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Digging Deep: Resource Exploitation and Higher Education

Autores:
Lenin H. Balza
Camilo De Los Rios
Nathaly M. Rivera

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sdt@econ.uchile.cl
econ.uchile.cl/publicaciones

Digging Deep: Resource Exploitation and Higher Education*

Lenin H. Balza[†] Camilo De Los Rios[‡] Nathaly M. Rivera[§]

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Abstract

Do resource-extraction booms crowd out postsecondary education? We explore this question by examining the higher education-related decisions of Chilean high school graduates during the 2000s commodities boom. We find mineral extraction increases a person's likelihood of enrolling in postsecondary technical education while reducing the likelihood of completing a four-year professional degree program. Importantly, effects are heterogeneous across economic backgrounds. The impact on college dropouts is primarily present among students that graduated from public high schools, which generally cater to low-income groups. Our findings show that natural resources may affect human capital accumulation differently across income groups in resource-rich economies.

Keywords: Extractive Industries, Natural Resources, Resource Curse, Resource Booms, Human Capital, Education, Latin America, Chile
JEL Classification: Q32, Q33, I23, I25, I26

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[†]Inter-American Development Bank. Infrastructure and Energy Sector. ✉: leninb@iadb.org.
[‡]Sanford School of Public Policy. Duke University. ✉: camilo.de.los.rios.rueda@duke.edu.
[§]Department of Economics, University of Chile. ✉: nmrivera@fen.uchile.cl. Corresponding author.

1 Introduction

Natural-resource-rich economies generally suffer from several poor economic and political outcomes, including slow economic growth (Sachs and Warner, 1995, 2001; Papyrakis and Gerlagh, 2007; James and Aadland, 2011), public corruption (Vicente, 2010; Caselli and Michaels, 2013; Brollo et al., 2013; James and Rivera, 2022), violence and conflict (Ross, 2004; Brückner and Ciccone, 2010; Berman et al., 2017), and political instability (Tsui, 2011; Caselli and Tesei, 2016), especially in the presence of weak institutions (Mehlum et al., 2006; Robinson et al., 2006). We present plausible causal evidence that an exogenous shock to the natural-resource sector, such as a recent discovery or a price boom, also hinders human capital accumulation, particularly higher education. Considering that mineral production is likely to soar as demand for clean energy increases (Hund et al., 2020), a crowding out of postsecondary education in resource-abundant countries could result in severe long-lasting development consequences for these economies in the near future.

A positive shock to this sector may increase the opportunity cost of studying through higher salaries (Thomas et al., 2004; Atkin, 2016) or increasing labor requirements of unskilled workers (Leamer et al., 1999; Aragon and Rud, 2013). These short-term fluctuations in wages or economic opportunities should come close to isolating the substitution effect (Soares et al., 2012), thus diminishing a person's incentives to acquire higher education. On the other hand, resource booms may raise household budgets (Emery et al., 2012; Yamada et al., 2018), inducing additional investment in education (Birdsall et al., 2001). Additionally, if interest in higher education is counter-cyclical, booms may merely delay postsecondary enrollment (Emery et al., 2012) without affecting human capital accumulation in the long run. We build on this body of work by exploring the impact an exogenous shock to mineral extraction has on the postsecondary enrollment and completion decisions of high school students. As the response to changes in income may vary with wealth (Soares et al., 2012), we also dig into the socioeconomic background of the students affected.

The focus of this paper is Chile, a country with a substantial mineral extraction sector and with relatively high levels of literacy. Mineral extraction in Chile is dominated by copper extraction, which consists primarily of large-scale, capital-intensive operations, and unlike other nations in the region, the sector shows no evidence of illegal operations in this country.[1] Importantly, more than 90% of the labor force working in large-scale mining operations has at least a high school diploma (Oñate, 2011). This creates a unique opportunity to investigate the impact a positive economic shock to an industrialized extraction sector—as opposed

[1]See "Organized Crime and Illegal Gold Mining in Latin America," Global Americans, Online, accessed February 3, 2021.

to more artisanal operations—may have on acquisition of higher education, while concerns about compulsory education are minimal.

We start our analysis following Atkin (2016)'s analytical framework on how an economic shock affects a student's decision between compulsory and postsecondary education. In our empirical exercise, we use a rich data set on the universe of high school students who graduated 2006 – 2018. These are the years of a copper supercycle – a period during which real prices rose more than 200% climbing from $1.18 per pound of refined copper in 2003 to $3.78 in 2007. We track these students over time and examine their enrollment and degree completion decisions through the estimation of a set of reduced-form equations. We explore a set heterogeneous effects by type of postsecondary institution and degree program (i.e., professional or technical), and students' economic backgrounds using the funding source of the high school attended as a proxy for family income levels. For identification, we adopt a set of continuous double-difference specifications that use plausible exogenous variation in copper prices and pretreatment variation in resource endowment throughout the country. To consider the whole extent of a labor demand shock on local employment, we conduct our analysis within local labor markets incorporating short- distance commuting patterns, a crucial factor in the response of local employment to a local labor demand shock (Moretti, 2010; Monte et al., 2018). We test the robustness of our results by carrying out a battery of alternative specifications, and analyze a variety of mechanisms that may explain our results.

Our results show a positive resource shock increases the likelihood of postsecondary enrollment in resource-rich areas. We find a 1-dollar rise in prices increases a person's likelihood of postsecondary enrollment by 2.58 percentage points in resource-richest areas, equivalent to a 3.59% increase. This boost is in the form of delayed enrollment, and is found primarily among students opting for postsecondary technical programs that align with the mining industry labor requirements. Notwithstanding, our analysis also reveals a significant effect on the likelihood of dropping out of college. A student in resource-rich areas is roughly 0.3-3.8 percentage points less likely to finish their postsecondary education during a similar rise in copper prices, which is equivalent to an 8.79% decrease in the likelihood of finishing college in resource-richest areas. We find this effect mostly among students enrolled in professional degree programs as opposed to technical ones. Further analysis reveals students experiencing a boost in the likelihood of postsecondary enrollment are mostly associated with middle-income groups, while those with an increased likelihood of college dropout come primarily from public high schools that often cater to low-income groups. This is suggestive that positive resource shocks decrease human capital accumulation, but mostly among students with poor economic backgrounds. An additional wage premium paid to low-skilled workers in areas with mineral extraction as well as a higher household income both seem to be driving these results. Yet, which of the two effects dominates seem to be conditional on students' income level.

This paper makes a substantive contribution to the literature on economic shocks and the cycle of educational outcomes in emerging economies. Using an educational choice framework, Ferreira and Schady (2009) show that rich economies are likely to have counter-cyclical schooling outcomes, whereas in middle-income countries the effect becomes ambiguous. For instance, Funkhouser (1999) finds a reduction in compulsory school attendance during the 1980s recessionary period in Costa Rica. In contrast, McKenzie (2003) documents increasing enrollment of school children aged 15-18 during the Mexican peso crisis of 1995-1996, whereas Kruger (2007) observes an increase in the probability of school enrollment in the presence of negative changes in coffee-growing economies in Brazil. We add to this discussion by showing that the cycle of postsecondary education, particularly college graduation, is conditional on students' economic backgrounds as low-income students are less likely to graduate during an exogeneous economic shock to a country's key sector, while upper-income students are unaffected.

Our paper also adds to the literature on natural resources and the link between extractive industries and human capital (Cascio and Narayan, 2022; Rickman et al., 2017; Mejía, 2020; Balza et al., 2021; Mosquera, 2022; Acuna et al., 2022). Most of these analyses use within-country variation and focus on primary or secondary education, with only a few exploring effects on higher education (Emery et al., 2012; Rickman et al., 2017; Yamada et al., 2018; Balza et al., 2021; Mosquera, 2022; Acuna et al., 2022). We contribute to this body of work by employing individual-level variation, which allows us to proxy for factors known to affect an individual's decision to pursue or finish higher education, such as ability (Arcidiacono, 2004; DesJardins et al., 2006); financial aid (Dynarski, 2000, 2003; Bettinger et al., 2019); school or college quality (Light and Strayer, 2000; Deming et al., 2014); and high school socioeconomic context (Finnie et al., 2005). Moreover, by exploring enrollment and completion decisions, we are among the first to offer such a comprehensive overview of the long-term impact of natural resources on human capital accumulation at the postsecondary level. Furthermore, to the best of our knowledge, virtually no other existing work expands on the heterogeneous aspect that resource booms have on higher education across different socioeconomic backgrounds. Thus, our results help to inform about the unequal economic consequences of resource shocks.

2 Mining in Chile

Mineral extraction is a substantial sector in Chile's economy. Currently, it represents 10.5% of the country's GDP, roughly 41% of its total authorized foreign investments, and more than 54% of its total exports. Copper mining represents 51% of these exports (COCHILCO, 2021) as the country currently leads worldwide production of this metal with 28% of participation (U.S. Geological Survey, 2021).

This sector represents 2.8% of national employment (COCHILCO, 2021) equivalent to 230,000 jobs. Appendix Figure A1 shows that this participation has consistently increased over time.[2] More than 85% of these jobs belong to large- and medium-scale mining companies (COCHILCO, 2014), where at least 50% of workers hold high school diplomas and 45% tertiary degrees (Consejo Minero, 2019).[3]

While a significant percentage of workers employed by large-scale mining companies in Chile holds postsecondary degrees, previous research shows the mining sector discourages higher education (e.g., Álvarez and Vergara (2022); Trujillo and Puello (2021)).[4] Although informative, these earlier analyses use enrollment rates aggregated at the city level, which may lead to inaccurate conclusions on individuals' economic behavior (Garrett, 2003). We improve upon this previous research by looking at individual-level postsecondary enrollment and completion decisions, which enables us to control for a set of variables known to affect students' decisions relative to obtaining a tertiary degree, such as ability (Arcidiacono, 2004; DesJardins et al., 2006) and financial aid (Dynarski, 2000, 2003; Bettinger et al., 2019), among others. We also carry out our analysis across local labor markets and explore a richer set of postsecondary outcomes such as delayed enrollment and completion decisions, giving a more comprehensive overview of the impact of higher copper prices on higher education.[5]

2.1 The 2000s Copper Price Boom

To study the impact an exogenous shock to the resource extraction sector has on postsecondary education decisions, we rely on the 2000s boom in copper prices as a natural experi-

[2] Appendix Figure A1 also depicts the wage ratios between mining and the country's general wage index and wages in the manufacturing sector. Congruous with the years of high copper prices, wages in mining were relatively higher during the mid-2000s and early 2010s.

[3] These figures are an improvement over national trends. In Chile, only 25% of adults (aged 25-64 years old) have a tertiary qualification, although current estimates show 72% of young people expect to enter college before the age of 25 (OECD, 2022). Regarding compulsory education, current completion rates are 96.30% for primary education and 85.75% for upper secondary education (UNESCO, 2022).

[4] For instance, Álvarez and Vergara (2022) find a negative relationship between higher mining exports and tertiary enrollment rates. In particular, the authors show that during the recent commodity price boom, enrollment rates of people aged 17-20 decreased in municipalities with high local labor market exposure to this sector while employment rates increased for the same cohort. Similarly, Trujillo and Puello (2021) show that this commodity price boom led to lower returns to schooling, decreasing municipality-level enrollment rates of young individuals (aged 15-24), and increasing their labor market participation.

[5] By exploring the postsecondary education channel, we also add to the body of literature on the local impacts of mining in Chile (Aroca, 2001; Arias et al., 2013; Rivera and Aroca, 2014; Paredes and Rivera, 2017; Rivera, 2020).

ment. Scholars agree rapid industrial development and urbanization of emerging economies such as China and India created sharp increases in copper demand and thus, the drastic rise in copper prices 2004 – 2014 (Humphreys, 2010; Erten and Ocampo, 2013; Berman et al., 2017).[6] In fact, China accounted for 100% of the growth in global demand for copper from 2000 to 2008. This demand suggests the recent price boom was exclusively due to China's growing need for this product (Humphreys, 2010). The demand-driven particularity of this supercycle thus allows us to consider the 2000s rise in copper prices as a phenomenon exogenous to Chile's copper production levels.

Real copper prices rose more than 200% during this supercycle, climbing from \$1.18 per pound of refined copper in 2003 to \$3.78 in 2007 (see Appendix Figure A2). Although prices significantly dropped over the subsequent two years, they climbed again in 2009 to \$2.72 per pound, staying high for a couple more years. Internal copper production moved in tandem with copper prices during this period; the correlation between these variables is equal to 66% (see Appendix Figure A2). On average, annual copper production has increased 1.5% since 2013, reaching a peak during the 2003-2007 period when production rose more than 13%. During these years, twelve new large-scale mining companies launched operations as well, with a joint production equivalent to 18% of the country's total copper production (as of 2019). One can expect that additional copper production driven by an exogenous price boom distorts the labor market. The following sections explore the extent to which this shock also may disrupt tertiary schooling.

3 Theoretical Framework

We follow Atkin (2016) and lay out a theoretical framework that allows us to understand students' decisions to pursue postsecondary education. Given the high completion rates of compulsory elementary and secondary schooling in Chile, we simplify Atkin (2016)'s original work and consider a framework in which students choose between only two education levels, $e = (1, 2)$, compulsory education and postsecondary education. In period t a high school student receives utility $u(\bar{y}_t)$, which consists of the direct utility that comes from schooling as well as any family support that may be provided. A worker with education e who enters the labor force in period i earns a wage of $y_{e,i,t}$ in period t. Assuming a log utility and a Mincerian wage function, we can express an individual worker's utility as follows:

$$u(y_{e,i,t}) = \ln(y_{e,i,t}) = \beta_0 + \theta e + b[t - i] + \nu_{e,i}, \tag{1}$$

[6] While this supercycle affected a wide range of commodities, we focus on copper prices give the relevance of this metal for Chile's economy.

where β_0 is a base salary, θ is the return to an additional level of education e, b is the return to experience, and $\nu_{e,i}$ is a stochastic and persistent year-of-entry wage premium specific to education level e.

We assume the year-of-entry wage premium $\nu_{e,i}$ exists as only certain firms will offer a worker a job in any given year. These premia are a weakly increasing function of new job opportunities l_i during the year of entry into the labor force,

$$\nu_{e,i} = \omega_{e,i}\phi_{e,i}l_i, \tag{2}$$

where $\phi_{e,i}$ is the proportion of new jobs due to the resource boom available to workers with education e, and $\omega_{e,i} \geq 0$ captures the premia new jobs pay during the resource boom compared with job opportunities in a normal year. We consider an infinite-time period. Taking ρ as the discount rate, a drop-out decision in period t depends on whether the student's discount rate is greater than the discount cutoff, $\bar{\rho}_{e,t}$, which is equal to the ratio between the net present value of obtaining exactly one more school stage, $e+1$, and the net present value of dropping out with education e:

$$\bar{\rho}_{e,t} = \frac{\theta + E_t\nu_{e+1,t+1} - b - \nu_{e,t}}{\beta_0 + \theta e + \nu_{e,t} - \ln \bar{y}} \equiv \frac{RS_{e+1,t}}{OC_{e,t}}. \tag{3}$$

The numerator in Equation (3) corresponds to the perceived per-period utility gain from acquiring one additional level of education (i.e., the return to schooling $RS_{e+1,t}$), whereas the denominator represents the utility difference between working in period t and being at school (i.e., the opportunity cost of education $OC_{e,t}$). From Equation (3), we can conclude that an impatient student with $\rho \geq \bar{\rho}_{1,t}$ in period t will choose education level $e = 1$, while in period $t+1$ only a patient student with $\rho < \bar{\rho}_{1,t+1}$ will choose $e = 2$.[7]

Next, we evaluate the impact of a positive resource shock in period T on aggregate schooling of the cohort at our key exposure age of 18.[8,9] We assume students are homogeneous in all aspects except for their discount rates. Let ρ be distributed with a PDF $f(x)$ and CDF $F(x)$ across a continuum of high school students. This CDF and the discount-rate cutoffs define the aggregate education, Φ, of an 18-year-old cohort in period T:

$$\Phi = 1 + [F(\bar{\rho}_{1,T})]. \tag{4}$$

[7]As in Atkin (2016), we assume the return to schooling and the opportunity cost are both positive.

[8]This positive shock could affect the number of new job opportunities available or the premia that new jobs pay during boom years or both.

[9]Age 18 is the average age of graduating high school seniors in Chile. Hence, if they choose to stay at school, they will have, on average, $e = 1$ in period T.

We consider that a resource boom leads to many job vacancies, $l_T > 0$. For simplicity, we assume that in subsequent periods some vacancies persist, but are smaller than in the previous period so that $l_{T+1} = \delta l_T$ with $\delta \in (0, 1)$. Taking a first-order Taylor expansion of Equation (4) around $l_T = 0$ (the counterfactual to a resource boom), we obtain the resulting change in the cohort's education acquisition:

$$\Phi|_{l_{T>0}} - \Phi|_{l_{T=0}} = \underbrace{\left.\frac{d(\bar{\rho}_{1,T})}{d\nu_{1,T}}\right|_{l_{T=0}}}_{<0} d_{1,T}\omega_{1,T}\phi_{1,T}l_T + \underbrace{\left.\frac{d(\bar{\rho}_{1,T})}{d\nu_{2,T+1}}\right|_{l_{T=0}}}_{>0} \delta d_{1,T}\omega_{2,T}\phi_{2,T}l_T, \tag{5}$$

where $d_{1,T} \equiv f(\bar{\rho}_{1,T})$ is the density of 18-year-olds on the margin of compulsory and postsecondary education.

The first term in Equation (5) captures the impact of new jobs that require only a high school education. These jobs induce students on the margin of high school and postsecondary education to drop out by raising the opportunity cost of school $OC_{1,T}$, lowering the return to school $RS_{2,T}$, and thus, lowering the discount-rate cutoff $\bar{\rho}_{1,T}$. The second term represents new jobs requiring a postsecondary degree, which raises the returns to school $RS_{2,T}$ and $RS_{2,T+1}$ and encourages youths on the margin to enroll in a postsecondary program and acquire more schooling by increasing the $\bar{\rho}_{1,T}$ and $\bar{\rho}_{1,T+1}$ cutoffs. Taken together, we observe that the final impact of a resource boom on aggregated schooling is at first ambiguous as it depends on the returns to an additional level of education, the opportunity cost of studying, and ultimately, the type of new job vacancies offered.

Equation (5) constitutes the core of our empirical analysis. We quantify the impact of the 2000s copper price boom on postsecondary education by modeling the decision-making process of the average high school graduate located in resource-rich areas. The resulting estimated marginal effect of the shock under analysis gives an indication of the overall sign of $\Phi|_{l_{T>0}} - \Phi|_{l_{T=0}}$, averaged from 2006 to 2018. In future sections, a discussion of potential mechanisms allows determine the extent to which returns to postsecondary education $RS_{2,T}$ and its opportunity cost $OC_{2,T}$ explain our results.

4 Data Description

4.1 Educational Outcomes

We use Chile's most comprehensive administrative data on education gathered from Chile's Ministry of Education (MINEDUC).[10] We first obtain data on the universe of high

[10] See http://datosabiertos.mineduc.cl

school seniors who graduated from a secondary institution 2006 to 2018. This data set contains students' demographics (e.g., age, gender), proxies for students' ability (e.g., high school grades and attendance), students' type of high school attended (regular, for adults, vocational), and the high school funding source (i.e., private, public, or voucher school), a proxy of students' socioeconomic conditions. Using high schools' unique identifiers, we also construct a set of covariates at the high school level, such as high schools' average grades and attendance, and the ratio between failing and passing students. We use these variables as proxies of high school quality, an important predictor of college enrollment decisions (Deming et al., 2014).

We merge high school students with the universe of students enrolled in a postsecondary institution from 2007 to 2019 using a student-level unique identifier and high school graduation year. This last data set contains comprehensive information on the postsecondary institution in which students enrolled and the type of degree chosen (either a 4-year –or more– postsecondary degree program or a technical program).[11] These data also contain information on tuition and on whether students ever requested and were granted financial aid – variables we use in our postsecondary completion analysis.

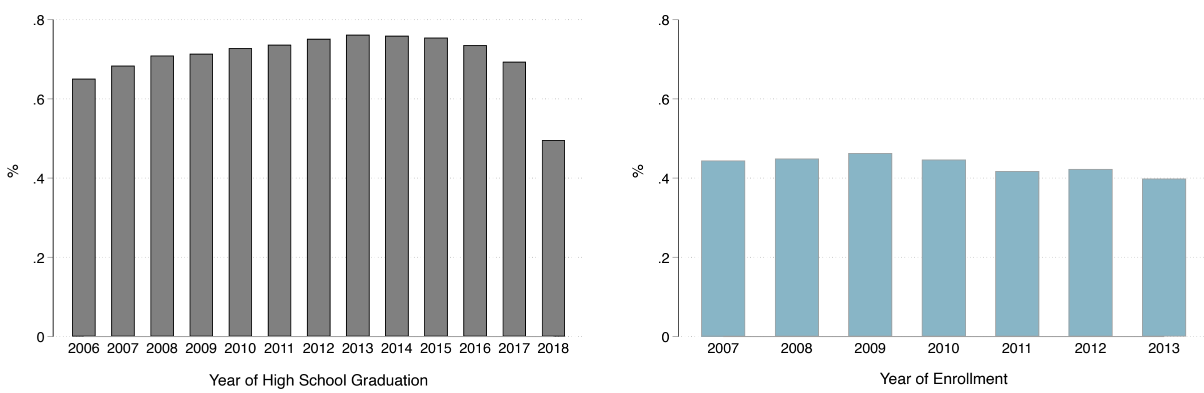
We define our relevant postsecondary enrollment sample by limiting enrollment to students enrolled in undergraduate programs that require a high school degree or diploma as a prerequisite. We discard all students enrolled in graduate school or any other types of programs requiring a bachelor's degree as a prerequisite. When matching high school graduates to postsecondary students, we follow two approaches. First, we isolate the universe of high school graduates in year t and merge them with the year $t + 1$ enrollment database. This allows us to ascertain whether a recent high school graduate immediately enrolls in a postsecondary educational institution. We assign the value of 1 to high school graduates appearing in the postsecondary enrollment data set in year $t + 1$ and 0 to those that did not. We refer to this as our "immediate enrollment" sample. Our second approach intends to identify whether high copper prices merely produce a delay in postsecondary enrollment. To that end, we merge the universe of high school graduates in year t with postsecondary enrollment in years $t+d$, where $d = \{2, ..., D\}$. Given the duration of the copper price booms captured in our sample period, we explore possible delays in enrollment of up to six years ($D = 6$) following high school graduation. We call this our "late enrollment" sample.

Our final enrollment sample contains more than 3 million high school students who graduated from high school 2006 to 2018. Roughly 70% of them enrolled in a postsecondary

[11] Postsecondary institutions include those that offer professional programs that last four years or more, and two-year institutions that offer associate's and technical degrees and certificates. Throughout the paper, we refer to the former as "Universities", to the latter as "Technical Institutions" and to either group simply as "Colleges".

education program 2007 to 2019. On average, 65% of students enrolling in a postsecondary degree program did so immediately following high school graduation. Descriptive statistics are in Appendix Table A1 for enrollment (panel A), student-level characteristics (panel B), and high school level covariates (panel C).

We also gathered information on students who completed a postsecondary education during our study period. We merge these data with the universe of students with postsecondary enrollment to identify the subset of college-enrolled students who completed at least one degree. Specifically, we search for every college student enrolled in year t in our postsecondary completion data set in years $t + n$, where $n = \{1, ..., N\}$. We assign a value of 1 to college-enrolled students appearing in the degree completion data set and 0 to those who do not. In the process of merging these data sets, completion rates decrease mechanically over time as the information on degree completion available for each time window $t + n$ becomes smaller for more recent years.[12] To avoid misleading conclusions about postsecondary graduation rates, our completion analysis only uses data for enrollment years from 2006 until 2013.[13] Using this criterion, 42% of postsecondary students (enrolled from 2007 to 2013) completed a postsecondary degree between 2007 and 2019. Descriptive statistics on postsecondary completion outcomes are in panel A of Appendix Table A1.



(a) Enrollment (b) Completion

Figure 1: Postsecondary Enrollment and Completion Rates Over Time

Notes: This figure shows postsecondary enrollment and degree completion rates over time. Panel (a): Enrollment over time is by year of high school graduation. Data on postsecondary enrollment come from the Ministry of Education (MINEDUC), from 2007 to 2019. Panel (b): Completion over time is by enrollment year. Data on postsecondary completion come from the Ministry of Education (MINEDUC), from 2007 through 2013.

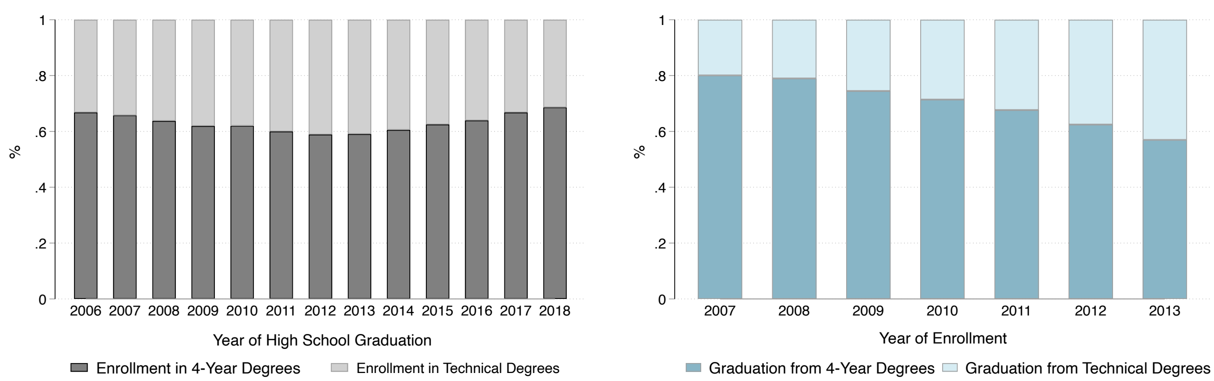
Figure 1 illustrates postsecondary enrollment (by year of high school graduation) and completion (by year of enrollment) rates over time. Postsecondary enrollment has increased

[12] Additionally, completion rates in 2007 are minimal as the enrollment data set starts in 2006.

[13] The sample average for the number of years to finish an academic degree is 5.6. Hence, the average 2013-enrolled college student in our sample is expected to have graduated by 2019.

over time (Figure 1(a)), although this trend is reversed after 2013. The late enrollment variable likely accounts for the recent drop in enrollment, which mechanically falls in the last years of the study period. Further in our empirical analysis, we account for this possibility and exclude 2017 and 2018 from some estimations. Postsecondary completion rates are relatively similar over time, yet, we observe a peak in 2009 followed by a consistent decline. As enrollment data start in 2007, we remove completion year 2007 from some estimations in our analysis.[14]

Most of the students enrolling in and completing a postsecondary degree program opt for a university education or a professional degree. Notwithstanding, these rates also have fallen over time. Figure 2 (Appendix Figure A3) depicts enrollment and completion rates by type of degree (by type of institution). A marked preference for university enrollment and 4-year degree programs characterizes the start of our sample period. This situation gradually changes from 2008 to 2014, as postsecondary technical degree programs seem to become equally attractive. Meanwhile, graduating from a professional program notably declines over time (Figure 2(b)). Whereas 80% of postsecondary students enrolled in 2007 graduated from a professional degree program, only 57% of students finished a similar track in 2013. This suggests the drop in postsecondary graduation observed in Figure 1 is likely driven by students enrolled in postsecondary professional programs as opposed to those in more technical ones. We test this hypothesis further in the analysis.



(a) Enrollment

(b) Completion

Figure 2: Postsecondary Enrollment and Completion Rates Over Time by Type of Degree

Notes: This figure shows annual postsecondary enrollment and completion rates by type of degree. Panel (a): Enrollment is by year of high school graduation. Data on postsecondary enrollment come from the Ministry of Education (MINEDUC), from 2007 to 2019. Panel (b): Completion is by year of enrollment. Data on postsecondary completion come from the Ministry of Education (MINEDUC), from 2007 to 2013. Years 2014-2019 also are available.

[14] In 2007, only 27 students in our sample finish a postsecondary degree program.

4.2 Copper Price

We rely on exogenous variations in the price of copper, the primary mineral extracted in Chile. Annual London Metal Exchange copper prices from 2006 to 2019 come from the Chilean Copper Commission (COCHILCO), which we deflate to 2000 prices using the Chilean Consumer Price Index obtained from the National Statistics Institute. As copper prices are mostly driven by demand and reflect expectations about global economic growth (see Section 2), fluctuations in the price of this commodity are exogenous to variations in individual decisions about higher education. See descriptive statistics for this variable in panel D of Appendix Table A1. Historical movements of international real copper prices (dashed line) are depicted in Figure 3.

4.3 Resource Extraction

Ideally, we would complement exogenous variation in copper prices with exogenous spatial variation in resource extraction throughout the country. One might use metrics of mineral endowments or reserves, but comprehensive data on geological deposits are unavailable. To overcome this limitation, we use two alternative proxies of resource endowment based on a geo-referenced mining cadastre obtained from the National Geology and Mining Service (SERNAGEOMIN). This cadastre contains detailed information on all exploration and extraction concessions (hereinafter "concessions", "mining leases", or "mining titles") issued since 1983. From these data, we gather information on the titles' location, total area leased (in square meters), the host city (municipality), and the year of lease. Unfortunately, this information is not available for exploration concessions, thus, we discard all exploration titles from our analysis. Figure 3 depicts the number of mining titles leased over time. Most of these titles belong to large-scale mining companies.

In assigning our measures of resource extraction to a spatial unit, we consider local labor markets using Berdegué et al. (2011)'s delimitation of 102 local labor markets in Chile.[15] After assigning each extraction lease to a corresponding labor market, we obtain two measures: 1) the average percentage of leased area, and 2) the average number of leases. Because the number of leases and the leased area can mechanically increase with the size of the spatial demarcation, we define these variables relative to each labor market size. Moreover, to ensure exogeneity, we consider only titles leased before what is considered in the literature as the start of the 2000s copper price boom, that is, 2003.[16] Equations (6) and (7)

[15]Doing so allows the capture of socioeconomic interactions that may affect educational decisions (and labor demand), but that do not necessarily follow administrative boundaries and that may, otherwise, bias our estimations.

[16]Though our educational outcomes begin in 2006, we define our pre-treatment period only up to 2003 to

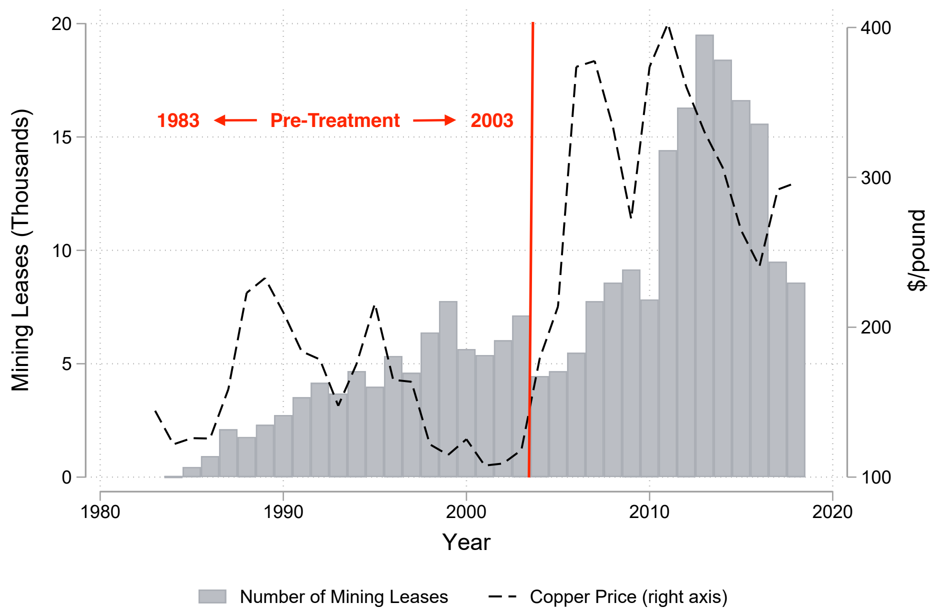


Figure 3: Copper Price and Mining Leases Over Time

Notes: This figure shows the evolution of mining concessions leased from the 1983 NMC through 2019, and real copper prices from 1983 through 2019. Concessions are leases for extraction. Copper prices are measured in US$ cents. Data on mining concessions are drawn from the mining cadastre obtained from SERNAGEOMIN, while data on copper prices come from COCHILCO. Copper prices are refined prices from the London Metal Exchange in constant 2012 USD.

summarize the calculation of these two measures; their descriptive statistics are in panel A of Appendix Table A1, and their spatial distribution in Appendix Figure A4. Additionally, Appendix Figure A5 portrays the spatial relationship between these variables and their contemporaneous (2006-2018) versions, while in Appendix Figure A6 we scatter plots these pretreatment and contemporaneous values. Both figures illustrate the positive correlation between pre- and post-mineral extraction in Chile, which means that labor markets with a previous presence of the mining industry are also those where the industry develops during the boom period.

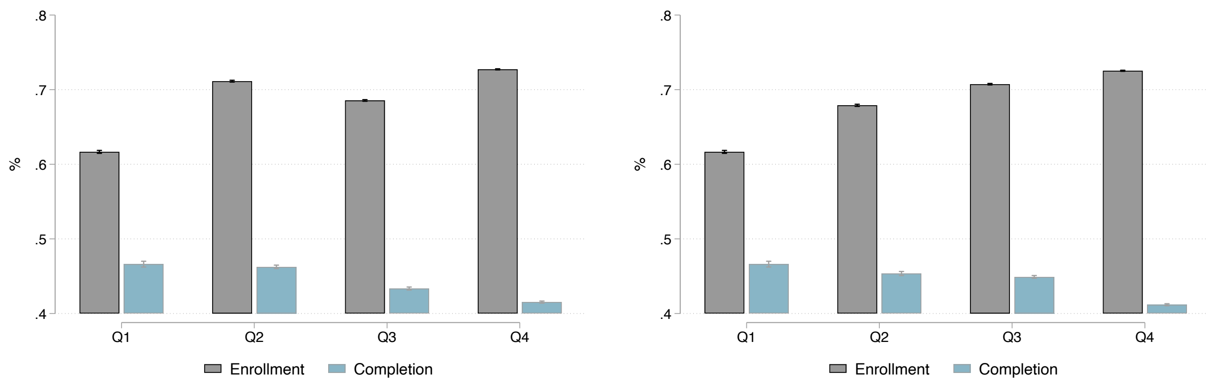
$$\text{Average Percentage of Local Area Leased}_l = \frac{T^{-1}\sum_{1983}^{2003}\text{Titled Area}_{lt}}{\text{Total Area}_l}. \tag{6}$$

$$\text{Average Number of Leases}_l\ (\text{per km}^2) = \frac{T^{-1}\sum_{1983}^{2003}\text{Number of Titles}_{lt}}{\text{Total Area}_l}. \tag{7}$$

Figure 4 displays enrollment and completion rates by quartiles of resource extraction using our two proxies of mineral endowment. Both panels show average enrollment rates are higher for areas with mineral endowments (i.e., quartile four) regardless of how we measure extraction. Meanwhile, completion rates decline across areas with more intense levels of

avoid any potential endogeneity thread.

mineral endowment; namely, on average, they are lowest for the top quartile of the resource endowment distribution.



(a) Percentage of Local Area Leased

(b) Number of Mining Leases

Figure 4: Postsecondary Enrollment and Completion Rates by Quartiles of Extraction

Notes: This figure compares postsecondary enrollment and degree completion rates across quartiles of resource extraction. Panel (a) measures resource extraction with the percentage of local area leased. Panel (b) measures extraction with the number of mining leases per square kilometer. Data on postsecondary enrollment comes from the Ministry of Education (MINEDUC), from 2006 to 2019. Data on resource extraction come from the mining cadastre obtained from SERNAGEOMIN.

5 Empirical Approach

We evaluate the impact of high copper prices on postsecondary enrollment and completion decisions using repeated cross-sectional data of Chilean high school graduates 2006 to 2018. We derive causal effects by estimating a set of continuous difference-in-difference (DID) equations leveraging annual exogenous variation in copper prices and pretreatment spatial variation in resource endowment across labor markets. Our empirical design relies on the identifying assumptions of exogeneity of international copper prices and that spatial variation in the pretreatment indicators of resource endowment approximate current variations in endowment (see Section 4).

Given that postsecondary enrollment in Chile occurs every January, we assume that copper prices in year t affect college enrollment decisions in year $t+1$.[17] As we also consider

[17] The academic year in Chile runs from March to December. Postsecondary enrollment generally begins during the senior year of high school and is conditional on the PSU score, the nationwide college admission test. The PSU test is mandatory for postsecondary college admission, but not for trade or vocational (i.e., technical) schools. A typical timeline for college enrollment unfolds as follows: 1) June-August: high school seniors register for the PSU; 2) November: registered high school seniors take the PSU; 3) mid-December: PSU scores are communicated; 4) mid- December: college applications begin; 5) late December: college application deadlines; 6) mid-January: college admission results are announced; 7) mid-January: enrollment begins; 8) March: classes start.

the possibility of delayed college enrollment, we define the postsecondary enrollment decision-making process as a procedure that involves three potential outcomes: immediate enrollment, late enrollment, or no enrollment. We allow a copper price increase in year t to affect the probability of postsecondary enrollment Y_{t+1} of a high school senior i from a school in labor market l as follows:

$$Y_{ilt+1} = \beta_0 + \beta_1 Extraction_l + \beta_2 Extraction_l \times Price_t + \mathbf{X_{ilt}}\eta + \tau_t + \zeta_{ilt} + \epsilon_{ilt+1}, \quad (8)$$

where Y_{ilt+1} is a categorical variable that takes a value of 1 if high school graduate i enrolls into a postsecondary institution in year $t+1$ (immediate enrollment), a value of 2 if high school graduate i enrolls in during year $t+d$ where $d > 1$ (late enrollment), or a value of 0 otherwise (no enrollment). The variable $Extraction_l$ measures the pretreatment level of resource extraction in student i's labor market l, and $Price_t$ is real copper prices in year t. We define a positive price shock as deviation from its mean. The vector $\mathbf{X_{ilt}}$ measures relevant individual-level demographics such as the student's age, gender, an indicator of rurality, as well as individual-level socioeconomic characteristics, such as high school funding source, type of secondary education (i.e., vocational), and current GPA and attendance record. τ_t is a vector of year-of-high school-graduation fixed effects, ζ_{ilt} is a vector of high-school-level covariates, such as the ratio of failing to passing students, average GP, and average attendance records, that we replace later with high school fixed effects to control for common time-invariant unobservables at the school level.[18] ϵ_{ilt+1} is an idiosyncratic error term. We estimate Equation (8) with a multinomial logistic regression clustering standard errors by high school to account for potential within-school heterogeneity across students.

Our interest in Equation (8) is on the estimation of the average partial effect of the interaction term. Since international copper prices and our extraction variables are orthogonal to annual variation in individual postsecondary education decisions, the average partial effect of this interaction represents the impact of a copper price increase (above its mean) on a person's likelihood of college entry in labor markets with varying levels of mineral extraction.[19]

As an alternative specification of Equation (8), we measure whether a copper price in-

[18] Estimating Equation (8) with high school fixed effects is a computationally intense procedure as there more than 4,000 high schools are in our sample. To manage this, we adopt the Mundlak approach, which projects unobserved school-level heterogeneity onto the average of all variables in vector $\mathbf{X_{it}}$ across all T periods. For more details on this approach, see Wooldridge (2010).

[19] Defined this way, our interaction term resembles a Bartik-style treatment shock (Bartik, 1991).

crease in year t delays college entry by estimating the following equation:

$$\ln(YearsToEnroll)_{ilt+d} = \gamma_0 + \gamma_1 Extraction_l + \gamma_2 Extraction_l \times Price_t + \mathbf{X_{ilt}}\eta + \tau_{t+d} + \zeta_{ilt} + \varepsilon_{ilt+d}, \quad (9)$$

where $YearsToEnroll_{ilt+d}$ is the number of years that elapsed before student i, who graduated from high school in year t, enrolled in a postsecondary degree program, with $d = \{1, ..., 6\}$. The vector τ_{t+d} contains year-of-enrollment fixed effects, and with $\mathbf{X_{ilt}}$, ζ_{ilt} and ε_{ilt+d} are defined as above. Specified in this way, the parameter γ_2 gives a sense of the effect of a copper price increase on the decision to delay enrollment. Yet, to account for the possibility of self-selection into postsecondary education, we estimate Equation (9) with a Heckman procedure that considers the possibility of self-selection into postsecondary education. We carry out the estimation of Equation (9) using a full maximum likelihood estimator and clustering standard errors by high school. In the selection equation, we define a binary outcome equal to 1 if high school graduate i enrolled in postsecondary education (=0 otherwise).[20] The parameter γ_2 in Equation (9) gives us the impact of a copper price increase on the number of years by which postsecondary enrollment is delayed.

In addition to enrollment decisions, we also look at the impact of a copper price boom on postsecondary degree completion. To this end, we replace outcome Y_{ilt+1} in Equation (8) with a binary outcome y_{ilt+n} that takes a value of 1 if college-enrolled student i from labor market l finishes a postsecondary program in year $t+n$, where $n = \{1..., 6\}$, and 0 otherwise:

$$y_{ilt+n} = \delta_0 + \delta_1 Extraction_l + \delta_2 Extraction_l \times Price_t + \mathbf{X_{ilt}}\eta + \tau_t + \zeta_{ilt} + \omega_{ilt+n} + \phi_{ilt+n} + \nu_{ilt+n}, \quad (10)$$

where $\mathbf{X_{ilt}}$ is a vector of student-level covariates, τ_t considers year-of-enrollment and year-of-high school-graduation fixed effects, ζ_{ilt} is a vector of high school covariates as defined before, ω_{ilt+n} is a vector of college-specific covariates (i.e., whether a university or a technical school) that we later replace with college fixed effects, ϕ_{ilt+n} is a vector of degree-specific variables such as annual tuition and length of the program, and ν_{ilt+n} is an idiosyncratic effect. In this case, the vector $\mathbf{X_{ilt}}$ also includes indicators of whether the college-enrolled student has requested and been awarded financial aid during their time in college. Similar to our enrollment estimations, the interest in Equation (10) is in the parameter δ_2 that indicates the impact of a copper price increase on the probability of postsecondary completion in areas with varying levels of resource extraction. We estimate Equation (10) with a logit estimator clustering standard errors by students' college.

We further estimate two alternative specifications to Equation (10). We first investigate

[20] The selection equation resembles a binary version of Equation (8) with τ_t considering year-of-high school-graduation fixed effects. We also include the variables $Extraction_{il}$ and $Extraction_l \times Price_t$.

whether a positive resource shock affects the number of years it takes college student i to finish their postsecondary education. To this end, we replace the outcome y_{ilt+n} with a continuous variable "$YearsToFinish_{ilt+n}$" (in logs) on the number of years it took student i to complete their degree. Similarly to Equation (9), we control for selection into finishing a degree by specifying a Heckman model that controls for selection into graduation.[21] Once we have established the impact of a positive resource sock on completion decisions, we delve deeper on whether these effects are conditional on the type of postsecondary enrollment. In that case, we estimate a triple difference-in-difference version of Equation (10), leveraging variation on the type of postsecondary enrollment, i.e., immediate or late enrollment. This specification helps to understand whether delaying postsecondary enrollment is associated with an increased likelihood in future college dropout.

6 The Impact of Mineral Extraction on Postsecondary Education Decisions

6.1 Postsecondary Enrollment Decisions

Table 1 presents regression estimates on enrollment using the specification outlined in Equation (8) with resource extraction measured as the pretreatment percentage of the local area leased in panel A, and as the pretreatment number of leases (per square kilometer) in panel B. Each column represents alternative set of covariates, although all of them include student-level covariates. We add covariates at the high school level in column (2). In column (3), we exclude recent years as late enrollment mechanically decreases for the last years in our sample period (see Section 4). In column (4), we select only medium- and large-size labor markets in order to account for potential disparities in the availability of academic programs across spatial units. In column (5), we replace high school level covariates with high school fixed effects. This is our preferred specification.

The results show higher copper prices increase the probability of postsecondary enrollment in resource-rich labor markets. Column (1) in panel A shows that a 1-dollar rise in copper prices boost enrollment (i.e., decreases the likelihood of not enrolling) by $1.84\times0.002=0.0037$, or 0.37 percentage points, for an average level of resource extraction. This positive effect on the likelihood in enrollment is higher for students in areas with the maximum level of resource extraction. A person's likelihood of enrolling in postsecondary

[21] We define the selection equation as a binary outcome that takes a value of 1 if a postsecondary student i graduates and 0 otherwise. In this estimation, we replace year-of-high school-graduation fixed effects from the vector τ_t with a continuous variable on the time taken to enroll.

Table 1: The Impact of a Copper Price Increase on the Probability of Postsecondary Enrollment

	Pr(Enrollment)				
	(1)	(2)	(3)	(4)	(5)
Panel A. Extraction as the Percentage of Local Area Leased					
Extraction × *Price*					
Y = No Enrollment	-0.0184***	-0.0188***	-0.0153***	-0.0101**	-0.0103***
	(0.0048)	(0.0047)	(0.0040)	(0.0043)	(0.0037)
Y = Immediate Enrollment	0.0089	0.0089	0.0058	-0.0007	-0.0002
	(0.0076)	(0.0076)	(0.0067)	(0.0074)	(0.0062)
Y = Late Enrollment	0.0095**	0.0099**	0.0094*	0.0108**	0.0105**
	(0.0047)	(0.0048)	(0.0049)	(0.0054)	(0.0048)
Panel B. Extraction as the Number of Mining Leases					
Extraction × *Price*					
Y = No Enrollment	-0.0384***	-0.0384***	-0.0307***	-0.0225***	-0.0231***
	(0.0088)	(0.0087)	(0.0075)	(0.0083)	(0.0074)
Y = Immediate Enrollment	0.0235*	0.0234*	0.0169	0.0076	0.0076
	(0.0132)	(0.0132)	(0.0117)	(0.0131)	(0.0108)
Y = Late Enrollment	0.0149*	0.0150*	0.0138	0.0149	0.0156*
	(0.0085)	(0.0085)	(0.0086)	(0.0096)	(0.0086)
Observations	3,111,381	3,089,578	2,629,131	2,296,290	2,258,824
Mean Enrollment	0.705	0.707	0.707	0.719	0.719
Mean Late Enrollment	0.355	0.356	0.356	0.358	0.359
Student-Level Covariates	✓	✓	✓	✓	✓
High School-Level Covariates		✓	✓	✓	
Excluding 2017 Onward			✓	✓	✓
Excluding Small Labor Markets				✓	✓
High School Fixed Effects					✓

Notes: This table shows estimation results from regressions of the probability of postsecondary enrollment on resource extraction, copper prices, and their interaction. Estimation results are marginal effects from multinomial logit regressions at the high school graduate level. Multiple outcomes are immediate enrollment, late enrollment, and no enrollment (baseline option). All regressions include year-of-high school-graduation fixed effects and student-level covariates. Column (2) includes high school-level covariates we replace with high school fixed effects in column (5). Panel A proxies resource extraction with the pretreatment (1983-2003) percentage of local labor market surface leased as defined by Equation (6). Panel B proxies resource extraction with the pretreatment (1983-2003) number of mineral leases per square kilometer as defined by Equation (7). Data on mineral concessions come from the National Service of Geology and Mining (SERNAGEOMIN). Data on high school graduation and postsecondary enrollment come from the Ministry of Education (MINEDUC). Clustered standard errors by high school are in parentheses. Significance levels: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

education raises by 4.6 percentage points in resource-richest areas.[22] This shows the impact of higher copper prices on a student's likelihood of postsecondary enrollment increases in magnitude with resource intensity across labor markets. This effect is highly statistically significant and remains almost unaltered throughout the different specifications. Our preferred specification in column (5) shows that a 1-dollar increase in prices leads to a 0.2 and a 2.58 percentage points increase for an average and a maximum level of extraction, respectively, equivalent to a .27%-3.59% increase. Similar estimates, although higher in magnitude,

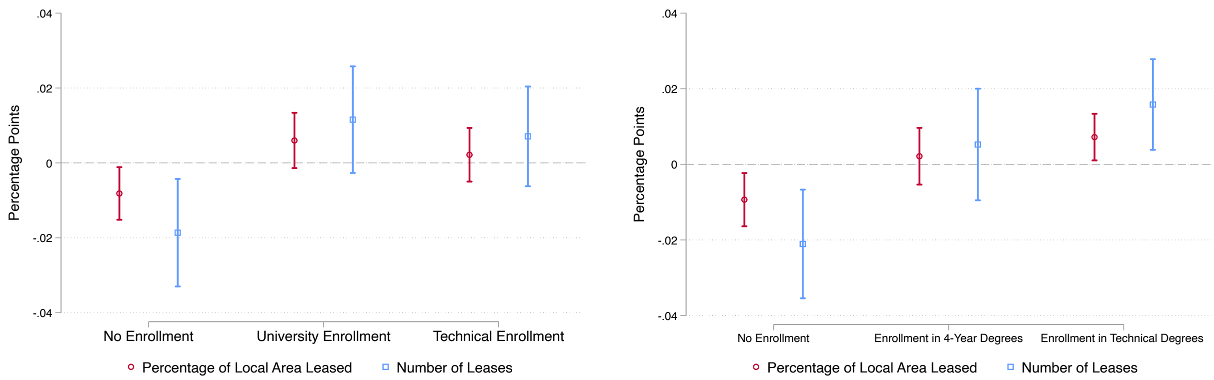
[22] Panel D of Table A1 shows the maximum percentage of local area leased is 0.025.

are found in panel B using our second measure of resource extraction. The reason for the difference in magnitudes between panels A and B likely resides with the fact that the number of mineral leases per squared kilometer is about half of the percentage of local area leased.

The increase in postsecondary enrollment observed in Table 1 in resource-rich areas tends to occur as late enrollment as indicated by the positive and statistically significant results for this alternative. Column (1) of panel A indicates that a 1-dollar increase in copper prices has no effects on immediate enrollment, but it leads to a $0.95 \times 0.025 = 0.0238$ or 2.38 percentage point increase in the likelihood of late enrollment into college in resource-richest areas. These results are persistent as we move from column (1) to column (4). In column (5), we obtain that a 1-dollar rise in copper prices increases a person's likelihood of late enrollment by 2.63 percentage points in resource-richest areas. This evidence indicates copper price booms increase the attractiveness of late college enrollment in resource-rich areas relative to the alternative option of no enrollment. We further investigate this idea by estimating the specification in Equation (9) on the impact of copper prices on the number of years between high school graduation and postsecondary enrollment (Appendix Table A2). Consistent with the evidence in Table 1, we observe that a copper price boom delays postsecondary enrollment among students of resource-rich areas who decide to pursue higher education.

To delve deeper into whether the positive effect of a copper price increase on postsecondary education enrollment decisions can translate into long-term benefits for the economic development of resource-rich areas, we look at the impact of this boom on tertiary enrollment decisions by type of postsecondary institution and degree. As described earlier, we distinguish between traditional universities that offer 4-year (or more) degree programs and vocational and technical institutions. We re-estimate Equation (8) accounting for this distinction, allowing the multiple enrollment decision to now reflect either university enrollment, technical enrollment, or no enrollment. We follow a similar approach for type of postsecondary degree. Figure 5 illustrates the estimated average partial effects and 95% confidence intervals for our preferred specification. Full results are in Appendix Tables A3 and A4 for type of institution and degree, respectively.

On the one hand, the two panels in Figure 5 again show how a copper price boom increases a person's likelihood of postsecondary enrollment in resource-rich areas, regardless of how we measure extraction. On the other hand, they also suggest this increased likelihood in postsecondary enrollment seems to have been directed towards acquisition of a postsecondary technical education. While Figure 5(a) on the type of institution indicates that this additional enrollment benefited any type of establishment, the results are only slightly statistically significant. The results in Figure 5(b) on the type of degree, however, depict a more compelling story. We find that a positive shock to mineral extraction increases the



(a) Type of Institution

(b) Type of Degree

Figure 5: The Impact of a Positive Resource Shock on the Probability of Postsecondary Enrollment by Type of Institution and Degree

Notes: This figure shows estimation results from regressions of the probability of postsecondary enrollment on resource extraction, copper prices, and their interaction, by type of institution (panel (a)) and type of degree (panel (b)). Estimation results are marginal effects from logit regressions at the college student level using our preferred difference-in-difference specification (column (5) of Appendix Tables A3 and A4). Data on postsecondary enrollment comes from the Ministry of Education (MINEDUC). Dashed lines are 95% confidence intervals using clustered standard errors by high school.

likelihood of postsecondary enrollment in technical degree programs. Specifically, a 1-dollar increase in copper prices raises the probability of enrolling in postsecondary technical degrees by 0.1 and 1.8 percentage points for an average and maximum levels of resource extraction, respectively (see column (5) of Table A4). This finding is consistent with the labor demand requirements of the Chilean mining industry, which generally orient towards a workforce with technical and vocational training. Yet, this estimated average effect is lower in magnitude than the impact on overall postsecondary enrollment, suggesting a plausible additional impact on professional degree programs as well. Note, however, that this effect is hard to determine empirically given the lack of lack statistical significance of these results.

6.2 Degree Completion Decisions

The focus thus far has been on the role mineral extraction plays in postsecondary enrollment decisions of high school graduates in areas with varying levels of resource endowment. In this section, we assess whether a positive shock to copper prices affects students' likelihood of finishing a postsecondary education. If resource extraction discourages post-secondary students from finishing their degrees, then the negative prospects of concluding a postsecondary program may outweigh the positive effects of a resource boom on postsecondary enrollment. The estimated average impact of a copper price boom on the probability of completing a tertiary education is displayed in Table 2.

Table 2 shows a strong and highly significant negative effect of booming copper prices

Table 2: The Impact of a Copper Price Increase on the Probability of Postsecondary Completion

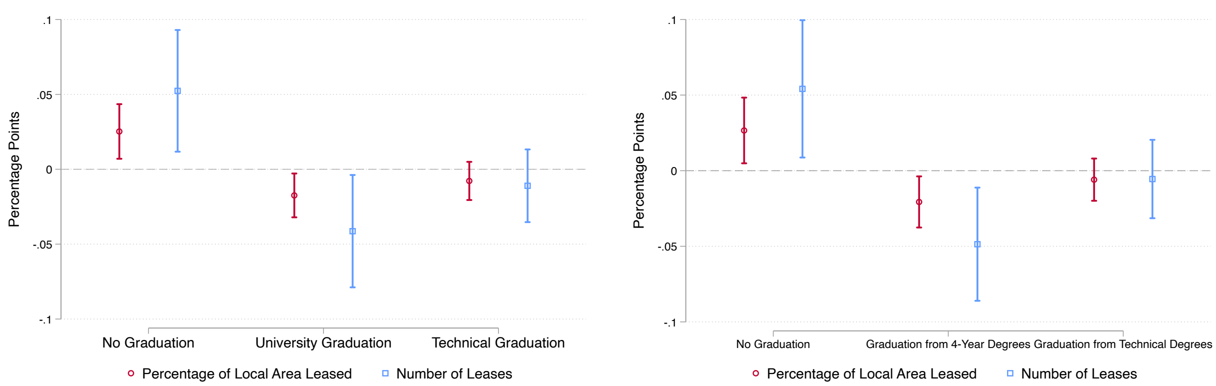
	Pr(Degree Completion)				
	(1)	(2)	(3)	(4)	(5)
Panel A. Extraction as the Percentage of Local Land Area Leased					
Extraction × *Price*	-0.0255***	-0.0279***	-0.0281***	-0.0268***	-0.0152**
	(0.0087)	(0.0092)	(0.0088)	(0.0089)	(0.0069)
Panel B. Extraction as the Number of Mining Leases					
Extraction × *Price*	-0.0502***	-0.0526***	-0.0541***	-0.0518***	-0.0273*
	(0.0188)	(0.0193)	(0.0183)	(0.0185)	(0.0145)
Observations	996,672	996,672	996,672	986,755	986,280
Mean Degree Completion	0.432	0.432	0.432	0.432	0.432
High School-Level Covariates	✓	✓	✓	✓	✓
College-Level Covariates		✓	✓	✓	
Degree-Level Covariates			✓	✓	✓
Only Medium and Large Labor Markets				✓	✓
College Fixed-Effects					✓

Notes: This table shows estimation results from regressions of the probability of completing a postsecondary education on resource extraction, copper prices, and their interaction. Estimation results are marginal effects from logit difference-in-difference regressions at the college student level. All regressions include year-of-enrollment fixed effects, time-to-enroll fixed effects, student-level and school-level covariates. Column (2) includes college-level covariates that we replace for college-fixed effects in column (5). Panel A proxies resource extraction with the pretreatment (1983-2003) percentage of local labor market surface leased as defined by Equation (6). Panel B proxies resource extraction with the pretreatment (1983-2003) number of mineral leases per squared kilometer as defined by Equation (7). Data on mineral concessions comes from the National Service of Geology and Mining (SERNAGEOMIN). Data on postsecondary enrollment and graduation come from the Ministry of Education (MINEDUC). Clustered standard errors by college are in parentheses. Significance levels: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

on a person's likelihood of completing a postsecondary education in resource-rich areas. Namely, our preferred specification in column (5) of panel A shows a 1-dollar increase in copper prices decreases the likelihood of finishing a postsecondary education by 0.3 and 3.8 percentage points for an average and maximum level of resource extraction, respectively. Considering the average rate of degree completion, these results are roughly equivalent to a 0.7%-8.79% decrease. These estimates remain similar for an alternative measure of resource extraction in panel B. The estimated impact on students' likelihood of dropping out of college is an order of magnitude larger than the estimated positive impact on the likelihood of enrollment in Table 1, suggesting an overall net negative impact of mineral extraction on the individual likelihood of acquiring postsecondary education. To the extent that delaying postsecondary graduation produces additional expenses, resource extraction also may lead to inefficient outlays of personal resources due to an increased likelihood of having incomplete higher education.

We also investigate whether students from areas with resource extraction are more likely to delay postsecondary graduation during booming copper prices. The logic behind this question is that students may merely delay graduation during such a period by taking some time off college without actually dropping out. We observe no statistically significant effects on the number of years it takes postsecondary students to finish their degrees (Table A5). These results, in combination with the findings in Table 2, indicate a positive resource shock increases a student's likelihood of actually dropping out of college rather than delaying their graduation.

Given the observed reductions in the probability of finishing college, one might ask whether this effect persists across students with immediate or late enrollment, or both. To answer this question, we estimate a triple DID version of Equation (10), by including a binary indicator on the type of postsecondary enrollment (immediate or late) interacted with mineral extraction. The results of this exercise are reported in Appendix Table A6. Consistently throughout all five different specifications, the findings show the increased likelihood of dropping out from college is exclusive to students who enrolled in these programs right after high school graduation. We see this as evidence that resource extraction affects postsecondary education through different, simultaneous, mechanisms. While an income effect may, for instance, underlie enrollment decisions among students who otherwise would not have been able to pursue higher education, a substitution effect may govern dropping-out decisions among enrolled students. We further pursue these ideas in Section 7.



(a) Type of Institution

(b) Type of Degree

Figure 6: The Impact of a Copper Price Increase on the Probability of Postsecondary Degree Completion by Type of Institution and Degree

Notes: This figure shows estimation results from regressions of the probability of postsecondary completion on resource extraction, copper prices, and their interaction, by type of institution (panel (a)) and type of degree (panel (b)). Estimation results are marginal effects from logit regressions at the college student level using our preferred difference-in-difference specification (column (5) of Appendix Tables A7 and A8). Data on postsecondary enrollment and graduation come from the Ministry of Education (MINEDUC). Dashed lines are 95% confidence intervals using clustered standard errors by college.

The likelihood of dropping out of college during high copper prices also may be happening to the detriment of students enrolled in universities relative to those in technical institutions. Figure 6 illustrates the completion results by type of postsecondary institutions (Figure 6(a)) and by type of program (Figure 6(b)) for our preferred specification (see full results in

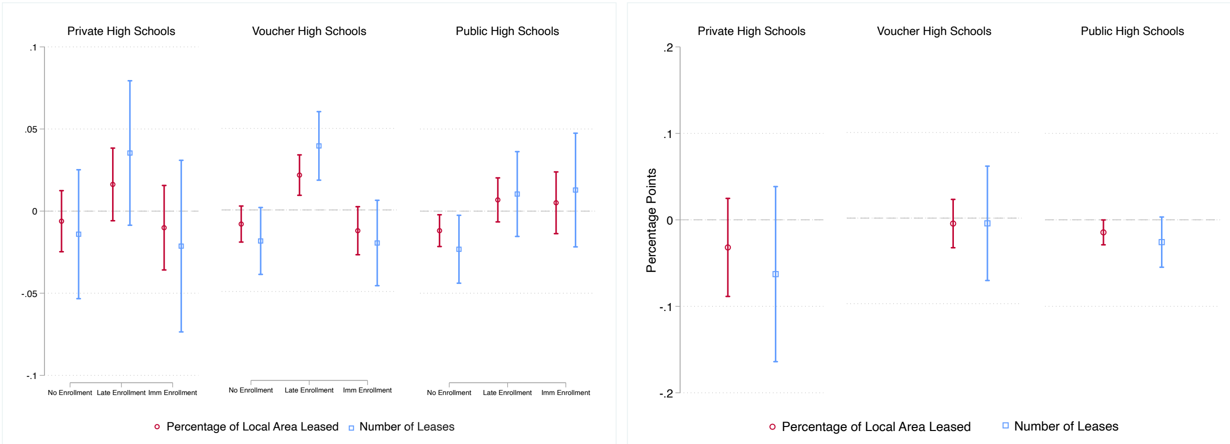
Appendix Tables A7 and A8). In the left-hand figure, a 1-dollar rise in the price of copper sees a 0.35 percentage point increase in the likelihood of dropping out from universities in areas with average levels of mineral extraction. In the right-hand side figure, we observe that a 1-dollar rise in copper prices increases a person's likelihood of dropping out from professional degree programs by 0.4 and 5.18 percentage point for average and maximum levels of resource extraction. Thus, combining our enrollment and completion results, we observe that while a positive resource boom increases the likelihood of enrolling in a postsecondary (technical or vocational) degree program, this effect is outweighed by a simultaneous increase in the probability of not finishing the degree, especially a professional one.

6.3 Who are the Students Affected?

The results thus far show that, while a positive resource shock boosts postsecondary enrollment in technical programs, it simultaneously fosters college dropout, mostly among students enrolled in professional programs. In this section, we examine the socioeconomic profile of the affected students more closely. On the one hand, if a resource boom enhances access to higher education for students who otherwise would have not enrolled, then mineral extraction booms would be welfare-improving in resource-rich areas. On the other hand, if low-income students also are facing a higher likelihood of dropping out of college, mineral booms would not only represent a source of inefficiency in the acquisition of postsecondary education, but would also be hampering intergenerational mobility in the country.

To determine the existence of disparities among who is affected by a positive resource shock, we look at the funding source of the high school attended, either private, public, or subsidized (i.e., a voucher school). In Chile, the kind of high school one attends depends mostly on family income, with students from disadvantaged backgrounds often attending to public (municipal) schools. Meanwhile, more diverse student bodies can be found in voucher (subsidized) schools, while students from upper-income groups will generally attend private schools (Pont et al., 2013). Hence, examining high school funding sources allows us to approximate students' income groups with relatively high accuracy. We do so by estimating a triple-difference version of Equations (1) and (2). We include an indicator of high school dependence as an additional source of variation interacted with our key interaction term. Full results are in Appendix Tables A9 and A11. Figure 7 illustrates the estimated results for our triple-difference preferred specification (column (5) of Tables A9 and A11).[23]

[23] In our sample, more than 49% of high school graduates come from a voucher high school, 42% from a public high school, and less than 9% from a private high school. Postsecondary enrollment and completion rates are, however, 74% and 31% for students from voucher schools, 62% and 28% for students from public high schools, and 92% and 33% for students from private high schools.



(a) Enrollment

(b) Completion

Figure 7: The Impact of a Copper Price Increase on the Probability of Postsecondary Enrollment and Completion by Students' High School Funding Source

Notes: This figure shows estimation results from regressions of the probability of postsecondary enrollment (panel (a)) and completion (panel (b)) on resource extraction, copper prices, high school funding source, and their multiple interactions. Estimation results are marginal effects from a logit triple-difference regression at the high school student level using our preferred specification. Data on postsecondary enrollment and graduation come from the Ministry of Education (MINEDUC). Dashed lines are 95% confidence intervals using clustered standard errors by high school.

The results in Figure 7 show a heterogeneous impact of copper prices across income groups. The previously estimated boost in the likelihood of tertiary enrollment benefits mostly students graduated from voucher high schools and public high schools (Figure 7(a)), which cater to medium- and low-income groups, respectively. On the contrary, we find no statistically significant effects among upper-income groups. In the case of students graduated from voucher high schools, Figure 7(a) illustrates effects at both the intensive and the extensive margin as the boost in the likelihood of enrollment takes the form of a late enrollment in lieu of students who otherwise would have enrolled immediately after high school or students who would not have enrolled at all. The possibility that middle-income students switch from immediate to late enrollment during a resource boom suggests these families could be responding counter-cyclically to rises in copper prices when it comes to postsecondary education, which would imply a dominance of the income effect across families in this income group. Something similar could ocurr among upper-income group families, yet, we lack precision in estimating an increase in late enrollment among students coming from private schools.

Regarding public high schools graduates, Figure 7(a) also indicates an increase in the likelihood of postsecondary enrollment. Yet, and similarly to the case of students from private school, we cannot perform statistical inference on whether this additional enrollment is taking the form of an immediate or delayed entry to college. Notwithstanding, in terms of postsecondary graduation for this income group, Figure 7(b) clearly shows an increase in the likelihood of dropping out from college that is exclusively affecting these students , suggesting that the additional probability of desisting from college found in Table 2 is predominantly present among low-income students. We can also corroborate this result by replacing the high school dependence variable with a dummy of whether a student was ever awarded with financial aid during their college education. Financial aid in Chile is merit-based aid and mostly offered to students with financial needs. Thus, it is also an indicator of the students' socioeconomic status.[24] The results in Appendix Table A12 on the triple interaction tell a consonant story. A resource boom decreases the likelihood of finishing a college degree in resource-rich areas, notably among low-income students.

Both the positive effect in the likelihood of postsecondary enrollment and the negative impact on the likelihood of finishing college that affect low-income students are simultaneously at play and are plausibly obeying two different mechanisms. While some low-income students may be discouraged from a postsecondary education during higher copper prices, others may be better suited to enter college after high school graduation. We shed light on these substitution and income effects, and other potential mechanisms, in the next section. Notwithstanding, the point estimates in Appendix Tables A9 and A11 suggest the additional boost in the likelihood of postsecondary enrollment among low-income students during a copper price increase is outweighed by the increased likelihood in abstaining from this type of education. This suggest that an increase in the opportunity cost of post-secondary education dominates a A dominating opportunity cost of post-secondary educatio, suggesting an overall negative effect of resource booms on higher education that primarily affects students from low-income groups.

6.4 The Role of Long-Distance Commuting

Previous related studies suggest that the local labor supply tends to be insufficient to meet the labor demand requirements of some mining projects and, as a result, companies generally pull in people from other labor markets (Aroca, 2001; Aroca and Atienza, 2011). Under the premise that a positive shock to the copper mining sector affects the labor supply of markets other than those housing the mineral, our estimated impacts on postsecondary enrollment and completion are likely a lower bound of the overall impact of a copper price boom on higher education. We address this possibility by replacing our pretreatment resource variables with the pretreatment share of workers in the mining sector. This variable is constructed using the 2003 Chilean National Socioeconomic Characterization (CASEN) Survey, which contains information on employment by sectors within labor markets.

[24] In our sample, 92% of the students that were ever awarded with financial aid come from public high schools.

The results using the pretreatment share of mining employment are shown in Appendix Table A13 for enrollment (panel A) and completion (panel B). These findings document a negative effect of mineral extraction on postsecondary enrollment in labor markets with a significant workforce in the sector. We observe that a rise in copper prices lowers the probability of postsecondary enrollment. Yet, no significant effects are found on the likelihood of finishing college. The negative impact on postsecondary enrollment in labor markets that do not necessarily have an important endowment of minerals but likely host an important fraction of long-distance commuting workers exacerbates the negative impact on postsecondary degree completion found above among students of resource-rich areas.

7 Exploring Mechanisms

We test several mechanisms that may explain why high school graduates of resource-rich areas may take longer to enroll in postsecondary education, or are less likely to finish their degree, particularly a professional degree program, during a positive resource shock. We use alternative data sets, each with different degrees of granularity. Overall, the results suggest that lower incentives to obtain a postsecondary degree may help explain the crowding out of higher education in resource-rich areas in Chile.

7.1 Returns to Education

We begin by assessing whether a resource boom reduces the incentives to acquire a postsecondary degree by diminishing returns to higher education. Lower returns to higher education may occur if the sector is biased toward low-skilled workers (Aragón et al., 2015), thus raising the opportunity cost of earning a postsecondary diploma, particularly during price booms, and inducing high school graduates to join the labor market immediately following high school graduation. We investigate this idea by estimating Mincerian wage equations using repeated cross-sections of workers obtained from the CASEN waves available for the years between 2006 and 2017.[25] We model the relationship between the levels of resource extraction and education by estimating the following equation in triple differences:

$$\begin{aligned} \ln w_{ilt} = \gamma_0 + E_{ilt} \times (Price_t + Extraction_l + Price_t \times Extraction_l)\boldsymbol{\delta} + \gamma_1 W_{ilt} \\ + \gamma_2 W_{ilt}^2 + \mathbf{X_{ilt}}\eta + \tau + \theta + \upsilon_{ilt}, \end{aligned} \tag{11}$$

where w_{it} is the monthly wage of worker i from labor market l during year t (in logs), and E_{ilt} reflects i's education level in year t. Worker i's experience is represented by W_{ilt};

[25] Specifically, we use the surveys from 2006, 2009, 2011, 2013, 2015, and 2017.

$\mathbf{X_{ilt}}$ is a vector with individual-level covariates that include dummies for gender, marital status, ethnicity, and household head, as well as whether the job is long- or short-term, full- or part-time, and shift work or salaried; τ is a vector of year fixed effects; θ is a vector of labor market fixed effects (o municipality fixed effects); and υ_{ilt} is an idiosyncratic error. We define individual i's experience W using i's age minus i's years of education minus six. For education levels, we define E_{ilt} based on completion of primary (or incomplete secondary), completion of secondary (or incomplete postsecondary), and completion of postsecondary education, using no formal education (or incomplete primary) as our baseline category. We estimate Equation (11) with a Heckman estimator that considers a potential self-selection into the job market by estimating a binary model of the probability of being employed.[26] Results for the triple interaction term, $\boldsymbol{\delta}$, are illustrated in Figure 8. Full results are displayed Appendix Table A14.

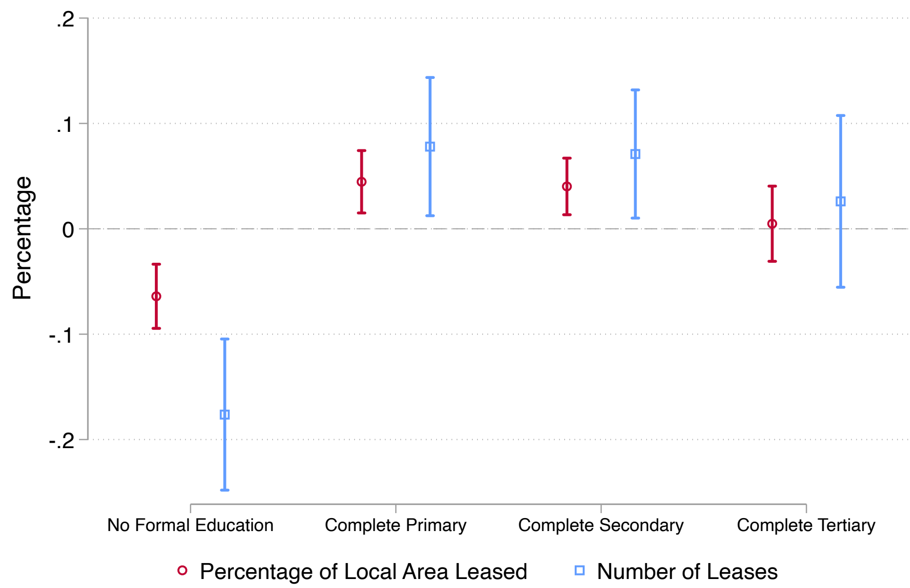


Figure 8: The Impact of a Copper Price Increase on the Returns to Education

Notes: This figure shows estimation results from regressions of wages on resource extraction, copper prices, education levels, and their multiple interactions (see Equation (11)). Estimation results are marginal effects of the triple interaction between resource extraction, copper prices and education, from Heckman regressions at the individual level that control for selection into the labor market. Estimations are performed with a two-step estimator. We illustrate the results for our preferred specification, which includes individual-level demographics, experience, quadratic of experience, job-level covariates, and time and labor market fixed effects. Selection equation includes the interaction $Extraction \times Price$ and all other covariates except for job-level characteristics and labor market-level fixed effects, which are replaced by region-level fixed effects. Data on wages and workers' characteristics come from the Chilean National Socieconomic Characterization Survey (CASEN) for all available years from 2006 to 2017. Dashed lines are 95% confidence intervals using bootstrapped standard errors.

The results in Figure 8 illustrate a copper price increase has a positive impact on the returns to compulsory education relative to no formal education. Yet, no significant effects are found on the returns to postsecondary education. We take this evidence as indicative

[26]We define the selection equation as a function of $\mathbf{X_{ilt}}$, W_{ilt}, W_{ilt}^2, E_{ilt}, and the mineral extraction interaction.

that a positive shock to mineral extraction brings a wage premium that mainly benefits individuals with low educational levels. This idea aligns with an increase in the likelihood of delaying postsecondary enrollment (see Tables 1 and A2): students at the margin of acquiring higher education and joining the labor market may decide to benefit from this wage premium and enroll in postsecondary degree programs later on. While these results may help decipher our enrollment results, they do not fully explain the estimated increase in the likelihood of dropping out of college, principally from professional degree programs. To better understand how a positive resource shock affects students at the margin of secondary and tertiary education, we re-estimate Equation (11) but now focus only on the returns to complete secondary and tertiary education. Within this group, we make a distinction between incomplete tertiary and complete tertiary by type of degree, that is, either technical or professional. Additionally, we explore heterogeneous effects by type of economic sector by splitting workers between those in the mining and non-mining sector.

Appendix Figure A7 indicates high copper prices increase the returns to complete compulsory education (including incomplete tertiary) and to postsecondary technical education, which helps to understand the increased likelihood of college dropouts, primarily from professional degree programs. Yet, these increased returns are prevalent only within the booming sector, which illustrates the increased opportunity cost students at the margin of secondary and postsecondary education face in areas with varying levels of mineral extraction during high copper prices. Among workers with a complete professional degree program, we observe higher returns to education within non-mining sectors; yet, these increased returns are, on average, lower than the returns to other education levels of workers in the mining sector. Moreover, we observe the returns to postsecondary professional education within the booming sector decrease during high copper prices, which signals that a rise in the opportunity cost of finishing college seems a plausible mechanism behind the likelihood of dropping out from postsecondary professional degree programs during a positive resource shock. The differences in the length and costs of acquiring a professional degree program relative to a technical one may further accentuate the dominance of the substitution effect.

7.2 Household Income

Although the increase in the cost of time seems a plausible explanation for the negative effect on the likelihood of finishing college during high copper prices, we still need to understand what may drive the positive impact on postsecondary enrollment. Instead of obeying a substitution effect, an increased household income and wealth during copper price booms and the dominance of an income effect in resource-rich areas may explain the increase in the likelihood of tertiary enrollment.

We investigate this by estimating the effect of resource booms on household income using 2006-2017 household information from CASEN. We start by running DID estimations (Equation (12) at the household head level using total family income M (logged) in household h in labor market l during year t as the outcome variable and expressed as a function of $Price_t$, $Extraction_l$, and their interaction, controlling for household-level covariates $\mathbf{X_{ilt}}$, labor market fixed effects θ, and year fixed effects τ. We first estimate Equation (12) for the full sample, and then for households with young adults (aged 18-25 years) at home. We complement these estimations with a triple DID estimation in which we add the household head's education level as a proxy for the family's socioeconomic background. We do this in order to identify whether any income effect is more salient to a specific income group, as suggested by the boost in postsecondary enrollment found among low- and middle-income groups in Section 6.3.[27] Finally, we explore heterogeneous effects by economic sector using the household head's employment sector (i.e., either mining or non-mining). We present these results in Table 3 for our preferred measure of resource extraction. Full results are in Appendix Table A15.

$$\ln M_{hlt} = \alpha_0 + \alpha_1 Extraction_l + \alpha_2 Extraction_l \times Price_t + \mathbf{X_{ilt}} + \tau + \theta + \epsilon_{hlt}, \qquad (12)$$

The findings in Table 3 first show resource booms increase family income in resource-rich areas (column (1)), predominantly among families with young adults at home (column (2)). This boost in income, however, is specific to middle-income families (columns (3) and (4)) as suggested by the respective education level of the household head. This result is in line with our findings in Section 6.1 showing an increased likelihood of postsecondary enrollment among high school graduates associated with middle-income groups. Moreover, it suggests that, despite the strong substitution effect derived in the previous subsection, an income effect can be prevalent over a substitution effect for certain income groups. When exploring heterogeneous effects by employment sector (columns (5)-(7)), we observe a substantial positive income effect that is present among households whose household head has a job in the mining sector (column (5)). Notwithstanding, we also observe a positive income effect among families linked to other productive sectors, which shows the spillover effect of a copper price boom on the rest of the economy. The results in columns (6) and (7) show a coherent story:

[27]See Appendix Figure A8 for the average household income across different household heads' education level, and Appendix Figure A9 for the relationship between the most common type of high school attended by children 6-17 years and the education level of their household head. This last figure shows that children attending to private high schools generally have (at least) one parent with a college diploma, children attending to voucher high schools generally have one parent with a high school diploma, and children attending to public high schools commonly have one parent with a high school diploma or less education.

Table 3: The Impact of a Copper Price Increase on Household Income

	Baseline				Heterogeneous Effects by Sector		
	Double DID		Triple DID		Double DID	Triple DID	
	Full Sample	HHs with Young Adults	Full Sample	HHs with Young Adults	Full Sample	Full Sample	HHs with Young Adults
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A. Extraction as the Percentage of Local Land Area Leased							
Extraction × *Price*	0.038**	0.034**	0.066	0.070	0.027*	0.066	0.066
	(0.015)	(0.015)	(0.094)	(0.126)	(0.014)	(0.093)	(0.126)
Extraction × *Price* × Inc. Primary			0.015	0.018		0.015	0.019
			(0.030)	(0.035)		(0.031)	(0.035)
Extraction × *Price* × Com. Primary			0.034	0.020		0.028	0.015
			(0.026)	(0.032)		(0.027)	(0.035)
Extraction × *Price* × Inc. Secondary			0.031	0.036		0.014	0.018
			(0.022)	(0.029)		(0.022)	(0.028)
Extraction × *Price* × Com. Secondary			0.071***	0.062***		0.053***	0.046**
			(0.021)	(0.021)		(0.020)	(0.021)
Extraction × *Price* × Inc. Tertiary			0.049*	0.077**		0.038	0.066*
			(0.027)	(0.034)		(0.030)	(0.037)
Extraction × *Price* × Com. Tertiary			-0.006	-0.015		-0.014	-0.021
			(0.053)	(0.049)		(0.047)	(0.044)
Extraction × *Price* × 1[Mining]					0.141***	0.082	0.256
					(0.029)	(0.306)	(0.380)
Extraction × *Price* × Inc. Primary × 1[Mining]						0.039	0.015
						(0.061)	(0.080)
Extraction × *Price* × Com. Primary × 1[Mining]						0.122*	0.093
						(0.072)	(0.083)
Extraction × *Price* × Inc. Secondary × 1[Mining]						0.236***	0.255***
						(0.051)	(0.069)
Extraction × *Price* × Inc. Secondary × 1[Mining]						0.195***	0.176***
						(0.047)	(0.058)
Extraction × *Price* × Inc. Tertiary × 1[Mining]						0.125**	0.153***
						(0.049)	(0.053)
Extraction × *Price* × Com. Tertiary × 1[Mining]						0.045	0.027
						(0.084)	(0.086)
Observations	385,887	309,015	385,887	309,015	385,887	385,887	309,015

Notes: This table shows estimation results from regressions of household income on resource extraction, copper prices, and their interaction. Estimation results are marginal effects from OLS regressions at the household level. All regressions include household head gender, age, education level, an indicator of civil status, household size, a rural indicator, time and labor market fixed effects. Clustered standard errors by labor market are in parentheses. Significance levels: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

middle-income families experience the highest boost in income, regardless of whether their household head is in the mining sector or not. In any case, this boost seem to be more important among families linked to the booming sector. This suggests low-income families may be in the position of acquiring higher education for their children during a positive resource shock only if (at least) one of the parents works in the booming sector. If not, the increased opportunity cost of time during a resource boom may dominate among low-income groups. These results are independent of the measure of extraction used (see Appendix Table A15).

7.3 School Inputs and Quality of Education

Differences in government spending on compulsory education (Jackson et al., 2016; Hyman, 2017) or the quality of teachers (Chetty et al., 2014) across areas with different levels of resource endowment may well be additional channels throughout which resource booms affect postsecondary decisions. For instance, fewer resources invested in compulsory education may harm students' academic performance during early childhood and make them, consequently, less likely to move on to higher education or more likely to drop out if they do enroll. We test whether differences in the availability of school inputs or the quality of compulsory education among labor markets with differing exposure to mineral extraction are driving the results.

Local Public Funds to Education. We gather municipality-level data on local public finances from 2006 to 2018 from the National Municipal Information System (SINIM), particularly on local revenues from various sources that flow into public education and on local education spending. We transform these variables to real terms (base = 2000) and, to account for variation in local governments' size, we divide these variables by the local population over time. The results on the estimated marginal effect of our key interaction term are presented in Appendix Table A16 for labor markets and in Appendix Table A17 for municipalities.[28] To consider potential dynamics in the allocation of public resources, we include the contemporaneous effect of copper prices as well as one-period lag.

The findings in Table A16 suggest a positive impact of high copper prices on both local revenues and expenditures on public compulsory education. In principle, these results may help to explain the impact on college entry, yet they are weakly statistically significant (panel B). High copper prices may positively impact local transfers to education from the central government (MINEDUC), though no plausible *a priori* reasons exist to expect that these transfers would vary based on the municipalities' relative amounts to resource extraction. When we explore these effects at the municipal level, the results in Table A17 show no significant impacts of rising copper prices on the local finances of municipalities with resource endowment, with the exception of a reduction in overhead expenses as shown in panel A. Combining the results in Tables A16 and Table A17, we find no significant differences in primary and secondary school spending in resource-rich areas during a period of booming copper prices.

Number of Teachers. We also look at the number of high school teachers in areas with mineral endowments. Appendix Table A18 shows the results on the impact of rising copper prices on the ratio of students to teachers, the number of teachers per capita, and the number of class hours for each teacher in labor markets with varying levels of mineral endowments. Appendix Table A19 displays similar results at the municipality level. We obtain student-

[28]We use a log transformation of our outcome variables and a panel data fixed-effect estimator.

teacher ratios at public schools from SINIM at the municipality level. The number of teachers and teachers' class hours is gathered from MINEDUC at the high school level.

Appendix Table A18 shows a copper price increase has no effect on the number of students per teacher regardless of our measure of mineral extraction. Notwithstanding, we do observe a positive and statistically significant contemporaneous effect of rising copper prices on the number of teachers and teacher-class hours that is consistent across our two measures of resource endowment. The effect on the number of teachers in classrooms is, however, attenuated by the negative impact of lagged copper prices, which may simply obey labor market adjustments during the boom. In any case, the contemporaneous positive effect outweighs this negative effect. Similar results are found at the municipality level in Appendix Table A19. While explaining why the number of teachers in classrooms of resource-rich areas increases during copper price booms is beyond the scope of this paper, we take this finding as evidence that a potential lack of teachers in areas with significant mineral endowments is unlikely to underlie the results on postsecondary education.

Quality of Compulsory Education. We next explore, in greater detail, whether resource-rich areas exhibit poor quality secondary (and primary) education during a time of booming copper prices. We gather 2006-2018 information on the number of high school students taking the national college admission test PSU. We also obtain the percentage of these students who meet or exceed the minimum score required for college admission (450 points). This information is obtained from the SINIM at the municipal level and disaggregated by the high school fee structure.

We complement this analysis with data on public-school teachers from the annual national Teacher Assessment Survey,[29] obtained at the teacher level from MINEDUC from 2010 to 2018. Though data on voucher- and private-schools teacher quality are unavailable, the analysis of public school teachers should provide a sufficiently clear overall picture of the relationship (if any) between resource extraction and the quality of education. The results of the copper price impact on PSU scores are shown in Appendix Tables A20 and A21 for the analysis at the labor market and municipality level, respectively. Similarly, results on the teacher quality are presented in Appendix Tables A22 and A23 by education level (primary or high school), type of core teaching subject (here, we provide data on mathematics and Spanish teachers), and type of evaluation (content-based evaluation and the overall assessment score).[30]

In terms of the college admission test, results in the first column of Appendix Tables

[29] *Encuesta de Evaluación Docente*

[30] The Teacher Assessment Survey is composed of four different blocks: a content-based evaluation, a self-evaluation, a teacher interview, and peer references.

A20 and A21 both show a significant increases in the number of public high school students (per 1,000 people)who take the test. This is mainly due to a contemporaneous effect of high copper prices, though we also observe a significant lagged effect. The fact that more public high school students are taking the college admission test during a period of high copper prices aligns with the income hypothesis and the idea that households are increasing the prospects of their children acquiring more education. As we do not observe an impact among students from voucher or private high schools, this effect is likely exclusive to low-income households. Note that more students from areas with mineral extraction taking the college admission test during a time of high copper prices does not translate into better scores, as shown by the last three columns of the same tables. This is somewhat consistent with an increased likelihood in postsecondary technical enrollment, degrees that do not have a minimum PSU score requirement. Even though high school graduates of resource-rich areas are more likely to pursue a tertiary education during increased copper prices, which explains the boost in the number of students taking the college admission test, this effect does not necessarily translate into more students qualifying for college, in turn explaining the increase in postsecondary vocational enrollment.

Regarding teacher quality, findings in Appendix Tables A22 and A23 show no impact of rising copper prices on teacher quality at the primary school level. In contrast, we do observe a positive effect among high school teachers. These results do not, therefore, conclusively support – as a potential mechanism behind the rise in college dropouts during a copper price boom – a decline in education quality of high school graduates of resource-rich areas.

8 Conclusion

Countries rich in natural resources may suffer from several negative economic and political outcomes. Here, we explore the link between natural resource extraction and a specific development outcome: human capital accumulation. We specifically ask whether natural resource extraction crowds out investment in postsecondary education. We explore this question using individual-level data on the universe of Chilean high school graduates and analyze their individual postsecondary education decisions during a period of high copper prices. We focus on postsecondary enrollment, postsecondary delayed enrollment, and completion degree. To identify causal effects, we run a set of continuous double-difference equations using continuous exogenous variation in both copper prices and two pretreatment measures of mineral extraction throughout the country. Moreover, as a person's response to a resource boom may vary with income, we also estimate a set of continuous triple-differences regressions using students' socioeconomic backgrounds.

Our results show resource booms increase a person's likelihood of enrolling in postsecondary education, particularly in technical or vocational programs, in areas with varying levels of extraction. That said, our postsecondary degree completion analysis reveals a significant effect also on the likelihood of dropping out of college in these areas. This likelihood is stronger among students enrolled in a professional degree program as opposed to those enrolled in a technical one. Our estimation of triple-differences specifications shows students who graduated from both vouchers (or subsidized) high schools and public high schools drive the results. On the one hand, students of resource-rich areas who previously attended voucher schools that generally cater to medium-income groups, are more likely to delay their decision to enroll in a tertiary education rather than either enrolling immediately after high school graduation or not enrolling at all. This result suggests that middle-income families in Chile may be taking counter-cyclical postsecondary educational decisions. On the other hand, our results also show that students who previously attended public high schools, which cater to the low-income group, experience a boost in the likelihood of postsecondary enrollment as well as an increased likelihood of dropping out from college. This last result suggests an increase in the opportunity cost of acquiring post-secondary education dominates any income effect among low-income families during a copper price boom. To the extent that low-income students with an increased likelihood of dropping out from college also are first-generation college students, then mineral extraction would pose a severe threat to educational mobility and income inequality in the country.

Our analysis of mechanisms strongly suggests resource extraction increases the opportunity cost of higher education by raising the returns to workers with complete compulsory (or incomplete postsecondary) education as opposed to complete postsecondary education, which plausibly explains the increased likelihood of college desertion. At the same time, we find evidence resource booms increase household income, which may ease college enrollment. Notwithstanding, our analysis of heterogeneous effects suggests this income effect may not be homogeneous across different socioeconomic backgrounds. We take this as an indication a substitution effect derived from a resource boom likely dominates any increase in income among certain socioeconomic groups, leading ultimately to a college dropout. A fruitful avenue for further research would be to explore whether these lower returns to higher education have encouraged a brain drain away from either resource-rich areas or from the country in general, which may hinder Chiles's path to long-term development.

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Appendix

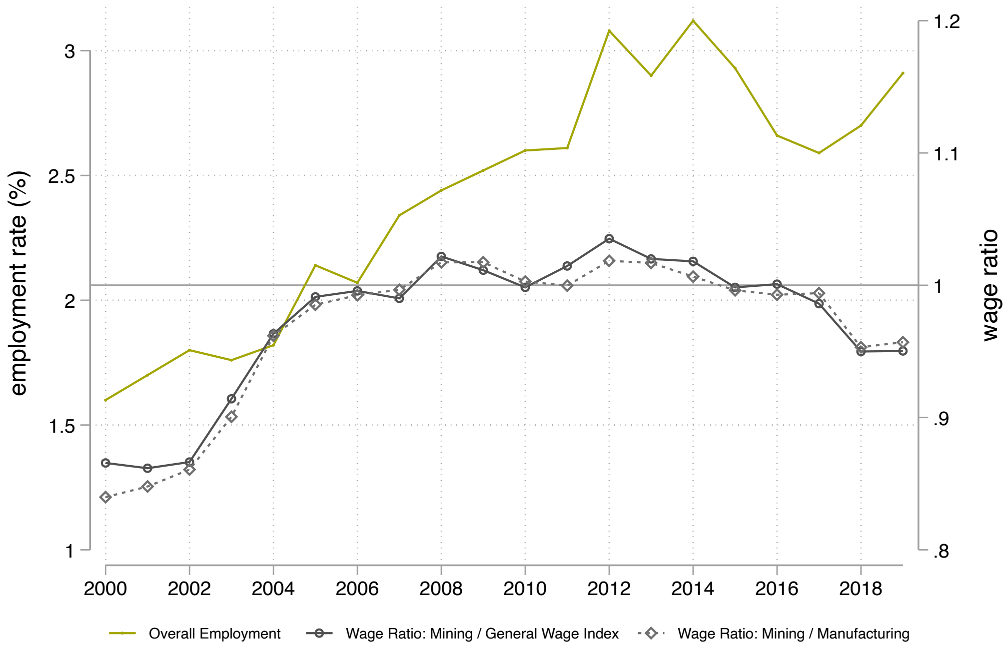


Figure A1: Overall Employment Rate and Wage Ratios in the Mining Sector

Notes: This figure shows annual employment rate and wage ratios in the mining sector from 2000 to 2019. Overall employment rate is depicted in the main vertical axis as the percentage of total country employment. Wage ratios are depicted in the secondary vertical axis. We plot wage ratios of mining with respect to the general wage index and with respect to wages in manufacturing. Wage ratios use 2009 as the base year. Data on employment and wage indexes come from COCHILCO (2021).

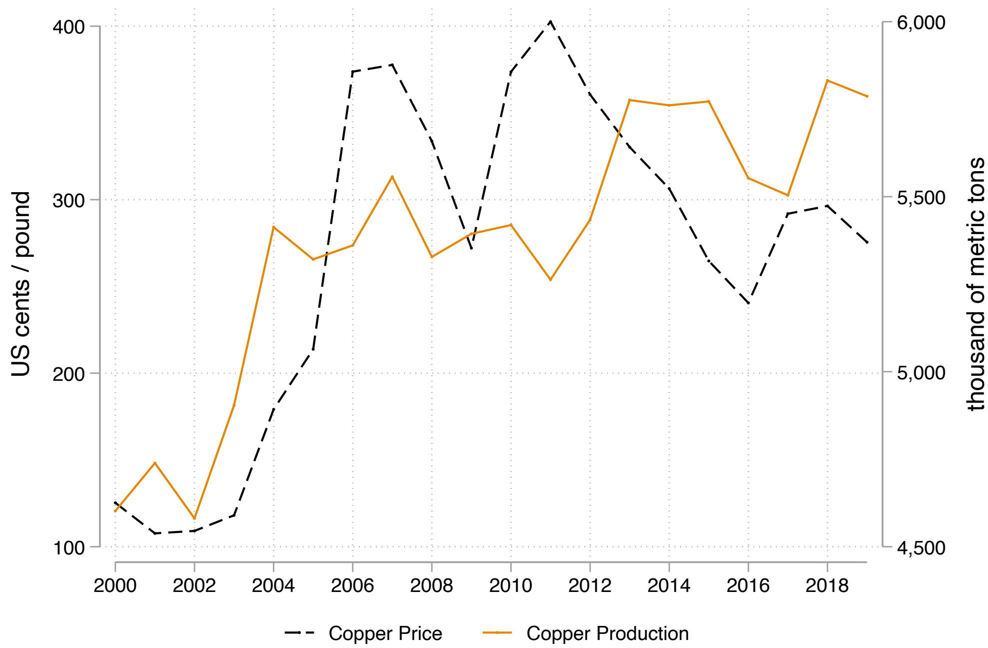


Figure A2: Annual Copper Prices and Production

Notes: This figure shows annual copper prices and copper production from 2000 to 2019. Copper prices are depicted in the main vertical axis. Production is depicted in the secondary vertical axis. Copper prices are from the London Metal Exchange in constant 2012 USD per pound of refined copper. Copper production corresponds to thousands of metric tones of fine copper content. Data on prices and production come from COCHILCO (2021).

Table A1: Descriptive Statistics on Main Variables

Variable	Mean	Std. Dev.	Min.	Max.	Observations
Panel A. Higher Education Outcomes					
Enrollment	0.71	0.46	0	1	3,111,975
Degree Completion	0.42	0.50	0	1	1,070,648
Panel B. Student Covariates					
Age	18.52	3.08	17	43	3,111,975
Gender (= 1 Female)	0.51	0.5	0	1	3,111,975
Rural	0.03	0.18	0	1	3,111,975
Average GPA	5.61	0.57	4	7	3,111,381
Attendance Rate	90.32	9.05	0	100	3,111,975
Panel C. High School Covariates					
Average GPA	5.60	0.27	4.33	6.9	3,111,973
Attendance Rate	90.57	3.43	57.76	100	3,111,975
Failing Students/Passing Students	0.11	0.14	0	6.34	3,090,171
Funding Source					3,111,975
Public High Schools					1,315,242
Voucher High Schools					1,537,755
Private High Schools					258,978
Type of High School					3,111,975
Regular High School					1,476,714
High School for Adults					556,549
Regular Trade High School					375,852
Regular Industrial High School					380,491
Regular Technical High School					243,549
Others					78,820
Panel D. Resource-Related Variables					
Copper Price (¢)	302.94	49.32	220.56	399.67	14
Pretreatment % of Local Area Leased	0.002	0.004	0	0.025	102
Pretreatment Number of Leases (per km^2)	0.001	0.002	0	0.009	102

Notes: This table presents basic descriptive statistics of our main variables. *Panel A.* Descriptive statistics on enrollment use data on high school graduation from 2006 to 2018 and on postsecondary enrollment from 2007 to 2019. Degree completion uses data on enrollment between 2007 and 2013. All data sets come from the Ministry of Education (MINEDUC). *Panel B.* Student covariates are at the high school senior level. Chile's grading system goes from 0.00 to 7.00, with 4.00 being the lowest passing grade. Data come from the high school graduation data set obtained from MINEDUC from 2006 to 2018. *Panel C.* Data on high school covariates from 2006 to 2018 comes from MINEDUC. *Panel D.* Observations are years for copper prices, and labor markets for resource extraction variables. London Metal Exchange copper prices are prices for refined copper from 2006 to 2019 in real US$ cents, with 2000 as the base year. We deflate copper prices using the Consumer Price Index (CPI) of the Central Bank of Chile. The percentage of surface leased corresponds to the percentage of the local labor market's surface that is in the form of extraction concessions from 1983 to 2003. The number of leases corresponds to the total amount of mineral leases per square kilometer of local labor market's surfaces. Data on copper prices come from http://www.cochilco.cl. Data on mineral leases comes from SERNAGEOMIN.

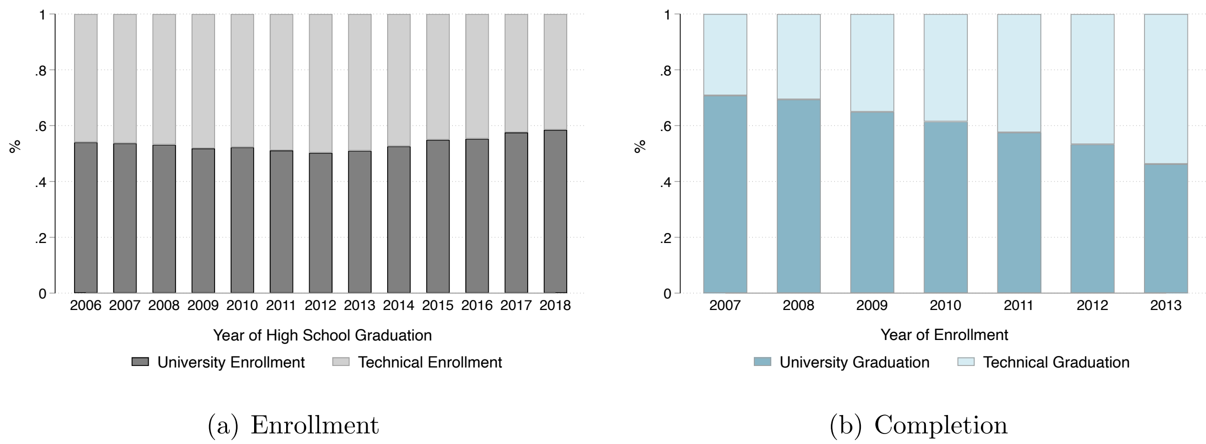


Figure A3: Postsecondary Enrollment and Completion Rates Over Time by Type of Institution

Notes: This figure shows annual postsecondary enrollment and completion rates by type of institution. Panel (a): Enrollment is by the year of high school graduation. Data on postsecondary enrollment comes from the Ministry of Education (MINEDUC) from 2007 to 2019. Panel (b): Completion is by the year of enrollment. Data on postsecondary completion come from the Ministry of Education (MINEDUC) from 2007 to 2013.

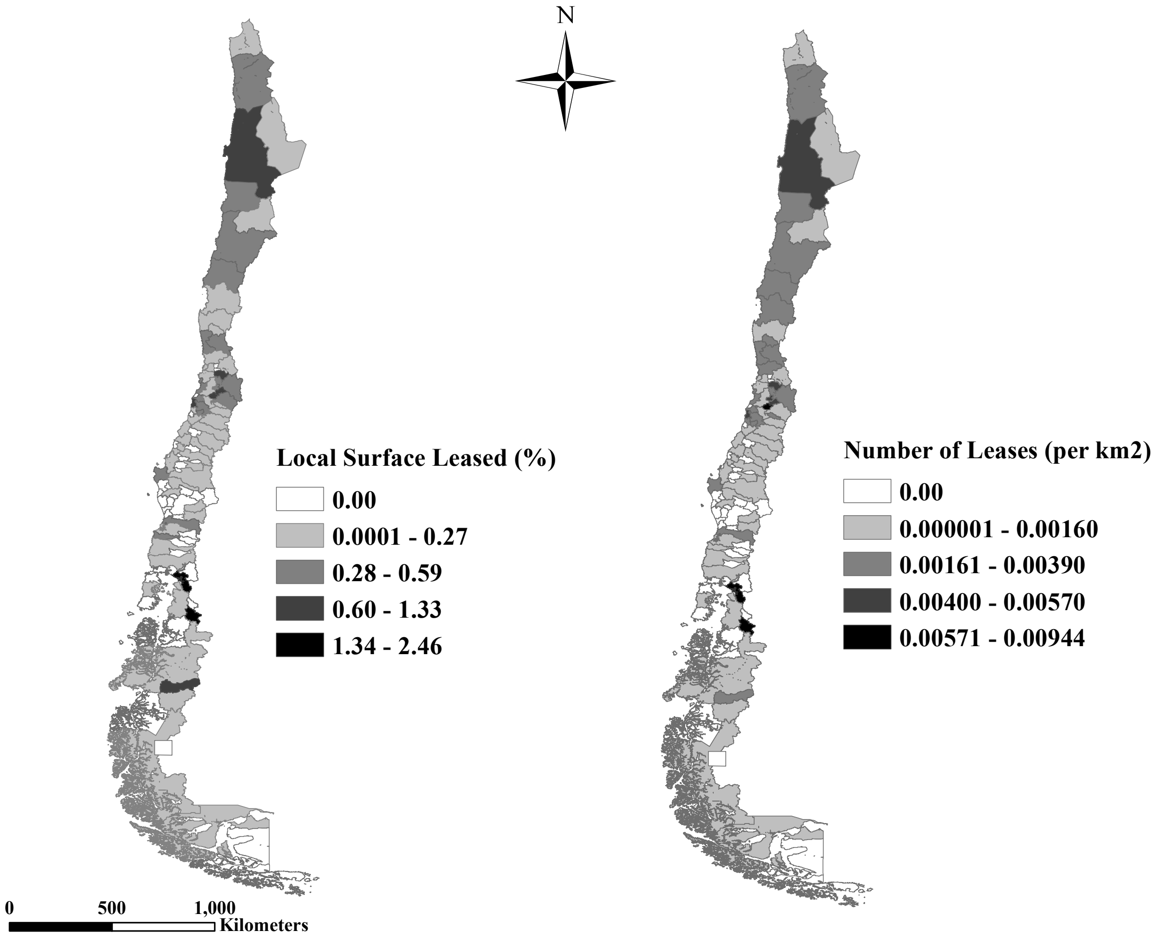
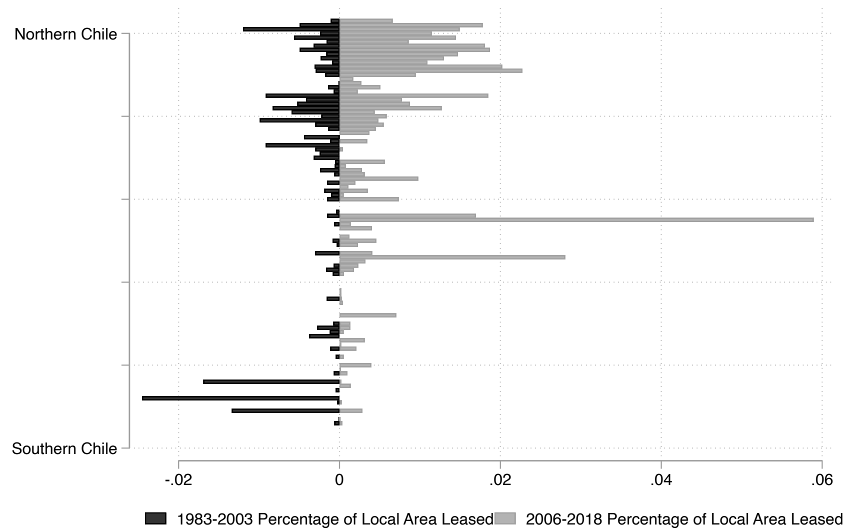
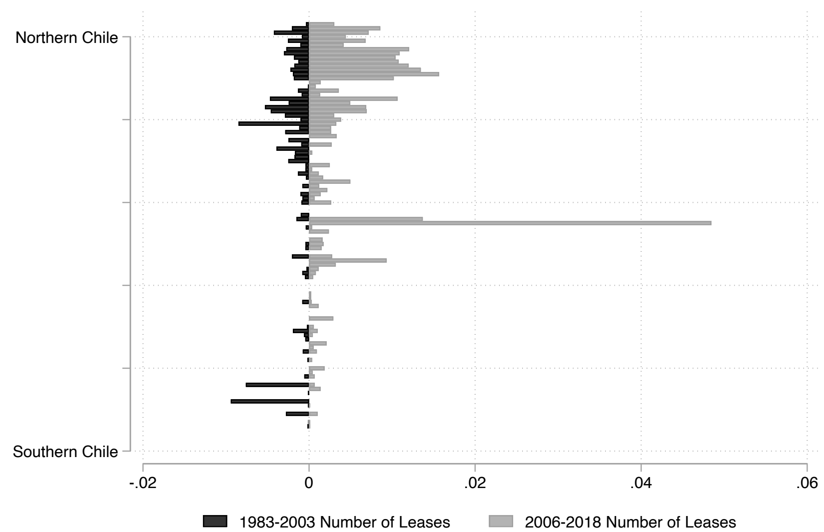


Figure A4: Spatial Distribution of Pretreatment Resource Extraction

Notes: This figure shows the spatial distribution of resource extraction across local labor markets in Chile during pretreatment years (1983-2003). The left-hand panel displays the percentage of the land area of each labor market leased (see Equation (6)). The right-hand panel displays the number of mineral concessions leased per square meter (see Equation (7). Data come from the national mining cadastre obtained from the National Service of Geology and Mining (SERNAGEOMIN). Gray lines depict the boundaries of the 102 labor markets as defined by Berdegué et al. (2011).



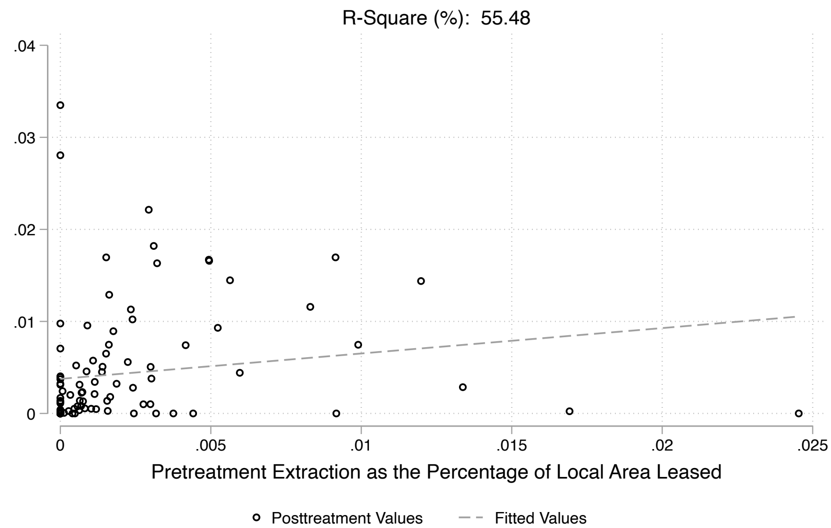
(a) Percentage of Local Area Leased



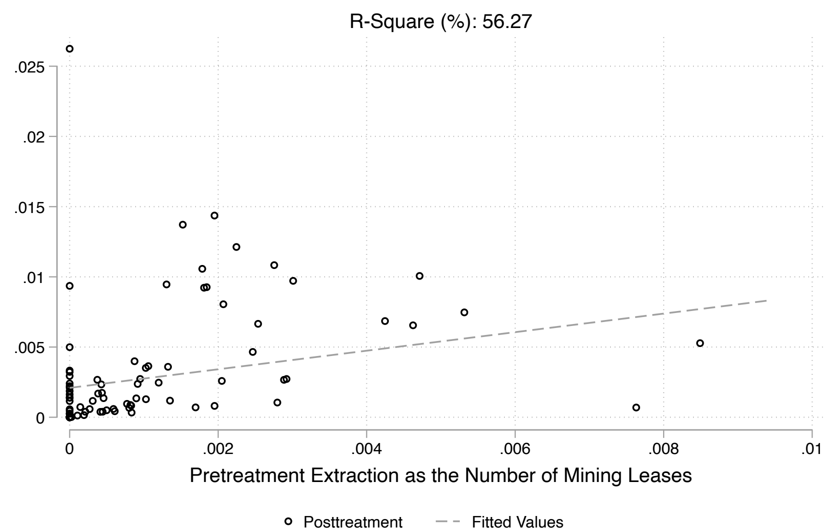
(b) Number of Leases (per km^2)

Figure A5: Pretreatment and Contemporaneous Measures of the Resource Extraction Across Labor Markets

Notes: This figure shows the spatial relationship between the pretreatment (1983-2003) and contemporaneous (2006-2018) versions of our resource extraction measure throughout the country. Panel (a) shows the percentage of local area leased. Panel (b) shows the number of mineral leases per square kilometer of local labor market area. Data come from the national mining cadastre obtained from the National Service of Geology and Mining (SERNAGEOMIN).



(a)



(b)

Figure A6: Predictive Power of Pretreatment Measures of the Resource Extraction Across Labor Markets

Notes: This figure shows the temporal relationship between the pretreatment (1983-2003) and contemporaneous (2006-2018) versions of our resource extraction measure in the country between local labor markets. Panel (a) shows fitted values of regressing contemporaneous values on pretreatment values interacted with labor markets and measuring extraction as the percentage of local area leased. Panel (b) shows fitted values of regressing contemporaneous values on pretreatment values interacted with labor markets and measuring extraction as the number of mineral leases per squared kilometer of local labor market area. Data come from the national mining cadastre obtained from the National Service of Geology and Mining (SERNAGEOMIN).

Table A2: The Impact of a Copper Price Increase on the Number of Years Between High School Graduation and Postsecondary Enrollment

	Log(Number of Years to Enroll)				
	(1)	(2)	(3)	(4)	(5)
Panel A. Extraction as the Percentage of Local Area Leased					
Extraction × *Price*	0.103***	0.103***	0.210***	0.224***	0.229***
	(0.007)	(0.007)	(0.012)	(0.013)	(0.010)
Panel B. Extraction as Number of Mining Leases					
Extraction × *Price*	0.204***	0.205***	0.434***	0.463***	0.472***
	(0.012)	(0.012)	(0.021)	(0.023)	(0.018)
Observations	2,194,945	2,184,100	1,908,758	1,699,150	1,661,860
Mean Dep. Var.	1.596	1.59	1.65	1.65	1.66
Student-Level Covariates	✓	✓	✓	✓	
High School-Level Covariates		✓	✓	✓	✓
Excluding 2017 Onward			✓	✓	✓
Excluding Small Labor Markets				✓	✓
High School Fixed-Effects					✓

Notes: This table shows estimation results from regressions of the number of years of delay in postsecondary enrollment on resource extraction, copper prices, and their interaction. Estimation results are marginal effects from Heckman regressions at the college student level that control for selection into higher education. All regressions include year-of-enrollment fixed effects and student-level covariates. Column (2) includes high school-level covariates that we replace with high school fixed effects in column (5). The selection equation includes the interaction $Extraction_l \times Price_t$ and all other covariates except for year-of-enrollment fixed effects which we replace with the year of high school graduation. Panel A proxies resource extraction with the pretreatment (1983-2003) percentage of local labor market surface leased as defined by Equation (6). Panel B proxies resource extraction with the pretreatment (1983-2003) number of mineral leases per squared kilometer as defined by Equation (7). Data on mineral concessions come from the National Service of Geology and Mining (SERNAGEOMIN). Data on postsecondary enrollment come from the Ministry of Education (MINEDUC). Clustered standard errors by high school are in parentheses. Significance levels: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A3: The Impact of a Copper Price Increase on the Probability of Postsecondary Enrollment by Type of Institution

	Pr(Y = Enrollment)				
	(1)	(2)	(3)	(4)	(5)
Panel A. Extraction as the Percentage of Local Area Leased					
Extraction × *Price*					
Y = No Enrollment	-0.0163***	-0.0168***	-0.0133***	-0.0080*	-0.0082**
	(0.0047)	(0.0047)	(0.0041)	(0.0044)	(0.0036)
Y = University Enrollment	0.0129***	0.0131***	0.0097***	0.0066**	0.0060
	(0.0034)	(0.0033)	(0.0031)	(0.0033)	(0.0038)
Y = Technical Enrollment	0.0034	0.0037	0.0035	0.0014	0.0022
	(0.0043)	(0.0042)	(0.0039)	(0.0042)	(0.0037)
Panel B. Extraction as the Number of Mining Leases					
Extraction × *Price*					
Y = No Enrollment	-0.0340***	-0.0338***	-0.0266***	-0.0181**	-0.0186**
	(0.0087)	(0.0086)	(0.0076)	(0.0083)	(0.0073)
Y = University Enrollment	0.0232***	0.0240***	0.0179***	0.0124*	0.0116
	(0.0066)	(0.0064)	(0.0059)	(0.0064)	(0.0073)
Y = Technical Enrollment	0.0108	0.0097	0.0087	0.0057	0.0071
	(0.0077)	(0.0075)	(0.0070)	(0.0078)	(0.0068)
Observations	3,111,381	3,089,578	2,629,131	2,296,290	2,258,824
Student-Level Covariates	✓	✓	✓	✓	✓
High School-Level Covariates		✓	✓	✓	
Excluding 2017 Onward			✓	✓	✓
Excluding Small Labor Markets				✓	✓
High School Fixed Effects					✓

Notes: This table shows estimation results from regressions of the probability of postsecondary enrollment on resource extraction, copper price, and their interaction, by type of postsecondary institution. Estimation results are marginal effects from multinomial logit regressions at the high school graduate level. Multiple outcomes are university enrollment, technical (vocational) enrollment, and no enrollment (baseline option). All regressions include year-of-high-school-graduation fixed effects and student-level covariates. Column (2) includes high school-level covariates that we replace for high school fixed effects in column (5). Panel A proxies resource extraction with the pretreatment (1983-2003) percentage of local labor market surface leased as defined by Equation (6). Panel B proxies resource extraction with the pretreatment (1983-2003) number of mineral leases per squared kilometer as defined by Equation (7). Data on mineral concessions come from the National Service of Geology and Mining (SERNAGEOMIN). Data on high school graduation and postsecondary enrollment come from the Ministry of Education (MINEDUC). Clustered standard errors by high school are in parentheses. Significance levels: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A4: The Impact of a Copper Price Increase on the Probability of Postsecondary Enrollment by Type of Degree

	Pr(Y = Enrollment)				
	(1)	(2)	(3)	(4)	(5)
Panel A. Extraction as the Percentage of Local Area Leased					
Extraction × Price					
Y = No Enrollment	-0.0181***	-0.0185***	-0.0144***	-0.0091**	-0.0094***
	(0.0047)	(0.0047)	(0.0041)	(0.0044)	(0.0036)
Y = Enrollment in 4-Year Degrees	0.0077**	0.0080**	0.0054	0.0022	0.0021
	(0.0037)	(0.0036)	(0.0033)	(0.0036)	(0.0038)
Y = Enrollment in Technical Degrees	0.0105***	0.0105***	0.0091***	0.0069*	0.0072**
	(0.0038)	(0.0037)	(0.0034)	(0.0037)	(0.0031)
Panel B. Extraction as the Number of Mining Leases					
Extraction × Price					
Y = No Enrollment	-0.0377***	-0.0373***	-0.0290***	-0.0204**	-0.0211***
	(0.0087)	(0.0086)	(0.0076)	(0.0083)	(0.0073)
Y = Enrollment in 4-Year Degrees	0.0133*	0.0141**	0.0095	0.0048	0.0053
	(0.0071)	(0.0069)	(0.0064)	(0.0069)	(0.0075)
Y = Enrollment in Technical Degrees	0.0243***	0.0232***	0.0195***	0.0156**	0.0158***
	(0.0067)	(0.0067)	(0.0063)	(0.0069)	(0.0061)
Observations	3,111,381	3,089,578	2,629,131	2,296,290	2,258,824
Student-Level Covariates	✓	✓	✓	✓	✓
High School-Level Covariates		✓	✓	✓	
Excluding 2017 Onward			✓	✓	✓
Excluding Small Labor Markets				✓	✓
High School Fixed Effects					✓

Notes: This table shows estimation results from regressions of the probability of postsecondary enrollment on resource extraction, copper price, and their interaction, by type of postsecondary degree. Estimation results are marginal effects from multinomial logit regressions at the high school graduate level. Multiple outcomes are enrollment in 4-year degree programs, enrollment in technical (vocational) programs, and no enrollment (baseline option). All regressions include year-of-high-school-graduation fixed effects and student-level covariates. Column (2) includes high school-level covariates that we replace for high school fixed effects in column (5). Panel A proxies resource extraction with the pretreatment (1983-2003) percentage of local labor market surface leased as defined by Equation (6). Panel B proxies resource extraction with the pretreatment (1983-2003) number of mineral leases per squared kilometer as defined by Equation (7). Data on mineral concessions come from the National Service of Geology and Mining (SERNAGEOMIN). Data on high school graduation and postsecondary enrollment come from the Ministry of Education (MINEDUC). Clustered standard errors by high school are in parentheses. Significance levels: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A5: The Impact of a Copper Price Increase on the Number of Years to Finish a Postsecondary Education

	Log(Number of Years to Finish)				
	(1)	(2)	(3)	(4)	(5)
Panel A. Extraction as the Percentage of Local Area Leased					
Extraction × *Price*	0.0059	-0.00001	0.0086	0.0072	0.0077
	(0.0159)	(0.0126)	(0.0113)	(0.0113)	(0.0104)
Panel B. Extraction as the Number of Mining Leases					
Extraction × *Price*	0.050	-0.0126	0.0106	0.0076	0.0121
	(0.0298)	(0.0244)	(0.0223)	(0.0223)	(0.0210)
Observations	996,660	996,660	996,660	986,743	986,268
Mean Dep. Var.	4.71	4.71	4.71	4.72	4.72
College-Level Covariates	✓	✓	✓	✓	
Degree-Level Covariates		✓	✓	✓	✓
Excluding Small Labor Markets				✓	✓
College Fixed-Effects					✓

Notes: This table shows estimation results from regressions of the number of years (in logs) to finish a postsecondary degree on resource extraction and copper prices. Estimation results are marginal effects from Heckman regressions at the college student level that control for selection into postsecondary graduation. All regressions include year-of-enrollment and year-of-high-school-graduation fixed effects, student-level and high school-level covariates. Column (2) includes college-level covariates that we replaced with college-fixed effects in column (5). Selection equation includes the interaction $Extraction_l \times Price_t$ and all other covariates except for year-of high-school-graduation that we replace for time-to-enroll fixed effects. Panel A proxies resource extraction with the pretreatment (1983-2003) percentage of local labor market surface leased as defined by Equation (6). Panel B proxies resource extraction with the pretreatment (1983-2003) number of mineral leases per square kilometer as defined by Equation (7). Data on mineral concessions come from the National Service of Geology and Mining (SERNAGEOMIN). Data on postsecondary enrollment and graduation come from the Ministry of Education (MINEDUC). Clustered standard errors by college are in parentheses. Significance levels: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A6: The Impact of a Copper Price Increase on the Probability of Postsecondary Completion by Type of Enrollment

	Pr(Y = Graduation)				
	(1)	(2)	(3)	(4)	(5)
Panel A. Extraction as the Percentage of Local Land Area Leased					
Extraction × *Price*					
Y = Graduation × Immediate Enrollment	-0.0214**	-0.0240***	-0.0249***	-0.0239***	-0.0144*
	(0.0090)	(0.0092)	(0.0090)	(0.0090)	(0.0077)
Y = Graduation × Late Enrollment	-0.0062	-0.0056	-0.0048	-0.0040	-0.0008
	(0.0105)	(0.0106)	(0.0104)	(0.0104)	(0.0097)
Panel B. Extraction as the Number of Mining Leases					
Extraction × *Price*					
Y = Graduation × Immediate Enrollment	-0.0430**	-0.0464**	-0.0485**	-0.0469**	-0.0256
	(0.0196)	(0.0198)	(0.0191)	(0.0193)	(0.0160)
Y = Graduation × Late Enrollment	-0.0060	-0.0040	-0.0038	-0.0025	-0.0005
	(0.0212)	(0.0212)	(0.0208)	(0.0209)	(0.0195)
Observations	996,672	996,672	996,672	986,755	986,280
High School-Level Covariates	✓	✓	✓	✓	✓
College-Level Covariates		✓	✓	✓	
Degree-Level Covariates			✓	✓	✓
Only Medium and Large Labor Markets				✓	✓
College Fixed-Effects					✓

Notes: This table shows estimation results from regressions of the probability of completing a postsecondary education on resource extraction, copper prices, type of enrollment, and their multiple interactions. Estimation results are marginal effects from logit triple difference-in-difference regressions at the college student level. All regressions include year-of-enrollment fixed effects, time-to-enroll fixed effects, student-level and school-level covariates. Column (2) includes college-level covariates that we replace for college-fixed effects in column (5). Panel A proxies resource extraction with the pretreatment (1983-2003) percentage of local labor market surface leased as defined by Equation (6). Panel B proxies resource extraction with the pretreatment (1983-2003) number of mineral leases per square kilometer as defined by Equation (7). Data on mineral concessions come from the National Service of Geology and Mining (SERNAGEOMIN). Data on postsecondary enrollment and graduation come from the Ministry of Education (MINEDUC). Clustered standard errors by college are in parentheses. Significance levels: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A7: The Impact of a Copper Price Increase on the Probability of Postsecondary Completion by Type of Institution

	Pr(Y = Graduation)				
	(1)	(2)	(3)	(4)	(5)
Panel A. Extraction as the Percentage of Local Land Area Leased					
Extraction × *Price*					
Y = No Graduation	0.0306***	0.0335***	0.0319***	0.0300***	0.0252***
	(0.0095)	(0.0098)	(0.0099)	(0.0099)	(0.0093)
Y = University Graduation	-0.0120	-0.0144	-0.0110	-0.0099	-0.0175**
	(0.0097)	(0.0099)	(0.0088)	(0.0088)	(0.0075)
Y = Technical Graduation	-0.0186	-0.0191	-0.0209**	-0.0201**	-0.0078
	(0.0119)	(0.0120)	(0.0092)	(0.0091)	(0.0065)
Panel B. Extraction as the Number of Mining Leases					
Extraction × *Price*					
Y = No Graduation	0.0626***	0.0687***	0.0631***	0.0594***	0.0524**
	(0.0200)	(0.0204)	(0.0200)	(0.0201)	(0.0207)
Y = University Graduation	-0.0227	-0.0280	-0.0240	-0.0219	-0.0413**
	(0.0186)	(0.0189)	(0.0172)	(0.0173)	(0.0191)
Y = Technical Graduation	-0.0398	-0.0406*	-0.0391**	-0.0375*	-0.0110
	(0.0246)	(0.0247)	(0.0194)	(0.0194)	(0.0124)
Observations	996,674	996,674	996,674	986,757	986,282
High School-Level Covariates	✓	✓	✓	✓	✓
College-Level Covariates		✓	✓	✓	
Degree-Level Covariates			✓	✓	✓
Only Medium and Large Labor Markets				✓	✓
College Fixed-Effects					✓

Notes: This table shows estimation results from regressions of the probability of completing a postsecondary education on resource extraction, copper prices, and their interaction, by type of postsecondary institution. Estimation results are marginal effects from multinomial logit regressions at the postsecondary student level. Multiple outcomes are university graduation, technical (vocational) graduation, and no graduation (baseline option). All regressions include year-of-enrollment fixed effects, student-level covariates, and time to enroll. Column (2) includes college-level covariates that we replace for college fixed effects in column (5). Panel A proxies resource extraction with the pretreatment (1983-2003) percentage of local labor market surface leased as defined by Equation (6). Panel B proxies resource extraction with the pretreatment (1983-2003) number of mineral leases per square kilometer as defined by Equation (7). Data on mineral concessions come from the National Service of Geology and Mining (SERNAGEOMIN). Data on postsecondary enrollment and graduation come from the Ministry of Education (MINEDUC). Clustered standard errors by college are in parentheses. Significance levels: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A8: The Impact of a Copper Price Increase on the Probability of Postsecondary Completion by Type of Degree

	Pr(Y = Graduation)				
	(1)	(2)	(3)	(4)	(5)
Panel A. Extraction as the Percentage of Local Land Area Leased					
Extraction × Price					
Y = No Graduation	0.0240**	0.0273***	0.0236**	0.0224**	0.0266**
	(0.0096)	(0.0100)	(0.0110)	(0.0110)	(0.0111)
Y = Graduation from 4-Year Degrees	-0.0165*	-0.0207**	-0.0171*	-0.0167*	-0.0207**
	(0.0094)	(0.0099)	(0.0093)	(0.0093)	(0.0086)
Y = Graduation from Technical Degrees	-0.0076	-0.0066	-0.0065	-0.0058	-0.0059
	(0.0105)	(0.0106)	(0.0079)	(0.0079)	(0.0071)
Panel B. Extraction as the Number of Mining Leases					
Extraction × Price					
Y = No Graduation	0.0476**	0.0548***	0.0467**	0.0446**	0.0541**
	(0.0204)	(0.0211)	(0.0219)	(0.0219)	(0.0232)
Y = Graduation from 4-Year Degrees	-0.0352**	-0.0443**	-0.0396**	-0.0384**	-0.0486**
	(0.0173)	(0.0182)	(0.0179)	(0.0179)	(0.0191)
Y = Graduation from Technical Degrees	-0.0124	-0.0105	-0.0071	-0.0063	-0.0055
	(0.0206)	(0.0206)	(0.0166)	(0.0166)	(0.0132)
Observations	996,674	996,674	996,674	986,757	986,282
High School-Level Covariates	✓	✓	✓	✓	✓
College-Level Covariates		✓	✓	✓	
Degree-Level Covariates			✓	✓	✓
Only Medium and Large Labor Markets				✓	✓
College Fixed-Effects					✓

Notes: This table shows estimation results from regressions of the probability of completing a postsecondary education on resource extraction, copper prices, and their interaction, by type of postsecondary institution. Estimation results are marginal effects from multinomial logit regressions at the postsecondary student level. Multiple outcomes are graduation from a 4-year degree program, graduation from a technical (vocational) programs, and no graduation (baseline option). All regressions include year-of-enrollment fixed effects, student-level covariates, and time to enroll. Column (2) includes college-level covariates that we replace with college fixed effects in column (5). Panel A proxies resource extraction with the pretreatment (1983-2003) percentage of local labor market surface leased as defined by Equation (6). Panel B proxies resource extraction with the pretreatment (1983-2003) number of mineral leases per square kilometer as defined by Equation (7). Data on mineral concessions come from the National Service of Geology and Mining (SERNAGEOMIN). Data on postsecondary enrollment and graduation come from the Ministry of Education (MINEDUC). Clustered standard errors by college are in parentheses. Significance levels: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A9: The Impact of a Copper Price Increase on the Probability of Postsecondary Enrollment by Students' High School Funding Source

	Pr(Y = Enrollment)				
	(1)	(2)	(3)	(4)	(5)
Panel A. Extraction as the Percentage of Local Area Leased					
Extraction × *Price*					
Y = No Enrollment × Private High School	-0.0150	-0.0176	-0.0055	-0.0033	-0.0061
	(0.0133)	(0.0133)	(0.0116)	(0.0122)	(0.0095)
Y = No Enrollment × Voucher High School	-0.0138**	-0.0140**	-0.0135**	-0.0098	-0.0087
	(0.0068)	(0.0068)	(0.0060)	(0.0064)	(0.0056)
Y = No Enrollment × Public High School	-0.0193***	-0.0196***	-0.0166***	-0.0114*	-0.0119**
	(0.0071)	(0.0072)	(0.0059)	(0.0063)	(0.0049)
Y = Late Enrollment × Private High School	0.0115	0.0149	0.0154	0.0152	0.0163
	(0.0118)	(0.0123)	(0.0133)	(0.0135)	(0.0113)
Y = Late Enrollment × Voucher High School	0.0246***	0.0237***	0.0224***	0.0232***	0.0214***
	(0.0065)	(0.0066)	(0.0068)	(0.0072)	(0.0063)
Y = Late Enrollment × Public High School	0.0054	0.0068	0.0056	0.0062	0.0068
	(0.0065)	(0.0066)	(0.0066)	(0.0077)	(0.0068)
Y = Immediate Enrollment × Private High School	0.0035	0.0027	-0.0099	-0.0119	-0.0101
	(0.0184)	(0.0187)	(0.0178)	(0.0184)	(0.0131)
Y = Immediate Enrollment × Voucher High School	-0.0107	-0.0096	-0.0089	-0.0134	-0.0127*
	(0.0101)	(0.0101)	(0.0091)	(0.0097)	(0.0075)
Y = Immediate Enrollment × Public High School	0.0139	0.0129	0.0110	0.0052	0.0051
	(0.0114)	(0.0114)	(0.0100)	(0.0113)	(0.0096)
Panel B. Extraction as the Number of Mining Leases					
Extraction × *Price*					
Y = No Enrollment × Private High School	-0.0353	-0.0402	-0.0139	-0.0087	-0.0141
	(0.0275)	(0.0272)	(0.0233)	(0.0248)	(0.0200)
Y = No Enrollment × Voucher High School	-0.0302**	-0.0300**	-0.0279***	-0.0206*	-0.0190*
	(0.0121)	(0.0120)	(0.0107)	(0.0116)	(0.0105)
Y = No Enrollment × Public High School	-0.0347***	-0.0342**	-0.0298***	-0.0223*	-0.0232**
	(0.0135)	(0.0137)	(0.0113)	(0.0124)	(0.0105)
Y = Late Enrollment × Private High School	0.0238	0.0299	0.0300	0.0322	0.0354
	(0.0230)	(0.0242)	(0.0259)	(0.0265)	(0.0224)
Y = Late Enrollment × Voucher High School	0.0438***	0.0424***	0.0392***	0.0409***	0.0393***
	(0.0111)	(0.0112)	(0.0115)	(0.0122)	(0.0107)
Y = Late Enrollment × Public High School	0.0094	0.0116	0.0092	0.0075	0.0104
	(0.0128)	(0.0128)	(0.0129)	(0.0152)	(0.0132)
Y = Immediate Enrollment × Private High School	0.0115	0.0104	-0.0160	-0.0235	-0.0213
	(0.0372)	(0.0377)	(0.0348)	(0.0364)	(0.0267)
Y = Immediate Enrollment × Voucher High School	-0.0136	-0.0123	-0.0113	-0.0203	-0.0203
	(0.0176)	(0.0175)	(0.0159)	(0.0171)	(0.0134)
Y = Immediate Enrollment × Public High School	0.0254	0.0226	0.0205	0.0148	0.0128
	(0.0209)	(0.0208)	(0.0183)	(0.0212)	(0.0177)
Observations	2,974,930	2,953,820	2,511,476	2,186,596	2,149,940
Student-Level Covariates	✓	✓	✓	✓	✓
High School-Level Covariates		✓	✓	✓	
Excluding 2017 Onward			✓	✓	✓
Excluding Small Labor Markets				✓	✓
High School Fixed Effects					✓

Notes: This table shows estimation results from regressions of the probability of postsecondary enrollment on resource extraction, copper prices, high school funding source, and their multiple interactions. Estimation results are marginal effects from multinomial logit triple difference-in-difference regressions at the high school graduate level. Multiple outcomes are immediate enrollment, late enrollment, and no enrollment (baseline option). All regressions include year-of-high school-graduation fixed effects and student-level covariates. Data on mineral concessions come from the National Service of Geology and Mining (SERNAGEOMIN). Data on high school graduation and postsecondary enrollment come from the Ministry of Education (MINEDUC). Clustered standard errors by high school are in parentheses. Significance levels: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A10: The Impact of a Copper Price Increase on the Probability of Postsecondary Completion by Students' High School Funding Source

	Pr(Y = Graduation)				
	(1)	(2)	(3)	(4)	(5)
Panel A. Extraction as the Percentage of Local Land Area Leased					
Extraction × *Price*					
Y = Graduation × Private High School	-0.0312	-0.0361	-0.0525	-0.0534	-0.0319
	(0.0343)	(0.0342)	(0.0332)	(0.0333)	(0.0289)
Y = Graduation × Voucher High School	-0.0098	-0.0113	-0.0097	-0.0105	-0.0064
	(0.0151)	(0.0150)	(0.0148)	(0.0148)	(0.0144)
Y = Graduation × Public High School	-0.0240***	-0.0267***	-0.0273***	-0.0257***	-0.0145**
	(0.0090)	(0.0096)	(0.0093)	(0.0093)	(0.0073)
Panel B. Extraction as the Number of Mining Leases					
Extraction × *Price*					
Y = Graduation × Private High School	-0.0538	-0.0613	-0.0910	-0.0928	-0.0628
	(0.0603)	(0.0605)	(0.0589)	(0.0592)	(0.0516)
Y = Graduation × Voucher High School	-0.0193	-0.0222	-0.0183	-0.0200	-0.00611
	(0.0360)	(0.0360)	(0.0355)	(0.0355)	(0.0341)
Y = Graduation × Public High School	-0.0459**	-0.0488**	-0.0510***	-0.0482**	-0.0258*
	(0.0192)	(0.0198)	(0.0188)	(0.0189)	(0.0148)
Observations	996,672	996,672	996,672	986,755	986,280
High School-Level Covariates	✓	✓	✓	✓	✓
College-Level Covariates		✓	✓	✓	
Degree-Level Covariates			✓	✓	✓
Only Medium and Large Labor Markets				✓	✓
College Fixed-Effects					✓

Notes: This table shows estimation results from regressions of the probability of completing a postsecondary education on resource extraction, copper prices, high school funding source, and their multiple interactions. Estimation results are marginal effects from logit triple difference-in-difference regressions at the postsecondary student level. All regressions include year-of-enrollment fixed effects, student-level covariates, and time to enroll. Data on mineral concessions come from the National Service of Geology and Mining (SERNAGEOMIN). Data on postsecondary enrollment and graduation come from the Ministry of Education (MINEDUC). Clustered standard errors by college are in parentheses. Significance levels: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A11: The Impact of a Copper Price Increase on the Probability of Postsecondary Completion by Students' High School Funding Source

	Pr(Y = Graduation)				
	(1)	(2)	(3)	(4)	(5)
Panel A. Extraction as the Percentage of Local Land Area Leased					
Extraction × *Price*					
Y = Graduation × Private High School	-0.0312	-0.0361	-0.0525	-0.0534	-0.0319
	(0.0343)	(0.0342)	(0.0332)	(0.0333)	(0.0289)
Y = Graduation × Voucher High School	-0.0098	-0.0113	-0.0097	-0.0105	-0.0064
	(0.0151)	(0.0150)	(0.0148)	(0.0148)	(0.0144)
Y = Graduation × Public High School	-0.0240***	-0.0267***	-0.0273***	-0.0257***	-0.0145**
	(0.0090)	(0.0096)	(0.0093)	(0.0093)	(0.0073)
Panel B. Extraction as the Number of Mining Leases					
Extraction × *Price*					
Y = Graduation × Private High School	-0.0538	-0.0613	-0.0910	-0.0928	-0.0628
	(0.0603)	(0.0605)	(0.0589)	(0.0592)	(0.0516)
Y = Graduation × Voucher High School	-0.0193	-0.0222	-0.0183	-0.0200	-0.00611
	(0.0360)	(0.0360)	(0.0355)	(0.0355)	(0.0341)
Y = Graduation × Public High School	-0.0459**	-0.0488**	-0.0510***	-0.0482**	-0.0258*
	(0.0192)	(0.0198)	(0.0188)	(0.0189)	(0.0148)
Observations	996,672	996,672	996,672	986,755	986,280
High School-Level Covariates	✓	✓	✓	✓	✓
College-Level Covariates		✓	✓	✓	
Degree-Level Covariates			✓	✓	✓
Only Medium and Large Labor Markets				✓	✓
College Fixed-Effects					✓

Notes: This table shows estimation results from regressions of the probability of completing a postsecondary education on resource extraction, copper prices, high school funding source, and their multiple interactions. Estimation results are marginal effects from logit triple difference-in-difference regressions at the postsecondary student level. All regressions include year-of-enrollment fixed effects, student-level covariates, and time to enroll. Data on mineral concessions come from the National Service of Geology and Mining (SERNAGEOMIN). Data on postsecondary enrollment and graduation come from the Ministry of Education (MINEDUC). Clustered standard errors by college are in parentheses. Significance levels: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A12: The Impact of a Copper Price Increase on the Probability of Postsecondary Completion by Financial Aid Status

	Pr(Y = Graduation)				
	(1)	(2)	(3)	(4)	(5)
Panel A. Extraction as the Percentage of Local Land Area Leased					
Extraction × *Price*					
Y = Graduation	-0.0143	-0.0160	-0.0154	-0.0158	-0.00574
	(0.0102)	(0.0109)	(0.0106)	(0.0107)	(0.0086)
Y = Graduation × 1[Financial Aid]	-0.0346***	-0.0375***	-0.0367***	-0.0339***	-0.0193*
	(0.0130)	(0.0128)	(0.0126)	(0.0126)	(0.0114)
Panel B. Extraction as the Number of Mining Leases					
Extraction × *Price*					
Y = Graduation	-0.0254	-0.0254	-0.0255	-0.0267	-0.0033
	(0.0222)	(0.0227)	(0.0220)	(0.0221)	(0.0182)
Y = Graduation × 1[Financial Aid]	-0.0713***	-0.0737***	-0.0720***	-0.0671***	-0.0411*
	(0.0254)	(0.0249)	(0.0244)	(0.0247)	(0.0219)
Observations	996,672	996,672	996,672	986,755	986,280
High School-Level Covariates	✓	✓	✓	✓	✓
College-Level Covariates		✓	✓	✓	
Degree-Level Covariates			✓	✓	✓
Only Medium and Large Labor Markets				✓	✓
College Fixed-Effects					✓

Notes: This table shows estimation results from regressions of the probability of completing a postsecondary education on resource extraction, copper prices, financial aid, and their multiple interactions. Estimation results are marginal effects from logit triple difference-in-difference regressions at the postsecondary student level. All regressions include year-of-enrollment fixed effects, student-level covariates, and time to enroll. Data on mineral concessions come from the National Service of Geology and Mining (SERNAGEOMIN). Data on postsecondary enrollment and graduation come from the Ministry of Education (MINEDUC). Clustered standard errors by college are in parentheses. Significance levels: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A13: The Impact of a Copper Price Increase on the Probability of Postsecondary Enrollment and Completion in Markets with a Workforce in Mineral Extraction

	(1)	(2)	(3)	(4)	(5)
Panel A. Postsescondary Enrollment					
Extraction × *Price*					
Y = No Enrollment	0.0006*	0.0006*	0.0004	0.0006*	0.0006**
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0002)
Y = Immediate Enrollment	-0.0001	-0.0001	0.000005	-0.0001	-0.00005
	(0.0003)	(0.0003)	(0.0003)	(0.0004)	(0.0004)
Y = Late Enrollment	-0.0005	-0.0005	-0.0004	-0.0005	-0.0005
	(0.0005)	(0.0005)	(0.0004)	(0.0005)	(0.0004)
Observations	3,110,198	3,088,398	2,628,163	2,296,290	2,258,824
Panel B. Postsecondary Completion					
Extraction × *Price*	-0.0004	-0.0004	-0.0004	-0.0004	-0.0005
	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0005)
Observations	996,387	996,387	996,387	986,472	985,997

Notes: This table shows estimation results from regressions of the probability of postsecondary enrollment and completion on resource extraction, copper prices, and their interaction. Estimation results are marginal effects from logit difference-in-difference regressions at the high school student level (panel A) and college student level (panel B). All regressions include the same set of controls used previously in Tables 1 and 2. Resource extraction is proxied with the pretreatment (2003) share of workers in the mining sector. Data on postsecondary enrollment and graduation come from the Ministry of Education (MINEDUC). Clustered standard errors by college are in parentheses. Significance levels: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A14: The Impact of a Copper Price Increase on Returns to Education by Education Level

	(1)	(2)
Panel A. Extraction as the Percentage of Local Area Leased		
$Extraction \times Price$	-0.0837***	-0.0640***
	(0.0203)	(0.0197)
$Extraction \times Price$ × Complete Primary	0.0466***	0.0446**
	(0.0161)	(0.0204)
$Extraction \times Price$ × Complete Secondary	0.0429**	0.0402**
	(0.0174)	(0.0177)
$Extraction \times Price$ × Complete Tertiary	0.0058	0.0048
	(0.0190)	(0.0223)
Panel B. Extraction as the Number of Mining Leases		
$Extraction \times Price$	-0.208***	-0.176***
	(0.0328)	(0.0300)
$Extraction \times Price$ × Complete Primary	0.0796***	0.0780***
	(0.0288)	(0.0281)
$Extraction \times Price$ × Complete Secondary	0.0749***	0.0710**
	(0.0279)	(0.0278)
$Extraction \times Price$ × Complete Tertiary	0.0298	0.0260
	(0.0395)	(0.0408)
Observations	475,761	475,761
Labor Market Fixed Effects	×	
Municipality Fixed Effects		×

Notes: This Table shows estimation results from regressions on wages on resource extraction, copper prices, education levels, and their multiple interactions (see Equation (11)). Estimation results are marginal effects of the triple interaction between resource extraction, copper prices and education, from Heckman regressions at the individual level that control for selection into the labor market. Estimations are performed with a two-step estimator. All regressions include individual-level demographics, experience, quadratic of experience, job-level covariates, and time fixed effects. Selection equation includes the interaction $Extraction \times Price$ and all other covariates except for job-level characteristics and labor market-level fixed effects, which are replaced by region-level fixed effects. Data on wages and workers' characteristics come from the Chilean National Socioeconomic Characterization Survey (CASEN) for all available years between 2006 and 2017. Bootstrapped standard errors in parentheses. Significance levels: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

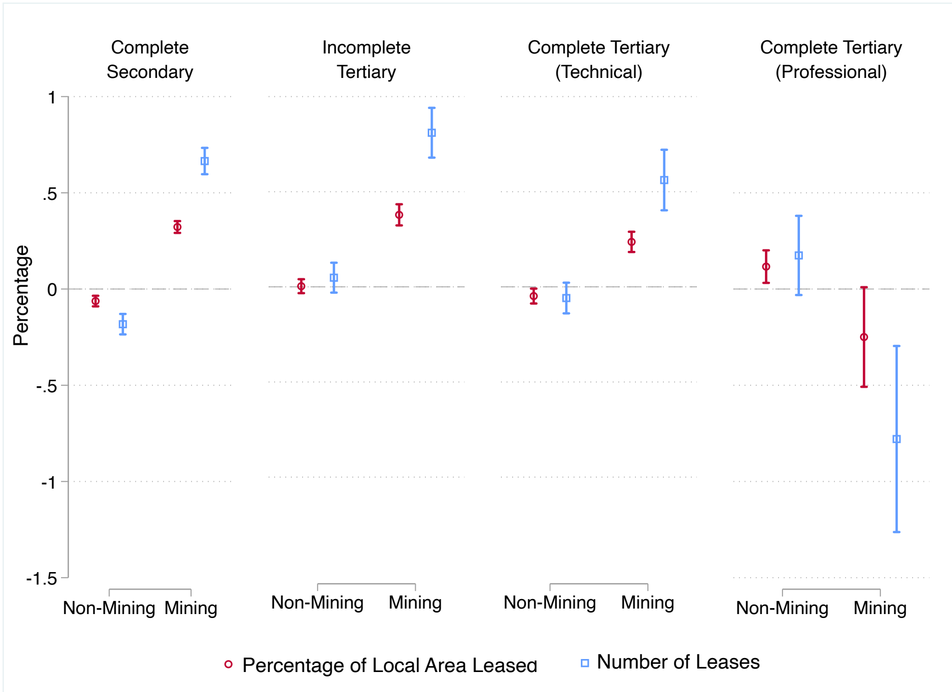


Figure A7: The Impact of a Copper Price Increase on the Returns to Education — Heterogeneous Effects by Sector

Notes: This figure shows estimation results from regressions on wages on resource extraction, copper prices, education levels, and their multiple interactions (see Equation (11)) allowing for heterogeneous effects by economic sector (mining and non-mining). Estimation results are marginal effects of the triple interaction between resource extraction, copper prices and education, and interacted with a sector-based dummy. Regressions are Heckman estimations at the individual level that control for selection into the labor market. Estimations are performed with a two-step estimator. We illustrate the results for our preferred specification that includes individual-level demographics, experience, quadratic of experience, job-level covariates, and time and labor market fixed effects. Selection equation includes the interaction $Extraction \times Price$ and all other covariates except for job-level characteristics and labor market-level fixed effects, which are replaced by region-level fixed effects. Data on wages and workers' characteristics come from the Chilean National Socieconomic Characterization Survey (CASEN) for all available years between 2006 and 2017. Dashed lines are 95% confidence intervals using bootstrapped standard errors.

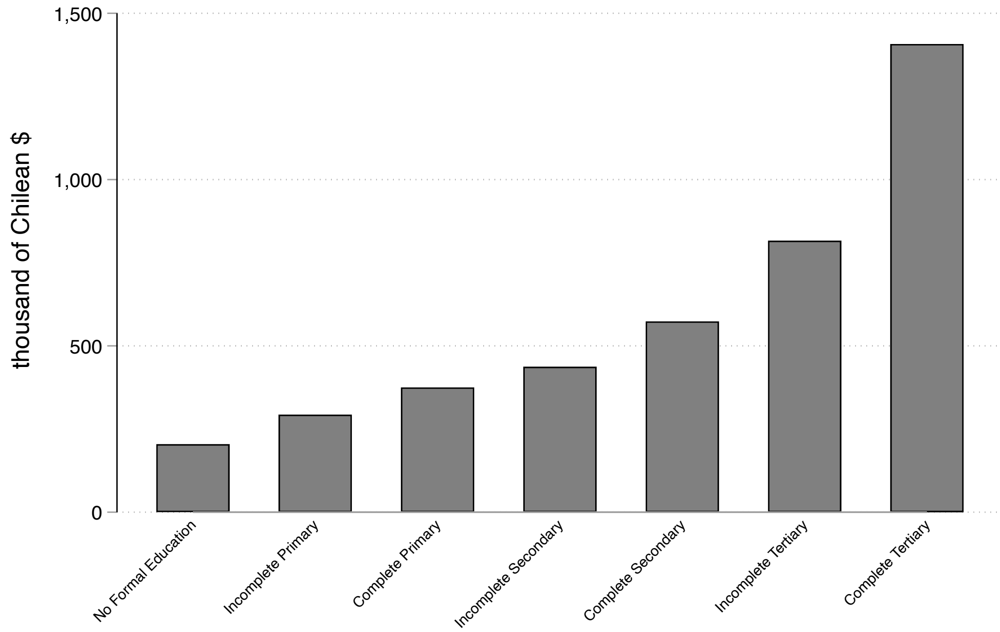


Figure A8: 2006-2017 Average Household Income by Education Level

Notes: This figure shows 2006-2017 average household income by education level. Data come from the Socioeconomic Household Survey CASEN for the available waves (2006, 2009, 2011, 2013, 2015, 2017).

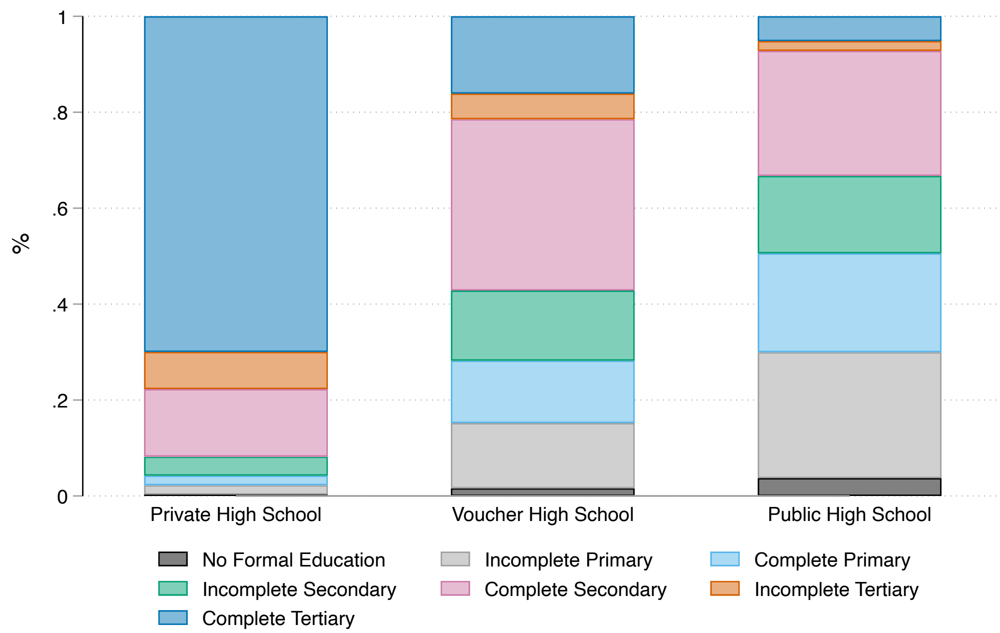


Figure A9: Frequency of Household Heads' Education Level by Type of High School

Notes: This figure shows household heads' education levels by type of high school attended by their children. Data come from the Socioeconomic Household Survey CASEN for the available waves (2006, 2009, 2011, 2013, 2015, 2017).

Table A15: The Impact of a Copper Price Increase on Household Income — Full Results

	Baseline				Heterogeneous Effects by Sector		
	Double DID		Triple DID		Double DID	Triple DID	
	Full Sample	HHs with Young Adults	Full Sample	HHs with Young Adults	Full Sample	Full Sample	HHs with Young Adults
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A. Extraction as the Percentage of Local Land Area Leased							
Extraction × *Price*	0.038**	0.034**	0.066	0.070	0.027*	0.066	0.066
	(0.015)	(0.015)	(0.094)	(0.126)	(0.014)	(0.093)	(0.126)
Extraction × *Price* × Inc. Primary			0.015	0.018		0.015	0.019
			(0.030)	(0.035)		(0.031)	(0.035)
Extraction × *Price* × Com. Primary			0.034	0.020		0.028	0.015
			(0.026)	(0.032)		(0.027)	(0.035)
Extraction × *Price* × Inc. Secondary			0.031	0.036		0.014	0.018
			(0.022)	(0.029)		(0.022)	(0.028)
Extraction × *Price* × Com. Secondary			0.071***	0.062***		0.053***	0.046**
			(0.021)	(0.021)		(0.020)	(0.021)
Extraction × *Price* × Inc. Tertiary			0.049*	0.077**		0.038	0.066*
			(0.027)	(0.034)		(0.030)	(0.037)
Extraction × *Price* × Com. Tertiary			-0.006	-0.015		-0.014	-0.021
			(0.053)	(0.049)		(0.047)	(0.044)
Extraction × *Price* × 1[Mining]					0.141***	0.082	0.256
					(0.029)	(0.306)	(0.380)
Extraction × *Price* × Inc. Primary × 1[Mining]						0.039	0.015
						(0.061)	(0.080)
Extraction × *Price* × Com. Primary × 1[Mining]						0.122*	0.093
						(0.072)	(0.083)
Extraction × *Price* × Inc. Secondary × 1[Mining]						0.236***	0.255***
						(0.051)	(0.069)
Extraction × *Price* × Inc. Secondary × 1[Mining]						0.195***	0.176***
						(0.047)	(0.058)
Extraction × *Price* × Inc. Tertiary × 1[Mining]						0.125**	0.153***
						(0.049)	(0.053)
Extraction × *Price* × Com. Tertiary × 1[Mining]						0.045	0.027
						(0.084)	(0.086)
Panel B. Extraction as the Number of Mining Leases							
Extraction × *Price*	0.058	0.054	0.046	0.100	0.041	0.058	0.102
	(0.040)	(0.040)	(0.216)	(0.266)	(0.038)	(0.216)	(0.264)
Extraction × *Price* × Inc. Primary			0.043	0.046		0.041	0.042
			(0.059)	(0.064)		(0.060)	(0.066)
Extraction × *Price* × Com. Primary			0.040	-0.002		0.027	-0.014
			(0.068)	(0.083)		(0.072)	(0.089)
Extraction × *Price* × Inc. Secondary			-0.016	-0.006		-0.041	-0.034
			(0.065)	(0.081)		(0.059)	(0.078)
Extraction × *Price* × Comp. Secondary			0.114*	0.093		0.089	0.070
			(0.064)	(0.066)		(0.060)	(0.065)
Extraction × *Price* × Inc. Tertiary			0.175**	0.249**		0.154*	0.229**
			(0.085)	(0.102)		(0.090)	(0.109)
Extraction × *Price* × Comp. Tertiary			0.017	0.004		0.013	0.003
			(0.083)	(0.083)		(0.084)	(0.086)
Extraction × *Price* × 1[Mining]					0.247***	-0.348	0.059
					(0.093)	(0.597)	(0.699)
Extraction × *Price* × Inc. Primary × 1[Mining]						0.098	0.149
						(0.121)	(0.170)
Extraction × *Price* × Com. Primary × 1[Mining]						0.239*	0.175
						(0.139)	(0.172)
Extraction × *Price* × Inc. Secondary × 1[Mining]						0.308	0.346
						(0.192)	(0.229)
Extraction × *Price* × Comp. Secondary × 1[Mining]						0.313**	0.277*
						(0.136)	(0.147)
Extraction × *Price* × Inc. Tertiary × 1[Mining]						0.346**	0.418**
						(0.159)	(0.176)
Extraction × *Price* × Comp. Tertiary × 1[Mining]						0.0625	0.0288
						(0.115)	(0.117)
Observations	385,887	309,015	385,887	309,015	385,887	385,887	309,015

Notes: This table shows estimation results from regressions of household income on resource extraction, copper prices, and their interaction. Estimation results are marginal effects from OLS regressions at the household level. All regressions include household head gender, age, education level, an indicator of civil status, household size, a rural indicator, time and labor market fixed effects. Clustered standard errors by labor market are in parentheses. Significance levels: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A16: The Impact of a Copper Price Increase on Local Public Revenues and Expenditures (Labor Markets)

	Revenues for Education			Expenditures to Education		
	From Local Budgets	From MINEDUC	Total Revenues	Staff Per Capita	Overhead Per Capita	Total Expenditures
Panel A. Extraction as the Percentage of Local Area Leased						
$Extraction \times Price_t$	0.0320	0.0286	0.0461	0.0454*	0.0797	0.0445
	(0.0820)	(0.0320)	(0.0283)	(0.0254)	(0.0782)	(0.0284)
Observations	4,224	4,445	4,461	4,461	4,458	4,460
$Extraction \times Price_{t-1}$	-0.0194	0.0268	0.0235	0.0423	0.0373	0.0366
	(0.111)	(0.0303)	(0.0283)	(0.0273)	(0.0551)	(0.0273)
Observations	3,893	4,103	4,119	4,119	4,117	4,118
Panel B. Extraction as the Number of Mining Leases						
$Extraction \times Price_t$	0.0629	0.103*	0.112*	0.0987*	0.212	0.111*
	(0.158)	(0.0583)	(0.0587)	(0.0577)	(0.143)	(0.0569)
Observations	4,224	4,445	4,461	4,461	4,458	4,460
$Extraction \times Price_{t-1}$	0.0443	0.0587	0.0293	0.0640	0.131	0.0713
	(0.198)	(0.0622)	(0.0689)	(0.0717)	(0.0955)	(0.0686)
Observations	3,893	4,103	4,119	4,119	4,117	4,118

Notes: This table shows estimation results from regressions of local public real expenditures and revenues (in logs, base 2000) on resource extraction, copper prices, and their interaction. Estimation results are marginal effects from fixed-effects panel data regressions at the labor market level. Outcome variables are log transformed and per capita. All regressions include year fixed-effects. Data on local public finances from 2006 to 2018 come from the National Municipal Information System (SINIM). Clustered standard errors by labor markets are in parentheses. Significance levels: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A17: The Impact of a Copper Price Increase on Local Public Revenues and Expenditures (Municipalities)

	Revenues for Education			Expenditures to Education		
	From Local Budgets	From MINEDUC	Total Revenues	Staff Per Capita	Overhead Per Capita	Total Expenditures
Panel A. Extraction as the Percentage of Local Area Leased						
$Extraction \times Price_t$	0.0023	-0.0068	-0.0038	-0.0002	-0.0204**	-0.0037
	(0.0179)	(0.0055)	(0.0044)	(0.0048)	(0.0097)	(0.0044)
Observations	4,224	4,445	4,461	4,461	4,458	4,460
$Extraction \times Price_{t-1}$	-0.0115	-0.0036	-0.0045	0.0009	-0.0113	-0.0023
	(0.0161)	(0.0047)	(0.0042)	(0.0044)	(0.0104)	(0.0044)
Observations	3,893	4,103	4,119	4,119	4,117	4,118
Panel B. Extraction as the Number of Mining Leases						
$Extraction \times Price_t$	-0.0061	0.0022	-0.0004	-0.0001	-0.0101	-0.0001
	(0.0256)	(0.0108)	(0.0090)	(0.0088)	(0.0260)	(0.0090)
Observations	4,224	4,445	4,461	4,461	4,458	4,460
$Extraction \times Price_{t-1}$	-0.0223	0.0041	0.0015	0.0053	0.0130	0.0048
	(0.0230)	(0.0095)	(0.0088)	(0.0083)	(0.0234)	(0.0088)
Observations	3,893	4,103	4,119	4,119	4,117	4,118

Notes: This table shows estimation results from regressions of local public real expenditures and revenues (in logs, base 2000) on resource extraction, copper prices, and their interaction. Estimation results are marginal effects from fixed-effects panel data regressions at the municipality level. Outcome variables are log transformed and per capita. All regressions include year fixed-effects. Data on local public finances from 2006 to 2018 come from the National Municipal Information System (SINIM). Clustered standard errors by municipality are in parentheses. Significance levels: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A18: The Impact of a Copper Price Increase on the Number of Teachers and Teacher's Class Hours (Labor Markets)

	Student-to-	# of Teachers		# of Teacher Class Hours	
	Teacher Ratio	in Classrooms	in High-Level Positions	in Classrooms	in High-Level Positions
Panel A. Extraction as the Percentage of Local Area Leased					
$Extraction \times Price_t$	-0.0032	0.0288***	0.0155	0.0470***	0.0245*
	(0.0141)	(0.0107)	(0.0113)	(0.0132)	(0.0136)
Observations	4,463	39,432	32,735	39,432	32,735
$Extraction \times Price_{t-1}$	0.0109	-0.0174**	0.0091	-0.0001	0.0192*
	(0.0173)	(0.0074)	(0.0100)	(0.0089)	(0.0108)
Observations	4,119	39,432	32,735	39,432	32,735
Panel B. Extraction as the Number of Mining Leases					
$Extraction \times Price_t$	0.0214	0.0637***	0.0288*	0.0936***	0.0669***
	(0.0290)	(0.0192)	(0.0162)	(0.0236)	(0.0207)
Observations	4,463	39,432	32,735	39,432	32,735
$Extraction \times Price_{t-1}$	0.0454	-0.0327**	0.0098	-0.0024	0.0323*
	(0.0345)	(0.0137)	(0.0142)	(0.0169)	(0.0170)
Observations	4,119	39,432	32,735	39,432	32,735

Notes: This table shows estimation results from regressions of the number of teachers and teaching time on resource extraction, copper prices, and their interaction. Estimation results on the student-to-teacher ratio (logged) are marginal effects from fixed-effects panel data regressions at the labor market level; on the number of teachers (logged) and teaching time (logged) are marginal effects from fixed-effects panel data regressions at the school level. All regressions include year fixed-effects. Data on the student-teacher ratio from 2006 to 2018 comes from the National Municipal Information System (SINIM). Data on the number of teachers and teaching time from 2006 to 2018 come from the Ministry of Education (MINEDUC). Clustered standard errors by labor market (in the first case) and by schools (in the second case) are in parentheses. Significance levels: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A19: The Impact of a Copper Price Increase on the Number of Teachers and Teacher's Class Hours (Municipalities)

	Student-to-	# of Teachers		# of Teacher Class Hours	
	Teacher Ratio	in Classrooms	in High-Level Positions	in Classrooms	in High-Level Positions
Panel A. Extraction as the Percentage of Local Area Leased					
$Extraction \times Price_t$	-0.0005	0.0010	0.0016	0.0023	0.0030*
	(0.0035)	(0.0014)	(0.0012)	(0.0016)	(0.0016)
Observations	4,463	39,433	32,736	39,433	32,736
$Extraction \times Price_{t-1}$	-0.0021	-0.0014	-0.0007	0.0004	-0.0001
	(0.0031)	(0.0010)	(0.0009)	(0.0012)	(0.0013)
Observations	4,119	39,433	32,736	39,432	32,735
Panel B. Extraction as the Number of Mining Leases					
$Extraction \times Price_t$	0.0079	0.0037*	0.0030	0.0076***	0.0054**
	(0.0060)	(0.0022)	(0.0022)	(0.0026)	(0.0027)
Observations	4,463	39,433	32,736	39,433	32,736
$Extraction \times Price_t$	0.0018	-0.0008	0.0003	0.0027	0.0014
	(0.0079)	(0.0016)	(0.0017)	(0.0019)	(0.0021)
Observations	4,119	39,433	32,736	39,433	32,736

Notes: This table shows estimation results from regressions of the number of teachers and teaching time on resource extraction, copper prices, and their interaction. Estimation results on the student-to-teacher ratio (logged) are marginal effects from fixed-effects panel data regressions at the municipality level. Estimation results on the number of teachers (logged) and teaching time (logged) are marginal effects from fixed-effects panel data regressions at the school level. All regressions include year fixed-effects. Data on the student-teacher ratio from 2006 to 2018 come from the National Municipal Information System (SINIM). Data on the number of teachers and teaching time from 2006 to 2018 come from the Ministry of Education (MINEDUC). Clustered standard errors by municipality (in the first case) and by schools (in the second case) are in parentheses. Significance levels: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A20: The Impact of a Copper Price Increase on High School Students' PSU (College Admission) scores (Labor Markets)

	Number of High School Students Taking the PSU (per 1,000 People)			% of High School Students with ≥450 Score in the PSU		
	Public High School	Voucher High School	Private High School	Public High School	Voucher High School	Private High School
Panel A. Extraction as the Percentage of Local Area Leased						
$Extraction \times Price_t$	0.730***	0.205	-0.0589	-0.0276	-0.0199	0.931
	(0.228)	(0.133)	(0.0501)	(0.0661)	(0.195)	(0.706)
Observations	4,485	4,485	4,485	4,485	4,485	4,485
$Extraction \times Price_{t-1}$	0.439**	0.212*	-0.0089	0.0133	0.0311	0.0409
	(0.220)	(0.120)	(0.0305)	(0.0234)	(0.0772)	(0.0595)
Observations	4,140	4,140	4,140	4,140	4,140	4,140
Panel B. Extraction as the Number of Mining Leases						
$Extraction \times Price_t$	1.593***	0.309	-0.163	-0.0141	-0.0317	0.0814
	(0.443)	(0.291)	(0.112)	(0.0731)	(0.123)	(0.0763)
Observations	4,485	4,485	4,485	4,485	4,485	4,485
$Extraction \times Price_t$	1.024**	0.414	-0.0606	0.0192	0.0443	0.0204
	(0.405)	(0.255)	(0.0673)	(0.0545)	(0.120)	(0.0913)
Observations	4,140	4,140	4,140	4,140	4,140	4,140

Notes: This table shows estimation results from regressions of the number of high school students taking the PSU (college admission) test and the percentage obtaining a score *geq* 450 points on resource extraction, copper prices, and their interaction. Estimation results are marginal effects from fixed-effects panel data regressions on the number of students taking the test (columns (2)-(4)), and from fractional logit regressions on the percentage of students with a high score (colummns (5)-(7)), all at the labor market level. All regressions include year fixed-effects. Data on PSU scores come from the National Municipal Information System (SINIM) from 2006 to 2018. Clustered standard errors by labor market in parentheses. Significance levels: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A21: The Impact of a Copper Price Increase on High School Students' PSU (College Admission) Scores (Municipalities)

	Number of High School Students Taking the PSU (per 1,000 People)			% of High School Students with ≥450 Score in the PSU		
	Public High School	Voucher High School	Private High School	Public High School	Voucher High School	Private High School
Panel A. Extraction as the Percentage of Local Area Leased						
$Extraction \times Price_t$	0.0538*	-0.0427	-0.0510*	-0.0027	0.0136	0.0318
	(0.0305)	(0.0284)	(0.0265)	(0.0138)	(0.0107)	(0.0411)
Observations	4,485	4,485	4,485	4,485	4,485	4,485
$Extraction \times Price_{t-1}$	0.0282	-0.0387	-0.0272***	-0.0090	0.0063	0.0037
	(0.0243)	(0.0241)	(0.0090)	(0.0084)	(0.0045)	(0.0032)
Observations	4,140	4,140	4,140	4,140	4,140	4,140
Panel B. Extraction as the Number of Mining Leases						
$Extraction \times Price_t$	0.0879**	-0.109	-0.0948*	0.0058	0.0102*	0.0010
	(0.0443)	(0.0697)	(0.0548)	(0.0123)	(0.0060)	(0.0068)
Observations	4,485	4,485	4,485	4,485	4,485	4,485
$Extraction \times Price_{t-1}$	0.0592*	-0.0628	-0.0479***	-0.0094	0.0098*	0.0060
	(0.0349)	(0.0524)	(0.0176)	(0.0124)	(0.0056)	(0.0076)
Observations	4,140	4,140	4,140	4,140	4,140	4,140

Notes: This table shows estimation results from regressions of the number of high school students taking the PSU (college admission) test and the percentage obtaining a score ≥ 450 points on resource extraction, copper prices, and their interaction. Estimation results are marginal effects from fixed-effects panel data regressions on the number of students taking the test (columns (2)-(4)), and from fractional logit regressions on the percentage of students with a high score (columns (5)-(7)), all at the municipality level. All regressions include year fixed-effects. Data on PSU scores come from the National Municipal Information System (SINIM) from 2006 to 2018. Clustered standard errors by municipalities in parentheses. Significance levels: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A22: The Impact of a Copper Price Increase on Teachers' Quality (Labor Markets)

	Primary School				High School			
	Math Teachers		Spanish Teachers		Math Teachers		Spanish Teachers	
	Evaluation	Overall Score	Evaluation	Overall Score	Evaluation	Overall Score	Evaluation	Overall Score
Panel A. Extraction as the Percentage of Local Area Leased								
$Extraction \times Price_t$	-0.0141*	0.0077	-0.0083	-0.0047	0.0152*	0.0311***	0.0074	0.0091
	(0.0083)	(0.0107)	(0.0062)	(0.0085)	(0.0091)	(0.0109)	(0.0069)	(0.0083)
Observations	10,093	10,093	10,146	10,146	8,245	8,245	8,361	8,361
$Extraction \times Price_{t-1}$	-0.0226***	-0.0160	-0.0106*	-0.0091	0.0148**	0.0240**	0.0009	0.0072
	(0.0076)	(0.0099)	(0.0063)	(0.0077)	(0.0072)	(0.0098)	(0.0059)	(0.0081)
Observations	10,093	10,093	10,146	10,146	8,245	8,245	8,361	8,361
Panel B. Extraction as the Number of Mining Leases								
$Extraction \times Price_t$	-0.0245	0.0161	0.0005	0.0051	0.0330*	0.0552**	0.0263**	0.0275*
	(0.0165)	(0.0199)	(0.0120)	(0.0160)	(0.0190)	(0.0217)	(0.0131)	(0.0164)
Observations	10,093	10,093	10,146	10,146	8,245	8,245	8,361	8,361
$Extraction \times Price_{t-1}$	-0.0300**	-0.0137	-0.0129	-0.0111	0.0211	0.0413**	0.0033	0.0071
	(0.0139)	(0.0178)	(0.0121)	(0.0159)	(0.0149)	(0.0186)	(0.0121)	(0.0167)
Observations	10,093	10,093	10,146	10,146	8,245	8,245	8,361	8,361

Notes: This table shows estimation results from regressions of the quality of teachers on resource extraction, copper prices, and their interaction. Estimation results are marginal effects from fixed-effects panel data regressions at the school level measuring resource extraction at the labor market level. All regressions include year fixed-effects and controls for type of high school. Data on quality come from the Teacher Assessment Survey gathered from the Ministry of Education (MINEDUC) from 2010 to 2018. Clustered standard errors by high school in parentheses. Significance levels: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A23: The Impact of a Copper Price Increase on Teachers' Quality (Municipalities)

	Primary School				High School			
	Math Teachers		Spanish Teachers		Math Teachers		Spanish Teachers	
	Evaluation	Overall Score	Evaluation	Overall Score	Evaluation	Overall Score	Evaluation	Overall Score
Panel A. Extraction as the Percentage of Local Area Leased								
$Extraction \times Price_t$	-0.0016	0.0003	-0.0020*	-0.0006	0.0004	0.0025*	0.0011	0.0030
	(0.0013)	(0.0016)	(0.0012)	(0.0014)	(0.0011)	(0.0015)	(0.0017)	(0.0019)
Observations	10,093	10,093	10,146	10,146	8,245	8,245	8,361	8,361
$Extraction \times Price_{t-1}$	-0.0025**	-0.0015	-0.0016	-0.0008	-0.0004	0.0015	0.0010	0.0018
	(0.0011)	(0.0014)	(0.0010)	(0.0013)	(0.0010)	(0.0014)	(0.0014)	(0.0018)
Observations	10,093	10,093	10,146	10,146	8,245	8,245	8,361	8,361
Panel B. Extraction as the Number of Mining Leases								
$Extraction \times Price_t$	-0.0020	0.0006	-0.0009	0.0013	0.0014	0.0020	0.0049**	0.0081***
	(0.0023)	(0.0027)	(0.0021)	(0.0024)	(0.0021)	(0.0028)	(0.0024)	(0.0028)
Observations	10,093	10,093	10,146	10,146	8,245	8,245	8,361	8,361
$Extraction \times Price_{t-1}$	-0.0029*	-0.0021	-0.0005	0.0013	0.0007	0.0003	0.0058***	0.0081***
	(0.0018)	(0.0023)	(0.0018)	(0.0023)	(0.0018)	(0.0025)	(0.0021)	(0.0027)
Observations	10,093	10,093	10,146	10,146	8,245	8,245	8,361	8,361

Notes: This table shows estimation results from regressions of the quality of teachers on resource extraction, copper prices, and their interaction. Estimation results are marginal effects from fixed-effects panel data regressions at the school level measuring resource extraction at the municipality level. All regressions include year fixed-effects and controls for type of high school. Data on quality come from the Teacher Assessment Survey gathered from the Ministry of Education (MINEDUC) from 2010 to 2018. Clustered standard errors by high school in parentheses. Significance levels: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.