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Resource Windfalls and Public Sector Employment: Evidence from Municipalities in Chile

ABSTRACT We study the effect of extra resource revenues on employment expenditures at the municipal level in Chile. We exploit a novel quasi-experiment: a legal reform in 2005 that increased the portion of the income collected from mining licenses that is assigned to municipalities where mines operate from 30 to 50 percent. Our main result is a statistically significant expansion of municipal employment expenditures in mining municipalities, driven by expenditures on long-term employment. Additionally, we found a meaningful effect on allowances to the municipal council, but we did not find a robust impact on transfers to health, transfers to community programs, or municipal investment, while the increase in transfers to education is small with respect to the employment expenditures effect. These results are complemented by evidence of an increase in the mayor's probability of reelection not related to the provision of public goods, which links our findings with the clientelism mechanism of resource rents. Our results also have several implications for the fiscal decentralization debate in resource-abundant economies.

JEL Codes: H41, H72, H75, O13, Q33

Keywords: Natural resources, clientelism, municipalities, fiscal decentralization

To compensate citizens affected by the natural resource extraction process, several resource-abundant countries have turned to fiscal decentralization policies that transfer the management of resource revenues to local governments. However, a vast economic literature highlights the potential adverse outcomes of resource windfalls through the political

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process. Most of these studies focus on cross-country comparisons or do not directly test the specific channels through which resource windfalls operate.¹ In contrast, this paper exploits the 2005 reform of the mining law in Chile, which suddenly increased the portion of the income collected from mining licenses that is assigned to municipalities where mining companies operate from 30 to 50 percent, to study the effect of an increase in resource revenues on municipal expenditures. In particular, we focus on whether extra revenues are allocated to improve social outcomes or whether they may be used for patronage or the self-enrichment of municipal officers.

Our work is based on the framework developed by Robinson, Torvik, and Verdier.² When a permanent resource boom occurs, an incumbent politician must decide whether resource rents will be consumed or distributed as patronage in the form of public employment. If the probability of staying in power is an increasing function of public sector employment, there are strong incentives to divert extra revenues to this purpose. This clientelism mechanism reduces the efficiency of the economy by transferring labor to unproductive jobs in the public sector. On the other hand, empirical evidence suggests that resource windfalls may also be diverted to finance the accumulation of personal wealth, by increasing different kinds of direct payments to municipal officers. For instance, Caselli and Michaels show that in the case of oil windfalls to municipalities in Brazil, the misallocated funds may be assigned to a combination of patronage and self-enrichment.³

In our context, the 2005 legal reform to mining licenses in Chile can be viewed as an exogenous change in municipal income that is analogous to a permanent resource boom. Specifically, since a resource boom can be understood as a complex phenomenon that can have associated shocks in both resource rents and production, which may have different effects through the political process, we interpret the legal reform of 2005 as the rent channel of a resource boom.⁴ In that sense, the use of a structural legal change allows us to better isolate the specific effects of resource rents. Our empirical strategy consists in a difference-in-differences approach to compare mining municipalities that were affected by the reform of 2005 with their peers located in

1. See, for example, Bhattacharyya and Hodler (2010); Boschini, Pettersson, and Roine (2007, 2013); Collier and Goderis (2012).

2. Robinson, Torvik, and Verdier (2006, 2014).

3. Caselli and Michaels (2013).

4. See Maldonado (2014).

nonproducing areas, including municipality-specific and time effects. To that end, we take advantage of the highly detailed data on municipal expenditures available in Chile, obtained from the National System of Municipal Information (SINIM) and covering the period 2001–15.

Our main result is that extra mining licenses generate a sizable and statistically significant expansion of municipal employment expenditures, even if the income from mining licenses in Chile was intended to be used for development projects in local areas. We also distinguish among different kinds of municipal employees according to the length of their contracts. In Chilean municipalities, there are three major categories of workers, based on the length of their employment contract: long-term employees (called *planta*), whose contracts have no stated end date and thus are mostly permanent over time; annual employees (called *contrata*), whose contracts have a fixed term of one year and may or may not be renewed at the end of that period; and short-term employees (called *honorarios*), whose contracts are supposed to end when a specific task or service is completed. We find that the effect is larger for permanent employees than for annual contract workers, while the effect is not robust for short-term employees. These differences can be partially explained by the different regulations governing municipal expenditures on each kind of employment. Even if these findings are not directly attributable to patronage, they support the prediction of a large expansion of public sector employment from an increase in resource rents.

Chilean data also allow us to evaluate the effect on allowances received by the members of the municipal council in mining municipalities, which may be indicative of resources being diverted to financial personal wealth accumulation. The municipal council in Chile is composed of the mayor and a group of six to ten council members, depending on the size of the local population, all of whom are elected by popular vote. We find a sizable and statistically significant increase in allowances, while the effect on travel expenses assigned to municipal employees seems to be meaningful for municipalities where mining represents a high percentage of their income. We cannot conclude from this evidence that resource revenues are being diverted, but it is hard to think of efficiency arguments that would justify a considerably higher increase in allowances in mining municipalities relative to other municipalities in the country. When analyzing other municipal expenses, we did not find a significant impact on transfers to health or community programs. The impact on municipal investment is not robust to alternative econometric specifications, and the increase in transfers to education is small with respect to the municipal employment effect.

Our findings have important implications for the fiscal decentralization debate. In resource-abundant economies, the degree of fiscal decentralization is intrinsically related to the direct contribution of resource revenues to local governments. In the case of Chile, the only mining revenues that are managed directly by municipalities correspond to mining licenses, which depend on the size of the exploration and production area, while corporate taxes on profits and sales are not allocated to municipalities. Whether a decentralization process will lead to higher living standards for local communities than this centralized scheme is not clear, since we should consider the efficiency cost of an overexpansion of municipal employment or possible resource diversion for personal purposes. Nevertheless, our results do not lead us to assert that fiscal decentralization should be discarded. For instance, the Robinson-Torvik-Verdier framework also suggests that the extent to which resource revenues are diverted depends on the quality of institutions.⁵ Hence the evidence of this paper reinforces a common policy recommendation, which is not as commonly taken into account: any fiscal decentralization process should be accompanied by improvements in accountability at the local level.

This paper is framed within a large literature that approaches the potential adverse effects of resource windfalls, beginning with the seminal works of Sachs and Warner on the so-called resource curse.⁶ However, empirical evidence is not conclusive, since resource revenues seem to be a blessing for some countries and a curse for others. Some papers empirically show that these divergent results may be caused by differences in the quality of institutions and the specific characteristics of the natural resource that is extracted or by endogeneity issues regarding the resource-intensity variable.⁷ Nevertheless, these divergent results could also be due to the econometric limitations of cross-country comparisons. Since municipalities share a similar institutional framework, culture, and political context, the within-country approach that we use to test the effect of resource windfalls through the political process allows for a clearer causal identification. In that sense, our approach is closely related to a new wave of quantitative studies on the resource curse that exploit pseudo-experiments and within-country variations and estimate local impacts.⁸

5. Robinson, Torvik, and Verdier (2006, 2014).

6. Sachs and Warner (1995, 2001).

7. Boschini, Pettersson, and Roine (2007, 2013); Collier and Goderis (2012); Brunnschweiler and Bulte (2008).

8. Loayza and Rigolini (2016); Dube and Vargas (2013); Caselli and Michaels (2013); among others. See Van der Ploeg and Poelhekke (2017) for a comprehensive review of this new wave of studies on resource revenues.

Our paper contributes to this new approach by providing empirical evidence on specific political economy channels through which resource revenues are claimed to operate—the expansion of public sector employment expenditures and direct transfers to municipal officers.

Two papers are closely related to our work. Using data at the municipal level in Peru, Maldonado documents a nonmonotonic response in electoral outcomes, the provision of public goods, and municipal employment; and he finds a large positive impact on the number of temporary public sector employees.⁹ Similarly, Monteiro and Ferraz find that the increase in oil production in Brazil affects electoral outcomes in the short term but not in the medium term, and they also find a large effect on employees hired on a temporary basis.¹⁰ Our work complements these findings on public sector employment in at least three ways.

First, unlike these previous works, we document that the expansion of municipal employment expenditures is driven by long-term employment, which suggests that the characteristics of local regulations influence the operation of the public sector employment mechanism from resource revenues, but they do not prevent it. Indeed, while Chile imposes several restrictions on the hiring of short-term employees at the municipal level, the opposite is the case in Brazil, where municipalities cannot use oil windfalls to hire permanent employees, which may explain differences in the effects on short- and long-term employment in each case.

Second, while the earlier two papers evaluate effects on the number of public sector employees, we focus on municipal expenditures on public sector employment. Since short-term employees tend to imply lower costs than their long-term peers, it is possible that even if the number of long-term employees has a lower increase, they may account for the largest share of revenue misallocation. Nevertheless, we present evidence on voting effects from the expansion of public sector employment, in order to link higher expenditures on employment to the clientelism mechanism proposed by theory. Moreover, we also approach a possible increase in direct payments to municipal officers by analyzing the allowances assigned to the municipal council.

Third, we use a different mechanism as a source of exogenous variation, namely, a change in the legal framework to assign mining revenues to municipalities, which we interpret as a direct change in the rent channel effect of a resource boom. While significant advances have been made to

9. Maldonado (2014).

10. Monteiro and Ferraz (2012).

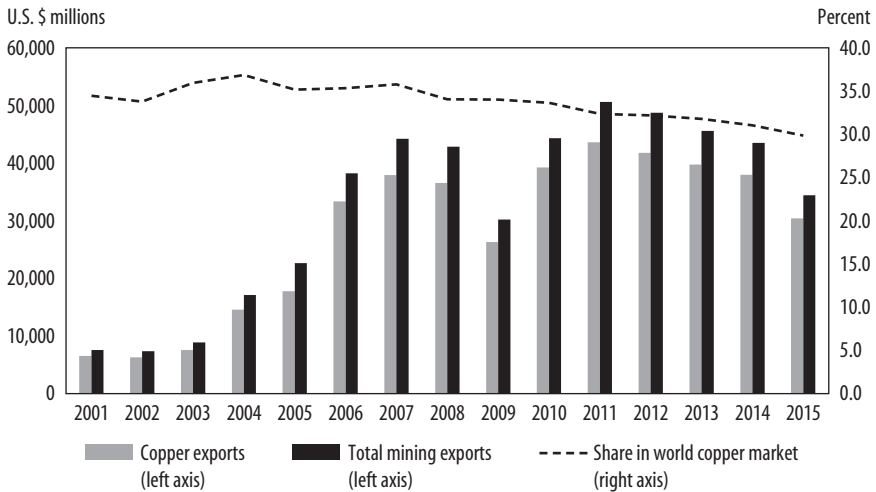
obtain more credible identification strategies of the political resource curse, there is still much to build, and we see our framework as an expansion of traditional strategies exploiting changes in commodity prices and resource discoveries.

The rest of this paper is structured as follows. The next section briefly describes the allocation of mining revenues to municipalities in Chile. The paper then discusses the clientelism mechanism proposed by the theoretical literature. After describing the data and our empirical strategy, we present our results on municipal employment expenditures and other municipal outcomes. The final section offers some concluding remarks.

Mining and Municipalities in Chile

The Chilean economy is intensive in mining production, especially copper, which is its main export product. According to the Chilean Committee of Copper (COCHILCO), copper exports reached U.S. \$30.371 billion in 2015, which represented 47.9 percent of the country's total exports, while the mining sector as a whole accounted for nearly U.S. \$34.400 billion (54.3 percent of total exports). These numbers were even larger during the commodities boom of the 2000s. Chile accounted for 36.9 percent of world copper production in 2004, which gradually diminished to 29.9 percent in 2015. Figure 1 illustrates the evolution of copper exports, overall mining exports, and Chile's share of the copper world market in 2001–15.

The most basic administrative units in Chile are municipalities, for which we have detailed data on income and outcome variables from the National System of Municipal Information (SINIM). Even if mining is one of the main economic activities of the country, municipalities do not directly receive any of the corporate taxes and mining-specific royalties that are charged on mining producers. The only revenues from mining that are collected by municipalities correspond to mining licenses, which must be acquired by mining companies before they can explore and produce in municipal territory. In practice, mining licenses operate as an annual concession, in which those who exploit the territory for exploration or production purposes must pay an associated amount in advance in March of each year. Therefore, mining licenses correspond to a fixed value for each hectare available for exploitation, which is regulated by the Mining Code of Chile (Article X). The total amount collected from mining licenses is distributed between the National Fund for Regional Development (FNDR), which assigns the resources to

FIGURE 1. Evolution of Copper and Total Mining Exports in Chile, 2001–15

Source: Chilean Copper Commission (COCHILCO).

specific development projects at the regional level, and the municipalities where mines operate. Until 2005, 70 percent of the revenue from mining licenses was transferred to the FNDR and the remaining 30 percent was managed by local municipalities. The 2005 legal reform (Law No. 20,033) modified the current distribution rule for mining license revenues (regulated by Law No. 19,143), establishing an equitable distribution of 50 percent to municipalities and 50 percent to the FNDR, which came into force in 2006. The stated aim of this policy was to compensate the local communities that were directly affected by the externalities of mining activities. As we discuss later in the paper, the legal reform was not designed to address the particular financial needs of mining municipalities, and it was not part of a larger reform to improve local finances.

To analyze the relative importance of mining licenses for municipalities, we begin by briefly describing the main components of the municipal budget in Chile, which include the municipality's permanent own income (POI), the Common Municipal Fund (CMF), direct transfers from the central government, and other minor sources. The main difference between the POI and the CMF is the way in which the funds are collected: while the POI corresponds to the municipality's own fiscal revenues, the CMF is a redistribution

TABLE 1. Average Municipal Budget and Mining Licenses in 2005

<i>Municipal budget item</i>	<i>Nonmining municipalities</i>	<i>Mining municipalities^a</i>	
		<i>< 5%</i>	<i>> 5%</i>
POI as % of total budget	0.274	0.299	0.227
CMF as % of total budget	0.525	0.487	0.513
Other sources as % of total budget	0.211	0.214	0.259
<i>Mining licenses</i>			
As % of POI	0.000	0.005	0.355
As % of total budget	0.000	0.001	0.068
No. municipalities	131	161	50

Source: Authors' calculations, based on SINIM data.

Note: a. Mining municipalities are separated into two groups based on the percentage of their permanent own income (POI) that was derived from mining licenses in 2005.

mechanism through which richer municipalities subsidize poorer localities according to established rules.¹¹ Mining licenses are a share of the POI of municipalities located in mining production areas. Table 1 summarizes the municipal budget for 2001–15, considering municipalities located in nonmining areas (131 municipalities); municipalities located in mining production areas where mining licenses represented less than 5 percent of the POI in 2005 (161), the year before the reform was implemented; and municipalities located in mining production areas where mining licenses represented more than 5 percent of the POI in 2005 (50). As discussed below, the breakdown by the relative share of mining licenses in a mining municipality's budget is relevant, since the magnitude of the effect of the 2005 legal reform on municipal revenues was proportional to that.

In 2005, POI accounted for 23 to 30 percent of the total municipal budget, depending on the municipality group considered, while the CMF represented 49 to 52 percent of the total budget. Taken together, these components constitute what is called the municipality's own income (OI), which can be used autonomously by the municipal administration and which accounts for about three-quarters of the total municipal budget. Table 1 also shows the relative importance of mining licenses in the municipal budget. By definition, nonmining municipalities had no income at all from mining licenses in 2005. In

11. Thirty-five percent of the CMF is distributed according to the *permanent own income* (POI) per capita of each municipality. Hence, municipalities that are under the national average of POI per capita receive an amount that is proportional to their distance from the national average. This mechanism implies that when mining municipalities increase their revenues from mining licenses, the rest of municipalities will be relatively poorer, so a portion of the CMF will be redistributed from mining licenses to other municipalities.

municipalities that received less than 5 percent of their POI from mining licenses in 2005, mining licenses accounted for 0.6 percent of the POI, on average, and 0.1 percent of the total budget. Therefore, the legal reform of 2005 should have had little impact on this group of municipalities. However, in a group of fifty municipalities, mining licenses were a major share of the POI in 2005. For this group, mining licenses represented around 7 percent of the total budget, on average, and 35 percent of the POI that year. Thus, over a third of the direct autonomous resources of these municipalities came from mining licenses, as opposed to transfers or redistribution mechanisms. The legal reform of 2005 should have had a meaningful impact on this last group of municipalities.

Mechanisms: Resource Windfalls and Public Sector Employment

One of the channels through which a fiscal windfall is claimed to operate in the political process (in this case, a municipal windfall coming from mining licenses) is addressed by the model developed by Robinson, Torvik, and Verdier.¹² If the probability of remaining in power is an increasing function of active political supporters, an incumbent politician has incentives to expand public sector employment in exchange for political support. Therefore, an increase in fiscal income coming from natural resources may induce the incumbent to offer unproductive jobs in the public sector, which leads to an efficiency loss in the economy.

The Robinson-Torvik-Verdier model can be applied to our local government context under the same arguments, where the mayor is the relevant incumbent politician. In the model, the rise in fiscal income comes from an increase in resource prices that are exogenously determined in world markets. In the Chilean case, municipalities do not collect taxes from resource production or profits, so variation in international prices has no direct impact on the municipal budget, but it may have an indirect impact through production levels. Nevertheless, as we discuss, we claim that the legal reform to mining licenses in 2005 can be viewed as an equivalent exogenous change in municipal income, capturing the rent channel of a resource boom. Moreover, the resource windfall is modeled as a permanent increase in prices instead of short-term fluctuations, so the theoretical model analyzes a permanent resource boom that is, to some extent, analogous to the permanent rise in mining licenses from 30 to 50 percent.

12. Robinson, Torvik, and Verdier (2006, 2014).

A difference in the model, with respect to our context, is that in the case of Chilean municipalities, the incumbent does not decide the amount of resources to be extracted in each period. Instead, the only decision to be made is the amount of resource revenues that will be diverted to patronage and the amount to be used for other municipal expenditures. Nevertheless, the public sector employment mechanism would operate in the same manner. Since this mechanism transfers labor to unproductive jobs in the public sector, the positive income effect of a resource windfall may turn negative if clientelism is too high.

An expansion of public sector employment is not the only way to divert fiscal resources to obtain political support. However, while we do not rule out the possibility that other forms of patronage may also be present, there are reasons to think that clientelism is more likely to occur than transactions involving money payments. According to Robinson and Verdier, an offer of employment may be more credible than the promise of money transfers.¹³ Moreover, an incumbent politician may be able to hire people in advance, while transfers of money could be subject to further institutional restrictions. Along the same lines, Coate and Morris suggest that public sector employment is a less explicit way to obtain political support than direct money transfers, especially in countries where institutions are not particularly weak, as is the case in Chile.¹⁴

The Role of Institutions

Another key feature of the Robinson, Torvik, and Verdier approach is that it can capture the divergent experiences of resource-rich economies in a single framework. In this model, a resource boom increases total income if accountability is strong, but it may decrease income if political institutions are weak. Though Chile is still a developing economy, its political institutions at the national level are significantly stronger than in most Latin American countries, and they also compare well to some members of the Organization for Economic Cooperation and Development (OECD).¹⁵ According to

13. Robinson and Verdier (2013).

14. Coate and Morris (1995).

15. For instance, Chile received the maximum score possible on the Polity2 index (Polity IV database), which measures the quality of democratic institutions. Moreover, Chile ranks twenty-seventh worldwide in the 2018 Corruption Perceptions Index maintained by Transparency International. Later in the paper, we discuss the quality of Chile's institutions and the implications for the resource revenue effect.

our framework, this implies that an overexpansion of public sector employment should be limited in the Chilean case. However, it is also possible that municipalities do not face the same levels of accountability as the central government, especially mining municipalities located in remote areas. Our results provide some insight into whether accountability at the municipal level in a developing country such as Chile is enough to avoid excessive spending on public jobs.

Several empirical works also assert that the presence of a resource curse is conditional on the quality of institutions. Collier and Goderis show that the combination of poor governance and high-rent commodities such as oil and minerals can generate a resource curse in the long run.¹⁶ Boschini, Pettersson, and Roine find that high-value minerals are the most detrimental to economic development in a context of weak institutions, while their later work shows that the adverse effect of minerals can be reversed if institutions are strong enough.¹⁷ Nevertheless, these studies are based on cross-country comparisons that introduce an interaction between institutional quality and a resource-abundance measure into a growth regression. Our approach is slightly different, since we use a within-country setting and focus on a specific channel of resource rents through the political process.

The Debate over Fiscal Decentralization

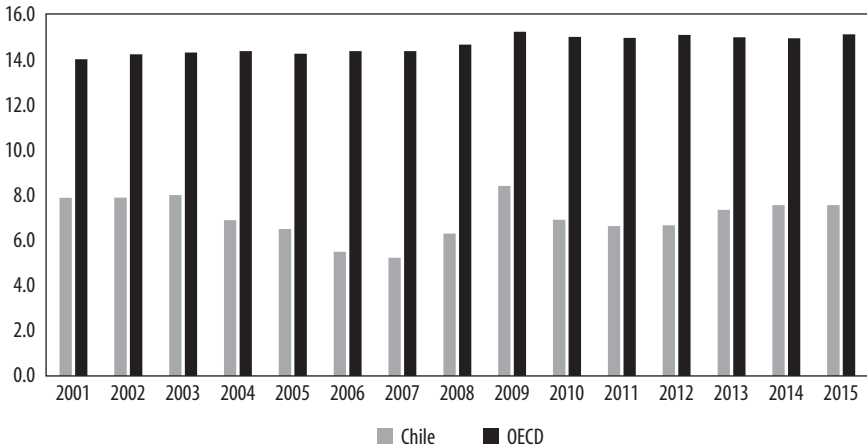
In fiscal terms, Chile is a highly centralized country. As shown in figure 2, tax revenues allocated outside the central government do not exceed 8.5 percent in the sample period, while the OECD average is around 14 percent. In a resource-based economy, fiscal decentralization is closely related to the fiscal contribution of resource production to local communities where resources are extracted. In Peru, a neighboring mining country, 50 percent of taxes from mining companies are directly allocated to local governments where mines operate.¹⁸ Whether the Peruvian decentralized scheme or the Chilean centralized scheme leads to higher living standards for local communities depends, in part, on the effects of resource windfalls through the political process.

According to Loayza and Rigolini, the effect of mining activity on local communities in Peru is mixed, as it has a positive income effect but a negative

16. Collier and Goderis (2012).

17. Boschini, Pettersson, and Roine (2007, 2013).

18. This decentralization scheme is known as the *Mining Canon* in Peru (Loayza and Rigolini, 2016).

FIGURE 2. Percentage of Total Tax Revenues Allocated outside the Central Government

Source: OECD Fiscal Decentralization Database.

distributional effect.¹⁹ However, they focus on the overall effect of mining on socioeconomic outcomes rather than on the specific effect of fiscal revenues through the local government. In a more closely related study, Caselli and Michaels find that an increase in revenues in oil-rich municipalities in Brazil resulted in an expansion of reported spending on public goods and services without a correlate in social outcomes.²⁰ Indeed, their evidence suggests that funds may be allocated to a combination of self-enrichment and vote buying. Maldonado points out that the effect of additional resource rents on public goods provision and clientelism has a nonmonotonic relationship.²¹ Nevertheless, he also documents that even when the provision of public goods increases, it is not comparable to the magnitude of the resource boom. Martínez shows that extra fiscal revenues have a different impact on local communities in Colombia whether they come from taxation or from oil windfalls.²² This suggests that it is the less accountable nature of resource rents, but not the extra revenue itself, that leads to a misallocation of fiscal resources at the local level.

19. Loayza and Rigolini (2016).

20. Caselli and Michaels (2013).

21. Maldonado (2014).

22. Martínez (2016).

We do not aim to find a comprehensive answer concerning the effects of the fiscal decentralization of resource revenues. However, the Chilean quasi-experiment allows us to better understand its consequences through the political process. The presence of the public sector employment mechanism would imply that a fiscal decentralization process should be accompanied by a corresponding improvement of accountability at the municipal level, to ensure that extra revenues will be efficiently spent in the benefit of the community. This is a common policy recommendation, but it is not commonly implemented, in part because of a lack of reliable evidence. This new set of studies based on within-country analysis of resource rents aims to fill that gap.

Empirical Strategy

In 2005 the Chilean parliament approved a reform to the law governing the distribution of revenues from mining licenses (Law No. 19,143). As explained earlier, a mining license gives a mining company the right to exploit the local territory, and the amount paid depends exclusively on the number of hectares used for exploration and mining production. The total amount collected from this item is distributed between a regional fund to finance local development projects (the National Fund for Regional Development) and the municipalities where mines operate. When the 2005 legal reform came into effect, the portion of revenues from mining licenses allocated to municipalities increased from 30 to 50 percent of the total amount collected. We argue that this legal reform can be viewed as an exogenous fiscal windfall for mining municipalities, which provides a useful quasi-experiment to estimate the effect of additional mining revenues through the political process, particularly its impact on public sector employment expenditures.

We first need to analyze the validity of the 2005 legal reform as an adequate framework for our empirical strategy. One issue is whether the reform was effectively exogenous to mining municipalities, since municipalities could have influenced the legal change by allocating resources to lobby and influence public debate. Since most of the affected municipalities were small units, which did not have enough resources to individually affect public policy decisions, a key element is whether mining municipalities joined efforts to affect political outcomes. In Chile, for the past twenty-five years, municipalities have been grouped in the Chilean Association of Municipalities (ACHM), which represents municipalities before other public authorities or the private

sector. However, this organization is structured at the national level and does not directly pursue the interests of mining municipalities, while the legal reform was only relevant for this subgroup of municipalities. In the absence of an organization to look after their own interests, mining municipalities formed the National Association of Mining Municipalities in 2010. Prior to that, these municipalities were not properly organized for lobbying purposes and thus had very limited political power to influence public policy when the reform was being discussed in 2005. Since its foundation, the National Association of Mining Municipalities has proposed additional legal changes affecting mining revenues. Because this was not the case in 2005, mining municipalities had very limited political power to influence public policies by that time.

Another issue is the motivation behind the 2005 legal reform. It could have been the case that mining municipalities had larger financial needs than non-mining municipalities, which induced the reform to mining licenses. This would be problematic to the validity of the exogeneity condition. Moreover, in that case an increase in employment expenditures after the reform could just reflect a prior deficit in human resources. However, this was not the case of the 2005 legal reform. First, the declared aim of this policy was to compensate the local communities that are directly affected by the externalities of mining activities, and not to approach the financial needs of mining municipalities.²³ Indeed, the 2005 legal reform affected only mining licenses, and it was not part of a larger reform to improve municipalities' financial resources. In addition to the explicit aims of the legal reform, there is the fact that mining municipalities were, on average, richer than municipalities located in nonmining areas. In 2005 the average municipal revenues of mining municipalities where over 5 percent of their POI came from mining (which benefited the most from the reform) was CLP 364,000 per capita. This is far more than the average municipal budget of municipalities without any mining activity in their territories (CLP 211,000 per capita).

Even if the 2005 reform can be viewed as a mostly exogenous change, we still need to analyze whether it can be interpreted as a resource windfall. Most of the recent contributions that analyze the impact of resource windfalls on political outcomes interpret them as an increase in the resource rents that a governmental unit receives, commonly due to an exogenous increase in commodity prices.²⁴ However, Maldonado points out that resource windfalls

23. This fact is well documented in the minutes of the parliamentary discussions of Law No. 20,033 during 2005 (Library of Congress of Chile).

24. Caselli and Michaels (2013); Monteiro and Ferraz (2012); Martínez (2016).

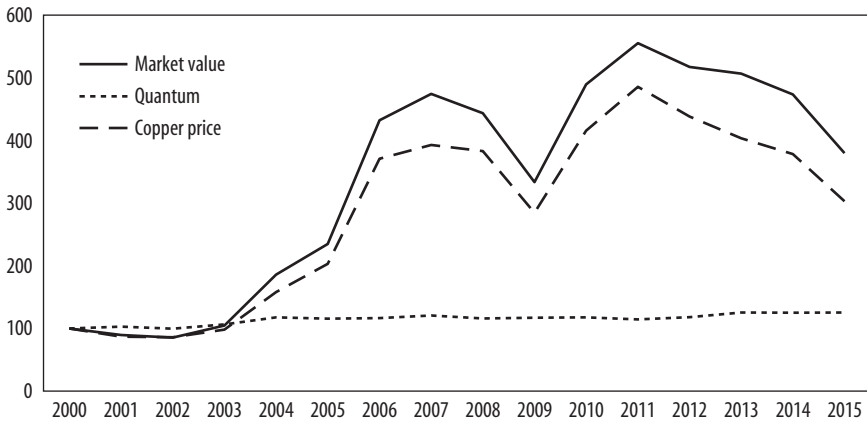
should be understood as a more complex phenomenon that can be associated with shocks not only in resource rents but also in production, and production changes may also have relevant effects through the political process.²⁵ Following this definition, we argue that the legal reform of 2005 can be interpreted as the rent channel of a resource windfall, which allows us to identify the specific effects of this channel on municipal outcomes. Indeed, the impact of the 2005 legal reform on municipal revenues is equivalent to the impact that an increase in commodity prices would have on fiscal revenues in a country with royalties or direct taxes on mining profits. While an increase in prices may be associated with an increase in production, this is not the case of our legal reform framework, which allows us to better isolate the effect of the rent channel than the previous studies that attempted to do so. It is important to distinguish between the two effects since, as shown by Maldonado, changes in rents may have different consequences for political outcomes than changes in production.²⁶

A final concern is that even if the 2005 legal reform provides an appropriate design to clarify the effects of the rent channel versus the production channel, we cannot dismiss the fact that a commodity price boom was occurring by the time the reform was implemented. If the 2000 boom in mining prices led to an increase in mining production, this could be problematic in at least two main aspects. First, since the cost of a mining license depends on the size of the mining operations, the increase in mining license revenues received by municipalities could be due not only to the 2005 legal reform, but also to an increase in production. Second, as we already discussed in this section, an increase in mining production can also affect the political outcomes of interest. To explore this issue, figure 3 shows the evolution of the value of copper production in the sample period, which accounts for around 90 percent of the entire mining sector, decomposed between its quantum component (metric tons produced) and its price component.²⁷ The increase in the market value of copper production in the 2000s was almost entirely due to price variation, while real quantities produced were relatively stable. For instance, the metric tons of copper produced decreased in some years following the legal reform of 2005 (namely, in 2005, 2008, 2011, and 2014), increased less than 2 percent in others (2006, 2009, 2010, and 2015), and

25. Maldonado (2014).

26. Maldonado (2014).

27. Central Bank of Chile, National Accounts.

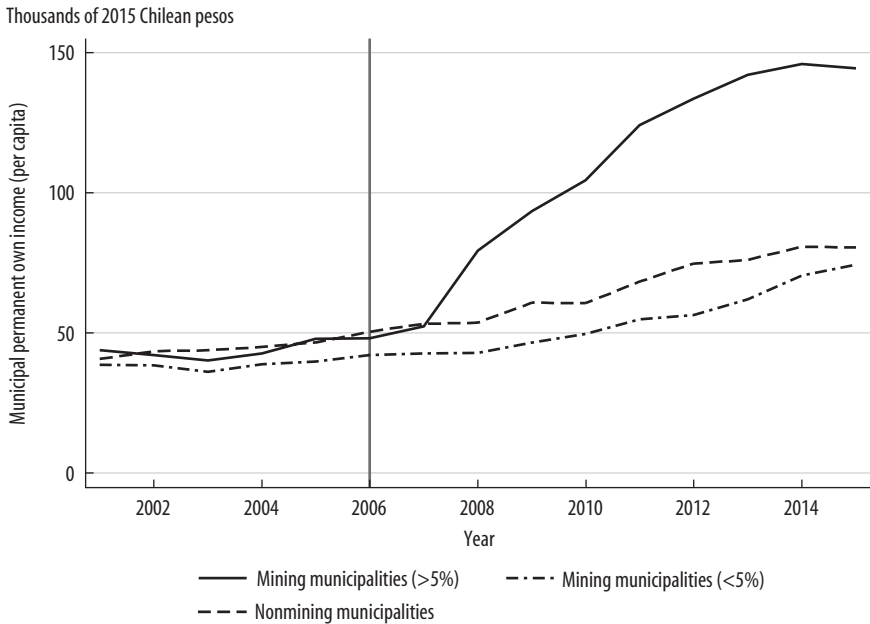
FIGURE 3 . Decomposition of Copper Production Value in Chile, 2000–15

Source: Chilean Copper Commission (COCHILCO); Central Bank of Chile.
 Note: Fixed-base index: 2000 = 100.

only exceeded a 5 percent growth in 2013 (6.3 percent). This evidence suggests that the price boom in Chile did not translate into a relevant production effect, which diminishes the concerns about this channel affecting our analysis. However, small aggregate increases in production could still have relevant effects for some specific municipalities. Since we do not possess reliable data on production at the municipal level, we should take this issue into account when interpreting our results.

The Treated: Mining Municipalities

Our empirical strategy is based on comparing municipalities located in mining areas, which were affected by the reform of 2005, to their peers located in nonmining areas. However, the definition of our treatment group is not as straightforward as it may at first seem. Since the reform established that all municipalities with mining activities in their territory will benefit from a twenty-percentage-point increase in the share collected from mining licenses, the magnitude of the effect on municipal revenues is proportional to the relative importance of mining licenses in the municipal budget before the reform was implemented. Therefore, even if in the abstract all municipalities located in mining areas are considered by the 2005 legal reform, in practice some of them were not effectively treated, since the reform implied an insignificant increase in their municipal revenues.

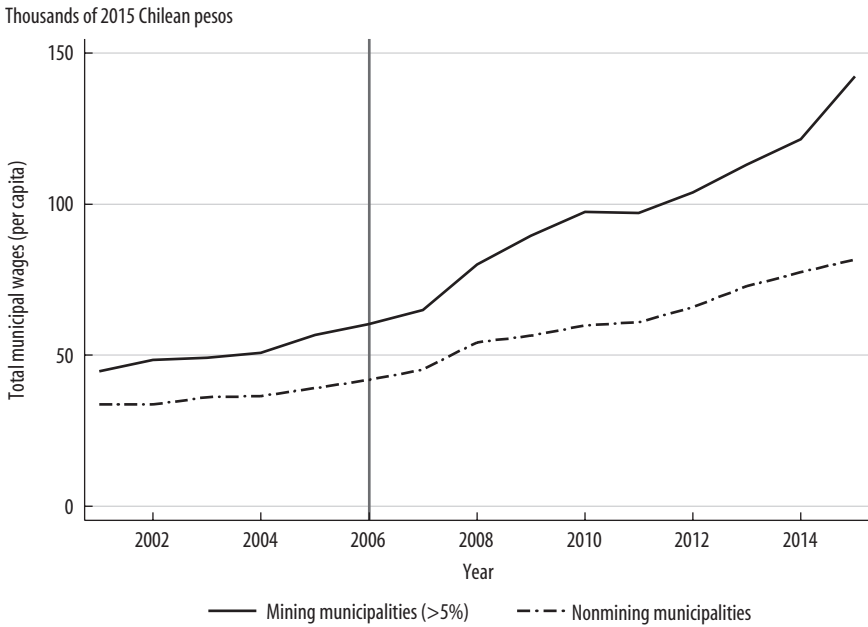
FIGURE 4. Municipal Permanent Own Income, by Share of Income from Mining Licenses

Note: Municipalities were grouped according to the percentage of their permanent own income (POI) that derived from mining licenses in 2005: zero (nonmining municipalities), less than 2.5 percent, less than 5 percent, and over 5 percent.

Figure 4 shows the trend in POI, in per capita terms, for different municipality groups according to the percentage of POI collected from mining licenses the year before the reform entered into force. Municipalities for which mining licenses represented less than 5 percent of POI followed a parallel trend to municipalities located in nonmining areas, both before and after the reform was implemented. This suggests that the effect of the legal reform of 2005 was negligible for this group. In municipalities in which mining licenses represented more than 5 percent of their POI, however, the trend parallels nonmining municipalities before the reform but increases sharply after the reform.

Another reason why the 2005 legal reform may have had little effect on mining municipalities with a very low share of income from mining licenses has to do with the Chilean fiscal rule for allocating financial resources to municipalities. As mentioned, municipalities receive transfers from the Common Municipal Fund (CMF) to finance their operations. The fund operates as a redistribution mechanism through which wealthier

FIGURE 5. Municipal Employment Expenditures: Mining versus Nonmining Municipalities



Note: Mining municipalities derived over 5 percent of their permanent own income (POI) from mining licenses in 2005. Nonmining municipalities are all municipalities that did not receive any income from mining licenses in 2005.

municipalities subsidize poorer municipalities. Thirty-five percent of the transfer depends on the municipality’s POI. Since an increase in mining licenses translates into a higher POI, the increase may be partially offset by a reduction in CMF transfers.

The above analysis suggests that an adequate empirical strategy should consider municipalities for which mining licenses represented more than 5 percent of their POI as the treatment group, since they were actually affected by the legal reform. Figure 5 shows that our main variable of interest, municipal employment expenditures in per capita terms, meets the parallel trend assumption when this treatment group is compared with nonmining municipalities. Municipal employment expenditures were already higher in this group of mining municipalities before 2005, but the trend ran parallel to their nonmining pairs. After the legal reform came into effect, both groups seem to increase their expenditures on municipal employment, but the rise is considerably sharper in mining municipalities. Therefore, a difference-in-differences

approach seems suitable for evaluating the effect of additional revenue from mining licenses on municipal employment expenditures. We also observe that the increase in municipal employment occurred one year after the reform took effect, and it continued expanding in subsequent years. This suggests that municipalities had a lagged and gradual response to the increase in their budget from mining licenses.

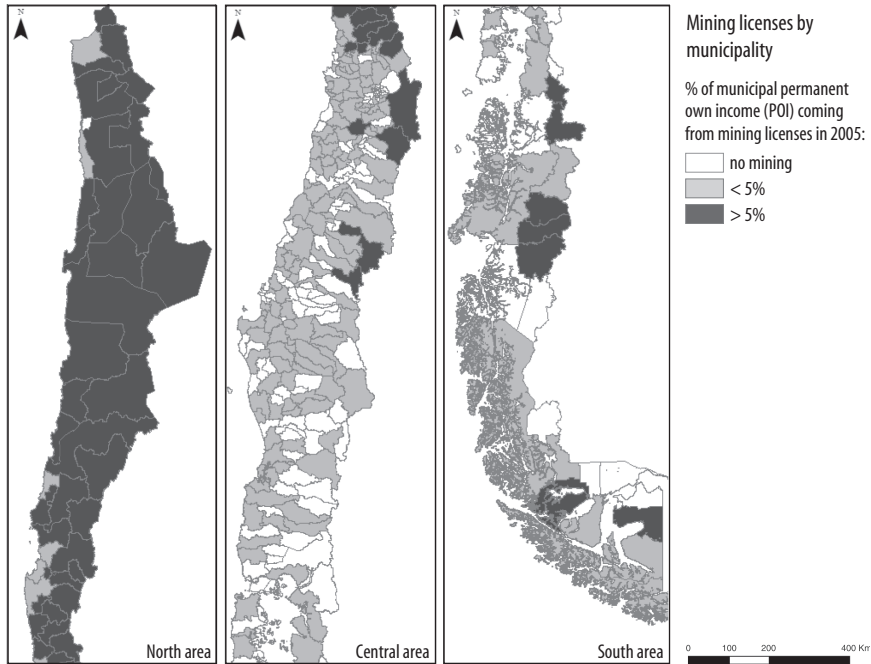
Although the group of mining municipalities that received more than 5 percent of POI from mining licenses seems like the suitable treatment group, this approach has relevant issues. The main problem is that we are excluding a significant number of municipalities located in producing areas. Under this criterion, the treatment group is composed of fifty mining municipalities and the control group contains 131 nonmining municipalities. This leaves 161 municipalities with some income from mining licenses that are not being considered in the analysis. Moreover, there is not a clear economic justification for using the 5 percent cutoff instead of a different threshold. Therefore, we also employ a second econometric strategy, in which we estimate an extended difference-in-differences model that includes an interaction term between the treated municipalities and the percentage of their POI deriving from mining licenses the year before the reform was implemented. This allows us to account for the fact that the legal reform had a proportional effect that could be meaningless to some mining municipalities without reducing the number of observations in our sample.

Finally, figure 6 presents the location of mining municipalities that had more than 5 percent of POI coming from mining in 2005, mining municipalities that had less than 5 percent of POI coming from mining in 2005, and nonmining municipalities. Most of the municipalities with a high share of income from mining licenses are concentrated in the north-central regions of the country, where most of the copper industry is located. We therefore evaluated an alternative specification in which we compared mining municipalities to their nonmining counterparts located in the north-central area, to account for possible common shocks affecting these regions of the country. The results of this exercise are consistent with the main results shown below and are available on request.

The Empirical Model

The main interest of this paper is to explain the effect on municipal employment expenditures from a resource windfall, as well as its impact on other municipal expenses. Our empirical strategy exploits the 2005 legal reform

FIGURE 6. Geographic Location of Mining and Nonmining Municipalities



Source: Authors' construction using SINIM data on mining licenses and municipal permanent own income (POI).

of mining licenses by comparing mining municipalities to municipalities located in nonproducing areas, for which we use two econometric models. We first use a standard difference-in-differences (DD) strategy, considering the group of mining municipalities that were affected by the 2005 legal reform as our treatment group. As we discussed above, the effect of the 2005 legal reform was insignificant for a large group of mining municipalities, since its impact on municipal income depended on the relative importance of mining licenses in a given municipality's POI before the reform was implemented. Therefore, we defined our treatment group as municipalities located in producing areas for which mining licenses represented at least 5 percent of their POI in 2005. The DD specification is as follows:

$$(1) \quad Y_{mt} = \alpha_m + \gamma_t + \beta(\text{POST}_t \times \text{MIN5}_m) + \varepsilon_{mt},$$

where Y_{mt} is a set of municipal outcomes in per capita terms for municipality m in year t ; α_m and γ_t are municipality and year fixed effects, respectively, to account for specific characteristics at the municipality level and common shocks that could have affected all municipalities in a certain year; $POST_t$ is a dummy variable that takes a value of one in the years after the legal reform was approved and zero otherwise; and $MIN5_m$ is a dummy variable that takes a value of one if the municipality belongs to the defined treatment group of mining municipalities (where mining licenses represented more than 5 percent of POI before the legal reform was in force) and zero otherwise. The parameter of interest is β , which follows the interaction between $POST_t$ and $MIN5_m$, and accounts for the differentiated effect on treated mining municipalities with respect to nonmining municipalities. Finally, ε_{mt} is the error term.

The standard DD estimator seems to be a natural approach to analyze the effect of the 2005 legal reform on mining revenues and municipal outcomes, but the definition of the treatment group can be problematic. As shown earlier in figure 4, the revenues of municipalities for which mining licenses represented less than 5 percent of their POI in 2005 follow a parallel trend to the group of municipalities located in nonmining areas, which suggests that they were not effectively treated. However, there is no clear economic justification for using the 5 percent cutoff. Moreover, by establishing the 5 percent cutoff, we are ruling out a significant number of municipalities that are located in producing areas. To address this concern, we use a modified DD specification, in which we control for the relative importance of mining licenses in mining municipalities:

$$(2) \quad Y_{mt} = \alpha_m + \gamma_t + \beta_1 (POST_t \times MIN0_m) + \beta_2 (POST_t \times MIN0_m \times PAT_m) + \beta_3 PAT_m + \varepsilon_{mt},$$

where $MIN0_m$ is a dummy variable that takes the value of one if the municipality is located in a mining producing territory, so we do not exclude extra municipalities from our sample, and PAT_m is the ratio of mining licenses to the POI in municipality m in 2005. The main difference between specifications 1 and 2 is that, besides using $MIN0_m$ instead of $MIN5_m$ we introduce an interaction term between $POST_t \times MIN0_m$ and PAT_m , which accounts for the differential effect of the 2005 legal reform on mining municipalities' outcomes depending on the relative importance of mining licenses in municipal income. Since the effect of the reform on municipal income was proportional to the relevance of mining licenses, this specification incorporates the intensity of

TABLE 2. Summary Statistics for Total Municipal Revenues and Employment Expenditures, Per Capita

Chilean pesos, per capita

Type of municipality and statistic	2001–05			2006–15		
	Obs.	Mean	Std. dev.	Obs.	Mean	Std. dev.
Mining municipalities (> 5%)						
Total municipal revenues	246	319,310	432,670	496	539,060	782,630
Total wages	246	49,950	63,740	496	96,860	164,930
Long-term contracts	246	37,270	44,840	496	70,580	117,050
One-year contracts	246	8,400	11,540	496	19,010	34,780
Short-term contracts	246	4,280	8,470	496	7,270	16,310
Mining municipalities (< 5%)						
Total municipal revenues	801	144,840	169,170	1,606	217,270	216,200
Total wages	801	24,740	19,180	1,606	41,560	56,330
Long-term contracts	801	19,100	14,790	1,606	30,260	40,970
One-year contracts	801	4,140	4,290	1,606	8,430	11,780
Short-term contracts	801	1,510	1,270	1,606	2,860	9,070
Nonmining municipalities						
Total municipal revenues	641	196,600	247,480	1,304	310,750	414,370
Total wages	641	35,800	42,150	1,304	61,630	85,840
Long-term contracts	641	27,860	32,160	1,304	45,320	63,680
One-year contracts	641	5,690	7,510	1,304	11,720	15,640
Short-term contracts	641	2,250	5,100	1,304	4,590	13,380

Notes: All variables are expressed in Chilean pesos at constant 2015 prices, per capita. Mining municipalities are separated into two groups based on the percentage of their permanent own income (POI) deriving from mining licenses in 2005.

the treatment in our estimation. Therefore, β_2 accounts for whether the effect of the legal reform on municipal outcomes was conditional on the initial level of mining licenses.²⁸

Descriptive Statistics

Most of our data are from the National System of Municipal Information (SINIM), which contains highly disaggregated data on municipal revenues and expenditures during the period 2001–15. In this section, we explore the characteristics of our sample in the periods before (2001–05) and after (2006–15) the treatment. Table 2 presents summary statistics for our main municipal outcomes, that is, total municipal revenues and municipal

28. We also evaluated an alternative instrumental variable (IV) approach, in which we used the 2005 legal reform as an instrument for the change in municipal revenues. The results under the IV approach were consistent with the main results that we show here for both DD models; they are available on request.

employment expenditures in per capita terms, distinguishing between mining municipalities with more than 5 percent of their POI from mining licenses in 2005 (municipalities with high income from mining), mining municipalities with less than 5 percent of their POI from mining in 2005 (municipalities with low income from mining), and nonmining municipalities.

As the table shows, before the legal reform (2001–05), the expenditure on wages was higher in mining municipalities with over 5 percent of their POI coming from mining licenses (CLP 49,950 per capita) than in nonmining municipalities (CLP 35,800).²⁹ The group with the lowest expenditures on wages was the mining group with less than 5 percent of POI from mining licenses (CLP 24,740). After the legal reform went into effect, wages in municipalities with high mining income rose to CLP 96,860 in 2006–15, equivalent to a 94 percent increase. Meanwhile, wages rose to CLP 61,630 in the nonmining group, which represents a 72 percent increase. This shows that after 2005, wages grew much faster in municipalities that received significant additional revenues from mining licenses. On the other hand, total wages per capita grew most slowly in municipalities that had low mining income at the time of the reform (67 percent).

When we disaggregate per capita expenditures by the length of the employment contract (long-term, annual, and short-term), we arrive at similar conclusions for long-term and annual contracts, while only short-term wages grew faster in nonmining municipalities than in municipalities with high mining income. In fact, after the 2005 legal reform, long-term wages in municipalities with high mining income increased 89 percent, while they grew only 63 percent in the nonmining group and 58 percent in mining municipalities with low income from mining. One-year contracts increased by 126 percent in municipalities with high mining income versus 106 percent in the nonmining group and 104 percent in mining municipalities with low income from mining.

Although the percentage increase was highest for one-year contracts in all groups, they account for a smaller share of total wages than long-term-contract employees, which reflects the Chilean municipal rules that put stricter limits on hiring short-term and contract workers than on hiring long-term employees. Moreover, the increase in long-term wages in municipalities with high mining income was greater, relative to the increase in the nonmining group, than the other two categories of municipal employment.

29. All amounts are expressed in Chilean pesos at constant 2015 prices. In 2015 the exchange rate was 650 pesos to the U.S. dollar.

TABLE 3. Summary Statistics for Other Municipal Expenditures, Per Capita

<i>Type of municipality and statistic</i>	<i>2001–05</i>			<i>2006–15</i>		
	<i>Obs.</i>	<i>Mean</i>	<i>Std. dev.</i>	<i>Obs.</i>	<i>Mean</i>	<i>Std. dev.</i>
Mining municipalities (> 5%)						
Allowances	246	7,400	15,740	496	17,750	47,490
Travel expenses	246	7,560	19,180	496	9,030	29,230
Municipal investment	246	61,400	87,130	496	91,550	127,490
Transfers to education	246	23,750	32,090	496	39,820	53,440
Transfers to health	246	11,420	14,800	496	17,560	25,840
Community programs	246	1,610	4,400	496	3,340	6,990
Mining municipalities (< 5%)						
Allowances	801	2,080	5,270	1,606	3,660	11,550
Travel expenses	801	1,220	3,810	1,606	1,560	4,920
Municipal investment	801	28,440	50,770	1,606	32,590	40,320
Transfers to education	801	11,650	12,410	1,606	16,920	22,030
Transfers to health	801	6,740	8,240	1,606	10,380	18,270
Community programs	801	570	1,000	1,606	1,400	2,190
Nonmining municipalities						
Allowances	641	3,860	9,000	1,304	7,120	16,890
Travel expenses	641	1,800	4,000	1,304	2,280	4,800
Municipal investment	641	36,160	67,480	1,304	53,360	121,220
Transfers to education	641	16,120	26,410	1,304	23,740	43,150
Transfers to health	641	7,690	9,640	1,304	12,910	24,330
Community programs	641	740	1,410	1,304	1,950	3,470

Notes: All variables are expressed in Chilean pesos at constant 2015 prices, per capita. Mining municipalities are separated into two groups based on the percentage of their permanent own income (POI) deriving from mining licenses in 2005.

Table 3 presents summary statistics for other municipal outcomes in per capita terms, which include allowances for the municipal council, travel expenses, municipal investment, transfers to health, transfers to education, and transfers to community programs. We observe a particularly large increase in allowances for the municipal council, which grew from CLP 7,400 per capita before the reform was implemented to CLP 17,750 per capita afterward, that is, a 140 percent increase. This growth rate is well above the increase in the nonmining group (84 percent) and in municipalities with low income from mining (76 percent). In contrast, other municipal expenditures did not increase more in the group of municipalities with high mining income than in the nonmining group. In fact, municipal investment per capita increased 49 percent in both groups; transfers to health increased 54 percent in municipalities with high mining income and 68 percent in nonmining municipalities; and transfers to community programs increased 107 percent and 163 percent, respectively. Only transfers to education grew more in municipalities with

TABLE 4. Impact of Mining Revenues on Per Capita Municipal Employment Expenditures: Difference-in-Differences Results

<i>Explanatory variable</i>	<i>Total municipal revenues</i> (1)	<i>Employment expenditures</i>			
		<i>Total</i> (2)	<i>Long-term</i> (3)	<i>One-year contracts</i> (4)	<i>Short-term</i> (5)
POST × MINS	101.72*** (21.60)	21.40*** (5.38)	16.02*** (3.87)	4.73*** (1.22)	0.64 (0.59)
Municipality fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
No. observations	2,690	2,687	2,687	2,687	2,687

Notes: All dependent variables are expressed in thousands of Chilean pesos at constant 2015 prices. MINS includes mining municipalities where more than 5 percent of their permanent own income (POI) derived from mining licenses in 2005. POST is a dummy variable that takes the value of one in the years after the legal reform was implemented. Robust standard errors are reported in parentheses.

*** Statistically significant at the 1 percent level.

high mining income, increasing 68 percent versus 48 percent in nonmining municipalities. These are no more than descriptive statistics, but they suggest a clear difference between the allocation of resources to municipal employment expenditures with respect to other components of municipal spending after the 2005 reform.

Results

In this section we start by analyzing the impact of additional mining revenues on total municipal revenues and employment expenditures, distinguishing among different kinds of municipal employees. Table 4 shows the results using the standard DD model, in which the treatment group is defined as municipalities with high mining income, that is, mining municipalities with at least 5 percent of their POI from mining licenses the year before the legal reform entered into force. In column 1, we show that municipal revenues effectively increased for this group of mining municipalities as a consequence of the 2005 reform. The point estimate is an increase of CLP 101,720 per capita, with a statistical significance of 1 percent. This is a meaningful increase in municipal revenues given that average municipal revenues were around CLP 465,808 per capita for this group of mining municipalities during the whole sample period. Evaluating the impact on total municipal revenues is an important step for the analysis, since the 20-percentage-point increase in mining licenses could have been partially offset by a reduction in redistributive

transfers received from the CMF, a reduction in other direct transfers from the central government, or an increase in incentives to fiscal laziness in other components of the POI that are collected by the municipality itself.

Column 2 presents the results for total municipal employment expenditures per capita. The magnitude of this effect is CLP 21,400 per capita, with a statistical significance of 1 percent, while the average municipal employment expenditures for this group of mining municipalities was CLP 81,309 per capita for the sample period. Columns 3–5 present disaggregated results for the three main categories of municipal employment in Chile. According to these results, the largest increase in employment expenditures corresponds to long-term employees (called *planta* in Chile), which account for around 75 percent of the total increase in municipal employment expenditures. Workers with a one-year contract (*contrata*) account for around 22 percent of the total increase in employment expenditures. Both coefficients are statistically significant at the 1 percent level. In contrast, short-term employees (*honorarios*) account for only 3 percent of the total effect on wage expenditures, but the coefficient is not statistically significant. These proportions may be partially explained by the differentiated legal restrictions that affect different categories of municipal employees. Namely, expenditures on long-term employees cannot exceed 35 percent of the municipality's own income, while one-year contracts cannot exceed 20 percent of long-term wages (Law No. 18,883), and short-term contracts cannot exceed 10 percent of long-term wages (Law No. 19,280).³⁰

Table 5 shows the results using the extended DD model, in which we consider all mining municipalities as the treatment group and include an interaction term to account for the relative importance of mining licenses in municipal POI the year before the reform came into effect. This approach allows us to avoid excluding municipalities with low mining income from the sample, even if the 2005 reform may have had an insignificant effect on their municipal budget. Column 1 shows the effect on total municipal revenues per capita. The DD coefficient has a negative and statistically significant effect at the 1 percent level, while the interaction term has a positive and statistically

30. Law No. 18,883 was recently modified by Law No. 20,922, which expanded the limit on long-term employee expenditures from 35 to 42 percent of own income, while the limit on one-year contracts was raised from 20 to 40 percent of long-term employee expenditures. This new regulation was published in May 2016, after the end of our sample period, so it does not affect our analysis.

TABLE 5. Impact of Mining Revenues on Per Capita Municipal Employment Expenditures: Extended Difference-in-Differences Results

<i>Explanatory variable</i>	<i>Total municipal revenues</i> (1)	<i>Employment expenditures</i>			
		<i>Total</i> (2)	<i>Long-term</i> (3)	<i>One-year contracts</i> (4)	<i>Short-term</i> (5)
POST × MINO	−32.83*** (9.85)	−7.62*** (2.44)	−5.00*** (1.76)	−1.45*** (0.52)	−1.17*** (0.40)
POST × MINO × PAT	294.73*** (94.92)	72.45*** (25.40)	49.59*** (17.45)	16.56*** (5.86)	6.31** (2.55)
Municipality fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
No. observations	5,098	5,094	5,094	5,094	5,094

Notes: All dependent variables are expressed in thousands of Chilean pesos at constant 2015 prices. MINO includes mining municipalities. POST is a dummy variable that takes the value of one in the years after the legal reform was implemented. PAT is the percentage of a given municipality's permanent own income (POI) that came from mining licenses in 2005. Robust standard errors are reported in parentheses.

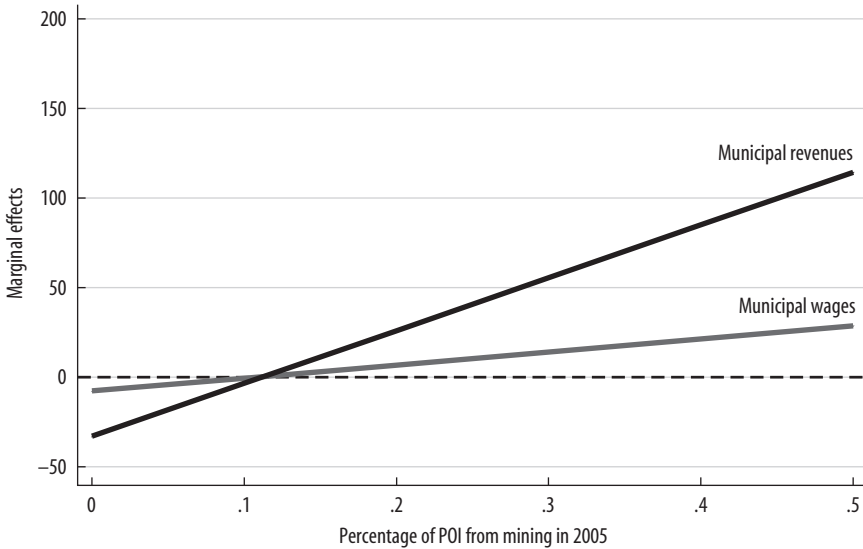
** Statistically significant at the 5 percent level.

*** Statistically significant at the 1 percent level.

significant effect at the 1 percent level. Consistent with the previous analysis, this means that whether the reform had a positive impact on a municipality located in a mining area depends on the relative contribution of mining licenses to the municipal budget. Column 2 shows similar results for municipal employment expenditures. To interpret these results, we compute marginal effects according to the percentage of the POI that came from mining licenses in 2005. Figure 7 plots marginal effects for municipal revenues and employment expenditures. Under this estimation, the effect on municipal revenues becomes positive for municipalities that received more than 10.1 percent of their POI from mining licenses in 2005, while the effect on employment expenditures becomes positive after 10.5 percent.

Columns 3–5 show the disaggregated impact on different municipal employment categories. These results are consistent with those obtained with the standard DD model, with long-term employment expenditures accounting for the largest share of the total increase in municipal employment expenditures. Computing marginal effects shows that the coefficients for long-term, annual, and short-term employment turn positive for municipalities that derived at least 9.1, 8.8, and 18.5 percent of their POI from mining, respectively. Short-term employment continues to account for the smallest part of the aggregate effect on employment expenditures, but it now has a statistically significant contribution for municipalities with large revenues from mining. Considering that the average ratio of mining licenses to POI was

FIGURE 7. Marginal Effects of the Impact of Mining Revenues on Total Municipal Revenues and Municipal Employment Expenditures



Notes: The figure plots the average marginal effects of mining revenues on total municipal revenues and municipal employment expenditures, according to the relative importance of mining licenses in the municipality's permanent own income (POI) in 2005. Marginal effects are computed using the results from the extended DD model shown in table 5.

35.5 percent for the high mining income group (those with more than 5 percent of their POI from mining in 2005), the average municipality in this group would see per capita increases of CLP 12,604 in long-term employment, CLP 4,429 in annual employment, and CLP 1,070 in short-term employment, for a total employment effect of CLP 18,099 per capita. This represents almost a quarter of average expenditures on municipal employment for this group of municipalities in the sample period (CLP 81,309).

These results are consistent with the framework outlined by Robinson, Torvik, and Verdier, in which an exogenous fiscal windfall generated by natural resources is allocated to public sector employment.³¹ According to the same model, our results suggest that Chilean institutions at the municipal level are not strong enough to eliminate the public sector employment mechanism. Two points stand out. First, our results show that this mechanism operates mainly through long-term employment, whereas studies for Peru and

31. Robinson, Torvik, and Verdier (2006, 2014).

Brazil find that the mechanism operates through temporary employees.³² This may reflect the fact that Chile imposes stricter restrictions on hiring short-term employees than on hiring long-term employees. In Brazil, municipalities cannot use revenues from resource windfalls to hire long-term employees. Our results thus suggest that the public sector employment mechanism can operate through different categories of employees, depending on local restrictions and regulations, and is not limited to temporary employees. Second, we focus on municipal employment expenditures by job category, while previous studies analyzed the effects on the number of employees. Since long-term employees tend to be costlier than their short-term peers, the main source of revenue misallocation could reside in long-term employment even if there was a larger increase in short-term versus long-term employees.

Effects on Allowances, Travel Expenses, and Other Municipal Expenditures

In this section, we evaluate the effect of additional mining revenues on municipal outcomes that may be associated with the diversion of resources to personal benefit and compare them with other municipal outcomes that may be more directly linked to improvements in the living standards of the local community.

We first evaluate the evolution of the allowances assigned to the municipal council. In Chile, the municipal council is composed of the mayor and a group of six to ten councilors (depending on the size of the local population) who are directly elected by popular vote. Since allowances are intended to finance the execution of municipal council tasks, there is no obvious reason for the municipal council's needs to have suddenly increased in mining localities with respect to other municipalities in the country. Thus a large increase in allowances does not constitute conclusive evidence that revenues are being siphoned off for the accumulation of personal wealth, but it does point in that direction. Table 6 shows the results for the standard DD model. Column 1 shows a point estimate of CLP 7,060 per capita for allowances assigned to the municipal council, with a statistical significance of 1 percent. This a meaningful effect insofar as municipal council allowances averaged CLP 14,318 in the whole sample period for the group of mining municipalities with more than 5 percent of their POI from mining. Column 2 shows results for travel expenses assigned to municipal employees, but in this case the effect is not statistically significant.

32. Maldonado (2014); Monteiro and Ferraz (2012).

TABLE 6. Impact of Mining Revenues on Per Capita Allowances, Travel Expenses, and Other Municipal Expenditures: Difference-in-Differences Results

<i>Explanatory variable</i>	<i>Municipal council allowances</i> (1)	<i>Travel expenses</i> (2)	<i>Municipal investment</i> (3)	<i>Transfers to education</i> (4)	<i>Transfers to health</i> (5)	<i>Transfers to community programs</i> (6)
POST × MINS	7.06*** (1.64)	1.00 (0.73)	12.49** (6.19)	8.31*** (1.92)	0.49 (1.04)	0.47 (0.31)
Municipality fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
No. observations	2,687	2,687	2,687	2,688	2,687	2,686

Notes: MINS includes mining municipalities where more than 5 percent of their permanent own income (POI) derived from mining licenses in 2005. POST is a dummy variable that takes the value of one in the years after the legal reform was implemented. All dependent variables are expressed in thousands of Chilean pesos at constant 2015 prices. Robust standard errors are reported in parentheses.

** Statistically significant at the 5 percent level.

*** Statistically significant at the 1 percent level.

Columns 3–6 show results for municipal outcomes that may be closely related to public goods provision and local living standards. We observe a statistically significant increase in municipal investment of CLP 12,490 per capita, but this result is not robust to using the extended DD model, as we discuss below. We do find a statistically significant effect on transfers to education of CLP 8,310 per capita. To assess whether the allocation of new mining revenues was balanced among the different local needs, it is illustrative to notice that the effect on transfers to education is only slightly higher than the effect on municipal council allowances. Moreover, we did not find a statistically significant effect on transfers to health or community programs.

Table 7 presents our results for the extended DD model. The effects on municipal council allowances and transfers to education are consistent with the results of the standard DD model. In this case, however, the effect on travel expenses may be positive and statistically significant for municipalities that had more than a certain level of mining licenses. In particular, when marginal effects are computed on travel expenses, the effect turns positive for municipalities where more than 8 percent of their POI derived from mining licenses in 2005. On the other hand, the extended DD model does not support a positive impact on municipal investment for any level of income coming from mining. Finally, while we did not find any effect on transfers to community programs, according to the extended DD model the effect on transfers to health may be positive in municipalities with large mining revenues (in particular, in municipalities where more than 29 percent of their POI came from mining in 2005).

TABLE 7. Impact of Mining Revenues on Per Capita Allowances, Travel Expenses, and Other Municipal Expenditures: Extended Difference-in-Differences Results

<i>Explanatory variable</i>	<i>Municipal council allowances</i> (1)	<i>Travel expenses</i> (2)	<i>Municipal investment</i> (3)	<i>Transfers to education</i> (4)	<i>Transfers to health</i> (5)	<i>Transfers to community programs</i> (6)
POST × MINO	−1.40** (0.62)	−0.49** (0.21)	−8.14** (3.69)	−1.25 (1.01)	−1.74** (0.73)	−0.25** (0.13)
POST × MINO × PAT	23.02*** (8.09)	7.59** (3.11)	14.56 (21.69)	14.07** (5.96)	6.10** (3.05)	0.64 (0.89)
Municipality fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
No. observations	5,094	5,094	5,094	5,094	5,094	5,093

Notes: All dependent variables are expressed in thousands of Chilean pesos at constant 2015 prices. MINO includes mining municipalities. POST is a dummy variable that takes the value of one in the years after the legal reform was implemented. PAT is the percentage of a given municipality's permanent own income (POI) that came from mining licenses in 2005. Robust standard errors are reported in parentheses.

** Statistically significant at the 5 percent level.

*** Statistically significant at the 1 percent level.

The results from this section complement our previous findings on municipal employment expenditures. As suggested by Caselli and Michaels, the diversion of resource revenues by local governments may reflect a combination of clientelism and personal wealth accumulation.³³ We found a significant expansion of public sector employment expenditures that points in the direction of patronage, which we analyze in more detail in the next section. On the other hand, it is extremely hard to prove that a portion of resource revenues was diverted to personal benefit instead of the interests of the local community. However, the results of this section suggest that extra revenues from mining were, at the very least, allocated in an unbalanced way among different local needs.

Public Employment Expenditures, Voting, and Provision of Public Goods

Robinson, Torvik, and Verdier identify a clientelism mechanism from resource rents that is linked to an increase in political support and the probability of staying in power.³⁴ We found that additionally, mining revenues had a statistically significant and meaningful impact on municipal employment expenditures and allowances to the municipal council, which is not the case for other municipal expenditures more closely related to the living standards of the local population. So far, this evidence suggests an unbalanced allocation

33. Caselli and Michaels (2013).

34. Robinson, Torvik, and Verdier (2006, 2014).

TABLE 8 . Impact of Mining Revenues on the Reelection of the Mayor and the Political Coalition

<i>Explanatory variable</i>	<i>Mayor reelection (1)</i>	<i>Coalition reelection (2)</i>	<i>Mayor reelection (3)</i>	<i>Coalition reelection (4)</i>
POST × MINO	-0.085 (0.078)	-0.123 (0.077)	-0.189* (0.100)	-0.162 (0.099)
POST × MINO × EMPL			0.014*** (0.005)	0.009* (0.005)
No. observations	518	518	516	516

Notes: The results consider the municipal elections of 2004 and 2008 (before and after the legal reform of 2005 was implemented). The dependent variables are dummy variables that take the value of one if the incumbent (the mayor or the political coalition, respectively) is reelected. MINO includes mining municipalities. POST is a dummy variable that takes the value of one in the years after the legal reform was implemented. EMPL is the change in municipal employment expenditures between 2004 and 2008. Robust standard errors are reported in parentheses.

* Statistically significant at the 10 percent level.

*** Statistically significant at the 1 percent level.

of new mining resources according to local needs, which may or may not be driven by an attempt to increase political support. To analyze whether our results are consistent with the theoretical claim of a clientelism mechanism, in this section we analyze the effect of the new mining revenues on electoral outcomes, specifically, on the probability of the mayor being reelected and the probability that the political coalition of the mayor remains in power.

We collected data on municipal elections for 2000, 2004, and 2008 and built reelection variables for the 2004 and 2008 elections. We then estimated a DD model to analyze the effect of mining revenues from the 2005 legal reform on these electoral outcomes. Our main variable of interest is a dummy variable that takes the value of one if the mayor was reelected. We also built a second dummy variable that takes the value of one if the political coalition of the mayor remained in power. Since clientelism networks tend to be more related to personal affinities than to political identification, we expect a stronger impact on the mayor’s probability of reelection than on the permanence of the political coalition. Moreover, if the impact on political support is driven by the expansion of municipal employment expenditures, the effect should be conditional on the magnitude of the increase in employment expenditures at each municipality. Therefore, we also include an interaction term considering the change in municipal employment expenditures from 2004 to 2008.

Table 8 presents the results for these exercises. As shown in columns 1 and 2, the main effect on the mayor’s probability of reelection and on the probability that the mayor’s political coalition remained in power are not statistically significant. Columns 3 and 4 introduce an interaction term for the magnitude

of the increase in municipal employment expenditures. The interaction term is statistically significant for the mayor's probability of reelection, which means that the probability of reelection increased for municipalities with large expansions in municipal employment expenditures. This result is consistent with Robinson, Torvik, and Verdier, who argue that public sector employment is related to increasing political support, and it links our previous results on municipal employment expenditures to the clientelism mechanism proposed in their model.³⁵ The effect on the reelection of the mayor's political coalition is weaker, and it is only statistically significant at the 10 percent level, which is consistent with the idea that clientelism networks are mostly driven by personal affinity to the local authority rather than by political identification.

While the results in table 8 show a positive impact on political support in municipalities with large expansions on employment expenditures, we still need to incorporate the role of public goods provision in these results. If the expansion of municipal employment expenditures led to an increase in the efficiency of public goods provision, the increase in political support could be due to the improvement in public goods rather than to the clientelism mechanism. This would be the case if incumbents expanded public sector expenditures in order to build state capacity instead of using patronage. Table 9 shows the results when we introduce an additional interaction term that accounts for the change in the provision of public goods from 2004 to 2008. We use different proxies for the efficiency of public goods provision, which include the change in the infant mortality rate, the change in the ratio of students to teachers in public schools, the student dropout rate from public schools, and the change in green areas maintained by the municipality. The results are consistent with our previous findings for all measures of public goods provision: the mayor's probability of reelection increased in municipalities that experienced large expansions in public sector employment expenditures, while the impact on the probability that the mayor's political coalition remained in power is weaker. These results reinforce the idea that the increase in municipal employment expenditures is driven by the clientelism mechanism.

Table 10 shows the impact of additional mining revenues on different measures of the efficiency of public goods provision. We find no clear improvement in any of these indicators. On the contrary, the infant mortality rate

35. Robinson, Torvik, and Verdier (2006, 2014).

TABLE 9. Impact of Mining Revenues on the Reelection of the Mayor and the Political Coalition: Changes in Public Goods Provision

<i>Explanatory variable</i>	<i>Mayor (1)</i>	<i>Coalition (2)</i>	<i>Mayor (3)</i>	<i>Coalition (4)</i>	<i>Mayor (1)</i>	<i>Coalition (2)</i>	<i>Mayor (3)</i>	<i>Coalition (4)</i>
POST × MINO	-0.188* (0.101)	-0.159 (0.100)	-0.193* (0.101)	-0.167* (0.099)	-0.250** (0.106)	-0.190* (0.108)	-0.270** (0.116)	-0.278** (0.115)
POST × MINO × EMPL	0.015*** (0.006)	0.008 (0.005)	0.014*** (0.005)	0.008* (0.005)	0.020*** (0.006)	0.011 (0.007)	0.016** (0.008)	0.014* (0.007)
POST × MINO × MORT	-0.004 (0.006)	0.000 (0.006)						
POST × MINO × STUD			-0.012 (0.017)	-0.016 (0.017)				
POST × MINO × DROP					-0.016 (0.023)	-0.001 (0.022)		
POST × MINO × GREEN							0.005 (0.007)	0.011 (0.007)
No. observations	516	516	516	516	508	508	444	444

Notes: The results consider the municipal elections of 2004 and 2008 (before and after the legal reform of 2005 was implemented). The dependent variables are dummy variables that take the value of one if the incumbent (the mayor or the political coalition, respectively) is reelected. MINO includes mining municipalities. POST is a dummy variable that takes the value of one in the years after the legal reform was implemented. EMPL is the change in municipal employment expenditures between 2004 and 2008. MORT is the change in the infant mortality rate. STUD is the change in ratio of students to teachers in public schools. DROP is the change in the student dropout rate in public schools. GREEN is the square meters of green areas maintained by the municipality. Robust standard errors are reported in parentheses.

* Statistically significant at the 10 percent level.

*** Statistically significant at the 1 percent level.

TABLE 10. Impact of Mining Revenues on the Efficiency of Public Goods Provision

<i>Explanatory variable</i>	<i>Infant mortality rate (1)</i>	<i>Student-teacher ratio (2)</i>	<i>Student dropout rate (3)</i>	<i>Green areas (4)</i>
POST × MINO	0.73** (0.36)	-0.51*** (0.18)	0.21 (0.13)	-3.71 (8.80)
POST × MINO × PAT	0.64 (2.43)	0.34 (0.52)	0.88* (0.45)	-0.66 (5.15)
Municipality fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
No. observations	4,830	5,080	4,975	4,496

Notes: All dependent variables are expressed in thousands of Chilean pesos at constant 2015 prices. MINO includes mining municipalities. POST is a dummy variable that takes the value of one in the years after the legal reform was implemented. PAT is the percentage of a given municipality's permanent own income (POI) that came from mining licenses in 2005. Robust standard errors are reported in parentheses. The ratio of students to teachers and the student dropout rate are in public schools in the municipality. Green areas are the square meters of public green areas maintained by the municipality.

** Statistically significant at the 5 percent level.

*** Statistically significant at the 1 percent level.

seems to increase in municipalities with large income from mining, student dropout rates in public schools also seem to increase (although this effect is only statistically significant at the 10 percent level), and the effect on green areas is not statistically significant. On the other hand, the ratio of students to teachers seems to improve after the legal reform of 2005. Taken together, this evidence suggests that the impact of additional mining revenues did not translate into a substantial improvement in public goods provision.

Finally, our finding that municipalities with large expansions of municipal employment expenditures increased the mayor's probability of reelection is consistent with the findings of Maldonado, who finds nonmonotonic effects on municipal electoral outcomes in Peru, depending on the magnitude of mining transfers.³⁶ Moreover, our results show a significant impact on the mayor's probability of reelection just two years later after legal reform came into force. This is in line with Monteiro and Ferraz's finding of a short-term impact from resource rents on electoral outcomes.³⁷ More important, our results show an increase in political support associated with an expansion of municipal employment expenditures even when we control for changes in the provision of public goods, which allows us to establish a closer link between

36. Maldonado (2014).

37. Monteiro and Ferraz (2012).

our findings on employment expenditures and the clientelism mechanism proposed by Robinson, Torvik, and Verdier.³⁸

Discussion: Are Institutions Strong Enough at the Local Level?

Theoretically, the extent to which resource revenues expand employment expenditures depends on the quality of local institutions. Several empirical studies highlight the relevance of institutions for the effect of natural resources through the political process. For instance, Bhattacharyya and Hodler use a cross-country sample to find that the extent to which resource rents foster corruption is conditional on the quality of democratic institutions.³⁹ Vicente reports that perceived corruption levels increased in São Tomé and Príncipe relative to Cape Verde, two countries with weak institutions, after the former discovered oil.⁴⁰ Moreover, Boschini, Pettersson, and Roine and Collier and Goderis show empirically that divergent results among resource-abundant countries may be caused by differences in the quality of institutions and the specific characteristics of the natural resource that is extracted.⁴¹

Chile is a resource-abundant developing economy, but the quality of its institutions is well above the median of developing countries. For instance, Chile received the maximum possible score in the Polity2 index developed by the Polity IV Project, which measures the quality of democratic institutions.⁴² Moreover, Chile ranked twenty-seventh in the world in the 2018 Corruption Perceptions Index maintained by Transparency International. Chile's average GDP growth was 4.1 percent in 2001–15 and even higher in previous decades.⁴³ It is therefore often cited as a resource-abundant country that may have overcome the resource curse. Despite all that, this paper found that mining revenues caused a significant expansion of municipal employment expenditures at the municipal level, which are linked to voting effects, instead of increasing other municipal outcomes that can be more directly linked to the welfare of the local population.

38. Robinson, Torvik, and Verdier (2006, 2014).

39. Bhattacharyya and Hodler (2010).

40. Vicente (2010).

41. Boschini, Pettersson, and Roine (2007, 2013); Collier and Goderis (2012).

42. The Polity2 index considers aspects such as the competitiveness of political participation, the regulation of participation, the openness and competitiveness of the executive office's recruitment, and the institutional constraints on the executive office.

43. Central Bank of Chile, National Accounts.

A first explanation has to do with the distinction between market-based and political economy mechanisms.⁴⁴ Since natural resources operate through multiple mechanisms, it is possible that Chile's institutional framework was able to avoid some of the market-based effects from mining rents, which allowed accelerated GDP growth, but the country still has some areas to strengthen to prevent some of the political economy mechanisms. Second, there can be differences between central and local institutions within the same country. Chile has a highly centralized fiscal system, so institutions at the local level may be less developed than central institutions and may not be prepared to efficiently handle a sudden increase in resources. Moreover, because of the nature of mining activities, several mining municipalities are located in remote areas that are far away from the Metropolitan Region of Chile (the most developed area of the country), which may be associated with lower accountability.

If local institutions are underdeveloped with respect to central institutions, the decentralization of resource revenues may result in efficiency losses, opening the door to patronage and other adverse political outcomes. Therefore, even if fiscal decentralization could increase public sector efficiency by bringing government action closer to the people, its overall effect on the economy would have no clear direction. Some empirical studies find a consistently negative impact of fiscal decentralization on economic development, while more recent studies document an insignificant effect.⁴⁵ Nevertheless, most of the empirical literature on fiscal decentralization has not focused on revenues from natural resources, which are a key element of any decentralization process in many development economies and may have a differentiated effect in relation to other sources of fiscal revenues, as is well documented for the case of Colombia.⁴⁶

The results for the Chilean case suggest that even if a country has strong central government institutions and low corruption at the national level, any fiscal decentralization process should be accompanied by improved accountability for local governments. The extent to which local governments have lower accountability and whether this explains their behavior in the face of an increase in resources are key elements for further research, to provide a better understanding of the effects of fiscal decentralization in resource-abundant economies.

44. Caselli and Michaels (2013).

45. Zhang and Zou (1998); Thornton (2007); Baskaran and Feld (2013).

46. Martínez (2016).

Concluding Remarks

This paper has examined the effects of an increase in mining revenues allocated to municipalities in Chile, induced by the legal reform of 2005, on municipal employment expenditures and other municipal outcomes. This setting is a novel quasi-experiment that allowed us to analyze the rent channel of a resource boom through the political process. Moreover, the within-country approach reduces concerns about differences in institutions, culture, and the political context, which are hard to control under a cross-country regression. Our work is part of a wave of studies measuring the political impact of resource windfalls moving from national to local effects.⁴⁷

We found that the twenty-percentage-point increase in revenues collected from mining licenses translated into a significant expansion of municipal employment expenditures, which was driven by expenditures on long-term municipal employment. We also found a meaningful increase in allowances for the municipal council. We did not find a robust effect on other municipal outcomes that are more directly related to local welfare, such as municipal investment, transfers to health, and transfers to community programs, and the effect on transfers to education was small compared with the effect on municipal employment expenditures.

In the Robinson-Torvik-Verdier model, resource rents may be allocated to patronage in order to increase political support.⁴⁸ When analyzing electoral outcomes, we found that extra mining revenues increased the mayor's probability of reelection in municipalities with a large expansion of municipal employment expenditures, which links our results on municipal employment expenditures to the clientelism mechanism proposed by theory. Moreover, while previous studies find that the clientelism mechanism operates mostly through short-term employment, our results suggest that it can also operate through long-term employment expenditures, depending on local restrictions and regulations.⁴⁹ For instance, while Brazilian municipalities are not allowed to use resource windfalls on long-term employment, Chilean municipalities have greater restrictions on short-term and annual employment expenditures than on long-term employment expenditures, which may explain the different impact of resource rents in the two countries.⁵⁰

47. Caselli and Michaels (2013); Maldonado (2014); Martínez (2016); Monteiro and Ferraz (2012).

48. Robinson, Torvik, and Verdier (2006, 2014).

49. Maldonado (2014); Monteiro and Ferraz (2012).

50. Monteiro and Ferraz (2012).

Finally, our findings suggest that Chilean institutions at the local government level are not strong enough to prevent the adverse effects of resource rents through the political process, leading to an unbalanced allocation of extra revenues among local needs. Since the quality of central institutions in Chile is well above that of other developing economies, these results could be due to differences in accountability between national and local institutions. This point implies that the global trend to fiscal decentralization must be taken with caution, especially in resource-abundant countries. Although much needs to be studied in the relationship between national and local institutions, and regarding a differentiated effect from natural resource revenues with respect to other sources of fiscal income, our results suggest that any process of fiscal decentralization must be accompanied by an increase in accountability at the local level.

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