* (1.366)	0.269 (0.746)	-2.626** (1.317)
C) <i>% of Population under Extreme Poverty Line</i>	-2.605* (1.623)	0.582 (0.894)	-2.132* (1.281)	0.563 (0.799)	-2.466* (1.267)
D) <i>Gini Coefficient(%)</i>	1.22*** (0.374)	0.524** (0.218)	0.803*** (0.241)	0.422*** (0.129)	0.610*** (0.233)
<b>2007 Census</b>					
E) <i>% Immigrant Population</i>	5.716*** (1.374)	-0.364 (0.583)	6.669*** (1.342)	0.517 (0.592)	6.384*** (1.356)
<i>Controls*</i>					
<i>Region Dummies</i>	-	-	YES	YES	-
<i>Province Dummies</i>	-	-	-	-	YES
<i>Observations</i>	1,381	1,381	1,381	1,381	1,381

\*All regressions include the following control variables: Provincial Capital Dummies; Log of Area; Log of Altitude; Log of Population in 1993; % of Rural Population in 1993; % of Household with Water Supply in 1993; % of Household with Electricity in 1993; % of Illiteracy in 1993 (population older than 15 years old); % of Population with Paid Work at the Time of Census in 1993; Log of Accumulated Foncomun Transfers Per Capita in Soles (2002-2006). Robust standard errors are reported in parentheses below each coefficient.

\*\*\* p<0.01; \*\* p<0.05; \* p<0.1.

**TABLE 3. PROPENSITY SCORE MATCHING: AVERAGE EFFECT OF TREATMENT ON THE TREATED (ATT)  
SUBSAMPLE OF ALL DISTRICTS IN PRODUCING REGIONS**

<i>Dependent Variable</i>	<i>Across and Within Regions</i>		<i>Within Region</i>		<i>Within Province</i>
	<i>Producing Districts vs Districts in Nonproducing Provinces ( b<sub>1</sub> )</i>	<i>Nonproducing Districts in Producing Provinces vs Districts in Nonproducing Provinces ( b<sub>2</sub> )</i>	<i>Producing Districts vs Districts in Nonproducing Provinces ( b<sub>1</sub> )</i>	<i>Nonproducing Districts in Producing Provinces vs Districts in Nonproducing Provinces ( b<sub>2</sub> )</i>	<i>Producing Districts vs Nonproducing districts in the same Province( b<sub>1</sub> )</i>
A) <i>Log of Average Per Capita Expenditures</i>	0.198*** (0.054)	0.037 (0.026)	0.066 (0.045)	0.015 (0.024)	0.128*** (0.046)
B) <i>% of Population under Poverty Line</i>	-6.547*** (2.333)	-1.172 (1.311)	-0.712 (2.319)	1.767 (1.254)	-3.610** (1.638)
C) <i>% of Population under Extreme Poverty Line</i>	-4.504** (2.109)	-0.473 (1.207)	-1.712 (1.689)	1.552 (1.273)	-3.793** (1.720)
D) <i>Gini Coefficient(%)</i>	1.155*** (0.433)	0.501 (0.220)	0.831*** (0.283)	0.364*** (0.160)	0.619** (0.281)
<i>Controls*</i>					
<i>Region Dummies</i>	-	-	YES	YES	-
<i>Province Dummies</i>	-	-	-	-	YES
<i>Observations (on common support)</i>	799	1257	795	1242	660

\*The propensity score is built via a probit where each treatment group is regressed on: Provincial Capital Dummies; Log of Area; Log of Altitude; Log of Population in 1993; % of Rural Population in 1993; % of Household with Water Supply in 1993; % of Household with Electricity in 1993; % of Illiteracy in 1993 (population older than 15 years old); % of Population with Paid Work at the Time of Census in 1993. Districts are matched using an epanechnikov kernel method, with a radius of 0.2. Robust standard errors are reported in parentheses below each coefficient. \*\*\* p<0.01; \*\* p<0.05; \* p<0.1.

**TABLE 4. MAGNITUDE OF PRODUCTION: IMPACT OF ACCUMULATED VALUE OF MINING PRODUCTION PER CAPITA  
OLS: SAMPLE OF ALL DISTRICTS IN PRODUCING REGIONS**

<i>Dependent Variable</i>	<u>Across and Within Regions</u>		<u>Within Region</u>		<u>Within Province</u>
	Value of Production in the District per Capita <sup>£</sup>	Dummy for Nonproducing Districts in Producing Provinces * Value of Production in the Province per Capita <sup>£</sup>	Value of Production in the District per Capita <sup>£</sup>	Dummy for Nonproducing Districts in Producing Provinces * Value of Production in the Province per Capita <sup>£</sup>	Value of Production in the District per Capita <sup>£</sup>
A) Log of Average Per Capita Expenditures	0.0170*** (0.00449)	0.00583*** (0.00206)	0.0128*** (0.00386)	0.00282* (0.00162)	0.00897** (0.00349)
B) % of Population under Poverty Line	-0.469*** (0.153)	-0.160* (0.0926)	-0.307** (0.131)	-0.0425 (0.0838)	-0.244* (0.128)
C) % of Population under Extreme Poverty Line	-0.228 (0.148)	0.0744 (0.0959)	-0.264** (0.113)	-0.0139 (0.0849)	-0.244** (0.114)
D) Gini Coefficient (%)	0.132*** (0.0350)	0.0649*** (0.0229)	0.0703*** (0.0245)	0.0411*** (0.0147)	0.0524** (0.0236)
<i>Controls*</i>					
<i>Region Dummies</i>	-	-	YES	YES	-
<i>Province Dummies</i>	-	-	-	-	YES
<i>Observations</i>	1,364	1,364	1,364	1,364	1,364

\*All regressions include the following control variables: Provincial Capital Dummies; Log of Area; Log of Altitude; Log of Population in 1993; % of Rural Population in 1993; % of Household with Water Supply in 1993; % of Household with Electricity in 1993; % of Illiteracy in 1993 (population older than 15 years old); % of Population with Paid Work at the Time of Census in 1993; Log of Accumulated Foncomun Transfers Per Capita in Soles (2002-2006). Robust standard errors are reported in parentheses below each coefficient.

\*\*\* p<0.01; \*\* p<0.05; \* p<0.1.

£ All production values (x) are measured in Soles per capita and transformed to log(1+x).

TABLE 5. OTHER ROBUSTNESS CHECKS

Dependent Variable	Across and Within Regions		Within Region		Within Province
	Producing Districts vs Districts in Nonproducing Provinces ( $\beta_1$ )	Nonproducing Districts in Producing Provinces vs Districts in Nonproducing Provinces ( $\beta_2$ )	Producing Districts vs Districts in Nonproducing Provinces ( $\beta_1$ )	Nonproducing Districts in Producing Provinces vs Districts in Nonproducing Provinces ( $\beta_2$ )	Producing Districts vs Nonproducing districts in the same Province ( $\beta_1$ )
<b>EXTENDED SAMPLE</b>					
A) Log of Average Per Capita Expenditures	0.152*** (0.0374)	0.0416** (0.0182)	0.105*** (0.0329)	0.0138 (0.0137)	0.0808** (0.0315)
B) % of Population under Poverty Line	-4.767*** (1.571)	-1.353 (0.848)	-2.071 (1.294)	0.167 (0.732)	-2.096* (1.248)
C) % of Population under Extreme Poverty Line	-2.051 (1.606)	0.195 (0.886)	-1.628 (1.231)	0.281 (0.782)	-1.855 (1.204)
D) Gini Coefficient	1.268*** (0.368)	0.531** (0.216)	0.758*** (0.233)	0.424*** (0.132)	0.600*** (0.219)
Observations	1,412	1,412	1,412	1,412	1,412
Producing Districts	116	116	116	116	116
<b>ONLY HIGHLANDS</b>					
A) Log of Average Per Capita Expenditures	0.141*** (0.0401)	0.0164 (0.0196)	0.130*** (0.0391)	0.0128 (0.0150)	0.100** (0.0400)
B) % of Population under Poverty Line	-6.403*** (1.763)	-1.114 (0.887)	-4.826*** (1.526)	0.356 (0.783)	-4.089*** (1.501)
C) % of Population under Extreme Poverty Line	-3.583* (1.921)	0.816 (1.002)	-4.330*** (1.535)	0.688 (0.894)	-4.041*** (1.430)
D) Gini Coefficient	1.784*** (0.406)	0.785*** (0.236)	1.225*** (0.264)	0.671*** (0.149)	0.602** (0.280)
Observations	1,115	1,115	1,115	1,115	1,115
Producing Districts	86	86	86	86	86
<b>ADDITIONAL CONTROLS</b>					
A) Log of Average Per Capita Expenditures	0.150*** (0.0380)	0.0460*** (0.0176)	0.118*** (0.0332)	0.0175 (0.0133)	0.0896*** (0.0325)
B) % Pop. under Poverty Line	-4.050** (1.609)	-1.707** (0.825)	-2.672** (1.293)	-0.0464 (0.700)	-2.470* (1.279)
C) % Pop under Extreme Poverty Line	-1.909 (1.655)	0.155 (0.874)	-2.530** (1.200)	0.231 (0.739)	-2.780** (1.200)
D) Gini Coefficient	1.241*** (0.374)	0.679*** (0.217)	0.842*** (0.239)	0.464*** (0.137)	0.648*** (0.237)
Observations	1,364	1,364	1,364	1,364	1,364
Producing Districts	104	104	104	104	104
<b>Controls*</b>					
Region Dummies	-	-	YES	YES	-
Province Dummies	-	-	-	-	YES

\*All regressions include the following control variables: Provincial Capital Dummies; Log of Area; Log of Altitude; Log of Population in 1993; % of Rural Population in 1993; % of Household with Water Supply in 1993; % of Household with Electricity in 1993; % of Illiteracy in 1993 (population older than 15 years old); % of Population with Paid Work at the Time of Census in 1993; Log of Accumulated FONCOMUN Transfers Per Capita in Soles (2002-2006); % of Population in households without drain in 1993; % of Population in overcrowded households in 1993; % of Population in households with kids without schooling in 1993; % of Population in households with unsatisfied physical characteristics in 1993; % of Population in households with economic dependency in 1993. Robust standard errors are reported in parentheses below each coefficient. \*\*\* p<0.01; \*\* p<0.05; \* p<0.1.

**TABLE 6. DIFFERENT IMPACTS ACROSS NEIGHBORING DISTRICTS  
OLS: SAMPLE OF ALL DISTRICTS IN PRODUCING REGIONS**

<i>Dependent Variable</i>	<i>Within Province</i>		
	<i>Producing Districts vs Nonproducing Second Neighbors (<math>\beta_1</math>)</i>	<i>Nonproducing First Neighbors vs Nonproducing Second Neighbors (<math>\beta_2</math>)</i>	<i>Producing Districts vs Nonproducing First Neighbors (<math>\beta_1 - \beta_2</math>)</i>
A) <i>Log of Average Per Capita Expenditures</i>	0.0875** (0.0389)	0.00171 (0.0220)	0.0858** (0.0333)
B) <i>% of Population under Poverty Line</i>	-3.127** (1.390)	-0.858 (0.799)	-2.270* (1.346)
C) <i>% of Population under Extreme Poverty Line</i>	-2.615** (1.315)	0.113 (0.832)	-2.728** (1.266)
D) <i>Gini Coefficient (%)</i>	0.803*** (0.256)	0.399** (0.158)	0.404* (0.237)
<i>Controls*</i>			
<i>Provincial Dummies</i>	YES	YES	YES
<i>Observations</i>	1,364	1,364	1,364

\*All regressions include the following control variables: Provincial Capital Dummies; Log of Area; Log of Altitude; Log of Population in 1993; % of Rural Population in 1993; % of Household with Water Supply in 1993; % of Household with Electricity in 1993; % of Illiteracy in 1993 (population older than 15 years old); % of Population with Paid Work at the Time of Census in 1993; Log of Accumulated FONCOMUN Transfers Per Capita in Soles (2002-2006). Robust standard errors are reported in parentheses below each coefficient. \*\*\* p<0.01; \*\* p<0.05; \* p<0.1.

**TABLE 7. IMPACT OF ACCUMULATED VALUE OF MINING PRODUCTION AND MINING CANON PER CAPITA SAMPLE OF ALL DISTRICTS IN PRODUCING REGIONS**

<i>Dependent Variable</i>	<i>Within Province</i>			
	<i>OLS</i>		<i>IV (2SLS)</i>	
	<i>Value of Mining Production per Capita in the District</i>	<i>Value of Mining Canon per Capita</i>	<i>Value of Mining Production per Capita in the District</i>	<i>Value of Mining Canon per Capita</i>
A) <i>Log of Average Per Capita Expenditures</i>	0.0111*** (0.00364)	-0.0638*** (0.0232)	0.0119*** (0.00377)	-0.0878 (0.0624)
B) <i>% of Population under Poverty Line</i>	-0.337*** (0.130)	2.740** (1.160)	-0.409** (0.159)	4.856 (3.323)
C) <i>% of Population under Extreme Poverty Line</i>	-0.289** (0.119)	1.350 (1.065)	-0.283* (0.146)	1.169 (2.614)
D) <i>Gini Coefficient (%)</i>	0.0581** (0.0251)	-0.169 (0.215)	0.0470* (0.0284)	0.160 (0.573)
<i>Controls*</i>				
<i>Province Dummies</i>	YES	YES	YES	YES
<i>Observations</i>	1,364	1,364	1,364	1,364

\*All regressions include the following control variables: Provincial Capital Dummies; Log of Area; Log of Altitude; Log of Population in 1993; % of Rural Population in 1993; % of Household with Water Supply in 1993; % of Household with Electricity in 1993; % of Illiteracy in 1993 (population older than 15 years old); % of Population with Paid Work at the Time of Census in 1993; Log of Accumulated FONCOMUN Transfers Per Capita in Soles (2002-2006). Robust standard errors are reported in parentheses below each coefficient. \*\*\* p<0.01; \*\* p<0.05; \* p<0.1.

**TABLE 8. EDUCACIONAL AND EMPLOYMENT DIFFERENCES ACROSS NATIVE AND IMMIGRANT POPULATIONS**  
**OLS: SAMPLE OF ALL DISTRICTS IN PRODUCING REGIONS**

<i>Dependent Variable</i>	<i>Producing Districts vs Nonproducing Districts in the Same Province ( <math>\beta_1</math> )</i>		
	<i>Native Population</i>	<i>Immigrant Population</i>	<i>General Population</i>
<b>2007 Census</b>			
<b>Population older than 15 years old</b>			
A) % of Population that is Illiterate	-0.259 (0.299)	-2.921*** (0.500)	-0.917*** (0.281)
B) % of Population with Less Than Primary Education	-0.378 (0.342)	-2.954*** (0.552)	-1.019*** (0.327)
C) % of Population with Primary Education	-0.425 (0.556)	-4.304*** (0.818)	-1.509*** (0.486)
D) % of Population with Secondary Education or Above	0.713 (0.794)	9.130*** (1.322)	4.048*** (0.847)
E) % of Population with Paid Work at the Time of Census	3.574*** (1.064)	10.41*** (1.407)	6.486*** (1.174)
<i>Controls*</i>			
Province Dummies	YES	YES	YES
Observations	1,364	1,364	1,364

\*All regressions include the following control variables: Provincial Capital Dummies; Log of Area; Log of Altitude; Log of Population in 1993; % of Rural Population in 1993; % of Household with Water Supply in 1993; % of Household with Electricity in 1993; % of Illiteracy in 1993 (population older than 15 years old); % of Population with Paid Work at the Time of Census in 1993; Log of Accumulated FONCOMUN Transfers Per Capita in Soles (2002-2006). Robust standard errors are reported in parentheses below each coefficient. \*\*\* p<0.01; \*\* p<0.05; \* p<0.1.



Appendix Table A1. Variables Definitions and Sources

	Type	Source
<b>Outcome Variables</b>		
<i>Average Per Capita Monthly Consumption Expenditures in 2007 (Soles)</i>	2007 Poverty Map	National Statistical Institute (INEI)
<i>Poverty headcount index: Percent of Population under Poverty Line in 2007</i> 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 Region and urban/rural geographic areas.	2007 Poverty Map	National Statistical Institute (INEI)
<i>Extreme poverty headcount index: Percent of Population under Extreme Poverty Line in 2007</i> 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 Region and urban/rural geographic areas.	2007 Poverty Map	National Statistical Institute (INEI)
<i>Gini Coefficient of Consumption Expenditure in 2007</i>	2007 Poverty Map	National Statistical Institute (INEI)
<b>Regressors</b>		
<i>1993 Control Variables</i>	1993 Census	National Statistical Institute (INEI)
<i>Producing Districts</i> Dummy variable that takes the value of one for all districts where there was (tax paying) production of any mineral (mainly copper, gold, and silver) between 2002 and 2006	Administrative Data	Peruvian Ministry of Energy and Mining (MINEM)
<i>Nonproducing districts in Producing Provinces</i> 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	Peruvian Ministry of Energy and Mining
<i>Districts in Nonproducing Provinces</i> Dummy variable that takes the value of one for Non-Producing Districts in a Non-Producing Province in a Region where there is at least one Producing District.	Administrative Data	Peruvian Ministry of Energy and Mining (MINEM)
<i>Value of Mineral Production in Producing District</i> Accumulated value of mineral production by all mining facilities within a district for the period 2002-2006. Quantity of mineral production is reported annually by the Ministry of Energy and Mining (MINEM). Mineral prices are the annual average dollar prices per mineral reported by MINEM. Dollar values are converted into Peruvian Soles using average exchange rates, then divided by the CPI to adjust for inflation, and finally added over 2002-06.	Administrative Data	Peruvian Ministry of Energy and Mining (MINEM)
<i>Value of Mineral Production in Producing Provinces</i> Sum of the value of production across all districts in a producing province for 2002-2006 in (constant price) Soles.	Administrative Data	Peruvian Ministry of Energy and Mining
<i>Foncomun</i> Accumulated revenues from the <i>Foncomun</i> between 2002-2006 in (constant price) Soles.	Administrative Data	Peruvian Ministry of Economy and Finance
<i>Mining Canon</i> Accumulated revenues from the Mining Canon for 2002-2006 in (constant price) Soles.	Administrative Data	Peruvian Ministry of Economy and Finance

**APPENDIX TABLE A2. SUMMARY STATISTICS**  
COMPARISON OF MEANS OF OUTCOME VARIABLES AND REGRESSORS BY GROUPS (Standard deviations in parentheses)

	(1)	(2)	(3)
	<i>Producing Districts</i>	<i>Nonproducing Districts in Producing Provinces</i>	<i>Districts in Nonproducing Provinces</i>
<b>Outcome Variables</b>			
<i>Average Per Capita Monthly Expenditures in 2007 (Soles)</i>	339.57 (462.79)	281.36 (1,102.69)	214.60 (112.09)
<i>% of Population under Poverty Line</i>	52.92 (22.67)	60.46 (21.49)	63.66 (21.97)
<i>% of Population under Extreme Poverty Line</i>	23.29 (20.00)	29.74 (20.81)	31.13 (19.92)
<i>Gini Coefficient (%)</i>	29.86 -3.60	28.71 -3.67	28.42 -4.18
<b>Regressors</b>			
<i>Altitude (meters)</i>	2,812.33 (1,232.11)	2,821.69 (994.06)	2,600.40 (1,219.31)
<i>Area (square kilometers)</i>	551.17 (463.18)	333.09 (432.08)	433.11 (1,171.17)
<i>Provincial Capital Dummy</i>	0.11 (0.31)	0.08 (0.27)	0.11 (0.32)
<i>Log of Population in 1993</i>	8.45 (1.15)	7.81 (1.12)	8.43 (1.08)
<i>% of Rural Population in 1993</i>	54.30 (31.56)	57.55 (28.01)	65.01 (28.74)
<i>% of Household with Water Supply in 1993</i>	22.63 (21.39)	21.50 (21.19)	18.85 (20.90)
<i>% of Households without Electricity in 1993</i>	66.28 (31.45)	77.57 (27.11)	76.53 (27.91)
<i>% of Population that is illiterate in 1993 (population older than 15 years old)</i>	20.44 (12.76)	22.73 (13.33)	26.40 (13.70)
<i>% of Population with Paid Work at the Time of Census in 1993</i>	29.59 (8.07)	29.04 (8.76)	27.08 (6.91)
<i>Accumulated Mineral Production Per Capita Within District In Soles (2002-2006)</i>	284,086.10 (792,933.10)	0.00 0.00	0.00 0.00
<i>Accumulated Foncomun per capita in Soles (2002-2006)</i>	648.01 (469.24)	1,009.40 (842.78)	733.24 (701.80)
<i>Accumulated Mining Canon per capita in soles (2002-2006)</i>	628.59 (1,817.60)	375.29 (1,213.66)	177.41 (336.07)
<b>Observations</b>	104	563	697