The Political Effects of Resource Booms: Political Outcomes, Clientelism and Public Goods Provision in Peru*

Stanislao Maldonado**

University of California, Berkeley

This version: September, 2014 (first version: September 2013)

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 several scholars, the existing empirical evidence remains inconclusive regarding whether resource booms are beneficial or detrimental to citizens via their effects on public good provision and welfare outcomes. I argue that, despite the fact that many of the existing theoretical models allow for the possibility of non-monotonic responses, the empirical literature has mostly approached this phenomena using linear models, failing to correctly understand the nature of resource booms. Exploiting the recent extraordinary increase in mineral prices along with a set of rules for the distribution of natural resource rents in Peru, I show that the effects of resource booms in reelection outcomes, political competition, and public goods provision 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 a simple model of electoral competition in a resource rich economy.

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

* A preliminary version circulated under the title "The Political Effects of Resource Abundance: Evidence from Peru". I appreciate the advice of Elisabeth Sadoulet during the development of this project and comments by Micheal Anderson, Lee Behman, David Collier, Ruth Collier, Alain de Janvry, Larry Karp, Fred Finan, Ethan Ligon, Jeremy Madruger, Ted Miguel, John Nye, Mary Shirley, Alberto Simpser, Jas Sekhon, Colin Xu and seminar participants at the Ronald Coase Institute institutional workshop at University of Chicago, Development Workshop and Environment and Resource Economics seminar at UC Berkeley. Tania Lozano, Sarita Ore and Victor Huamani provided excellent research assistance. I am grateful for a research grant from ACDI/IDRC-Economic and Social Research Consortium. All remaining error is my responsibility.

**Correspondence: Department of Agriculture and Resource Economics, 207 Giannini Hall, University of California, Berkeley, CA 94720-3310.E-mail: smaldonadoz@berkeley.edu.

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 not only failing in terms of transforming their natural wealth in well-being for their citizens but they are also more vulnerable to a set of economic and political pathologies that are impoverishing them[1]. This has led to some scholars to describe this phenomenon as a “resource curse” (Sachs and Warner 1995, Karl 1997 and Ross 1999, among others). Despite the significant theoretical work in this area (Tornell and Lane 1999, Mehlum 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 seems to be specially the case of the political dimensions of the resource curse[2]. Some scholars have suggested that resource abundance can weaken the levels of governance and the quality of democracy in resource-rich areas (Watchenkon 2002, Jensen and Watchenkon 2004, Morrison 2007 and 2009, Robinson et al 2006, among others) but the empirical evidence is not conclusive and even contradictory[3]. Although there are differences in terms of the proposed mechanisms, there exist a consensus among researchers that what matters in order to understand this relationship is the behavior of politicians and political elites. For instance, Jensen and Wantchekon (2004) suggests 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, we shed light on these issues by studying how a mineral resource boom affects the electoral behavior of politicians and its consequences in terms of citizens’ well-being. Specifically, we are interested in understanding how mineral resource booms affect reelection outcomes and political competition paying attention to the instruments politicians use in order to affect these outcomes such as public good provision and public employment. We then analyze how these dimensions are related to citizens’ well-being.

To do so, we use variation in mineral resource rents and mineral production across Peruvian municipalities and over time. This variation is due to a set of rules about the allocation of mining tranfers to resource-rich areas along with the extraordinary increase in the prices of the most important minerals produced by the country over the past years. This set of rules establish that a fraction of the taxes paid by mining companies and a percentage of their revenues have to be allocated to areas where these resources are extracted. This is the key element of our research

---

[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 indebtedness, export earnings instability and lack of export diversification. See Frenkel (2010) and van der Ploeg (2011) for an overview of these issues.

[2] See Deacon (2011) and Rosser (2006) for an overview.

[3] This is particular the case for the impact of resource abundance on democracy. Ross (2001) is the first of a large collection of studies that find a negative association between natural resource and democracy. More recently, Haber and Menaldo (2011) have found evidence questioning this relationship. These authors find that, in fact, natural resources are linked to better democratic outcomes.

design because allows us to take advantage of variation across local governments with and without access to these transfers, before and after the recent increase of the prices of mineral resources, in order to explore the causal effect of an 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. In the first place, the country is one of the most important mineral producers of the world. Currently, Peru is the 2nd producer of copper and silver, the 3rd of zinc and tin, the 4th in lead and molybdenum, and 6th in gold[4]. 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 by the country. Mineral production has been multiplied by more than 5 (from 1.35 to 7.05 US billions) and rents distributed to producer regions increased by 118-fold (from 7 to 827 US millions) from 1996 to 2010, including a peak in 2007 where mining rents reach the record of 1.317 US billions. This extraordinary increase in a very short-period have created few rich municipalities that have experienced a dramatic increase in their budgets creating an ideal scenario to study the impact of natural resource windfalls on the electoral incentives of politicians. A fourth reason is the set of rules for the allocation of mining rents across Peruvian municipalities. The current legal framework establish a distribution rule that not only grants a significant fraction of the mining royalties and taxes paid by mining companies to mineral producer districts but that also allocates part of these transfers to non-producer districts located in neighboring areas. This fact allows us to distinguish between the impacts of a resource boom related to the increase of mining rents (something we can call a "rent effect") from the impacts related to changes in the local economy associated to increases in mineral production (or "production effect")[5]. A final reason, it is the nature of the local political arena in the country, characterized by its high level of fragmentation and weekly connection with national political parties, making the Peruvian case less sensitive to strategic interactions between local politicians and national political parties that may affect the rules of mining rents distribution.

In order to understand the connection between resource abundance and political outcomes, it is critical to study how natural resource rents affect the electoral behavior of politicians. This calls for a theoretical framework. In this paper, we adapt a basic model of electoral competition in the presence of exogenous rents developed by Caselli (2006). In this simple two-period model, an incumbent politician decides the present value of his consumption by allocating the local government budget between political rents and public goods. He faces the potential competition of an entrepreneur who has to decide whether to work in the industrial sector or to become a

[4] See MINEM (2012) for details.

[5] Conceptually, we can think that an exogenous rise of mineral prices can lead to an increase in mining transfers due to a pure price effect without changes in the actual production levels. In this case, the behavior of politicians will be affected only through the increase in local government budgets. However, higher prices can also be associated to 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.; that can negatively affect citizens' welfare and influence both the incumbent and citizens' political behavior.

challenger for the incumbent. Production of industrial goods depends on the level of public goods like roads or physical infrastructure. Therefore, the incumbent can avoid political competition by providing more public goods to citizens in the face of a resource boom, making the opportunity cost of becoming a political challenger high. However, this boom also makes more profitable for the entrepreneur to become a challenger since the value of holding power is higher as well. Hence, there is a threshold value of natural resource rents after which it is optimal for the incumbent underinvest in public goods. This is due to the fact that, from the point of view of the entrepreneur, the potential rents of controlling office are higher than the level of profits he would make given the provision of public goods. Then, the incumbent cannot prevent entry and therefore he maximizes the present value of his consumption by underinvesting in public goods. As a result, the model predicts a non-monotonic relationship between the level of natural resource rents and the level of political competition which is a consequence of a non-monotonic relationship between these rents and public goods provision.

In this basic model, if the mayor prevents competition, he also gets reelected. A more realistic approach is to model reelection as an interaction between the mayor and citizens along the interaction between the mayor and other politicians. In this extension of the model, the incumbent politician can also use natural resource rents for buying-off the electorate and affect in this alternative way the entry decision of the entrepreneur. His ability to do so will depend on how effective political patronage is in deterring competition and obtaining electoral support from citizens. This effectiveness can be thought as a function of local state capacity. When this capacity is low, then patronage is basically ineffective in getting citizens' electoral support, so it is not optimal for the incumbent invest in it. As a consequence, the results are essentially the same as previously described with the difference that the mayor is not reelected. On the other hand, when this capacity is high, then the incumbent can use patronage in an effective manner to obtain electoral support, being always able to prevent competition and to get reelected. When local capacity is intermediate, then a non-monotonic pattern between natural resource rents and reelection outcomes emerge, having this relationship a U-shaped form.

We take to the implications of this model to the empirical test using a unique dataset of mineral production, transfers from central government, electoral outcomes, public good provision, electoral conflict and local government characteristics for the period 1996-2010. We use detailed knowledge about the institutional setting to link the theoretical framework with the empirical test. In particular, we assume that the levels of institutional capacity are intermediate, so non-monotonic patterns between natural rents and economic and political outcomes are expected. In order to claim causality, our 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, we compare the political and economic outcomes of districts that differ in the level of mining rents they receive from the central government. We implement this design using two empirical approaches. In the first case, we use a difference in difference (DD) strategy in which mining rents are defined as a continuous treatment. Using mining rents as treatment would be problematic if rents are also a result of endogenous changes in production levels induced by the boom of mineral prices. This is the justification for our second approach based on an instrumental variable (IV) design. We use mining Canon revenues –a subset of mining rents- as an instrument since it is less sensitive to changes in production than other transfers related to natural resource exploitation. Mining canon depends on the taxes paid by mining companies and are distributed to different level of subnational governments following a set of fixed rules as we will explain later. We recognize that this is an imperfect instrument since the exclusion restriction might not hold[6]. To address this issue, we implement the sensitivity analysis developed by Nevo and Rosen (2012) and derive one-side bounds for the treatment effect under study. We offer evidence that endogenous responses related to production are not present in the context of this paper and that –even if we allow for a significant departure from the validity of the exclusion restriction- the main results of the paper are largely unaffected.

We find evidence of a non-monotonic patterns consistent with this theoretical framework. For municipalities with average mining transfers (130 nuevos soles per-capita), we estimate a reduction of 38% in mayors' reelection probability for each 1,000 nuevos soles of mining transfers. However, for districts with extraordinarily high levels of mining transfers (above 4,800 nuevos soles per-capita) a positive relationship is observed. A similar pattern is observed for the case of political competition. We estimate a negative impact of 4.9% in terms of our measure of political competition for the average municipality with a turning point above of 11,000 nuevos soles per-capita after which the effect becomes positive. These results are robust to controlling for mineral production and remain essentially the same for several sub-samples. When the Nevo and Rosen's (2012) bounds are estimated, the results are basically unchanged even for the case in which significant departures of the exclusion restriction are allowed.

We also find patterns consistent with a non-monotonic effect for the case of public good provision, the construction of local infrastructure, investment in roads and public employment. This also applies to the case of household income as a measure of welfare, but no evidence is found for household consumption. We interpret this result as evidence of short-term impacts of the mineral resource boom on citizens' welfare.

Taking these results together, we believe that we have enough evidence to argue that the existing literature is failing in 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 privileged linear approximations. To best of our knowledge, this is one of the first papers on addressing these non-monotonic patterns in response to natural resource booms exploiting sub-national variation.

[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. We 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. We provide evidence that shows that this is actually the case and use a set of robustness checks to provide evidence in that regard.

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

This paper also contributes to an old debate regarding the political consequences of resource abundance and its links with citizens' welfare. 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 Klueger 2008, Dube and Vargas 2013, and Arellano 2011a), corruption (Brollo et al 2013, Maldonado 2011 and Vicente 2010), and citizens' confidence in political institutions and democracy (Maldonado 2012), and local government efficiency (Ardanaz 2013, Ardanaz and Maldonado 2014). Other scholars have explored the impact of resource booms on citizens' well-being via public good provision (Caselli and Micheals 2013, Monteiro and Ferraz 2012) and demand of local inputs (Aragon and Ruud 2013).

The closest antecedents to this paper are Brollo et al (2013) and Monteiro et al (2012). In the first case, the authors study the impact of a fiscall windfall on political corruption and selection of politicians exploiting exogenous variation in federal transfers to local governments given by discontinuities induced by population thresholds established in the Brazilian constitution. They find that larger transfers increase political corruption and lower the quality of politicians. The second paper uses variation in oil royalties induced by a geographical rule to explore the impact of resource booms on local elections. The authors find the boom creates a large incumbency advantage but this effect disappears in the short-run.

This paper differs from Brollo et al (2013) and Monteiro et al (2012) in terms of the analysis of the non-monotonic nature of resource booms recognized by the theoretical literature but that has been largely neglected in the empirical literature. It also differs in terms of the role played by production levels in the empirical analysis. Compared to Brollo et al (2013), this paper exploits a source of variation in transfers that is related to natural resources instead of a generic inter-governmental transfer or fiscal windfall. Since some cross-country evidence shows that their political properties might be different (Dalgaard and Olsson 2008), we believe our approach is more suitable to capture the nature of the political resource curse[7].

The rest of the paper is organized as follows. Section 2 provides some basic details about the institutional setting. Section 3 introduces a basic theoretical framework whereas Section 4 presents the empirical strategy. Section 5 describes the data and section 6 presents the empirical results. Section 7 concludes the paper.

2. Institutional background

2.1. Local Politics.

Local governments as independent political units are relatively new in Peru[8]. The Constitution of 1979 is the first one recognizing 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 1 seats in the council implying a limited ability of political accountability by local political parties from the opposition.

Elections for mayor and members of local council are held each four years[10]. There are not term limits but local authorities can be subject to impeachment due to a set of direct democracy

[7] Dalgaard and Olsson (2008) show that windfalls associated with influx of foreign aid has a negative impact on corruption whereas natural resource rents are positively related to corruption. This suggests that fiscal windfalls may have different political properties depending on the set of institutional rules attached to them. Unfortunately, there is no strong causal evidence to evaluate the validity of this argument since most of it comes from cross-country studies. This constitutes a relevant topic for future research.

[8] Local governments are the smallest autonomous political and administrative units in the country. There are about 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 in 25 regions besides the province of Lima that has a special status for being the nation's capital.

[9] The local elections by direct universal suffrage were first introduced in 1963 during the first government of Fernando Belaunde Terry. With the overthrow of Belaunde and came to power by military coup of General Juan Velasco Alvarado in October 1968, municipal elections were suspended. Between 1968 and 1980 when civilians return to power, mayors were appointed by the executive branch, particularly the Ministry of Interior. For more details, see Bensa (2002).

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

mechanisms introduced in the Constitution of 1993. 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 study for the World Bank (World Bank 2001), interviewed local politicians indicated that no funding from national parties was received by them. Also, evidence of party loyalty is absent. Many mayors were re-elected under different political brands over the past years. Along the same lines, local politics became increasingly fragmented due to the rise of provincial and local political movements with weak links with national political parties[11]. As a consequence, local politics is highly personalistic and increasingly disconnected of national politics.

Although electoral rules allow local politicians a high degree of freedom, the weak institutional capacity of local governments works as an important constraint for their political behavior. To illustrate this point, we can approximate institutional capacity using some dimensions related to low capacity such as the presence of local management instruments. Using the Registro Nacional de Municipalidades (RENAMU) from 2011, we have estimated that only 14% of local governments had urban planning plans and 20% had local development plans. On the other hand, only 29% had cadastral information systems. Along the same lines, most local governments in the country lack of stable and qualified public servants. Using the RENAMU again, we have estimated that only 21% of the 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.

According to the current legal framework, local governments' responsibilities can be classified in two: exclusive and shared. Exclusive functions include urban and rural development, regulation and management of local public goods, local government organization, local development planning, and execution and monitoring of local public infrastructure (World Bank 2010a: 37). On the other hand, shared functions require coordination with other government levels (either provincial, regional or central government) and include participation in management of school services, public health, culture, sports and recreation, citizen security, transport, housing, and social programs and waste management. In practice, this overlap of functions has shown to be problematic since it has caused coordination problems among different levels of governments, affecting the performance of economic development and social programs.

2.2. Local public finance

Peru is a very centralized country. From a fiscal perspective, 97% of taxes are collected by the central government (Polastri and Rojas 2007). Local governments' ability to establish taxes and its marginal rates is very limited. Property taxes (vehicles, real estate and real estate transfer) are the main source of local tax revenues for Peruvian municipalities (90% in 2007), playing production and consumption taxes a marginal role. However, it is important to note that revenues

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

from these taxes are low and represent at most 13% of local governments' current incomes (World Bank 2010a and Canavire-Bacarreza et al 2012).

Consequently, local governments are highly dependent from central government transfers. On average, transfers from central government represent 75% of local governments' budget for 2008 (Canavire-Bacarreza et al 2012). A significant part of transfers from central governments are allocated in the form of the Fondo de Compensación Municipal (FONCOMUN), which represents a 33% of all intergovernmental transfers. This transfer is universally distributed among local governments. The rest is allocated as targeted transfers. From these targeted transfers, canon transfers (including all sources of canon such as oil, hydropower, forest and gas canon) represent a 91% of the total targeted transfers, being the mining canon and the mining royalty the most important ones, representing 72% of all canon transfers and 29% of local governments' budgets (Canavire-Bacarreza et al 2012:16). Therefore, mining canon and mining royalties represent a significant fraction of local governments' budget in mineral-rich areas, close to 70% of municipal budgets in some producer districts.

2.3. Mining legal framework

Mining is an activity with long tradition in Peru since colonial times. Historically, it has been associated to exploitation[12] and environmental degradation, which explains the negative perception that this activity has in areas where is performed (World Bank 2005). During the 20th century the most important mines of the country were in foreign hands[13]. 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) which can be explained by 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 to promote 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 for foreign and national investors, and property rights restrictions to foreign citizens were removed. Environmental regulations were relaxed and land expropriation was allowed in

[12] 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.

[13] 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.

favor of mining investors when original land owners were no willing to sell their properties after negotiation[14]. Along the same lines, restrictions to sell communal lands were eliminated[15].

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.

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 the Law 27506 (known as the Canon Law),which states that the 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%). In addition, a 5% is allocated to the public universities of the region (see Appendix I for details). The changes to the distribution rule were designed to precise the criteria used to allocate the transfers among the local governments located in the same province and region of the mineral producer districts[16].

---

[14] 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 a lot of 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.

[15] 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.

[16] 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% 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

Two important characteristics about mining Canon are important to mention here. Firstly, there is a lag between the generation of the transfer and the moment in which is distributed to the regional and local governments. Mining companies paid taxes in March for the previous fiscal year and mining canon is distributed in the mid of the year[17]. Secondly, mining Canon transfers can be used only 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)[18]. Current expenses are prohibited by law, including payroll expenses[19].

The mining royalty follows a similar allocation rule, although it has a different tax base[20]. 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%. Appendix I summarizes the legal framework behind the collection and distribution of mining royalties.

2.4. Fiscal windfall and the boom of mineral resources

As discussed above, the production of mineral resources experienced a significant increase as a consequence of the policies implemented to attract foreign investment in the mining sector. Figure 1 presents the evaluation of the real value of mineral production for period 1996-2010. After 2000, mineral production experienced an extraordinary increase of about 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 should be a consequence of the new regulatory framework in the mining sector implemented during the market reforms based on the Washington Consensus.

---

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).

[17] 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.

[18] 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).

[19] 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.

[20] 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.

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 eight most important mineral resources produced by the country during the period of reference. 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 the cases the prices were multiplied by two or three times in relation to the average prices before 2003.

Figure 3 shows that were changes in prices that explain most of the variation observed in mining rents. As seen, the prices and quantities evolve similarly to 2003 and after that experienced different patterns, with prices that showed a change up to 4 times their original value (15 times in the case of molybdenum). Moreover, changes in the levels of production were much more modest seldom above 100% during the period under review. This suggests that were changes in prices the main factor to explain variation in mining rents levels. Although the variation in average price levels is more important than the variation in production levels, it is important to note that the latter are not negligible and could play a role in explaining the phenomenon of interest. We will return to this point later.

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 canon transfers that increased the participation of regional and local governments from the areas where mineral resources are extracted from 20% to 50%. Figure 4 describes that evolution. As it should be clear from the graph, the amount of transfers due to royalties and mining canon were relatively low (roughly 67 and 95 million of nuevos soles) during 2001 and 2002, having a spectacular increase since then reaching the extraordinary number of 4.15 billion in 2007[21]. Towards 2010, this amount was about 2.5 billion nuevos soles. This windfall was particularly beneficial for mineral producer districts. Figure 5 shows the evolution of average mining transfers according to whether the district is producer or only recipient of mining transfers. Starting 2005, producer districts began to concentrate a significant fraction of mining transfers.

To illustrate the magnitude of this concentration, Figure 6 presents the Lorenz curve for the average mining transfers for period 1996-2010. Few districts were benefited with extraordinarily high levels of mining canon transfers, something reflected in a Gini coefficient of 0.8. This is a critical element since previous evidence for the Peruvian case suggests that the behavior of municipalities with extraordinary high levels of transfers is generally different than the average mining transfer recipient[22].

This is also reflected geographically. Since the distribution of mineral resources depends on geographic characteristics, we should observe that some areas are more suitable for the extraction of minerals. As a consequence, different areas are affected by different prices and then are benefited by the shock in mining revenues in different ways. The evolution of transfers from mining transfers shows two basic patterns: a) there are huge differences in terms of mining rents

[21] For reference, the current exchange rate is 2.85 nuevos soles per US dollar.
[22] See, for instance, Maldonado (2012).

across districts, and b) there are disparities in terms of the evolution overtime of mining rents across districs. This suggests that the effects of the shocks may be heterogeneous, as it should be clear from Map 1. This map shows the allocation of average mining rents for period 1996-2010. We observe a clear pattern with concentration of mineral rents-rich districts in the south (Tacna, Moquegua and Cusco), center coast (Ancash) and north (Cajamarca). The jungle and the coast close to the frontier with Ecuador are the areas in which mineral rents-poor districts are located.

3. Analytical framework

This paper's contribution is empirical since the existing literature on the political resource curse is already rich in theoretical contributions highlighting a set of potential channels that can explain the relationship between resource abundance and political outcomes. However, we consider the following simple model adapted from Caselli (2006) and Caselli and Cunningham (2009) to motivate the empirical exercise. The details are covered in the Appendix II.

3.1. Sketch of the Model

We consider 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. In the first period, this economy is composed by two sectors: the natural resource and subsistence sectors. The mineral resource sector is assumed to provide an exogenous flow of rents to the local government. This way to model a resource boom basically considers the "rent effect" discussed above. Modelling the "production effect" is harder since both positive and negative externalities can be result of changes in the level of mineral output. We leave aside these issues here since, as mentioned in the introduction, there is no evidence of the impact of mineral production on political outcomes.

It is assumed that production in this economy depends on the provision of public goods by the local government. A typical public good would be roads or any other type of basic infrastructure. Therefore, the incumbent politician can influence the level of output in this economy according to the level of public goods he decides to provide.

The talented agent has managerial skills that can be used either in the industrial sector or politics. The talented agent problem is to decide whether to become an industrialist in the second period or a challenger to the incumbent politician. She compares the net benefit of becoming a politician against her opportunity cost in the industrial sector. If she becomes a politician, she would face the result of an election in which she has some positive (exogenous) probability of winning. If she wins, she can extract rents from the municipality otherwise she would need to face the cost of losing the election. If she becomes an industrialist, she would hire unskilled workers to produce an industrial good that also depends on the stock of public goods.

Therefore, the incumbent politician 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 of becoming an electoral challenger. A high level of consumption associated to a low provision of public goods reduces the opportunity cost for the talented agent of becoming a politician and increases the chance for the incumbent to face a competitor. The opposite is also true.

The game follows the next structure. During period 1, a level 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 with respect to public 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 of 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 in industrial production). Nevertheless, the mayor also has access to more mineral rents 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 would become useless for very high levels of mineral rents associated to a mineral resource boom since 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^*) after 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 since his probability of reelection has been reduced.

This basic model predicts a non-monotonic relationship between per-capita mineral rents and political competition. Since more political competition is associated in this framework with lower probability of reelection, then the inverse result is valid for reelection outcomes. However, explaining reelection solely in terms of the interaction between the mayor and the potential challenger is limited since the former has in practice more instruments to influence electoral outcomes. The mayor can use mineral resource rents not only to influence the decision of the talented agent but also for buying off the electorate in exchange of electoral support via the distribution of public and private goods as well as public employment.

This fact can be accommodated in an extension to the basic model. Clientelism can be modeled as a factor affecting the probability of winning the election of the competitor. The more the mayor invests in clientelistic expenditures, the less chance of winning the election for the competitor. Of course, we need to take into account the effectiveness of these clientelistic practices to influence the electoral outcomes. Caselli (2006) models this by using an elasticity for the relationship between clientelistic expenditures and the probability of winning the election for the talented agent (γ in Appendix II). He shows that the basic results differ for different levels of this elasticity. When this elasticity is low, then the results are similar to the previous basic model since the 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 over 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 the clientelistic expenditures are high enough to buy electoral support, reducing the incentives of the talented agent to run for election. Finally, when the elasticity is high, clientelistic expenditures are very effective to prevent entry.

In terms of reelection outcomes, a low elasticity between clientelistic expenditures and the probability of election of the competitor basic implies that the relationship between mineral rents per-capita and reelection is negative. Mayor cannot prevent entry because clientelistic expenditures are basically ineffective. The opposite is true for a high elasticity being the mayor always able to prevent competition. The middle case is more interesting. We find a non-monotonic relationship between mineral rents and the probability of reelection for the mayor. Given that mining rents are somewhat effective, there is a reduction in the probability of keeping office for the mayor for relatively low levels of rents. However, when these rents are higher, the mayor is able to retain office because he can influence the electoral outcome -even if clientelistic expenditures are just somewhat effective- due to the amount of rents he is able to control.

3.2. Link with the Empirical Test

The values of some parameters need to be fixed before taking the model to the empirical test. For instance, in the model γ is an exogenous parameter. This parameter can be interpreted as a measure of the institutional capacity of local governments. High levels reflect a greater ability of local government to transform the public budget on goods and services for citizens. In the context of this paper, the assumption that the level of γ for the average local government is intermediate is maintained[23].

We also need to consider the initial level of political competition. As seen in Section 2, the local political arena is fragmented due to the existence of many political parties and local political movements competing at the local level. The model simplifies this by assuming only one potential competitor. When many parties are present at baseline, then it is possible that each local politician faces her own value of c^*. We discuss below the empirical consequences of relaxing this assumption.

Using this conceptual framework (see Appendix II for details), the following testable predictions are derived:

Hypothesis 1: *Political competition is non-increasing in mining rents per-capita for* $c < c^*$ *and non-decreasing for* $c > c^*$.

A similar hypothesis can be derived for the case of reelection outcomes:

Hypothesis 2: *Incumbent reelection is non-increasing in mining rents per-capita for* $c < c^*$ *and non-decreasing for* $c > c^*$ *for an intermediate value of* γ.

---

[23] Peruvian local governments certainly have less institutional capacity than local governments in developed countries but they do not suffer the limitations that are observed in local governments in poor African countries. Thus, an intermediate level is assumed.

To explore the role of public good provision and clientelism as mechanisms to explain political outcomes, we consider the following testable predictions:

Hypothesis 3: *Public goods provision is non-decreasing in mining rents per-capita for* $c < c^*$ *and non-increasing for* $c > c^*$ *for an intermediate value of* γ.

H3 is a more generic hypothesis and applies not only to the provision of public goods, but it will be also used to understand the expansion in local infrastructure, in terms of physical units and investment.

Hypothesis 4: *Clientelistic spending is non-decreasing in mining rents per-capita for* $c < c^*$ *and non-increasing for* $c > c^*$ *for an intermediate value of* γ.

We link the clientelistic spending to the provision of private benefits to citizens. This takes the form of specific transfers or public employment funded with mining transfers. This latter form of empirically approaching clientelism has antecedents in the theoretical literature. Robinson et al (2006) model clientelism as a job offer in the public sector. This offer has the advantage over other forms of redistribution since it provides a credible commitment device to support elector exchanges between politicians and voters. That credibility comes from the fact that this type of job offer based on commitment is difficult to reverse.

One limitation of the theoretical model is that it only predicts aggregate expenditure patterns in public goods and clientelism without specifying how local politicians allocate natural resource rents between different types of public goods or forms of clientelism. In the case of clientelism, the theoretical literature suggests that public employment is the most common form and it has the advantage of working as a credible, selective and reversible mechanism to ensure electoral support (Robinson and Verdier 2013). In the case of the provision of public goods, it is possible to propose a similar intuition where the type of public good to be provided by the local government depends on the political properties of its production function. Thus, a public good whose production function is intensive in unskilled labor provides a greater electoral return for incumbent mayor than a public good whose production function requires skilled labor and physical capital. Therefore, it is more likely that the first to be built[24]. Similar reasoning helps to understand the construction of "white elephants", since they are buildings that, despite having marginal social benefits, are intensive in unskilled labor force and it is highly profitable from an electoral point of view[25].

[24] A clear example would be the decision to build a school versus a hospital. The infrastructure in the first case is relatively basic and it can be built by staff with little human capital as opposed to a hospital that requires a specialized infrastructure, not to mention the stock of tools and machinery that are needed to make it operate. For a school to work, it is required to train teachers. Those are trained in teacher training centers that are relatively abundant in the country. By contrast, health personnel requires specialized training, so relatively few are able to received compared to teachers. Thus, the production function of a school offers greater returns and less complexity than in the case of a hospital, which would explain why politicians favor their construction.

[25] Robinson and Torvik (2005) present a formal model that suggests that "white elephants" are an inefficient redistribution mechanism in order to influence election results.

To summarize this conceptual section, it is important to keep in mind the non-monotonic patterns that emerge between mineral resource rents and electoral outcomes. Since incumbents use the provision of public goods and clientelistic expenditures as the mechanisms to influence these outcomes, it is also expected that the relationship of these variables with natural resource rents is also non-monotonic. We take the implications of this conceptual framework to the empirical test in the rest of the paper.

4. Empirical Strategy

4.1. Identification

The goal of this paper is to estimate the impact of a mineral resource boom on reelection and political competition via the analysis of how politicians use public good provision and clientelism to influence the electoral outcomes. We use changes in international prices of mineral resources produced by the country and a set of rules regarding distribution of mineral rents to subnational governments as sources of variation to claim causality.

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 a bit trickier to differentiate between changes in levels of production and mining rents levels as a result of changes in international prices. This difficulty arises from the fact that both changes (levels of production and mining rents) are associated and the impact of each of them on the election results will not necessarily go in the same direction[26].

We argue that mineral prices are exogenous to local politics in mineral rich districts. The basic reason has to do with the pattern of insertion of the Peruvian economy in the global economy as a price-taker of international prices of its more important commodities and recent changes in the international context, particularly the expansion experienced by the Chinese economy as a result of its industrialization process[27]. This is critical since Peru is one of the most important producers of minerals in the world, which implies that the country can potentially influence international prices, affecting in this way the validity of our research design[28]. There are many reasons why this is not the case. Firstly, there is not a single state-owned producer company in the

[26] In producing districts, the increase in international prices leads to increase of mining royalties which may cause an increase in the provision of public goods, which in turn can positively influence the mayor's ability of staying in power. On the other hand, 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 levels of unrest, which could adversely affect the reelection of the mayor. The net effect is thus ambiguous, since there is no perfect way to isolate the role of these two factors on the election results. We will address these issues later.

[27] Historically, Peru has been a small open economy heavily dependent on exports of primary products, a feature that was reinforced by liberal reforms based on the Washington Consensus during the 90. For this reason, the country is basically a price taker in international markets of its major exports and, therefore, very sensitive to external shocks. In fact, some researchers (see, for example, Dancourt 1999) have suggested that most of the economic crisis experienced the country since 1950 have been linked to external shocks such as a fall in the terms of trade.

[28] Today, Peru is the second largest producer of silver, third in zinc, copper and tin, fourth in lead and molybdenum and fifth in gold. See MINEM (2011) for details.

country as it is common in many developing countries. Many private companies operate in the country[29], so it is very hard for an individual company to influence international prices. Secondly, there is a consensus among the experts about the role of China in the boom of international prices. According to a World Bank study (Winters and Yusuf 2007), China has become the largest consumer of minerals in the world (24% of total world production) after the increase of its demand since 1999. From 1999 to 2005, China consumed two thirds of the growth of world metal production, which made it the most important factor in explaining the growth in metal prices observed in the period under analysis. Finally, the fall of the interest rates is another explanation for the increase of commodity prices (Frenkel 2008).

Another concern with our 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 already operating mining companies react to higher prices by expanding the levels of production and starting new production units. We believe these factors are not relevant although we cannot completely rule out their role. On the one hand, local governments play 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 Environment and Ministry of Culture). On the other hand, starting a new exploitation requires 7 years on average, so it is hardly the case that any response like this can be relevant in our setting since any new exploitation started as a consequence of the boom of prices in 2003 would appear at the end or beyond the period under analysis (1996-2010). We cannot rule out any endogenous increase of production in already existing exploitations, although we do know that most of the variation comes from the shock in prices as discussed in Section 2.4. Changes in production may have impacts on political outcomes indirectly due to its impact in mining rents allocated to local governments or directly due to its impact in the local economy. We will control for this in the empirical model and use additional robustness checks to evaluate the validity of the empirical results.

One final concern is that mining rents were endogenous. Mining rents can be endogenous due to endogeneity in prices and quantities as well as an endogenous placement of the distribution rule. We already discuss the role of prices and quantities. Regarding the distribution rule, a serious concern would be that changes in distribution rules of mining rents were the result of an active role of the political authorities of local governments in anticipation of the price boom. For instance, the mining Canon was originally funded with the 20% of taxes paid by mining companies and this rate was raised to 50% in 2001. The allocation criteria was further modified to assign more rents to mineral producer districts. If these changes were concessions to local interest, the mining rents were endogenous. However, the political system is fragmented and national political parties have very weak connections with local politicians, so this is hardly the case. 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. The only reason

[29] 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 (2014).

why we should be worried about the endogeneity of rents is due to the potential source of endogeneity of mineral production discussed above. We address these issues in the next section.

4.2. Empirical Model

The empirical model followed in this paper is based on two different econometric approaches. We first use a difference-in-difference strategy (DD) exploiting the pattern of mineral prices over the period. We directly use mining transfers as a treatment variable in a DD design with continuous treatment. We also include a measure of mineral production to account for changes in the political environment of local governments associated to changes in production levels. The basic specification is as follows:

(1) $y_{ijt} = \alpha_j + \lambda_t + \beta f(MR_{jt}) + \gamma Q_{jt} + X_{ijt}^{'}\delta + \varepsilon_{ijt}$

where y_{ijt} is the outcome of interest for the observation i in district j and period t. α_j and λ_t are respectively district and years fixed effects. MR_{it} and Q_{it} are respectively measures of mining transfers per-capita and real value of mineral output for district j in period t. $X_{ijt}^{'}\delta$ includes individual/household and district level characteristics whereas 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 $f(MR_{jt})$ is used in order to indicate the use of a non-monotonic specification for the case of mining rents. This includes a specification in levels as well as a quadratic specification in accordance with the theoretical framework. In addition, although most of the outcomes to be analyzed are defined at district level, we consider the individual/household level since welfare outcomes 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 due to changes in the level of mineral production. It is important to remember that control variables need not to be orthogonal to unobservables contained in the error term; it is only required that their inclusion in the econometric specification allows us to remove any remaining selection bias[30].

This specification is a generalization of the standard two period-two groups DD approach (see, for instance, Bertrand, Duflo and Mullainathan 2004 and Hansen 2007). The time fixed-effects accounts for the time-series changes in political outcomes. The district fixed-effects controls for time-invariant characteristics at district level and the MR_{jt} accounts for changes in dependent variable in treated districts associated to the movement of mining revenues after the increase of prices of mineral resources. Identification in this setting requires controlling for any

[30] See Stock and Watson (2006) for a discussion about the role of control variables.

systematic shock to political outcomes of districts affected by the increase of prices of mineral resources that are potentially correlated with, but not a consequence of, the revenues shock[31].

In the previous section, we discussed the importance of controlling for endogenous changes in production levels. Although evidence suggests that endogenous changes in production levels are at best marginal, it is important to take seriously this issue in the empirical analysis. One way to do this is to evaluate if the basic results of the study are maintained when sub-samples of interest are analyzed. In particular, an interesting example is the sample composed by mining rents recipient districts in which there is no production. In this case, there are no problems associated with endogenous production as discussed above. In this case, the specification (1) will also be used but only for the sub-group of districts that receives transfers but that are not producers. Alternative specifications for different groups will be discussed below.

The use of this continuous treatment variable is problematic since does not control for the fact that there may exist endogenous responses in production even after controlling for mineral production. One way to address this issue consists in constructing 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, but this alternative does not work due to lack of information[32]. Although these are relevant issues from a conceptual point of view, we believe the practical evidence is less compelling. The evidence discussed in section 2.4 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 which did not experience a significant variation over the period under analysis. Although we believe that including a measure of mineral production should be enough to account for any potential endogenous response related to changes in production, we take this concern seriously. This leads to our alternative research design based on an instrumental variable approach.

The use of an instrumental variables (IV) method in this context is motivated by the presence of a credible source of exogeneity in mining revenues due to fluctuations in international prices. Despite this, isolating the role of prices is hard due to the informational constraints about taxes and profits discussed above. Therefore, we propose the use of mining Canon transfers, a subset of mining revenues as an instrument for total mining revenues. We proceed in this way since mining Canon revenues is less sensitive to endogenous responses to production among the set of rents distributed to local governments. Mining Canon basically depends on the rules of

[31] Formally, this is known as the common trends assumption. In terms of counterfactuals, this implies an additive structure for the potential outcomes for the untreated districts (without considering covariates) as follows: $E(y_{ijt} / j, t) = \alpha_j + \lambda_t$. For a discussion, see Angrist and Pischke (2009), chapter 6.

[32] There are many reasons why this alternative is difficult to implement: a) 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 since they are a function of profits. In the case in which a mining company operates in more than a district or has more than one exploitation, it is hard to assign what fraction of the paid taxes are 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 a secret by tax authorities; b) 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.

allocation established by Law that contains fixed rates for each level of government and the variation of prices. Despite the weak evidence regarding endogenous production responses, we recognize that this is an imperfect instrument in the sense suggested by Nevo and Rosen (2012) and proceed accordingly by incorporating a sensitive analysis in our design based on Nevo and Rosen's work on identification with imperfect instruments, as it is going to be discussed below.

Leaving aside the imperfect instrument issue for a moment, we believe that mining Canon recovers relevant variation to identify the causal effect of interest. The estimated effect represents a generalized local average treatment effect (LATE) [33]. 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 being independent of all potential outcomes and treatment intensities implying that mining Canon transfers should have no effect on political outcomes other than through its effect on mining transfers. We will argue that, even if we allow for a significant departure from the validity of the exclusion restriction, the basic results of this paper would not be significantly affected.

The first stage estimates the impact of mining Canon on mining transfers and can be written as follows:

(2) $MR_{jt} = a_j + d_t + bf(MC_{jt}) + cQ_{jt} + X'_{jt}\gamma + v_{jt}$.

The term MR_{jt} is a measure of per-capita mining rents allocated to the district j in period t. a_j and d_t are respectively district and time fixed effects while MC_{it} is the level of per-capita Mining Canon transfers for district j in period t. X_{jt} includes district level characteristics and v_{jt} is an error term.

The second stage estimates the impact of mining transfers on political and economic outcomes. The basic specification is as follows:

(3) $y_{ijt} = \alpha_j + \lambda_t + \beta f\left(\overline{MR_{jt}}\right) + \gamma Q_{jt} + X'_{ijt}\delta + \varepsilon_{ijt}$;

where y_{ijt} is the outcome of interest for individual i in district j for period t. α_j and λ_t are respectively district and time fixed effects. $X'_{ijt}\delta$ includes individual and district level characteristics and ε_{it} is an error term. The parameter of interest is β which recovers the causal effect of interest.

The validity of the exclusion restriction is likely to hold with the proposed instrument. As previously show, the change of prices basically affected fiscal revenues and not significantly

[33] See Imbens and Angrist (1994), and Angrist, Imbens and Rubin (1996) for the LATE parameter and its estimation using IV. Heckman (1997) provides a critique to this approach.

production levels[34]. This fact is largely explained by the characteristic of the mining activity, which lack of linkages with other sectors of the economy and only employs 1% of the labor force. The business cycle is also relevant since a new mining project takes about 6-7 years to start operations, which implies that even if mining companies react by expanding operations as a consequence of the shock in prices, it is hard that would be relevant for this paper since any new operation would be largely excluded from the period under analysis.

To analyze how sensitive are the IV results to potential violations of the exclusion restriction, we implement the sensitivity analysis proposed by Nevo and Rosen (2012). This approach is based on the idea that the validity of the exclusion restriction is always hard to defend with only informal arguments and a more formal argument is required to evaluate the consequences of departures from the standard assumption regarding the exogeneity of the instrument. 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; in particular, a) same direction of correlation between the endogenous regressor and the imperfect instrument with the error term, b) the instrument is less endogenous than the original endogenous variable. They start by defining the ratio between the correlations between the instrument and the endogenous regressor with the error term as follows:

(4) $\lambda_j^* = \rho_{MC,\mu} / \rho_{MR,\mu}$;

where $\rho_{MC,\mu}$ and $\rho_{MR,\mu}$ are respectively the correlation coefficient between Mining Canon and the error term and Mining transfers and the error term. Nevo and Rosen show that, under the above assumptions, the following condition is true:

(5) $E\left[\left(\sigma_{MR} MC_{it} - \lambda_j^* \sigma_{MC} MR_{it}\right)\mu\right] = \sigma_{MR}\sigma_{MC,\mu} - \lambda_j^* \sigma_{MC}\sigma_{MR,\mu} = 0.$

Where σ_{MR} and σ_{MC} are the standard deviations for mining transfers and mining Canon respectively. Therefore, if the value of λ_j^* were known, using the expression $\sigma_{MR} MC_{it} - \lambda_j^* \sigma_{MC} MR_{it}$ instead of the imperfect instrument would provide a valid instrument to identify the causal effect of interest. The problem is that λ_j^* is unknown. However, Nevo and Rosen show that under the assumptions above the value of λ_j^* is bounded between [0,1]. Then, a function $V(\lambda_j)$ can be estimated for different values of λ_j as follows:

[34] Notice that not necessarily all production change is endogenous. Recall from Section 2 that the period under analysis is characterized by important efforts by the Peruvian government to attract foreign investment. This happened 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, typically mining companies appear to react to the new high prices period by expanding their activities to new mining projects rather than expanding production because the maturation process is long.

(6) $V(\lambda_j) \equiv \sigma_{MR} MC_{it} - \lambda \sigma_{MC} MR_{it}$.

Using $V(\lambda_j)$ it is possible to bound the treatment effect using different values for λ_j. In the empirical application we use values from 0.1 to 0.9 to assess the impact of different levels of violation of the exclusion restriction. One limitation of the Nevo and Rosen approach is that the identification of two sides bound requires a negative correlation between the instrument and the endogenous variable with the error term. This does not seem to be the case in the context of this paper. Since the error term basically recovers non-observable production responses to the boom of mineral prices, one should expect a positive correlation between these variables and the error term. In this scenario, the authors show that only a one-side bound can be identified.

We conclude this section with some details 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, Duflo and Mullainathan (2004)[35]. To deal with both issues, we cluster the standard errors at 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; which is the case in our setting[36].

5. Data

5.1. Data sources

The empirical analysis 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. We assemble a panel dataset for local elections for years 1998, 2002, 2006 and 2010 to construct measures of reelection and political competition, the main outcomes of this study. This covers years in which mineral prices were stable (1998 and 2002) and years after a significant increase (2006 and 2010).

Data on municipalities' revenues and mineral transfers from the central government over the period 2001-2010 were collected from the Ministry of Economy and Finance. This includes detailed information from all type of transfers received by local governments as well as information about other regular sources of incomes (taxes, contributions, fees for services, among others). The sample is composed by about 1,830 districts. These data are used to explore how

[35] According to these authors, this is due to the following reasons: a) usually estimates are based 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. Since all these factors may play a role in our setting, we proceed in this way.
[36] For a discussion for the case of a small number of clusters, see Angrist and Pischke (2009). Cameron, Gelbach and Miller (2007) propose bootstrap-based solutions. Particularly, the wild cluster bootstrap appears to perform well in a set of simulations studied by the authors.

politicians use local government budget. We complement this dataset with information about mining Canon transfers from 1996 to 2000 obtained from the Ministry of Energy and Mines.

A panel dataset about local governments' characteristics was constructed from the Registro Nacional de Municipalidades (RENAMU). This source is a census of municipalities carried out by the National Statistical Institute (INEI) yearly since 2002. It includes information about human resources, assets, public good provision and budget of local governments as well as data about socioeconomic characteristics of the district itself. Information for the period 2002-2010 is exploited in this paper.

The 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 real value of mineral production (using prices of 2001 as reference) for each district over the period under analysis.

Another piece of information is the Encuesta Nacional de Hogares (ENAHO), carried out yearly by Peru's national statistical agency. The ENAHO is a national representative survey with detailed information about living conditions at household level. The sample size is about 19,000 households for each year. In this study, we use a repeated cross-section for period 1998-2010 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 in the period of the study. The details are discussed in Online Appendix I. In the first case, all nominal variables were converted to real terms using the price index based on December 2001. Using a special deflator, real values were expressed in prices of metropolitan Lima for the same year. In the case of the creation of new districts, homogeneous geographical identifiers were constructed for the period 1993-2010.

5.2. Main variables

The basic dependent variables are constructed from ONPE's electoral data. Following the theoretical framework, the two basic political outcomes are a measure of incumbency advantage and one of political competition. In the first case, we simply construct a dummy variable equal to 1 if the mayor was re-elected. 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 since it is common to observe politicians migrating from one political movement to another.

Constructing reelection outcomes at individual level was straightforward for the electoral cycles 2002-2006 and 2006 and 2010. We use the number of the national document of identity (DNI) and match the numbers within each cycle. Since the DNI is unique for each individual, we are confident in the quality of the match. For the cycle 1998-2002, we had no information about

DNI for observations from 1998. So we matched observations using first and last names and controlling for information about age and district from a third source (INFOGOB, an online platform with information about politicians) to make sure that the match was done correctly.

Measuring political competition is more complicated[37]. We proceed by computing a basic measure of political competition based on the Herfindahl-Hirschman index (H). We define political competition (PC) following Skilling and Zeckhauser (2002) as follows:

(7) $PC = 1 - H$.

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 one will reflect higher levels of political competition.

The treatment variable is a real measure of mining transfers. This variable is the sum of all transfers related to exploitation of mineral resources being the most important categories mining Canon and mining royalties. This measure is expressed in real terms using prices of Lima for 2001 as reference. For the regression analysis, we convert this measure in 1,000 of nuevos soles per-capita.

The rest of outcomes related to public good provision, public employment, local governments' budget and living conditions will be discussed later. Online Appendix I presents the details of the definition and construction of each variable as well as the methodological decisions behind them.

5.3. Summary statistics

Table I presents basic summary statistics of the mining transfers. We 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 I). In the case of districts that do not receive transfers, levels of reelection in the period of analysis is 11%. Reelection levels for the case of producer districts is 19% whereas in the case of recipient districts this value is 18%. In the case of the measure of political competition the results go in the opposite direction since they suggest a high level of competition. For the case of recipient districts, the average value is 0.81 (for an indicator that varies 0 and 1) while in the case of producer districts the indicator is 0.84. For mining transfers recipient districts, the indicator is 0.82.

Regarding mining tranfers, mineral producer districts received 475 nuevos soles per-capita during the period under analysis (Panel II of Table I). This amount represents a 25% of the average monthly income per-capita in these areas. Canon recipient districts (excluding producers) receive 92 soles on average. These numbers do not take into account the extremes inequalities in the distribution of mining canon transfers. For instance, whereas the percentile 90 of mineral producers gets 877 nuevos soles per-capita, the percentile 99 obtains 9,479 soles. This is evidence that, whereas a large number of districts receive this transfer, only few of them get it in large

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

magnitudes. Consequently, there are significant differences in relation to the public budget across districts. While the public budget is 347 nuevos soles per capita for non-recipient districts, it is 1,496 nuevos soles per-capita in case of producer districts and 568 soles for recipient districts.

Panel III of Table I 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 $ 2 million. Copper is the most important mineral in relation to its production value, followed by zinc and gold. The minor is molybdenum with an average value of $ 17,000 in the period.

Panel IV of Table I presents also descriptive statistics for a set of socio-economic characteristics for districts using Census 1993 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 II explores the impact of mining transfers on mayor's reelection in the case of the DD design. In the top panel, we use as a treatment variable the average per-capita mining transfer (measured in thousands of Nuevos Soles in Lima 2001 prices) for the period that includes the election cycles 1998-2002, 2002-2006 and 2006-2010. The lower panel considers only mining transfers in the election year (2002, 2006 and 2010)[38]. The dependent variable of interest is a dummy variable equal to one if the mayor is reelected.

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

Column 2 includes the quadratic specification, consistent with the theoretical framework of this study. For the average mining transfers, the coefficients for the level and the square of transfers are not significant. The opposite occurs in the case of mining transfers for the election year. In this case, from being no statistically significant in column 1, the coefficients for the level and the square of the transfers are now significant at 1% significance level. Consistent with the theoretical framework, the coefficient for the level is negative (-0.066) while the case of the coefficient for the square is positive (0.007). Given the non-monotonic nature of the impact of

[38] We opt for both specifications in order to evaluate whether the results are sensitive to political transfers during elections in line with the literature of "political budget cycle" (Nordhaus 1975) or respond to the average over the term in office of a mayor.

transfers, the effect of transfers on the election results in a given district depends on the level of mining transfers received. We 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 mayors' reelection. These results are in line with the evidence previously presented that suggests that the recent Peruvian mining boom is basically due to a price effect of the external boom in demand for minerals rather than due to 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, and 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 stories related to the production effect that explain the reduced-form results presented here[39].

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. Since Lima concentrates more than half 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, excluding the districts of 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 while in the case of the square is 0.007. The same happens for the case of 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 from the sample 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.

It is interesting to contrast the results for the case of the average transfers for the electoral cycle versus the results for the case of mining transfers in the election year. While results for the

[39] It is important to note that these results do not imply that production levels do not exert any role in the economic and social dynamics of the producer districts. It just indicates that on the political dimensions analyzed, they do not play a relevant role.

latter one are robust to various specifications, the results for the former are only significant for the simple specification in levels. This is consistent with the international evidence that suggests that transfers are more sensitive to electoral periods[40]. In that sense, it is expected that mining transfers in election years have a greater impact on the probability of mayors' reelection.

In order 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 since there is a high level of inequality in the levels of per capita transfers distributed to municipalities, as it was discussed above. Figure 8 presents the calculation of the marginal effects according to the level of mining transfers. As discussed above, the average district receives 130 soles per capita. With that level of transfers, the total marginal effect is -0.0652, a reduction of 38 % compared to the average rate of reduction in the sample of districts. The effect of mining transfers on mayors' reelection is negative for most districts except for those which receive very high levels of transfers. The turning point occurs in districts with levels of per-capita real transfers above 4,800 soles annually. For districts with these levels, mining transfers have a positive impact on the probability of mayors' reelection.

The results in Table II are in line with the theoretical framework of this study. They suggest that empirical approaches that are prevalent in the literature may fail to capture the dynamics of mining booms since they are not adequately approximating the non-monotonic nature of the phenomenon under analysis. These results contrast with the evidence in the case of the re-election of political authorities in other countries. For example, Monteiro and Ferraz (2012) find a positive impact of oil royalties on 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 done in our study, the authors did not find any effect of oil royalties 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 a positive impact (about 7%) of intergovernmental transfers on the re-election of mayors, also for the case Brazilian. However, since this study does not study variation associated with the exploitation of natural resources, it is hard to compare it with our results[41].

---

[40] Several studies in the case of Latin America provide evidence in this direction. Drazen and Eslava (2010) found increases in pre-election periods in spending associated with infrastructure projects for municipalities in Colombia. In the case of Mexico, Gonzalez (2002) finds increases in public investment in the pre-election periods and transfers in the year of the election. Sakurai and Menezes-Filho (2008) find that capital expenditures in the years prior to the election and current spending in the election year have positive impact on the probability of reelection of mayors in Brazil. Evidence exists in the same direction in the case of other countries such as Russia (Akhmedov and Zhuravskaya 2004) and Portugal (Veiga and Veiga 2007). Jones et al (2012) found positive effects of spending increases for the case of the provinces of Argentina, but they did not find that spending on election years play a special role. The evidence for the case of developed countries tends to suggest that the increase in spending or fiscal deficit prior to an election has no impact on the election or even that impact is negative. For an overview of the literature, see Eslava (2006).

[41] How to interpret the results of our paper in relation to the previously discussed studies? In both cases, there is a positive impact. According to our theoretical framework, a positive relationship exists when the elasticity between patronage spending and the probability of election for the competitor is high. We have suggested that this elasticity

6.2. Political Competition

Table III presents the results for political competition. The same specifications shown in Table II 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 DD model for the average mining transfers.

The results of the empirical exercise are in line with the findings from the previous section. In the first specification (column 1), there is not a relationship between the average mining transfer levels and the indicator of 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 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 in the district 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. In this case, for a district with a level of per-capita mining transfers similar to the average (130 soles per year), the total marginal effect is -0.8266. In relation to the average of the measure of political competition, the size of the effect is very small, about 1%. This is because levels of political competition in Peru are very high due to political fragmentation (average of 83.15 for a measure of political competition whose 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%.

As in the case of reelection, the impact of transfers is negative for most of the districts except those with very high levels of per-capita mining transfers. In particular, for districts with levels of per-capita mining transfers over 11,700 annual soles, there is a change in the sign of the effect. These districts are in the top 1% of the mining transfer distribution.

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 for the case of the level and the square of mining transfers do not change substantially. Also, in all cases the logarithm of

may depend on local government institutions. In Peru, these institutions are relatively new and there is consensus regarding institutional weakness (World Bank 2001 and Aragon et al 2008). In contrast, the Brazilian case is often used as an example of vibrant local institutions which play an important role in terms of the provision of public goods. Thus, the Brazilian case would be one in which the elasticity of patronage spending and the probability of election for the competitor is high and therefore the relationship between mining rents and reelection is positive. On the other hand, the Peruvian case is one where this elasticity has an intermediate value, and therefore the non-monotonic relationship would be expected. Of course, this explanation is just a possible one among many other ones. However, the fact that the results of our study are similar to those of Monteiro and Ferraz (2012) when a similar specification is used is very suggestive.

the real value of mineral production is not statistically significant, confirming that changes in mineral production have no impact on political competition.

In the lower panel of Table III, the results for the case of mining transfers in the election year are presented. In this case, the results are not statistically significant in any of the specifications used. This result contrasts with those found in the previous section for the case of reelection. This difference in results may be explained by the different incentives faced by political agents. On the one hand, mayors have incentives to spend more during election periods in order to influence voter's choices, which would explain why mining transfers in the election year are more sensitive to explain reelection. Moreover, political competition is more related to the incentives of local politicians, which usually have better information regarding the fiscal situation of local governments. In that sense, it is expected that the relevant information to the local politicians in terms of the decision to contest in elections is more related 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 our theoretical 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 due to the change in the level of mining revenues received by local governments and not associated with the levels of mineral production, which-as previously stated-it rule out sources of bias in estimating the causal effect of interest associated with changes in production.

Our results differ from those found by Monteiro and Ferraz (2012), the only other study that examines this issue of which we are aware. In this case, the authors find a negative impact on various measures of political competition in the short term, but this effect disappears in the medium term. Although in the case of the average district our results are similar, we found a non-monotonic pattern consistent with the theoretical literature, having districts with very high levels of mining rents more political competition[42].

6.3. Robustness Analysis for Reelection Outcomes and Political Competition

In the previous sections the basic results for the case of the central variables of interest have been presented. In this section, we explore the robustness of the results to alternative specifications. In particular, we are interested in evaluating 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

[42] The authors do not discuss the implications of this result and they only use it as evidence that are changes induced by the boom on the behavior of mayors (and not in the other local politicians) what explain the results of their work. Our work differs in that it provides a mechanism for understanding the behavior of local politicians based on a theoretical model that models the interaction between the incumbent mayor and potential competitors. In our paper, for low levels of mining rents, mayors have the ability to prevent entry because mining rents are not high enough to compensate for the opportunity cost of potential competitors. Only when mining rents are very high mining, the benefits of controlling the municipality outweigh the opportunity cost of competing in elections, leading to a positive impact of mining rents on political competition.

production (or production effect) on the levels of political competition and reelection. In the previous section, we have found that the levels of production did not play a role in explaining the impact of the mining boom, suggesting that this impact was due primarily to the rent effect. In this section, by excluding producer regions from the analysis, we eliminate any potential effect of changes in production levels, making it possible to identify the causal effect of interest more precisely.

Table IV presents the results of robustness checks. The results for the case of the average mining transfers are presented in the upper panel while in the lower panel considers transfers during the election year. In addition, columns 1-4 present results for the case of mayors' reelection while columns 5-8 do the same for the case of indicators of political competition.

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 it can be seen, for the case of average transfers, the results are significant for the level once the producer districts are excluded from the sample. Interestingly, the results for the square are not significant[43].

A different scenario occurs in the case of transfers in the election year. Compared to the basic specification of column 1, the exclusion of the producing districts makes stronger the relationship between mining transfers and mayors' reelection. The coefficients for the level and the square of the transfers are now two times the original ones (from -0.067 to -0.113 in case the level and from 0.007 to 0.015 in the case of the square). Statistical significance levels are maintained.

Column 3 presents the results of a specification in which producer districts are excluded and the analysis has been restricted to the producer regions. The analysis does not consider the non-producing regions to construct the counterfactual. The results are not substantially modified in terms of magnitude of the coefficients as well as levels of statistical significance. The same occurs in column 4, where the analysis focuses on the 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 the election year are more sensitive to explain changes in the probability of mayors' reelection. The evidence in this section suggests that these results are robust to the exclusion of the producer districts. In the case of average transfers, the previous section found that these transfers had no impact on reelection, but in this section we find that there is a negative linear relationship, although the statistical significance is weakened in the specification that excludes producer districts in producer provinces.

Columns 5, 6, 7 and 8 present the results of the analysis for the case of the political competition indicator. Overall, the results are weaker than in the case of reelection. For example, the results of the column 6 for the case of the average transfer are essentially the same for the case

[43] Since producer districts receive on average higher levels of mining transfers, it is not surprising that their exclusion explain the loss of significance of the coefficient associated to the square of the transfers.

of the level of the transfer (coefficient of -0.922, significant at 10% confidence), but is not the same for the square. When producer districts are excluded, the relationship is no longer significant, although when the analysis focuses on the producer provinces (column 8) the coefficient associated with the level of transfer is again significant (coefficient -1.250, significant at the confidence level of 5%). The results for the case of transfers during the election year are not statistically significant in any of the employed specifications.

6.4. Instrumental Variables Results for Reelection Outcomes

In this section we discuss the results of the IV approach. As mentioned above, there is a concern regarding the fact that some of the variability in mining transfers may be endogenous. The source of exogenous variation in this study is the movement of international prices of mineral resources along the set of rules for mining transfer allocation across local governments. This variation in prices explains the variability in mining transfers and therefore can be exploited to identify the causal effect of interest. However, it is possible that the variation in prices has also affected the levels of production of mining companies and therefore it might have influenced by other mechanisms -besides mining rents- the political outcomes of interest. In previous sections we have found that production levels do not directly impact the electoral results. Furthermore, it has been found that the results are not substantially altered when producer districts are excluded from the analysis, which reinforces the idea that changes in production levels have a marginal role in explaining the political variables under study. In this section, we use the IV technique in order to provide additional evidence on the robustness of the basic results of this paper.

Mining transfers may be endogenous for the reasons indicated in the previous paragraph, although the evidence we have found so far suggests that endogeneity problems -if they exist- should play a 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 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 Section 5. Then, using the Nevo and Rosen's (2012) proposal, we evaluate the sensitivity of our results.

Table V presents the results of analysis. Column 1 in the upper panel shows the results of the preferred specification as reference. Column 2 presents the results of IV using mining canon transfers as instrument. As it is shown, the results are essentially similar to the DD specification in terms of magnitude and statistical significance (coefficient of -0.076, significant at a confidence level of 1%). If this were a perfect instrument, this result would suggest that the bias of the DD design is marginal[44].

To assess the sensitivity of this result, we implement the methodology developed by Nevo and Rosen (2012). Columns 3-7 present the results for different values of the parameter λ. This parameter allows a level of association between imperfect instrument and the unobservables from

[44] It is important to remember that, under a design difference in difference, it is assumed that mining transfers are exogenous.

the main equation. Given the evidence discussed previously, it is expected that the estimated coefficients do not vary substantially because production levels do not exert a role in explaining the political outcomes. The results are in line with these expectations. For example, if we assume a low level of correlation between unobservables and the imperfect instrument ($\lambda = 1$ in column 3), it is found that 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 for 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 as an imperfect instrument is quite robust since 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 so high, so despite assuming high levels of correlation we still obtain small changes 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 lower panels of Table V present the first stage for the level and the square of the mining Canon instrument. Column 2 presents the results for the imperfect instrument. The association between imperfect instrument (mining Canon) and the endogenous variable (mining transfers) is very strong in the case of the variable in levels, as evidenced by the levels of statistical significance of the coefficient associated with the instrument (statistically significant at 1 %) and the F test for the first stage (F = 1.644), which is well above the empirical value usually used in the literature (F = 10)[45]. This result rules out the existence of a weak instruments problem. The same applies for the case of the square of mining Canon (F = 64.83).

Columns 3 to 7 of the lower panels show the first stage to the function $V(\lambda)$ and its square for each value of λ used. The patterns are in line with the estimate in column 3. There is no evidence for weak instruments for the relevant values of λ.

The results for the case of political competition are essentially the same. For this reason, they are not discussed here, but are available in Online Appendix II.

6.5. Provision of Public Goods

In previous sections, the impact of mining transfers on political competition and reelection of local authorities were discussed. The evidence is in line with the theoretical framework which suggests that the relationship between mining transfers and political outcomes is non-monotonic.

---

[45] This empirical rule was proposed by Stock, Wright and Yogo (2002). Murray (2010) discusses the strategies available to deal with weak instruments.

In this section, we study how mining transfers affect mayors' incentives to provide public goods. Table VI 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). The upper panel shows the results of the DD design while the lower one the IV estimates. Since in terms of magnitude and statistical significance, the results of both econometric techniques are essentially the same, we only discuss the estimates for the DD model.

The evidence is consistent with our previous findings, with some exceptions. For example, we estimate a non-monotonic relationship between access to public lighting, garbage collection and access to security services. Although the sign of the coefficients for the case of contracted security personnel and number of police stations per 1,000 inhabitants is in line with expectations, they lack of statistical significance, suggesting that for these variables the relationship is essentially linear. We did not find any relationship between mining transfers and access to potable water or access to libraries[46].

In line with previous evidence, we find that the level of mineral production have 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). This result can be explained as a result of the "Mining Program of Solidarity with the People" implemented during the second government of Alan García (2006-2011). The construction and implementation of libraries was one of the investments that mining companies privileged during this period (2006-2010)[47].

Our results contrast with the existing literature. Caselli and Micheals (2013) study the impact of oil royalties on the provision of housing, urban services, infrastructure as well as educational and health inputs. The authors found no impact, except for some educational dimensions, although these results were not robust in most cases. Monteiro and Ferraz (2012) found similar results using a different dataset and research design. Arellano (2011b) presents previous evidence for Peru going in the same direction. Using census data from 1993 and 2007, the author studies the impact of mining Canon on changes in the percentage of people between 15 and 24 who finish high school, the percentage of households with sanitary facilities, potable water and electricity supply using propensity-score matching. In all the above indicators, except in case of electricity supply, there is no impact.

While in previous work, the lack of impact was considered a "puzzle", in our work these results are consistent with our theoretical framework. Although it is hard to make a comparative

[46] In the case of access to potable water, it is important to note that qualitative evidence indicates that this is a priority by the population (Arellano 2011b). The absence of an impact in this direction could be explained by the technical complexity of these projects and the rules of the system of public investment that requires the formulation of public investment projects that are technically and financially viable. In smaller towns, these conditions are hardly met. In addition, as discussed below, the political cycle matters since these are projects which longer horizons and thus are not electorally profitable for mayors.

[47] For example, Yanacocha invested in implementing libraries in 184 educational institutions between 2007 and 2008 Cajamarca. See SASE (2012).

analysis in this regard[48], our results call into question the common sense that had been established regarding the lack of impact of natural resource booms 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. We return to this point later.

In short, the provision of public goods experienced a non-monotonic dynamics. For most districts, there was an increase in the provision of local public goods but for those with extraordinary levels of mining revenues the impact was moderated if no zero. This result is consistent and it is in line with the theoretical framework of this study.

6.6. Local Infrastructure

In this section we study the relationship between the mining boom and local infrastructure. Given data limitations, in this section we focus on infrastructure related to health, sports and transportation. Tables VII and VIII summarize the findings. Similarly to the previous section, we discuss only the results of the DD design given the similarity of the results with those obtained by the IV design.

Columns 1-4 present the results for the case of health infrastructure. We do not find evidence that the mining boom has any connection with the construction of hospitals, health centers and polyclinics. We do find a nonlinear relationship between mining transfers and the availability of basic health infrastructure, although the impact is very modest in absolute terms (0.007 units per thousand inhabitants for the district with average level of mining transfers).

These results contrast with the case of the sports infrastructure (columns 5-8). The mining boom is associated in a non-monotonic way with a greater availability of stadiums, multipurpose, soccer and basketball fields. No evidence is found in terms of a relationship between the mining boom and the availability of gyms and volleyball fields.

Why mayors seem to favor sports infrastructure over health infrastructure? There are several ways to answer the previous question. On the one hand, one could argue that the decisions of mayors in relation to the type of infrastructure to build simply reflect voter preferences. However, qualitative evidence indicates that the inhabitants of these areas have more preferences for health infrastructure as evidenced by the results of participatory budgeting[49]. A more complex explanation would emphasize the nature of the production function of public goods. Since mayors have reelection incentives and voters favor private over public goods, mayors have a basic preference for the construction of infrastructure that is intensive unskilled work. In that sense, it is

[48] Countries differ in terms of public goods that are under the responsibility of local governments. In the Peruvian case, there is also 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 are the responsibility of local governments, in the case of Peru such provision is shared, playing the central government a more important role in this regard.

[49] Qualitative evidence on this issue has been collected by several studies. See for example, Gil (2009) and Arellano (2011b).

more profitable from an electoral point of view to build sport fields against hospitals, which will require more skilled labor and special equipment[50].

Table VIII presents the results for the case of the mining boom impact on road construction in terms of cost and quantity. Columns 1-6 show the results for the case of the amount built. There is only evidence of an increase in per-capita square meters of constructed roads, although the relationship is only linear. All other variables that recover the construction of roads, sidewalks and rural roads do not show a statistically significant relationship with mining transfers.

Columns 7-12 show increases in costs assumed by local governments for the construction and repair of roads, sidewalks and rural roads. In this case, we found a nonlinear relationship between mining transfers and the construction and repair of roads, and a linear effect in the case of rural roads built and sidewalks repaired. The case of the cost of rural roads constructed is interesting since the results for the level are not statistically significant even when the square it is. However, the results of the IV design show the expected signs, suggesting that it was just a marginally non-significant result.

6.7. Clientelism

In the previous section, we studied the relationship between mining transfers and the provision of public goods and local infrastructure. An alternative strategy used by local politicians to influence the election results is through the use of public employment. This mechanism has been emphasized in the literature by works such as Robinson et al (2006) and Robinson and Verdier (2013). In this section we analyze the impact of mining transfers on public employment by contract type (Table IX) and human capital level (Table X).

Table IX considers three types of public officials according to the type of contracts they have: Appointees; those who have some type of medium-term contract; and temporary employees, are considered[51]. This last category adds different types of temporary contracts established by the Peruvian government, such as non-personal services (SNP) and administrative service contracts (CAS), during the reference period of the study, although they differ in terms of social rights granted to workers[52]. Also, we focus on three econometric specifications. First, we include the

[50] For example, in 2010 a survey conducted by the project "Improving Municipal Investment" in the district of San Marcos (where Antamina, one of the largest mines in the country, operates) showed that 60% of the population identified access to safe drinking water as the main problem of the community followed by health (10%). However, that same year the local government of San Marcos invested only 13% of its budget on sanitation and only 1.3% in health. The main investment in that year was the construction of community centers. For details, see MIM (2011).

[51] The legal framework distinguishes between municipal officials and employees, which are governed by the Basic Law on the Civil Service and Public Sector Remuneration (Legislative Decree 276) - and blue collar workers are in the private sector labor regime under Law of Productivity and Competitiveness (Legislative Decree 728). Municipal officials include elected officials and managers or trusted personnel. The appointed public servants are part of the civil service of the state and have a set of rights that include training, job stability and job progression. Public servants with contracts do not have the rights associated with administrative career. For a detailed discussion on the subject, see Castro Pozo (2012).

[52] Temporary contracts in the public sector evolved during the period under study. From 1996 to 2008, SNP contracts prevailed, which did not guarantee any rights to workers. In 2008, the CAS contract was introduced in order to formalize the staff hired by the state under temporal modalities and to ensure a set of basic rights. Since our analysis

specification in levels without including controls for the level of mining production in the district. The second specification includes the quadratic component and production levels to finally add a specification that excludes producer districts.

Evidence suggests that the number of employees per 1,000 inhabitants increased with the level of mining transfers. This applies to both hired and appointed officials as well as the case of temporary workers, although the percentual change differs. Specifically, there was an increase of 0.10 appointees per 1,000 residents per 1,000 nuevos soles from per-capita transfer (Column 1, Table IX). This increase is 2.56 for the case of employees with contracts (column 4, Table IX) and 0.63 in the case of temporary employees (column 7, Table IX). This increase is 2.56 for the case of employees with contracts (column 4, Table IX) and 0.63 in the case of temporary employees (column 7, Table IX).

Unlike the previous sections, the evidence of non-monotonic effects is weaker. In the case of appointed officials, the coefficient associated to the square of the transfers is negative but not statistically significant. The coefficient for the level is still significant but only for a confidence level of 90% (Column 2, Table IX). For employees with contracts, the quadratic model is not significant (column 5, Table IX). Only in the case of temporary employees the non-monotonic relationship is consistent with previous results (column 8, Table IX). This result is interesting, since it is acknowledged that temporary jobs are more sensitive to the political cycle and they are a typical instrument used by politicians to influence the outcome of election. For this reason, the statistical evidence on the nonlinear relationship between mining transfers and temporary employment suggests that the existing political dynamics in regions rich in minerals is consistent with our theoretical framework.

Results vary slightly when producer regions are excluded from the analysis. No effects are found for the case of appointed officials (Column 3, Table IX), but the non-monotonic relationship is present in the case of employees with contract (Column 6, Table IX). Finally, we find that the levels of transfers affect the level of temporary employment, although this is not confirmed in the case of the square.

Table X presents the results for the case of an analysis by type of employees. Five types of employees are considered: Municipal officials, professionals, technicians, security workers and porters. For each of them we 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 for 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 per -capita soles of mining transfers for the case of districts with average levels of per-

period ends in 2010, it has little relevance in terms of the results of the study to make a distinction between temporary contracts. Therefore, we add all temporary workers into one category.

capita transfer (Column 1, Table X). Since the number of officers per 1,000 inhabitants is 0.59, this effect is important. For the case of 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 in order 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 sign of the coefficients as in the previous case, except for professionals and technicians.

These results provide substantial evidence regarding the political dynamics in regions benefited from mining transfers with respect to the use of public employment for electoral purposes[53]. On the one hand, it is evident that the greater variability is caused by the use of temporary workers. On the other hand, the non-monotonic pattern suggested by the theoretical framework is confirmed. This result is consistent for different types of workers.

Our results contrasts with the ones by Monteiro and Ferraz (2012). These authors estimate an increase of 7 employees per 1,000 inhabitants for the Brazilian case. They do not find evidence that the oil boom has increased the proportion of public employees with higher education or contract. Our econometric results suggest a more complex panorama. Thus, an increase in public employment for recipient districts is observed, but this effect is attenuated and even goes in the opposite direction in the case of districts with very high levels of mineral rents. This pattern is consistent with our theoretical framework. It also provides evidence consistent with the emphasis made by Robinson et al (2006) regarding the use of public employment as the main tool used by politicians to gain electoral support, with the difference that the relationship is not monotonic rather than linear.

6.8. Local Government Expenditures

In this section, we analyze the impact of mining transfers on local government expenditures. The goal is to understand how local governments spend mining rents using different spending categories. The results for the preferred specification for eight different spending categories (including payroll, pensions, goods and services, other current expenditure, investment financing, other capital expenditures and debt) are presented in Table XI.

We find the proposed non-monotonic relationship between mining rents and three types of expenditures: goods and services, investment and other capital expenditures. Since mining rents are required by law to be used as public investment, these results are not surprising. In the case of

[53] Although the current legal framework prohibits the use of Canon 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 without violating restrictions imposed by law. Using qualitative methods (interviews and field visits), specialists in the field of sociology have documented the increased of temporary public employment and wages in districts that experienced a substantial increase in their budgets due to the mineral price boom (Arellano 2008 2011b). For example, Arellano (2011b) finds that several mineral-rich municipalities diverted resources from investment projects financed by the mining Canon to pay salaries of municipal officials using a spending category called "institutional strengthening".

investment, the effect is an increase of 845 nuevos soles in investment for each 1,000 soles of mining transfers for the case of the average district in the sample. This amount is 109 and 9 nuevos soles for the case of goods and services and other capital expenditures respectively.

Table XII presents results of the impact of mining transfers on functional expenditures. We consider the nine most important functions of local government in Peru. We find a pattern consistent with the non-monotonic relationship suggested by the theoretical framework. All the coefficients for the level and the square of mining transfers are strongly statistically significant for almost all the expenditures categories studied with the exception of “Health and sanitation” in which case the coefficient for the square is not statistically significant.

The type of expenditure most affected by mining transfers is “Transport”, which is again consistent with the current legal framework that favors investment in infrastructure. This type of expenditure has also other economic and political properties that convert it in one of the most attractive use of mining revenues. It is usually associated to construction and maintenance of roads and sidewalks, which is highly intensive in low-skilled labor, being a common way politicians use in order to get political support from citizens. It also has the advantage of serving as a signal for politicians to show citizens their quality[54].

To gauge an idea about the net effect of mining transfers on transport expenditures, we proceed in the same way as above. The average municipality experienced an increase of about 250 nuevos soles in transport expenditures for each 1,000 nuevos soles of mining transfers. Besides “Transport”, “Planning” and “Agriculture” are the expenditures categories more benefited from the resource windfall. According to Arellano (2011), the increase in “Agriculture” can be explained by the interest of local politicians to compensate citizens from rural areas for the potential negative effects of mining activity. It usually takes the form of irrigation projects, seed distribution or similar programs.

6.9. Welfare Outcomes

We have studied the impact of a mineral resource boom on politician behavior and the use of public good provision and public employment as instruments to influence electoral outcomes. We now turn to the issue of the welfare effects of the mineral resource boom.

Table XIII analyzes the impact of the natural resource boom on income and consumption per-capita. We consider the basic specifications of Table II. The upper panel presents the IV results for the case of monthly household income per-capita whereas the lower panel the evidence for the case of monthly household consumption per-capita. Both measures are expressed in real terms using prices of Lima in 2001. We consider these two measures together since they are supposed to recover different aspects of welfare. In particular, consumption is believed to provide a better

---

[54] 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 in working age." The program set a higher wage almost 4 times the agricultural wage (10 soles) in exchange for maintenance of basic infrastructure such as roads cleaning, maintenance of unpaved roads, construction of retaining walls, among others. According to Salas, the implementation of this program was effective to avoid the impeachment of the mayor.

measure of long-term well-being whereas income is better measure of short-term changes in welfare. Since most of the impact of the recent mineral boom can be assessed only in the short-term, income seems to be a good candidate in the context of this paper but it is important to note that there is an old debate regarding whether income or consumption is the best measure of welfare (see, for instance, Hentschel and Lanjouw 1996, Blundell and Presston 1998 and Deaton 1997 for a discussion).

We start by discussing the results about household income. Column 1 of Table XIII reports the results in levels. We estimate an average increase of 32 nuevos soles per-capita for each 1,000 nuevos soles 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 average municipality, this implies an average increase of 95 nuevos soles for each 1,000 nuevos soles. The results are consistent with our theoretical 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 household per-capita real 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 our 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.

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. Since consumption is a measure of long-term welfare, it is not surprising that we find no effect in this case. Taking together, these results suggest that there is a positive short-term effect of the mineral resource boom on well-being in the Peruvian case.

Our results contrast with those of the existing literature. For the Brazilian case, Caselli and Micheals (2013) do not find impact of the oil boom on per-capita household income, although some very weak evidence of impacts in the bottom quintile of the income distribution (10 per cent real per-capita). For the Peruvian case, Loayza et al (2013) find positive impacts of mining on household welfare but these are not explained by the mining transfers but by mineral production[55].

[55] There are many reasons why our results differ from those obtained by Loayza et al (2013). The first has to do with the identification strategy. These authors use different counterfactuals to evaluate the impact of the mining boom. While their identification strategy is based on the comparison between producers and non-producers districts with cross-sectional data (supplemented with a set of identification tests based on the assessment of differences in pre-boom socio-economic characteristics between producers and non-producers), our empirical strategy uses panel data, which has the advantage of controlling for all economic and institutional factors that do not vary over time and that are unique to each district. The authors also instrumented mining Canon with mineral production, which are potentially endogenous to price changes, which calls into question their causal interpretation for exogeneity in the econometric analysis. Additionally, the sample in our study covers the period 1998-2010 while Loayza et al (2013) studied the period 2002-2006, relatively short to find impacts of mining transfers on welfare. Finally, there are differences in terms of the type of information used in the analysis. While Loayza et al (2013) combine census data with household

This result is also found by Aragon and Rud (2013) for the case of Cajamarca, a northern Peruvian region. They found in a robustness test that mining Canon has no explanatory role in the increases in real income for households located close to the Yanacocha mine[56].

6.10. Electoral Conflict

We conclude this section analyzing the impact of the resource boom on electoral conflict. So far, we have paid attention to political impacts that are mediated by the electoral rules and political institutions. However, it is common in developing countries that formal democratic rules are challenged when electoral results are not in line with the interest of *de facto* political powers. Political conflict is the natural consequence in a weakly institutionalized political environment[57].

Table XIV presents the results. The dependent variable is a dummy equal to one if the district experienced at least some conflict during an electoral period. These activities typically include destruction of property, assaults on ONPE's staff and board members, invasion and/or destruction of polling stations, destruction of electoral materials, among others. We concentrate on the electoral conflict because of its political nature, which is distinguished from the socio-environmental conflicts related to mining which have been widely studied by other authors and that have regularly captured the attention of the media and public opinion. The advantage of this approach is that it allows to evaluate the conflict directly associated with the control of mining revenues which has received less attention from the empirical literature.

The results in Table XIV follows the same format as those presented in Table II. Column 1 of the top panel of Table XIV presents the results in levels for the case of the DD design. As noted, there is not an impact of mining transfers on electoral conflict. However, when the quadratic specification is considered, both the coefficients for the level to the square of mining transfers become statistically significant (Column 2). The coefficient is positive for the level and negative in the case of the square of transfers which suggests that mining rents are positively associated with electoral conflict, except in the case of districts with unusually high levels of mining transfers. The results did not change when controlling for levels of mineral production (Column 3). In line with the previous evidence, production levels have no direct influence on the electoral conflict, which is consistent with the political nature of this type of phenomenon and confirms the soundness of our research strategy.

The results reported in columns (4), (5) and (6) provide additional evidence of the robustness of the empirical exercise. The coefficients of our preferred specification (3) are robust

---

surveys to impute expenditure at the district level, this paper uses data from a pseudo-panel of households built from the ENAHO for the period under analysis. The use of imputation techniques, developed by experts from the World Bank, has been widely criticized by experts like Angus Deaton (see Banerjee et al 2006 for criticism and Lanjouw and Ravallion 2006 for a defense).

[56] The basic difference of this paper with our paper has to do with the scope of the study. The authors use a (somewhat) similar empirical approach but their study is limited to neighboring provinces of the Yanacocha mine in Cajamarca. Their period of analysis covers years 1997-2006, which could underestimate the impact of mining Canon since this started to grow exponentially from 2004-2005.

[57] Theoretical models that analyze the choice between democratic rules and political violence are scarce. To the best of our knowledge, Aslaksen and Torvik (2006) is the only one that explores the issue for resource-rich countries.

to the exclusion of Lima, non-producer regions and non-producer provinces. Also, mineral production levels are not significant in any of the above specifications. The results using instrumental variables are essentially the same as in the case of DD, which are not discussed in detail here.

The above results suggest that the political conflict follows the same non-monotonic pattern found in the previous sections. For low levels of mining rents, there is a positive relationship between conflict and mining transfers. The relationship changes direction only for the case of districts with unusually high levels of mining transfers. For the average mining district in terms of mining rents, the effect is positive.

The conflict associated with the electoral process can be interpreted as a form of non-institutionalized competition for power. For the average district, higher levels of mining revenues are associated with the use of this type of violence. Local politicians are less willing to peacefully accept the election results when there are higher levels of mining rents for the case of the average district. The use of violence implies an important deterioration in the acceptance of the institutional rules governing the transfer of political power.

7. Discussion of Results

The recent literature that analyzes the role of natural resources on development using econometric strategies that provide a credible identification of the causal effect of interest is relatively new and small, and is therefore relatively little is known about the phenomenon of interest. 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 2011b and Loayza et al 2013) and the cultivation of the coca leaf (Angrist and Krueger 2008, Dube and Vargas 2013). Other authors have studied the impact of unexpected increases in fiscal resources (Brollo et al 2013).

Although there is no systematic evidence about it, 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 welfare should be more linked to the mining rent. An exception would be the artisanal gold production in parts of the Peruvian jungle, which is characterized by labor-intensive and therefore capable of directly impact on household welfare through market mechanisms. The dramatic decline in poverty levels in this region may be associated with this characteristic[58].

Similarly with the case of 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

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

an increase in self-employment income and the probability of employment in rural areas of Colombia, as documented Angrist and Kluger (2008). Moreover, the authors also document an expansion of male youth labor supply.

It is much more difficult to interpret the results of Brollo et al (2013) if we consider 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. From this depends, in our view, that 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 without these are associated with the exploitation of any natural resource. Hence, it is difficult to interpret this source of variation as a case of "resource curse".

Finally, it is important to note that although we have found increases in the provision of public goods and gains in living standards, these changes are relatively modest compared to the magnitude of the boom. This leads to ask the question about the use of mining transfers. We have documented increases in public employment and the expansion of local infrastructure based on unskilled labor, which constitute an unproductive use of mining transfers but with high political returns[59]. Additionally, we should consider the corruption of political authorities and local officials as suggested by Maldonado (2011), which has been widely documented by the local press[60]. The combination of perverse political incentives with low local institutional capacity would allow us to understand why the impacts of the mining boom are modest relative to the magnitude of the increase observed mining rents in the last decade.

8. Concluding Remarks

In this paper we have studied the way in which a mineral resources boom has affected the incentives of local politicians as well as their implications in terms of provision of public goods, clientelism and welfare of citizens. Despite the recent emphasis given by the some new scholarship about the resource curse on novel identification strategies to estimate the impact of resource booms on political and economic outcomes, there is still a lot of work to do in terms of providing credible

[59] The press has emphasized the misuse of mining transfers showing the proliferation of white elephants and magnificent buildings in mineral-rich regions. Thus, for example, it has been documented the construction of stadiums with capacity greater than the population of the district (in Yarabamba, Arequipa, three stadiums were built, the largest with capacity of 3,000 for a population of 1,200 habitants), construction/repair of main squares, and construction of exotic monuments honoring the soccer referee in Tumbes, the maca in Junin, the hat in Cajamarca, the lizard in Tumbes, just to mention some examples. Beyond the eccentricity of the buildings, the fact is that the use of mining transfers in this way has a high political returns as it allows to redistribute resources through public employment for electoral purposes in public investment projects based on unskilled labor, which it is perfectly rational from the perspective of the mayors.

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

causal estimates about this relationship. More importantly, it is little what we know regarding the mechanisms that explain it. In particular, there is an empirical puzzle in the current literature related to the impact of resource booms on citizen's well-being. Most of the existing papers fail to detect impacts on household welfare and public good provision. This is hard to believe given the large amounts of rents created due to the spectacular rise of international prices. This empirical failure may be just reflecting our poor understanding of the phenomenon.

An adaptation model of Caselli (2006) provides –in our view- a simple framework for understanding this phenomenon. This theoretical framework studies the interaction between incumbent mayor and a potential competitor to decide whether to engage in industrial production or political activity competing in elections. In the presence of a resource boom, the mayor has more fiscal resources to provide more public goods or larger spending on patronage. However, he also faces more competition because the value of being mayor is higher. The mayor can expand the provision of public goods and patronage spending to prevent the entry of competitors and increase its electoral support, but it is limited by the institutional capacity of local government. If mining rents levels are too high, the mayor may not provide a level of public goods and patronage spending to discourage entry into electoral competition by the potential competitor. As a result, his optimal response is to underinvest in public goods. Thus, the model highlights the non-monotonic responses associated to a resource boom.

We found a reduction in the probability of re-election (38% for each 1,000 nuevos soles per-capita mining transfers) and the level of political competition (4.9% for each 1,000 nuevos soles per-capita mining transfers) for districts with average levels of mining transfers, but positive effects for the case of extremely rich in mineral resources districts (over 5,000 nuevos soles per capita). These results are robust to the inclusion of mining production and maintained for different sub-samples. Also, when producer districts are excluded from the sample, the results do not change substantially. To assess the validity of the exclusion restriction of the instrumental variables design, Nevo and Rosen's (2012) bounds were estimated and it was found that-even if significant deviations from the exclusion restriction are allowed- the basic results of the study are not altered.

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 welfare of the citizens. We found an increase in provision of public goods, public employment and short-term increases in household welfare (proxied by household income) for the average municipality, although these effects are relatively modest compared with the large influx of fiscal resources distributed as mining Canon and mining royalties to local governments in resource-rich regions. In line with the theoretical framework, the relationship between public goods, welfare and electoral conflict 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 of a more careful approach to study the impact of resource abundance since we show that the use of linear approximations can seriously underestimate its true impact on the political and economic dimensions usually discussed in the literature. Even worse, it can be even possible to be unable to detect any impact, as we have shown for several of the dimensions analyzed. We believe this is one of the most important contributions of this paper.

These results are also relevant for policy makers interested in the design of intergovernmental transfer schemes. The large influx of transfers associated with unexpected movements in international prices can create perverse incentives among local politicians. The increase in temporary public employment as an electoral strategy has been widely documented in qualitative research from case studies (Arellano Salas 2011b and 2010) and confirmed in our quantitative analysis, taking into account the already noted differences. This creates concern about the ability of municipalities in mineral-rich areas to respond to citizen demands.

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

9. References

Akhmedov, A. and K. Zhuravskaya. 2004. "Opportunistic political cycles: Test in a young democracy setting." *Quarterly Journal of Economics*, 119(4), pp.1301-1338.

Angrist, J. and G. Imbens. 1995. "Two-stage least square estimation of average causal effects in models with variable treatment intensity." *Journal of the American Statistical Association*, 90, pp. 431-442.

Angrist, J; G. Imbens and D. Rubin. 1996. "Identification of causal effects using instrumental variables." *Journal of the American Statistical Association*, 91, pp. 444-455.

Angrist, J. and A. Kluger. 2008. "Resource windfall or a new resource curse? Coca, income and civil conflict in Colombia." *Review of Economics and Statistics*, 90, pp.191-215.

Angrist, Joshua and J.S. Pischke. 2009. *Mostly Harmless Econometrics: An empiricist's companion.* Princeton University Press. New Jersey.

Aragon, Fernando and Juan Rud. 2013. "Natural resources and local communities: Evidence from a Peruvian gold mine". *American Economic Journal: Economic Policy*, 5, pp.1-25.

Aragon, F. and C. Casas. 2008. "Local governments' capacity and performance: Evidence from Peruvian municipalities." Unpublished manuscript. LSE

Arellano, Javier. 2011a. "Aggravating the resource curse: Decentralization, mining and conflict in Peru." *Journal of Development* Studies, 47, pp.617-638.

Arellano, Javier. 2011b. *¿Minería sin fronteras? Conflicto y desarrollo en regiones mineras del Perú*. Instituto de Estudios Peruanos. Lima.

Aslaksen, S. and R. Torvik. 2006. "A theory of civil conflict and democracy in rentier states." *Scandinavian Journal of Economics*, 108, pp.571-585.

Banerjee, A; A. Deaton, N. Lustig, and K. Rogoff. 2006. "An evaluation of World Bank research, 1998-2005." The World Bank. Washington, DC.

Bardhan, P. and T. Yang. 2004. "Political competition in economic perspective." BREAD working paper 078.

Barrantes, R; M. Tanaka, S. Vera and M. Perez-Leon. 2010. "El boom de los recursos naturales y las coaliciones presupuestarias. Una ilustración del caso peruano." Manuscrito no publicado. Instituto de Estudios Peruanos. Lima.

Bebbington, Anthony (editor). 2013. *Industrias extractivas, conflicto social y dinámicas institucionales en la región andina*. Instituto de Estudios Peruanos. Lima.

Bertrand, M; E. Duflo and S. Mullainathan. 2004. "How much should we trust differences-in-differences estimates?" *Quarterly Journal of Economics*, 119, pp. 249-275.

Bensa, Jessica. 2002. "El sistema electoral subnacional en Perú y Chile entre 1980 y 2002." *Elecciones*, 1, pp.81-122. Oficina Nacional de Procesos Electorales. Lima.

Brollo, F; T. Nannicini, R. Perotti and G. Tabellini. 2013. "The political resource curse." *American Economic Review*, 103, pp.1759-1796.

Blundell, R. and I. Preston. 1998. "Consumption inequality and income uncertainty." *Quarterly Journal of Economics*, 113, pp.603-640.

Cameron, Colin; Jonah Gelbach and Douglass Miller. 2007. "Bootstrap-based improvements for inference with clustered errors". NBER technical working paper series 344. Cambridge.

Cameron, A. Colin and Pravin Trivedi. 2005. *Microeconometrics*. Cambridge University Press.

Canavire-Bacarreza, G; J. Martinez-Vazquez and J. Sepulveda. 2012. "Subnational revenue mobilization in Peru." IDB working paper series 299. Washington, DC.

Carrion, Ana. 2004. "Participación ciudadana y descentralización en el Perú." Unpublished manuscript.

Caselli, F. 2006. "Power struggles and the natural resource curse." Unpublished manuscript. LSE.

Caselli, F. and T. Cunningham. 2009. "Leader behavior and the natural resource curse". *Oxford Economic Papers*, 61, pp.628-650.

Caselli, F. and A. Tesei. 2011. "Resource windfalls, political regimes and political stability." Unpublished manuscript. LSE.

Caselli, F. and G. Micheals. 2013. "Do oil windfalls improve living standards? Evidence from Brazil." *American Economic Journal: Applied Economics*, 5, pp.208-238.

Castro Pozo, Hildebrando. 2012. "Guía de los regímenes laborales y de servicios en las municipalidades". Municipio al Día. Disponible en:

http://www.municipioaldia.com/guia_de_los_regimenes_laborales_y_servicios_en_las_municipalidades.html#.U-8nG_ldU00

Dalgaard, C. and O. Olsson. 2008. "Windfall gains, political economy and economic development." *Journal of African Economics*, 17, pp.72-109.

Dammert, A. and F. Molinelli. 2007. *Panorama de la Minería en el Perú*. OSINERGMIN. Lima.

Dancourt, Oscar. 1999. "Neoliberal reforms and macroeconomic policy in Peru". *CEPAL Review*, 67, April, pp. 51-73. Santiago.

Deacon, Robert. 2011. "The political economy of the natural resource curse: A survey of theory and evidence." *Foundations and Trends in Microeconomics*, 7(2), pp.111-208.

Deaton, Angus. 1997. *The Analysis of Household Surveys: A Microeconometric Approach to Development Policy*. The World Bank. Washington, DC.

Dell, Melissa. 2010. "The persistent effects of Peru's mining Mita." *Econometrica*, 78 (6), pp.1863-1903.

Drazen A. and M. Eslava. 2010. "Electoral manipulation via voter-friendly spending: Theory and evidence." *Journal of Development Economics*, 92, 39-52.

Dube, O. and J. Vargas. 2013. "Commodity price shocks and civil conflict: Evidence from Colombia". *Review of Economic* Studies, 80, pp.1384-1421.

De Echave, J; A. Diez, L. Huber, B. Revesz, X. Ricard, and M. Tanaka. 2009. *Minería y Conflicto Social*. Instituto de Estudios Peruanos, Centro de Investigación y Promoción del Campesinado, Centro Bartolomé de las Casas, Consorcio de Investigación Económica y Social. Lima.

Eslava, Marcela. 2006. "The political economy of fiscal policy: survey." IADB Research Department working paper 583. Washington, DC.

Frenkel, Jeffrey. 2008. "Falling interest rates explain rising commodity prices" Available at: http://content.ksg.harvard.edu/blog/jeff_frankels_weblog/2008/03/17/falling-interest-rates-explain-rising-commodity-prices/

Frenkel, Jeffrey. 2010. "The natural resource curse: A survey". NBER working paper 15836.

Gil, Vladimir. 2009. *Aterrizaje minero. Cultura, conflicto, negociaciones y lecciones para el desarrollo desde la minería de Ancash, Perú*. Instituto de Estudios Peruanos. Lima.

Glave, M. and J. Kuramoto. 2002. "Minería, minerales y desarrollo sustentable en Perú." En: Equipo MMSD América del Sur (editor). *Minería, Minerales y Desarrollo Sustentable en América del Sur*. CIPMA y IDRC. Montevideo.

Gonzalez, M. 2002. "Do changes in democracy affect the political budget cycle? Evidence from Mexico." *Review of Development Economics*, 6(2), pp.204-224.

Haber, S. and V. Menaldo. 2011. "Do natural resources fuel authoritarianism? A reappraisal of the resource curse." *American Political Science Review*, 105, pp.1-26.

Hansen, Christian. 2007. "Generalized least squares inference in panel and multilevel models with serial correlation and fixed effects." *Journal of Econometrics,* Vol. 140, pp. 670-694.

Heckman, James. 1997. "Instrumental variables: A study of implicit behavioral assumptions in one widely used estimator." *Journal of Human Resources*, 32, pp. 441-462.

Hentschel, J. and P. Lanjouw. 1996. "Constructing an indicator of consumption for the analysis of poverty." World Bank Living Standard Measurement Study 124. World Bank. Washington, DC.

INEI. 1999. *Perú: Estimaciones de Población por Departamentos, Provincias, Distritos, 1995-2000*. Instituto Nacional de Estadística e Informática. Lima.

INEI. 2009. *Perú: Estimaciones y Proyecciones de Población por Sexo segun Departamento, Provincia, y Distrito, 2000-2015*. Instituto Nacional de Estadística e Informática. Lima.

INEI. 2011. *Perú: Perfil de la Pobreza por departamentos, 2001-2010*. Instituto Nacional de Estadística e Informática. Lima.

Imbens, G. and J. Angrist. 1994. "Identification and estimation of local average treatment effects." *Econometrica*, 62, pp. 467-475.

Imbens, Guido and Jeffrey Wooldridge. 2009. "Recent developments in the econometrics of program evaluation." *Journal of Economic Literature*, XLVII, pp.5-86.

Jensen, N. and L. Wantchekon. 2004. "Resource wealth and political regimes in Africa." *Comparative Political Studies*, 37(7), pp.816-841.

Jones, M; O. Meloni and M. Tommasi. 2012. "Voters as fiscal liberals: Incentives and accountability in federal systems." *Economics and Politics*, 24 (2), pp.135-156.

Karl, Terry. 1997. *The Paradox of Plenty: Oil Booms and Petro States*. University of California Press. Berkeley.

Lanjouw, P. and M. Ravallion. 2006. "Response to the Evaluation Panel's critique of poverty mapping." The World Bank.

Liang, K. and S. Zeger. 1986. "Longitudinal data analysis using generalized linear models." *Biometrika,* 73, pp.13-22.

Loayza, N.; A. Mier y Teran, and J.Rigolini. 2013. "Poverty, inequality, and the local natural resource curse." Unpublished manuscript. The World Bank.

Maldonado, Stanislao. 2011. "Resource windfall and corruption: Evidence from Peru." Unpublished manuscript. UC Berkeley.

Maldonado, Stanislao. 2012. "Resource curse, political support and democratic consolidation: Evidence from Peru." Unpublished manuscript. UC Berkeley.

Mehlun, H.; K.Moene and R.Torvik. 2006. "Institutions and the resource curse." *Economic Journal*, 116, pp.1-20.

MIM. 2011. "MIM informa Ancash". Boletín disponible en http://mim.org.pe/boletines/BoletinAncash/131#.U-8dCfldU01

MINEM. 2005. *Anuario Minero 2004*. Ministerio de Energía y Minas. Lima.

MINEM. 2012. *Anuario Minero 2011*. Ministerio de Energía y Minas. Lima.

MINEM. 2013. *Anuario Minero 2012*. Ministerio de Energía y Minas. Lima.

MINEM. 2014. *Anuario Minero 2013*. Ministerio de Energía y Minas. Lima.

Monteiro, J. and C. Ferraz. 2012. "Does oil make leaders unaccountable? Evidence from Brazil's offshore oil boom." Unpublished manuscript. PUC-Rio.

Morrison, Kevin. 2007. "Natural resources, aid, and democratization: A best-case scenario." *Public Choice*, 131, pp.365-386.

Morrison, Kevin. 2009. "Oil, nontax revenue, and the redistributional foundations of regime stability." *International Organization*, 63, pp.107-138.

Moulton, Brent. 1986. "Random group effects and the precision of regression estimates." *Journal of Econometrics,* 32, pp. 385-397.

Murray, Micheal. 2010. "The bad, the weak, and the ugly: Avoiding the pitfalls of instrumental variable estimation." Unpublished manuscript. Bates College.

Nevo, A. and A. Rosen. 2012. "Identification with imperfect instruments." *Review of Economics and Statistics*, 94(3), pp. 659-671.

Nordhaus, William. 1975. "The political business cycle." *Review of Economic Studies*, 42, 169-190.

ONPE. 2010a. "Conflictos electorales en el ámbito local. Estudio de las acciones violentas y elaboración de un mapa nacional." Documento de trabajo 22. Oficina Nacional de Procesos Electorales. Lima.

ONPE. 2010b. "Competencia electoral en el ámbito provincial. Escenarios y tácticas de oferta política durante las elecciones regionales y municipales." Documento de trabajo 23. Oficina Nacional de Procesos Electorales. Lima.

ONPE. 2010c. "Consultas populares de revocatoria 1997-2009 y nuevas elecciones municipales 2005-2010." Reporte de procesos y consultas 1. Oficina Nacional de Procesos Electorales. Lima.

Polastri, R. and F. Rojas. 2007. "Decentralization." En: Giugale, M; V. Fretes-Cibils and J. Newman. *An Opportunity for a Different Peru. Prosperous, Equitable and Governable.* The World Bank. Washington, DC.

Reyna, Carlos. 2003. "Las malas artes. Violencia en elecciones locales." Documento de trabajo. Oficina Nacional de Procesos Electorales. Lima.

Roberts, Kenneth. 2006. "Do Parties Matter? Lessons from the Fujimori Experience." Published in: Carrion, Julio. *The Fujimori Legacy: The Rise of Electoral Authoritarianism in Peru.* The Pennsylvania State University Press.

Robinson, J; R. Torvik and T. Verdier. 2006. "The political foundations of the resource curse." *Journal of Development Economics*, 79, pp.447-468.

Robinson, J. and R. Torvik. 2005. “White elephants.” *Journal of Public Economics*, 89, pp.197-210.

Robinson, J. and T. Verdier. 2013. “The political economy of clientelism.” *Scandinavian Journal of Economics*, 115(2), pp.260-291.

Ross, Micheal. 1999. “The political economy of the resource curse.” *World Politics*, 51, pp.297-322.

Ross, Micheal. 2001. “Does oil hinder democracy?” *World Politics*, 53, pp.325-361.

Roubini, Noriel. 2006. “Commodity prices sharp rise…and recent sharp fall: bubbles or fundamentals?” Available at: http://www.rgemonitor.com/roubini-monitor/128552/commodity_prices_sharp_riseand_recent_sharp_fall_bubbles_or_fundamentals

Sachs, Jeffrey and A. Warner. 1995. “Natural resource abundance and economic growth.” Unpublished manuscript. Harvard University.

Sakurai, S. and N. Aquino. 2008. “Fiscal policy and reelection in Brazilian municipalities.” *Public Choice*, 137, pp.301-314.

Salas, Guillermo. 2010. “La embriaguez del canon minero. La política distrital en San Marcos a doce años de la presencia de Antamina.” *Anthropologica*, 28, pp.111-138.

SASE. 2012. “Estudio de evaluación final (2007-2011) del Programa Minero de Solidaridad con el Pueblo de Cajamarca.” Informe Final. Lima.

Skilling, David and Richard Zeckhauser. 2002. “Political competition and debt trajectories in Japan and the OECD.” *Japan and the World Economy*, 14, 121-135.

Stock, J. and M. Watson. 2006. *Introduction to Econometrics*. Second edition. Addison-Wesley.

Stock, J; J. Wright and M. Yogo. 2002. “A survey of weak instruments and weak identification in Generalized Method of Moments.” *Journal of Business and Economic Statistics*, 20(4), 518-529.

Tornell, A. and P. Lane. 1999. “The voracity effect.” *American Economic Review*, 89, pp.22-46.

Torvik, Ragnar. 2002. “Natural resources, rent-seeking and welfare.” *Journal of Development Economics*, 67, pp.455-470.

Van der Ploeg, Frederick. 2011. "Natural resources: Curse or blessing?" *Journal of Economic Literature*, 49(2), pp.366-420.

Vargas, Carlos. 2002. “Derecho electoral municipal: Un análisis sociológico de su variación en el Perú.” *Elecciones*, 1, pp.43-80. Oficina Nacional de Procesos Electorales. Lima.

Veiga, L. and F. Veiga. 2007. “Political business cycles at the municipal level.” *Public Choice*, 131, pp.45-64.

Vicente, P. 2010. “Does oil corrupt? Evidence from a natural experiment in West Africa.” *Journal of Development Economics*, 92, pp.28-38.

Wantchekon, L. 2002. “Why do resource dependent countries have authoritarian governments?” *Journal of African Finance and Economic Development*, 5 (2), pp.57-77.

White, Halbert. 1980. “A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity.” *Econometrica,* 48, pp.817-838.

Winters, A. and S. Yusuf (editors). 2007. *Dancing with Giants: China, India and the Global Economy*. The World Bank. Washington, DC.

Wooldridge, Jeffrey. 2010. *Econometric Analysis of Cross-section and Panel Data*. MIT Press.

Wooldridge, Jeffrey. 2006. “Cluster-sample methods in applied econometrics: An extended analysis.” Unpublished manuscript. Michigan State University.

World Bank. 2001. *Peru: Institutional and Governance Review*. The World Bank. Washington, DC.

World Bank. 2005. *Wealth and Sustainability: The Environmental and Social Dimensions of the Mining Sector in Peru*. The World Bank. Washington, DC.

World Bank. 2010a. *Peru: The Decentralization Process and its links with Public Expenditure Efficiency*. The World Bank. Washington, DC.

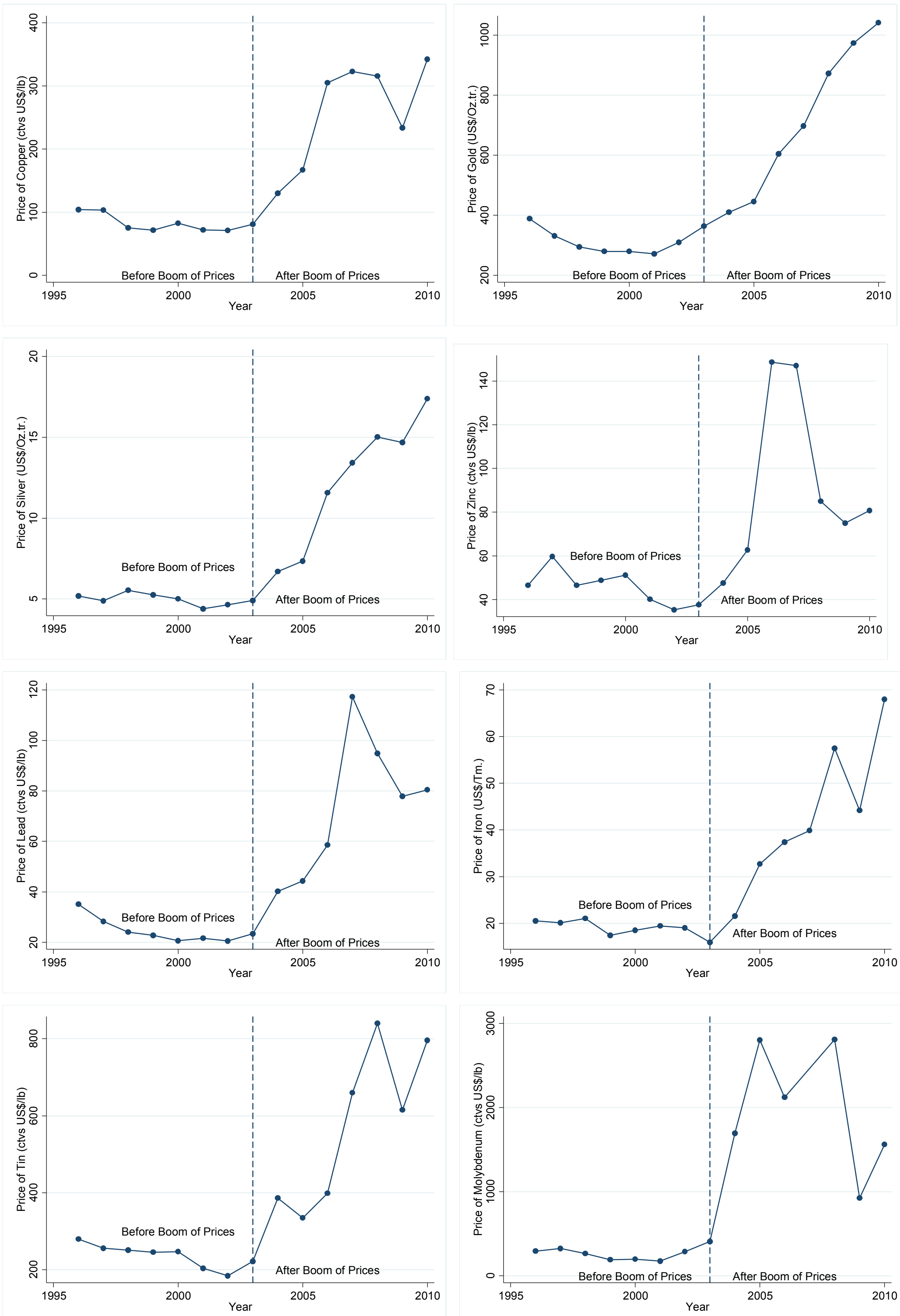
World Bank. 2010b. *Natural Resources in Latin America and the Caribbean. Beyond Booms and Busts?* World Bank Latin American and Caribbean Studies. Washington, DC.

World Bank. 2012. *Public Expenditure Review for Peru: Spending for Results*. Report 62856-PE. The World Bank. Washington, DC.

Figure 1: Evolution of Mineral Production

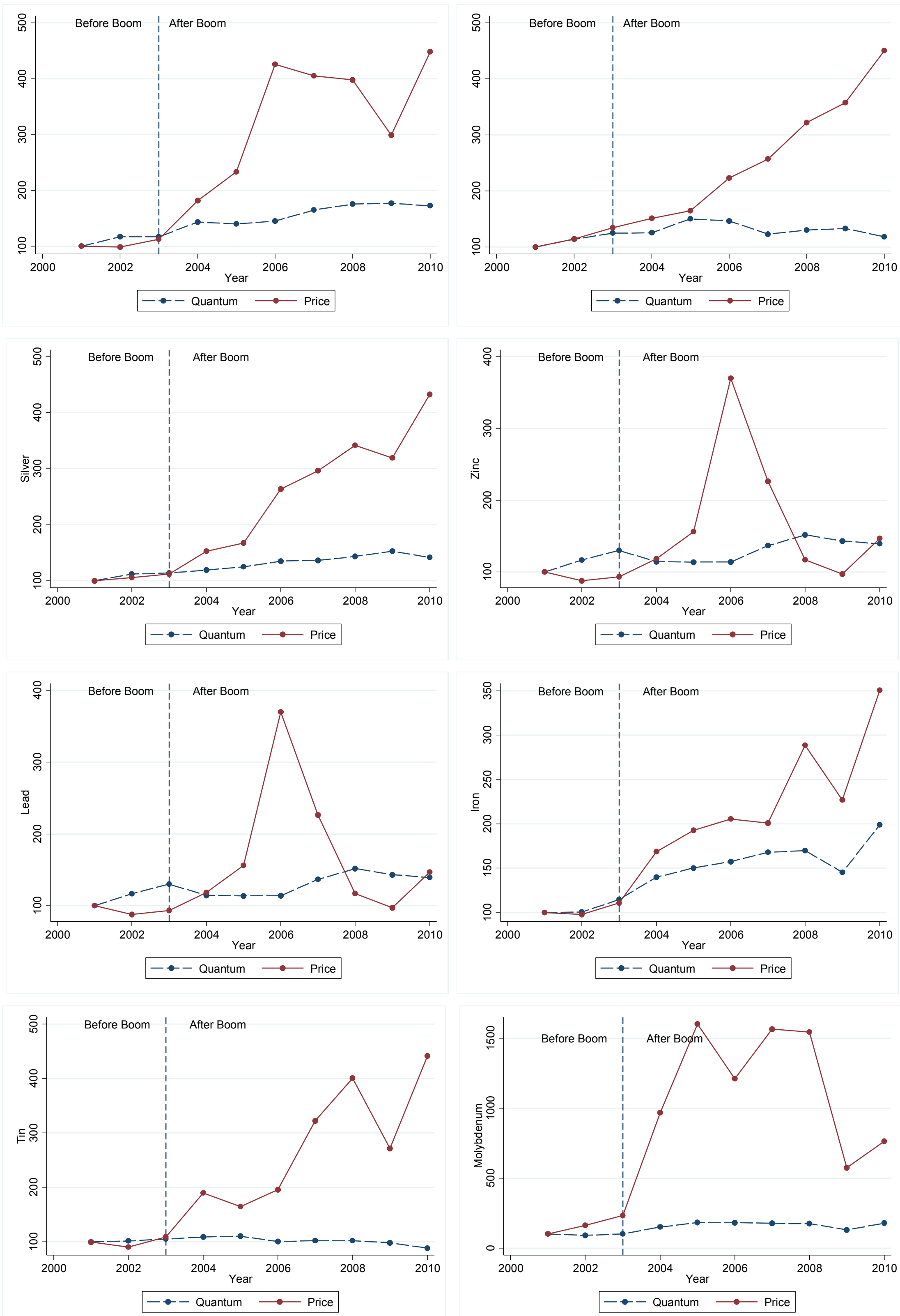
Source: Own from data from Ministry of Energy and Mines.

Figure 2: Evolution of Mineral Prices



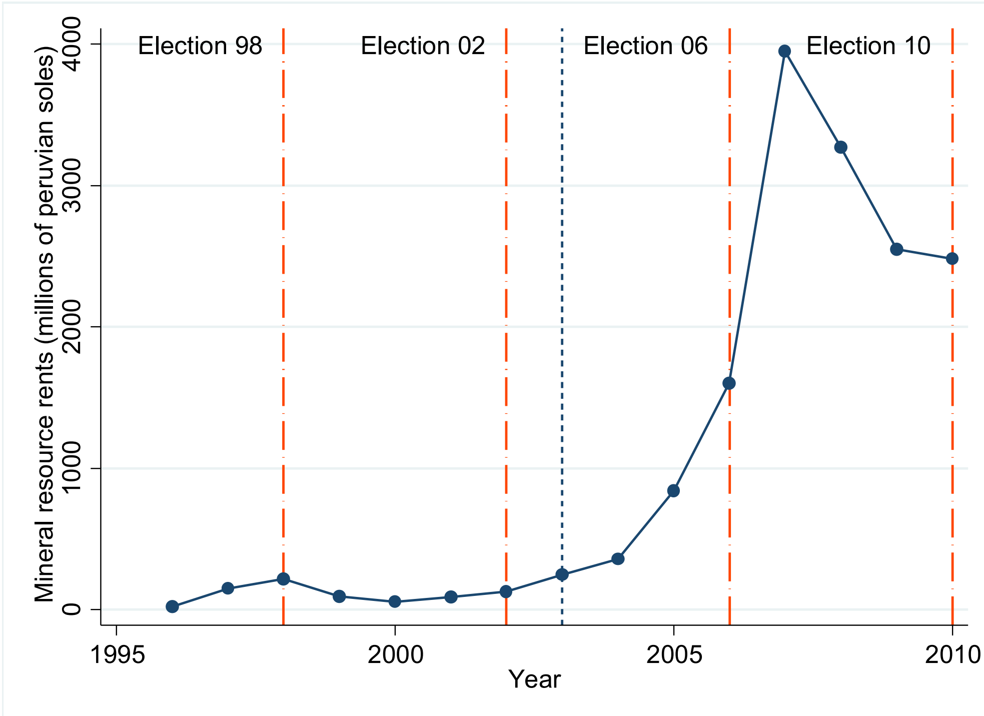
Source: Own from data of Ministry of Energy and Mines.

Figure 3: Evolution of quantum and prices of mineral exports (2001-2010)



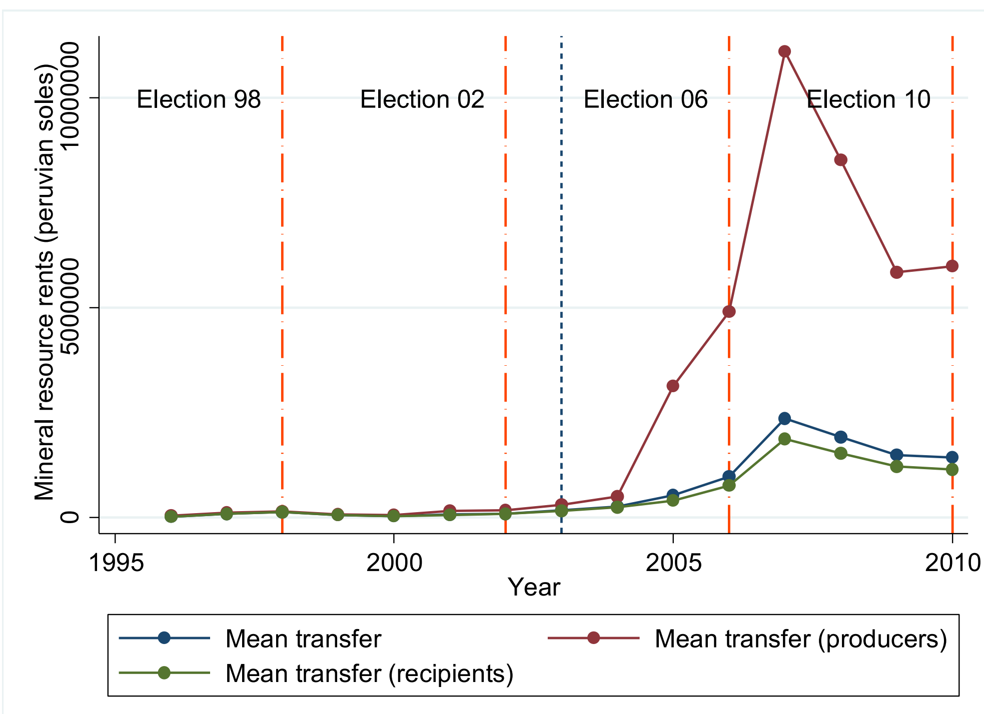
Source: Own from data of Ministry of Energy and Mines.

Figure 4: Evolution of mining rents distributed to local governments (1996-2010)



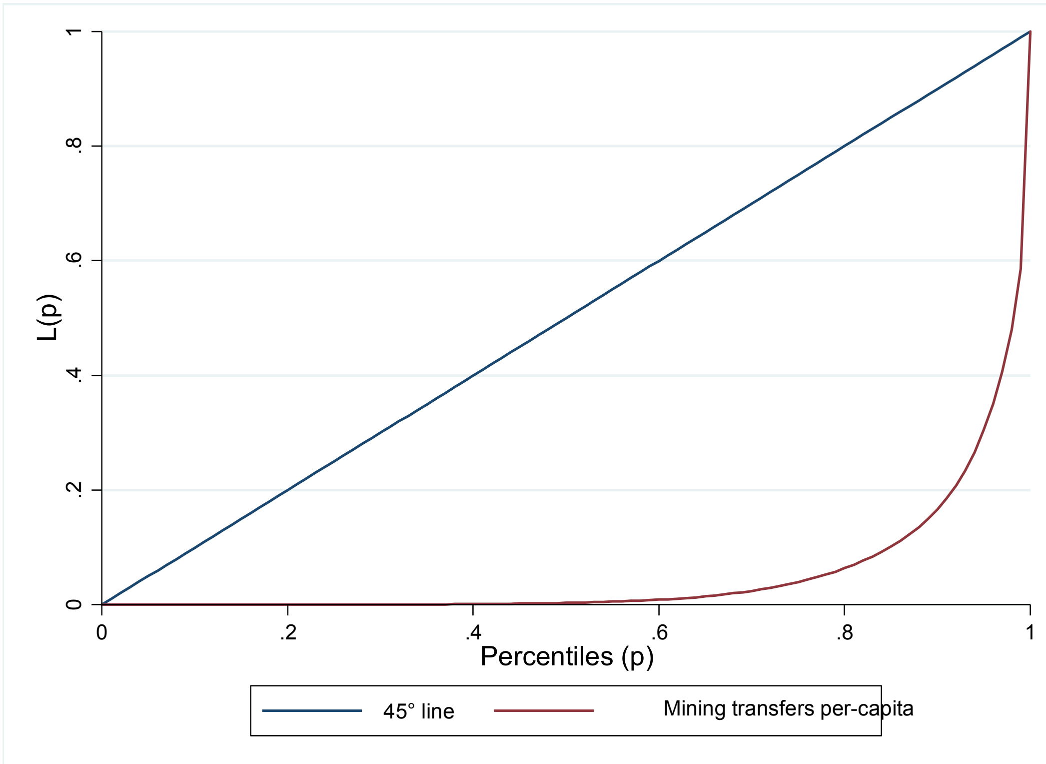
Source: Own from data of Ministry of Energy and Mines and Ministry of Economics and Finance.

Figure 5: Evolution of mining rents by type of district



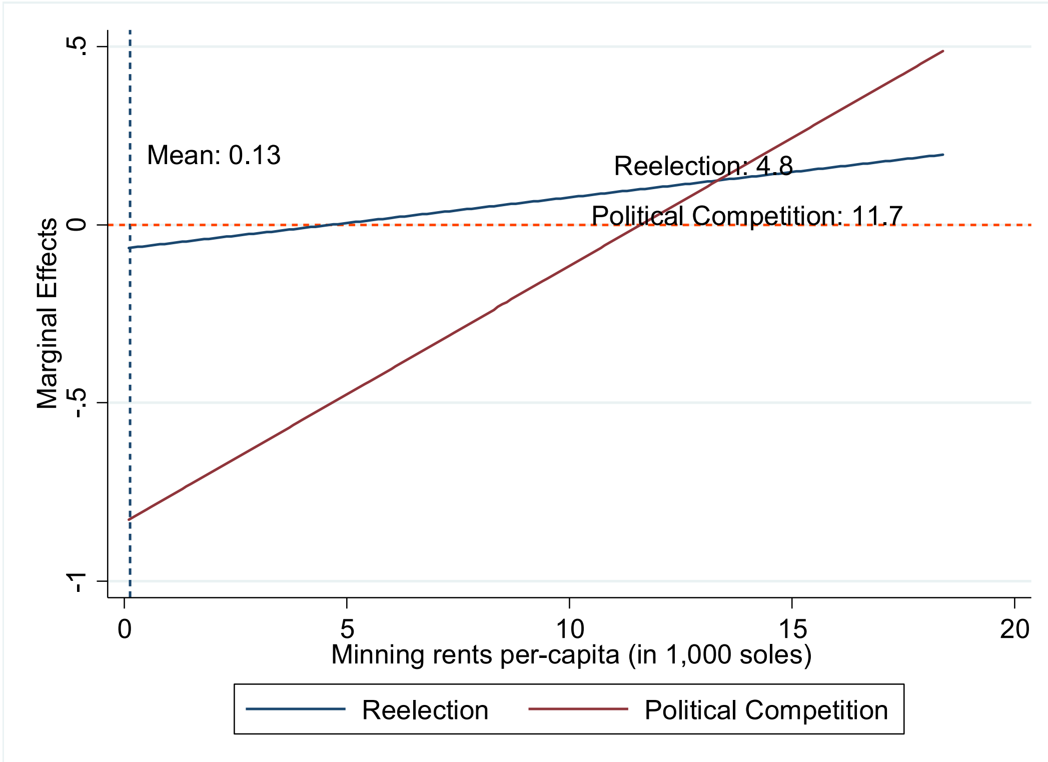
Source: Own from data of Ministry of Energy and Mines and Ministry of Economics and Finance.

Figure 6: Lorenz curve for average mining transfers (1996-2010)



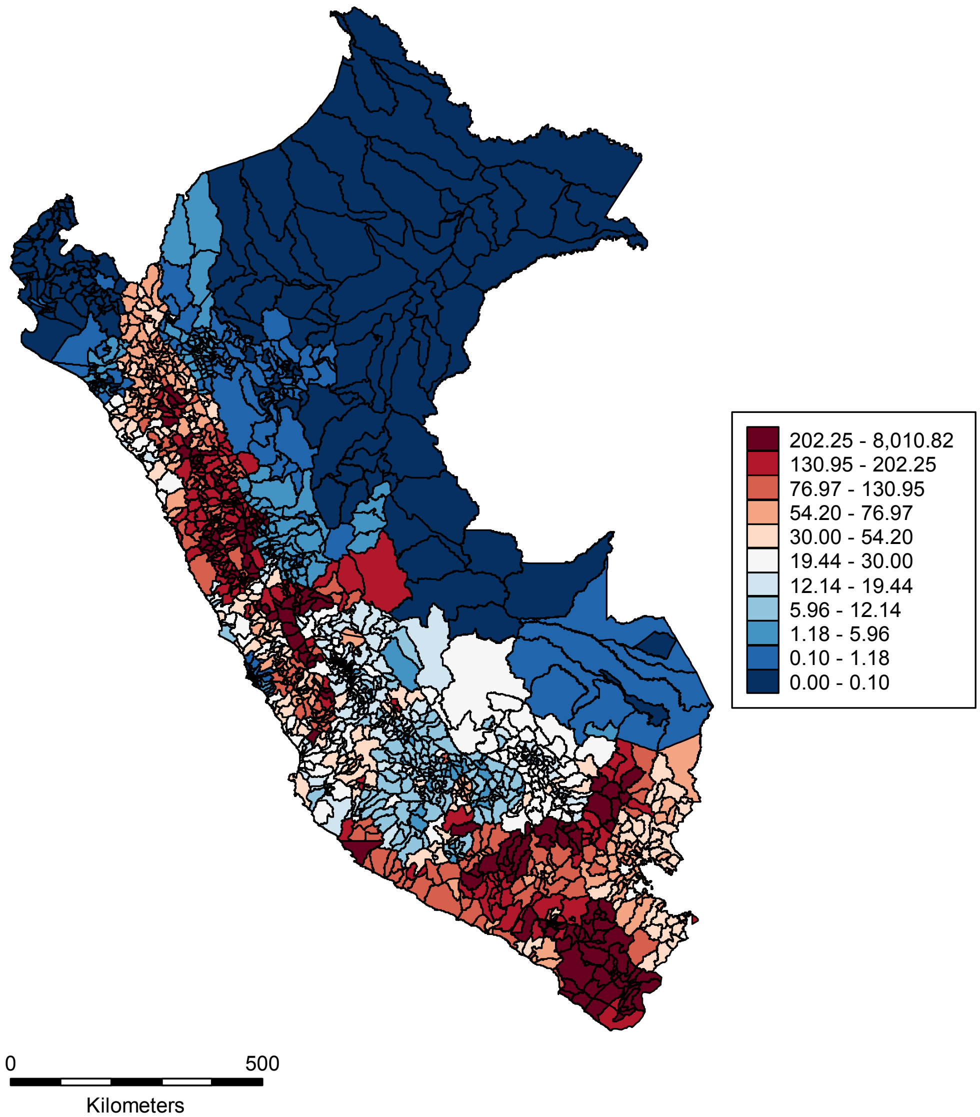
Source: Own.

Figure 7: Marginal effects of the impact of mining transfers on reelection and political competition



Source: Own.

Map 1: District allocation of average mining transfers (1996-2010)



Source: Own elaboration using data from the Ministry of Economic and Finance.

Table I: 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: Own.

Table II: 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-capita^2		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-capita^2		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 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 of nuevos soles. All monetary values are in prices of Lima in 2001. Real value of mineral production is measured in mineral prices of 2001.

Table III: 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-capita^2		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-capita^2		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 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 of nuevos soles. All monetary values are in prices of Lima in 2001.

Table IV: Robustness Checks for Impact of Natural Resource Rents on Reelection and Political Competition

	Impact of Mining Transfers on Reelection				Impact of Mining Transfers on Political Competition			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Average Transfers for Electoral Cycle								
Mining Transfers per-capita	-0.034	-0.079**	-0.075**	-0.067*	-0.830**	-0.922*	-0.854	-1.250**
	(0.026)	(0.033)	(0.033)	(0.036)	(0.402)	(0.513)	(0.523)	(0.565)
Mining Transfers per-capita^2	0.001	0.003	0.002	0.002	0.036**	0.016	0.012	0.036
	(0.001)	(0.002)	(0.002)	(0.002)	(0.016)	(0.029)	(0.030)	(0.030)
Log of (1+Real Value of Production)	0.001				-0.021			
	(0.004)				(0.057)			
Year of Election								
Mining Transfers per-capita	-0.067***	-0.113**	-0.103**	-0.130**	-0.307	-0.158	-0.097	-0.554
	(0.024)	(0.046)	(0.047)	(0.052)	(0.394)	(0.644)	(0.649)	(0.721)
Mining Transfers per-capita^2	0.007***	0.015***	0.014***	0.017***	0.003	-0.076	-0.083	-0.035
	(0.002)	(0.005)	(0.005)	(0.005)	(0.022)	(0.063)	(0.063)	(0.067)
Log of (1+Real Value of Production)	0.001				0.000			
	(0.004)				(0.052)			
Excluding Producer Districts	No	Yes	No	No	No	Yes	No	No
Excluding Producer Districts in Producing Regions	No	No	Yes	No	No	No	Yes	No
Excluding Producer Districts in Producing Provinces	No	No	No	Yes	No	No	No	Yes
Mean dependent variable	0.17				83.15			
Number of observations	4,582	4,316	3,468	2,080	4,581	4,315	3,468	2,080
R2	0.016	0.014	0.011	0.012	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 of nuevos soles. All monetary values are in prices of Lima in 2001. Real value of mineral production is measured in mineral prices of 2001.

Table V: Instrumental Variable 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)
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-capita^2	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)
		First Stage for Level of Transfers					
Mining Canon		1.231***					
		(0.063)					
Mining Canon^2		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

	First Stage for the Square of Transfers					
Mining Canon	-0.621					
	(0.897)					
Mining Canon^2	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. All specifications include district and year fixed effects. The treatment variable is measured in 1,000 of nuevos soles. All monetary values are in prices of Lima in 2001. Real value of mineral production is measured in mineral prices of 2001.

Table VI : Impact of Natural Resource Booms on Public Goods Provision

	Access to Water Network	Acess to Public Light	Garbage Collection		Security Services			Access to Library
			In Capital	Rest	Access	Perssonel	Stations	
DID Estimates								
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-capita^2	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)
IV Estimates								
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-capita^2	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 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 of nuevos soles. All monetary values are in prices of Lima in 2001. Real value of mineral production is measured in mineral prices of 2001. Perssonel and stations are measured in units per 1,000 habitants. All other variables are dummy variables of whether the district has access to a particular public good.

Table VII: Impact of Natural Resource Booms on Local Infrastructure

	DID Estimates									
	Health Infrastructure				Sport Infrastructure					
	Hospital	Health Center	Polyclinic	Odontological/Basic Medical Services	Stadiums	Multipurpose Fields	Soccer Fields	Basquetball Fields	Volleyball Fields	Gymnasiums
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-capita^2	-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-capita^2	-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 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 of nuevos soles. 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 VIII: 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-capita^2	-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-capita^2	-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 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 of nuevos soles. 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 per-capita terms.

Table IX: Impact of Natural Resource Booms on Public Employment by Type of Contract

	DID Estimates								
	Appointed Staff			Contracted Employees			Temporary Employees		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
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-capita^2		-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-capita^2		-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 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 of nuevos soles. 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 number of employees per 1,000 habitants.

Table X: Impact of Resource Booms on Public Employment by Type of Employment

	Officials		Professionals		Technicians		Security Workers		Janitors	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
DID Estimates										
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-capita^2	-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)	
IV Estimates										
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-capita^2	-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 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 of nuevos soles. 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 number of employees per 1,000 habitants.

Table XI: 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-capita^2	-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-capita^2	-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 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 of nuevos soles. 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 per-capita terms.

Table XII: Impact of Natural Resource Booms on Local Government Expenditures

	Planning	Agriculture	Social Assistance	Education and Culture	Energy and Natural Resources	Industry, Trade and Services	Health and Sanitation	Transport	Housing and Urban Development
DID Estimates									
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-capita^2	-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)
IV Estimates									
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-capita^2	-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 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 of nuevos soles. 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 per-capita terms.

Table XIII: 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-capita^2		-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^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 dependent variable: income	400.56					
Mean 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 of nuevos soles. All monetary values are in prices of Lima in 2001. Real value of mineral production is measured in mineral prices of 2001. The analysis covers period 1998-2010.

Table XIV: Impact of Natural Resource Booms on Electoral Conflict

	Dependent variable: =1 if at least one incident of electoral conflict was reported					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
			Differences in Differences			
Mining Transfers per-capita	0.016	0.042**	0.043**	0.044**	0.047***	0.050***
	(0.012)	(0.017)	(0.017)	(0.017)	(0.017)	(0.018)
Mining Transfers per-capita^2		-0.002***	-0.002***	-0.002***	-0.002***	-0.003***
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Log of (1+Real Value of Production)			-0.002	-0.001	-0.002	-0.002
			(0.002)	(0.002)	(0.002)	(0.002)
			Instrumental Variables			
Mining Transfers per-capita	0.020	0.048***	0.050***	0.051***	0.054***	0.056***
	(0.013)	(0.016)	(0.016)	(0.016)	(0.016)	(0.017)
Mining Transfers per-capita^2		-0.002***	-0.002***	-0.003***	-0.003***	-0.003***
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Log of (1+Real Value of Production)			-0.002	-0.001	-0.002	-0.002
			(0.002)	(0.002)	(0.002)	(0.002)
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 dependent variable	0.06	0.06	0.06	0.06	0.06	0.06
Number of observations	5,138	5,138	5,138	4,651	4,174	2,572
R2	0.034	0.034	0.035	0.039	0.031	0.030

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 of nuevos soles. All monetary values are in prices of Lima in 2001. Real value of mineral production is measured in mineral prices of 2001.

Appendix I: Rules for mining Canon and mining royalty distribution

Transfer	Use / Destination	Constitution base	Form of allocation of the resources	Legal base
(1) Canon 1 /	Public Investment 2 /	* 50% Income Tax 3/	* 10% to the municipalities in the district where the natural resource is located. * 25% to the municipalities of the province where the natural resource is located. * 40% to municipalities in the region where the natural resource is located. * 40% to municipalities in the region where the natural resource is located. * 25% to regional government (80% CR and 20% for regional universities).	* Constitution of Peru (Article 77) assigns to districts a share of income received by the State due to the exploitation of natural resources. * Law 27,506, Canon Law (July 10, 2001) establishes the allocation rule to local and regional governments. * Supreme Decree 005-2002-EF, regulation of Canon. * Law 28,077 (September 26, 2003) and Law 28,322 (August 10, 2004) amended several articles of the Canon Law. These modification were regulated by Supreme Decree 029-2004-EF and EF-187-2004, respectively.
(2) Mining Royalty	Public Investment	* % on the value of minerals (or its equivalent) sold according to international prices.	* 20% to the local 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 Royalty (June 24, 2004), that establishes the mining royalties, its constitution, determination, administration, distribution and use. * Law 28323, Law that modifies the Law of Mining Royalty (August 10, 2004). * Supreme decree 157-2004-EF, Regulation of the Law of Mining Royalties (November 15, 2004). * Supreme decree 018-2005-EF, which dictates complementary norms of the regulation of the Law of Mining Royalties (January 29, 2004). * Ministerial resolution 163-2006-EF-15, which establishes the exchange rate and rank for the payment of mining royalties (March 22, 2006).

1. It includes mining, oil, hydropower, fishing, forest and gas Canon.
2. Valid for all Canon except the oil Canon, in which case the assignment rule is the following: in Loreto, Ucayali and Huánuco until a 20% can be used for current expenditures. In Piura and Tumbes, 100% has to be used for public investment.
3. Some variants for the cases of the oil, gas and fishing Canon exist. For the case of oil Canon, it is constituted on 12.5% of the Value of the Production. Details for other forms of Canon are discussed on www.mef.gob.pe.

Appendix II: Model[61]

Consider a simple two-period local economy composed by $N+2$ citizens. In the first period, this economy has two sectors: a) a natural resource sector and b) a subsistence sector. The natural resource sector produces a per-period flow rent C which is assumed to be exogenous and it is completely appropriated by the local government (controlled by the incumbent mayor)[62].

In the first period, each agent in this economy can produce in the subsistence sector. The output x_t depends on the stock of a public good g_t provided by the local government following a linear production function, $x_t = \rho_x g_t$, where ρ_x is an exogenous technological parameter. In the second period, it is possible to produce in the industrial sector, which is assumed to be more efficient but requires managerial skills. A talented agent can hire l_t workers and produce an output $y_t = \rho_y g_t l_t$. It is assumed that $\rho_x < \rho_y$, so producing industrial goods is more efficient.

Local government revenues depends on C and taxes collected from the subsistence and industrial sector, $\tau(x_t + y_t)$, with t exogenous with $t < 1$. These revenues are used to produce public goods g_t and to finance incumbent's consumption. In an extension of this basic model revenues are also used to fund patronage b_t. The amount of public goods g_t is exogenous in period 1 but endogenous in period 2. We assume that $g_2 = g_1 + I$ where I represents the investment in expanding the stock of public goods.

The incumbent mayor seeks to maximize the present value of his own consumption. In the first period the mayor in power is exogenously given. For simplicity, it is assumed that there is just one talented agent to avoid strategic interactions. The talented agent can choose between producing in the subsistence sector; becoming an entrepreneur and hiring workers for producing in the industrial sector; or becoming a challenger to the incumbent mayor and running for office. The talented agent problem is to choose between politics and industrial production. It is assumed that the skills needed for being an entrepreneur are the same for engaging in politics. If the talented agent runs for election he wins office with (exogenous) probability γ. With probability $(1-\gamma)$ he losses the election and has to incur in a cost D. The incumbent politician stays in office if the talented agent decides not to run for office or if he loses the election. The untalented agents can work either in the subsistence sector or be employed as workers for talented individuals. All agents are assumed to be risk-neutral.

The timing of the game is as follows:

[61] We closely follow the exposition in Caselli (2006).

[62] This assumption is consistent with the setting of this study in which mineral production is performed by mining companies whose economic decisions are weakly connected with local politics and local government are recipients of mining transfers.

i. Incumbent, the initial level of public goods and mining canon rents are exogenously given in period 1.
ii. Incumbent maximizes the present value of his consumption with respect to the level of investment in public goods for period 2.
iii. At the beginning of period 2, the talented agent decides to become an entrepreneur or to become a challenger to the incumbent mayor.
iv. At the end of period 2 an election takes place. If the talented agent decides not to become a challenger, or if he loses the election, the period-1 mayor continues in office. Otherwise, the talented agent becomes the new mayor.

1.1 Analysis

a) Talented agent's decision

The talented agent basically compares the cost and benefit of running for election. In particular, he will run for election if the utility of being the mayor is higher than the profits of being an industrialist:

(A.1) $\gamma\left[C+\tau\rho_x g_2 N\right]-(1-\gamma)D>(1-\tau)\rho g_2 N,$

The left-hand side term is composed by two expressions. The first one is the local government revenue for period 2 weighted by the probability of winning the election. The second term represents the expected cost of losing the election. The right-hand term is the level of profits after tax of becoming an entrepreneur in the industrial sector where $\rho=\rho_y-\rho_x$. After rearranging these expressions we find that the talented agent will run for election if and only if:

(A.2) $\gamma c-[(1-\tau)\rho-\gamma\tau\rho_x]g_2>(1-\gamma)d,$

where $c=C/N$ is Mining canon revenues per-capita and $d=D/N$. It is clear that the role of public goods depends on the level of tax, the probability of winning the election and the productivity parameters. The second term in the left-side hand of equation 2 recovers the difference between the opportunity cost (profits) and the return from running for election. To solve this problem we need the following assumption:

Assumption 1: $(1-\tau)\rho>\gamma\tau\rho_x$.

This assumption implies that local economic development reduces political competition which seems plausible. We use this assumption to establish the following lemma:

Lemma 1: *the talented agent will run for election if* $g_2<g^*$, *where*

(A.3) $g^* = \dfrac{\gamma c - (1-\gamma)d}{(1-\tau)\rho - \gamma\tau\rho_x}$

This solution shows that the incumbent politician has incentive to invest in public goods since by this mean the opportunity cost of the talented agent can be increased. As a consequence, he will be more likely to be reelected in period 2. On the other hand, Lemma 1 also suggest that the required level of public good is increasing in c. This implies that larger levels of c make more likely that the incumbent mayor will face more political competition and, as a consequence, he will need to invest more in g to prevent political competition by making the opportunity cost of the talented agent higher.

b) Incumbent politician's decision problem

The incumbent politician's problem is to maximize the present value of consumption with respect to public good investment I. Therefore, his objective function is the following:

(A.4) $c + \tau\rho_x g_1 + Z(c + \tau\rho_y g_2) + (1-Z)(1-\gamma)(c + \tau\rho_x g_2) - I,$

where

$$Z = \begin{cases} 1 \text{ if } g_2 \geq g^* \\ 0 \text{ if } g_2 < g^* \end{cases}$$

subject to

$$g_2 = g_1 + I$$
$$I \leq \tau\rho_x g_1 + c$$
$$g_1, c \text{ given.}$$

The first two elements are the (exogenous) local government's revenues for period 1. The third and fourth terms are the second-period revenues which depend on whether the talented agent runs for election (recovered by the indicator function Z) and his probability of winning it. The first constraint is the production function for the public good which is assumed to be linear. The second constraint is the budget constraint for period 1.

In period 1 the incumbent politician solves this problem by comparing the costs and benefits of investing in public good g. Notice that if the incumbent expect the talented agent to become a challenger, then one unit of resources invested in providing the public good yield a return of $(1-\gamma)\tau\rho_x$. On the other hand, when no challenger is expected, this return will be equal to $\tau\rho_y$. We impose two additional parametric assumptions:

Assumption 2: $\tau\rho_y > 1$ which basically means that the return of investing in g is higher than its opportunity cost, and

Assumption 3: $(1-\gamma)\tau\rho_x < 1$, which essentially implies that if the incumbent politician does not expect to be able to prevent a challenger then he does not invest in public goods at all.

Using these two assumptions, we can solve this problem[63]. Hence, we have the following lemma:

Lemma 2: *Whenever* $g^h \geq g^*$ *the incumbent politician uses all its resources in period 1 to provide public goods and there are no incentives for the talented agent to become a challenger in period 2. When* $g^h < g^*$ *the incumbent politician makes no investment in public goods in period 1 and the talented agent becomes a challenger in period 2.*

This result is related to the level of public goods. To connect the level of natural resource rents per-capita c with policies pursued by the incumbent, we need the following parametric assumption:

Assumption 4: $\gamma/[(1-\tau)\rho - \gamma\tau\rho_x] > 1$

This assumption says that the challenger's probability of winning the election is sufficiently large relative to the returns of investing in public goods. Using A4 and the definitions for g^* and g^h we can state the following proposition:

Proposition: *If* $c > \dfrac{(1-\gamma)d + g_1(1+\tau\rho_x)[(1-\tau)\rho - \gamma\tau\rho_x]}{\gamma - (1-\tau)\rho + \gamma\tau\rho_x} \equiv c^*$, *then the incumbent makes no investment in public goods in period 1 and faces a challenger in period 2. Otherwise, the incumbent uses all his resources in period 1 to provide public goods and the talented agent does not choose to become a challenger in period 2.*

This constitutes the basic result of this simple model.

---

[63] To see this, consider the case in which the incumbent pursues a policy such that $g_2 \geq g^*$. Under A2, the optimal incumbent's response is to use his entire first-period budget in expanding the stock of public good ($I = \tau\rho_x g_1 + c$). Then, the new stock of public good in period 2 will be $g_2 = g_1(1+\tau\rho_x) + c \equiv g^h$. This represents the maximum level of public good in period 2 given the available budget in period 1. This policy is feasible if this level is good enough to prevent political competition ($g^h \geq g^*$). Now let's consider the case in which the incumbent pursues a policy such that $g^h < g^*$. Given A3, the incumbent will no invest in public goods ($I = 0$). As a consequence, $g_2 = g_1$, which is always a feasible policy. Therefore, if $g^h < g^*$, the incumbent faces a challenger in the second period.

1.2 Extension: Endogenous challenger's probability of election

Consider the case in which the incumbent can use spending on patronage B to influence the challenger's probability of election. For simplicity, we assume that patronage is produced using a simple linear technology:

(A.5) $\gamma(B) = \max[\gamma_0 - \delta B, 0]$

In this scenario, the incumbent's optimization problem becomes:

(A.6) $c + \tau\rho_x g_1 + Z(c + \tau\rho_y g_2) + (1 - Z)(1 - \gamma)(c + \tau\rho_x g_2) - I - B,$

where:

$$Z = \begin{cases} 1 \text{ if } g_2 \geq g^*(\gamma) \\ 1\text{-}\gamma \text{ if } g_2 < g^*(\gamma) \end{cases}$$

subject to:

$$g_2 = g_1 + I$$
$$\gamma = \min[\gamma_0 - \delta B, 0]$$
$$I + B \leq \tau\rho_x g_1 + c$$
$$g_1, c \text{ given.}$$

The solution of this problem is complicated because changes in B have ambiguous effects on the challenger's probability of election and the return to investment in public goods. On the one hand, patronage spending increases the incumbent's re-election probability but also reduces the investment in public goods, reducing the challenger's opportunity cost. On the other hand, this reduction in public good investment also reduces the total output affecting the tax base over which the incumbent can extract rents. Therefore, there is no a simple solution for this problem since many scenarios, most of them with no empirical relevance, are possible.

To avoid a complex classification exercise, Caselli (2006) presents a set of numerical exercises to evaluate the behavior of the main variables of the model. What is important in this scenario is the behavior of the parameter γ that reflects the elasticity between patronage spending and the probability of election of the talented agent.

Figure A.1 shows the relationship between the levels of mining transfers per capita and levels of investment in public goods to different values of γ parameter. We consider a low value, one intermediate and one high in the previous parameter. As seen in the figure, when the parameter is low, the results are essentially the same as those of the basic model. That is, when the mayor is not effective in using mining revenues to affect the competitor's probability of election by mean of patronage spending, the previously discussed non-monotonic pattern is maintained. Investment in public goods is positive up to a point, after which decreases.

When γ has an intermediate value, the pattern is more complex. In this case, there are two thresholds per-capita rents. The first is similar to above, showing a positive relationship between mining rents and investment in public goods in a first section and then show a negative relationship. Then, for a very high level of mining rents, the relationship is again positive. The intuition behind this change is that, when the mayor has huge amount of mining rents, is always possible to prevent entry of competitors and is therefore profitable for the mayor to invest in public goods. Finally, when γ is high, then it is always possible for the incumbent mayor prevent the entry of potential competitors and therefore it is profitable to invest in public goods.

A similar analysis is possible for the case of the relationship between spending on patronage and levels of per-capita rents. Figure A.2 presents the results of the exercise. When γ is low, the incumbent mayor does not invest in patronage spending since its ineffectiveness makes it a bad investment. For intermediate levels of γ, only high levels of per-capita rents are associated with increased levels of spending on patronage. For high levels of γ, the relationship between mining transfers and patronage spending is positive.

Figure A.3 presents the case of the relationship between per-capita mining rents and the probability of reelection. When γ is too low, the mayor cannot be reelected for any income level. The opposite occurs when γ is very high: the mayor always gets reelected. The most interesting case is for an intermediate value of γ. In this case the relationship looks like an inverse U; that is, negative for the first tranche (more mining transfers are associated with a lower probability of re-election) and positive after a mining rents threshold.

Figure A.1: Investment in Public Goods

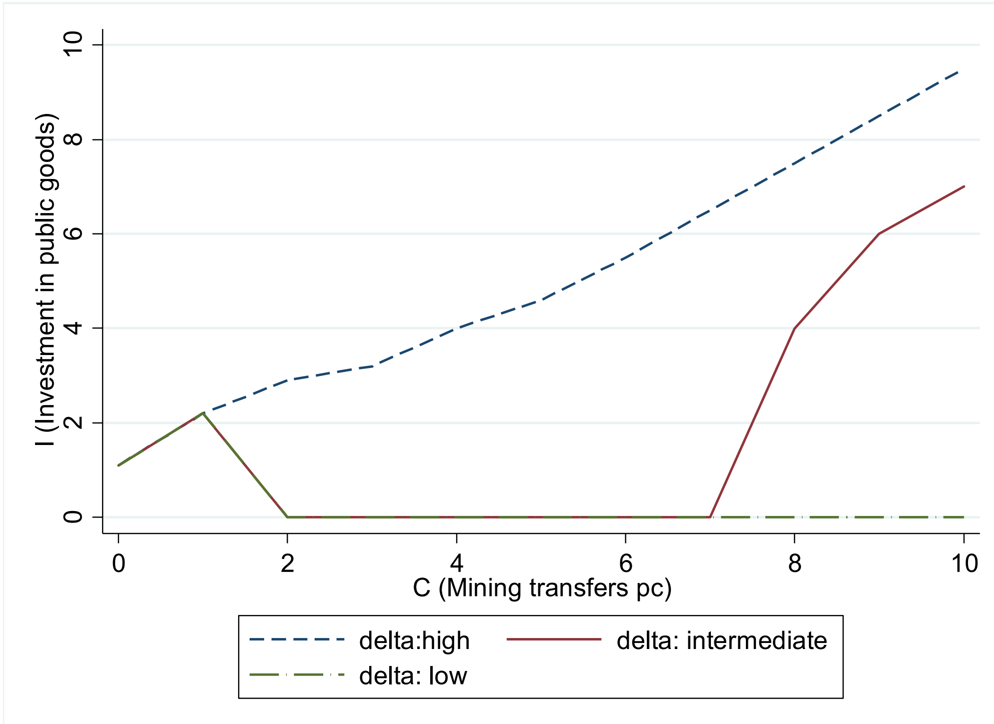


Figure A.2: Investment in Patronage Spending

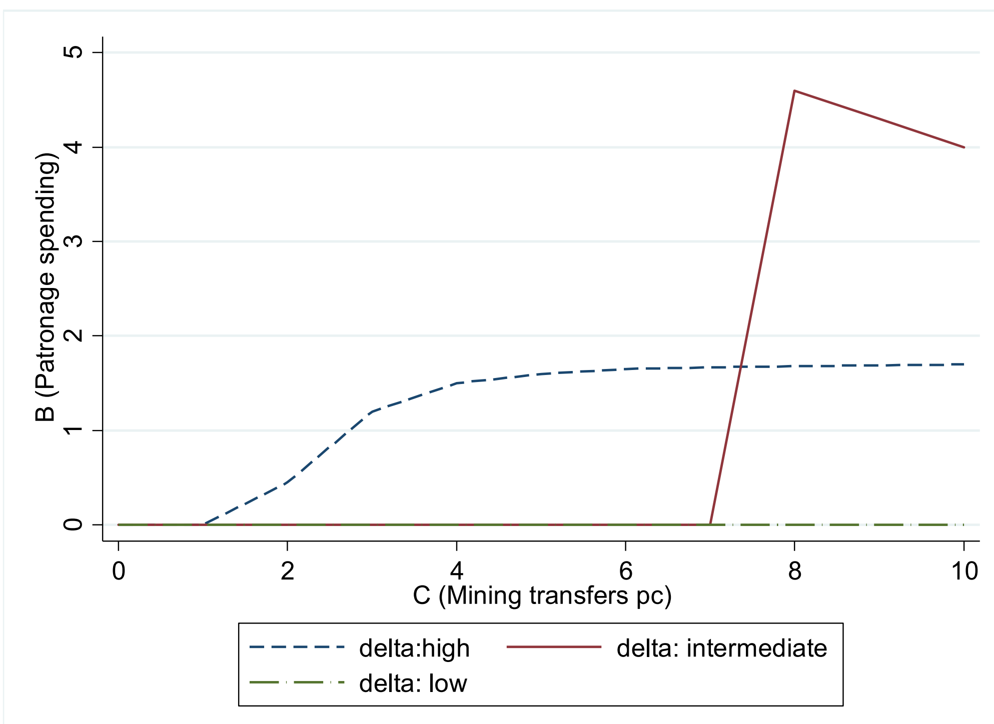


Figure A.3: Probability of Reelection