# Commodity Prices Shocks and Poverty Reduction in Chile*


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**Abstract**

This paper examines the local economic impact on poverty of large increases in metal-mining products prices in Chile. Using household data from 1998 to 2013, and exploiting differences in municipalities' exposure to changes in prices, we find evidence of a reduction in poverty rates associated with the positive terms of trade shock. According to our estimations, doubling commodity prices, an increase in the minerals' price equivalent to the experienced between 2003 and 2009, reduces poverty by more than 2 percentage points in municipalities relatively exposed to the commodity boom –with at least 7% of employment working in the metal-mining sector– in comparison to municipalities with no exposure to the boom. In addition, we explore some of the mechanisms explaining the reduction in poverty. We find significant effect of higher products prices on wages and employment, especially for unskilled workers and those in metal-mining industries.



**JEL Classification: I32, R23, O13**



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## 1. Introduction

Over the last decade, several commodity-producing countries have experienced large, positive and persistent terms-of-trade shocks. The existing literature (e.g., 'Dutch Disease' and natural resource 'curse' literatures) suggests that this phenomenon should have a negative effect over medium-term economic activity (e.g. Corden, 1982; Krugman, 1987). However, the good economic performance of developing countries during the last commodity boom –in particular the case of Latin America countries – has challenged this view.[1] Resource-abundant countries not only experienced higher growth rates than the rest of the world over the last decade, but were also less affected during the recent financial crisis.[2]

There is a large literature related to the impact of terms of trade on economic growth (see, for example, Edwards and Levi-Yeyati, 2005; Collier and Goderis, 2012), but less work has been done considering whether natural resource export-booms may have a positive effect over other dimensions of economic welfare –such as poverty–, and if so, how these shocks could transmit to local communities that are potentially more exposed to the booms. One exception is the work by Goderis and Malone (2011) looking at cross-country evidence about the impact of natural resources booms on income inequality. They find that inequality falls during a boom and then increases over time until this effect disappears.

[1] The 'Dutch Disease' channel suggests that the boom in commodities lead to an appreciation of the real exchange rate and a reallocation of resources away from the tradable sector not affected by the shock towards the commodity sector (Corden, 1982; Krugman, 1987).

[2] See De Gregorio (2014) and De Gregorio and Labbé (2014) for the case Latin American countries recent growth performance, and Chile in particular.

In this paper, we study the local effect of commodity-shocks on poverty. To this end, we exploit the exogenous price shock associated to the last commodities' 'super cycle' (starting circa 2003), and use municipal-level data from Chile –a country which economy is highly dependent on minerals' cycle– to analyze the effect of the commodity boom on local-level poverty. Our identification strategy relies on the use of the different exposure that municipalities –the smallest administrative division in Chile– had to the positive minerals' shock. By comparing the change in poverty rates across municipalities with different degrees of exposure to the shock, we obtain an estimate of the differential effect of the commodities' boom on poverty.

In contrast to other shocks of similar magnitude (such as the 1970's oil shocks), the recent boom in commodities seems to have been most likely driven by demand –China and its insatiable appetite for commodities– rather than supply forces (see Yu, 2011, and Farooki and Kaplinsky, 2013, among others).[3] This makes unlikely that the shock was related to local economic conditions of Chilean municipalities. On the other hand, our strategy for identifying the different exposures of municipalities to the shock –which relies on the use of initial employment shares in the commodities sector– is similar to that followed previously by other authors studying the effect of trade reforms on local markets (Topalova, 2007 and 2010).

Our main result suggests that municipalities relatively exposed to mining sector's fluctuations experienced larger reductions in poverty during the commodities' boom.

[3] The mining industry is subject to capacity constraints: production is limited by the number of mines under exploitation. Therefore, the short-run the supply response to any demand shock is most likely limited.

According to our estimations, doubling commodity prices, an increase in the minerals' price equivalent to the experienced between 2003 and 2009, reduces poverty by more than 2 percentage points in municipalities relatively exposed to the commodity boom –with at least 7% of employment working in the metal-mining sector– in comparison to municipalities with no exposure to the boom.[4] This result is robust to several robustness checks and falsification exercises, and to changes in the sample of municipalities, the period under analysis, and the inclusion of several alternative control variables and other regional or county-specific shocks that might be driving our results.

The within-country analysis we perform for the case of Chile is particularly interesting for several reasons. First, the Chilean economy is highly dependent on mining exports: minerals' production represent about 13 % of GDP over the last decade. However, in some regions such as the Northern Region of Antofagasta, the mining contribution to the GDP has been higher than 60%. Second, despite of the fact that Chile is the world's main producing country of Copper and Molybdenum, the change in export prices can be considered as exogenous because it seems to have been driven by demand rather than supply. Third, the mining activity is oddly distributed across several local markets, providing enough heterogeneity to identify the impact of price shock using the ex-ante exposure to this boom. Finally, as we document in the following sections, Chile experienced an important reduction of 6.4 percentage points in the national poverty rate over the period

[4] This number roughly corresponds to the upper-decile of the metal-mining employment share unconditional distribution and to the upper quartile of the metal-mining employment share conditional on having positive employment in this sector.

under analysis: 1998-2013. Our results allows to shed light on how important were the positive shock to export prices to explain the decline in national poverty.

In the second part of the paper, we investigate the potential mechanisms through which the commodity price shock could have reduced poverty. The literature on local effects of natural resources shocks has focused on, for example, the impact through higher public incomes coming from taxes Caselli and Michaels (2013) and the impact of vertical linkages on close communities. In this paper, based on the working hypothesis that the shock's impact is mostly channeled through local labor markets, we look at how increases in minerals prices increased employment and wages. We also examine the impact across industries' and workers skills, and analyze if migration could be lessening the effect of the shock over poverty and wages. Our results indicate that reduction in poverty rates are potentially generated by the impact of price changes on labor market outcomes. In particular, we find differential effects of about 8.0 percent in nominal wages and 1 percentage points in the employment rate between more exposed municipalities (percentile 90$^{th}$) compared with those non-exposed ones.

This paper relates to a recent empirical literature on local effect of macroeconomic shocks on income and poverty. In a series of influential papers, Topalova (2007, 2010) exploits differences in the initial industrial composition of India's districts (in terms of employment as we do in this paper) to assess the impact of import competition induced by trade liberalization on local income, poverty, consumption and income inequality. Her results suggests a negative effect of import competition on local poverty and income. A similar strategy is followed by Costa, et al. (2014) to analyze the effect of China's competition on Brazil's local manufacturing wages and income inequality, McCaig (2011), to study how the bilateral U.S.-Vietnam trade agreement affected provincial poverty in Vietnam, and by Kovak (2013) and Dix-Carneiro and Kovak (2015) to study the effect of Brazil's trade liberalization on wages, and the skill-premium, respectively. The general conclusion in these studies suggests that stronger import competition affect negatively local wages and poverty, while trade liberalization improving access to export markets affects positively local income and reduces poverty.[5]

Our paper also relates to a literature studying the effect of resource abundance on local economic outcomes. Aragón and Rud (2013) examine the local impact of the expansion of a large gold mine in Peru, using differences in exposure originated by the distance of localities to the mine. Their results reveal positive effects on real income, which are driven by a higher demand for local inputs. Michaels (2011) studies the long-term effects of oil abundance on local economic development in the US South between 1890 and 1900, finding a positive effect on the local educational level and income. Allcot and Keniston (2015) studies the effect of oil and gas busts and booms on local economic growth, with a particular emphasis in the manufacturing sector. Their findings suggest a high sensitivity of local economic growth to the natural resources cycles, but find no evidence of a resource curse.

Finally, in concurrent work to ours, Pellandra (2015) studies the effect of commodity boom on the wages and employment of skilled and unskilled workers in Chile between 2003

[5] Similar approaches have also been used to evaluate the impact of Indian trade reforms on schooling and child labor (Edmonds, et al. 2010), the spread of the sub-prime crisis over U.S counties (Stumpner, 2015), and the impact of U.S. anti-dumping duties applied to exports of Vietnamese catfish products on rural households' income in Vietnam (Brambilla, Porto and Tarozzi, 2012).

and 2011. Although closely related, the focus of Pellandra (2015) is on the skill-premium and employment by skill levels, while ours lies on understanding the effect of the commodity boom on poverty. In addition, in Pellandra's paper the commodity boom is measured as the change in employment-weighted producer price index (PPI) between 2003 and 2011, which may capture forces different than the commodity price shock. In contrast, our paper measures the price shock directly using the mineral's prices.

Relative to the existing literature, we make several contributions. First, we provide evidence that suggests that countries with high dependence on natural resources as Chile benefited from the last commodity boom, helping them to reduce significantly poverty in regions with high-dependence from the natural resource sector. Second, our paper contributes to the 'natural resource curse' literature by providing local markets-level evidence on the economic effects of natural resources booms. The current consensus in this literature suggest that the negative effects of natural resources booms or windfalls would be much prevalent in economies with weak institutions (Van der Ploeg, 2011).[6] We contribute to this literature showing that in the context of a country with relatively strong institutions, as Chile, the negative impact of natural resources booms is not observed (consistent with previous country-level evidence by Mehlum et al., 2006). Finally, the evidence we present complements previous results on the effect of trade reforms on local poverty and income, showing that commodity shocks are amidst trade reforms –that improves access to foreign markets– in terms of its effect on local poverty and income.

[6] Robinson et al. (2006) explains these differences about the impact of resources booms, showing that countries with institutions that promote accountability and state competence are able to ameliorate the perverse political incentives originated during resources booms.

The paper is structured as follows. In the next section, we describe the data and the main stylized facts on the relationship between prices and poverty rates. The third section presents the empirical approach and discusses the identification strategy. In the fourth section, the main results and several robustness checks are presented. The fifth sections explore the labor markets mechanism – employment and wages - behind our results on poverty. The main findings and conclusions are discussed in the fifth section.

## 2. Background and Data

We begin this section describing the data we use in this paper. We then provide background on the commodity boom of mid 2000s and its effect on Chilean local communities. Finally, we present preliminary evidence of the relationship between the commodity price shock and poverty, looking at differences in poverty reduction between exposed and not-exposed local communities.

### 2.1 Metals' Commodity Boom

The mid-2000s 'super-cycle' has been one of the largest commodity booms of the last 100 years. Between 2003 and 2008, oil and metal prices tripled, and food and precious metal prices doubled (Baffes and Haniotis, 2010). Almost a decade after the beginning of the boom, there is consensus among scholars and market analysts that the boom was mostly caused by demand pressures from emerging economies – in particular China – rather than from general increases in the marginal production cost (as it was the case of the 1975-1980 boom).[7] This is important for our study, because it implies that most of the *initial shock* to

[7]Erten and Ocampo (2013) make a more general point and show evidence that suggest that all 'super-cycles' from 1865 to 2010 for non-oil commodities were essentially demand-driven.

international prices was largely exogenous for a commodity-producing country such as Chile.[8]

The commodity boom affected positively activity in most commodity producing countries. The case of Chile is a particularly attractive for study, because it is a large-scale producer of metals and its economic activity strongly commove with the price of Copper, its main metal. Besides, Chile it is not only the world's largest producer of copper, but it is also within the top-three largest producers of Molybdenum (U.S. Geological Service). The price of these two metals experienced substantial rises during the commodity boom: Copper price went from about USD 0.80 per pound in 2003 to over USD 4.00 per pound the second quarter of 2008, and Molybdenum jumped from USD 3.3 per pound to about USD 32.5 per pound over the same period –a ten-fold increase (see Figure 1). Over the same period, tax revenues – largely dependent on Chile's main state owned mine revenues, CODELCO's – jumped significantly, and employment and economic activity flourished in mining regions (see Cochilco, 2013).

### 2.2 Data

The main dataset we use in this paper is the Chilean National Socioeconomic Characterization (CASEN) Survey. CASEN is a household survey applied by the Chilean Social Development Ministry (MIDEPLAN) every two or three years. This survey is the main source for Chile's socioeconomic statistics –such as the official poverty rate–, and its

[8] In the medium-run, commodity producing countries adjusted their production to profit from the higher prices. This response may fed back to international prices lessening the magnitude of the initial shock, as long as the magnitude of the supply response is large enough. On the contrary, the commodity boom may also feedback positively if marginal costs increase as production adjust to demand (see Humphreys , 2010).

information is periodically used to assess the impact of social policies and programs. On average, CASEN includes survey information for about 65,000 households in 290 municipalities – around 1.5% of the national population (see Table A1).

In this paper, we use the five CASEN waves ranging from 1998 to 2013. CASEN is available from 1985. Nevertheless, we start our analysis in 1998, because the municipal coverage of earlier CASEN versions is significantly lower.[9] The fact that the commodity boom of 2003 is just halfway in between the beginning and end of our sample is important for our study, because it allows us to control for pre-shock trends in the poverty rate, and to study medium-term effects of the commodity boom on poverty, wages and employment. Specifically, we use three waves before the beginning of the commodity boom in 2004 (1998, 2000 and 2003), and four waves after the shock (2006, 2009, 2011 and 2013).

We aggregate CASEN's household data at the municipal level using expansion factors –the smallest administrative unit in Chile–, because municipalities look more similar to the concept of local labor markets[10]. In principle, the data could have been used at a higher aggregation level (e.g., provinces or regions). However, these alternative divisions are too broad for studying local labor markets. Regions –the most aggregated administrative unit– in most cases extend over 400 kilometers (250 miles) from north to south. This is also valid for most of provinces.

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[9] For instance, CASEN surveyed only household from 126 municipalities in 1996 –about 40 percent of the average number of municipalities covered in 1998-2013 and two-thirds of the municipalities surveyed in 1998.

[10] A municipality or commune may contain several cities and towns, and it similar to the concept of county. Each municipality is governed by a directly elected mayor (alcalde) and group of councillors (concejales), for a period of four years.

Note that our choice of municipalities as the relevant labor market is a conservative strategy: in case that provinces (or regions) were the relevant labor market, we would be less likely to find significant effects on municipalities. This would be the case in which the relevant exposure – for example whether people works in some municipality but lives in other municipality within the same province (or region) – is that at some higher level of aggregation. Nevertheless, in the absence of more detailed information about commuting, we employ municipalities as our unit of study for local labor markets.[11]

The resulting dataset is an unbalanced panel for seven waves of the survey, containing a minimum (maximum) of 196 (335) municipalities. As it can be seen in Table 1, there is a significant positive trend in the number of households surveyed. For example, in 1998 the survey was applied to 48,107 households from 196 municipalities, while in 2013 it was applied to 66,725 households in 324 municipalities.

The main variable we use in this study is the poverty rate. For each municipality c and period t, we define the poverty rate $\sigma_{ct}$ as:

$$\sigma_{ct} = \frac{\sum_i^I \omega_{ict} I(y_{ict} < \bar{y}_t)}{\sum_i^I \omega_{ict}}$$

Where $I(y_{ict} < \bar{y}_t)$ is an indicator function that takes the value one if individual i has income $y_{ict}$ below the poverty line $\bar{y}_t$, and $\omega_{ict}$ are weights given by the municipal expansion factor provided by CASEN. To define poverty, we use the Chilean official

[11] On the other end, we avoid working with household level data because in this case it may be more challenging to capture general equilibrium effects –such as spillovers to sectors not related directly to the commodity sector.

poverty line, defined in terms of the cost of a minimum bundle of products necessary to satisfy dietary requirements.[12]

Note that the value of poverty line is defined at the national level. The reason for using a common poverty line across municipalities – even non-tradable goods specially may evolve differently across less and more exposed communes - is the absence of prices disaggregated geographically, which makes impossible to construct poverty lines at the level of local markets. This may bias our results based in poverty rate downwards if prices increase relatively more in mining municipalities than in non-mining municipalities after the commodity boom. In a complementary exercise (available upon request), we analyzed the dynamics of housing rents –as a proxy for non-tradables– before and after the commodity shock. Although we find that rent grew relatively more in mining regions, the growth rate lower than the change in local wages. Therefore, we believe that our results would still hold under the hypothetical case that we were able to correct our results by local prices.

In addition to the poverty rate, we use a series of other variables either as outcome variables or as controls. These variables are (see Appendix A for details on the construction of the variables): (i) the average wage unskilled workers (high-school or lower) and skilled workers (some post-secondary education), (ii) the average years of schooling, (iii) the share of people living in urban zones, and (iv) the average household size, and (v) the share of metal-mining employment.

[12] The composition of the bundle is determined by the Economic Commission for Latin America and the Caribbean (ECLAC), based on the minimum caloric requirements advised by the World Health Organization and the Food and Agriculture Organization.

We complement CASEN's data with price and production information for the main metals produced in Chile. The data on metals' prices and production are from the *Chilean Copper Commission* (COCHILCO) and the IMF's *Macroeconomic Statistics Database*. Finally, to control for economic local economic activity, we use regional real GDP growth, provided by the Central Bank of Chile.[13]

In this paper we exploit the variation in metal prices to study the effect of the mid-2000s commodity boom on poverty, income and employment of local communities. To account for the price effect of the relevant metals for the Chilean economy, we construct a metal price index for all metals representing more than 1% of the overall production value in 2003. Five metals fall under this criterion: Copper, Silver, Gold, Molybdenum, and Iron ore.[14] We define, for each period *t* the average percentage change in metals' price $\tilde{P}_t$ as:

$$\tilde{P}_t = \frac{\Delta \overline{P}_t}{P_t} = \sum_{i=1}^{5} \theta_i^{98} \cdot \frac{\Delta P_{i,t}}{P_{i,t}}$$

where the subscript *i* represents each of the metals 5 metals defined in the previous paragraphs, $\theta_i^{98}$ is the production value share of each metal *i* (scaled by the production value of the 5 metals, so that they add up to one) and $P_{i,t}$ is the nominal price of each metal. Then, we compute the *metals' price index*$\tau_t$ as

$$\tau_t = \left(1 + \tilde{P}_t\right) \cdot \tau_{t-1}, \quad \text{with } \tau_{2003}\text{=100}$$

[13] Appendix A provides detailed information on the definition of each price and production variable used in this paper.

[14] These metals represent over 99.5% of the production value in 1998-2013. Out of these metals, copper is the most important by far: it account for over 85% of the total production value each year. Figure 1 shows the international price and Chilean production (normalized in 2003) of these five metals for the sample period.

### 2.3 Exposure to Price Shock and Poverty Reduction

Before turning to our main empirical results, we present preliminary (and unconditional) results on the relationship between the commodity boom and poverty reduction depending on exposure to the prices increases of metal products.

We compare the trajectory of poverty rate in mining and non-mining intensive municipalities, before and after the commodity shock that started in 2004. We define mining-intensive municipalities as those with employment share in the mining sector above 1% in 1998 – which roughly corresponds to the upper quartile of 1998's employment share distribution. If the commodity boom affected poverty, we would expect these trajectories to diverge after the beginning of the commodity boom in 2004, with poverty declining in mining relative to non-mining municipalities.

Figure 2 shows the trajectories for poverty rate, at the national level, and for mining and non-mining municipalities.[15] Also, in the right-axis we show the trajectory for the metals' price index introduced in section 2.2. As it can be seen, from 1998 to 2003, the price index remained relatively stable. From 2004 on, the price index shows an increasing trajectory. In 2004, the price index jumped about 70% with respect to the previous year, while in 2006 the price index was almost three-times higher than in 2003. After a pause from 2006 to 2009, where the metals' price stabilized and had a brief collapse in 2009 following the onset of the sub-prime financial crisis, the metals' price resumed its growing trajectory

[15] All poverty rates are computed as the share of population with income below the poverty line. This is equivalent to calculate the population-weighted average poverty rate for the municipalities under each definition.

until 2011, when it peaked at a value equal to 500 –almost 4 times the value of the index in 2003.

Regarding poverty, the figure reveals a negative trend in the national poverty rate from 1998 to 2013 – which is common to both mining and non-mining municipalities. National poverty rate experienced an important decline over the period, from 20.1% in 1998 to 13.7% in 2013. In 2006, poverty rate experienced the sharpest decline during the period, going from 18.6% in 2003 to 15.1% in 2006.[16] Interestingly, the decline in the poverty rate was significantly larger in mining municipalities. While in non-mining municipalities, poverty fell from 18.7% to 14.7%, the decline in mining municipalities was much larger –about 2 percentage points larger –, from 18.2% to 12.6%. After the financial crisis of 2008, poverty increased, but interestingly, the poverty gap between mining and non-mining municipalities even widened.

In Table 2 we summarize the evidence comparing average poverty rates between both groups of municipalities before and after the commodity boom, the reduction in poverty rates is 2.5 percentage points in more exposed communes. These result lend support to the hypothesis that the commodity boom helped to reduce poverty in municipalities relatively exposed to the commodity boom. In the next sections we complement this descriptive analysis with regression-based results, and study whether other factors could be driving the results.

[16] The difference between these number and the official poverty rates are due to the use of municipal expansion factors.

## 3. Empirical Model

The commodity boom of mid-2000s was externally originated and abrupt, providing a quasi-natural experiment for studying the effect of commodity price changes on poverty. The fact that municipalities are differentially exposed to the shock, allows us to perform a difference-in-difference (DID) approach to establish whether certain municipalities benefited relatively more from the commodity boom in terms of poverty reduction. In this case, we use a continuous measure of exposure.

We estimate versions of the following equation:

$$Y_{ct} = \alpha_c + \alpha_t + \gamma X_{ct} + \beta LogP_t \times \theta_c + e_{ct} \qquad (1)$$

where Y is the poverty rate of municipality c at time t, $\alpha_c$ and $\alpha_t$ municipal and year fixed-effects that account for all municipality-specific variables than might affect poverty and also for common time-varying shocks affecting to all counties, X is a vector that accounts for other variables that previous literature indicates as important for explaining changes in poverty across regions (McCaig, 2011, see next section for details), P is the metal-mining prices index described in the previous section, and $\theta$ is as measure of exposure of municipality c to changes in P.

The parameter of interest in equation (1) is $\beta$, and it measures the differential impact of the metals' price index on municipalities' poverty. We expect $\beta$ to be negative, indicating that positive shocks reduce poverty. Because $\theta$ is continuous, the shock's impact in a given municipality with metal-mining exposure $\theta_c$ will be $\beta \times \theta_c$ and the magnitude will be higher – in absolute terms – for municipalities with higher exposure.

Note that equation (1) does not identify the channel through which the commodity shock affects income and poverty. One possibility would be that municipalities benefit from the shock as a consequence of larger resources for municipalities, as in Caselli and Michaels (2013) for the case of oil shocks in Brazil. However, in the case of Chile, municipalities do not directly benefit from windfalls in the mining sector, because taxes from mining companies are collected by the central government. Local governments may indirectly benefit from the windfall if the central government transfers more resources to mining municipalities or through the increase of local revenues coming from the growing economic activity originated by the resources booms. Although this as interesting possibility, we focus on the broad impact of prices changes not distinguishing whether this was a direct effect on labor markets or indirect through increases in local government revenues.

A key variable in equation (1) is the metal-mining exposure $\theta$. We proxy this variable in term of metal-mining employment share, defined as the ratio of employment in the metal-mining sector over total municipal employment. In our baseline results we compute this variable using information for 1998 – the first year of our sample –, but we obtain similar results when using years 2000 or 2003. The advantage of using employment-based measures over other proxies of municipal exposure – such as measures based on economic activity or production – is that it allows to consider cases of municipalities with minor or no mineral deposits, but with a significant fraction of its population working in the metal-mining sector.[17]

[17] We believe this is a certain possibility in the mining sector, where workers tend to work in non-standard shifts, such as 7x7 (7 days working in the mine and 7 seven days resting) or 4x3.

Figure 3 shows the show the geographical distribution of the exposure variable θ.[18] As it can be seen, relatively exposed municipalities tend to be located close to mining deposits –e.g., *Chuquicamata* in the North of Chile or *El Teniente* in the Central zone. However, the figure also reveals an important heterogeneity in the exposure distribution. This lends support to our strategy of using ex-ante employment based exposure to the commodity boom.

# 4. Results

### 4.1 Effect of the Commodity Boom on Poverty

Before turning to our main empirical results, a note on the number of effective observations. In all regressions, the sample is restricted to the number of municipalities included in the 1998 version of CASEN, because we calculate municipalities' exposure in that year. Out of the maximum of 335 municipalities, only 196 are included in 1998 (see Table 1). This results in a reduction from a universe of 2,345 to 1,356 observations in the effective sample size.[19]

Table 3 presents our baseline estimates for the impact of the commodity shock on poverty. All regressions control for municipality and year fixed-effects. Columns 1-3 show results for the full sample 1998-2013; column 4 restrict the sample for the balanced sample of municipalities with information for all years between 1998-2013, which reduces the number of municipalities from 196 to 182. In terms of covariates, column 1 includes fixed

[18] For expositional purposes, in this figure we plot the simple average over 1998–2003.

[19] An alternative to avoid this drastic reduction in sample size is to use the average share in metal-mining employment over 1998-2000 to compute the exposure variable θ. Following this strategy enlarges our sample to 297 municipalities (1,950 observations). However, using this definition does not affect our main results.

effects only. Column 2 includes two household-based variables to control for differences in the composition of the average household across municipalities: the average number of years of schooling and the average household size (both in logarithms). Column 3 adds regional GDP growth – to control for economic activity –, and other covariates varying at the municipal-year level: municipality size (measured in terms of population), and the share of urban population of each municipality.[20,21] Finally, column 4 repeats the estimation of column 3 for the subset of municipalities with information in all five CASEN surveys from 1998 to 2013.

We expect poverty rate to be higher in municipalities with lower average schooling, larger household's size, and higher share of urban population. The sign of the municipality's size coefficient is not determined a priori: we include this variable to control for potential scale-effects, for example that larger municipalities may attract a larger share of fiscal resources aimed at reducing poverty or that workers have more employment opportunities in larger communes.

We find consistent and robust evidence that increases in metal prices were associated with higher poverty reductions in more exposed communes. In all regressions, the sign of the interaction between the log of the metals' price index and the index of municipal exposure is negative and statistically significant at the 95% confidence level. The coefficient is notably stable across specifications – it moves in the range -0.156 to -0.164.

[20] Note that economic activity is defined here at a broader level of aggregation —regions instead of municipalities—, thus the coefficient for this variable is not collinear with year fixed-effects.
[21] See appendix A for data sources and definition.

Note that because this coefficient is identified both by the cross-sectional exposure and the temporal variation of the price index, to gauge the economic significance of the commodity boom we need to evaluate this coefficient for municipalities with different levels of exposure. When we evaluate the effect for municipalities with the median exposure to the commodity shock, we find a modest impact: a 100 percent increase in the metals' price index reduces poverty in about 0.06 percentage points in these municipalities. The impact of the shock, however, increases significantly as we move away from the median exposure to the upper tail of its distribution: for municipalities in the percentile $75^{th}$ the impact of the shock increases to 0.32 percentage point, and for municipalities in the percentile $90^{th}$ , the effect is about 2.4 percentage points – more than 30 times the median effect–.

For the other variables - schooling, household size and urban share – the results are consistent with our expectations: poverty tends to be larger in municipalities with lower average schooling, larger household's size, and higher share of urban population. The coefficient on municipalities' size is non-significant (see columns 3 and 4), while regional real GDP growth is positive, although non-significant. Finally, using all the available information or restricting to the balanced sample of municipalities give us practically equal results.

**4.2 Confounding Factors**

In Table 4 we present results looking at the potential role of confounding factors as challenges to our strategy. First, we show that there are not unobservable factors that may be driving this higher poverty reduction in more exposed municipalities before the commodity prices boom. In fact, restricting the estimation to the pre-boom period (1998-

2003), we do not find any relationship between poverty and prices (column 1). Second, we show that during this pre-boom period both exposed and not-exposed commune were experiencing a similar reduction in poverty rates (column 2), which is consistent with the parallel trends pre-requisite for the application of this DID methodology. In this case, and in the rest of the estimations, a trend for less exposed and more exposed communes are defined for municipalities with mining employment share below and above the lower quartile in 1998 (about 1%). Finally, in column 3, we show that controlling for parallel trends, during the pre-boom period- the price variables is not significant.

Analyzing the pre-treatment parallel trends assumption, we would be relatively sure on this looking at the Figure 2, where both trends are indistinguishable. Nevertheless, to rule out this potential confounding factor, we include linear trends for both groups of communes in our estimation (column 4 in Table 4). Our main results remain unchanged. The coefficient for the interaction between mineral prices and exposure is negative and significant, although the parameter is lower than previous estimations (in absolute value).

We evaluate whether our exposure variable is simply capturing the effect of different starting point in the presence of a poverty convergence phenomenon. In fact, whether mineral resources abundance are poorer than mineral resources scarce municipalities, and poverty is falling everywhere, we should expect a higher poverty reduction in mineral abundant communes. To analyze this possibility, we interact poverty rate in 1998 with the logarithm of the price index. The results are presented without and with linear trends in columns 5 and 6 of Table 4. As we expected, poverty is reducing more in poorer municipalities, but the interaction between the price index and exposure remains negative and significant. Then, our results are robust to this convergence phenomenon.

### 4.3 Placebo

We also look at how the effect of the shock can be falsified. For this purpose, we re-run the baseline equation (1), but with forward changes in the price index interacted with exposure. If there are some other reasons than current commodity prices driving expected growth in more mineral abundant municipalities, and they are correlated with increases in commodity prices, then expected prices should also reduce poverty.

To test this potential effect, we introduce the interaction between the price index variable in t+s (with s=3 and 5) and our measures of communes 'exposure. The placebo test presented in Table 5 is rejected for both specifications (5-year and 3-year forward) and including and not including linear trends. The coefficient for the interaction is always not significant

### 4.4 Further Robustness Checks

We performed a number of robustness checks and extensions. In this subsection, we discuss the most important of them. The results are presented in the appendix B.

- *Sample of Municipalities*. In our baseline results we use the 7 waves of CASEN carried out between 1998 and 2013, but the recent versions of this survey are not representative at municipality level. We replicate our results for poverty using a shorter panel during the period 1998-2009 and the results hold (see Table B1 in the Appendix).
- *Measurement of mining exposure.* A key variable in our results if the exposure of each municipality to the commodity shock. In our baseline results we computed this variable

using the employment share in 1998. This choice may be problematic, because only 196 municipalities were included in the 1998 CASEN survey. As an alternative, we measure exposure as the average employment share in 1998-2000. This enlarges the universe of municipalities to 297 municipalities (1,950 observations for the full panel 1998-2013). Table B2 shows that results using this alternative definition of exposure does not change qualitatively our main results.

- *Local labor markets.* It may be argued that our unit of observation —municipalities—is inconsistent with the idea of local labor markets. This may be especially true for large conurbations, such as Santiago —Chile's capital city—. To check if this affect our results, we repeat our estimations for poverty excluding the Metropolitan Region – which includes the 'Gran Santiago' as well as other neighboring municipalities that are close enough to the city center so that people can commute to their jobs. Results are largely unaffected by the exclusion of the Metropolitan region (see Table B3).
- Other robustness check is to control for the impact of other commodity shocks. Similar to the metals' price index we compute other commodity prices index and exposure as the employment share of these products[22]. As in the previous estimations, our results hold to the inclusion of this additional interaction term (see Table B4).

Our finding that poverty rate fell by more in more exposed municipalities - with higher mining employment share – to be convincing needs to be supported by some additional evidence on the mechanism, because mining in general represents a small share of

[22] The products included are some fruits, pulp, wine, and fish meal, among others.

employment. In what follows, we examine the impact of the prices shock on labor markets variables: employment and wages. Moreover, given that mining production in more intensive in unskilled labor, we estimate the impact of commodity prices for both skilled and unskilled workers.

## 5. Labor Market Mechanisms

We use a similar specification to look at some mechanisms or channels through which an increase in terms of trade might affect poverty. In those cases, the variable Y - also measured for counties over time – is some labor market outcome such as employment and wages. In fact, the most direct impact on labor markets of a positive terms of trade shock is an increase in labor demand, increasing wages and employment. However, this positive shock may also have general equilibrium effects in several other dimensions. First, consider other complementary activities associated with the mining boom such as input providers or non-tradable services. In fact, commodity booms are commonly associated with, for example, construction booms that can increase activity and wages in these sectors. Then, our empirical exercises on the mechanisms estimate the impact of prices on wages and employment by industries and workers skills. We consider skilled (unskilled) workers as those with schooling higher (lower) than secondary.

In Table 6 we show the estimation results of equation (1) using employment rate – defined as total employment over overall population – and average wages as dependent variables. The aim of this exercise is to understand whether in municipalities with higher exposure to the prices shock, the employment and wages increased by more than in municipalities less exposed to this shock.

Our results in Panel A of Table 6 – as expected – show a positive and significant coefficient for our variable of interest (Column 1). Then, our evidence is suggestive that a channel for poverty reduction was an increase in employment. Moreover, these poverty reductions would be associated with employment for unskilled workers which are closer to the poverty line than skilled workers. In fact, we present evidence consistent with this idea in columns 2 and 3 of Table 6. Dividing the sample between skilled and unskilled workers, our results indicate that positive price shocks were associated with increases in employment rate for unskilled workers. The impact was relevant, but not dramatic. Doubling the price index as happened between – roughly - 2003 and 2013 would have increased the unskilled employment rate in about 0.1 and 0.8 percentage points in percentiles 75$^{th}$ and 90$^{th}$ of mining labor share distribution[23].

Looking at the potential impact of metals prices shocks on unskilled employment across industries, we have found that the positive impact is only on the minerals industry and not in the rest of the economic sectors[24]. This would be consistent with the idea that commodities are enclaves dominated by multinationals with few interrelated activities with the rest of the economy (Arias et al, 2013).

In Panel B of Table 6 we present estimations for the impact of the price shock on average wages. Our findings reveals that price increase had –as expected – a positive impact on wages. Similar to our previous findings, our results indicate that the impact is positive and significant for unskilled workers only. For municipalities in the percentiles 75$^{th}$ and 90$^{th}$

[23] For comparison, note that unskilled employment participation is 30%.
[24] These not reported results are available upon request.

of the exposure distribution, doubling metals prices would have increased unskilled wages by 1% and 8%, respectively.

## 6. Conclusions

Several developing countries, and particularly Latin American economies, have largely benefited by positive terms of trade shocks during the 2000s. Although traditional literature has explored the aggregate effects of these booms on economic performance, little is known on the local effects on poverty and income distribution. In this paper, we use disaggregated Chilean municipality-level information to shed light on the impact of changes in mineral prices –mainly copper in the case the Chile – on poverty rates. The case of Chile is especially interesting, because it was largely favored by an increases in export prices during the 2000s, and its poverty rate showed an important decline during this period.

Following previous empirical works on local effects of trade shocks, we apply a difference in difference approach by exploiting exogenous prices changes in five mineral products and the different exposure of municipalities to this positive shock. We focus mainly on the poverty effects of this shock. Our results indicate that an increase in mineral prices contributed to poverty reduction significantly.

In addition, to better understand how prices changes are associated with poverty reduction, we investigate the potential mechanisms of the relationship between commodity prices and poverty. We investigate whether this impact is mostly channeled through labor markets and we look at how increases in minerals prices increase employment and wages. Our findings indicate that commodity price shocks had a positive impact on employment and wages, but particularly for unskilled workers in mining industries.

In sum, our results are more in line with the idea of direct effects on labor demand for unskilled workers rather than potential indirect effects on other industries and workers through backward linkages. However, with the data at hand, it could be possible to look more specifically to the impact on other sectors and workers, such as those in manufacturing and non-tradable industries. This and other questions, for example related to the short -and long-run effects on employment and wages, can be an interesting are of future research. In general, more work need to be done to understand better the local effects of resources booms, especially with the recent evolution of commodities prices and the potentially negative consequences of their current and future reduction.

**REFERENCIAS**


Aragón, F. M., andRud, J. P. (2013). Natural resources and local communities: evidence from a Peruvian gold mine. American Economic Journal: Economic Policy, 5(2), 1-25.

Aragona, F. M., Chuhan-Pole, P., & Land, B. C. (2015). The Local Economic Impacts of Resource Abundance. Mimeo.

Arias, M., Atienza, M. and J. Cademartori 82013). Large mining enterprises and regional development in Chile: between the enclave and cluster. Journal of Economic Geography, 14 (1): 73-95

Baffes, J. and Haniotis, T. (2010). Placing the 2006/08 Commodity Price Boom into Perspective. World Bank Policy Research Working Paper No. 537

Barnebeck Andersen, T., Barslundb, M, Worm Hansenc, T., Harrd, Thomas, and Sandholt Jensen, P. (2014). How much did China's WTO accession increase economic growth in resource-rich countries? *China Economic Review*, 30(1), 16-26.

Collier, P., & Goderis, B. (2012). Commodity prices and growth: An empirical investigation. European Economic Review, 56(6), 1241-1260.

Caselli, F., & Michaels, G. (2013). Do Oil Windfalls Improve Living Standards? Evidence from Brazil. American EconomicJournal: AppliedEconomics, 5(1), 208-38.

Comisión Chilena del Cobre (2013). Minería en Chile: Impacto en Regiones y Desafíos para su Desarrollo. Ministerio de Economía, Gobierno de Chile.

Corden, W.M. (1984). Booming sector and Dutch Disease Economics: Survey and Consolidation. Oxford Economic Papers 36(1984): 359-80.

Costa, F., Garred, J., & Pessoa, J. P. (2014). Winners and Losers from a Commodities-for-Manufactures Trade Boom, CEP Discussion Paper No 1269 May.

De Gregorio, J. and Labbé, F, (2014). Understanding Differences in Growth Performance in Latin America and Developing Countries between the Asian and Global Financial Crises, Working Paper Series WP14-11, Peterson Institute for International Economics.

De Gregorio, J. (2014). How Latin America Weathered the Global. Peterson Institute for International Economics.

Edmonds, E. V., Pavcnik, N., &Topalova, P. (2010). Trade Adjustment and Human Capital Investments: Evidence from Indian Tariff Reform. *American Economic Journal. Applied Economics*, 2(4), 42.

Edwards, S & E. Levy Yeyati. "Flexible exchange rates as shock absorbers." *European Economic Review*, 49(8): 2079-2105.

Erten, B., Ocampo, J. A. (2013). Super Cycles of Commodity Prices since the Mid-Nineteenth Century. *World Development* 44(1), 14-30.

Farooki, M., &Kaplinsky, R. (2013). The impact of China on global commodity prices: the global reshaping of the resource sector (Vol. 57). Routledge.

Gruss, B. (2014). After the Boom–Commodity Prices and Economic Growth in Latin America and the Caribbean. IMF Working Paper 14/154.

Howie, P., &Atakhanova, Z. (2014). Resource boom and inequality: Kazakhstan as a case study. Resources Policy, 39, 71-79.

Humphreys, D. (2010). The Great Metals Boom: A Retrospective. *Resources Policy*, 35(1), 1-13.

James, A. (2015). The resource curse: A statistical mirage?. Journal of Development Economics, 114, 55-63.

Krugman, P. (1987). "The Narrow Moving Band, the Dutch Disease, and the Competitive Consequences of Mrs. Thatcher: Notes on Trade in the Presence of Dynamic Scale Economies." Journal of Development Economics 27(1-2): 41-55

Marchand, J. (2014). The Distributional Impacts of an Energy Boom in Western Canada, Working paper (No. 2013-13), University of Alberta.

McCaig, B. (2011). Exporting out of poverty: Provincial poverty in Vietnam and US market access. Journal of International Economics, 85(1), 102-113.

McCaig, B., &Pavcnik, N. (2014). Export markets and labor allocation in a low-income country (No. w20455). National Bureau of Economic Research.

Mehlum, H., Moene, K., &Torvik, R. (2006). "Institutions and the Resource Curse". Economic Journal, 116(508), 1–20.

Sachs, J. D., & Warner, A. M. (2001). "The Curse of Natural Resources". European Economic Review, 45(4–6), 827–838.

Sachs, J. D., & Warner, A. M. (1999). “The Big Push, Natural Resource Booms and Growth”. Journal of Development Economics, 59(1), 43-76.

Smith, B. (2015). The resource curse exorcised: Evidence from a panel of countries. Journal of Development Economics, 116, 57-73.

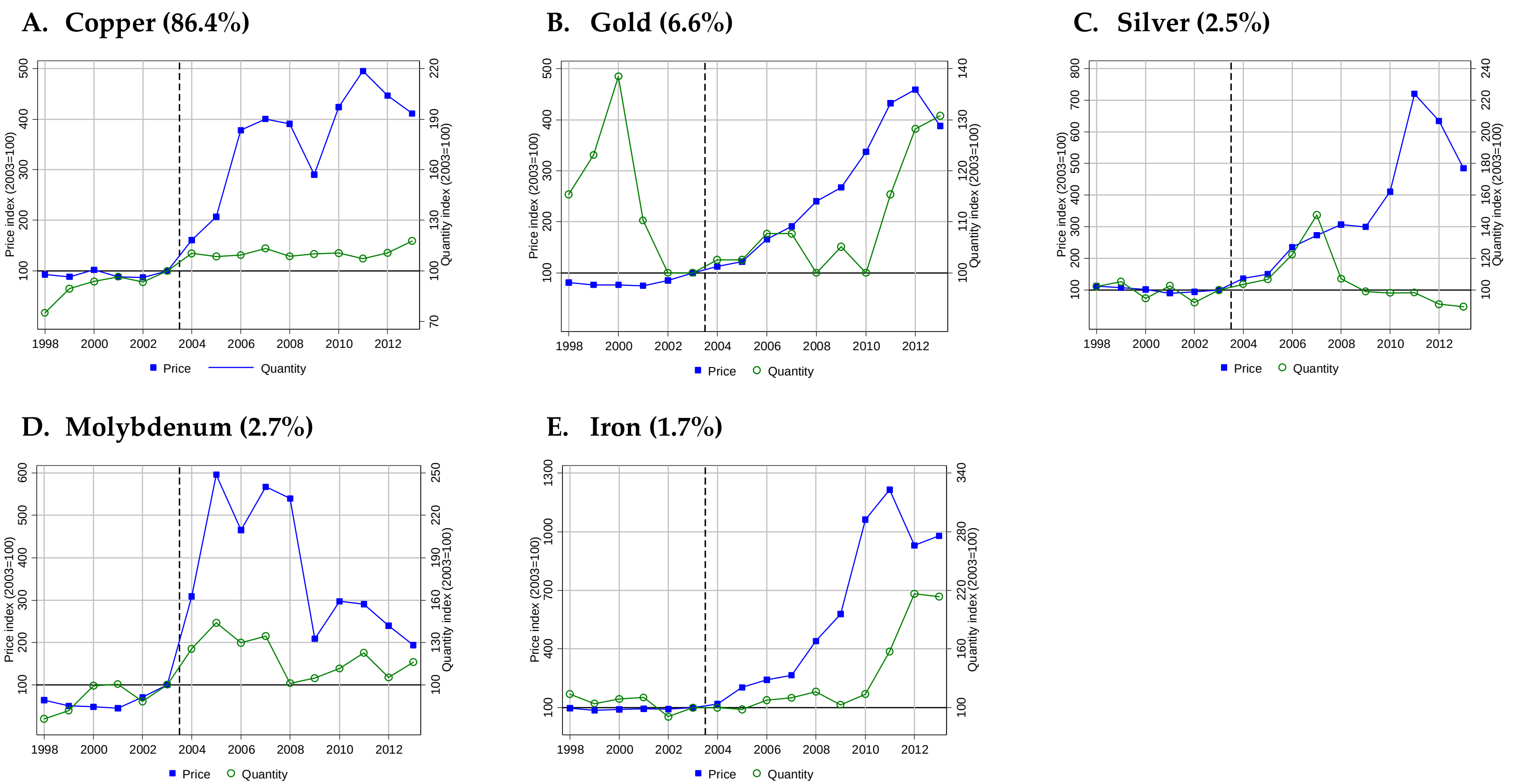
Topalova, P. (2010). Factor immobility and regional impacts of trade liberalization: Evidence on poverty from India. American Economic Journal: Applied Economics, 2(4), 1-41.

Van der Ploeg, F. (2011). “Natural Resources: Curse or Blessing?”, Journal of Economic Perspectives, 49(2): 366-420.

Yu, Y. (2011). Identifying the Linkages between Major Mining Commodity Prices and China’s Economic Growth—Implications for Latin America. IMF Working Paper 11/86.

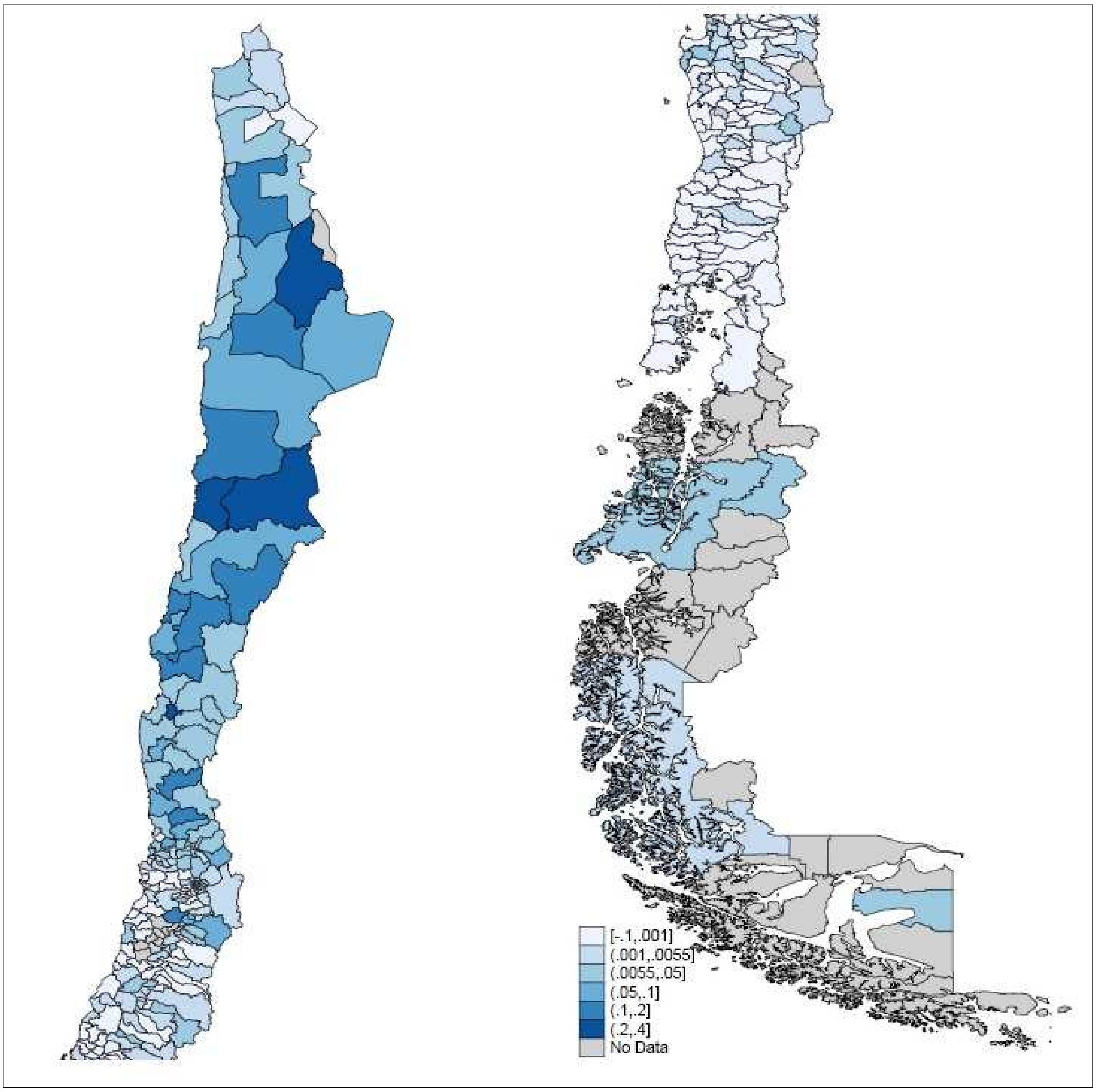
# FIGURES

Figure 1: World Price and Chilean Extraction of Selected Metals (2003=100)



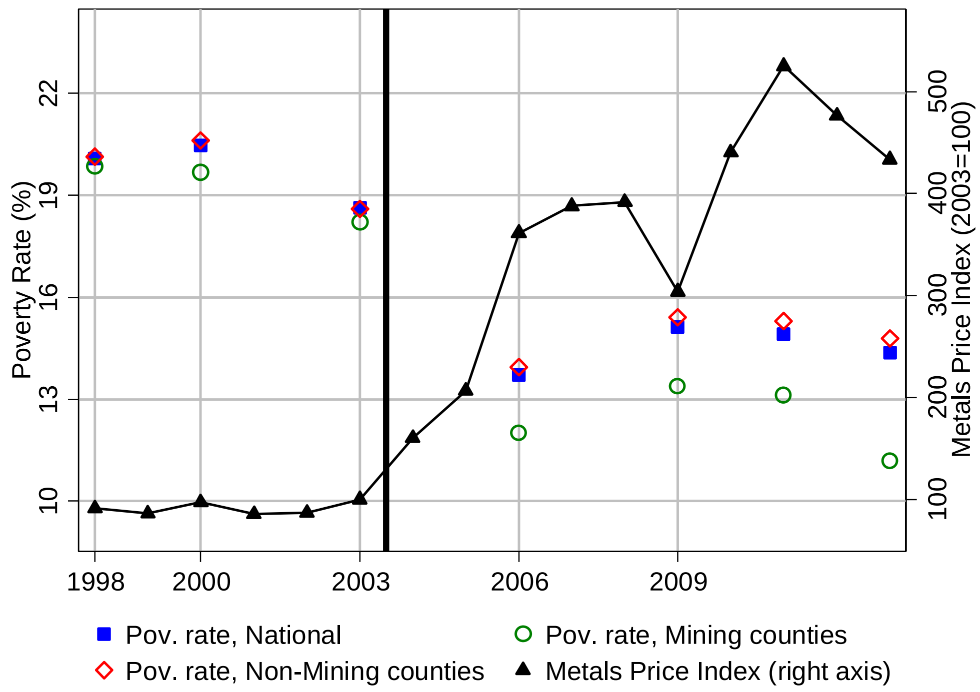

*Note*: The Figure shows price (left axis) and quantity (right axis) trajectories for the top-5 most important metals in Chile. These metals account for over 99% of the annual production value over the sample period. In parenthesis we show the relative importance of each metal in production value in 2003.

Figure 2: Metal-Mining Employment Share




Note: The figure the average municipal employment share for the period 1998-2003. Employment share is computed as the ratio of metal-mining employment over total municipal employment. Employment information is from CASEN.

Figure 3: Metals Price and Poverty rate in Chile




Note: The figure shows the national poverty rate, and the poverty rate in municipalities with high and low mining intensity for the period 1998-2013. Poverty rates are computed based on CASEN information for the period. Municipalities with high (low) mining intensity are those with metal-mining employment share above (below) the median; employment shares are computed in 2003.

# TABLES

Table 1

Observations in CASEN 1998-2013

| | **1998** | **2000** | **2003** | **2006** | **2009** | **2011** | **2013** | **MEAN** |
|---|---|---|---|---|---|---|---|---|
| Poverty Rate* | 20,1% | 20,5% | 18,6% | 15,1% | 14,9% | 14,4% | 13,7% | 16,8% |
| Surveyed Households | 48.107 | 65.036 | 68.153 | 73.720 | 71.460 | 59.084 | 66.725 | 64.612 |
| Surveyed Population | 188.360 | 252.748 | 257.077 | 268.873 | 246.924 | 200.302 | 218.491 | 233.254 |
| Population* | 13.143.833 | 14.361.014 | 15.340.042 | 16.115.197 | 16.584.521 | 16.902.542 | 17.218.400 | 15.666.507 |
| Municipalities | 196 | 285 | 302 | 335 | 334 | 324 | 324 | 300 |

*Note*: * indicates that the variable is computed with municipal expansion factors provided in CASEN

Table 2: Poverty Rate by Municipalities

(Simple average per-period)

| | Before: 1998-2003 | After: 2006-2013 | Difference |
|---|---|---|---|
| Non-exposed | 0,233 | 0,162 | -0,071 |
| St. dev. | 0,008 | 0,006 | 0,004 |
| Exposed | 0,244 | 0,147 | -0,096 |
| St. dev. | 0,012 | 0,009 | 0,009 |
| Difference | 0,011 | -0,014 | -0,025 |
| St. dev. | 0,015 | 0,011 | 0,010 |

Non-exposed municipalities are those with mining labor share lower than 1% (percentile 75%) and exposed municipalities are those with mining labor share higher than or equal to 1%.

Table 3: Impact on Poverty Rate

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Log $P_t$ x $\theta_c$ | -.164** | -.163** | -.162** | -.156** |
| | (.066) | (.068) | (.067) | (.066) |
| Schooling | --- | -.116*** | -.123*** | -.146*** |
| | | (.038) | (.038) | (.039) |
| Households Size | --- | .058** | .058** | .039 |
| | | (.025) | (.025) | (.025) |
| Urban Share | --- | --- | .073** | .084** |
| | | | (.036) | (.037) |
| GDP growth (Region) | --- | --- | .021 | .038 |
| | | | (.086) | (.084) |
| Municipality Size | --- | --- | .027 | .027 |
| | | | (.022) | (.022) |
| Constant | .261*** | .439*** | .120 | .195 |
| | (.008) | (.100) | (.231) | (.245) |
| Observations | 1,356 | 1,356 | 1,356 | 1,274 |
| Sample | All | All | All | Balanced |
| Year Fixed-Effects | ✓ | ✓ | ✓ | ✓ |
| Muncipality Fixed-Effects | ✓ | ✓ | ✓ | ✓ |
| R-squared | 0.353 | 0.366 | 0.370 | 0.393 |
| Number of Municipalities | 196 | 196 | 196 | 182 |

*Notes*: This table shows the effect of metal prices changes on poverty rate in a panel of municipalities over the period 1998-2014).θc corresponds to the metal mining employment share of municipality c in 1998. All regressions controls for municipality and year fixed effects. Standard errors (in parenthesis) are clustered at the municipal level. *** significant at 1%; ** 5%; * 10%.

Table 4

Potential Confounding Factors: Parallel Trends and Poverty Convergence

| Data | 1998-2003<br>(1) | 1998-2003<br>(2) | 1998-2003<br>(3) | 1998-2013<br>(4) | 1998-2013<br>(5) | 1998-2003<br>(6) |
|---|---|---|---|---|---|---|
| Log $P_t$ x $\theta_c$ | -0.026 | --- | 0.231 | -0.139* | -0.156*** | -0.125*** |
| | (0.992) | | (1.136) | (0.071) | (0.045) | (0.047) |
| Trend(Mining,98-03) | --- | -0.017*** | -0.017*** | -0.013*** | --- | -0.011*** |
| | | (0.004) | (0.005) | (0.004) | | (0.004) |
| Trend(Rest,98-03) | --- | -0.014*** | -0.014*** | -0.011*** | --- | -0.010** |
| | | (0.005) | (0.005) | (0.004) | | (0.004) |
| Trend(Mining,06-13) | --- | --- | --- | -0.010*** | --- | 0.000 |
| | | | | (0.002) | | (0.002) |
| Trend(Rest,06-13) | --- | --- | --- | -0.008*** | --- | 0.003 |
| | | | | (0.002) | | (0.002) |
| Log $P_t$ x $\tau_{98}$ | --- | --- | --- | --- | -0.208*** | -0.209*** |
| | | | | | (0.017) | (0.017) |
| F-test: Trend (Mining,Pre) = Trend (Rest,Pre) | --- | 0.280 | 0.287 | 0.134 | --- | .0825 |
| F-test: Trend (Mining,Post) = Trend (Rest,Post) | --- | --- | --- | 0.817 | --- | 1.575 |
| F-test: Trend (Mining,Pre) = Trend (Mining,Post) | --- | --- | --- | 1.099 | --- | 17.29*** |
| F-test: Trend (Rest,Pre) = Trend (Rest,Post) | --- | --- | --- | 1.703 | --- | 20.16*** |
| Observations | 576 | 576 | 576 | 1,356 | 1,356 | 1,356 |
| Year Fixed-Effects | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Muncipality Fixed-Effects | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Controls | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| R-squared | 0.107 | 0.107 | 0.108 | 0.371 | 0.431 | 0.433 |
| Number of Municipalities | 196 | 196 | 196 | 196 | 196 | 196 |

Table 5

Placebo Experiment on Poverty Rate

| Placebo | 5-years forward | | 3-years forward | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Commodity Shock Placebo | -0.028 | 0.003 | 0.035 | 0.111 |
| | (0.125) | (0.126) | (0.064) | (0.070) |
| Trend_(Mining,98-03) | --- | 0.033*** | --- | 0.032*** |
| | | (0.007) | | (0.007) |
| Trend_(Rest,98-03) | --- | 0.038*** | --- | 0.039*** |
| | | (0.007) | | (0.007) |
| Poverty98*Pindex | --- | -4.375*** | --- | -4.398*** |
| | | (0.509) | | (0.509) |
| F-test: Trend (Mining,Pre) = Trend (Rest,Pre) | --- | 0.992 | --- | 1.713 |
| Observations | 576 | 576 | 576 | 576 |
| Year Fixed-Effects | ✓ | ✓ | ✓ | ✓ |
| Muncipality Fixed-Effects | ✓ | ✓ | ✓ | ✓ |
| Controls | ✓ | ✓ | ✓ | ✓ |
| R-squared | 0.107 | 0.280 | 0.107 | 0.282 |
| Number of Municipalities | 196 | 196 | 196 | 196 |

Table 6

Impact on Employment and Wages

| Sample | All | Skilled | Unskilled |
|---|---|---|---|
| | (1) | (2) | (3) |
| Panel A: Employment Share | | | |
| Commodity Shock | 0.071*** | 0.018 | 0.052** |
| | (0.024) | (0.017) | (0.026) |
| R-Squared | 0.326 | 0.304 | 0.351 |
| Observations | 1,356 | 1,356 | 1,356 |
| Municipalities | 196 | 196 | 196 |
| Panel B: Log(Wages) | | | |
| Commodity Shock | 0.466** | 0.151 | 0.515*** |
| | (0.188) | (0.270) | (0.081) |
| R-Squared | 0.617 | 0.583 | 0.835 |
| Observations | 1,328 | 1,328 | 1,328 |
| Municipalities | 196 | 196 | 196 |
| For all regressions: | | | |
| Year Fixed-Effects | ✓ | ✓ | ✓ |
| Municipality Fixed-Effects | ✓ | ✓ | ✓ |
| Pre/post Trends for mining/non-mining | ✓ | ✓ | ✓ |
| Controls | ✓ | ✓ | ✓ |

*Notes*: This Table shows the effect of metal prices changes on total employment rate. Employment rate is defined as municipal-level employment over population. Skilled (Unskilled) are workers with schooling higher (lower) than secondary. $\theta_c$ corresponds to the metal mining employment share of municipality c in 1998. All regressions controls for municipality and year fixed effects. Standard errors (in parenthesis) are clustered at the municipal level. *** Significant at 1%; ** 5%; * 10%.

# A. DATA APPENDIX

| Variable | Source | Definition |
|---|---|---|
| Cooper Price | COCHILCO | Dollars per pound of refined cooper (U$/lb) - London Metal Exchange: Copper Grade A Settlement. |
| Molybdenum Price | COCHILCO | Dollars per pound of molybdenum (U$/lb) - US Dealers. |
| Gold Price | COCHILCO | Dollars per ounce of gold (U$/oz) - HANDY & HARMAN. |
| Silver Price | COCHILCO | Dollars per ounce of silver (U$/oz) - HANDY & HARMAN. |
| Iron Ore Price | FMI - MacroeconomicStatistics | Dollars per Metric Tons of iron ore (U$/MT). |
| Cooper Production | COCHILCO | Thousands of Metric Tons (MT). |
| MolybdenumProduction | COCHILCO | Metric Tons (MT) of Fine Content. |
| Gold Production | COCHILCO | Kilograms (Kg) of Fine Content. |
| SilverProduction | COCHILCO | Kilograms (Kg) of Fine Content. |
| Iron Ore Production | COCHILCO | Thousands of Metric Tons (MT). |
| Price Index weighted by production | COCHILCO | Index of metal prices, weighted by production of each metal over total production of five metals. |
| Price Index weighted by value of production | COCHILCO | Index of metal prices, weighted by value of production over total value of production of five metals. |
| Metal Mining Share | CASEN | Ratio of workers employed metal mining (ISIC Rev.3 1310 and 1320) over total municipal employment. |
| Municipal PovertyRate | CASEN | Ratio of poor people, over total municipal popullation. An individual is defined as "poor" if their income (or income per-capita of the household) doesn't covers the cost of a Basic Food Basket, and a Basic Non-Food Basket. So, the poverty thresholds is the total value of both baskets. |
| MunicipalitySize | CASEN | Number of people living in each municipality. |
| AverageSchooling | CASEN | Average years of schooling for older than 15 years. |
| Avg. Number of persons in households | CASEN | Average number of persons per household, for each monucipality. |
| Ethnic Share | CASEN | Ratio of people who belong to an ethnic, over total municipal popullation. |
| Urban Share | CASEN | Ratio of people living in urban area, over total municipal popullation. |
| SkilledWorkers | CASEN | Workers who at most ended high school. |
| UnskilledWorkers | CASEN | Workers with more education than high school. |
| AverageWages - skilledworkers | CASEN | Average wages (income from main occupation) of skilled workers, for each municipality. |
| AverageWages - unskilledworkers | CASEN | Average wages (income from main occupation) of unkilled workers, for each municipality. |

## B. Additional Tables

Table B1. Using Restricted PANEL 1998-2013

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Log Pt x$\theta_c$ | -0.155** | -0.140** | -0.101* | -0.108* |
| | (0.066) | (0.068) | (0.054) | (0.056) |
| Trends (Metal-mining) | | | -0.001 | -0.001 |
| | | | (0.002) | (0.002) |
| Trends (Non Metal-mining) | | | 0.003 | 0.003 |
| | | | (0.002) | (0.002) |
| Poverty98*Pindex | | | -0.240*** | -0.237*** |
| | | | (0.022) | (0.023) |
| Controls | y | y | y | y |
| Observations | 968 | 968 | 959 | 911 |
| Year Fixed-Effects | y | y | y | y |
| Muncipality Fixed-Effects | y | y | y | y |
| R-squared | 0.436 | 0.462 | 0.531 | 0.532 |
| Number of Municipalities | 196 | 196 | 195 | 183 |

Notes: This table shows the effect of metal prices changes on poverty rate, computing exposure θc as the average metal mining employment share of municipality c in 1998. Standard errors (in parenthesis) are clustered at the municipal level. Key: *** significant at 1%; ** 5%; * 10%.

Table B2. Using Alternative Measure of Exposure

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Log Pt x$\theta_c$ | -0.152 | -0.150 | -0.157 | -0.159 |
| | (0.065)** | (0.065)** | (0.066)** | (0.068)** |
| Regional GDP growth | -- | 0.037 | 0.047 | 0.032 |
| | | (0.088) | (0.084) | (0.084) |
| Log population | -- | -- | 0.025 | 0.028 |
| | | | (0.018) | (0.022) |
| Log Household Size | -- | -- | 0.047 | 0.040 |
| | | | (0.022)** | (0.025) |
| Log Years of Schooling | -- | -- | -0.087 | -0.146 |
| | | | (0.032)*** | (0.039)*** |
| Urban Share | -- | -- | 0.047 | 0.079 |
| | | | (0.031) | (0.036)** |
| Municipality FE | ✔ | ✔ | ✔ | ✔ |
| Year FE | ✔ | ✔ | ✔ | ✔ |
| R-squared | 0.33 | 0.33 | 0.34 | 0.39 |
| Observations | 1950 | 1950 | 1950 | 1274 |

*Notes*: This table shows the effect of metal prices changes on poverty rate, computing exposure $\theta_c$ as the average metal mining employment share of municipality c in 1998-2000. Standard errors (in parenthesis) are clustered at the municipal level. Key: *** significant at 1%; ** 5%; * 10%.

Table B3. Excluding Metropolitan Region

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Log Pt x$\theta_c$ | -0.123* | -0.114* | -0.109** | -0.108** |
| | (0.066) | (0.066) | (0.048) | (0.048) |
| Trends (Metal-mining) | - | - | 0.002 | 0.002 |
| | | | (0.002) | (0.002) |
| Trends (Non Metal-mining) | - | - | 0.008*** | 0.008*** |
| | | | (0.002) | (0.002) |
| Poverty98*Pindex | - | - | -0.199*** | -0.207*** |
| | | | (0.022) | (0.023) |
| Controls | ✗ | ✓ | ✓ | ✓ |
| Observations | 995 | 995 | 991 | 927 |
| Year Fixed-Effects | ✓ | ✓ | ✓ | ✓ |
| Muncipality Fixed-Effects | ✓ | ✓ | ✓ | ✓ |
| R-squared | 0,395 | 0,419 | 0,463 | 0,492 |
| Number of Municipalities | 144 | 144 | 144 | 133 |

Notes: This table shows the effect of metal prices changes on poverty rate, computing exposure θc as the average metal mining employment share of municipality c in 1998. Standard errors (in parenthesis) are clustered at the municipal level. Key: *** significant at 1%; ** 5%; * 10%.

Table B4. Including Other Commodities Prices

| | (1) | (2) |
|---|---|---|
| Log Pt x$\theta_c$ | -0.174*** | -0.112** |
| | (0.066) | (0.045) |
| Log Pot x$\phi_c$ | -0.077* | 0.046 |
| | (0.043) | (0.038) |
| Trends (Metal-mining) | - | 0.002 |
| | | (0.002) |
| Trends (Non Metal-mining) | - | 0.005*** |
| | | (0.002) |
| Poverty98*Pindex | - | -0.219*** |
| | | (0.017) |
| Controls | y | y |
| Observations | 1356 | 1356 |
| Year Fixed-Effects | y | y |
| Municipality Fixed-Effects | y | y |
| R-squared | 0.372 | 0.434 |
| Number of Municipalities | 196 | 196 |

Notes: This table shows the effect of metal prices changes on poverty rate, computing exposure θc (ϕc) as the average metal mining (other commodities) employment share of municipality c in 1998. Standard errors (in parenthesis) are clustered at the municipal level. Key: *** significant at 1%; ** 5%; * 10%.