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The Non-Monotonic Political Effects of Resource Booms

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Abstract

This study uses variation in natural resource rents and mineral production among Peruvian municipalities to analyze the impact of resource booms on local politicians' behavior and citizens' well-being. Although this topic has recently attracted scholarly interest, existing empirical evidence remains inconclusive regarding whether resource booms are beneficial or detrimental to citizens via their effects on public good provision and living standards. Despite many existing theoretical models allowing for the possibility of non-monotonic responses, empirical literature has largely approached this phenomena using linear models, thus misunderstanding the complex nature of resource booms. By examining recent extraordinary mineral price increases along with particular rules for natural resource rent distribution in Peru, I show that the effects of resource booms on reelection outcomes, political competition, public goods provision, clientelism, and well-being are conditional to the size of the rents in a non-monotonic fashion. These results are robust to endogenous production responses and are consistent with recent theoretical scholarship for resource rich economies.

Keywords: Resource booms, political competition, reelection, intergovernmental transfers.

JEL Classification Numbers: D72, D78, Q33.

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1 Introduction

The abundance of natural resources has been usually linked to poor economic and political performance. Anecdotal evidence and some previous cross-national research suggest that natural resource rich countries are failing in terms of transforming their natural wealth into well-being for their citizens. They are also more vulnerable to a set of economic and political pathologies that negatively affect their growth and economic performance[1]. This has led some scholars to describe this phenomenon as a "resource curse" (See Ross (1999), among others). Despite the significant theoretical work in this area (Mehlun et al. (2006), Robinson et al., 2006, Torvik, 2002, among others), our knowledge about this phenomenon remains limited from an empirical point of view.

This is especially true regarding the political dimensions of the resource curse[2]. Some scholars have suggested that resource abundance can weaken the level of governance and the quality of democracy in resource-rich areas (Jensen and Wantchekon (2004), Morrison (2009), Robinson et al. (2006), among others) but empirical evidence is not conclusive and often contradictory[3]. Although there are differences in terms of the proposed mechanisms, there exists a consensus among researchers that what matters (to best understand this relationship) is the behavior of politicians and political elites. For instance, Jensen and Wantchekon (2004) suggest that the key mechanism to explain the poor institutional and democratic performance in resource-rich areas is the *"......incumbent's discretion over the distribution of natural resource rents"*.

In this paper, I shed light on these issues by studying how a mineral resource boom affects the electoral behavior of politicians and what these consequences are in terms of citizens' well-being. Specifically, I am interested in understanding how mineral resource booms affect reelection outcomes and political competition, paying attention to the instruments politicians use to affect these outcomes including public good provision and clientelism. I then analyze how these dimensions relate to citizens' well-being.

To do so, I exploit variation in mineral resource rents and mineral production across Peruvian municipalities and over time. This variation is caused by a set of rules concerning the allocation of mining transfers to resource-rich areas along with an extraordinary increase in the prices of the most important minerals produced by the country over the past years. This set of rules establishes that a portion of the taxes paid by mining companies and their revenues must be allocated to those areas where the resources are extracted. This is the key element of the research design in this study because it makes it possible to take advantage of variation across local governments with and

[1]Resource abundance has been related to macroeconomic pathologies such as "Dutch disease" (exchange rate appreciation that contracts the trade sector), poor levels of economic growth, high unemployment, low savings, high external debt, export earnings instability and lack of export diversification. See Van der Ploeg (2011), Van der Ploeg and Poelhekke (2017), Venables (2016), Badeeb et al. (2017), and Cust and Poelhekke (2015) for an overview of these issues.

[2]See Deacon (2011) for an overview.

[3]This is particularly so regarding the impact of resource abundance on democracy. Ross (2001) was the first of numerous studies that identify a negative association between natural resource and democracy. More recently, Haber and Menaldo (2011) found evidence questioning this relationship revealing that natural resources are in fact linked to better democratic outcomes.

without access to these transfers, before and after the recent increase of mineral resources prices. Thus, I can explore the causal effect of the increase of natural resource rents on the set of political and economic outcomes described above.

Peru offers an ideal setting to explore the impact of resource abundance on the behavior of local politicians. First, the country is one of the most important mineral producers in the world. Peru is currently the second largest producer of copper and silver, the third largest of zinc and tin, the fourth of lead and molybdenum, and the sixth of gold[4]. Second, and more importantly, there is a significant spatial variation within the country in terms of the type of mineral products exploited in each region, which facilitates the empirical analysis. A third reason relates to the characteristics of the recent mining boom experienced in Peru. Between 1996 and 2010, mineral production expanded five-fold (from US$1.35 billion to US$7.05 US billions) and rents distributed to producer regions increased by 118-fold (from US$7 to US$827 millions). Furthermore, mining rents peaked in 2007 reaching a record of US$1.317 billions. This extraordinary increase in a very short-period have created a small group of rich municipalities that have experienced a dramatic increase in their budgets. A fourth reason concerns the set of rules for the allocation of mining rents across Peruvian municipalities. The current legal framework establishes a distribution rule that not only grants a significant proportion of mining royalties and taxes paid by mining companies to mineral producer districts but also allocates part of these transfers to non-producer districts located in neighboring areas. This fact makes it possible to distinguish between the impacts of a resource boom related to the increase of mining rents (which I call a "rent effect") from the impacts related to changes in the local economy associated with the increase in mineral production (the "production effect")[5]. The final reason is the nature of the local political arena in the country, characterized by its high level of fragmentation and weak connection with national political parties. Thus, the Peruvian case is less sensitive to strategic interactions between local politicians and national political parties that may affect the rules of mining rents distribution.

I construct a unique dataset of mineral production, transfers from central government, electoral outcomes, public good provision, and local government characteristics for the period 1996-2010. To claim causality, my identification strategy exploits the increase of international prices of mineral resources and changes in the distribution rule of mining rents. Using variation in mining rents induced by these two factors, I compare the political and economic outcomes of districts that differ in the level of mining rents they receive from the central government.This design is implemented using two empirical approaches. In the first case, a difference in difference (DID) strategy is used in which mining rents are defined as a continuous treatment. Using mining rents as treatment would

[4]See MINEM (2013) for details.

[5]Conceptually, it is possible to understand how an exogenous rise of mineral prices can lead to an increase in mining transfers caused by a pure price effect without changes in the actual production levels. In this case, the behavior of politicians will be only affected via the increase in local government budgets. However, higher prices can also be associated with an increase in production levels, and these changes in production can lead to the emergence of public "bads" such as environmental degradation, crime, prostitution, etc. These can negatively affect citizens' well-being and influence both the incumbent and citizens' political behavior.

be problematic if rents are also a result of endogenous changes in production levels induced by the boom of mineral prices. Mining Canon revenues –a subset of mining rents– is used as an instrument because it is less sensitive to changes in production than other transfers related to natural resource exploitation. Mining canon revenue depends on the taxes paid by mining companies, and it is distributed to different level of subnational governments following a set of fixed rules that will be explained later. It is however accepted that this is an imperfect instrument because the exclusion restriction might not hold[6]. To address this issue, a sensitivity analysis developed by Nevo and Rosen (2012) is implemented and one-sided bounds are obtained for the treatment effect under study. It is also shown that there are no endogenous responses related to production and that—even if a significant departure from the validity of the exclusion restriction occurs–the main results of the paper are largely unaffected [7].

I find evidence of a non-monotonic relationship between mining rents and political outcomes. For municipalities with average-value mining transfers (130 PEN per-capita, above US$40), it is estimated that for each 1,000 PEN of mining transfers per-capita, the probability of a mayor being reelected will decrease by 38%. However, for districts with extraordinarily high levels of mining transfers (above 4,800 PEN per-capita, approximately US$1,600) a positive relationship is observed. A similar pattern is observed for the case of political competition. It is estimated that average-value mining transfers will have a negative effect on political competition (a reduction of 4.9%) but for those that receive more than 11,000 PEN per capita, the effect becomes positive. These results are robust to control for mineral production and remain essentially the same for several sub-samples. Similarly, evidence in provided that makes it possible to rule out alternative parametric and nonparametric specifications to the preferred quadratic approximation. When the Nevo and Rosen's (2012) bounds are estimated, the results are basically unchanged even when significant departures from the exclusion restriction are allowed.

I also find patterns that are consistent with a non-monotonic effect for public good provision, the construction of local infrastructure, investment in roads and public employment. This also applies to household income as a measure of well-being, but no evidence is found for household consumption. This result can be interpreted as evidence of the short-term impacts of the mineral

[6] Ideally, the identification of a causal effect in this setting would require that mining rents were exogenous. This may be the case if the variation in rents were exclusively explained by changes in the international prices of mineral resources. However, mining companies may have reacted to the new prices by expanding the level of mineral production or by starting new operations in ways that can affect the local economy and citizens' political behavior. Therefore, mining rents would be endogenous. I argue in this paper that even if these factors may have played a role, the most important driver of the increase in natural rents were movements in international prices. I provide evidence that shows that this is actually the case and use a set of robustness checks to provide evidence in that regard.

[7] This paper's identification strategy differs from research designs that instrument natural resource rents with the international commodity prices as in Dube and Vargas (2013). The reason of this difference is explained by the fact that not only producer municipalities are benefited with royalties as it used to be the case in Colombia, the setting analyzed by these authors. As will be described in detail later, municipalities located in the same province or region as the producer are also entitled to royalties. As such, instrumenting using pre-boom production levels and international commodity prices will only provide variation in producer municipalities, excluding from the analysis a large part of the relevant variation in this setting. Taking into account the dangers of IV estimation recently highlighted by Young (2017), this paper explore an alternative design based on a combination of empirical approaches.

resource boom on citizens' living standards.

These results can be interpreted within a recent theoretical scholarship about the political economy of resource booms (Caselli (2015), Caselli and Tesei (2016), and Caselli and Cunningham (2009)). These scholars emphasize the potential non-monotonic nature of resource booms as a result of the competition among political elites regarding the appropriation of natural resource rents. The intuition behind these models is that the increase of natural resource rents can have differential political effects depending on the size of the boom because it creates a differential effect on political incentives. On the one hand, an increase in rents provides greater fiscal revenues that incumbents can use to influence electoral outcomes via public good provision or clientelism. On the other hand, this influx of rents increases the value of holding office, which in turn increases political competition. What this scholarship shows is that whether one effect would dominate the other will depends on the size of the rents, explaining in this way the existence of a non-monotonic relationship between political outcomes and natural resource rents.

Taking these results together, there is compelling evidence to argue that the existing literature fails to correctly understand the nature of resource booms. It is interesting to note that, although the theoretical literature has long recognized the existence of non-monotonic patterns, the empirical literature have emphasized linear approximations. To the best of my knowledge, the present paper is one of the first to address these non-monotonic patterns in response to natural resource booms exploiting sub-national variation.

In addition, this paper contributes to the empirical literature on the economic and political effects of natural resources in several ways. First, unlike most of the recent empirical literature, in this paper resource booms are treated as complex phenomena associated with shocks in production and natural resource rents. While most recent contributions only analyze the role of natural resource rents (Brollo et al. (2013), Caselli and Micheals (2013), and Monteiro and Ferraz (2012)), I also study the contribution of production changes in political outcomes which represents a step forward in understanding resource booms from an empirical perspective. Second, instead of defending the validity of the exclusion restriction based on informal arguments, the present study provides a formal sensitivity analysis to evaluate how empirical results might be affected by departures from the condition of the strict exogeneity in my IV design. Given the complexity of the topic, it would be a good practice for researchers to routinely report bounds on treatment effects to improve the credibility of their estimates. Third, my design is able to solve the puzzle in the existing literature regarding the absence of the impact of natural resource rents on public services and well-being despite significant increases in public budgets (Caselli and Micheals (2013) and Monteiro and Ferraz (2012)). Whereas political corruption is certainly a factor that explains the lack of impact, it is difficult to believe that local politicians are able to misappropriate the entire budget to observe no impacts at all. By using a novel empirical approach that deals with non-monotonic responses, I show that the effects of mining rents on public good provision and living standards are conditional on the size of the rents. Finally, I exploit the fact that the mining sector in Peru is controlled by several private-owned companies, most of them international, which leaves no room for endogenous production and rent responses related to the political cycle as might be the case with state-owned companies. Along with the recent literature, differences in economic and political institutions are controlled for by exploiting subnational variation across local governments. The high degree of variation in natural resource rents and level of production across subnational governments are also controlled for via panel data techniques using fixed effects.

This paper also contributes to the old existing debate regarding the political consequences of resource abundance and its links to citizens' living standards. Particularly, this paper relates to a growing literature that explores the effects of resource booms using sub-national variation. Scholars have studied the effect of resource booms on civil conflict (Angrist and Kluger (2008) and Dube and Vargas (2013)), corruption (Brollo et al. (2013), Maldonado (2011), and Vicente (2010)), citizens' confidence in political institutions and democracy (Maldonado, 2012), and local government efficiency (Borge et al. (2015) and Maldonado and Ardanaz (2017)). Others have explored the impact of resource booms on citizens' well-being via public good provision (Olsson and Valsecchi (2015), Caselli and Micheals (2013), and Monteiro and Ferraz (2012)) and demand of local inputs and market-level externalities (Allcott and Keniston (2017) and Aragon and Rud (2013)). Finally, scholars are exploring the interaction of royalties with other sources of revenue (Martinez (2017)) and the role of institutional reforms in preventing the resource curse (Gallego et al. (2017)).

The remainder of the paper is organized as follows. Section 2 provides some background details about the institutional setting. Section 3 introduces a basic conceptual framework and Section 4 presents the empirical strategy. Section 5 describes the data and Section 6 outlines the empirical results. Section 7 places the results in context with the existing literature and Section 8 offers some conclusions.

2 Institutional Background

2.1 Local politics

Local governments as independent political units are relatively new in Peru[8]. The Constitution of 1979 was the first to recognize their political autonomy[9]. The current legal framework established that municipalities are governed by the mayor and a council. Electoral rules allow the mayor a great discretionary power in municipal government decisions. No matter the electoral results, mayors are granted 50% plus one seats in the council. Thus, political accountability is considered somewhat

[8] Local governments are the smallest autonomous political and administrative units in the country. There are 1645 local governments, 1840 including the provincial governments that also play the role of local governments in the provincial capitals (195 in total). These provinces are organized in turn into 25 regions besides the province of Lima which has a special status for being the nation's capital.

[9] Local elections by direct universal suffrage were first introduced in 1963 during Fernando Belaunde Terry's first term in office. With the overthrow of Belaunde, General Juan Velasco Alvarado came to power in October 1968 via military coup, and municipal elections were suspended. Between 1968 and 1980 when civilians returned to power, mayors were appointed by the executive branch, most commonly by the Ministry of the Interior.

limited by local political parties from the opposition.

Elections for mayor and members of local council are held every 4 years[10]. There are no term limits but local authorities can be subject to impeachment via a set of direct democracy mechanisms introduced into the 1993 Constitution[11]. This element can play an important role in shaping politicians' incentives since it reduces their political horizons.

Due to the collapse of the national party system, national political parties play a minor role in local elections. In a survey collected as part of a World Bank study (World Bank (2001)), interviewed local politicians indicated that they receive no funding from national parties. Furthermore, there was no evidence of party loyalty. Many mayors have been re-elected under different political brands in recent years. Similarly, local politics has become increasingly fragmented with the rise of provincial and local political movements with weak links with national political parties[12]. As a consequence, local politics is highly personalized and increasingly disconnected from national politics[13].

According to the current legal framework, local governments' responsibilities can be classified as either exclusive or shared. Exclusive functions include urban and rural development, regulation and management of local public goods, local government organization, local development planning, and the execution and monitoring of local public infrastructure (World Bank (2012)). In contrast, shared functions require coordination with other government levels (either provincial, regional or central government) and include participation in the management of school services, public health, culture, sports and recreation, citizen security, transport, housing, social programs and waste management. In practice, this overlap of functions has been shown to be problematic because it causes coordination problems among different levels of governments, affecting the performance of economic development and social programs.

2.2 Local public finance

Peru is highly centralized. From a fiscal perspective, 97% of taxes are collected by the central government. Local governments' ability to establish taxes is very limited. Property taxes (vehicles, real estate and real estate transfer) are the main source of local tax revenues for Peruvian munic-

[10]Law 27734 which amends various articles of the Municipal Elections Act (Law 26864), introduced in May of 2002. Before the publication of this norm, municipal elections were convened every 3 years.

[11]This was the case until 2014 when term limits were introduced for local elections. Due to this factor, I restrict the analysis to the period 1996-2010.

[12]According to ONPE (2010), 72% of candidates in the 2002 municipal elections belonged to this type of political organizations.

[13]Although electoral rules allow local politicians a high degree of freedom, the weak institutional capacity of local governments works as an important constraint on their political behavior. To illustrate this point, institutional capacity can be estimated using various dimensions related to low capacity such as the presence of local management instruments. Using the 2011 Municipality National Registry (RENAMU) from 2011, I estimate that only 14% of local governments had urban planning plans and 20% had local development plans. Furthermore, only 29% had cadastral information systems. Similarly, most local governments lack of stable and qualified public servants. Looking again to RENAMU, I estimate that only 21% of local public servants have permanent contracts whereas 50% have temporary ones. More importantly, only 19% of local public servants have professional degrees. Not surprisingly, investment capacity is low.

ipalities (90% in 2007), leaving production and consumption taxes a marginal role. However, it is important to note that the revenues from these taxes are low and represents at most 13% of local governments' incomes (World Bank (2012) and Canavire-Bacarreza et al. (2012)).

Consequently, local governments are highly dependent on central government transfers. In 2008, transfers from central government represent 75% of local governments' budget (Canavire-Bacarreza et al. (2012)). A significant part central governments transfers are allocated in the form of the Fondo de Compensacion Municipal (FONCOMUN), which represents 33% of all intergovernmental transfers. This transfer is universally distributed among local governments and the rest is allocated as targeted transfers. From these targeted transfers, canon transfers (including all sources of canon revenues including oil, hydropower, forest and gas) represent 91% of total targeted transfers. The mining canon and the mining royalty were the most important ones, representing 72% of all canon transfers and 29% of local governments' budgets (Canavire-Bacarreza et al. (2012)). Therefore, mining canon revenue and mining royalties represent a significant proportion of local governments' budget in mineral-rich areas, close to 70% of municipal budgets in some producer districts.

2.3 Mining sector in Peru: A brief overview

In recent years, there have been a significant increase in the production of mineral resources as a consequence of the pro-market policies implemented to attract foreign investment in the mining sector during the 1990s. Figure 1 presents the evolution of the real value of mineral production for the period 1996-2010. After 2000, mineral production experienced an extraordinary increase of approximately 200%. It is interesting to note that the most important variation occurred before the increase in prices of natural resources in 2003, which suggests that most of the observed variation is a consequence of the new regulatory framework [14].

Although the increase in production played an important role in the recent mineral boom, more relevant was the increase of mineral prices. Figure 2 presents the evolution of the international prices of the four most important mineral resources (copper, gold, silver and zinc) produced in Peru between 1996-2010 [15]. As shown in the figure, these prices were quite stable from 1995 to 2003 and then underwent an extraordinary rise until 2010. In almost all cases the prices increased, reaching values two to three times higher than the average prices before 2003. Although the variation in average price levels is more important than the variation in production levels, it is essential to note that the latter are not negligible and could play a role in explaining the phenomenon of interest.

As a consequence of the combined increase in prices and quantities, mining transfers experienced an extraordinary increase. This was also accompanied by a change in the rule of allocation of mining transfers, which increased the participation (from 20% to 50%) of regional and local governments in areas where mineral resources are extracted . Law 27506 established that the amount of mining transfers generated in a given year should be distributed between the regional government (20%),

[14] The Online Appendix provides more details regarding changes in the regulatory framework during the 1990s.

[15] See Figure A.1 in the Online Appendix for a similar figure with the evolution of prices for other minerals produced by Peru.

the municipality of the district (10%), the municipalities located in the province (25%), and those municipalities located in the region where the resource is exploited (40%). The remaining 5% is allocated to the public universities of the region (see Section A.2 in the Online Appendix for details).

Figure 3 describes the evolution of mining transfers. The graph shows that the amount of transfers from royalties and mining canon revenue were relatively low (roughly 67 and 95 million of PEN) during 2001 and 2002, following by a spectacular increase reaching PEN 4.15 billion in 2007[16]. Towards 2010, this amount was about PEN 2.5 billion. This windfall was particularly beneficial for mineral producer districts [17], creating significant inequalities across districts[18].

These inequalities were also reflected geographically. Because the distribution of mineral resources depends on geographic characteristics, some areas are more suitable for the extraction of minerals. As a consequence, different areas are affected by different prices and then benefit by the shock in mining revenues in different ways. The evolution of mining transfers shows two basic patterns: a) there are large differences in terms of mining rents across districts, and b) there are disparities in terms of the evolution overtime of mining rents across districts. This suggests that the effects of the shocks may be heterogeneous, as shown in Figure 4. This map illustrates the allocation of the average mining rents for the 1996-2010 period. It is possible to observe a clear pattern with a concentration of mineral rents-rich districts in the south (specifically in the regions of Tacna, Moquegua and Cusco), central coastal area (Ancash) and the north (Cajamarca). The jungle and the coastal zones close to the border with Ecuador are home to those districts that receive little resource rent [19].

3 Conceptual framework

There is a rich literature discussing the effects of resource booms on political outcomes. A suitable model with which to organize and interpret the results of this paper is found in Caselli (2015), which incorporates and organizes several ideas from previous studies on the political resource curse. The author considers a very simple two-period local economy with a large number of unskilled workers and two talented agents, one of them being the current incumbent and the other the competitor. In the first period, this economy is composed of two sectors: the mineral resource and subsistence sectors. The mineral resource sector is assumed to provide an exogenous flow of rents

[16] For reference, the exchange rate over the period was 2.85 PEN per US dollar.

[17] Figure A.2 in the Online Appendix shows the evolution of mining transfers by type of districts according to producer or Canon recipient status. It shows that mineral producer districts are largely benefited from the mining boom.

[18] This is reflected in a Gini coefficient of 0.8 for the distribution of mining rents across districts. See Figure A.3 in the Online Appendix for the Lorenz curve for average mining transfers.

[19] Figure A.4 in the Online Appendix presents a map with the location of producer districts in the period 1996-2010. This shows that producer municipalities are a small fraction of the total number of districts that are recipient of mining Canon transfers.

to the local government [20]. It is also assumed that production in this economy depends on the provision of public goods (e.g. roads, infrastructure, etc.) by the local government. Therefore, the incumbent politician can influence the level of output in this economy with the level of public goods he decides to provide.

The competitor's problem is to decide whether to become an industrialist in the second period or a challenger to the incumbent politician. He compares the net benefit of becoming a politician against his opportunity cost in the industrial sector. In contrast, the incumbent's problem is to maximize the net present value of his consumption taking into account the impact of his behavior on the decision of the talented agent to become an electoral challenger. A high level of consumption associated with the low provision of public goods reduces the opportunity cost for the potential competitor to become a politician and increases the chance for the incumbent to face a challenger. The opposite is also true.

The game has the following structure. During period 1, the levels of mineral rents and public goods are given exogenously. The mayor is also exogenously determined in the first period. At the end of the first period the mayor decides his level of consumption and the level of good provision for period 2. Once this level of public good is realized, the talented agent chooses whether to become an industrialist or a competitor for the incumbent. At the end of the second period there is an election.

The solution to this model delivers a non-monotonic pattern between mineral resource rents and political competition. In the presence of an increase in mineral resource rents per-capita, the value of holding power increases, making politics more attractive for the talented agent (reflected in an increase of the opportunity cost of involving industrial production). Nevertheless, the mayor also has access to more mineral rents that he can use to provide more public goods to reduce the opportunity cost of becoming an industrialist. This implies that, for low levels of mineral rents, the mayor can successfully prevent the entry of the talented agent into politics. However, this strategy becomes useless for very high levels of mineral rents associated with a mineral resource boom because the value of holding power would be higher than the level of profits the talented agent can obtain in the industrial sector. Hence, there exist a threshold value of per-capita mineral rents ($c*$) beyond which it is no longer optimal for the incumbent to invest in public goods. Therefore, the mayor cannot prevent the entry of the talented agent into politics. As a consequence, the mayor reduces his level of investment in public goods because his probability of reelection has been reduced as well.

This simple model can be extended to account for the fact that incumbents can use natural resource rents to obtain citizens' electoral support via clientelism. Clientelism can be modeled as a factor affecting the probability of winning the election of the competitor. The greater the

[20]This way of modelling a resource boom basically considers the "rent effect" discussed above. Modelling the "production effect" is harder because both positive and negative externalities can result from changes in the level of mineral output. I leave aside these issues here since, as mentioned in the introduction, there is no evidence of the impact of mineral production on political outcomes.

mayor's investment in clientelistic expenditures, the less chance the competitor has of winning the election. Of course, the effectiveness of these clientelistic practices to influence electoral outcomes must be taken into account. Caselli (2015) models this using an elasticity for the relationship between clientelistic expenditures and the probability of the talented agent winning the election. He shows that the basic results differ for different levels of this elasticity. When this elasticity is low, the results are similar to the previous basic model because clientelistic expenditure is basically ineffective. If this expenditure is somewhat effective, then a more complex non-monotonic pattern can emerge. For low levels of mineral rents a positive relationship with public good investment is observed but then a reduction is expected as the value of holding office dominates the potential profits in the industrial sector for the talented agent. However, when the levels of rents are very high, it is possible for the incumbent to prevent entry because clientelistic expenditure is high enough to buy electoral support, reducing the incentives of the talented agent to run for election. Finally, when this elasticity is high, clientelistic expenditure is very effective in preventing entry.

To summarize, the model delivers non-monotonic responses of political competition and reelection outcomes to increases in natural resource rents. These are explained by the strategies used by incumbents regarding the allocation of these rents to fund public good provision and clientelism with the goal of political survival. The level of increase of natural resource rents induces a non-monotonic response in these dimensions. Finally, these investments have an impact on citizens' well-being, which also follows a non-monotonic pattern in connection with the non-monotonic responses in public good provision and clientelism.

4 Empirical Strategy

4.1 Identification

A mining boom is defined in this paper as an increase in the levels of mineral production and mining rents associated with an exogenous variation in the levels of mineral prices. The exogeneity in the variation in mineral prices is relatively simple to justify as will be seen later. It is more difficult to differentiate between changes in levels of production and mining rents as a result of changes in international prices. This difficulty arises from the fact that both changes are related and the impact of each of them on electoral results will not necessarily go in the same direction[21].

It is argued that mineral prices are exogenous to local politics in mineral rich districts. The basic reason concerns the pattern of the insertion of the Peruvian economy in the global economy (as a price-taker of the international prices of its more important commodities) as well as recent changes in the international context, particularly the expansion experienced by the Chinese economy

[21] In producing districts, the increase in international prices leads to an increase in mining royalties that may cause an increase in the provision of public goods. This, in turn can positively influence the mayor's ability to stay in power. In contrast, if the increase in international prices is associated with an expansion of mineral production levels in the district, this could be accompanied by an increase in pollution and local unrest, which could adversely affect the reelection of the mayor. The net effect is thus ambiguous, as there is no perfect way to isolate the role of these two factors on the election results. These issues will be addressed later.

as a result of its industrialization process[22]. This is critical because Peru is one of the most important producers of minerals in the world, which implies that the country can potentially influence international prices, affecting the validity of my research design[23]. There are many reasons why this is not the case. First, there are no state-owned producer companies in Peru as is common in many developing countries. Many private companies operate in the country[24], so it is very difficult for an individual company to influence international prices. Second, there is consensus among experts about the role of China's demand for minerals in explaining the boom of international prices[25]. Finally, the fall in interest rates is another explanation for the increase in commodity prices (Frenkel (2008)).

Another concern with the present research design is the endogeneity of production levels. Local governments may influence production decisions by investing in ways to attract mining companies. It is also possible that operating mining companies react to higher prices by expanding the levels of production and starting new production units. I believe these factors are not relevant in this setting, although their influence cannot be completely ignored. On the one hand, local governments have no role in the process of granting mining rights. All required permits are granted by different units of the executive branch (mostly the Ministry of Energy and Mines, Ministry of the Environment and the Ministry of Culture). On the other hand, starting a new exploitation requires 7 years on average, so it is hardly the case that a response like this can be relevant in the present setting because any new exploitation started as a consequence of the 2003 price boom would appear at the very end or beyond the period under analysis (1996-2010). It is not possible rule out any endogenous increase in production in existing exploitations, although most of the variation comes from the shock in prices as discussed in Section 2.3. Changes in production may have an indirect impact on political outcomes because of their impact on mining rents allocated to local governments or a direct impact caused by their impact on the local economy. This will be controlled for in the empirical model and additional robustness checks will be conducted to evaluate the robustness of the empirical results.

A final concern is that mining rents are endogenous. Mining rents can be endogenous because of endogeneity in prices and quantities (as already discussed) as well as an endogenous placement in the distribution rule. Regarding the distribution rule, a serious concern is that changes in the

[22]Historically, Peru has been a small open economy heavily dependent on the exports of primary products, a feature that was reinforced by liberal reforms based on the Washington Consensus during the 1990s. For this reason, the country is basically a price taker in the international markets of its major exports and, therefore, very sensitive to external shocks. In fact, some researchers (see, for example, Dancourt (1999)) suggest that a large proportion of Peru's the economic crisis since 1950 is linked to external shocks such as a fall in the terms of trade.

[23]Recall that Peru is the second largest producer of silver, third largest of zinc, copper and tin, fourth largest of lead and molybdenum and fifth largest of gold. See MINEM (2013) for details.

[24]For instance, in 2013, there were 2,052 units under exploitation by 854 mining companies, including small producers. When small producers are excluded, there are 637 mining companies. See MINEM (2013).

[25]According to a World Bank study (Winters and Yusuf (2007)), China been the largest consumer of minerals in the world (24% of total world production) since 1999. From 1999 to 2005, China consumed two thirds of the world's growth in metal production, which made it the most important factor in explaining the growth in metal prices observed in the period under analysis

distribution rules of mining rents were the result of the active role played by local government authorities in anticipation of the price boom. For instance, mining Canon revenue was originally funded by 20% of the taxes paid by mining companies and this rate was raised to 50% in 2001. The allocation criteria were further modified to assign more rents to mineral producer districts. If these changes were concessions to local interests, the mining rents would be endogenous. However, the political system is fragmented and national political parties have very weak connections with local politicians, so this is hardly plausible [26].

4.2 Empirical model

The empirical model is based on a DID strategy exploiting the pattern of mineral prices between 1996 and 2010. Mining transfers are directly used as a treatment variable in a DID design with continuous treatment. A measure of mineral production is also used to account for changes in the political environment of local governments associated with changes in production levels. The basic specification is as follows:

$$y_{ijt} = \alpha_j + \varphi_t + \beta F(R_{jt}) + \gamma Q_{jt} + X_{ijt}^{'}\delta + \epsilon_{ijt}; \tag{1}$$

where y_{ijt} is the outcome of interest for the observation i in district j and period t. Furthermore, α_j and φ_t are district and years fixed effects respectively, and R_{jt} is mining transfers per-capita and Q_{jt} is the real value of mineral output for district j in period t. Individual/household and district level characteristics are denoted by X_{ijt} and ϵ_{ijt} is an error term. The parameter of interest is β which recovers the causal effect of interest.

It is important to note that the function $F(R_{jt})$ is used to indicate the use of a non-monotonic specification for mining rents. This includes a specification in levels as well as a quadratic specification in accordance with the conceptual framework. In addition, although most of the outcomes to be analyzed are defined at the district level, I consider the individual/household level because living standard measures are defined at these levels. Finally, the variable Q_{jt} is used as a control variable, so it removes any variation in political variables associated with endogenous changes in mining revenues levels that are caused by changes in the level of mineral production. It is important to remember that control variables are not required to be orthogonal to unobservables contained in the error term; it is only required that their inclusion in the econometric specification enables the removal of any remaining selection bias.

This specification is a generalization of the standard two period-two groups DID approach (see, for instance, Bertrand et al. (2004)). The time fixed effects account for the time series changes in political outcomes. The district fixed effects controls for time-invariant characteristics at the district level and R_{jt} accounts for changes in the dependent variable in treated districts associated

[26] In fact, Barrantes et al. (2010) show that changes in the mining Canon law were the product of circumstantial alliances between congressmen from mineral rich regions and not the result of pressure from regional and local actors or the executive power, ruling out this possible source of endogeneity

with the movement of mining revenues after the increase of mineral resources prices. Identification in this setting requires controlling for any systematic shock to the political outcomes of districts affected by the increase of prices of mineral resources that are potentially correlated with, but not a consequence of, the mineral rent shock.

The use of this continuous treatment variable could be problematic because it does not control for the fact that endogenous responses may exist in production even after controlling for mineral production[27]. This is a relevant issue from a conceptual point of view, although the practical evidence is less compelling [28]. The inclusion of a measure of mineral production should be enough to account for any potential endogenous response related to changes in production, however this concern is taken seriously. This leads to the alternative research design based on an instrumental variables (IV) approach.

The use of an IV method in this context is motivated by the presence of a credible source of exogeneity in mining revenues caused by fluctuations in international prices [29]. Despite this, isolating the role of prices is difficult because of the informational constraints regarding taxes and profits discussed above. Therefore, the use of mining Canon transfers (a subset of mining revenues) is proposed as an instrument for total mining revenues. This method is used because mining Canon revenues is less sensitive to endogenous responses to production among the set of rents distributed to local governments. Mining Canon revenue basically depends on the rules of allocation established by law, which contains fixed rates for each level of government and the variation of prices. Despite the weak evidence regarding endogenous production responses, it is accepted that this is an imperfect instrument as suggested by Nevo and Rosen (2012). Therefore, a sensitivity analysis is incorporated into the IV design, based on Nevo and Rosen's (2012) work on identification with imperfect instruments.

Leaving aside the imperfect instrument issue for one moment, it is predicted that mining Canon revenue will recover relevant variation to identify the causal effect of interest. The estimated

[27]One way to address this issue is to construct a measure of predicted mining transfers taking the pre-period district production levels as fixed and only allowing changes in prices to explain the variation in mining revenues. However, this alternative does not work because of a lack of information. There are many reasons why this alternative is difficult to implement and two are outlined as follows. First, mining transfers depends on revenues and taxes paid by mining companies. Although information about revenues is not hard to find, it is difficult to estimate the taxes paid by mining companies because they are a function of profits. Where a mining company operates in more than one district or has more than one exploitation, it is difficult to assign what proportion of the paid taxes is attributable to a given district. In addition, the information about mining companies' profits for computing the amount of mining rents to be distributed is considered confidential by tax authorities. Second, the transfers allocated to non-mineral producer districts are less transparent and depend on a formula developed by the Ministry of Economics and Finance based on poverty measures and population size.

[28]The evidence previously discussed suggests that a significant fraction of the variation in mining rents is related to the increase of mineral prices rather than a consequence of changes in mineral production that did not experience a significant variation over the period under analysis

[29]In a very important work, Young (2017) has highlighted the pitfalls of IV designs when it comes to inference. In particular, the author provides evidence that IV produces estimates that lack of accuracy or that are no that different of the biased OLS estimates. Given these results, some care is needed to evaluate the quality of inference of IV estimates.

effect represents a generalized local average treatment effect (LATE)[30]. Angrist and Imbens (1995) show that the standard LATE framework can be extended to accommodate models with variable treatment intensity in which the Wald estimator is a weighted average of the unit causal response. Identification under this design requires the instrument to be independent of all potential outcomes and treatment intensities implying that mining Canon transfers should have no effect on political outcomes other than via its effect on mining transfers. Thus, it is argued here that, even if there is a significant departure from the validity of the exclusion restriction, the basic results of this paper will not be significantly affected.

The validity of the exclusion restriction is likely to hold with the proposed instrument. As previously shown, the change in prices basically affected fiscal revenues but not production levels[31]. However, to analyze how sensitive the IV results are to potential violations of the exclusion restriction, the sensitivity analysis proposed by Nevo and Rosen (2012) is implemented. Their approach is based on the construction of a weighted combination between the imperfect instrument and the endogenous variable that is shown to be uncorrelated with the error term under a set of plausible assumptions: a) the same direction of correlation between the endogenous regressor and the imperfect instrument with the error term, and b) the instrument is less endogenous than the original endogenous variable.

I conclude this section with a discussion about inference. Since Moulton (1986), it is recognized that inference without accounting for within-group dependence can severely underestimate standard errors. In addition, there is a potential serial correlation problem, as highlighted by Bertrand et al. (2004)[32]. To deal with both issues, standard errors are clustered at the district level using the generalization of the White (1980) robust covariance matrix developed by Liang and Zeger (1986). This solution controls for clustering and heteroskedasticity, and it is valid as long as a large number of clusters are available; this is the case in our setting[33].

[30]See Angrist et al. (1996) for the LATE parameter and its estimation using IV.

[31]Notice that not all production change is necessarily endogenous. Recall from Section 2 that the period under analysis is characterized by important efforts by the Peruvian government to attract foreign investment. This occurred well before the increase in prices in 2003. Despite that, it is true that part of the changes after 2005 can be a response to changes in prices. However, according to experts in the Ministry of Energy and Mines, mining companies typically appear to react to the new high prices by expanding their activities to new mining projects rather than expanding production because the maturation process is long.

[32]According to these authors, this occurs for the following reasons: a) usually estimates are based on long time series, b) the dependent variable is usually highly positively serially correlated, and c) the treatment variable changes very little within the treatment unit over time. Because all these factors may play a role in the present setting, this proceed is followed.

[33]For a discussion for the case of a small number of clusters, see Angrist and Pischke (2009). Cameron et al. (2007) propose bootstrap-based solutions. Furthermore, the wild cluster bootstrap procedure appears to perform well in a set of simulations studied by the authors.

5 Data

5.1 Data sources

The empirical analysis in this paper is based on a unique dataset comprising information on electoral outcomes, intergovernmental transfers, public good provision, local government characteristics and living standard measures for the period 1996-2010. Data on electoral outcomes were collected from the Oficina Nacional de Procesos Electorales (ONPE), the Peruvian electoral office. A panel dataset was assembled for local elections for years 1998, 2002, 2006 and 2010 to construct measures of reelection and political competition, the main outcomes of this study [34].

Data on municipality revenues and mineral transfers from the central government over the period 2001-2010 were sourced from the Ministry of Economy and Finance. These include detailed information from all types of transfers received by local governments as well as information about other regular sources of incomes (taxes, contributions, and fees for services, among others). The dataset comprise approximately 1,830 districts and are used to explore how politicians use local government budgets. I complement this dataset with information about mining Canon transfers obtained from the Ministry of Energy and Mines from 1996 to 2000.

A panel dataset on local government characteristics was constructed from the Municipality National Registry (RENAMU). This source is a census of municipalities carried out by the National Statistical Institute since 2002. It includes information about human resources, assets, public good provision, and local governments budget as well as data on the socioeconomic characteristics of district. Information for the period 2002-2010 is used in this paper.

Information about mineral prices and mineral production was collected from the Ministry of Energy and Mines and covers the period 1996-2010. This information is used to construct a measure of the real value of mineral production (using 2001 prices as reference) for each district over the period under analysis.

Further information was sourced from the National Household Survey (ENAHO), an annual survey by Peru's national statistical agency. ENAHO is a national representative survey with detailed information on living conditions at the household level. The sample size is approximately 19,000 households. In the present study, a repeated cross-section for the period 1998-2010 is used to explore the impact of the natural resource boom on living conditions.

Finally, data from the 1993 Census of Population and Housing are used in order to evaluate district pre-treatment characteristics according to the levels of mineral production and mining transfers.

Several adjustments were made to the original data to account for inflation and the creation of new districts during the study period. First, all nominal variables were converted to real terms using the price index based on December 2001. Using a spatial deflator, real values were expressed in prices of metropolitan Lima for the same year. Second, regarding the creation of new districts,

[34] In 2014, reelection of mayors was forbidden by law. For this reason, the analysis does not consider the electoral cycle 2010-2014.

homogeneous geographical identifiers were constructed for the period 1993-2010.

5.2 Main variables

The main dependent variables were constructed from ONPE electoral data. Following the conceptual framework, the two basic political outcomes are a measure of incumbency advantage and one of political competition. In the first case, I simply construct a dummy variable equal to 1 if the mayor was re-elected [35]. Measuring political competition is more complicated[36]. I define political competition following Skilling and Zeckhauser (2002) as 1 minus the Herfindahl-Hirschman index [37].

The treatment variable is a real measure of mining transfers. This variable is the sum of all transfers related to the exploitation of mineral resources, with the most important categories being mining Canon revenue and mining royalties[38]. This measure is expressed in real terms using 2001 Lima prices as reference. For the regression analysis, I convert this measure to 1,000 PEN per capita.

The outcomes related to public good provision, public employment, local government budgets and living conditions are discussed later.

5.3 Summary statistics

Table 1 presents the basic summary statistics of the mining transfers. I distinguish between three types of districts: producers, mining transfer recipients (excluding producers) and non-mining transfers recipients. Regarding political variables, reelection levels are relatively low (Panel I of Table 1). In the case of districts that receive no transfers, levels of reelection of the period of analysis is 11%. The level of reelection for producer districts is 19% whereas in the case of recipient districts this value is 18%. Regarding the measure of political competition the results show an opposite trend. For recipient districts, the average value is 0.81 (for an indicator that varies between 0 and 1) while the indicator is 0.84 for producer districts. For mining transfers recipient districts, the indicator is 0.82.

Regarding mining transfers, mineral producer districts received 475 PEN per capita during the period under analysis (Panel II of Table 1). This amount represents 25% of the average monthly per-capita income in these areas. Canon recipient districts (excluding producers) receive 92 PEN on average. These numbers do not take into account the extremes inequalities in the distribution

[35] It is important to emphasize that this is a measure of individual reelection. As discussed in Section 2, the electoral arena is highly fragmented and political parties are weak. Therefore, a measure of party reelection would not be consistent with the basic workings of the political game in Peru because it is common to observe politicians migrating from one political party to another.

[36] See Bardhan and Yang (2004) for a conceptual discussion regarding different possible interpretations of the variable political competition.

[37] Notice that $H = \sum s_i^2$ is computed using the square of the share of votes s obtained for each candidate. Values of PC closer to 1 will reflect higher levels of political competition.

[38] See Section A in the Online Appendix for details regarding mining transfers, their composition and other related information.

of mining canon transfers. For instance, whereas the 90th percentile of mineral producers receives 877 PEN per-capita, the 99th percentile receives 9,479 PEN. This is evidence that, although a large number of districts receive this transfer, few receive high-value transfer. Consequently, there are significant differences in relation to the public budget across districts. While the public budget is 347 PEN per capita for non-recipient districts, it is 1,496 PEN per capita in the case of producer districts and 568 PEN for recipient districts.

Panel III of Table 1 presents the average real value of mining production by district and by type of mineral for the period 1996-2010. The average value of real output to 2001 prices equals more than US$ 2 million. Copper is the most important mineral in relation to its production value, followed by zinc and gold. The weakest is molybdenum with an average value of US$ 17,000 in the period.

Panel IV of Table 1 presents the descriptive statistics for a set of socio-economic characteristics for districts using the 1993 census data. The evidence suggests important differences among districts regarding population size, percentage of rural population and basic needs. The existence of these pre-treatment differences highlight the issue of research strategies based on the comparison of cross-section data as they may be associated with unobservable factors.

6 Empirical Results

6.1 Reelection outcomes

Table 2 explores the impact of mining transfers on mayoral reelection using the DID design. In the top panel, the treatment variable is the average per capita mining transfer (measured in thousands of PEN for 2001 Lima prices) for a period that includes three election cycles: 1998-2002, 2002-2006 and 2006-2010. The lower panel considers only mining transfers in the election year (2002, 2006 and 2010)[39]. The dependent variable of interest is a dummy variable equal to 1 if the mayor is reelected.

Column 1 presents the results for the specification in levels. The average mining transfer ins estimated to have a negative impact on the probability of reelection. The point estimate is -2.5 percentage points, significant at the 1% level. Considering an average reelection level of 17%, the previous estimate represents a reduction of 14.7% for every thousand PEN per capita distributed as mining transfers. In the case of mining transfers in the election year, there is no effect on the reelection of mayors.

Column 2 includes the quadratic specification, consistent with the conceptual framework of this study. For the average mining transfers, the coefficients for the level and the square of transfers are not significant. The opposite is true in the case of mining transfers in the election year, where the coefficients for the level and the square of the transfers are now significant at the 1% level.

[39] I opt for both specifications to evaluate whether the results are sensitive to political transfers during elections in line with the literature on "political budget cycle" (Nordhaus (1975)) or respond to a mayor's average during the term in office.

Consistent with the conceptual framework, the coefficient for the level of the transfer is negative (-0.066) while that for the square is positive (0.007). Given the non-monotonic nature of the impact of transfers, the effect of transfers on the election results in a given district depends on the level of mining transfers received. I return to this point later.

Column 3 includes the logarithm of the real value of mineral production in the district as a variable that captures the impact of changes in production levels on the electoral results. In both cases, the coefficients are not statistically significant, suggesting that changes in production levels have no impact on the reelection of mayors. These results are in line with evidence previously presented, which suggests that the recent Peruvian mining boom is basically the result of the price effect of the external boom in demand for minerals, and not because of changes in production levels. From the point of view of identifying the interest causal effect, this suggests that the boom only affected the income levels obtained by local governments. Thus, these income levels explain the election results rather than changes in the local economy associated with changes in production levels that could have affected the election results. In this scenario, it is possible to rule out alternative theories related to the production effect that explain the reduced-form results presented here[40].

Columns 4, 5 and 6 present the basic results obtained in column 3 for a set of sub-samples. First, column 4 excludes observations from Lima. Because Lima represents more than half of the country's GDP, it is important to evaluate whether the study results are robust to the exclusion of districts located in this region. As implied by the size and signs of the coefficients, the exclusion of those districts in Lima has a marginal impact on the basic results. The coefficient associated with the level of mining transfers in the election year is now -0.062 and the square is 0.007. A similar result is obtained for the average mining transfers, although the coefficients are not statistically significant.

Column 5 shows the results of a specification that excludes observations from non-producing regions. The intuition of this specification relates to the definition of the relevant counterfactual scenario. Non-producing regions differ in several ways from producing regions so the use of the former ones as part of the counterfactual scenario could be problematic. Excluding non-producing regions from the sample restricts the comparison between mining rent recipient districts that differ in terms of the magnitude of the transfers they receive. In this scenario, the emphasis is on the intensity in which districts are treated. The econometric results suggest that this concern is not relevant in the context of this paper. The coefficients for the level and the square are not substantially modified in terms of magnitude and level of statistical significance.

Column 6 follows the same logic as the previous exercise but this time only excludes the non-producing provinces. Again, the main results are robust to the exclusion of these provinces in terms of the coefficient's magnitude and in relation to their levels of statistical significance.

[40]It is important to note that these results do not imply that production levels have no role at all in the economic and social dynamics of the producer districts. It simply indicates that regarding the political dimensions analyzed here, they do not play a relevant role.

It is interesting to contrast the results for the case of the average transfers for the electoral cycle against the results of mining transfers in an election year. While results for the latter are robust to various specifications, the results for the former are only significant for the simple specification in levels. This is consistent with international evidence that suggests that transfers are more sensitive to electoral periods[41]. Thus, it is expected that mining transfers in election years have a greater impact on the probability of mayoral reelection.

To interpret the results of the empirical exercise, it is necessary to compute the total marginal effects according to mining transfer levels. This step is important because there is a high level of inequality in the levels of per capita transfers distributed to municipalities, as previously mentioned. Figure 5 presents the calculation of the marginal effects according to the level of mining transfers. As discussed above, the average transfer value a district receives is 130 PEN per capita. With that level of transfers, the total marginal effect is -0.0652, a reduction of 38% compared with the average rate of reduction in the sample of districts. The effect of mining transfers on mayoral reelection is negative for most districts except for those that receive very high levels of transfers. The turning point occurs in districts with annual per-capita real transfers above 4,800 PEN. For districts with these levels, mining transfers have a positive impact on the probability of mayoral reelection.

The results in Table 2 are in line with the conceptual framework of this study. They suggest that empirical approaches that are prevalent in the literature may fail to capture the nature of mining booms because they do not adequately approximate the non-monotonic nature of the phenomenon under analysis. These results contrast with recent evidence in the case of the re-election of political authorities in other countries [42].

6.2 Political competition

Table 3 presents the results for political competition. The same specifications shown in Table 2 are used here. The dependent variable is the measure of political competition suggested by Skilling and Zeckhauser (2002). The upper panel shows the results for the DID model for the average mining transfers.

The results of the empirical exercise are in line with the findings in the previous section. In the first specification (column 1), there is no relationship between average mining transfer levels and political competition. However, when the square of mining transfers (column 2) is included, both coefficients become statistically significant, suggesting that the linear approximation is not

[41] Several studies in Latin America provide evidence in this direction. For an overview of the literature, see Eslava (2006).

[42] For example, Monteiro and Ferraz (2012) find that oil royalties have a positive impact on the short-term reelection of mayors in Brazilian municipalities (an increase of 32% relative to the mean). This effect disappears in the medium term, which is interpreted by the authors as evidence for the existence of a surprise effect of an increase of oil royalties. Interestingly, when all elections are analyzed as a whole as in this study, the authors find that oil royalties had no effect on the re-election of mayors, similar to that obtained in the linear specification in column 1 of Table II in this paper. Furthermore, Brollo et al. (2013) find that intergovernmental transfers have a positive impact (about 7%) on the re-election of mayors, also for the Brazilian case. However, because this study does not study variation associated with the exploitation of natural resources, it is hard to compare it with the present study.

consistent with the empirical evidence. The coefficient associated with the transfer level is negative (-0.836), while the square is positive (0.036). The results are not altered when the logarithm of the real value of mineral production is included (column 3), which suggests that changes in production levels associated with the mining boom have no impact on political competition.

Given the non-monotonic nature of the phenomenon under study, the interpretation of the results requires a similar calculation as the one performed previously for the case of reelection. Here, for a district with per capita level of mining transfers similar to the average (130 PEN per year), the total marginal effect is -0.8266. In relation to the average of political competition, the size of the effect is very small, about 1%. This is because the levels of political competition in Peru are very high due to political fragmentation (average of 83.15 for a measure of political competition where the maximum value is 100). An alternative interpretation would be to take the inverse of this measure; this is what it would take to reach the perfect level of political competition (an indicator of 100 points). In that case, the size of the effect related to the average transfer would be 4.9% [43].

Columns 4, 5 and 6 present the analysis for the sub-samples analyzed in the previous section. In all cases, the coefficients and levels of statistical significance regarding the level and the square of mining transfers do not change substantially. Furthermore, in all cases the logarithm of the real value of mineral production is not statistically significant, confirming that changes in mineral production have no impact on political competition.

The lower panel of Table 3, the results for the case of mining transfers in the election year are presented. The results are not statistically significant in any of the specifications used. This result contrasts with those found in the previous section for reelection. This difference may be explained by the different incentives faced by political agents. On the one hand, mayors have incentives to spend more during election periods to influence voters' choices, which would explain why mining transfers in the election year are more sensitive to explain reelection. Moreover, political competition is strongly related to the incentives of local politicians, who usually have better information regarding the fiscal situation of local governments. In that sense, it is expected that the relevant information held by local politicians in terms of the decision to compete in elections is more connected to the average level of transfers received by a local government during the years prior to the election than in the election year.

The results of this section are consistent with this paper's conceptual framework and show the limitations of using monotonic approximations to account for the phenomenon of interest. The results are also robust to the inclusion of mining production levels, suggesting that the effects of the mining boom are essentially caused by the change in the level of mining revenues received by local governments. Thus, they are not associated with the levels of mineral production, which-as previously stated- rule out sources of bias in estimating the causal effect of interest associated with

[43] As in the case of reelection, the impact of transfers is negative for most of the districts, but not those with very high levels of per-capita mining transfers. In particular, for districts with levels of per-capita mining transfers over 11,700 PEN annually, there is a change in the sign of the effect. These districts are in the top 1% of the mining transfer distribution.

changes in production [44].

6.3 Robustness checks

In this section, I explore the robustness of the results to alternative specifications and functional forms. First, I evaluate whether the central results of the previous section change when districts from producer regions are excluded. The idea is to deepen the analysis of the differences regarding the role of mining transfers (or rent effect) and levels of production (or production effect) on the levels of political competition and reelection. In this section, by excluding producer regions from the analysis, I eliminate any potential effect of changes in production levels, making it possible to more accurately identify the causal effect of interest. Second, I assess whether the basic results are robust to changes in the econometric specification. The conceptual framework suggests a quadratic model but alternative specifications might also fit the data. To address this issue, I test whether alternative parametric and semiparametric approaches are consistent with the baseline approach used in this paper.

Table 4 presents the results for the first set of robustness checks. Because of space constraints, I focus on the case of reelection. Results for political competition are similar and are reported in Table A2 in the Online Appendix. Column 1 replicates the results from column 3 from the previous section for comparative purposes. Column 2 presents the results for a specification in which all producers districts are excluded from the sample. As can be seen, the exclusion of the producer districts strengthens the relationship between mining transfers and the reelection of mayors. The coefficients for the level and the square of the transfers are now two times that of the original ones (from -0.067 to -0.113 for the level and from 0.007 to 0.015 for the square). Statistical significance levels are maintained.

Column 3 presents the results of a specification in which producer districts are excluded and the analysis is restricted to producer regions. The analysis does not consider non-producing regions to construct the counterfactual. The results are not substantially modified in terms of the magnitude of the coefficients as well as the levels of statistical significance. The same occurs in column 4, where the analysis focuses on producer provinces. In this case, the analysis is refined to exclude provinces that do not have producer districts. The results are maintained. As previously indicated, the results in the case of transfers in an election year are more sensitive to explain changes in the probability of the reelection of mayors. The evidence in this section suggests that these results are robust to the exclusion of the producer districts.

I now turn to a discussion on the validity of the quadratic parametric approach. As a first approximation, I plot the residuals after partialling out district and time fixed effects for the

[44] These results differ from those found by Monteiro and Ferraz (2012), which to the best of my knowledge, is the only other study that examines this issue. In this study, the authors find a negative short-term impact of oil royalties on various measures of political competition, but this effect disappears in the medium term. Although the result of the present study are similar for the average district, I found a non-monotonic pattern consistent with the theoretical literature, where districts with very high levels of mining rents enjoy greater political competition.

treatment and outcomes variables. These residuals recover the remaining variation in these variables after accounting for fixed effects, so they can be used to examine whether the relationship between the treatment and outcomes variables is quadratic as suggested by the theoretical framework. A set of nonparametric estimators are used to shed light on the empirical relationship between the residuals of both political outcomes and mining rents. In the first place, a kernel regression is implemented, using an Epanechnikov kernel with optimal bandwidth. I then use a local linear regression and a polynomial regression of degree two with the same kernel and bandwidth. Results are presented in Figure 6 for reelection [45]. As shown, all the nonparametric approximations deliver essentially the same results and suggest that the relationship between political outcomes and mining rents is quadratic.

A formal analysis using parametric and semiparametric regressions and statistical tests now follows. Table 5 evaluates the validity of the quadratic parametric approximation versus the alternative parametric models. The focus is only on reelection outcomes because of space constraints, but results for political competition are available in Table A3 in the Online Appendix. Columns 1 of Panel A presents the baseline results for the quadratic model for reelection to facilitate the comparison. I test whether the coefficients of the quadratic specification are both equal to 0. The null hypothesis can be confidently rejected (F statistic of 9.36 with a p-value of 0.00). Column 2 presents a cubic model, but fails to reveal any statistically significant coefficients, although the coefficient for the level of mining transfers is weakly significant. To compare the quadratic model against the cubic model, an F-test for nested models is used, assuming that the quadratic model is adequate as the null hypothesis. The null that the quadratic model is adequate is not rejected (F-statistic of 0.34 and p-value of 0.559). The results for the quartic model are essentially the same. I fail to find statistically significant coefficients in all the cases and the F-test model (which compares the quadratic versus the quartic model) fails to reject the null hypothesis that the quadratic model is adequate. In sum, there is no evidence against the parametric quadratic model suggested by our conceptual framework[46].

Although the evidence is compelling, the baseline model was not formally compared against a fully semi or non-parametric approach. Unfortunately, the semiparametric literature for panel data models is relatively new and no similar tests are available to compare parametric and semiparametric models as occurred with parametric models above. To overcome this limitation, the sample is restricted to a two-period version, and the difference for all the variables is taken, so that the available tests for the semiparametric cross-sectional cases can be used. The results are presented in Panel B of Table 5. Columns 1 presents the results for the quadratic parametric model for the restricted sample in differences for reelection. Results for political competition are available in

[45] Figure A.5 in the Online Appendix presents a similar analysis for political competition.

[46] To provide additional evidence on this regard, the semiparametric fixed effect model developed by Baltagi and Li (2002) with standard errors clustered at the district level is implemented. Results are reported in Figures A.6 and A.7 in the Online Appendix. The local polynomial smoothing derived from the Baltagi and Li's model for both outcomes suggests that the relationship closely resembles a quadratic one. These results are robust to different degrees of polynomial smoothing using an Epanechnikov kernel.

the Online Appendix. All coefficients have the expected signs and are statistically significant. I then estimate the double residual semiparametric model proposed by Robinson (1988) for different degrees of local polynomial fit (from 1 to 3) using a Gaussian kernel. Standard errors are clustered at the district level. The coefficients for the parametric part of the semiparametric model are similar to the ones reported in the quadratic parametric model, confirming the lack of explanatory power of mineral production in explaining political outcomes.

The results for the nonparametric part of the model are used to evaluate whether the quadratic parametric approach is better than the semiparametric one using the Hardle and Mammen (1993) test. I specifically test the null hypothesis that the nonparametric fit derived from the Robinson model can be approximated by a second-degree parametric adjustment as the one used in the baseline results. Critical values for this test were computed using wild bootstrap with 1,000 replications. Column 2 runs this test, comparing the quadratic parametric approach against the semiparametric model with a local polynomial fit of degree one. The null hypothesis is not rejected (p-value of 0.907), which suggests that the former model is at least as good an approximation as the latter. Similar results are found for the case of the semiparametric models with local polynomial fit of degree two (columns 3) and three (columns 4). Because scholars have suggested that-if the correct functional form is known-parametric estimates are always better because they are more efficient than their nonparametric counterparts, I am confident in the use of the quadratic parametric analysis in this paper.

6.4 Instrumental variables results for reelection outcomes

In this section, an IV design is used to provide additional evidence on the robustness of the basic results of this paper. Mining transfers may be endogenous for the reasons indicated above, although the evidence found so far suggests that endogeneity problems-if they exist-should play a very marginal role in this setting. The solution would be to use an instrument; that is, a source of exogenous variation that explain mining transfers but that is not correlated with unobservable factors in the original equation. In the context of this study, it has not been possible to identify a source of variation of that nature but it is possible to use mining Canon transfers as an imperfect instrument. As discussed in detail in the Online Appendix, mining Canon is the less susceptible to endogenous production responses among all the sources of mining rents. Despite this, it is an imperfect instrument and therefore the Nevo and Rosen's (2012) bounds are constructed to evaluate the sensitivity of the current results.

Table 6 presents the results of analysis. Column 1 in the upper panel shows the results of the preferred DID specification as reference. Column 2 presents the results of IV using mining Canon as an instrument. As shown, the results are essentially similar to the DID specification in terms of magnitude and statistical significance (coefficient of -0.076, significant at the 1% level). If this were a perfect instrument, this result would suggest that the bias of the DID design is marginal[47].

[47] It is important to remember that it is assumed that mining transfers are exogenous under a DID design.

To assess the sensitivity of this result, I implement the methodology developed by Nevo and Rosen (2012). Columns 3-7 present the results for different values of the parameter λ. This parameter enables a level of association between imperfect instrument and the unobservables from the main equation. Given the evidence discussed previously, it is expected that the estimated coefficients will not vary substantially because production levels do not influence political outcomes. The results are in line with these expectations. For example, if a low level of correlation is assumed between the unobservables and the imperfect instrument ($\lambda = 0.1$ in column 3), the results do not vary substantially from those presented in column 2 (-0.077 for the level and 0.008 for the square of mining transfers, both significant at a confidence level of 1%). It is important to note that, even in the case of high levels of correlation such as 0.5 and 0.7, the resulting coefficients do not change substantively. For example, for a level of $\lambda = 0.7$, the coefficient for the level is -0.093 while the square is 0.011, both significant at 1% and not so different in magnitude to the estimated coefficients in column 2 for the imperfect instrument.

These results suggest that the IV design using mining Canon transfers as an imperfect instrument is quite robust because the estimated coefficients are not substantially modified when high levels of correlation between this imperfect instrument and unobservables in the main equation are allowed. As already noted, this correlation-if it exists-should not be very high, and therefore despite assuming high levels of correlation, small changes are still obtained in the estimated coefficients. These results speak about the robustness of the econometric exercise in this section. It is also important to note that in all specifications used, the relationship between production levels and the mayors' reelection is not statistically significant.

The results for political competition are essentially the same. For this reason, they are not discussed here, but are available in the Online Appendix (Table A4), as are the results for the first stage [48]. It is important to note that the first stage is strong and there are no concerns about weak instruments [49].

6.5 Provision of public goods

In this section, I examine how mining transfers affect mayors' incentives to provide public goods. Table 7 presents the results of the empirical exercise.

Each column represents a public good using the preferred specification that includes the level and square of transfers as well as the real value of mineral production (in logs). Because the results of IV and DID are essentially the same regarding magnitude and statistical significance, only the estimates for the IV model are discussed here. Results for DID are available in Table A9 in the Online Appendix.

[48] The first stages for the level and square of mining transfers for reelection are reported in Table A5 and A6. Table A7 and A8 report the same for political competition.

[49] In all cases, the F-statistic for the imperfect instrument is larger than the standard used in the empirical literature. For reelection, the F statistics is 1,644 for the level of mining transfers and 64.83 for the its square. The same applies for the instruments developed using the Nevo and Rosen (2012) bounds. See Table A5 and A6 in the Online Appendix for details.Table A7 and A8 report similar F statistics for political competition.

The evidence is consistent with my previous findings, with some exceptions. For example, I estimate a non-monotonic relationship between access to public lighting, garbage collection and access to security services. Although the sign of the coefficients regarding security personnel and number of police stations per 1,000 inhabitants is in line with expectations, the quadratic term lacks any statistical significance. I find no relationship between mining transfers and access to potable water or libraries[50].

In line with previous evidence, I find that the level of mineral production has no direct impact on the provision of public goods, with the exception of access to libraries (coefficient of 0.004 and standard error of 0.002)[51].

These results contrast with those in existing literature. Caselli and Micheals (2013) study the impact of oil royalties on the provision of housing, urban services, infrastructure and educational and health inputs. The authors find no impact, except for some educational dimensions, although those results were not robust in most cases. Monteiro and Ferraz (2012) find similar results using a different dataset and research design.

While the lack of impact in previous studies has been considered a "puzzle", the results from the present study are consistent with the conceptual framework. Although it is difficult to make a comparative analysis in this regard[52], the results obtained above call into question the accepted notion that natural resource booms have little impact on the provision of public goods. Despite this, it is true that the impacts, when they exist, are relatively modest in relation to the magnitude of the expansion of fiscal resources associated with the mining boom. I return to this point later.

Additional evidence is provided in the Online Appendix regarding non-monotonic responses in other forms of public goods such as local public infrastructure (Table A10) and investment in roads (Table A11) [53].

[50]In the case of access to potable water, it is important to note that qualitative evidence indicates that this is a priority for the population (Arellano (2011)). The absence of such relationship could be explained by the technical complexity of these projects and the rules of the public investment system that requires the formulation of technically and financially viable public investment projects. In smaller towns, these conditions are rarely met. In addition, as discussed below, the political cycle matters because these are projects with longer horizons and are therefore not electorally profitable for mayors.

[51]This result can be explained as a product of the "Mining Program of Solidarity with the People" implemented during the second term of Alan Garcia (2006-2011). Under this program, mining companies committed to providing funds for public goods in localities close to their operations. The construction and implementation of libraries was one of the investments that mining companies supported during this period (2006-2010). For example, the Yanacocha mine helped to implementing libraries in 184 educational institutions between 2007 and 2008 in the region of Cajamarca.

[52]Countries differ in terms of which public goods are the responsibility of local governments. In Peru, there is a set of public goods whose provision is shared by various levels of government. While in some countries like Brazil the provision of education and health services is the responsibility of local governments, in Peru such provision is shared, with the central government playing a larger role.

[53]I do not find evidence that the mining boom has any connection with the construction of hospitals, health centers and polyclinics. I do find a non-monotonic relationship between mining transfers and the availability of basic health infrastructure, although the impact is very modest. These results contrast with the case of the sports infrastructure. The mining boom is associated in a non-monotonic way with a greater availability of stadiums, multipurpose, soccer and basketball fields. Regarding investment in roads, I find no relationship with constructed or repaired roads, sidewalks, and rural roads (measured in m2), but a non-monotonic relationship with cost measures. See the Online Appendix for details.

6.6 Clientelism

In the previous section, I studied the relationship between mining transfers and the provision of public goods. An alternative strategy used by local politicians to influence the election results is the use of clientelism, done so via public employment. This mechanism has been emphasized in studies by Robinson et al. (2006) and Robinson and Verdier (2013). In this section, I analyze the impact of mining transfers on public employment by human capital level.

Table 8 presents the results for the IV specification. Five types of employees are considered: municipal officials, professionals, technicians, security workers, and porters. For each I consider two specifications. The first considers the quadratic model including the actual level of mineral production measured in logarithms while the second excludes the mineral producer districts.

The results for the first specification are consistent with previous findings regarding the relevance of the quadratic specification. For all types of employees except technical workers, a non-monotonic relationship is observed between mining transfers and employment of municipality workers. For example, there is a net increase of 0.22 officers per 1,000 inhabitants per 1,000 PEN per capita of mining transfers for the case of districts with average levels of per-capita transfer (Column 1, Table 8). Because the number of officers per 1,000 inhabitants is 0.59, this effect is important. Regarding technicians, the coefficients of the quadratic specification are both positive. This is consistent with an increased demand for technicians in regions with high levels of mining transfers, a fact associated with some institutional constraints that requires local governments to formulate public investment projects to use mining transfer funds. Moreover, the results for the specification that excludes producer districts are essentially the same in terms of statistical significance and signs as in the previous case, except for professionals and technicians.

These results provide substantial evidence regarding the political dynamics in regions that benefit from mining transfers with respect to the use of public employment for electoral purposes[54]. On the one hand, it is evident that the greater variability is caused by the use of temporary workers [55]. On the other hand, the non-monotonic pattern suggested by the conceptual framework is confirmed. This result is consistent for different types of workers [56].

Thus, an increase in public employment for recipient districts is observed, but this effect is attenuated or even works in the opposite direction for districts with very high levels of mineral rents.

[54]Although the current legal framework prohibits the use of Canon transfers and mining royalties for hiring workers, anecdotal evidence suggests that local authorities have been using a number of mechanisms to use these fiscal resources in current expenditures in such a way without violating the restrictions imposed by law. Using qualitative methods (interviews and field visits), sociologists have documented an increase in temporary public employment and wages in districts that experienced a substantial increase in their budgets because of the mineral price boom. For example, Arellano (2011) finds that several mineral-rich municipalities diverted resources from investment projects financed by the mining Canon to pay the salaries of municipal officials using a budget category called "institutional strengthening".

[55]Table A12 in the Online Appendix reports the result of an analysis by type of contract. I find a non-monotonic pattern for employees with temporary contracts, but a weak linear effect for appointed staff. This is consistent with the use of temporary contracts as a clientelistic tool.

[56]The results of the present study contrasts with those of Monteiro and Ferraz (2012). They estimate an increase of 7 employees per 1,000 inhabitants for Brazil. They find no evidence that the oil boom increased the proportion of public employees with higher education or contracts. My econometric results suggest a more complex panorama.

This pattern is consistent with my theoretical framework. It also provides evidence consistent with the claim in Robinson et al. (2006) that public employment is the main tool used by politicians to gain electoral support, with the difference that the relationship is non-monotonic rather than linear [57].

6.7 Local government expenditures

In this section, I analyze the impact of mining transfers on local government expenditures. The goal is to understand how local governments spend mining rents using different expenditure categories.

Table 9 presents results of the impact of mining transfers on functional expenditures using the IV design [58]. I consider the nine most important functions of local government in Peru. A pattern emerges that is consistent with the non-monotonic relationship suggested by the conceptual framework. All the coefficients for the level and the square of mining transfers are strongly statistically significant for all expenditures categories with the exception of "Health and sanitation" in which the coefficient for the square is not statistically significant, although it has the expected sign.

The type of expenditure most affected by mining transfers is "Transport", which is again consistent with the current legal framework, favoring investment in infrastructure. This type of expenditure also has other economic and political properties that make it in one of the most common uses of mining revenues. It is usually associated with the construction and maintenance of roads and sidewalks, which is very intensive in low-skilled labor, being a common way for politicians to use rents to obtain political support from citizens. It also has the advantage of serving as a signal for politicians to show citizens their quality[59].

Two further expenditure categories that experienced a large increase related with the resource windfall are "Planning" and "Agriculture". According to Arellano (2011), the increase in the category "Agriculture" can be explained by the interest of local politicians to compensate rural citizens for the potential negative effects of mining activities. This usually takes the form of irrigation projects, seed distribution or similar interventions [60].

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[57] Table A13 in the Online Appendix reports the results for the DID design. The results are similar.

[58] Table A14 in the Online Appendix report an analysis using expenditure categories such as payroll, pensions, goods and services, other current expenditure, investment financing, other capital expenditures and debt. I find the proposed non-monotonic relationship between mining rents and three types of expenditures: goods and services, investment and other capital expenditures. See the Online Appendix for details.

[59] The clearest example of this was the implementation of the "Pilot Plan for Maintenance of Public Infrastructure" in the district of San Marcos (Ancash), in the area of influence of the Antamina mine. According to Salas (2010), thanks to this program, "... the municipality has employed virtually all San Marcos residents of working age." The program offered a wage almost four times higher than the average agricultural wage (10 PEN) in exchange for the maintenance of basic infrastructure including roads cleaning, the maintenance of unpaved roads, and the construction of retaining walls, among others. According to Salas, the implementation of this program was effective to avoid the impeachment of the mayor.

[60] Results are similar under a DID. See Table A15 in the Online Appendix for details.

6.8 Living standards

I have studied the impact of the mineral resource boom on politician behavior, the use of public good provision, and public employment as instruments that may influence electoral outcomes. I now turn to the issue of the effect of the boom on well-being.

Table 10 analyzes the impact of the natural resource boom on income and consumption per capita. I consider the basic specifications of Table 2. The upper panel presents the IV results for the monthly household income per capita whereas the lower panel details the evidence for the monthly household consumption per-capita. Both measures are expressed in real terms using 2001 Lima prices. These two measures are considered together as they are supposed to recover different aspects of well-being. In particular, consumption is believed to provide a better measure of long-term well-being whereas income is a better measure of short-term changes in well-being. Because most of the impact of the recent mineral boom can only be assessed in the short-term, income seems to be a good candidate in the context of this paper. However, it is important to note that there is an long-standing debate as to whether income or consumption is the best measure of well-being (see, for instance, Deaton (1997) for a discussion).

First, I discuss the results for household income. Column 1 of Table 10 reports the results for the specification in levels. I estimate an average increase of 32 PEN per capita for each 1,000 PEN of mining transfers per capita. This effect is stronger in magnitude when the square of mining transfers is added to the specification (Column 2). For the municipality with the average level of per capita transfer, this implies an average increase of 95 PEN for each 1,000 PEN. The results are consistent with the conceptual framework in terms of the non-monotonic pattern between mining rents and economic outcomes.

Column 3 adds the log of the real value of mineral production to control for the impact of changes in mineral production on real household per capita income. The basic results are robust to the inclusion of mineral production. More importantly, the coefficient for mineral production is not statistically significant. This result is consistent with the previous results regarding the lack of impact of mineral production. These results remain essentially unchanged when districts from Lima (Column 4), non-producer regions (Column 5) and non-producer provinces (Column 6) are excluded from the sample [61].

The lower panel presents the results for the case of consumption. The evidence suggests that consumption has not been affected by the mineral boom, with the exception for the specification in which non-producer regions are excluded [62]. Because consumption is a measure of long-term well-being, it is not surprising that no effect is found in this case [63]. Taken together, these results

[61] These results are complemented with descriptive evidence that suggests that real income per-capita has been growing faster in mineral producer districts. See Figure A.8 in the Online Appendix.

[62] However, there is some evidence that consumption per capita is also growing faster in producer districts, although not in the same fashion as income. See Figure A.9 in the Online Appendix for details.

[63] Although the results on consumption do not reveal a significant increase, some descriptive evidence suggest that consumption-based poverty indicators are experienced a larger reduction in producer districts. This is clear for the total poverty headcount rate (see Figure A.10 in the Online Appendix). A similar, although less clear pattern, is

suggest that the mineral resource boom had a positive short-term effect on well-being[64].

7 Discussion of Results

The literature that analyzes the role of natural resources on development outcomes using credible identification strategies is relatively new and small. Recent evidence has exploited natural resource booms associated with oil exploitation (Caselli and Micheals (2013), Monteiro and Ferraz (2012), Dube and Vargas (2013), and Vicente (2010)), mining (Maldonado (2011), Aragon and Rud (2013), Arellano (2011), and Loayza et al. (2013)) and the cultivation of the coca leaf (Angrist and Kluger (2008) and Dube and Vargas (2013)). Other authors have studied the impact of unexpected increases in fiscal resources (Brollo et al. (2013)).

Although there is no relevant systematic evidence, there are reasons to believe that the impact of natural resources on development depends on the type of resource. In line with the results of Dube and Vargas (2013), one should expect different impacts depending on whether the resource exploitation is intensive in labor or capital. In the case of mining production, this has always been characterized as capital intensive, so any potential impact on well-being should have a stronger link to the mining rent. An exception would be artisanal gold production in parts of the Peruvian jungle, which is characterized as labor-intensive and therefore capable of directly impacting on household well-being via market mechanisms. The dramatic decline in poverty levels in this region may be associated with this characteristic[65]

This is similar to coca, whose cultivation is labor intensive. The expansion of the production of coca leaf in Colombia (due to air interdiction activities in Peru and Bolivia) led to an increase in self-employment income and the probability of employment in rural areas of Colombia, as documented by Angrist and Kluger (2008). Moreover, the authors also reveal an expansion of male youth labor supply [66].

Finally, it is important to note that, although increases in the provision of public goods and gains in living standards have been revealed, these changes are relatively modest compared with the

observed for extreme poverty (see Figure A.11 in the Online Appendix).

[64]These results contrast with those in the existing literature. For Brazil, Caselli and Micheals (2013) find no impact of the oil boom on per-capita household income, although they do find some very weak evidence of impacts in the bottom quintile of the income distribution (10 per cent of real income per capita). In a study on Peru, Loayza et al. (2013) find positive impacts of mining on household well-being but these are not explained by mining transfers but by mineral production. This result is also found by Aragon and Rud (2013) for Cajamarca, a northern region in Peru. One of their robustness test showed that mining Canon transfers have no explanatory role in the increases in real income for households located close to the Yanacocha mine.

[65]The best example is the Madre de Dios region. Between 2001 and 2010, the poverty rate in this region, characterized by informal gold-production, showed a significant reduction (from 36.7% to 8.7%), a much greater decline than the national average (54.8% to 31.3%). For a detailed discussion, see INEI (2011).

[66]It is more difficult to interpret the results of Brollo et al. (2013) from this perspective. The economic properties of natural resources with respect to the use of labor or capital factors are in turn linked to their political properties related to rent appropriation and its use by politicians to gain or remain in power. Thus, the exploitation of natural resources can be beneficial or detrimental to the citizens. In the case of Brollo et al. (2013), there is a dramatic increase in transfers to local governments that are not associated with the exploitation of a natural resource. Hence, it is difficult to interpret this source of variation as a case of the "resource curse".

magnitude of the boom. This leads to questions regarding the use of mining transfers. Increases in public employment and the expansion of local infrastructure based on unskilled labor have been noted, which constitute an unproductive use of mining transfers but with high political returns[67]. Additionally, as suggested by Maldonado (2011), the corruption of political authorities and local officials should be considered. Corruption has been widely documented by the local media[68]. The combination of perverse political incentives with low local institutional capacity helps us to understand why the impacts of the mining boom are modest relative to the magnitude of the increase in the observed mining rents in the last decade.

8 Concluding Remarks

This paper has analyzed the way in which a mineral resources boom has affected the incentives of local politicians as well as its effect in terms of the provision of public goods, clientelism and the well-being of citizens. While there has been a recent emphasis on novel identification strategies to estimate the impact of resource booms on political and economic outcomes with regard to the resource curse, there remains significant work in terms of providing credible causal estimates about this relationship. More importantly, little is known regarding the mechanisms that explain it. In particular, the current literature contains an empirical puzzle concerning the impact of resource booms on citizen's well-being. Most studies fail to detect impacts on household well-being and public good provision. This is hard to believe given the large amounts of rents created by the spectacular rise of international prices. This empirical failure may be a reflection of our poor understanding of the phenomenon.

I found a reduction in the probability of re-election (38% for each 1,000 PEN of mining transfers per-capita) and the level of political competition (4.9% for each 1,000 PEN of mining transfers per-capita) for districts with average levels of mining transfers, but positive effects for the extremely wealthy in mineral resources districts (over 5,000 PEN per capita). These results are robust to the inclusion of mining production and maintained for different sub-samples. Furthermore, when producer districts are excluded from the sample, the results do not change substantially. To assess

[67] The media has emphasized the misuse of mining transfers showing the proliferation of white elephants and magnificent buildings in mineral-rich regions. For example, stadiums have been built that possess seating capacities that exceed the local population (in Yarabamba, Arequipa, three stadiums were built, the largest with capacity of 3,000 for a population of 1,200 habitants). Furthermore, transfers have been used to construct/repair main squares, as well as the construction of monuments honoring a soccer referee in Tumbes, maca (a root of a plant) in Junin, a hat in Cajamarca, and a lizard in Tumbes. Beyond the eccentricity of such structures, the use of mining transfers in this way produces a high political returns as it allows for the redistribution of resources through public employment for electoral purposes in public investment projects based on unskilled labor. This is perfectly rational from the perspective of the mayors.

[68] The media has documented many cases of district and provincial mayors with serious allegations of corruption in mineral-rich regions. For example, the mayors in the districts of San Marcos and Chavin in Ancash have being investigated by the Comptroller General of the Republic (CGR) about the misappropriation of public funds. Recently, the Minister of Economics and Finance restricted access to public funds in several municipalities in the Ancash, Cajamarca, Tumbes, Pasco and Puno regions. According to the CGR, more than 3,000 public officials have been accused of corruption since 2009.

the validity of the exclusion restriction of the IV design, Nevo and Rosen's (2012) bounds were estimated and (even if significant deviations from the exclusion restriction are allowed) the basic results of the study did not alter.

These effects are explained by the strategic behavior of local politicians facing the resource boom, which in turn affects the provision of public goods and the well-being of citizens. I found an increase in the provision of public goods, public employment and short-term increases in household well-being (proxied by household income) for municipalities receiving average levels of per capita transfer. However, these effects are relatively modest compared with the large influx of fiscal resources distributed as mining Canon revenue and mining royalties to local governments in resource-rich regions. In line with the theoretical framework, the relationship between public goods and well-being with mineral rents is also non-monotonic, with a distinct pattern for districts with very high levels of mining transfers.

These results suggest the need for a more careful approach to study the impact of resource abundance because here I show that the use of linear approximations can seriously underestimate its true impact. Even worse, it is possible to fail to detect any impact, as shown for several of the dimensions analyzed. I believe this is one of the most important contributions of this paper.

Furthermore, the evidence presented in this paper contradicts the negative opinion regarding the role of natural resources in economic development. I show that, for most local governments in Peru, natural resources appear to be more of a blessing than a curse, but a relatively modest blessing in relation to the magnitude of the boom. This is true even in the context where institutions are weak, which also contradicts the cross-sectional literature that argues that natural resources are solely blessing in the presence of good institutions. This is an issue that requires further future research.

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Evolution of Mineral Production (1996-2014)

Figure 1. Author's elaboration based on data from the Ministry of Energy and Mines. This figure shows the evolution of mineral production during the period under analysis (1996-2014). The vertical line in 2003 represents the moment in which mineral prices experienced a large increase. Mineral production is valued in US$.

Evolution of Mineral Prices (1996-2014)

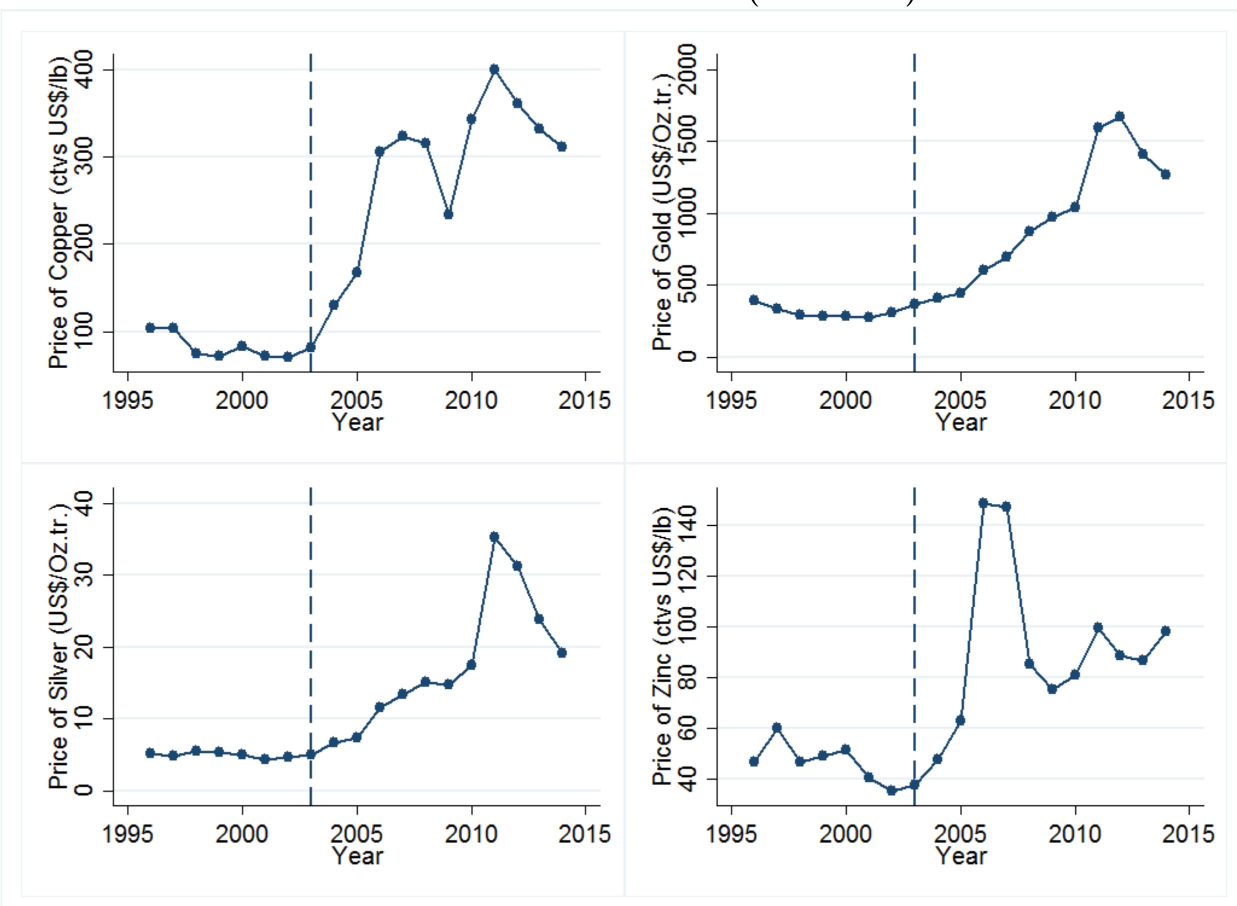

Figure 2. Author's elaboration based on data from the Ministry of Energy and Mines. This figure shows the evolution of international mineral prices for Copper, Gold, Silver and Zinc during the period under analysis (1996-2010). These are the four more important mineral products produced by Peru in the period under analysis. The vertical line in 2003 represents the moment in which mineral prices experienced a large increase. Prices of Copper and Zinc are in US$ cents per pound. Prices of Gold and Silver are in US$ per troy ounce.

Evolution of Mining Transfers (1996-2014)

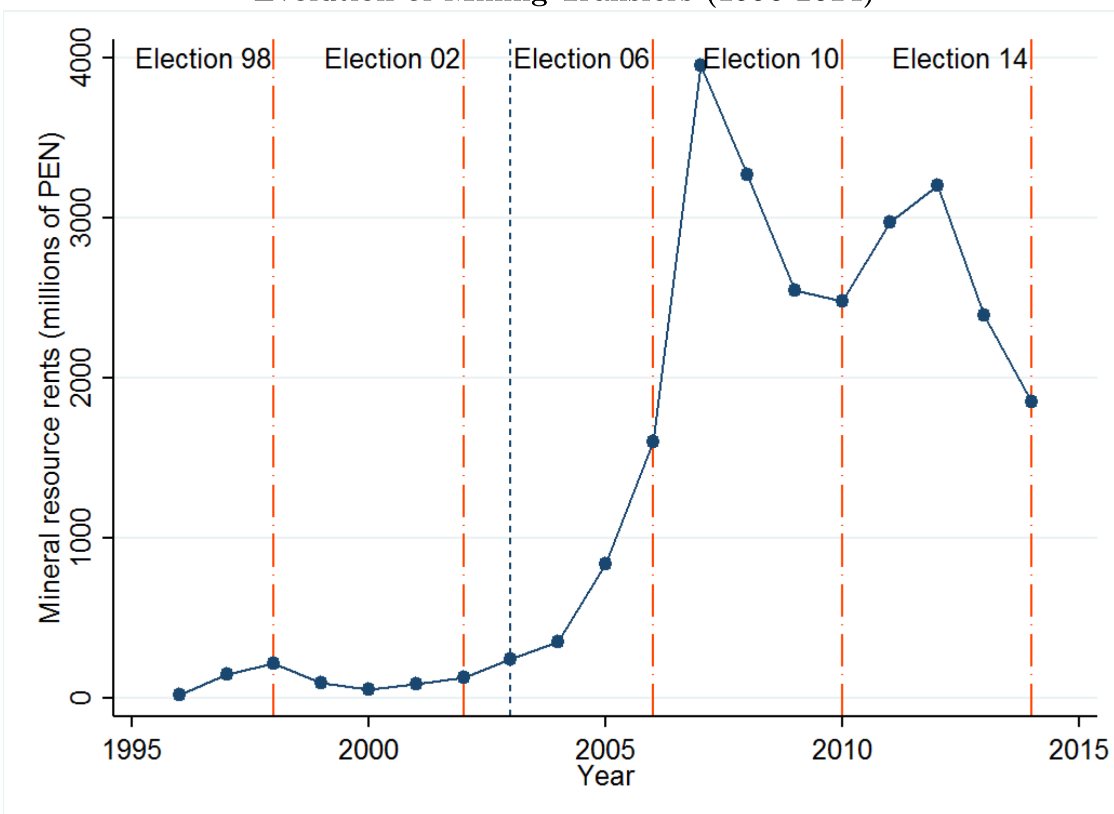

Figure 3. Author's elaboration based on data from the Ministry of Economics and Finance. This figure shows the evolution of mining transfers during the period under analysis (1996-2014). The blue vertical line in 2003 represents the moment in which mineral prices experienced a large increase. The orange vertical lines represents all the elections that took place over the period. Mining transfers are measured in PEN millions in 2001 Lima prices.

District Allocation of Average Mining Transfers (1996-2010)

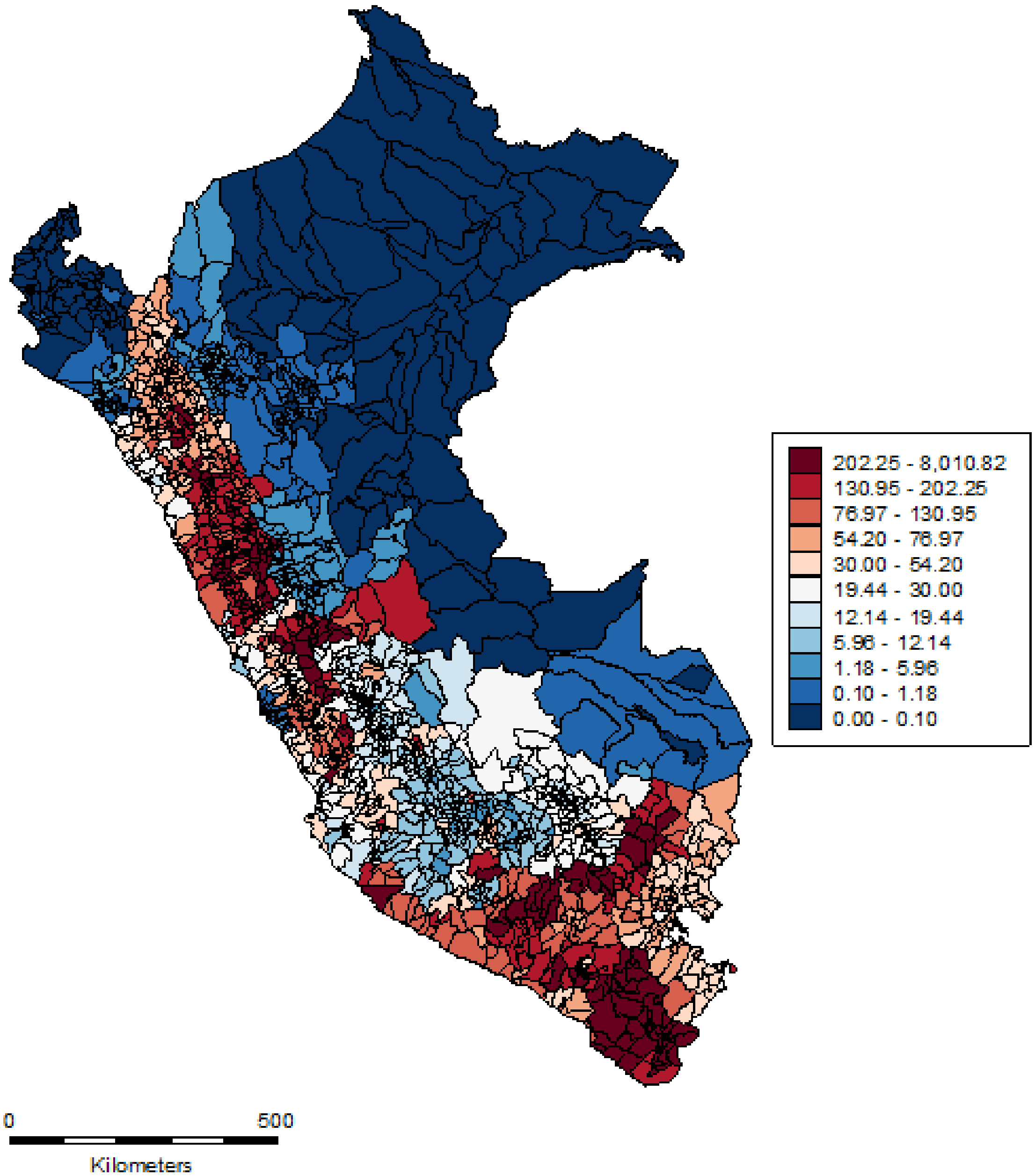

Figure 4. Author's elaboration based on data from the Ministry of Economics and Finance. This map shows the average mining transfers for the period 1996-2010. Mining transfers are measured in PEN per capita in 2001 Lima prices.

Marginal Effects for Reelection and Political Competition

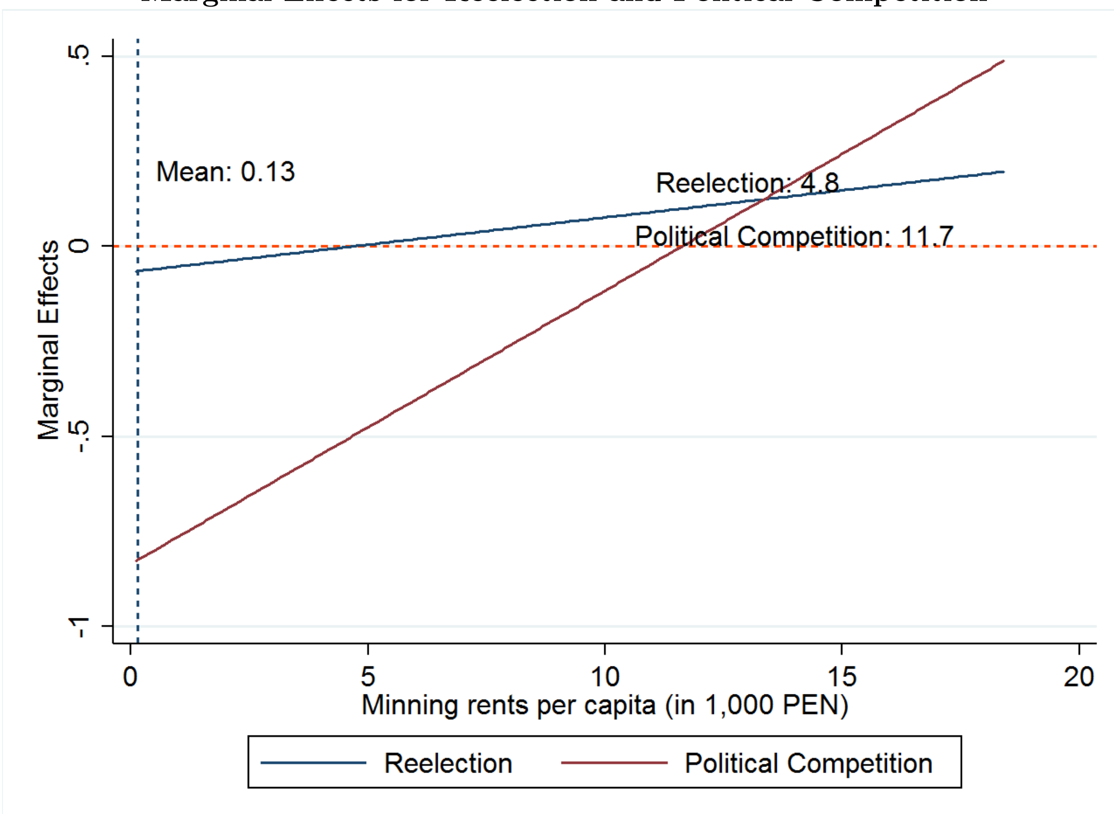

Figure 5. Author's elaboration. This figure shows the marginal effects computed for several levels of the treatment variable. It shows at which levels there is a switch in the sign of the marginal effect.

Nonparametric Analysis of Residuals for Reelection

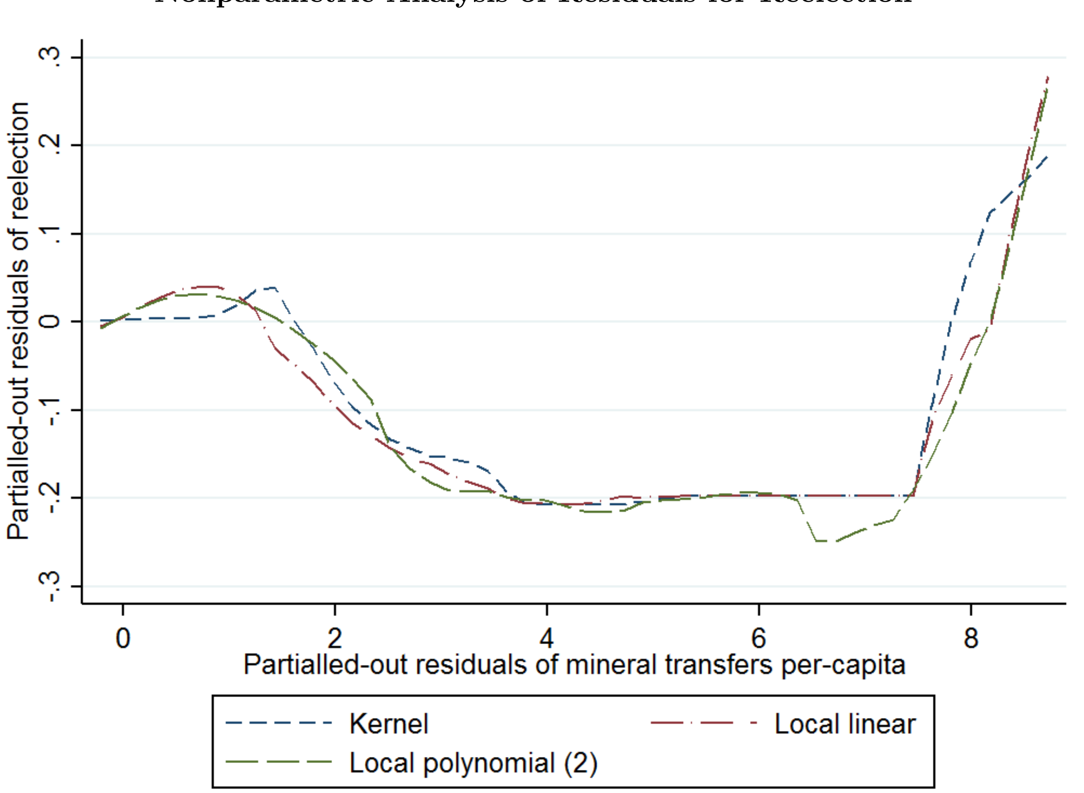

Figure 6. Author's elaboration. This figure plots the residuals after partialling out district and time fixed effects for the treatment and the outcome variable. A Kernel regression, a local linear regression, and a polynomial regression of degree two, all of them with an Epanechnikov Kernel and optimal bandwidth were implemented.

Table 1. Summary Statistics

	Recipients	Producers	Non-recipients
I. Political Outcomes			
Reelection	0.18	0.19	0.11
Political Competition	0.82	0.84	0.81
II. Transfers			
Mining Transfers (per-capita)	92.32	474.47	-
p10	0.09	0.39	-
p25	0.70	2.64	-
p50	4.92	27.75	-
p75	44.04	281.85	-
p90	179.31	877.38	-
p99	1,272.58	9,479.57	-
Municipality Budget (per-capita)	568.03	1,496.52	347.17
III. Mineral Production			
Real Value of Mineral Production (US$ in 2001)	-	2,324,875	-
Copper	-	898,122	-
Zinc	-	490,013	-
Lead	-	69,880	-
Tin	-	134,851	-
Molybdenum	-	17,171	-
Silver	-	219,311	-
Gold	-	466,456	-
Iron	-	29,070	-
IV. District Characteristics: Census 1993			
Population	12,339	10,788	22,618
% Rural Population	57.76	55.32	59.08
% Children (0-15 years old)	40.68	40.58	45.14
Malnutrition rates for Children	55.61	53.02	55.64
% Population without wastepipe-latrine	41.81	41.60	53.91
% Population without water	51.20	49.84	67.13
% Population without electricity	74.16	65.27	68.55
Female illiteracy rate	33.60	29.39	23.90
Altitude	2,326	2,720	498

Source: Author's elaboration based on data from the Ministry of Economy and Finance, and Ministry of Energy and Mines. Section III is based on 1993 Census data.

Table 2. Impact of Natural Resource Booms on Reelection

	Difference in Differences Estimates					
	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable: 1=Mayor is reelected.					
Average Transfers for Electoral Cycle						
Mining Transfers per capita	-0.025***	-0.034	-0.034	-0.028	-0.031	-0.024
	(0.010)	(0.026)	(0.026)	(0.026)	(0.026)	(0.028)
Mining Transfers per capita2		0.001	0.001	0.000	0.000	0.000
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Log of (1+Real Value of Production)			0.001	0.002	0.001	0.000
			(0.004)	(0.005)	(0.004)	(0.004)
Year of Election						
Mining Transfers per capita	0.007	-0.066***	-0.067***	-0.062**	-0.061**	-0.071***
	(0.018)	(0.024)	(0.024)	(0.024)	(0.025)	(0.025)
Mining Transfers per capita2		0.007***	0.007***	0.007***	0.007***	0.008***
		(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Log of (1+Real Value of Production)			0.001	0.002	0.001	0.001
			(0.004)	(0.004)	(0.004)	(0.004)
Excluding Lima	No	No	No	Yes	No	No
Excluding Non-producer Regions	No	No	No	No	Yes	No
Excluding Non-producer Provinces	No	No	No	No	No	Yes
Mean of dependent variable	0.17	0.17	0.17	0.16	0.17	0.18
Number of observations	4,582	4,582	4,582	4,128	3,734	2,346
R2	0.014	0.016	0.016	0.018	0.014	0.016

Note: * significant at 10%; ** significant at 5%; *** significant at 1%. Huber-White standard errors clustered at the district level. All specifications include district and year fixed effects. The treatment variable is measured in 1,000 PEN. All monetary values are in 2001 Lima prices. Real value of mineral production is measured in mineral prices of 2001. The dependent variable is a dummy equal to one if the mayor is reelected.

Table 3. Impact of Natural Resource Booms on Political Competition

	Difference in Differences Estimates					
	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable: (1-Herfindahl Index)*100					
Average Transfers for Electoral Cycle						
Mining Transfers per capita	-0.310	-0.836**	-0.830**	-0.825**	-0.752*	-0.899**
	(0.217)	(0.402)	(0.402)	(0.405)	(0.406)	(0.439)
Mining Transfers per capita2		0.036**	0.036**	0.037**	0.033**	0.040**
		(0.016)	(0.016)	(0.016)	(0.016)	(0.017)
Log of (1+Real Value of Production)			-0.021	-0.016	-0.019	-0.015
			(0.057)	(0.061)	(0.057)	(0.057)
Year of Election						
Mining Transfers per capita	-0.280	-0.307	-0.307	-0.283	-0.251	-0.371
	(0.193)	(0.391)	(0.394)	(0.396)	(0.394)	(0.421)
Mining Transfers per capita2		0.003	0.003	0.001	-0.001	0.007
		(0.022)	(0.022)	(0.022)	(0.022)	(0.023)
Log of (1+Real Value of Production)			0.000	0.004	0.001	0.006
			(0.052)	(0.055)	(0.052)	(0.052)
Excluding Lima	No	No	No	Yes	No	No
Excluding Non-producer Regions	No	No	No	No	Yes	No
Excluding Non-producer Provinces	No	No	No	No	No	Yes
Mean of dependent variable	83.15	83.15	83.15	83.15	83.15	83.15
Number of observations	4,581	4,581	4,581	4,127	3,734	2,346
R2	0.132	0.132	0.132	0.139	0.139	0.156

Note: * significant at 10%; ** significant at 5%; *** significant at 1%. Huber-White standard errors clustered at the district level. All specifications include district and year fixed effects. The treatment variable is measured in 1,000 PEN. All monetary values are in 2001 Lima prices. The dependent variable is 1 minus the Herfindahl index of votes, a measure of how much concentrated votes were in the election. This variable has been normalized to the scale 1-100 to facilitate interpretation.

Table 4. Robustness Checks for Impact of Natural Resource Rents on Reelection

	(1)	(2)	(3)	(4)
Average Transfers for Electoral Cycle				
Mining Transfers per capita	-0.034	-0.079**	-0.075**	-0.067*
	(0.026)	(0.033)	(0.033)	(0.036)
Mining Transfers per capita2	0.001	0.003	0.002	0.002
	(0.001)	(0.002)	(0.002)	(0.002)
Log of (1+Real Value of Production)	0.001			
	(0.004)			
Year of Election				
Mining Transfers per capita	-0.067***	-0.113**	-0.103**	-0.130**
	(0.024)	(0.046)	(0.047)	(0.052)
Mining Transfers per capita2	0.007***	0.015***	0.014***	0.017***
	(0.002)	(0.005)	(0.005)	(0.005)
Log of (1+Real Value of Production)	0.001			
	(0.004)			
Excluding Producer Districts	No	Yes	No	No
Excluding Producer Districts in Producing Regions	No	No	Yes	No
Excluding Producer Districts in Producing Provinces	No	No	No	Yes
Mean of dependent variable			0.17	
Number of observations	4,582	4,316	3,468	2,080
R2	0.016	0.014	0.011	0.012

Note: * significant at 10%; ** significant at 5%; *** significant at 1%. Huber-White standard errors clustered at the district level. All specifications include district and year fixed effects. The treatment variable is measured in 1,000 PEN. All monetary values are in 2001 Lima prices. Real value of mineral production is measured in mineral prices of 2001. The dependent variable is a dummy equal to one if the mayor was reelected.

Table 5. Robustness Checks on the Parametric Approach

Panel A	**Impact on Reelection**			
	(1)	(2)	(3)	(4)
Polynomial and Semiparametric Panel Regressions				
Mining Transfers per capita	-0.067***	-0.084*	-0.018	
	(0.024)	(0.047)	(0.069)	
Mining Transfers per capita2	0.007***	0.012	-0.027	
	(0.002)	(0.009)	(0.029)	
Mining Transfers per capita3		-0.000	0.005	
		(0.000)	(0.003)	
Mining Transfers per capita4			-0.000	
			(0.000)	
Log of (1+Real Value of Production)	0.001	0.001	0.001	0.000
	(0.004)	(0.004)	(0.004)	(0.005)
F-test for quadratic specification	9.36			
	[0.000]			
F-test for nested models comparison:		0.34		
Quadratic versus Cubic model		[0.559]		
F-test for nested models comparison:			1.08	
Quadratic versus Quartic model			[0.339]	
Panel B	**Estimation in Differences on the Restricted Samples**			
Semiparametric Cross-sectional Regressions				
Mining Transfers per capita	-0.091**			
	(0.036)			
Mining Transfers per capita2	0.008**			
	(0.004)			
Log of (1+Real Value of Production)	0.004	0.004	0.004	0.004
	(0.005)	(0.005)	(0.005)	(0.005)
Hardle and Mammen's test		0.286	1.074	1.143
		[0.907]	[0.308]	[0.294]

Note: * significant at 10%; ** significant at 5%; *** significant at 1%. All specifications include district and year fixed effects. The treatment variable is measured in 1,000 PEN. All monetary values are in 2001 Lima prices. Real value of mineral production is measured in 2001 mineral prices. Columns 4 of Panel A report the Baltagi and Li's (2002) semiparametric fixed effects model estimates using a local polynomial degree 4 with an Epanechnikov kernel. Columns 2-4 of Panel B report the Robinson's (1988) double residual semiparametric model estimates using different degrees of local polynomial fit with a Gaussian kernel. Columns 2 considers a local polynomial fit of degree 1, columns 3 use a local polynomial fit of degree 2, and columns 4 a local polynomial fit of degree 3. Restricted sample in Panel B is a cross-sectional sample from a two-period panel dataset expressed in differences. F-test for nested models evaluates a null hypotheses that the quadratic approximation (reduced model) is adequate versus the alternative hypotheses that the cubic or quartic model (full model) are better. The Hardle and Mammen's (1993) test evaluates the null hypotheses that the quadratic parametric is adequate versus the alternative hypotheses that the non-parametric approximation is better. Huber-White standard errors clustered at the district level (all columns in Panel A and columns 1 and 4 in Panel B) are reported in parentheses. P-values for F and Hardle and Mammen's (1993) tests are reported in brackets. Critical values for the Hardle and Mammen's (1993) test were obtained using wild bootstrap with 1,000 replications.

Table 6. Sensitivity Analysis for Instrumental Variable Regression for Reelection Outcomes

		Instrumental Variables					
	DID	**Imperfect IV**	**Nevo and Rosen (2012) One-sided Bounds**				
			(λ=0.1)	**(λ=0.3)**	**(λ=0.5)**	**(λ=0.7)**	**(λ=0.9)**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Mining Transfers per capita	-0.067***	-0.076***	-0.077***	-0.079***	-0.084***	-0.093**	-0.126**
	(0.024)	(0.027)	(0.028)	(0.029)	(0.031)	(0.037)	(0.057)
Mining Transfers per capita2	0.007***	0.008***	0.009***	0.009***	0.010***	0.011***	0.016***
	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.006)
Log of (1+Real Value of Production)	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)

Note: * significant at 10%; ** significant at 5%; *** significant at 1%. Huber-White standard errors clustered at the district level. All specifications include district and year fixed effects. The treatment variable is measured in 1,000 PEN. All monetary values are in 2001 Lima prices. Real value of mineral production is measured in mineral prices of 2001. The dependent variable is a dummy equal to one if the mayor was reelected. Column (1) replicates the benchmark result. Column (2) presents the IV estimate using mining Canon as an imperfect instrument. Nevo and Rosen's bound were computed for different values of the parameter λ, which measures the level of deviation with respect to the validity of the exclusion restriction. Results are reported in columns (3) to (7). Greater values of this parameter represent greater deviations from the validity of the exclusion restriction. Only top bounds are derived.

Table 7. Impact of Natural Resource Booms on Public Goods Provision

	IV Estimates							
	Access to	**Access to**	**Garbage Collection**		**Security Services**			**Access to**
	Water Network	**Public Light**	**In Capital**	**Rest**	**Access**	**Perssonel**	**Stations**	**Library**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Mining Transfers per capita	0.005	0.032***	0.056*	0.096***	0.054***	0.151***	0.084**	-0.016
	(0.010)	(0.011)	(0.030)	(0.037)	(0.013)	(0.054)	(0.034)	(0.010)
Mining Transfers per capita2	0.000	-0.001***	-0.002**	-0.004***	-0.001***	-0.003	-0.001	0.000
	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.003)	(0.002)	(0.000)
Log of (1+Real Value of Production)	-0.001	0.002	-0.003	0.003	-0.001	0.003	0.000	0.004*
	(0.003)	(0.001)	(0.004)	(0.006)	(0.002)	(0.009)	(0.001)	(0.002)
Mean of dependent variable	0.76	0.88	0.94	0.55	0.15	6.1	1.3	0.41
Number of observations	5,566	8,644	9,014	8,781	14,117	12,825	10,026	14,237
R2	0.242	0.264	0.017	0.113	0.115	0.242	0.078	0.013

Note: * significant at 10%; ** significant at 5%; *** significant at 1%. Huber-White standard errors clustered at the district level. All specifications include district and year fixed effects. All specifications include district and year fixed effects. The treatment variable is measured in 1,000 PEN. All monetary values are in 2001 Lima prices. Real value of mineral production is measured in mineral prices of 2001. Personnel and stations are measured in units per 1,000 habitants. All other variables are dummy equal to one if the district has access to a particular public good.

Table 8. Impact of Resource Booms on Public Employment by Type of Employment

	IV Estimates									
	Officials		**Professionals**		**Technicians**		**Security Workers**		**Janitors**	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Mining Transfers per capita	0.223**	0.291**	0.615***	0.550***	0.305	0.244*	0.199***	0.234***	0.200***	0.187***
	(0.091)	(0.135)	(0.132)	(0.104)	(0.190)	(0.132)	(0.064)	(0.079)	(0.073)	(0.070)
Mining Transfers per capita2	-0.006**	-0.009**	-0.010**	-0.013	0.016**	0.004	-0.007**	-0.012***	-0.007***	-0.008***
	(0.003)	(0.004)	(0.004)	(0.009)	(0.007)	(0.017)	(0.003)	(0.004)	(0.002)	(0.002)
Log of (1+Real Value of Production)	-0.007		-0.011		-0.002		-0.006*		-0.005	
	(0.005)		(0.007)		(0.006)		(0.003)		(0.006)	
Excluding Producer Districts	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Mean of dependent variable	0.59	0.59	0.91	0.91	1.24	1.24	0.24	0.24	0.67	0.67
Number of observations	15,523	14,801	15,523	14,801	15,523	14,801	15,523	14,801	15,523	14,801
R2	0.135	0.135	0.127	0.122	0.173	0.121	0.048	0.046	0.048	0.046

Note: * significant at 10%; ** significant at 5%; *** significant at 1%. Huber-White standard errors clustered at the district level. All specifications include district and year fixed effects. The treatment variable is measured in 1,000 PEN. All monetary values are in 2001 Lima prices. Real value of mineral production is measured in mineral prices of 2001. Dependent variables are measured in number of employees per 1,000 habitants.

Table 9. Impact of Natural Resource Booms on Local Government Expenditures

	IV Estimates								
	Planning	**Agriculture**	**Social Assistance**	**Education and Culture**	**Energy and Natural Resources**	**Industry, Trade and Services**	**Health and Sanitation**	**Transport**	**Housing and and Urban Development**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Mining Transfers per capita	239.767***	153.721***	30.971***	158.298***	13.295***	23.141***	96.984***	248.192***	34.273***
	(41.698)	(25.128)	(3.262)	(15.298)	(2.051)	(4.106)	(19.611)	(49.358)	(4.881)
Mining Transfers per capita2	-5.814***	-3.634***	-0.315**	-4.696***	-0.425***	-0.771***	-1.433	-7.596***	-1.029***
	(1.330)	(0.752)	(0.134)	(0.781)	(0.073)	(0.110)	(1.304)	(1.144)	(0.211)
Log of (1+Real Value of Production)	-1.733*	0.023	0.110	1.752	-0.374	-0.194	0.996	-0.994	0.265
	(0.991)	(0.820)	(0.364)	(1.661)	(0.303)	(0.288)	(1.187)	(1.397)	(0.342)
Mean of dependent variable	164.89	38.46	42.95	57.99	13.80	9.25	66.66	68.29	20.24
Number of observations	17,317	17,317	17,317	17,317	17,317	17,317	17,317	17,317	17,317
R2	0.318	0.167	0.119	0.259	0.034	0.068	0.232	0.233	0.053

Note: * significant at 10%; ** significant at 5%; *** significant at 1%. Huber-White standard errors clustered at the district level. All specifications include district and year fixed effects. The treatment variable is measured in 1,000 PEN. All monetary values are in 2001 Lima prices. Real value of mineral production is measured in mineral prices of 2001. Dependent variables are measured in per capita terms.

Table 10. Impact of Natural Resource Booms on Household Well-being

Instrumental Variables Estimates						
	Income per capita					
	(1)	(2)	(3)	(4)	(5)	(6)
Mining Transfers per capita	32.171***	96.399***	96.307***	97.452***	98.367***	105.063***
	(10.772)	(37.319)	(37.367)	(37.454)	(37.576)	(39.110)
Mining Transfers per capita2		-2.151**	-2.149**	-2.179**	-2.200***	-2.379***
		(0.845)	(0.847)	(0.847)	(0.849)	(0.885)
Log of (1+Real Value of Production)			1.634	1.589	1.746	1.773
			(1.878)	(1.906)	(1.898)	(1.927)
	Consumption per capita					
Mining Transfers per capita	0.641	8.437	8.398	8.575	9.883*	9.179
	(1.695)	(5.894)	(5.909)	(5.944)	(5.723)	(6.282)
Mining Transfers per-capita$\hat{2}$		-0.261*	-0.260*	-0.267*	-0.298**	-0.275*
		(0.142)	(0.142)	(0.143)	(0.136)	(0.151)
Log of (1+Real Value of Production)			0.695	0.499	0.861	0.997
			(0.864)	(0.853)	(0.900)	(0.917)
Excluding Lima	No	No	No	Yes	No	No
Excluding Non-producer Regions	No	No	No	No	Yes	No
Excluding Non-producer Provinces	No	No	No	No	No	Yes
Mean of dependent variable: Income	400.56					
Mean 0f dependent variable: Consumption	334.8					
Number of observations	200,861	200,861	200,861	171,002	145,565	87,843
R2	0.011	0.012	0.012	0.015	0.012	0.012

Note: * significant at 10%; ** significant at 5%; *** significant at 1%. Huber-White standard errors clustered at the district level. All specifications include district and year fixed effects. The treatment variable is measured in 1,000 PEN. All monetary values are in 2001 Lima prices. Real value of mineral production is measured in mineral prices of 2001. The analysis covers the period 1998-2010.

Online Appendix for: The Non-Monotonic Political Effects of Resource Booms

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Universidad del Rosario

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For the latest version of this paper, click here.

A Institutional rules for mining rents allocation

A.1 Mining legal framework

Mining is an activity with long tradition in Peru since colonial times. Historically, it has been associated with exploitation[1] and environmental degradation, which explains the negative perception that this activity has in areas where it is performed (World Bank 2005). During the 20th century the most important mines of the country were in foreign hands[2]. The limited regulatory state capacity and the unequal access to key resources like water and land were critical factors in shaping a historical conflictive relationship between mining interest and local communities located in mineral rich areas. In this scenario, the Peruvian state was regularly perceived as a biased actor in favor of mining companies (Gil 2009:31), due to the fact that the mining sector has been historically the most important source of fiscal revenues (Arellano 2011a:620).

During the 90s, mining experienced a significant expansion because of a set of laws and regulations oriented at promoting foreign direct investment in the sector as part of the market reforms introduced under the rule of Alberto Fujimori. These new regulations granted a set of advantages to investors such as legal and tax stability, tax reductions in exchange of infrastructure, freedom of profit remittances, and free availability of foreign currency (Glave y Kuramoto 2002, Dammert and Molinelli 2007, and Gil 2009). In addition, the new legal framework guaranteed the same treatment to foreign and national investors, and property rights restrictions to foreign citizens were removed.

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[1]The best example of this is the mining Mita, a labor-forced system implemented by the Spanish Crown during colonial times. See Dell (2010) for an evaluation of its impact of long-term economic development.

[2]The exception was the period 1968-1980 under the military government, in which there was a process of nationalization of the mining industry. Originally the military tried to expand production through the exploitation of new deposits (Cerro Verde, Santa Rosa, Tintaya, Antamina, Bambas Quellaveco, to name a few) for which the country took loans. The absence of adequate cost planning caused the process to fail and just a couple of mining projects (Tintaya and Cerro Verde) were finally implemented.

Environmental regulations were relaxed and land expropriation was allowed in favor of mining investors when original land owners were not willing to sell their properties after negotiation[3]. Along the same lines, restrictions to sell communal lands were eliminated[4].

Due to this new regulatory framework, mining investment experienced an important increase. For example, by 1996, US$ 387 million were invested in the sector (MEM 2005), while in 2001 this figure reached US$ 1.595 billion (MEM 2012). As a consequence, mineral production grew at an average rate of 7.2% between 1992 and 2000 while the average GDP did so at a rate of 4.8%. This growth was mainly driven by the start of new large scale operations in copper, gold and silver production. A larger fraction of the territory of the country has been devoted to the mining activity, from 2'258,000 hectares in 1991 (Glave and Kuramoto 2002: 532) to 14'418,227 hectares in 2011 (MEM 2012: 10). Today, mining covers 13.6% of the country and Peru is one of the most important producers of minerals in the world.

A.2 Allocation rules

Along with the legal framework for promotion of mining activity, in 1992 the Central Government passed the first Mining Canon Law (DS 014-92 EM) which stated that a 20% of income tax should be allocated to the areas in which the profits were generated. This law has as a historical antecedent the Oil Canon, which was established in 1976 during the military government through Decree-Law 21678 after the discovery of oilfields in the jungle. In 2001, as part of the decentralization process, this law was modified to increase the participation of mineral rich areas. The most important law is Law 27506 (known as the Canon Law),which states that 50% of income tax paid by mining companies should be allocated to the regional and local governments located in the areas where the minerals are extracted. After several amendments to this law, it was established that this amount should be distributed between the regional government (20%), the municipality of the district (10%), the municipalities located in the province (25%), and the municipalities located in the region where the resource is exploited (40%). The remaining 5% is allocated to the public universities of the region. The changes to the distribution rule were designed to specify the criteria used to allocate the transfers among the local governments located in the same province and region of the mineral producer districts[5].

[3]In 1995, Article 7 of the Land Law (Law 26505) was amended to facilitate the acquisition of land to holders of mining concessions. The law states that the land owner will receive compensation to be determined by the experts of the Ministry of Energy and Mines and, if there is no agreement between the parties, it would be enough that the holder of the mining concession pays the amount in the Bank of the Nation. This has generated protest among peasant communities who feel that their property rights are threatened. Therefore, this mechanism has not been used in practice by mining companies since they fear that this may affect the sustainability of their projects although it seems to have worked as a bargaining tool (Szablowski 2002). See Glave and Kuramoto (2002: 547) for details.

[4]Since the Constitution of 1920, the territories of the rural communities were protected by explicit prohibitions on the sale and/or lease of land. Article 11 of Law 26505 eliminated this restriction if two thirds of all community members were in agreement in the case of the communities located in the sierra and jungle, and 50% for each case those located in the coast.

[5]In its original version, the Law 27506 considered a distribution rule which allocated 20% of the mining canon rents to the municipalities of the province where the resource is exploited, 20% to the regional government and 60%

Two important characteristics of the mining Canon are important to mention here. Firstly, there is a lag between the generation of the transfer and the moment which it is distributed at the regional and local governments. Mining companies paid taxes in March for the previous fiscal year and mining canon is distributed in the middle of the year[6]. Secondly, mining Canon transfers can only be used for investment, which means that they have to be used as public investment projects that should follow the rules of the Public Investment National System (SNIP in Spanish)[7]. Current expenses are prohibited by law, including payroll expenses[8].

Mining royalties follow a similar allocation rule, although it has a different tax base[9]. In this case, it is a percentage of the value of mineral production using the international price as a reference. If the output value is less than 60 US$ million, the rate is 1%. For production values between 60 and 120 US$ million, the percentage is 2% while for values above 120 million the percentage is 3%. Table A.1 summarizes the legal framework behind the collection and distribution of mining royalties.

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to the provincial and district municipalities of the region where the mineral resource is extracted. The distribution among municipalities in the province and the region depended in turn on population density. This rule ended up benefiting the most densely populated areas to the detriment of communities where mining takes place, so that was severely questioned. Law 28077 of 2003 fixed this by focusing mining canon rents on producing localities, but only partially since it excluded producing districts of the distribution of mining canon rents at the province and region levels, which in practice received less resources than those districts without mining located in the same province and/or region. This situation was corrected in 2004 with Law 28332. These changes reflected a tension between two goals that gained prominence at different times. Initially, the mining Canon was perceived as an instrument of redistribution of resources which is reflected in the use of population density as a criterion for assignment. Later, with increasing resistance to the expansion of the mining activity (for example, in Tambogrande, Quellaveco and Quilish), the Canon took a more definite compensatory criterion. For a discussion of changes in the rules of the Canon, see Barrantes et al (2010) and Arellano (2011b).

[6]The way in which mining Canon rents were distributed also varied during the analysis period. Between 1998 and 2006, it was generally distributed in 12 installments starting in June following the fiscal year. Since 2007, it was distributed in one installment in the month of July of the following fiscal year. Between 1992 and 1997, mining Canon was distributed following ad-hoc rules using specific supreme decrees.

[7]The SNIP was designed with the aim of improving the quality of public investment. To be approved, all public investment projects must show that are a profitable use from an economic and social perspective of scarce resources. These projects were evaluated by the staff of MEF in Lima until 2007 when the system was decentralized. This decision coincided with the fiscal bonanza, after which subnational governments began to develop a greater number of projects and the SNIP started to show troubles handling this increase. It also started to show limitations to take into account local realities (Arellano 2011b).

[8]During the second government of Alan Garcia (2006-2011), this rule was relaxed by amendments to the annual state budget law. It was established that up to 5% of mining Canon rents can be used to finance the design of public investment projects and up to 20% of these rents can be used for maintenance of public infrastructure.

[9]Mining royalty was regulated in December 2004 by Supreme Decree 157-2004-EF. The royalty is understood as compensation to the State for the use of extracted natural resources (Arellano 2011b) and applies only to those mining operations that began in 2005 since all those producers that started before were protected by tax stability agreements.

Evolution of Prices for Alternative Minerals (1996-2014)

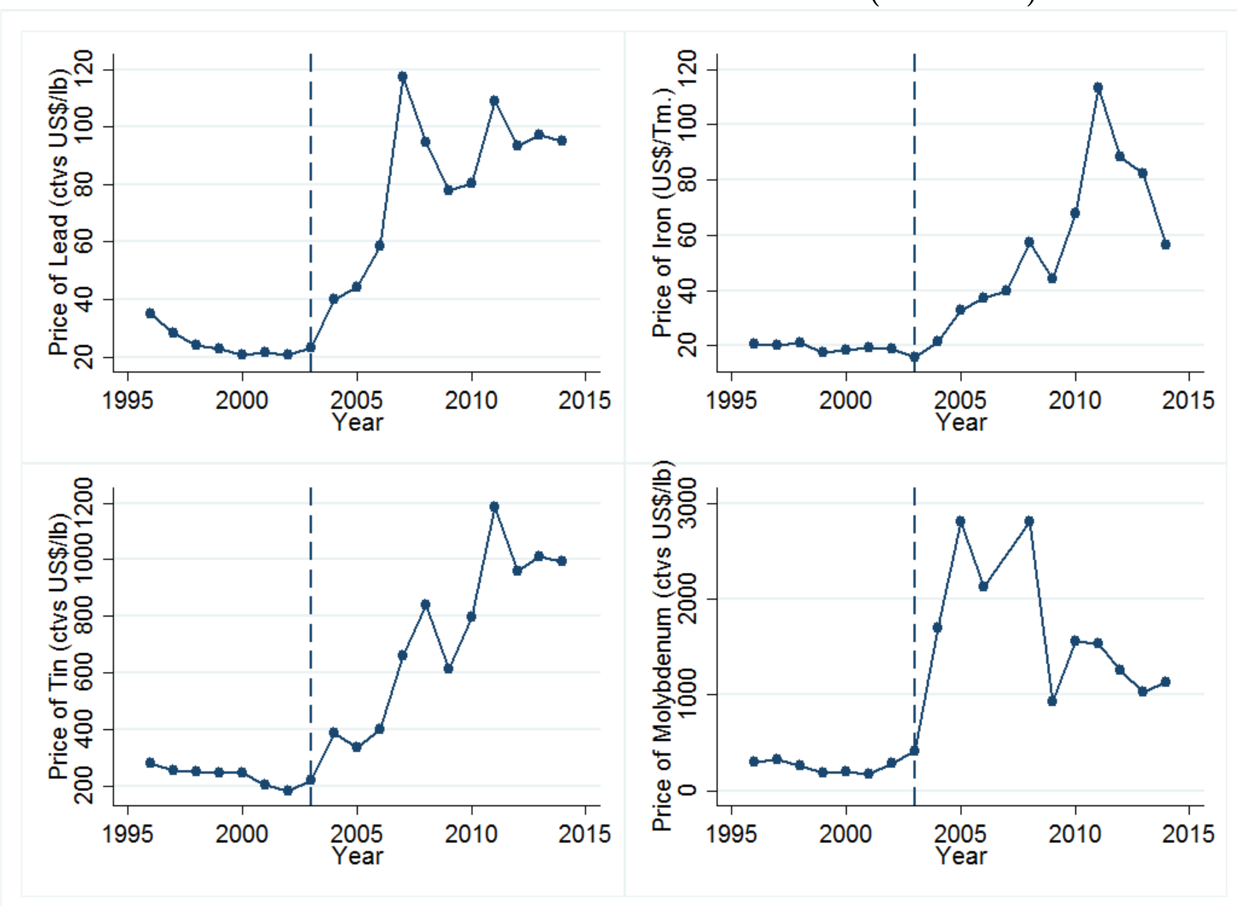

Figure A.1. Author's elaboration based on data from the Ministry of Energy and Mines. This figure shows the evolution of international mineral prices for Lead, Iron, Tin and Molybdenum during the period under analysis (1996-2014). These are the four less important mineral products among the 8 most produced by Peru in the period under analysis. The vertical line in 2003 represents the moment in which mineral prices experienced a large increase. Prices of Lead, Tin and Molybdenum are in US$ cents per pound. Price of Iron is in US$ per metric ton.

Evolution of Mining Transfers by Type of District (1996-2014)

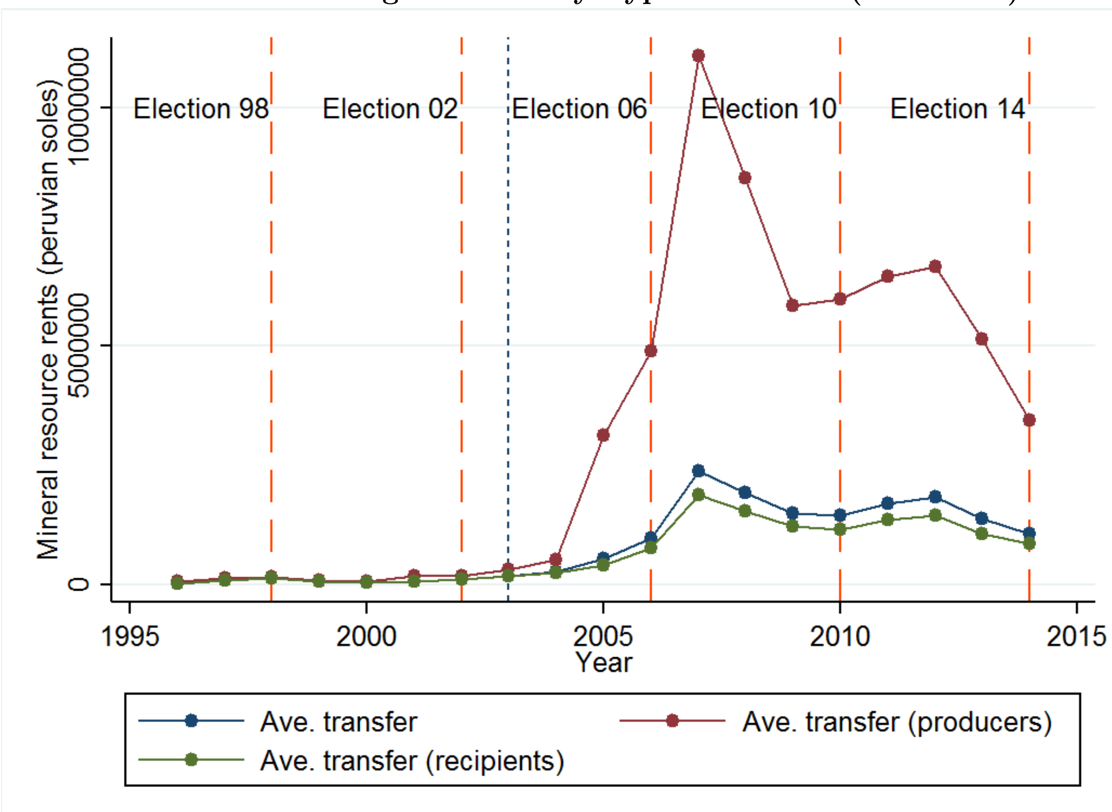

Figure A.2. Author's elaboration based on data from the Ministry of Economics and Finance. This figure shows the evolution of mining transfers during the period under analysis (1996-2014) by type of district. The blue vertical line in 2003 represents the moment in which mineral prices experienced a large increase. The orange vertical lines represents all the elections that took place over the period. Mining transfers are measured in PEN millions in 2001 Lima prices.

Lorenz Curve for Average Mining Transfers (1996-2010)

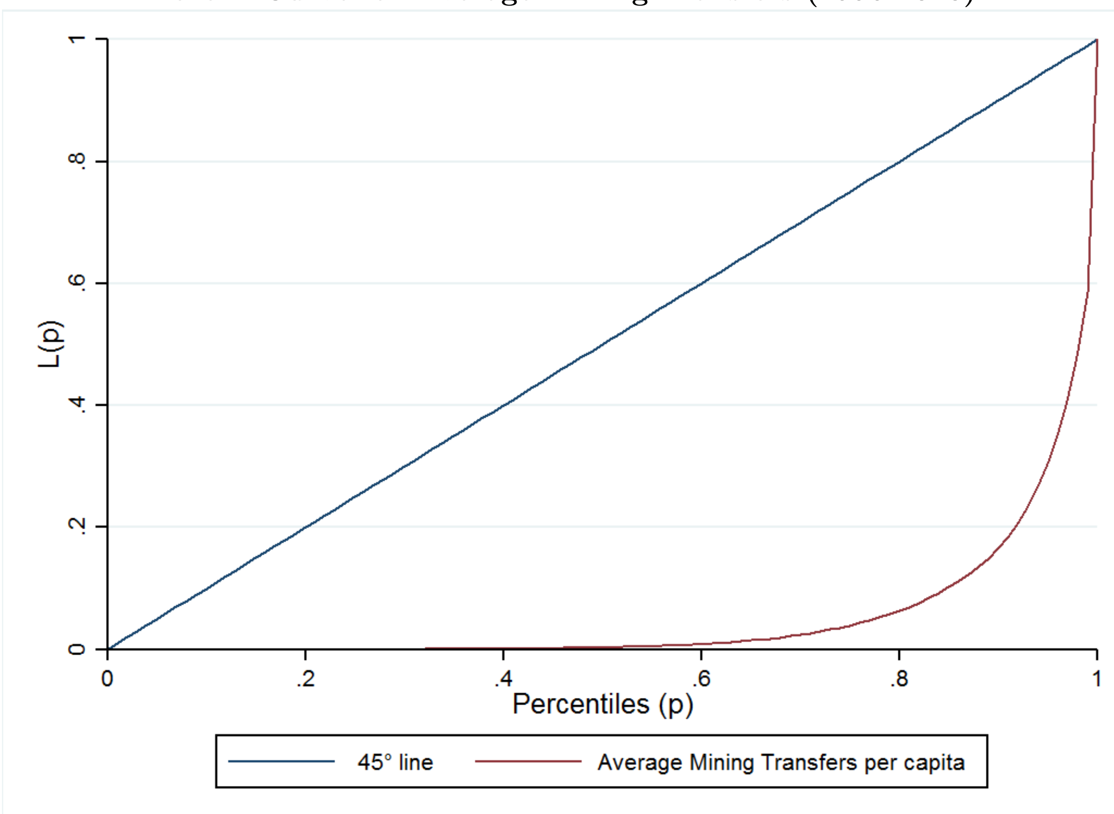

Figure A.3. Author's elaboration based on data from the Ministry of Economics and Finance. Mining transfers are measured in PEN in 2001 Lima prices.

Producer Districts (1996-2010)

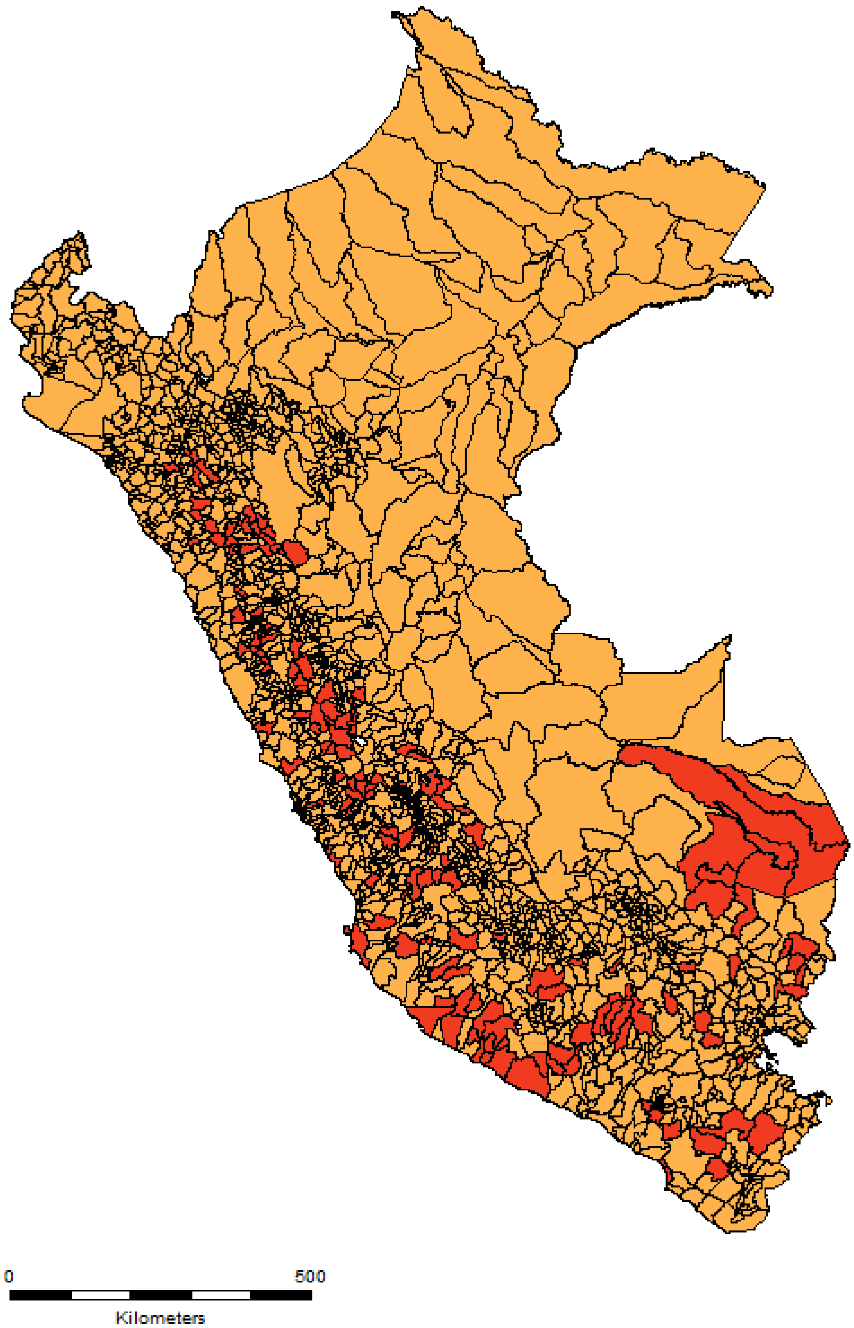

Figure A.4. Author's elaboration based on data from the Ministry of Energy and Mines. This map shows the districts where mineral exploitation took place for the period 1996-2010.

Nonparametric Analysis of Residuals for Political Competition

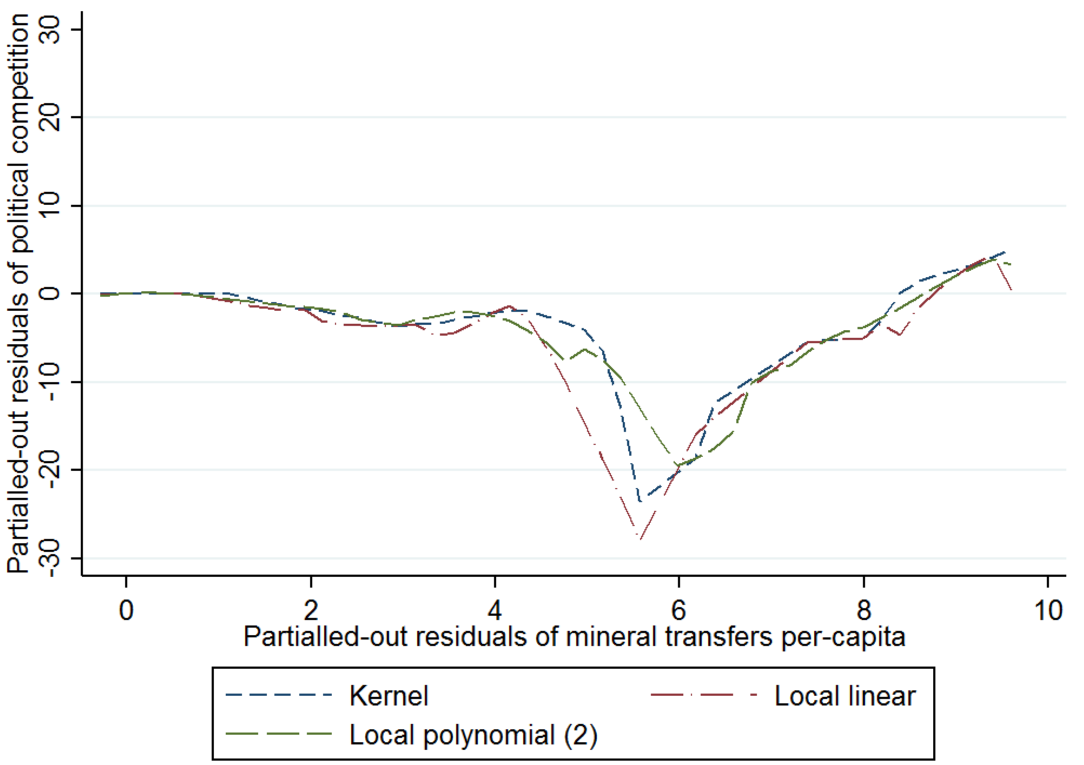

Figure A.5. Author's elaboration. This figure plots the residuals after partialling out district and time fixed effects for the treatment and the outcome variable. A Kernel regression, a local linear regression, and a polynomial regression of degree two, all of them with an Epanechnikov Kernel and optimal bandwidth were implemented.

Baltagi and Li's (2002) Semiparametric Fixed Effect Estimator for Reelection

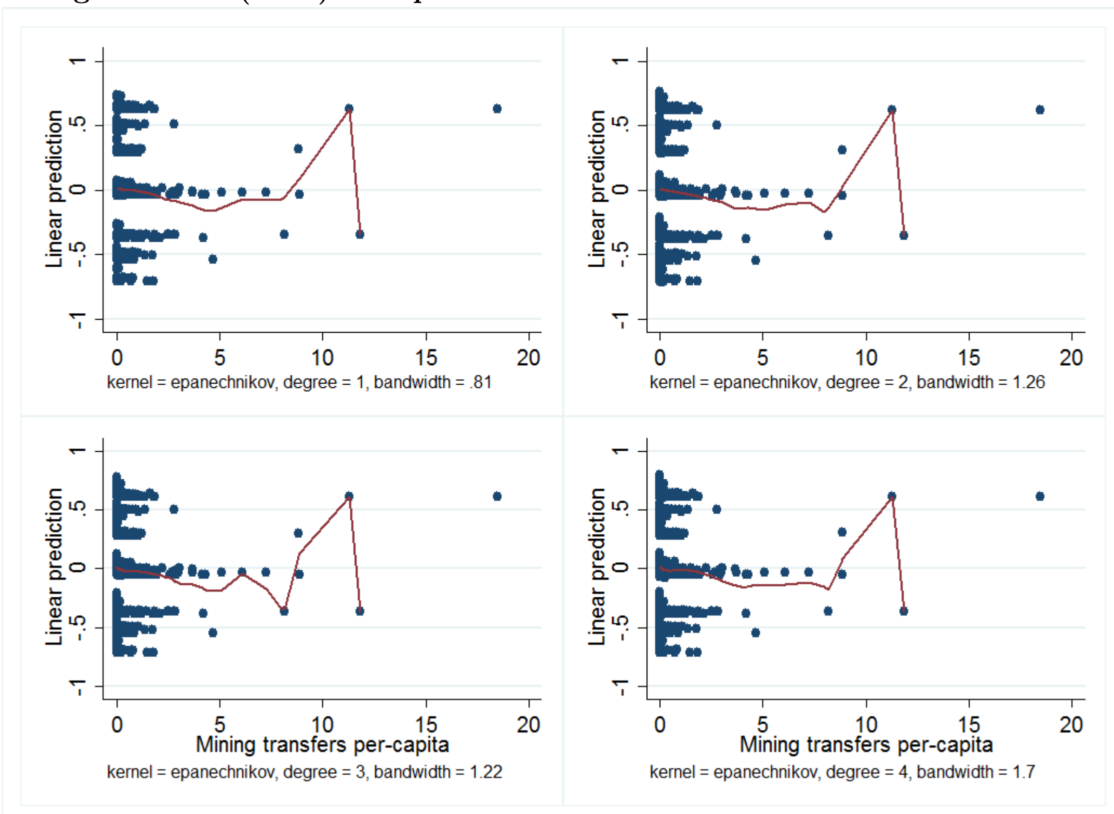

Figure A.6. Author's elaboration. This figure presents the local polynomial smooth derived from the Baltagi and Li's semiparametric model for reelection. The nonparametric component was derived using an Epanechnikov Kernel with a degree of the local weighted polynomial equal to 1, 2, 3 and 4 respectively. The bandwidth was calculated using a rule-of-thumb estimator. Standard errors are clustered at the district level.

Baltagi and Li's (2002) Semiparametric Fixed Effect Estimator for Political Competition

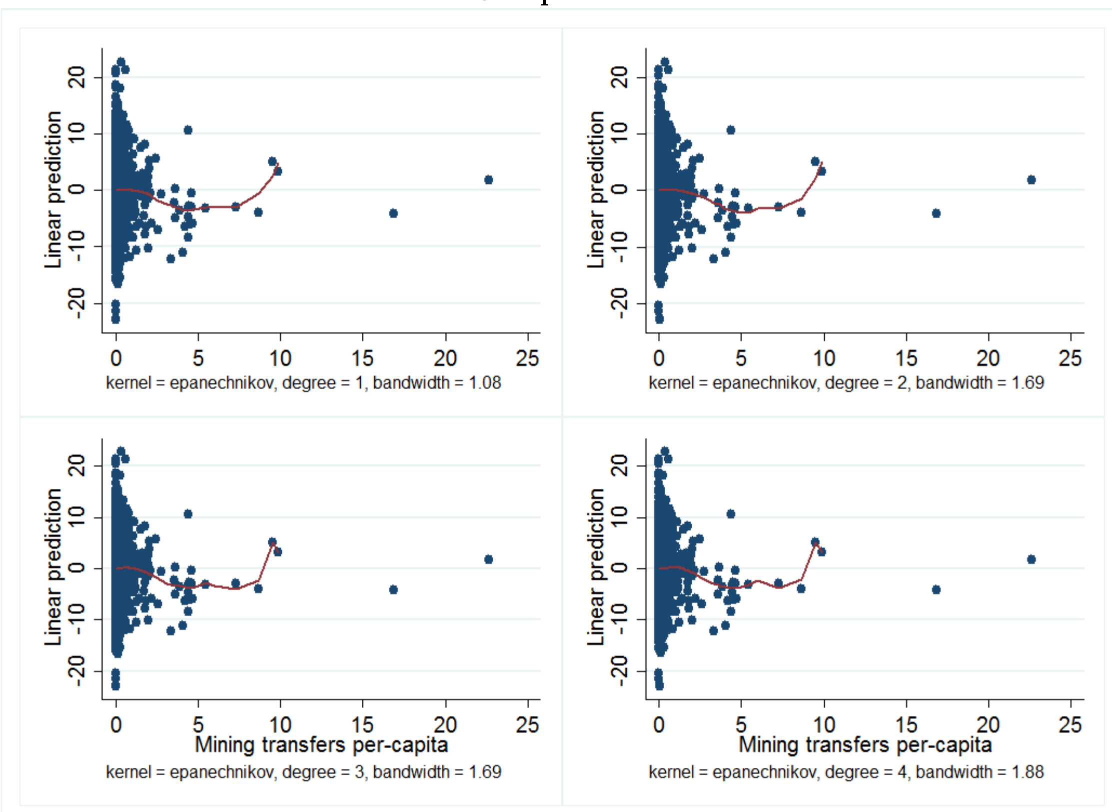

Figure A.7. Author's elaboration. This figure presents the local polynomial smooth derived from the Baltagi and Li's semiparametric model for political competition. The nonparametric component was derived using an Epanechnikov Kernel with a degree of the local weighted polynomial equal to 1, 2, 3 and 4 respectively. The bandwidth was calculated using a rule-of-thumb estimator. Standard errors are clustered at the district level.

Evolution of Income per capita (1998-2010)

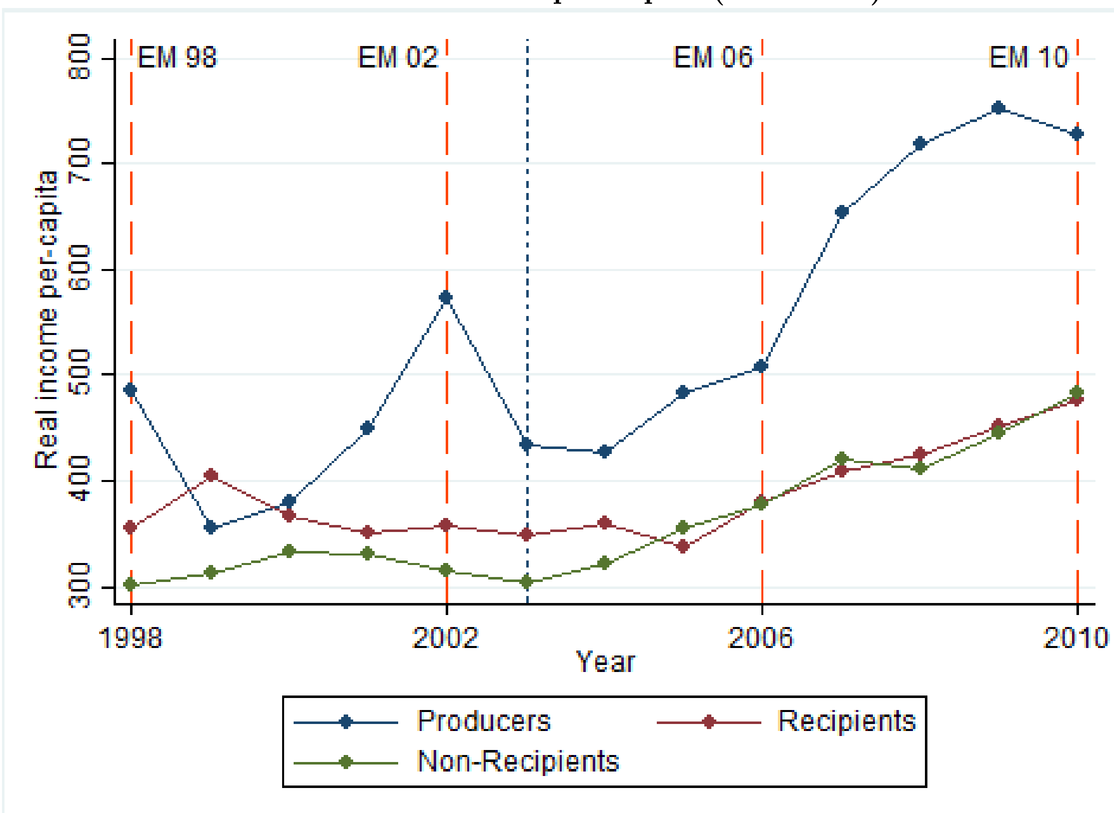

Figure A.8. Author's elaboration. This figure presents the evolution of the real income per capita for the period 1998-2010 by type of district. The blue vertical line in 2003 represents the moment in which mineral prices experienced a large increase. The orange vertical lines represents all the elections that took place over the period. Real income is measured in PEN in 2001 Lima prices.

Evolution of Consumption per capita (1998-2010)

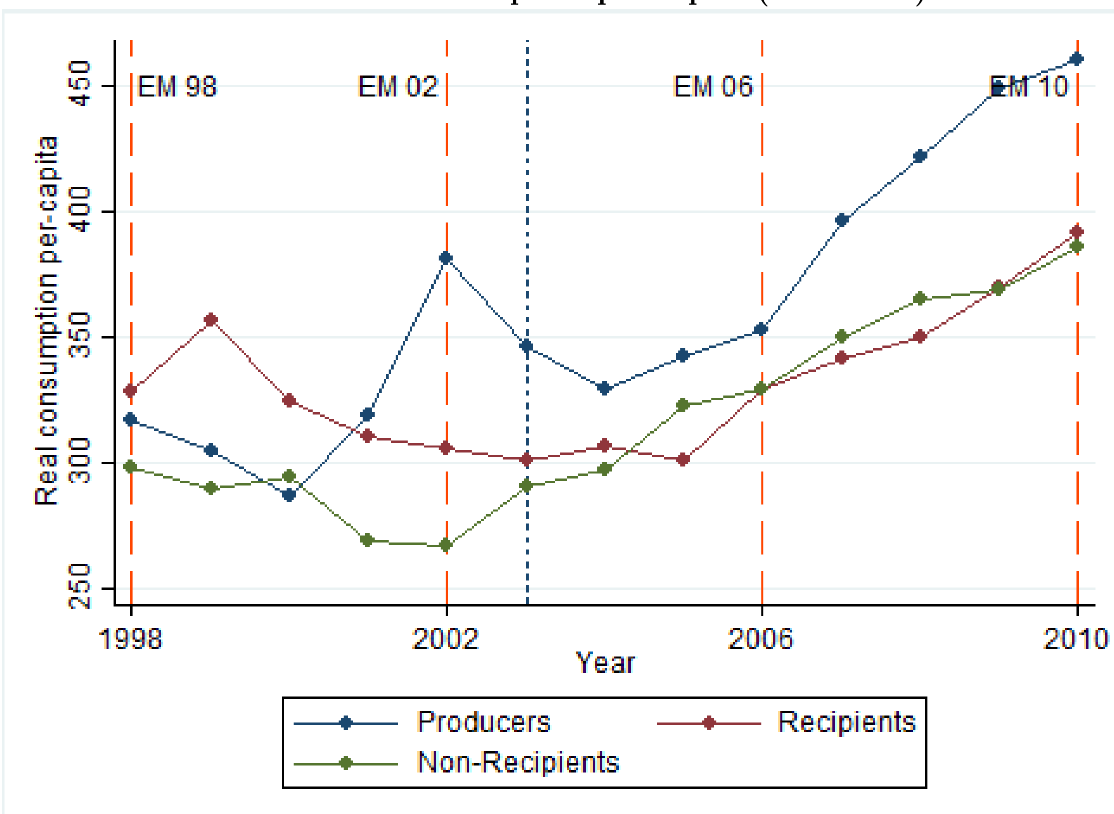

Figure A.9. Author's elaboration. This figure presents the evolution of the real consumption per capita for the period 1998-2010 by type of district. The blue vertical line in 2003 represents the moment in which mineral prices experienced a large increase. The orange vertical lines represents all the elections that took place over the period. Real consumption is measured in PEN in 2001 Lima prices.

Evolution of Total Poverty (1998-2010)

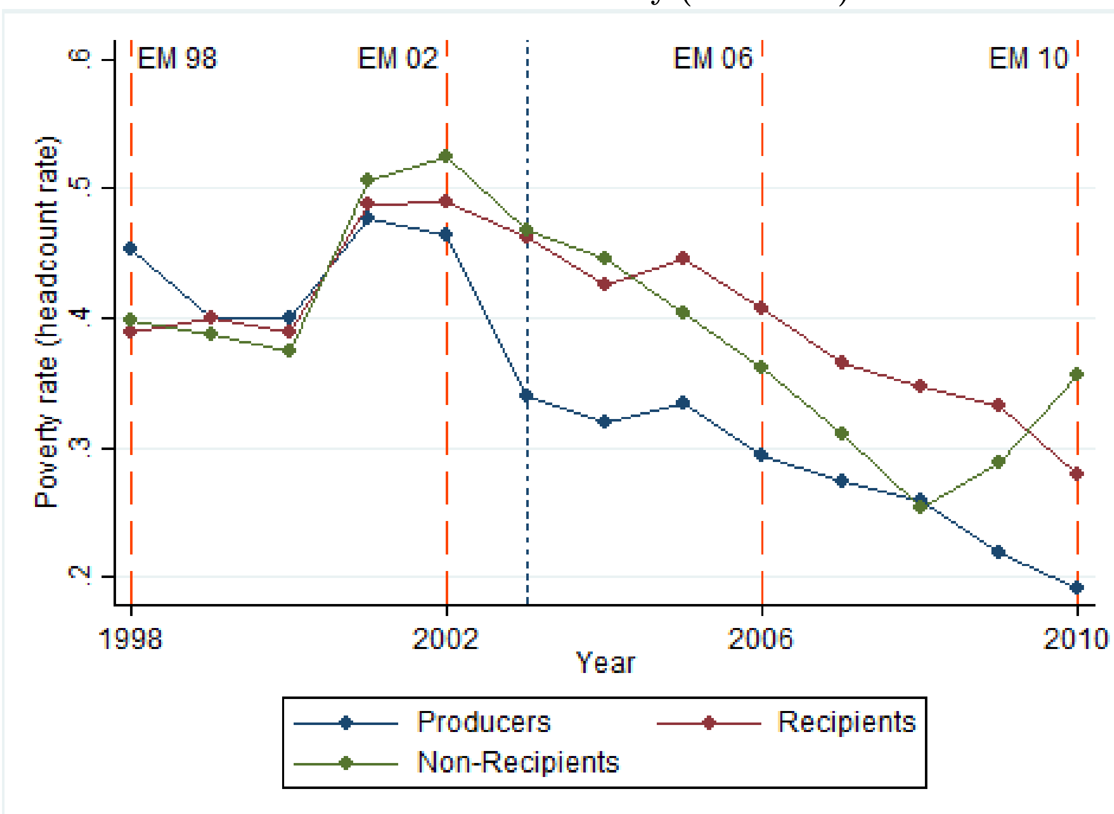

Figure A.10. Author's elaboration. This figure presents the total poverty for the period 1998-2010 by type of district. The poverty indicator is the headcount rate. The blue vertical line in 2003 represents the moment in which mineral prices experienced a large increase. The orange vertical lines represents all the elections that took place over the period.

Evolution of Extreme Poverty (1998-2010)

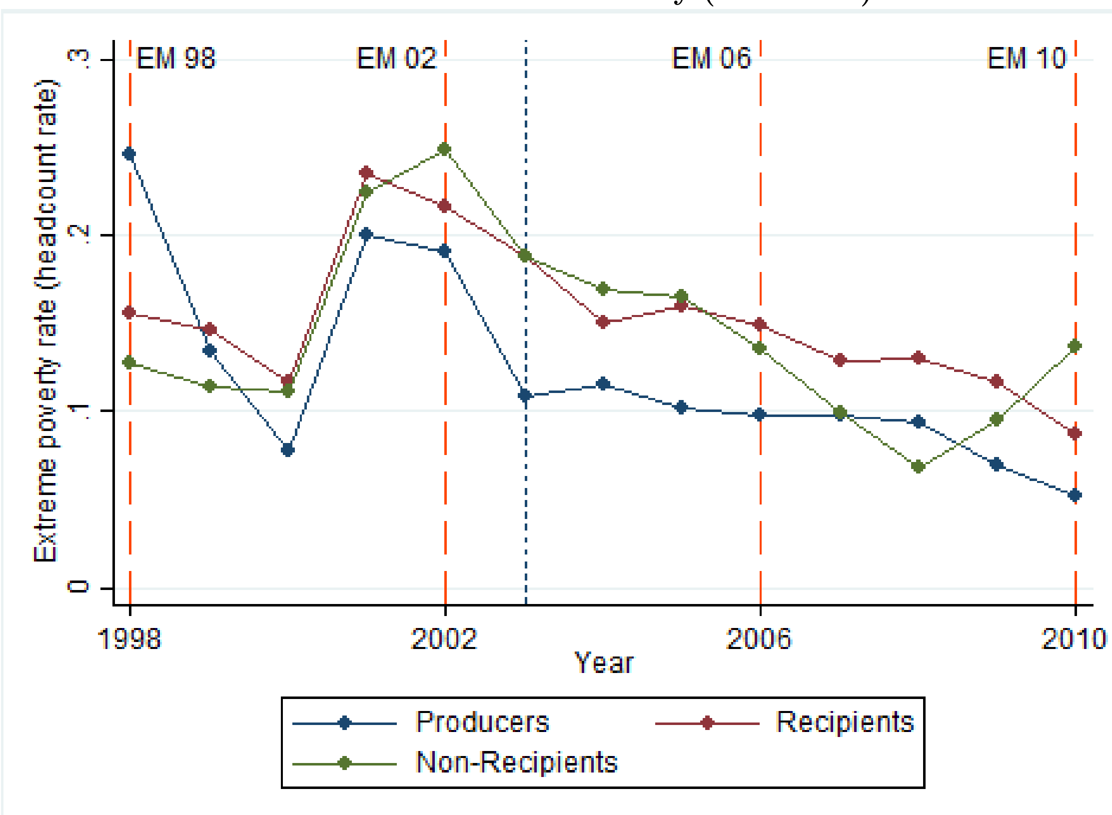

Figure A.11. Author's elaboration. This figure presents the extreme poverty for the period 1998-2010 by type of district. The poverty indicator is the headcount rate. The blue vertical line in 2003 represents the moment in which mineral prices experienced a large increase. The orange vertical lines represents all the elections that took place over the period.

Table A1. Canon and Mining Royalties Allocation Rules

Transfer	Use	Constitutition base	Form of Allocation	Legal Base
Canon	Public Investment	50% Income Tax	10% to the producer municipalities. 25% to the municipalities in the producer province. 40% to municipalities in the producer region. 25% to regional government (80% CR and 20% for universities)	Constitution of Peru (Article 77). Law 27,506, Canon Law (10 July 2001). Supreme Decree 005-2002-EF, Canon regulation. Law 28,077 (September 26, 2003) and Law 28,322 (10 August 2004). Regulated by Supreme Decrees 029-2004-EF and EF-187-2004.
Mining Royalty	Public Investment	% on the Value	20% to the municipality where the mining concession is located. 20% to the municipalities of the province where the mining concession is located. 40% to the municipalities of the region where the mining concession is located. 15% to the Regional Government. 5% to the universities.	Law 28258, Law of Mining Exemption (24 of June of 2004). Law 28323, Law that modifies the Law of Mining Royalty (10 of August of 2004). Supreme decree 157-2004-EF, Regulation of the Law of Mining Exemption (15 of November of 2004). Supreme decree 018-2005-EF (29 of January of 2004). Ministerial resolution 163-2006-EF-15 (22 of March of 2006).

1. It includes mining, oil, hydro-power, fishing, forest and gas canon.
2. Valid for all type of Canon, except Oil canon, in which case the following rule applies: in Loreto, Ucayali and Huánuco until a 20% can be for current cost. In Piura and Tumbes the 100% for cost of investment.
3. Some variants for the cases of the oil, gas and fishing canon also exist. The details are described in the Ministry of Economics and Finance's website.

Table A2. Robustness Checks for Impact of Natural Resource Rents on Political Competition

	(1)	(2)	(3)	(4)
Average Transfers for Electoral Cycle				
Mining Transfers per capita	-0.830**	-0.922*	-0.854	-1.250**
	(0.402)	(0.513)	(0.523)	(0.565)
Mining Transfers per capita2	0.036**	0.016	0.012	0.036
	(0.016)	(0.029)	(0.030)	(0.030)
Log of (1+Real Value of Production)	-0.021			
	(0.057)			
Year of Election				
Mining Transfers per capita	-0.307	-0.158	-0.097	-0.554
	(0.394)	(0.644)	(0.649)	(0.721)
Mining Transfers per capita2	0.003	-0.076	-0.083	-0.035
	(0.022)	(0.063)	(0.063)	(0.067)
Log of (1+Real Value of Production)	0.000			
	(0.052)			
Excluding Producer Districts	No	Yes	No	No
Excluding Producer Districts in Producing Regions	No	No	Yes	No
Excluding Producer Districts in Producing Provinces	No	No	No	Yes
Mean dependent variable			83.15	
Number of observations	4,581	4,315	3,468	2,080
R2	0.132	0.127	0.132	0.146

Note: * significant at 10%; ** significant at 5%; *** significant at 1%. Huber-White standard errors clustered at the district level. All specifications include district and year fixed effects. The treatment variable is measured in 1,000 PEN. All monetary values are in 2001 Lima prices. Real value of mineral production is measured in mineral prices of 2001. The dependent variable is 1 minus the Herfindahl index of votes, a measure of how much concentrated votes were in the election. This variable has been normalized to the scale 1-100 to facilitate interpretation.

Table A3. Robustness Checks on the Parametric Approach

Panel A	Impact on Political Competition			
	(1)	(2)	(3)	(4)
Polynomial and Semiparametric Panel Regressions				
Mining Transfers per capita	-0.830**	-0.765	-0.332	
	(0.402)	(0.565)	(0.876)	
Mining Transfers per capita2	0.036**	0.021	-0.165	
	(0.016)	(0.105)	(0.301)	
Mining Transfers per capita3		0.001	0.019	
		(0.004)	(0.027)	
Mining Transfers per capita4			-0.001	
			(0.001)	
Log of (1+Real Value of Production)	-0.021	-0.021	-0.023	-0.059
	(0.057)	(0.057)	(0.057)	(0.054)
F-test for quadratic specification	2.49			
	[0.083]			
F-test for nested models comparison:		0.02		
Quadratic versus Cubic model		[0.881]		
F-test for nested models comparison:			0.27	
Quadratic versus Quartic model			[0.765]	
Panel B				
Semiparametric Cross-sectional Regressions				
Mining Transfers per capita	-1.212**			
	(0.566)			
Mining Transfers per capita2	0.054***			
	(0.020)			
Log of (1+Real Value of Production)	-0.056	-0.056	-0.064	-0.062
	(0.063)	(0.064)	(0.064)	(0.064)
Hardle and Mammen's test		1.305	1.417	1.530
		[0.250]	[0.148]	[0.149]

Note: * significant at 10%; ** significant at 5%; *** significant at 1%. All specifications include district and year fixed effects. The treatment variable is measured in 1,000 PEN. All monetary values are in 2001 Lima prices. Real value of mineral production is measured in 2001 mineral prices. Columns 4 of Panel A report the Baltagi and Li's (2002) semiparametric fixed effects model estimates using a local polynomial degree 4 with an Epanechnikov kernel. Columns 2-4 of Panel B report the Robinson's (1988) double residual semiparametric model estimates using different degrees of local polynomial fit with a Gaussian kernel. Columns 2 considers a local polynomial fit of degree 1, columns 3 use a local polynomial fit of degree 2, and columns 4 a local polynomial fit of degree 3. Restricted sample in Panel B is a cross-sectional sample from a two-period panel dataset expressed in differences. F-test for nested models evaluates a null hypotheses that the quadratic approximation (reduced model) is adequate versus the alternative hypotheses that the cubic or quartic model (full model) are better. The Hardle and Mammen's (1993) test evaluates the null hypotheses that the quadratic parametric is adequate versus the alternative hypotheses that the non-parametric approximation is better. Huber-White standard errors clustered at the district level (all columns in Panel A and columns 1 and 4 in Panel B) are reported in parentheses. P-values for F and Hardle and Mammen's (1993) tests are reported in brackets. Critical values for the Hardle and Mammen's (1993) test were obtained using wild bootstrap with 1,000 replications.

Table A4. Sensitivity Analysis for Instrumental Variable Regression for Political Competition

		Instrumental Variables					
	DID	**Imperfect IV**	**Nevo and Rosen (2012) One-sided Bounds**				
			(λ=0.1)	**(λ=0.3)**	**(λ=0.5)**	**(λ=0.7)**	**(λ=0.9)**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Mining Transfers per capita	-0.830**	-0.815**	-0.817**	-0.823**	-0.843**	-0.931**	-8.45
	(0.402)	(0.412)	(0.413)	(0.414)	(0.416)	(0.426)	(51.544)
Mining Transfers per capita2	0.036**	0.037**	0.037**	0.038**	0.040**	0.048**	0.600
	(0.016)	(0.017)	(0.017)	(0.018)	(0.019)	(0.023)	(3.708)
Log of (1+Real Value of Production)	-0.021	-0.021	-0.021	-0.021	-0.021	-0.020	0.029
	(0.057)	(0.057)	(0.057)	(0.057)	(0.057)	(0.057)	(0.342)

Note: * significant at 10%; ** significant at 5%; *** significant at 1%. Huber-White standard errors clustered at the district level. All specifications include district and year fixed effects. The treatment variable is measured in 1,000 PEN. All monetary values are in 2001 Lima prices. Real value of mineral production is measured in mineral prices of 2001. The dependent variable is 1 minus the Herfindahl index of votes, a measure of how much concentrated votes were in the election. This variable has been normalized to the scale 1-100 to facilitate interpretation. Column (1) replicates the benchmark result. Column (2) presents the IV estimate using mining Canon as an imperfect instrument. Nevo and Rosen's bound were computed for different values of the parameter λ, which measures the level of deviation with respect to the validity of the exclusion restriction. Results are reported in columns (3) to (7). Greater values of this parameter represent greater deviations from the validity of the exclusion restriction. Only top bounds are derived.

Table A5. Instrumental Variable for Reelection Outcomes

	First Stage of Instrumental Variables for Level of Transfers					
	Imperfect IV	**Nevo and Rosen (2012) One-sided Bounds**				
		(λ=0.1)	**(λ=0.3)**	**(λ=0.5)**	**(λ=0.7)**	**(λ=0.9)**
	(1)	(2)	(3)	(4)	(5)	(6)
Mining Canon	1.231***					
	(0.063)					
Mining Canon2	0.005					
	(0.004)					
Log of (1+Real Value of Production)	0.000	0.000	0.000	0.001	0.002	0.005
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.004)
V(0.1)		2.275***				
		(0.125)				
V(0.1)2		0.001				
		(0.001)				
V(0.3)			2.718***			
			(0.178)			
V(0.3)2			0.001			
			(0.001)			
V(0.5)				3.322***		
				(0.275)		
V(0.5)2				0.002		
				(0.001)		
V(0.7)					4.039***	
					(0.510)	
V(0.7)2					0.005*	
					(0.003)	
V(0.9)						3.815***
						(1.305)
V(0.9)2						0.014
						(0.009)
Number of observations	5,141	5,141	5,141	5,141	5,141	5,141
R2	0.961	0.954	0.930	0.885	0.785	0.529
F test	1,644.01	1,339.42	804.94	384.58	124.88	59.86

Note: * significant at 10%; ** significant at 5%; *** significant at 1%. Huber-White standard errors clustered at the district level. All specifications include district and year fixed effects. The mining Canon variable is measured in 1,000 PEN. All monetary values are in 2001 Lima prices. Real value of mineral production is measured in mineral prices of 2001. Nevo and Rosen's bound were computed for different values of the parameter λ, which measures the level of deviation with respect to the validity of the exclusion restriction. Results are reported in columns (2) to (6). Greater values of this parameter represent greater deviations from the validity of the exclusion restriction. Only top bounds are derived.

Table A6. Instrumental Variable for Reelection Outcomes

	First Stage of Instrumental Variables for Square of Transfers					
	Imperfect IV	**Nevo and Rosen (2012) One-sided Bounds**				
		(λ=0.1)	**(λ=0.3)**	**(λ=0.5)**	**(λ=0.7)**	**(λ=0.9)**
	(1)	(2)	(3)	(4)	(5)	(6)
Mining Canon	-0.621					
	(0.897)					
Mining Canon2	1.788***					
	(0.139)					
Log of (1+Real Value of Production)	-0.010	-0.011	-0.013	-0.016	-0.019	-0.014
	(0.014)	(0.015)	(0.018)	(0.022)	(0.028)	(0.031)
V(0.1)		-1.210				
		(1.753)				
V(0.1)2		0.262***				
		(0.022)				
V(0.3)			-1.628			
			(2.366)			
V(0.3)2			0.315***			
			(0.029)			
V(0.5)				-2.328		
				(3.400)		
V(0.5)2				0.390***		
				(0.042)		
V(0.7)					-3.944	
					(6.087)	
V(0.7)2					0.497***	
					(0.066)	
V(0.9)						-11.860
						(17.237)
V(0.9)2						0.624***
						(0.176)
Number of observations	5,141	5,141	5,141	5,141	5,141	5,141
R2	0.954	0.945	0.919	0.869	0.764	0.514
F test	64.83	57.77	47.76	45.79	35.97	5.34

Note: * significant at 10%; ** significant at 5%; *** significant at 1%. Huber-White standard errors clustered at the district level. All specifications include district and year fixed effects. The mining Canon variable is measured in 1,000 PEN. All monetary values are in 2001 Lima prices. Real value of mineral production is measured in mineral prices of 2001. Nevo and Rosen's bound were computed for different values of the parameter λ, which measures the level of deviation with respect to the validity of the exclusion restriction. Results are reported in columns (2) to (6). Greater values of this parameter represent greater deviations from the validity of the exclusion restriction. Only top bounds are derived.

Table A7. Instrumental Variable for Political Competition

	First Stage of Instrumental Variables for Level of Transfers					
	Imperfect IV	**Nevo and Rosen (2012) One-sided Bounds**				
		(λ=0.1)	**(λ=0.3)**	**(λ=0.5)**	**(λ=0.7)**	**(λ=0.9)**
	(1)	(2)	(3)	(4)	(5)	(6)
Mining Canon	1.085***					
	(0.037)					
Mining Canon2	0.003					
	(0.002)					
Log of (1+Real Value of Production)	0.001*	0.002*	0.002*	0.002*	0.003*	0.004*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
V(0.1)		1.779***				
		(0.065)				
V(0.1)$\hat{2}$		0.000				
		(0.000)				
V(0.3)			2.115***			
			(0.092)			
V(0.3)$\hat{2}$			0.000			
			(0.000)			
V(0.5)				2.621***		
				(0.143)		
V(0.5)$\hat{2}$				0.001		
				(0.001)		
V(0.7)					3.579***	
					(0.278)	
V(0.7)$\hat{2}$					-0.000	
					(0.001)	
V(0.9)						6.233***
						(0.653)
V(0.9)$\hat{2}$						-0.013**
						(0.006)
Number of observations	4,692	4,692	4,692	4,692	4,692	4,692
R2	0.988	0.986	0.980	0.969	0.945	0.909
F test	1,022.16	863.57	582.39	348.32	175.26	114.85

Note: * significant at 10%; ** significant at 5%; *** significant at 1%. Huber-White standard errors clustered at the district level. All specifications include district and year fixed effects. The mining Canon variable is measured in 1,000 PEN. All monetary values are in 2001 Lima prices. Real value of mineral production is measured in mineral prices of 2001. Nevo and Rosen's bound were computed for different values of the parameter λ, which measures the level of deviation with respect to the validity of the exclusion restriction. Results are reported in columns (2) to (6). Greater values of this parameter represent greater deviations from the validity of the exclusion restriction. Only top bounds are derived.

Table A8. Instrumental Variable for Political Competition

	First Stage of Instrumental Variables for Square of Transfers					
	Imperfect IV	**Nevo and Rosen (2012) One-sided Bounds**				
		(λ=0.1)	**(λ=0.3)**	**(λ=0.5)**	**(λ=0.7)**	**(λ=0.9)**
	(1)	(2)	(3)	(4)	(5)	(6)
Mining Canon	-1.546**					
	(0.787)					
Mining Canon2	1.451***					
	(0.101)					
Log of (1+Real Value of Production)	0.004	0.005	0.005	0.003	-0.004	-0.020
	(0.005)	(0.005)	(0.006)	(0.008)	(0.011)	(0.045)
V(0.1)		-2.744*				
		(1.436)				
V(0.1)$\hat{2}$		0.156***				
		(0.012)				
V(0.3)			-3.797*			
			(2.167)			
V(0.3)$\hat{2}$			0.200***			
			(0.020)			
V(0.5)				-4.916		
				(3.454)		
V(0.5)$\hat{2}$				0.272***		
				(0.035)		
V(0.7)					-0.147	
					(6.244)	
V(0.7)$\hat{2}$					0.374***	
					(0.054)	
V(0.9)						75.755*
						(42.438)
V(0.9)$\hat{2}$						-0.020
						(0.310)
Number of observations	4,692	4,692	4,692	4,692	4,692	4,692
R2	0.985	0.982	0.970	0.942	0.851	0.614
F test	195.34	156.56	91.77	44.69	24.73	11.37

Note: * significant at 10%; ** significant at 5%; *** significant at 1%. Huber-White standard errors clustered at the district level. All specifications include district and year fixed effects. The mining Canon variable is measured in 1,000 PEN. All monetary values are in 2001 Lima prices. Real value of mineral production is measured in mineral prices of 2001. Nevo and Rosen's bound were computed for different values of the parameter λ, which measures the level of deviation with respect to the validity of the exclusion restriction. Results are reported in columns (2) to (6). Greater values of this parameter represent greater deviations from the validity of the exclusion restriction. Only top bounds are derived.

Table A9. Impact of Natural Resource Booms on Public Goods Provision

	DID Estimates							
	Access to	Access to	Garbage Collection		Security Services			Access to
	Water Network	Public Light	In Capital	Rest	Access	Perssonel	Stations	Library
Mining Transfers per capita	0.007	0.027**	0.054*	0.103***	0.052***	0.154***	0.093***	-0.015
	(0.010)	(0.011)	(0.028)	(0.035)	(0.013)	(0.056)	(0.035)	(0.011)
Mining Transfers per capita2	0.000	-0.001**	-0.002**	-0.004***	-0.001***	-0.004	-0.002	0.000
	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.003)	(0.002)	(0.000)
Log of (1+Real Value of Production)	-0.001	0.002	-0.003	0.003	-0.001	0.003	0.000	0.004*
	(0.003)	(0.001)	(0.004)	(0.006)	(0.002)	(0.009)	(0.001)	(0.002)
Mean of dependent variable	0.76	0.88	0.94	0.55	0.15	6.1	1.3	0.41
Number of observations	5,566	8,644	9,014	8,781	14,117	12,825	10,026	14,237
R2	0.242	0.264	0.017	0.113	0.115	0.242	0.078	0.013

Note: * significant at 10%; ** significant at 5%; *** significant at 1%. Huber-White standard errors clustered at the district level. All specifications include district and year fixed effects. All specifications include district and year fixed effects. The treatment variable is measured in 1,000 PEN. All monetary values are in 2001 Lima prices. Real value of mineral production is measured in mineral prices of 2001. Personnel and stations are measured in units per 1,000 habitants. All other variables are dummy equal to one if the district has access to a particular public good.

Table A10. Impact of Natural Resource Booms on Local Infrastructure

	Hospital	Health Center	Polyclinic	Odontological/Basic Medical Services	Stadiums	Multipurpose Fields	Soccer Fields	Basquetball Fields	Voleyball Fields	Gimnasiums
	Health Infraestructure				**Sport Infraestructure**					
	DID Estimates									
Mining Transfers per capita	0.000	-0.003	0.006	0.007**	0.029***	0.048**	0.042*	0.007**	-0.000	0.001
	(0.000)	(0.002)	(0.004)	(0.003)	(0.011)	(0.022)	(0.024)	(0.003)	(0.007)	(0.001)
Mining Transfers per capita2	-0.000	0.000	-0.000	-0.000**	-0.001**	-0.001	-0.002*	-0.000*	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)
Log of (1+Real Value of Production)	-0.000	0.000	0.001**	0.000	0.002	0.005	-0.000	-0.001*	-0.001	0.000
	(0.000)	(0.000)	(0.001)	(0.001)	(0.002)	(0.004)	(0.004)	(0.001)	(0.001)	(0.000)
	IV Estimates									
Mining Transfers per capita	0.000	-0.003	0.007	0.007**	0.027**	0.041*	0.030*	0.007**	0.000	0.002
	(0.000)	(0.002)	(0.004)	(0.003)	(0.011)	(0.022)	(0.017)	(0.004)	(0.007)	(0.001)
Mining Transfers per capita2	-0.000	0.000	-0.000	-0.000**	-0.001*	-0.001	-0.001*	-0.000*	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)
Log of (1+Real Value of Production)	-0.000	0.000	0.001**	0.000	0.002	0.005	-0.000	-0.001*	-0.001	0.000
	(0.000)	(0.000)	(0.001)	(0.001)	(0.002)	(0.004)	(0.004)	(0.001)	(0.001)	(0.000)
Mean of dependent variable	0.01	0.01	0.02	0.01	0.26	0.31	0.18	0.02	0.03	0.01
Number of observations	12,947	14,233	14,233	14,233	12,663	12,663	12,663	12,663	12,663	12,663
R2	0.002	0.004	0.013	0.004	0.004	0.006	0.005	0.004	0.003	0.012

Note * significant at 10%; ** significant at 5%; *** significant at 1%. Huber-White standard errors clustered at the district level. All specifications include district and year fixed effects. The treatment variable is measured in 1,000 PEN. All monetary values are in prices of Lima in 2001. Real value of mineral production is measured in mineral prices of 2001. Dependent variables are measured in units per 1,000 habitants.

Table A11. Impact of Natural Resource Booms on Roads Construction and Investment

	DID Estimates											
	Quantity						**Cost**					
	Roads Repaired (m2)	**Roads Constructed (m2)**	**Sidewalks Repaired (m2)**	**Sidewalks Constructed (m2)**	**Rural Roads Repaired (Km)**	**Rural Roads Constructed (Km)**	**Roads Repaired**	**Roads Constructed**	**Sidewalks Repaired**	**Sidewalks Constructed**	**Rural Roads Repaired**	**Rural Roads Constructed**
Mining Transfers per capita	0.040	0.211**	0.006	0.026	-0.090	0.071	5.393**	36.305***	5.333	4.172**	26.989**	4.716
	(0.050)	(0.105)	(0.010)	(0.028)	(0.328)	(0.067)	(2.408)	(13.317)	(4.465)	(2.088)	(12.686)	(2.869)
Mining Transfers per capita2	-0.003	0.003	-0.000	-0.000	0.002	-0.002	-0.289*	-0.786**	-0.192	0.025	-0.035	-0.153*
	(0.003)	(0.003)	(0.000)	(0.001)	(0.009)	(0.002)	(0.158)	(0.384)	(0.176)	(0.173)	(0.391)	(0.086)
Log of (1+Real Value of Production)	0.003	0.034	0.001	0.000	-0.008	0.001	-0.015	11.629	-0.001	-0.047	-0.109	-0.453**
	(0.003)	(0.031)	(0.001)	(0.001)	(0.019)	(0.002)	(0.186)	(9.707)	(0.065)	(0.071)	(0.479)	(0.184)
	IV Estimates											
Mining Transfers per capita	0.047	0.233**	0.009	0.020	-0.066	0.069	5.393*	39.909**	6.697	4.343*	29.439*	5.248*
	(0.063)	(0.111)	(0.012)	(0.034)	(0.323)	(0.066)	(3.008)	(15.701)	(5.595)	(2.346)	(16.443)	(2.964)
Mining Transfers per capita2	-0.003	0.000	-0.000	0.000	0.002	-0.001	-0.302*	-1.060**	-0.246	0.034	-0.129	-0.172*
	(0.004)	(0.003)	(0.000)	(0.001)	(0.009)	(0.002)	(0.183)	(0.474)	(0.225)	(0.191)	(0.552)	(0.090)
Log of (1+Real Value of Production)	0.003	0.033	0.001	0.000	-0.008	0.001	-0.015	11.597	-0.013	-0.049	-0.135	-0.458**
	(0.003)	(0.031)	(0.001)	(0.001)	(0.019)	(0.002)	(0.186)	(9.675)	(0.069)	(0.072)	(0.497)	(0.184)
Mean of dependent variable	0.06	0.19	0.01	0.06	0.41	0.13	2.63	15.90	1.21	4.19	16.29	11.97
Number of observations	12,831	12,831	12,831	12,831	11,954	13,235	12,831	12,831	12,831	12,831	11,954	13,235
R2	0.002	0.010	0.001	0.001	0.003	0.002	0.015	0.005	0.002	0.012	0.006	0.004

Note: * significant at 10%; ** significant at 5%; *** significant at 1%. Huber-White standard errors clustered at the district level. All specifications include district and year fixed effects. The treatment variable is measured in 1,000 PEN. All monetary values are in 2001 Lima prices. Real value of mineral production is measured in mineral prices of 2001. Dependent variables are measured in per capita terms.

Table A12. Impact of Natural Resource Booms on Public Employment by Type of Contract

	Appointed Staff			Contracted Employees			Temporary Employees		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
DID Estimates									
Mining Transfers per capita	0.104**	0.189*	0.262	2.555*	1.916	0.686***	0.630**	1.076***	1.106*
	(0.053)	(0.108)	(0.165)	(1.307)	(1.337)	(0.256)	(0.300)	(0.335)	(0.567)
Mining Transfers per capita2		-0.004	-0.007		0.032	-0.026***		-0.022*	0.003
		(0.003)	(0.006)		(0.026)	(0.009)		(0.014)	(0.038)
Log of (1+Real Value of Production)		-0.000			-0.018			-0.033*	
		(0.007)			(0.018)			(0.019)	
IV Estimates									
Mining Transfers per capita	0.103*	0.181	0.244	2.192*	1.755	0.647***	0.601**	0.956***	1.050*
	(0.056)	(0.118)	(0.173)	(1.223)	(1.152)	(0.239)	(0.286)	(0.345)	(0.560)
Mining Transfers per capita2		-0.004	-0.006		0.022	-0.026***		-0.018	0.003
		(0.004)	(0.006)		(0.025)	(0.008)		(0.015)	(0.039)
Log of (1+Real Value of Production)		0.000			-0.017			-0.032	
		(0.007)			(0.016)			(0.020)	
Mean of dependent variable		0.93			1.34			2.73	
Excluding Producer Districts	No	No	Yes	No	No	Yes	No	No	Yes
Number of observations	15,523	15,523	14,801	15,523	15,523	14,801	15,523	15,523	14,801
R2	0.161	0.162	0.166	0.125	0.128	0.060	0.106	0.109	0.114

Note: * significant at 10%; ** significant at 5%; *** significant at 1%. Huber-White standard errors clustered at the district level. All specifications include district and year fixed effects. The treatment variable is measured in 1,000 PEN. All monetary values are in 2001 Lima prices. Real value of mineral production is measured in mineral prices of 2001. Dependent variables are measured in number of employees per 1,000 habitants.

Table A13. Impact of Resource Booms on Public Employment by Type of Employment

	DID Estimates									
	Officials		Professionals		Technicians		Security Workers		Janitors	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Mining Transfers per capita	0.222***	0.300**	0.710***	0.603***	0.349*	0.275**	0.198***	0.239***	0.209***	0.204***
	(0.082)	(0.126)	(0.172)	(0.112)	(0.208)	(0.136)	(0.065)	(0.089)	(0.071)	(0.073)
Mining Transfers per capita2	-0.006**	-0.010**	-0.011**	-0.014	0.016***	0.003	-0.007**	-0.012***	-0.007***	-0.008***
	(0.003)	(0.004)	(0.005)	(0.009)	(0.006)	(0.017)	(0.003)	(0.004)	(0.002)	(0.002)
Log of (1+Real Value of Production)	-0.007		-0.012		-0.002		-0.006*		-0.005	
	(0.005)		(0.008)		(0.006)		(0.003)		(0.006)	
Excluding Producer Districts	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Mean of dependent variable	0.59	0.59	0.91	0.91	1.24	1.24	0.24	0.24	0.67	0.67
Number of observations	15,523	14,801	15,523	14,801	15,523	14,801	15,523	14,801	15,523	14,801
R2	0.135	0.135	0.127	0.122	0.173	0.121	0.048	0.046	0.048	0.046

Note: * significant at 10%; ** significant at 5%; *** significant at 1%. Huber-White standard errors clustered at the district level. All specifications include district and year fixed effects. The treatment variable is measured in 1,000 PEN. All monetary values are in 2001 Lima prices. Real value of mineral production is measured in mineral prices of 2001. Dependent variables are measured in number of employees per 1,000 habitants.

Table A14. Impact of Natural Resource Booms on Local Government Expenditures

	DID Estimates							
	Payroll	**Pensions**	**Goods and Services**	**Other Current Expenses**	**Investment**	**Finance Investment**	**Other Capital Expenditures**	**Debt**
Mining Transfers per capita	54.628*	0.292	109.853***	-0.222	850.268***	-0.028*	9.245**	-0.202
	(29.997)	(0.195)	(27.127)	(0.432)	(59.741)	(0.017)	(4.413)	(0.797)
Mining Transfers per capita2	-1.375	-0.014**	-2.404***	0.023	-20.394***	0.001	-0.370**	0.069
	(0.917)	(0.006)	(0.880)	(0.017)	(2.101)	(0.000)	(0.184)	(0.056)
Log of (1+Real Value of Production)	-0.698*	-0.005	-0.909	-0.072	2.066	-0.003	0.073	0.218
	(0.396)	(0.053)	(0.614)	(0.060)	(3.582)	(0.003)	(0.177)	(0.161)
	IV Estimates							
Mining Transfers per capita	48.258*	0.270	106.301***	-0.125	833.864***	-0.027	8.100**	-0.178
	(26.902)	(0.184)	(25.128)	(0.390)	(53.951)	(0.017)	(3.620)	(0.800)
Mining Transfers per capita2	-1.226	-0.014**	-2.299***	0.019	-20.397***	0.001	-0.347**	0.067
	(0.845)	(0.006)	(0.865)	(0.016)	(1.915)	(0.000)	(0.171)	(0.061)
Log of (1+Real Value of Production)	-0.641*	-0.005	-0.877	-0.073	2.221	-0.003	0.084	0.217
	(0.363)	(0.053)	(0.598)	(0.060)	(3.570)	(0.003)	(0.175)	(0.161)
Mean of dependent variable	34.13	5.21	96.89	14.17	313.66	0.01	4.43	16.58
Number of observations	17,317	17,317	17,317	17,317	17,317	17,317	17,317	17,317
R2	0.119	0.721	0.249	0.043	0.517	0.002	0.022	0.083

Note: * significant at 10%; ** significant at 5%; *** significant at 1%. Huber-White standard errors clustered at the district level. All specifications include district and year fixed effects. The treatment variable is measured in 1,000 PEN. All monetary values are in 2001 Lima prices. Real value of mineral production is measured in mineral prices of 2001. Dependent variables are measured in per capita terms.

Table A15. Impact of Natural Resource Booms on Local Government Expenditures

	DID Estimates								
	Planning	**Agriculture**	**Social Assistance**	**Education and Culture**	**Energy and Natural Resources**	**Industry, Trade and Services**	**Health and Sanitation**	**Transport**	**Housing and Urban Development**
Mining Transfers per capita	251.621***	167.233***	30.352***	155.660***	15.064***	25.808***	90.828***	252.922***	34.642***
	(46.664)	(28.607)	(3.036)	(14.942)	(3.394)	(4.886)	(21.678)	(55.535)	(4.938)
Mining Transfers per capita2	-6.203***	-3.852***	-0.276**	-4.581***	-0.460***	-0.813***	-1.123	-7.572***	-1.024***
	(1.456)	(0.844)	(0.112)	(0.734)	(0.106)	(0.128)	(1.367)	(1.303)	(0.204)
Log of (1+Real Value of Production)	-1.838*	-0.100	0.115	1.775	-0.390	-0.218	1.048	-1.039	0.262
	(1.026)	(0.840)	(0.365)	(1.662)	(0.312)	(0.287)	(1.188)	(1.423)	(0.340)
Mean of dependent variable	164.89	38.46	42.95	57.99	13.80	9.25	66.66	68.29	20.24
Number of observations	17,317	17,317	17,317	17,317	17,317	17,317	17,317	17,317	17,317
R2	0.318	0.167	0.119	0.259	0.034	0.068	0.232	0.233	0.053

Note: * significant at 10%; ** significant at 5%; *** significant at 1%. Huber-White standard errors clustered at the district level. All specifications include district and year fixed effects. The treatment variable is measured in 1,000 PEN. All monetary values are in 2001 Lima prices. Real value of mineral production is measured in mineral prices of 2001. Dependent variables are measured in per capita terms.