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Report on the Well Being and Socio-Economic Impacts of mining activities

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REPORT ON THE WELL BEING AND SOCIO-ECONOMIC IMPACTS OF MINING ACTIVITIES

1 Well-being as a measure of wellness of life: Introduction

A measure of economic affluence, such as the Gross Domestic Product (GDP) per capita, has been considered, for a long time, the main instrument to measure a country's economy. It assumed great relevance in the literature even as an indicator of well-being. A number of authors (Khan 1991; Stewart 2005; Stiglitz et al. 2009 among others), however, have raised criticism about the use of GDP per capita, since it only looks at the economic dimension of well-being. The awareness of the limitations of economic measures for assessing a country's living conditions and overall well-being has spread in recent years.

It is now widely recognized that, to go beyond the usual income-related aspect of well-being, it is fundamental to consider well-being as a multidimensional phenomenon concerning several dimensions of people's lives. Increasingly, scholars are calling for a shift toward measuring societal well-being using indicators that assess not only people's physical conditions, including their health, but also how people themselves evaluate their own well-being (Diener et al., 2010, among others).

In the recent literature, a number of measures aimed to take into account multiple aspects concerning the well-being of a society are proposed (Ciommi et al., 2013 among others) and might be grouped into two different approaches: the dashboard of indicators approach and that of a composite index that aggregates all well-being indicators into a single number. This work considers both approaches since each of them present pros and cons.

On the one hand, a dashboard of indicators provides a detailed picture of the well-being; however, because of the high number of indicators considered, it does not allow for a simple comparison across territories of a country and over time. On the other hand, although well-being is a multidimensional concept and, probably, it should be not reduced to a single measure, a composite index is advantageous for measuring the performance of a country (or regions in a country) over time and for sustain policymaking. Nevertheless, by synthesizing all the information into a single number, relevant aspects might be hidden (Bleys, 2012).

Among the several proposals of composite indices, the Human Development Index (HDI) is the most popular. Suggested by the United Nations in 1993, the HDI assesses the quality of life in member countries through a geometric mean of three components: life expectancy, knowledge and standard of living. In 2011, inspired by Stiglitz et al. (2009) recommendations, the Organization for Economic Co-operation and Development (OECD) launched the OECD's Better Life Index (BLI, hereafter) initiative. More recently, the OECD has proposed a computation of the BLI at a regional

level (OECD, 2014) in order to monitoring the performance of 362 Regions across 34 OECD countries (Ciommi et al., 2017).
The importance of measuring well-being at the local level has encouraged several countries to propose their own-specific well-being measures. In fact, well-being can be studied at different spatial scales of analysis. Many of the attributes and features that influence subjective and objective well-being are, in fact, likely to be locality-specific and hence spatially variable. Many rural areas, for example, are likely to have a cleaner and greener environment, less crime and less road congestion than most cities but are also likely to have inferior access to a number of public services and cultural facilities. Within the same country, people have different access to collective provisions (health care, education, wealth, political climate, etc.) depending on the region where they live. People living in the same region share a common cultural, political and socio-economic environment, which contributes, alongside individual characteristics, to life satisfaction. Therefore, the well-being of individuals living in the same country might differ by region (Aslam and Corrado, 2011).
The aim of this work is to shade some light on the geography of well-being in Chilean Regions
This will allow drawing both possible general policy implications and specific policy implications for particular fields of relevance/regions.

2 Literature review and theoretical backgrounds

The present work is related to a burgeoning research. A first bunch of papers deals with the efficiency measures for the assessment of Decision-Making Units (DMUs) performance.
In this respect, while the concept of efficiency is subject to different interpretations (Aigner et al., 1977; Coelli et al., 2005; Farrell, 1957), there is consensus in considering efficiency to be the degree of proximity of an actual production process to a standard of optimality. Efficiency can be thought of as the ability of a decision unit to minimize the amount of input for the production of a certain output (input-oriented TE) or to maximize the amount of output given a certain amount of input (output-orientated TE), for any level of technology. Since efficiency is evaluated in relation to the best practice, the key concerns in this field of research come from the methods. A common criterion of classification distinguishes between parametric and non-parametric approaches (Coelli et al., 2005; Kumbhakar and Lovell 2000). Parametric methods assign density functions to the stochastic component of the model, while nonparametric methods only define the deterministic part. Whereas, the SFA is the most used parametric method that assigns a distribution to the error term and allow doing inference, the Data Envelopment Analysis (DEA) is the most used non-parametric methods. The difference between SFA and DEA lies in the fact that the last class of methods does not assign a distribution function to the error term. Another criterion is based on how the distance from the frontier should be understood. In this respect, we have stochastic or deterministic methods. The first group admits that a DMU may be far from the frontier due to randomness and/or inefficiency. In other words, a stochastic method, such as the SFA, allows the decomposition of the error into two

parts, one attributable to inefficiency and the other to random error. On the other hand, when using a deterministic approach, the distance from the frontier is seen as being entirely due to inefficiency. Thus, the determinist approach ignores the existence of pure random disturbance, which may be, for example, due to measurement errors or unforeseen events (Aiello and Bonanno, 2018). For all these considerations and given the nature of DMU of our sample, we employ a generalised SFA, which relaxes the hypothesis of independence between the two error terms of a stochastic frontier, i.e. the erratic and the inefficiency components (Bonanno et al., 2017). Specifically, for example, in a context like the airport industry, current managerial decisions are influenced by past natural shocks, thereby rendering the assumption of independence too stringent. A shock may affect the random error component and, at the same time, may affect future decisions, influencing the inefficiency component. This can lead to the dependence between the two error components rather than independence, as assumed in standard SFA models.

A second bunch of papers focuses on wellbeing measurement. In this bunch, two strands of research have been attracting growing interest in recent economic literature on well-being: studies that look at subjective well-being and others that, trying to go beyond the usual income-related aspect of well-being, focus on aggregate measures of the quality of life (objective well-being – for a literature review and methods see Bonanno, D'Orio and Lombardo 2020).

The former approach relies upon individuals' stated satisfaction or happiness. The measurement of happiness generally draws upon surveys collecting people's responses to questions such as "All things considered, how happy are you with your life?" They consist of numerical scores ranging from the highest to the lowest level of satisfaction. The empirical economic literature groups the determinants of happiness into three different sets of variables: personal aspects, economic and socio-institutional factors (Frey and Stutzer 2002; Blanchflower and Oswald 2011; Rodrigues-Pose and Maslaukaite 2011; Stutzer and Frey 2012). Dolan et al. (2008) provide a detailed review of the empirical literature dealing with the determinants of subjective well-being since 1990 up to 2006.

The second approach, considers well-being as a multidimensional phenomenon concerning several dimensions of people's life events/status/situations A well-known conceptualisation of multidimensional well-being is Sen's capability approach (Sen, 1985), according to which an individuals' capabilities reflect the combinations of "functionings" that she can achieve. Sen defines functionings as "the things that he or she manages to do or be in leading a life" (Sen, 1999, p. 31), and well-being is measured in terms of an individual's capability to achieve these valued functionings.

Starting from the idea that the well-being nature might be captured by the aggregation of elementary macro-level objective indicator, several methods of measurement have been proposed (Fleurbaey, 2009). Among these latter, composite indicators, suitable for synthesizing the multidimensionality of well-being are widely used. Macroeconomic or aggregate measures of economic and non-economic dimensions of quality of life (such as environment, education, health, essential public services, research and innovation, institutional quality, etc.) are, indeed, usually weighted and

aggregated following different statistical methodologies (i.e. the simple arithmetic mean, the geometric mean, the principal component analysis) to form synthetic indices of well-being domains. These latter, in turns, could be combined in order to obtain an overall synthetic indicator of well-being. Various surveys exist on the subject: Annoni and Weziak-Bialowolska (2012); Bleys (2012); Stiglitz et al. (2009) among others. These measures provide useful information, however - since they are usually computed by using different components, weights and aggregation methods that refer to different years and countries - their use in empirical analysis is often limited as they are not comparable across countries or over time. The most used alternative indicator to GDP for measurement of well-being is the Human Development Index (HDI), calculated by the United Nations Development Programme (UNDP) for a large number of countries since 1990. Since 2010, the HDI has been calculated as a geometric mean of three indicators (the logarithm of per capita income, life expectancy at birth, and a synthetic index of education which combines with equal weight two elementary indices: the mean years of schooling and the expected years of schooling). The capability approach is often associated with the HDI (Yang, 2017). Although the HDI is a suitable indicator for cross-country comparisons over a time interval of twenty-five years, its three-dimensional nature does not take into account most of dimensions considered as relevant in assessing quality of life in recent literature. In fact, HDI is often "augmented" to take a wider spectrum of quality-of-life dimensions into account (Marchante et al., 2006).
We focus on the strand of the well-being literature that proposes to go beyond the usual income-related aspect of well-being.

Over the last decade, initiatives - promoted by an expert group or deriving from public debates - to develop frameworks for well-being at the community, national and international level, have multiplied. New impulse to the research aimed at improving data and indicators which integrate the GDP has been added by the European Commission ''GDP and beyond'' (European Commission 2009), the results of the so-called Stiglitz–Sen–Fitoussi report (2009) and the BLI, launched by the OECD in 2011.
Following these recommendations, most of the proposed well-being frameworks measure that concept along different dimensions of life and synthetize the different dimensions in an overall composite index by using different conceptual approaches as well as different sets of statistical measures. In the literature on composite indices, rapidly grown, one may distinguish three approaches to the development of indices of well-being, namely, the Top-Down, the Bottom-Up and the Bi-Directional. The Top-Down (or theoretical) approach consist in constructing a conceptual framework describing the researcher's understanding of well-being, including its constituents and determinants. The Bottom-Up (or empirical) approach explores the great variety of available data that might be relevant to most people's understanding of well-being. The Bi-Directional (or pragmatic) approach aims at constructing and exploring somewhat simultaneously (Michalos et al. 2010).
Bandura (2008) has provided a review of 178 composite indices for ranking or assessing country performance according to some economic, political, social or environmental

measure. However, there is no part of composite index construction that cannot be questioned. In fact, the idea of summarizing complex phenomena into single numbers is not straightforward.

The most used are additive methods, but they imply requirements and properties that are often not desirable or difficult to meet. For example, they assume a full substitutability among the different dimensions: a deficit in one dimension can be compensated by a surplus in another (e.g., in a quality of life index, economic growth may offset any environmental damage), but a complete compensability among the main components of the phenomenon is often not desirable. Therefore, it is necessary to combine in a consistent way both the selection of indicators representing the phenomenon and the choice of the aggregation function in order not to miss some statistical information (Mazziotta e Pareto, 2016).

A number of empirical papers are based on composite indicators calculated as weighted averages of variables and sub-indices (Marchante et al. 2006, Berloffa and Modena 2012; OECD 2011, 2013, among others). Other works are based on mixed statistical strategies with the principal component analysis to assess the internal coherence of the various domains and the weighted average of the partial indices to calculate the respective composite indicators (Annoni and Weziak-Bialowolska 2012).

Mazziotta and Pareto (2013) propose a non-additive method, the Method of Penalties by Coefficient of Variation. This method uses the assumption that the individual components are non-substitutable, i.e. it does not allow full compensation among them. This procedure rules out the unit of measurement and the variability effect, using a non-linear function to normalise the values around the mean, penalising more heavily the observations that are relatively far from the mean. The resulting Mazziotta-Pareto index (MPI) has the advantage of being easy to compute, to interpret and comparable over time. Differently from other aggregation methods (e.g. the Principal Component Analysis and the Data Envelopment Analysis), this index provides information on the intensity the phenomenon and not only on the ranking of the units (OECD, 2008).

The Adjusted Mazziotta-Pareto Index (AMPI), is a variant of the MPI, based on a re-scaling of the individual indicators by a Min–Max transformation, in contrast with the classic MPI where all the indicators are normalized by a linear combination of z-scores (Mazziotta and Pareto, 2016). The AMPI is the method trough which ISTAT synthetize the 129 variables of the 12 BES dimensions.

The regional well-being index (RWBI), a recently proposed composed index (Ferrara and Nisticò, 2015), synthetizes ten dimensions of people's quality of life by using a principal component analysis (hereafter PCA), in a two-steps approach. Starting from a fifty-seven elementary indices, mainly extracted from the ISTAT database on BES, as a measure of objective multidimensional well-being, it uses no subjective data. The authors calculate single-domain sub-indices in the first step and the overall well-being indicator in the second step. This is done by using the sub-indices, previously calculated with the same methodology, as the new variables.

The overall RWBI is used by Ferrara and Nisticò (2015) to compare the dynamics of regional well-being in Italy with those of the traditional indicator of economic

performance, the per capita GDP. The study is conducted for every year over the period 2004–2010. According to the authors' findings, differences in well-being between Italian regions are not necessarily in line with those based on per capita GDP. Furthermore, the paper looked at dispersion across regions and regional rank mobility over the same period and found that Italian regions have tended to become more similar in terms of well-being over time.

Ivaldi et al. (2016) propose an approach to measuring well-being in the European Union 27-Countries by creating a composite well-being index, the European Well-being Index (EWI), using the factorial analysis (FA) and adopting the social indicator approach. Such an aggregate indicator sets in the wake of socioeconomic well-being measures in the European Union, enlarging the number of variables included: indeed, the EWI is designed to describe the European reality and to try to understand which policies in different countries might ensure best results. The authors have chosen FA because it is a useful tool to select a set of explanatory variables to illustrate as much as possible of the phenomenon concerned. Furthermore, the index is compared with two indexes built on the same theoretical basis, but that differing in the used methodology: the additive index and the Pareto Mazziotta Index (MPI).

Ivaldi et al (2016) rank all countries according to their EWI score. The obtained results provide apparently conflicting outcomes: on the one hand, GDP per-capita can be considered a reasonable approximation of well-being; but, on the other hand, it is not sufficient to give an exhaustive description of the said well-being, making it useful to expand the amount of essential information to complete the evaluation. The high value of the coefficient of Spearman might leads to think that GDP per-capita may give a roughly similar result to EWI, but it does not convey several essential elements, such as social relations, the protection of environment or the political and institutional context that can create more or less useful basis for the improvement of well-being.

Several objections have been raised against the composite index approach. One objection is that composite indices reflect only average population performance, without revealing anything about inequalities among individuals. Indeed a number of composite indices of well-being that have been proposed simply add up population-level average indicators (Yang, 2014), which fails to differentiate between groups of individuals with cumulative disadvantages concentrated in multiple dimensions of well-being, such as poor health, low income, lack of education etc., and groups for whom disadvantages are spread over individuals more sporadically.

Yang (2017) aims to bridge the gap in theory between the theoretically weak 'representative agent' approach of multidimensional indices and the individualistic, preference-centred equivalence approach of social choice theory. The Yang (2017) preference index approach assesses well-being in a way that reflects interpersonal differences in preferences whilst retaining comparability among individuals. The framework is empirically exemplified with subjective well-being data from the British Household Panel Survey, using longitudinal life satisfaction regression to estimate different preference types between well-being dimensions. Individuals preferences are estimated by age group and education level. A surprising weaker preference for the health dimension is found within older groups. Across all groups, health is a priority

over income. When preference heterogeneities are considered, the picture of well-being looks quite different with respect to that painted by income, subjective well-being or standard multidimensional measures. The preference index proposal challenges the assumption of an easily available cardinal well-being measure specified identically across individuals, and the practice of using population averages in composite indices to seek an assessment.

3 A note on some important variables to be considered on well-being generation

The aim of this short note on variables used is to highlight some potential effects that some variables, alone or in some combination between them, can have on well-being. In this section, we focus our attention on some potential effects that some variables may have on well-being. We will not discuss in details the role of some common variables used in this kind of studies, such like “income”, “employment” or “innovation” on well-being since the literature on topic is very extensive and it is widely recognized that, for instance, “income” or “work” matters for well-being.
The idea of this short note is to highlight some possible effects of some categories of variables that in a “well-being” approach are, in our view, very important and that have not been extensively used in previous work on topic.

Economic Well-being and minimum conditions in education, health and participation in the labour market.

While the impacts of income inequality differ across various dimensions of well-being, reducing economic inequality will generally help to improve the well-being of a society. For us inequality is not just “economic”.
Here we want to focus on some effects on the need to associate the concept of social exclusion with a specific set of indicators. This will be useful to assess and monitor the problem of exclusion, which has been strongly addressed in the definition of the so-called "Laeken indicators", established by the European Council in December 2001.
These indicators are helpful to measure the progress made by European Regions on some agreed objectives in areas deemed crucial, such as the fight against poverty and social exclusion, health, education and participation in the labour market.
Social exclusion, which has replaced the old concept of economic poverty, is characterized as a fracture of the bond of solidarity and social participation between the society as a whole and the weaker groups in it.
This fracture, in some cases, it is recomposed through programs of “relations”, “sharing” and “acceptance”. In this sense, the rooting of a fully-fledged private social into civil society is the keystone of the new strategies to combat social exclusion and therefore the crucial and indispensable element of future well-being strategies.

Inequality can also be strongly related to education, health and labour market. When we talk about inequality we often focus on purely economic issues, ignoring issues of the "social" type that, instead, deserve the same consideration.
Inequality concerns the distances that separate each individual from everyone else in society. These distances are not necessarily simple gap in aggregates of an economic nature.
There are forms of non-economic inequality that may have significant implications in terms of well-being. A disabled person can be excluded a priori from education or access to work; the family and/or ethnic origin can decisively mark the destinies of people by binding their possibilities and freedom; sex membership often leads to differentiated and unequal life paths regardless of individual characteristics. These phenomena have not only unfair consequences for those directly involved, they also have for society as a whole, because they do not allow everyone to fully deploy their skills, thus impoverishing the human quality and the capacity for holding and innovation of the company in the its complex. Inequality, therefore, not only in income but also in politics.
It is therefore essential to consider, in a well-being indicator, information concerning equal opportunities as well as policies for the family and child poverty, unemployment benefits and poverty among mature workers, old-age pensions and poverty among the elderly. Full understanding of the real level of well-being requires a proper investigation of the institutional system in the level and distribution of social rights. Considering the factors that give rise to social stratification therefore deserves proper attention.

Social relationship and subjective well-being
Here we want to focus on some potential effects of “relational goods”.
The theory of modern relational goods raises questions that are simple but of fundamental importance for the definition of specific targets in the realization of a well-being indicator. The production of relational goods, the multiplication of socialization and support opportunities that may reduce the discomfort of minors, young people, the elderly and families are, in all respects, essential areas of well-being. They are a redefinition of the same model of social status, which can no longer be considered as a simple system of supply and a system of tampering with the most serious social risks.
With these categories, we can consider different aspects of well-being:

- well-being as a quality of the overall life of our society;
- well-being as social capital undeniably reconnected to human resources;
- well-being as the focal point of arrival of development models.

These three paths are present in everyday reality but scarcely (or not adequately) represented in the various models of individual and collective well-being measurement.
For these reasons, social relationship, as relational goods, are very important to be considered.

Relational goods are immaterial entities that consist of social relationships that emerge from agents/actors who are reflexively oriented towards producing and enjoying together a good that they could not otherwise obtain. In this perspective, the relationship assumes its own "materiality", when it becomes itself a good.
Non-instrumental relations as a source of well-being have not been frequently used in building synthetic welfare indicators. The main reason of this is that they were often considered not directly connected to typical economic phenomena, which would be characterized by instrumental logic, therefore an antithetical logic to that of "genuine" relations. The non-instrumental (social) relationship, to be such, must be reciprocal and bi-univocal, otherwise we would simply be in the presence of a differentiated product for which the consumer is willing to pay more.
Some significant examples are family, friendship, civil relationships, such as participation in the life of the community through association bodies, some relationships that are properly observable in family businesses, between companies belonging to relational "clusters", etc.
Even in these cases, it is possible to separate the instrumental relationship, which responds to the principle of the exchange of equivalents, from non-instrumental relations that conform to the principle of reciprocity.
The actions / performances useful to satisfy the relational needs are exclusively subjective. They depend on "intrinsic motivation". In considering these relational goods (and their relative opportunity cost) in a well-being indicator it is important to do not contrast consumer goods and relational goods, work time and relationship time, productive activities and participation activities. All these things can influence well-being. Subjective Well-being used in our analysis helps to do this together with Social Relations.
A simple example can be built as it follows: subjective well-being and social non-instrumental relations could signal that the time spent in personal relationships (affective, family, social), regardless of intrinsic motivations strongly influences our happiness. Once discovered that "money does not make happiness", this could flow directly from personal relationships. However, what sometimes (or by some) is seen as a cold and impersonal office, could be for others a community of “colleagues/friends”. These means that for some people office may be a family, for others it can instead represent a place of solitude, separation and conflict. Social participation, depending on the nature of relationship, can become careerism, friendship, exploitation of others for their own interests and so on.
When considering all these aspects, an important question concerns the principle of rationality. Is it necessary to reformulate the neoclassical principle of rationality to include relational goods in the economic analysis? The answer to this question is no.
Antoci, Sacco and Vanin (2002), using a neoclassical approach, show that it is possible to describe the rational behaviour of subjects who, having scarce resources, aim to satisfy material and relational needs. This makes possible to maintain a logical "consistency" between the various components of the composite indicator, since all the components of it can respond to a unique underlying logic: improving the quality of life. Therefore, using relational goods and subjective well-being into economic

analyses produces important effects in crucial areas: from the measurement of national wealth, to that of happiness and therefore in the overall well-being.

Environment, landscape and crime

Concepts of well-being and its connection with landscape and environmental features provide a wealth of information for popular phrases including “exercising outside is better than gym,” “a nice view from your hospital bed will aid recovery” and “living in a greener environment affects happiness.”

Providing precise evidence for these statements and analysing what the real relationships are, is an ongoing challenge but it is quite evident that environmental and landscape factors may influence people’s quality of life. Landscape, natural beauty & scenery are connected to psychological well-being A bulk of literature exists about people’s mental health and state of relaxation when looking at natural landscape images or when being outside in areas of parkland, gardens or the ‘wilderness.’ At the same time, a person or group of people could feel a deep loss and grief when the environment in their community is dramatically changed through such actions like strip mining, uncontrolled quality and quantity of building or a natural disaster. A few studies have revealed that greener environments lead to higher property values in areas of high urban density. These areas create more confidence in being desirable places to be and people feel happier if they live within these rather than a more down trodden part of town. The physical health of a person has been reported to increase with greater contact with nature. Notions of ‘outdoor gyms’ have inspired people to take up running, cycling and pursuits like yoga by doing them in forests and public parks. Both the young and the elderly appear to be particularly amenable to the benefits of development and recovery using elements from the outdoors.

People are expected to be more satisfied with their life and happier if they feel safe and secure in well-kept, tidy and pleasant business or residential area. Understanding if crime is associated with well-being is also important.

Criminal victimization and well-being have both been linked to health outcomes. Experiencing violence or theft victimization is normally associated with significantly lower happiness and life satisfaction.

Besides the direct effects of physical injury and/or psychological trauma, it is possible that victimization will affect well-being in a number of ways. Experiencing crime can destroy an individual’s basic assumptions about themselves and the world, resulting in both high levels of stress and anxiety and so lower levels of happiness and life satisfaction. Experience of crime and victimization, directly or just knowing about that, can bring to changes in behaviour and lifestyle such as staying at home at night, changing residence, changing workplace, not going out to run etc. All these situations may influence negatively on a victim’s overall quality of life and result in diminished well-being.

4 An analysis of Well-being in Chile.

In this section we have, in the first part (Paragraph General Well Being), an overall look at well-being in Chile extracting some information by OECD reports (march 2020) on quality of life, an analysis on Inequality in Chile with some reference to mining sector (Paragraph 4.2) and, on the second part (Paragraph 4.3 and Paragraph 4.4) , a comparative analysis between region (or groups) with predominant mining activities and other regions.

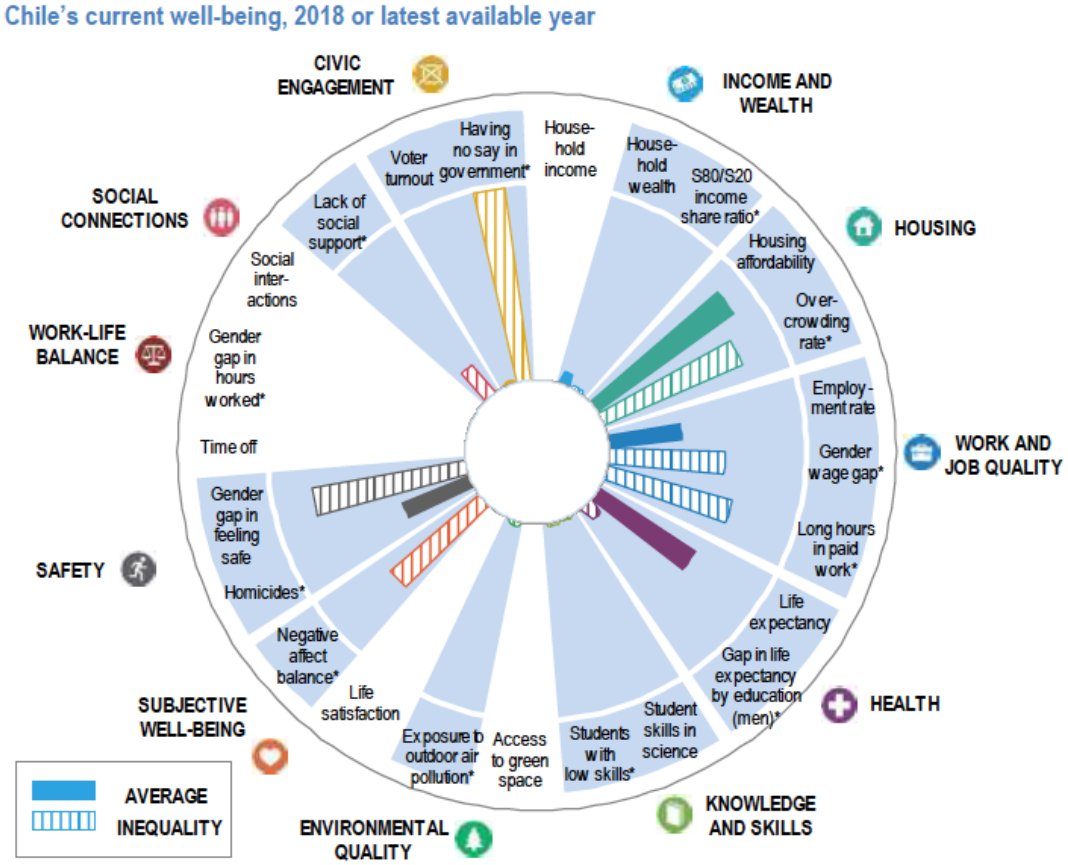
4.1 General Well Being issues

In this section we analyse some stylized facts regarding well-being in Chile. In the first part of the section (Paragraph 4.1) we comment some figures extracted from "How is life" (march 2020 OECD) in which there are evidences from an updated set of over 80 indicators, covering current well-being outcomes, inequalities, and resources for future well-being. Beyond an overall analysis of well-being trends since 2010, this report explores in detail the 15 dimensions of the OECD Better Life Initiative, including health, subjective well-being, social connections, natural capital, and more, and looks at each country's performance in dedicated country profiles.
In the second part (Paragraph 4.2) we comment own elaboration on some important facts relative to inequality.

Data depicted in Figure 1 are helpful to understand, in general terms, some important facts of Chile in terms of comparative well-being with other OECD countries. This is important, for the ai in this report, to have a clear starting basis of the country (and regions) analysis in terms of absolute meaning of some results that we will comment in second part of the section and in the territorial well-being analysis.

Income and wealth do not show relevant differences in average with other OECD countries. A first big inequality (compared to other OECD countries averages) in the Chilean well-being is observed in the Overcrowding rate of houses and, in general, in a high cost of house affordability. Relatively to work and job quality we have two big inequalities related to Gender wage gap and Long hours in paid work. The level of work protection in Chile is relatively low compared to the average observed in OECD countries and the level of wage rate differential between women and men shows important difference.

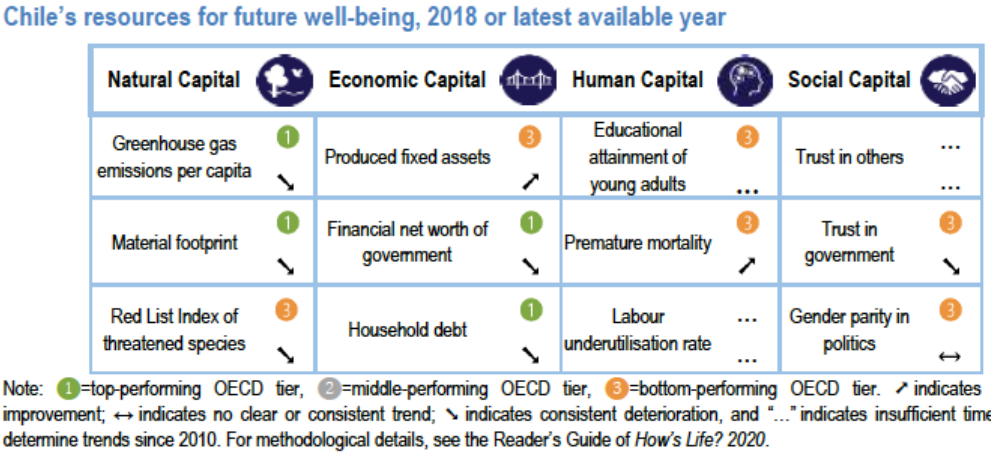
FIGURE 1 CHILE'S CURRENT WELL-BEING



Source: Own elaboration on OECD 2020

In subjective well-being, the most relevant inequality the we can observe in Chile is related to a Negative affect balance that influences in a determinant way the subjective perception of well-being of individuals. Again, a relevant difference in average of Gender gap in feeling safe shows that gender matters a lot in Chile when we analyse the perception of quality of life here in average or in distinct groups value. Other two very relevant inequalities are observed in Civic engagement and are relative to Lack of social support and Having no say in Government actions/politics.

FIGURE 2 CHILE'S RESOURCES FOR FUTURE WELL-BEING



Source: Own elaboration on OECD 2020

Figure 2 shows how Chile performs, compared to other OECD countries, in terms of Natural, Economic, Human and Social Capital. This can be a good proxy to understand where Chile may have important politics to use some positive benchmark that it has and to improve some negative situation that could lead to well-being positive evolution.

Natural and Economic Capital have more positive aspects than negative one. Chile performs quite well for Greenhouse gas emission per capita and for Material footprint if we focus on Natural Capital and in Financial net worth of government and Household debt if we analyse Economic capital. All the 4 indicators show a negative trend (deteriorating) and this is a worrying signal. The bad indicators in these two categories are relative to the red list index of threatened species (natural capital) and to the produced fixed assets (economic capital) that, shows an improving trend.

Human and Social Capital have almost all indicator in the low performing area. Educational attainment of young adults and Premature mortality are two important negative facts relative to human capital while Trust in government and gender parity in politics are the two most negative in Social capital

FIGURE 3 DEPRIVATIONS

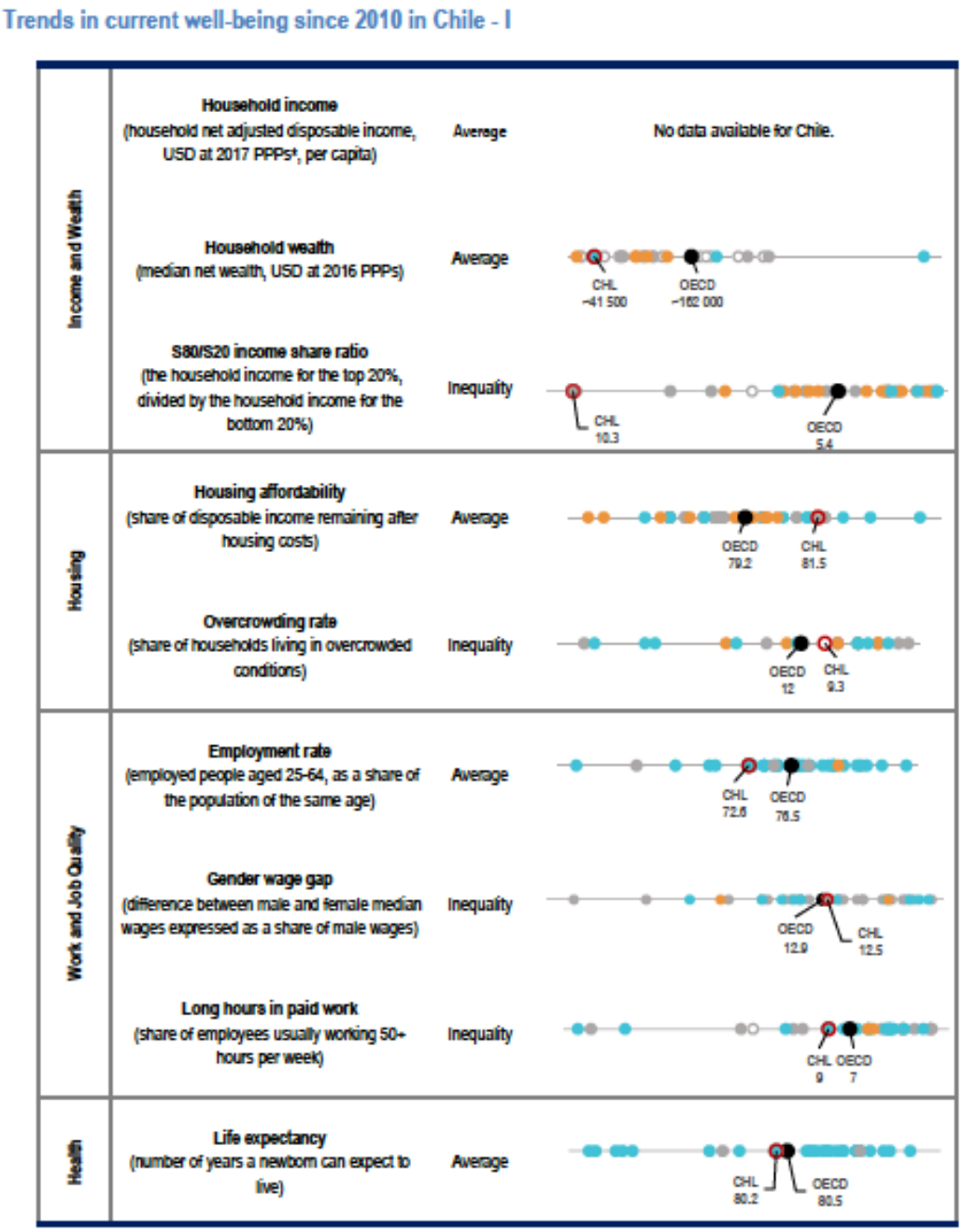
Note: Relative income poverty refers to the share of people with household disposable income below 50% of the national median; financial insecurity refers to the share of individuals who are not income poor, but whose liquid financial assets are insufficient to support them at the level of the national relative income poverty line for at least three months; housing cost overburden refers to the share of households in the bottom 40% of the income distribution spending more than 40% of their disposable income on housing costs; and low satisfaction with life and with time use refer to the share of the population rating their satisfaction as 4 or lower (on a 0-10 scale).

Source: Own elaboration on OECD 2020

Figure 3 shows some deprivations observed by OECD and that can be relevant for future well-being of Chile. The share of population that live in relative income poverty is the 17% of total and 53% of population would be at risk of falling into poverty if they had to forgo three months of their income. If we consider these two facts on the light of "estallido social" of October-December 2019 and of the Covid19 of February-Whoknowstheend 2020 we have that an impressive share of 70% of the population of Chile is at strong risk of relative poverty. An impressive share of 13% of the population say that they have no relatives or friends to turn to in times of need and, finally, 36% of poor household spend more than 40% of their income in housing cost. Strong inequality is the word that appears in this short analysis. This will be studied with more details later differentiating for area and considering mining.

Figure 4 and Figure 5 show the trend of some already commented variables related to Income, Inequality, Labour and wage, Housing, Health, Social and relational aspects of life, relevance in Politics and Gender Gap.

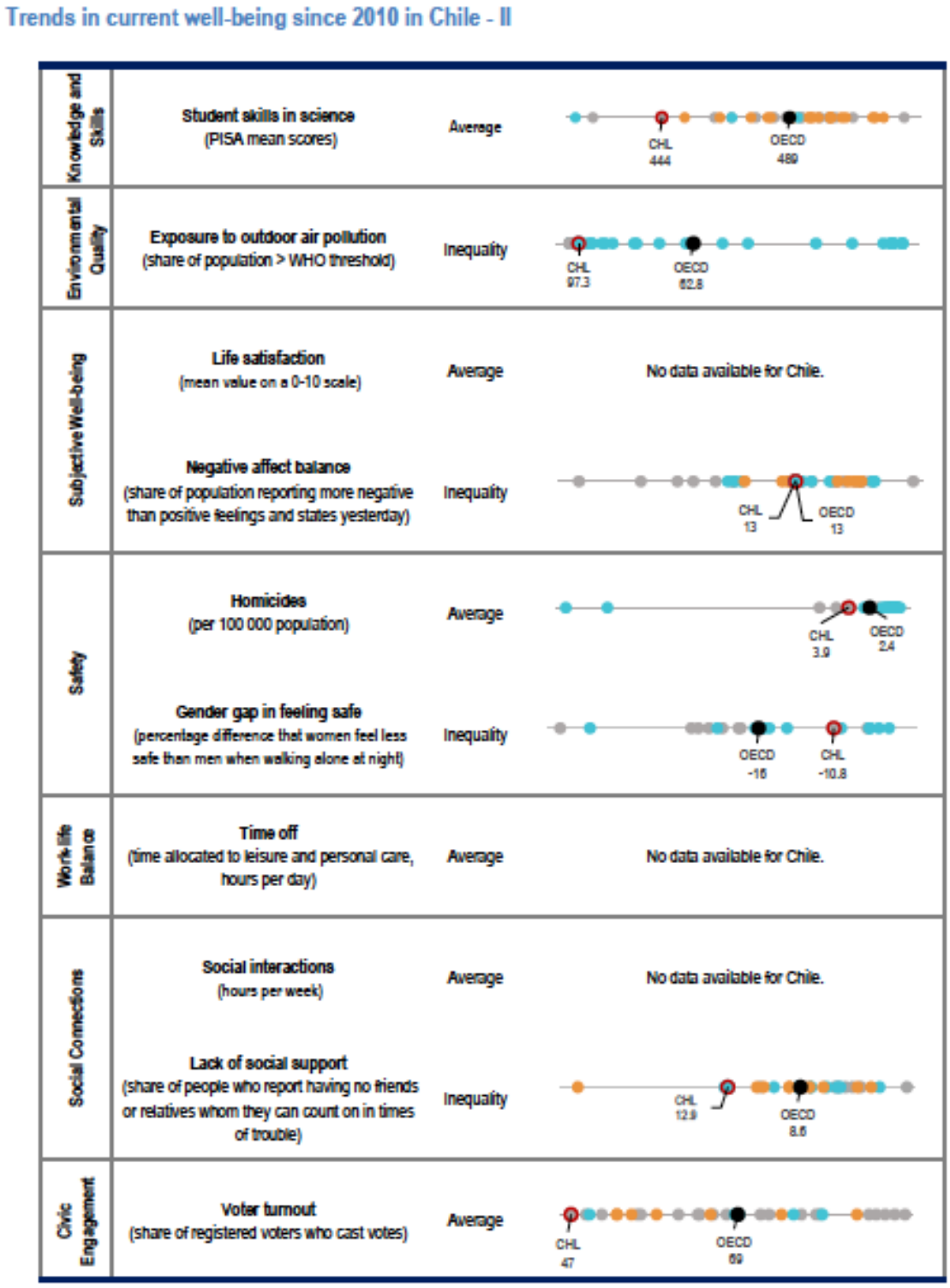
FIGURE 4 TRENDS



Note: The snapshot depicts data for 2018, or the latest available year, for each indicator. The colour of the circle indicates the direction of change, relative to 2010, or the closest available year: ● = consistent improvement, ● = consistent deterioration, ● = no clear trend, and white for insufficient time series to determine trends. The OECD average is marked in black. For methodological details, see the Reader's Guide of *How's Life? 2020*. * = Purchasing Power Parity.

Source: Own elaboration on OECD 2020

FIGURE 5 TRENDS (2)



Source: Own elaboration on OECD 2020

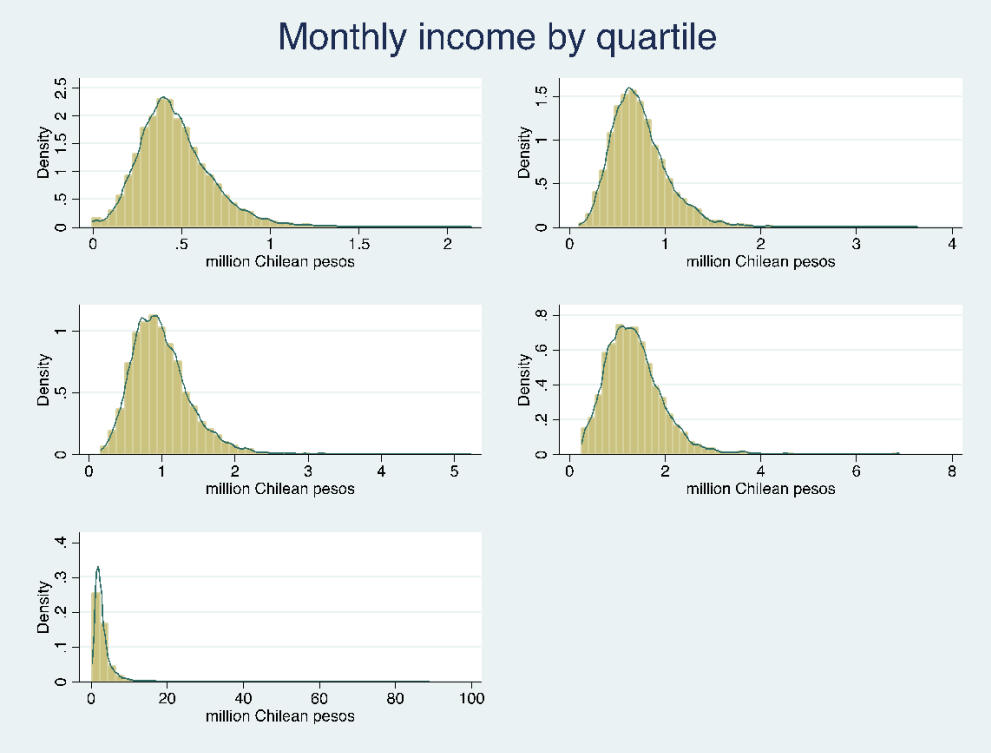
4.2 A short note on inequality in the Chilean economy

In this section, some stylized facts of the Chilean distribution of income are discussed.

I.	**Income distribution is a big issue, with a Gini coefficient of 0.42, considering household disposable income.**

We define income as the household disposable income[1]. In Figure 6 we can see the different densities of the household monthly income in million Chilean pesos by quartile.

FIGURE 6 INCOME DISTRIBUTION

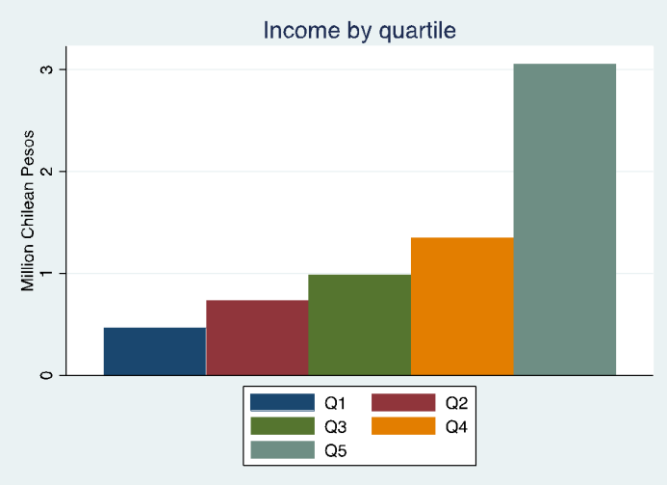


Source: Own elaboration on CASEN 2017 Data

[1] As usual, it considers earnings, self-employment and capital income and public transfers; income taxes and social security contributions paid by households are deducted.

The average income of the richest quartile is 6.5 times the poorest, see Figure 7.

FIGURE 7 INCOME DISTRIBUTION AND QUARTILE DIFFERENCES



Source: Own elaboration on CASEN 2017 Data

As measure of inequality we choose the Gini coefficient since it is a measure of statistical dispersion intended to represent the income or wealth distribution of a nation's residents, and is the most commonly used measurement of inequality.
The Gini coefficient measures the inequality among values of a frequency distribution (in our case, levels of income). A Gini coefficient of zero expresses perfect equality, where all values are the same (for example, where everyone has the same income). A Gini coefficient of one (or 100%) expresses maximal inequality among values (e.g., for a large number of people, where only one person has all the income or consumption, and all others have none, the Gini coefficient will be very nearly one).

We calculate the percentile ratios and the Gini coefficient for household disposable income[2] obtaining the value presented in Table 1

[2] P90/P10 is the ratio of the upper bound value of the ninth decile (i.e. the 10% of people with highest income) to that of the first decile; P90/P50 of the upper bound value of the ninth decile to the median income; and P50/P10 of median income to the upper bound value of the first decile. Gini is based on the comparison of cumulative proportions of the population against cumulative proportions of income they receive, and it ranges between 0 in the case of perfect equality and 1 in the case of perfect inequality.

TABLE 1 RATIO OF DISTRIBUTION AND INDEXES OF INEQUALITY

Percentile ratios

All obs	p90/p10	p90/p50	p10/p50	p75/p25
	5.934	2.628	0.443	2.485

Generalized Entropy indices GE(a), where a = income difference sensitivity parameter, and Gini coefficient

All obs	GE(-1)	GE(0)	GE(1)	GE(2)	Gini
	0.40119	0.30559	0.35921	0.78078	0.42442

Atkinson indices, A(e), where e > 0 is the inequality aversion parameter

All obs	A(0.5)	A(1)	A(2)
	0.15103	0.26331	0.44518

Source: Own elaboration on CASEN 2017 Data

II. Income distribution varies greatly per Province in Chile, miners enjoy less inequality

In the Table 2 we can see the Gini coefficient by Province. A province is a mining Province according to Casen Data. In Table 2 Mining Province are highlighted by a 1 in column Mining. As we can see, Province in which mining is relevant have a lower inequality.

TABLE 2 GINI INDEX BY PROVINCE

Provincia	Gini	Mining	Region
Antofagasta	0.363134533	1	Antofagasta
Arauco	0.420530707	0	Biobio
Arica	0.349419057	1	Arica y Parinacota
Aysén	0.392358154	0	Coyhaique
Biobío	0.367230684	0	Biobio
Cachapoal	0.348888814	1	Libertador Bernardo O´Higgins
Capitán Prat	0.357716113	0	Coyhaique
Cardenal Caro	0.332652807	0	Libertador Bernardo O´Higgins

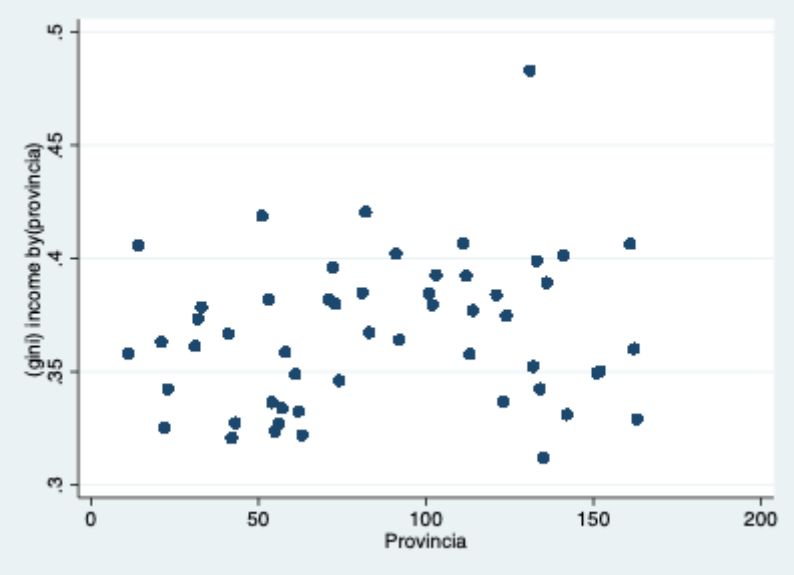
Cauquenes	0.395995021	0	Maule
Cautín	0.402127236	0	La Araucanía
Chacabuco	0.398764968	0	Metropolitana
Chañaral	0.373338461	1	Atacama
Chiloé	0.379566789	0	Los Lagos
Choapa	0.320824236	1	Coquimbo
Colchagua	0.321907073	0	Libertador Bernardo O´Higgins
Concepción	0.384845972	0	Biobio
Copiapó	0.361276209	1	Atacama
Cordillera	0.352190763	0	Metropolitana
Coyhaique	0.406539857	0	Coyhaique
Curicó	0.379868746	0	Maule
Diguillin	0.406522661	0	Ñuble
El Loa	0.325390458	1	Antofagasta
Elqui	0.366566926	1	Coquimbo
General Carrera	0.377043128	1	Coyhaique
Huasco	0.378427446	1	Atacama
Iquique	0.358062118	1	Tarapacá
Itata	0.36012283	0	Ñuble
Limarí	0.327410758	1	Coquimbo
Linares	0.346051812	0	Maule
Llanquihue	0.384610385	0	Los Lagos
Los Andes	0.381758213	1	Valparaíso
Magallanes	0.383835822	1	Magallanes y Antartica
Maipo	0.342429161	0	Metropolitana
Malleco	0.363933235	0	La Araucanía
Marga Marga	0.358555615	0	Valparaíso
Melipilla	0.312060684	1	Metropolitana
Osorno	0.392556787	0	Los Lagos
Parinacota	0.350365132	0	Arica y Parinacota
Petorca	0.336388946	1	Valparaíso

Punilla	0.329115897	0	Ñuble
Quillota	0.323626488	1	Valparaíso
Ranco	0.331029266	0	Los Ríos
San Antonio	0.327303886	0	Valparaíso
San Felipe de Aconcagua	0.333937854	1	Valparaíso
Santiago	0.482880652	0	Metropolitana
Talagante	0.389325112	0	Metropolitana
Talca	0.382020384	0	Maule
Tamarugal	0.405825168	1	Tarapacá
Tierra del Fuego	0.33693409	0	Magallanes y Antartica
Tocopilla	0.342363983	1	Antofagasta
Última Esperanza	0.374727964	0	Magallanes y Antartica
Valdivia	0.401251882	0	Los Ríos
Valparaíso	0.418702781	0	Valparaíso

Source: Own elaboration on CASEN 2017 Data

We can see great variance in the income distribution among Chilean Provinces.

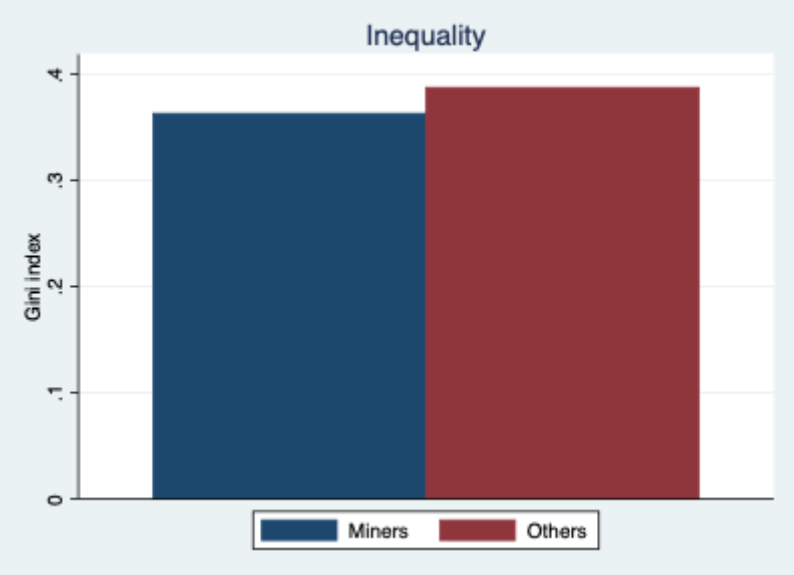
FIGURE 8 VARIANCE IN INCOME DISTRIBUTION



Source: Own elaboration on CASEN 2017 Data

As we can see in Figure 9, effectively, miners enjoy less inequality

FIGURE 9 INEQUALITY BETWEEN MINING PROVINCES AND NON MINING PROVINCES



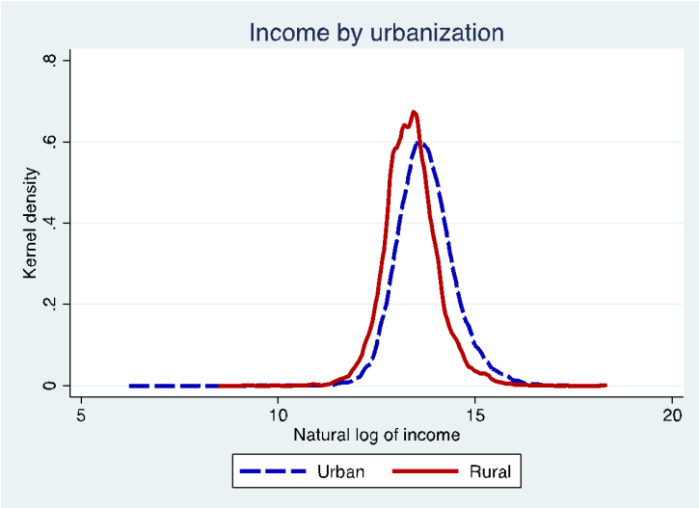
	income	gini	u_h	mining
income	1.0000			
gini	0.1976	1.0000		
u_h	0.4189	0.4716	1.0000	
mining	0.0361	-0.0879	0.0861	1.0000

Source: Own elaboration on CASEN 2017 Data

III. Most population live in urban areas, and the average income of urban families is greater

81% of the population lives in urban areas, and the average income of an urban family is 30% greater than the rural (1.242979 versus .825042 million pesos per month), see graphic below.

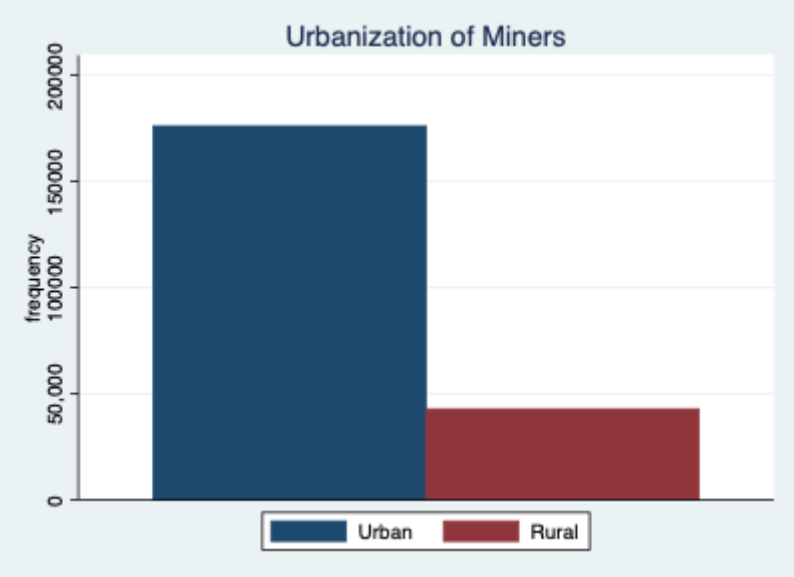
FIGURE 10 INCOME BY URBANIZATION



Source: Own elaboration on CASEN 2017 Data

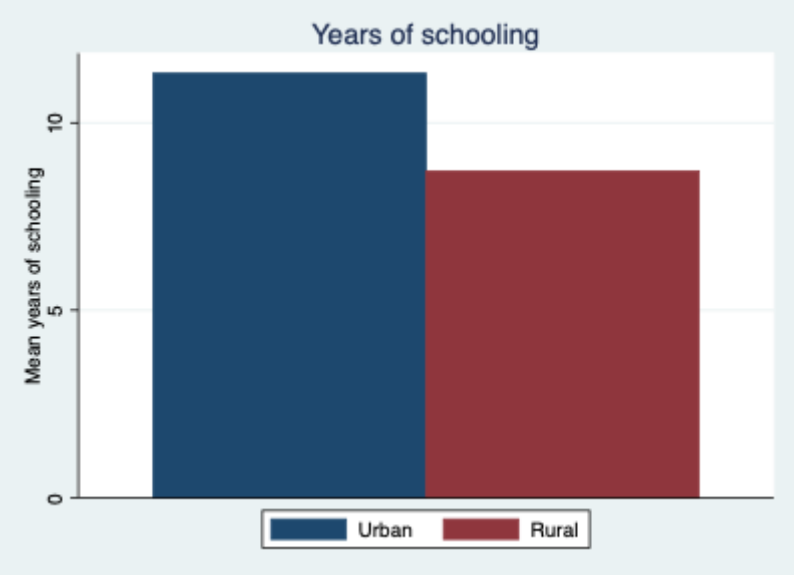
Urban residents also have in average 33% more years of education. In Figure 11 we notice that Miners are very urbanized. This has to be considered for all the analysis contained from Figure 12 to Figure 18.

FIGURE 11 URBANIZATION OF MINERS (1)



Source: Own elaboration on CASEN 2017

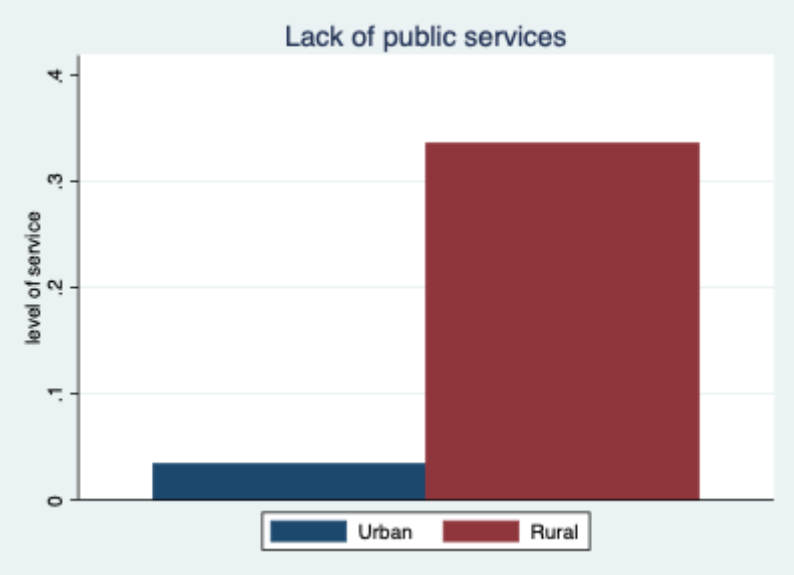
FIGURE 12 EDUCATION AND URBANIZATION



Source: Own elaboration on CASEN 2017 Data

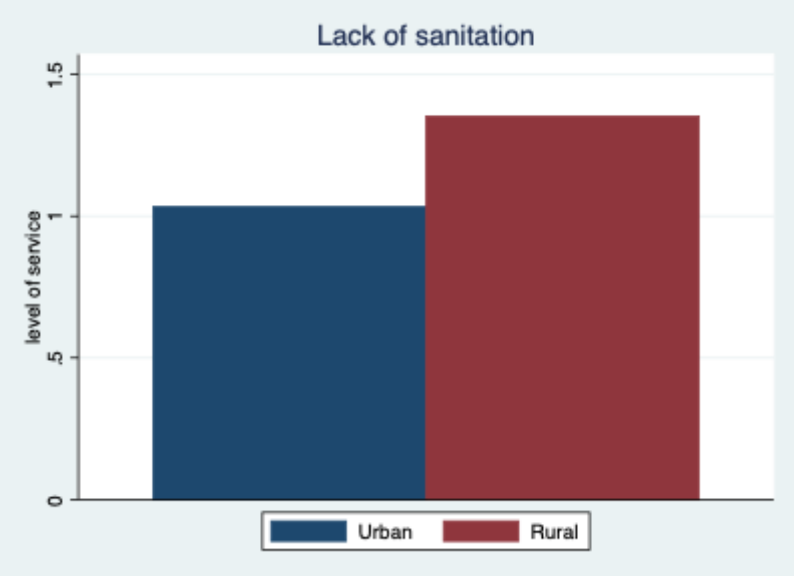
Despite experiencing much more the lack of public services, rural inhabitants seem to favour health as their inhabitants experience less prevalent health conditions.

FIGURE 13 LACK OF PUBLIC SERVICES AND URBANIZATION



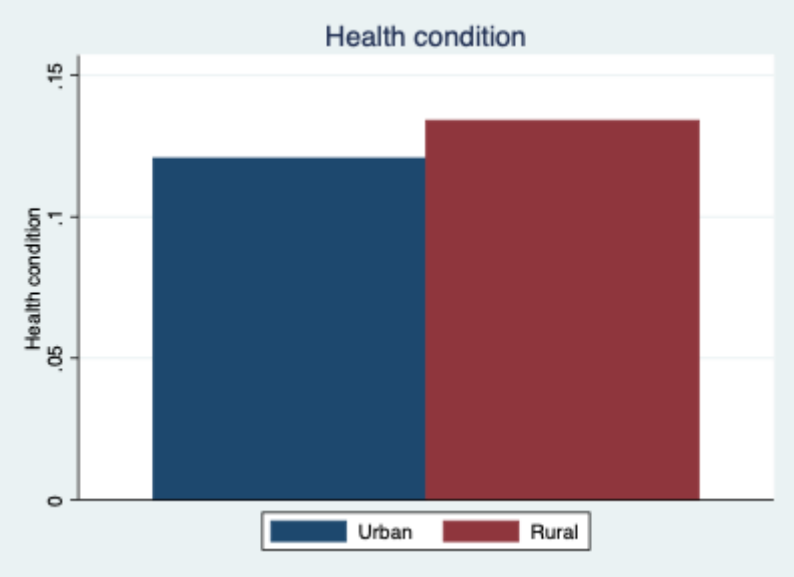
Source: Own elaboration on CASEN 2017 Data

FIGURE 14 LACK OF SANITATION



Source: Own elaboration on CASEN 2017 Data

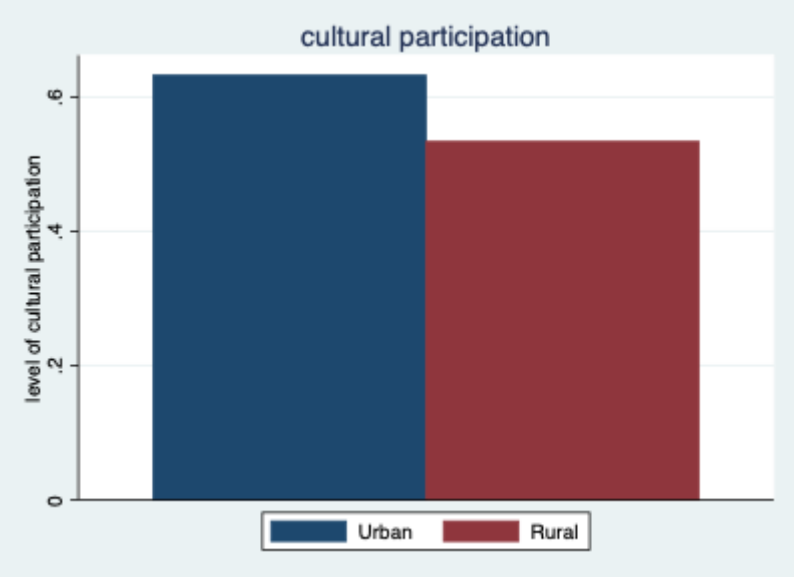
FIGURE 15 HEALTH CONDITIONS



Source: Own elaboration on CASEN 2017 Data

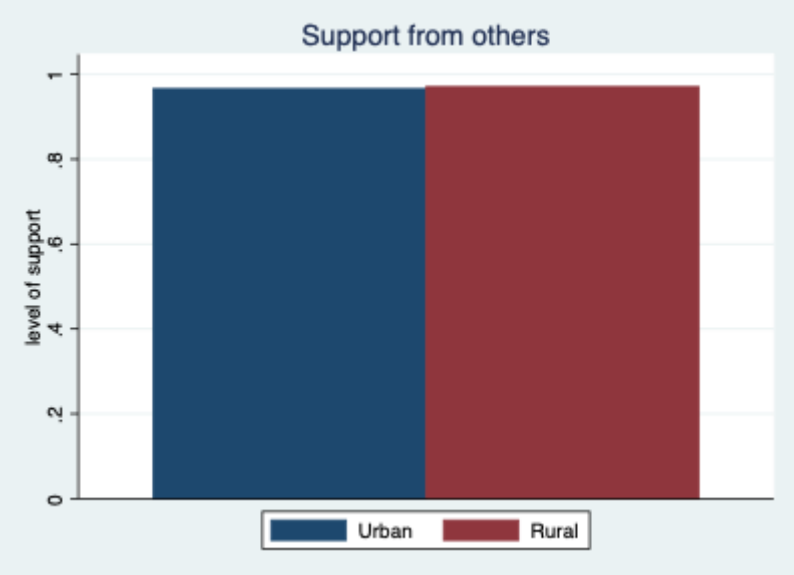
Possibilities to get help from others in cases of sickness or need of child or disabled care are the same for urban and rural citizens whereas possibilities for accessing social participation are greater in cities.

FIGURE 16 CULTURAL PARTICIPATION



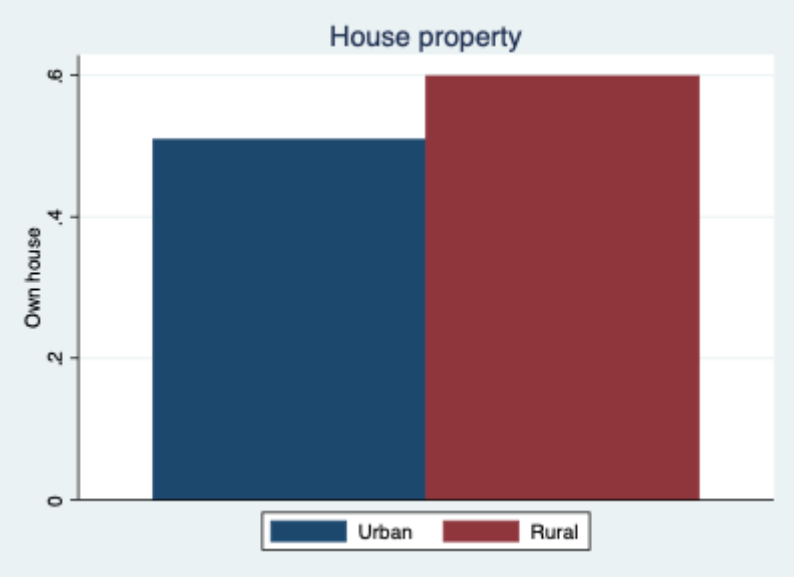
Source: Own elaboration on CASEN 2017 Data

FIGURE 17 SUPPORTS FROM OTHERS



Source: Own elaboration on CASEN 2017 Data

FIGURE 18 HOUSE PROPERTY



Source: Own elaboration on CASEN 2017 Data

4.3 Sectorial Well Being in Chile (mining sector focus): analysis of specific simple indicators related to some aspects of quality of life

We use data from the 2017 way of the National Socioeconomic Conditions Survey (Casen) aimed at providing information on the wellbeing of the population. Data were created by the Ministry of Social Development (MDS). CASEN survey aims to deliver an "in-depth examination" of socio-economic situation in Chilean households, being the principal data source to measure poverty and inequality, and it has been broadly used by international organizations and NGOs. Some of data used and incorporated in our database are created by the National Institute for Statistics (INE), incorporated in CASEN and relative to The New National Employment Survey (NENE) that classifies the working age population (PET), all the people from 15 years old and more, by their occupational situation, by applying a set of worldwide accepted rules and defined by the International Labour Organization (ILO), from which is derived the approach to measure employment, unemployment and households surveys.

We run three different analysis of data. The first analysis is a comparison between individuals (Table 3 and Table 4) while second and third analysis are a comparative analysis between territories.
In particular, the first territorial analysis (Table 5 and Table 6) is between Regions in which the mining activity is not predominant compared with Regions in which the mining activity is highly relevant (Region 1,2,3,4,5); the second territorial analysis (Table 7 and Table 8) is between Province in which the mining activity is not predominant compared with province in which the mining activity is highly relevant.

TABLE 3 INDIVIDUALS EMPLOYED IN ALL ECONOMIC SECTORS (EXCLUDING MINING)

	Obs	Mean	Std. Dev.	Min	Max
House in the hogar	214,431	1.085104	.3954926	1	10
Number of people in the house	214,431	3.849961	1.719629	1	19
Age	214,431	37.7494	23.02759	0	117
Educational level	213,875	8.865982	3.552459	1	17
Health	214,431	5.785922	1.322532	1	9
Women	214,431	.526589	.4992937	0	1
Income	62,520	491009	579236.4	0	3.40e+07
Ill	212,068	.1801545	.384317	0	1
Internet	69,606	.1353763	.3421275	0	1

Source: Own elaboration on CASEN Data

The average number of houses own in the familiar nucleus is quite similar between people employed in the mining sector (1.07) and people employed in all the other sectors (1.08). Even the number of people living in the house is pretty similar and close

to 4 in both. A first substantial difference is in the average age of people working in the mining sector (41.07) and people employed in others sector (37.74). Here we notice that people working in mining are usually older than people working in other sectors and this could be done to a number of factors like the necessary level of instruction to start some specific works in mining, the level of experience needed and a lower rate of turnover of the mining sector compared to other economic sectors.

The educational level of the two different categories analysed shows a relevant difference between the two groups and confirms, in a certain way, one motivation of being older if employed in mining. In fact, the average educational level observed in mining is 11.146 (out of a maximum of 17) while it is 8.86 for workers of other economic activities. Being in mining implies a higher level of education compared to being in other economic sectors.

TABLE 4 INDIVIDUALS EMPLOYED IN THE MINING SECTOR

Variable	Obs	Mean	Std. Dev.	Min	Max
House in the hogar	2,008	1.070219	.3288935	1	5
Number of people in the house	2,008	3.916335	1.684648	1	12
Age	2,008	41.0757	11.77226	17	91
Educational level	2,000	11.146	2.727344	1	17
Health	2,008	6.10508	1.184695	1	9
Women	2,008	.0996016	.2995427	0	1
Income	1,756	827677.1	675476.8	0	8000000
Ill	1,979	.0879232	.2832547	0	1
Internet	1,656	.1832145	.2642312	0	1

Source: Own elaboration on CASEN Data

Perception of having a good state of Health shows also some important differences., Being in mining, in this case, gives a worst health perception than being in others economic sector. On a rate between 1 and 9, individuals employed in mining sector show an average index of health of 6.10 higher than the 5.78 shown by the individuals employed in others economic sectors. This is quite relevant but we have to consider than people in mining are older than people in others sectors and we probably expect that older people could have a worst perception on their state of Health. In this case, this happens and we observe a worst “own health” perception in mining for older (but more educated) individuals.
This indicator of health perception can be analysed together to the indicator Ill, that is not an indicator of perception but of real illness had during months before the data collection. The average value signalled from individuals working in others economic sectors is 0.18 while the average observed in Mining is 0.08. This means that, in average values, 18% of people working in economic sectors different from mining signal an illness observed in months before the data collection while this percentage goes down to 8% for individuals employed in the mining sector.

The variable Women, the share of Women working in the sectors, shows a very relevant difference. If we consider Mining, the share of employed women is almost

10% of all people working in the sector while this percentage has a value of 52.66% in others economic sectors. Mining is not a job in which women presence is considerably relevant.
The average income earned in the two groups also shows a very relevant difference. While the average income on economic sectors other than mining is almost 500.000 Chilean pesos per month, in Mining this value is 827.677 Chilean pesos per month, almost the 50% higher than what it is expected to earn in average if not working in mining.

This difference shows that investing in education to be able to work in mining does pay more than the average expected to be earnt in others sectors. Mining can be seen has a high wage sector. Unfortunately, the presence of women in this sector does not help to compensate gender gap in salaries observed in Chile.

Finally, a variable related to the access and use of internet shows again a better value for individuals employed in mining (0.18) compared to individuals working in others economic sectors (0.13).

Being employed in mining sectors seems to have some important differences than being employed in others economic sectors. These differences are mainly related to a higher wage, depending probably by the higher level of education and the older age observed in Mining and differences in Health, while the gender gap in the sector shows a very relevant difference given to the very low rate of female employed in mining.

In Table 5 and Table 6 the variables analysed in Table 3 and Table 4 are declined for territories (Regions with high density of mining activity, specifically Region 1,2,3,4,5) instead of individuals. This analysis is helpful for two set of reason: first, the number of observations for phenomenon is more relevant than the previous one (observations for individuals employed in mining were around 2.000 cases while, if we consider the territories in which mining is a very relevant activity we move to more than 55.000 observations), second, we want to test if it is possible to observe a sort of spin off effect of mining activities in all the sample of Regions with relevant mining operations.

We start this analysis by observing the variable "Income", since it was the variable with the biggest difference in the previous analysis. In this case, the Mining sector does not represent a "spin off" for the territory in which mining activities are "dominant". The average income of individuals employed in territories in which mining is present with a low density is 502.120 Chilean pesos per month while the value observed in Region with high density of mining activity is 485.146 Chilean pesos per month. This means that while people working in mining is relatively richer than people working in other sectors, it is not sufficient to have "richer" Regions. This is probably due to 1) lower salaries in activities different from mining in Regions in which mining is predominant, 2) activities of mining more "capital intensive" than "labour intensive" in the direct activity and in all the indirect activities of mining and 3) a relatively low number of people working in mining even in region in which mining is a relevant activity (this is strictly correlated to the capital intensive consideration already done).

TABLE 5 REGIONS WITH LOW DENSITY OF MINING ACTIVITY

Variable	Obs	Mean	Std. Dev.	Min	Max
House	161,241	1.073474	.3712951	1	10
Individuals in the house	161,241	3.791312	1.672399	1	19
Age	161,241	38.14954	22.97246	0	117
Educational level	160,870	8.867328	3.577528	1	17
Health	161,241	5.757897	1.318795	1	9
Women	161,241	.5226586	.4994879	0	1
Internet	53,339	.1301487	.3364701	0	1
Income	48,598	502120.4	619743.7	0	3.40e+07
Ill	159,737	.1973619	.398009	0	1

Source: Own elaboration on CASEN Data

The other indicator with a strong difference was the one related to Women participation to work. In this case we do not observe relevant differences since the share of women working in the two different area is very similar (52,26% against 52,25%).

Education, that showed a relevant difference when we analysed individuals, does not have any more this peculiarity. The education average rate is almost equal in the two different "territories" showing a value of 8.94 in Region with high density of mining and of 8.86 in Region with a low level of mining activities.

Health as a similar trend since the two value are 5.87 and 5.75 showing again no relevant difference on good Health perception, while the indicator relative to the real state of illness is very similar at the one observed in the individuals analysis since it has a value of 0.12 in Regions with a high level of mining activity and of 0.19 in Region with low density of mining activities.

The indicator relative to Age shows a lower value in Regions with high density of mining (despite to the fact that "miners" were older) while there are not substantial differences in other indicators relative to Housing and people living in a house (with a slightly higher number in Regions with higher density of mining)

TABLE 6 REGIONS WITH HIGH DENSITY OF MINING ACTIVITY (REGION 1, 2, 3, 4 AND 5)

Variable	Obs	Mean	Std. Dev.	Min	Max
House	55,198	1.118537	.4553633	1	10
Individuals in the house	55,198	4.023697	1.83867	1	16
Age	55,198	36.70153	22.85327	0	110
Educational level	55,005	8.94495	3.477305	1	17
Health	55,198	5.879398	1.325908	1	9
Women	55,198	.522537	.4994963	0	1
Internet	49,657	.1290453	.3352534	0	1
Income	13,924	485146.9	463413.5	0	1.20e+07
Ill	54,310	.126183	.3320586	0	1

Source: Own elaboration on CASEN Data

In Table 7 and Table 8 the variables analysed in Table 3 and Table 4 are declined for Provinces with low density of mining activity and Provinces with high density of mining activity.

TABLE 7 PROVINCES WITH LOW DENSITY OF MINING ACTIVITY

Variable	Obs	Mean	Std. Dev.	Min	Max
House	166,057	1.077341	.3838412	1	10
Individuals in the house	166,057	3.826427	1.701442	1	19
Age	166,057	37.86654	22.90369	0	117
Educational level	165,647	8.866065	3.570714	1	17
Health	166,057	5.766502	1.324823	1	9
Woman	166,057	.5223206	.499503	0	1
Income	50,352	504371.2	613907	0	3.40e+07
ill	164,390	.1944826	.3958031	0	1
internet	54,516	.1303104	.3366477	0	1

Source: Own elaboration on CASEN Data

The results obtained by Province are quite similar to the one obtained in the analysis by Region. Even in this case, we do not have at a Province level the peculiarities that we

observed for individuals working in mining sector in terms of differential of education, income and health.
Again, even at a different territorial level, we do not have a sort of spin off effect generated by mining activities in the Region or Provinces where the activities are located.

TABLE 8 PROVINCES WITH HIGH DENSITY OF MINING ACTIVITY (REGION 1, 2, 3, 4 AND 5)

Variable	Obs	Mean	Std. Dev.	Min	Max
House	50,382	1.110099	.4284934	1	10
Individuals in the house	50,382	3.930173	1.774646	1	15
Age	50,382	37.49587	23.10314	0	104
Educational level	50,228	8.956498	3.490514	1	17
Health	50,382	5.862649	1.308535	1	9
Women	50,382	.5236394	.4994458	0	1
Income	15,678	494274.3	459110.1	0	1.20e+07
Ill	54,310	.126183	.3320586	0	1
Internet	16,256	.1624016	.3688301	0	1

Source: Own elaboration on CASEN Data

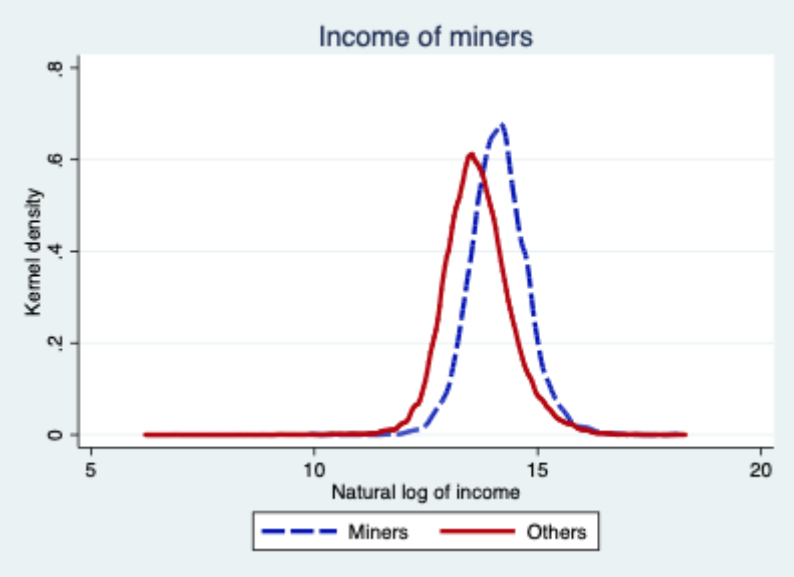
Some results of this first territorial report on well-being generated by mining activities are more relevant for individuals working in mining than on the territories where mining activities are on high density. This could probably be due to many facts: the sector is capital intensive, individuals that work in mining have residence in a different place in which the activity of mining is based, the expenditure of these individuals are done in different place respect the one where mining is prevalent and, on another hand, housing costs on area with mining are influenced by higher wage of non-residential miners and this increases the cost of housing of non-mining workers (that have a lower wage of miners) that cannot spend much of their wage since a relevant quote of it is absorbed by housing (as we have seen in the first part of the analysis done on OECD data 40% of the income could be absorbed by housing costs).

Here we have a series of stylized facts:

I. Miners have a higher average income and report better education

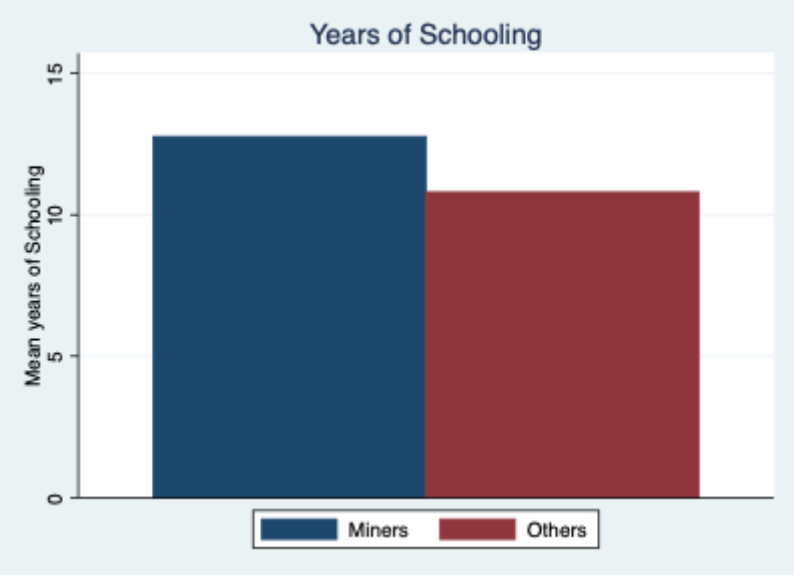
Income of miners is greater than that of non-miners, and on average they study two more years than the rest of Chileans.

FIGURE 19 INCOME OF MINERS



Source: Own elaboration on CASEN 2017

FIGURE 20 YEARS OF EDUCATION



Source: Own elaboration on CASEN 2017

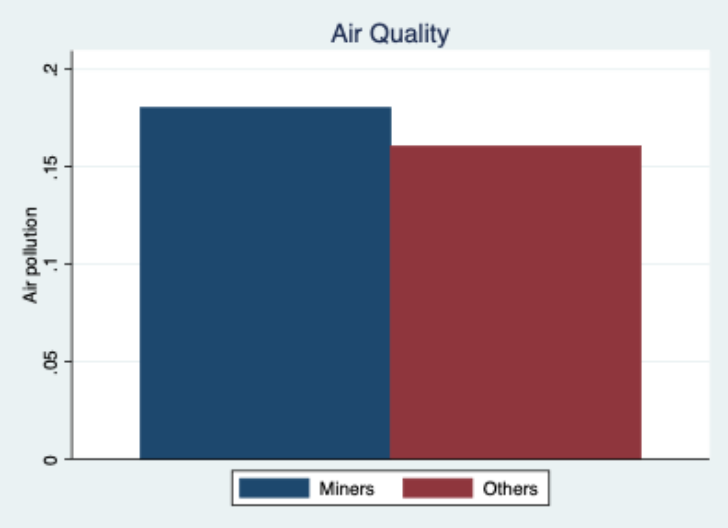
II. Miners are affected by lower environmental quality and more prevalent health conditions

Miners report having seen about 50% more environmental problems as compared to those working in other sectors. They have also witnessed about 10% more air pollution and bad odours and 34% more water pollution. Residues problems is the only variable analyzed performing slightly better, i.e. 3% less events witnessed. It should also be noted that air quality and residues problems are experienced more commonly than water pollution problems. Despite the previous, prevalent health conditions are only 2% more prevalent in miners.

FIGURE 21 ENVIRONMENTAL QUALITY

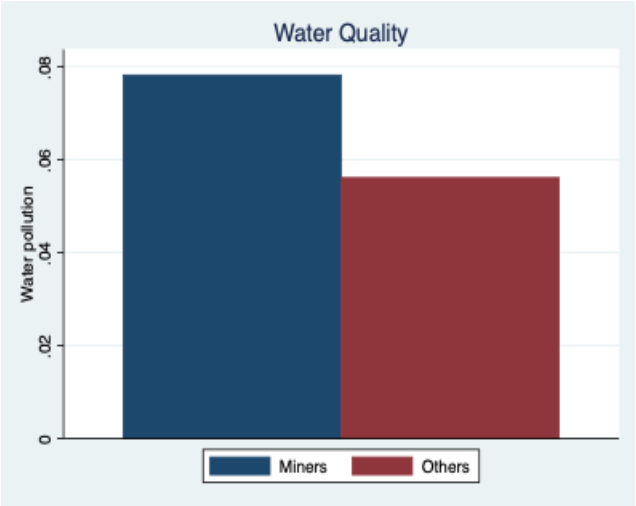
Source: Own elaboration on CASEN 2017

FIGURE 22 QUALITY OF AIR



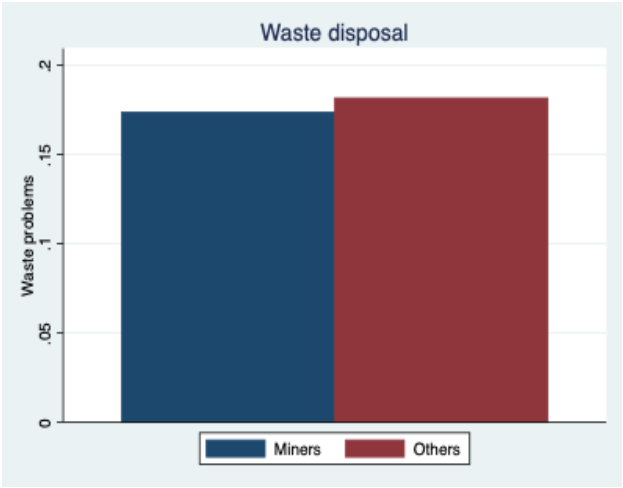
Source: Own elaboration on CASEN 2017

FIGURE 23 QUALITY OF WATER



Source: Own elaboration on CASEN 2017

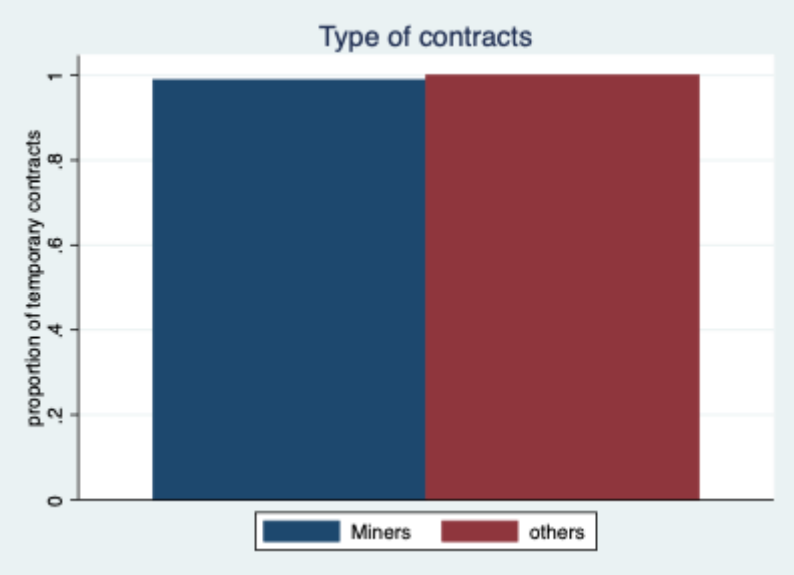
FIGURE 24 WASTE DISPOSAL



Source: Own elaboration on CASEN 2017

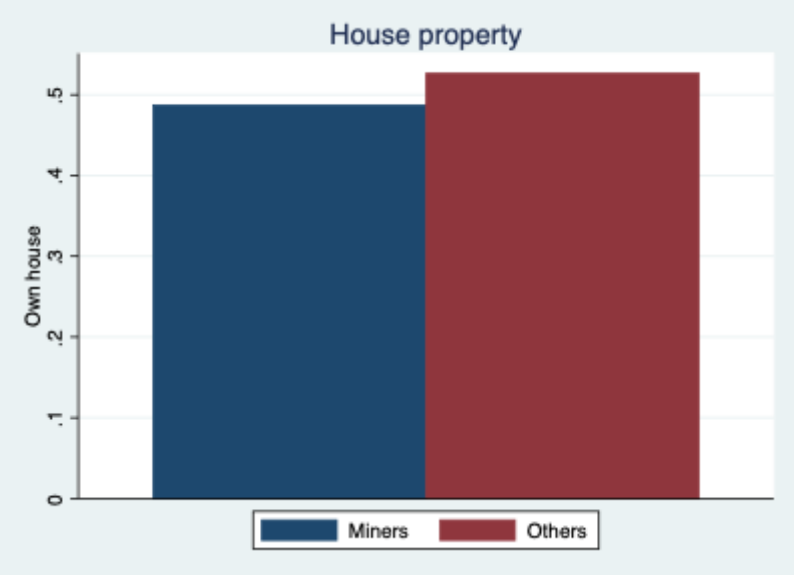
III. The degree of stability of miners as reflected by the property rights over their house and the type of contract they have, do not reflect major differences with the rest of the workers

FIGURE 25 CONTRACT FOR HOUSING



Source: Own elaboration on CASEN 2017

FIGURE 26 HOUSE PROPERTY

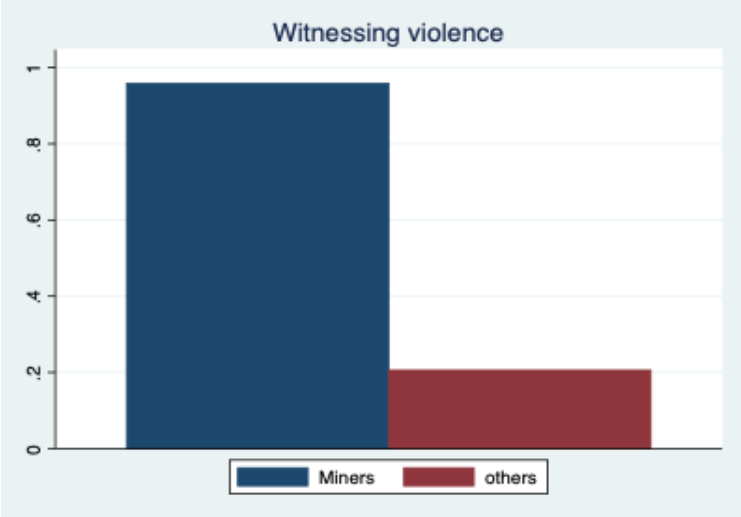


Source: Own elaboration on CASEN 2017

IV. Security incidents observed by miners are much higher despite experiencing better living conditions

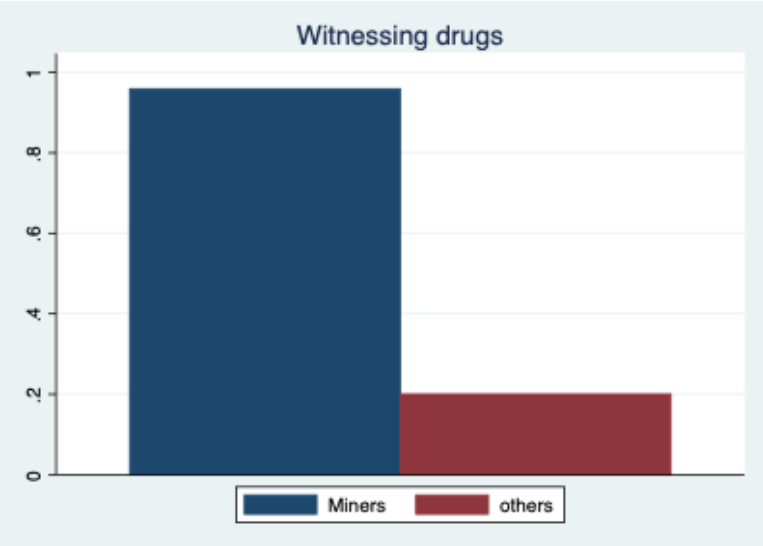
Security incidents observed by miners are almost four times more than those witnessed by the rest of the workers, when considering shooting and drug trafficking. This is despite the fact that miners report less incidence of lacking basic living conditions considering public service access and sanitation.

FIGURE 27 WITNESSING VIOLENCE



Source: Own elaboration on CASEN 2017

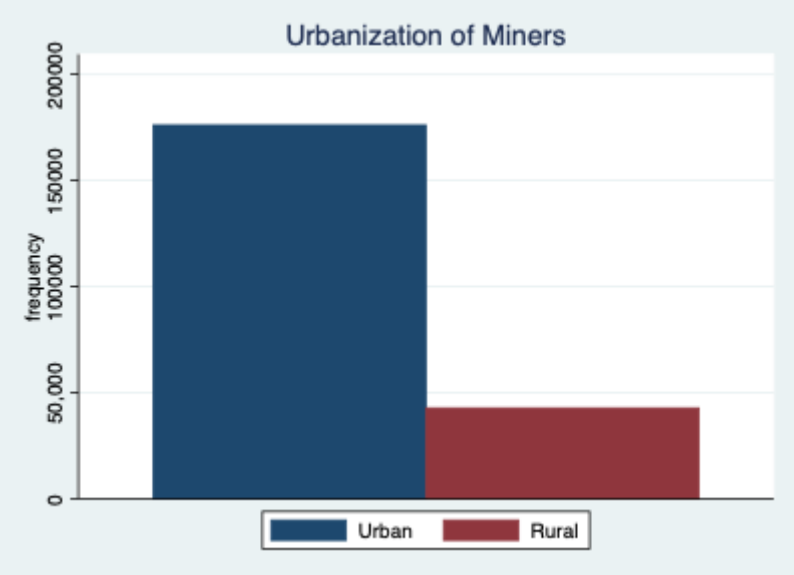
FIGURE 28 WITNESSING DRUGS



Source: Own elaboration on CASEN 2017

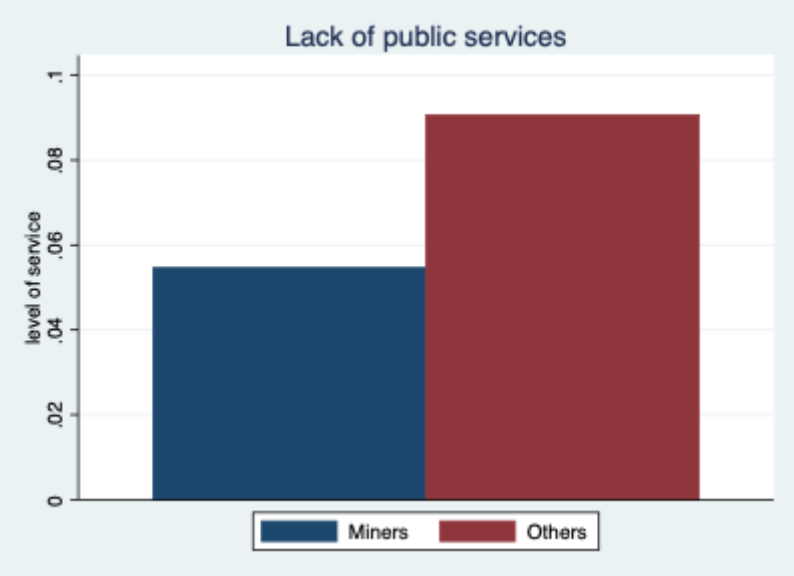
Further, miners live mostly in urbanized places and therefore experience better access to sanitation and public services.

FIGURE 29 URBANIZATION OF MINERS 2

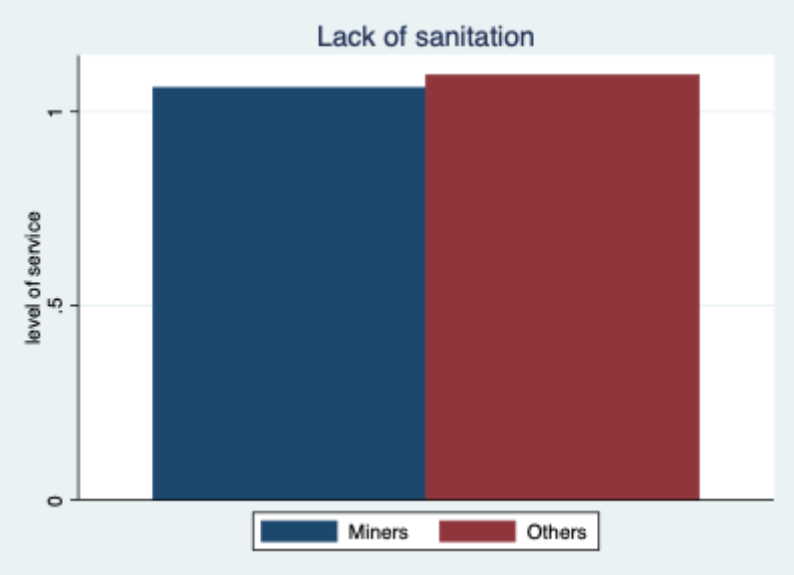


Source: Own elaboration on CASEN 2017

FIGURE 30 LACK OF PUBLIC SERVICES

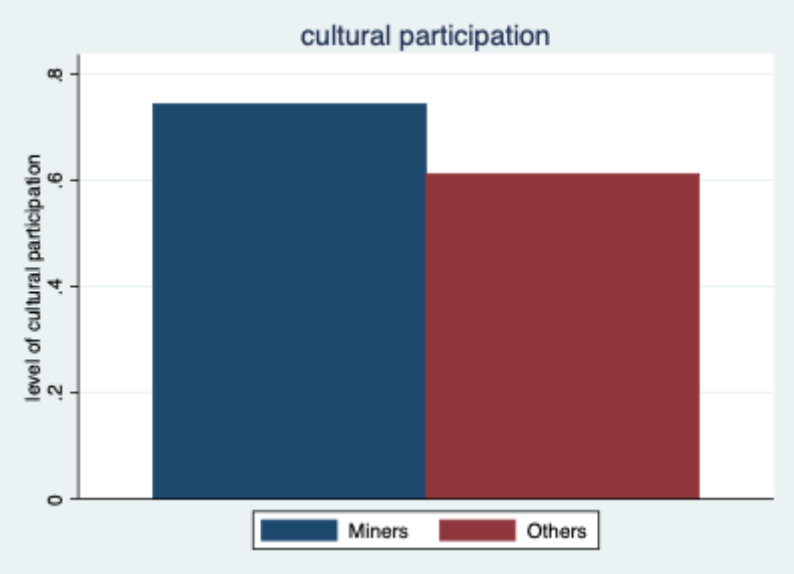


Source: Own elaboration on CASEN 2017



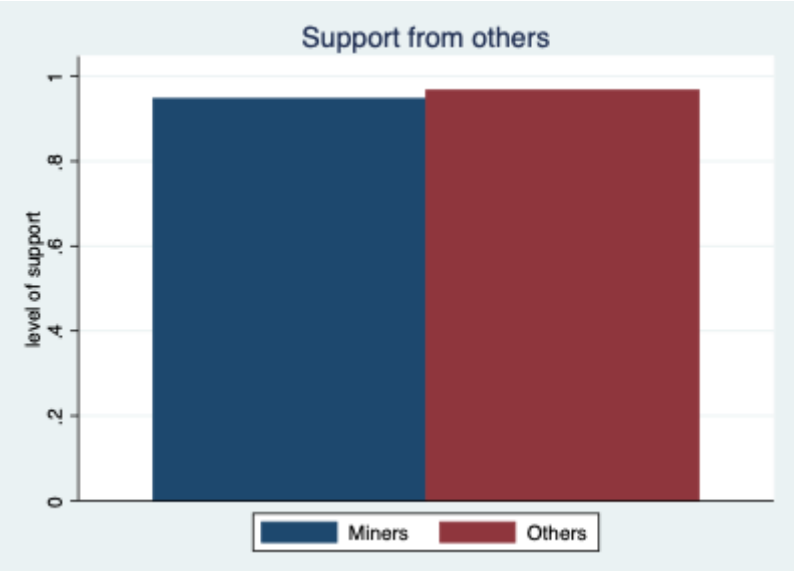
Source: Own elaboration on CASEN 2017

V. The participation in social instances is higher for miners



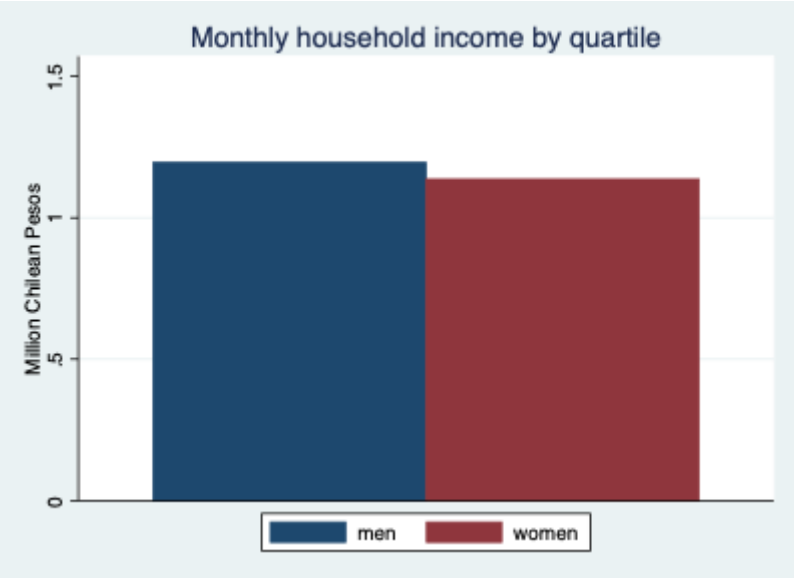
Source: Own elaboration on CASEN 2017

VI. The possibility to get help from others is similar among chileans regardless of working in mining

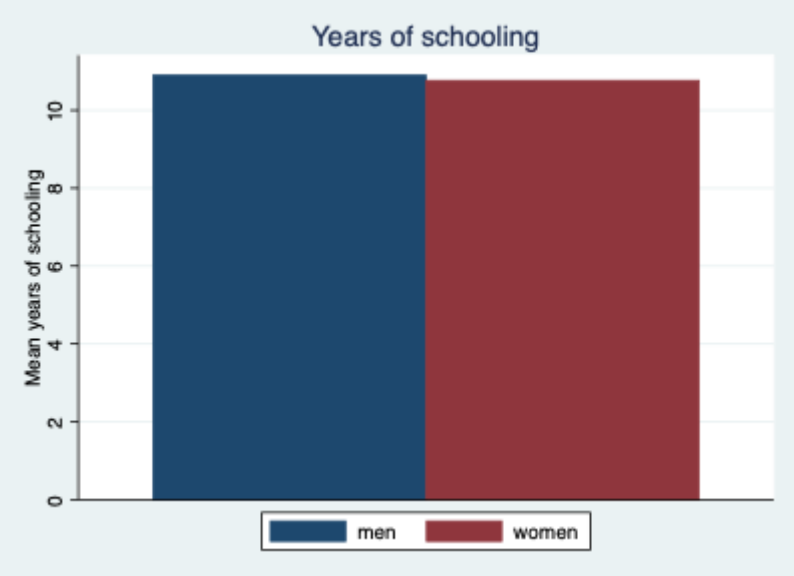


Source: Own elaboration on CASEN 2017

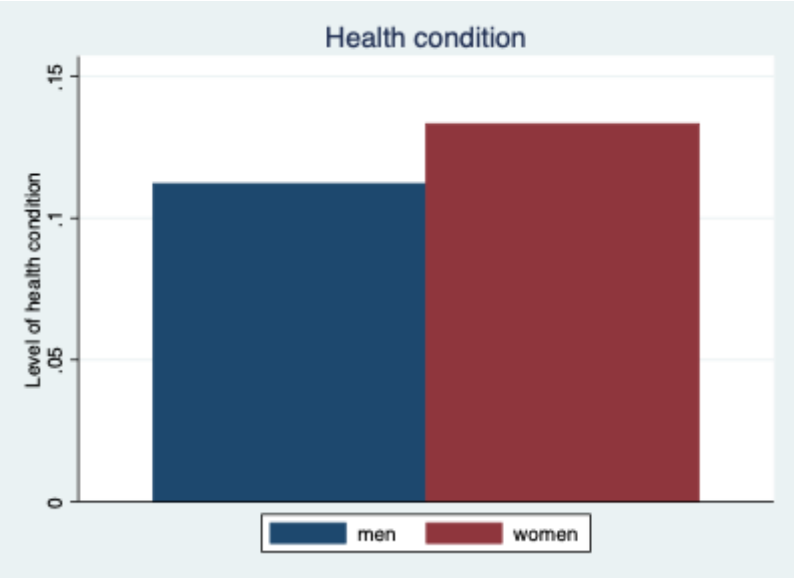
VII.	**Men report higher income and years of schooling than women, but women enjoys better health conditions.**



Source: Own elaboration on CASEN 2017



Source: Own elaboration on CASEN 2017



Source: Own elaboration on CASEN 2017

Finally, and to summarize:

- Women in general do no benefit of the higher wages payed in mining since the share of women employed in the sector is considerably low.

- Education level of individuals employed in mining is, on average higher than people employed in others sectors but this does not influence in a relevant way the level of education observed in territories where mining is relatively more relevant.

- The opposite happens for Health issues. While individuals working in mining signal a worst level of Health and a lower level of illness, this does not influence the general level of Health and Illness observed in the territories where mining is relatively more relevant.

- We cannot exclude, given the first results obtained, that most of advantages (benefit, direct and indirect) of mining activities are for the well-being of individuals working in the sector and that they are not transferred to individuals that are in the regions where mine are based and that do not work in the sector. This mean that we do not observe a general improvement in territorial well being given to mining activities and, on the other hand, for some situation, we observe that the higher level of wage paid to miners, leads to an increase on some prices (for instance in housing) that negatively influence the well-being of individuals

that live in region with a high density of mining but that they do not work (directly or indirectly) with mining sector.

Since some phenomenon observed could lead to some situation of relative or absolute poverty, the analysis of next section will study some possible indicators that are a proxy of relative and absolute poverty. This will be done, again, for individuals and for territories.

4.4 Sectorial Well Being in Chile (mining sector focus): analysis of specific simple indicators related to Poverty

We use data from the 2017 way of the National Socioeconomic Conditions Survey (Casen) aimed at providing information on the wellbeing of the population focusing especially on those in poverty and those groups defined as priority by social policy (childhood, youth, older adults, women, indigenous peoples, people with disabilities), mainly in relation to demographic, education, health, housing, work and income aspects. The survey also includes some multidimensional poverty variables according to the methodology validated by the Oxford Poverty & Human Development Initiative (OPHI).

We run three different analysis of data. The first analysis is a comparison between individuals (Table 9 and Table 10) while second and third analysis are a comparative analysis between territories.
In particular, the first territorial analysis (Table 11 and Table 12) is between Regions in which the mining activity is not predominant compared with Regions in which the mining activity is highly relevant (Region 1,2,3,4,5); the second territorial analysis (The results obtained by Province are quite similar to the one obtained in the analysis by Region. Even in this case, we do not have at a Province level the peculiarities that we observed for individuals working in mining sector in terms of differential in proxy for poverty.
Again, even at a different territorial level, we do not have a sort of spin off effect generated by mining activities in the Region or Provinces where the activities are located.
For completeness of analysis, data at Province level are reported in Table 13 and in Table 14.

Table 13and Table 14) is between Province in which the mining activity is not predominant compared with province in which the mining activity is highly relevant.

TABLE 9 INDIVIDUALS EMPLOYED IN ALL ECONOMIC SECTORS (EXCLUDING MINING)

Variable	Obs	Mean	Std. Dev.	Min	Max
Poor in assistance	214,067	.0305185	.1720094	0	1
Poor school lag	213,758	.3479729	.4763285	0	1
Poor: malnutrition children	212,818	.0687207	.2529792	0	1
Poor: lacking in affiliation to health system	212,934	.0586989	.2350609	0	1
Family Lacking in home care	212,644	.0365588	.1876763	0	1
Family lacking in occupation	214,223	.1147869	.3187654	0	1
Family lacking social security	211,461	.3455247	.4755402	0	1
Family lacking retirement security	214,223	.1133258	.3169914	0	1
Home lacking in habitability	213,514	.2151053	.4108964	0	1
Home with overcrowding	213,685	.0915085	.2883316	0	1
Household lacking in good condition of housing	213,903	.1476557	.3547592	0	1
Home lacking basic services	214,105	.0906891	.2871672	0	1
Home lacking in surrounding garden/environment	213,781	.1012999	.3017262	0	1
Home lacking in accessibility	213,818	.059387	.2363481	0	1
Home lacking in good environment conditions	214,154	.0437069	.2044426	0	1
Home lacking in support and social participation	213,161	.0610431	.2394098	0	1
Home lacking in equal conditions	214,223	.1200151	.32498	0	1
Home lacking in security conditions	214,223	.0948311	.2929822	0	1
Multidimensional poverty situation (4 dimensions)	214,223	.030767	.1726862	0	1

Source: Own elaboration on CASEN Data

The first category analysed is Family Poor in Assistance and the result is that individuals employed in all economic sectors show a relatively higher value (3%) than individuals employed in the mining sector (2,3%). If we refer to School Lag in the family, the difference observed is more relevant since 34.79% of individuals employed in other sectors signal this difficulty while only 20,57% of individual employed in mining signal this kind of “poorness”. Malnutrition for children and Lack in home care show a similar value in the two groups (6.8% other sectors vs 6.1% mining sector for malnutrition and 3.6% vs 3.8% for home care) while a small but relevant difference is shown in the lack in affiliation to an health system (5.8% vs 3.7%).

TABLE 10 INDIVIDUALS EMPLOYED IN THE MINING SECTOR

Variable	Obs	Mean	Std. Dev.	Min	Max
Poor in assistance	2,006	.0234297	.1513016	0	1
Poor school lag	1,993	.20572	.4043282	0	1
Poor: malnutrition children	1,988	.0613682	.2400649	0	1
Poor: lacking in affiliation to health system	1,997	.0375563	.1901683	0	1
Family lacking in home care	1,997	.0385578	.1925869	0	1
Family lacking in occupation	2,008	.0851594	.2791882	0	1
Family lacking social security	1,973	.1860112	.3892143	0	1
Family lacking retirement security	2,008	.0891434	.2850216	0	1
Home lacking in habitability	1,999	.154077	.3611129	0	1
Home with overcrowding	2,004	.0643713	.2454744	0	1
Household lacking in good condition of housing	2,003	.1018472	.3025228	0	1
Home lacking basic services	2,007	.0473343	.2124059	0	1
Home lacking in surrounding garden/environment	2,003	.0988517	.2985374	0	1
Home lacking in accessibility	2,002	.025974	.1590975	0	1
Home lacking in good environment conditions	2,008	.0732072	.2605411	0	1
Home lacking in support and social participation	2,002	.0594406	.2365065	0	1
Home lacking in equal conditions	2,008	.0886454	.2843021	0	1
Home lacking in security conditions	2,008	.0871514	.282127	0	1
Multidimensional poverty situation (4 dimensions)	2,008	.0253984	.1573711	0	1

Source: Own elaboration on CASEN Data

Lacking in occupation shows a relevant difference between the two sector (11.47% vs 8.5%) such as lack in social security (34.55% vs 18.6%) and lack in retirement security (11.33% vs 8.9%). The lack in social securities is very relevant considering the importance of this form of "assistance" while there are problems in employment and social services in general.

Habitability of the house, its overcrowding and the good condition of the house are three indicators in which, again, the individuals employed in mining sector show better value than individuals employed in others economic sectors. In particular, relatively to the habitability of the house, the 21.5% of houses related to individuals employed in other economic sectors show problems of some kind while this percentage decreases to a 15.4% for houses related to individuals employed in mining sector. Overcrowding shows 3% differences between the two groups and this difference is about 4 percentage points if we refer it to the wellness in the condition of the house.

Basic services' lack is another category in which the differences between the two groups are relevant. In fact, 9% of the houses of individuals employed in other sectors lack basic services while only 4.7% of the houses of individuals employed in mining has this kind of problem.
Lacks in surrounding like gardens and environment in general, accessibility of the house (especially for disabled people) and general efficient environmental conditions are other variables in which the difference is relevant and again, almost always in favour of individuals employed in mining. Specifically, goodness of the surrounding of the house is a problem for 10%of the houses of others sectors employees while this is the case for 9% of miners' houses, accessibility is a problem in 6% of non-miners' houses against 2.5% of miners' houses and finally, for the first time in the analysis, referring to efficiency

in the environment consumption of the house, only 4.3% of houses of individuals employed in others sectors has some problem while this value is higher (7.3%) for houses of mining employees.

Last three categories are related at support and social participation, equal conditions and security conditions. In all the three indicators poverty proxies are higher for individual outside of the mining sector. The most relevant differences, in particular, is shown in the lack in equal condition (12% vs 8.8%).

Finally, the multidimensional indicator for poverty situation shows a value of 3% for people working outside mining and 2.5% for people working in mining. In this case, the four dimensions considered are the three of Global "MPI" like Health, Education and Standard of Living (these mirror the Human Development Index.) plus a fourth dimension related to income and consumption (since there were relevant differences between the two groups in these categories).

Proxy signalling poverty are better for individuals employed in mining compared to the one observed for people employed in others economic sectors. This was a result more or less expected after the previous one shown in section 4.3 but there could be a sort of " average effect" if there were particularly bad conditions of wage/work for relatively low paid works/workers in mining sector. It does not seem the case even if, considering the relatively big difference we observed in incomes between the two sectors, the conditions of poverty observed are not as marked as the distance in income. This is a probable proxy of relevant differential in wages in the mining sector.

In Table 11 and Table 12 the variables analysed in Table 9 and Table 10 are declined for territories (Regions with high density of mining activity, specifically Region 1,2,3,4,5) instead of individuals. This analysis is helpful for two set of reason: first, the number of observations for phenomenon is more relevant than the previous one (observations for individuals employed in mining were around 2.000 cases while, if we consider the territories in which mining is a very relevant activity we move to more than 55.000 observations), second, we want to test if it is possible to observe a sort of "reduction of poverty" effect of mining activities in all the sample of Regions with relevant mining operations.

TABLE 11 REGIONS WITH LOW DENSITY OF MINING ACTIVITY

Variable	Obs	Mean	Std. Dev.	Min	Max
Poor in assistance	161,064	.0296528	.1696281	0	1
Poor school lag	160,987	.0292943	.1686307	0	1
Poor: malnutrition children	160,838	.3613698	.4803989	0	1
Poor: lacking in affiliation to health system	160,142	.0697319	.2546954	0	1
Family Lacking in home care	160,160	.0558067	.2295488	0	1
Family lacking in occupation	159,950	.0348609	.183428	0	1
Family lacking social security	161,064	.1115333	.3147924	0	1
Family lacking retirement security	159,201	.3482956	.4764317	0	1
Home lacking in habitability	161,064	.1107262	.3137937	0	1
Home with overcrowding	160,562	.2058457	.4043195	0	1
Household lacking in good condition of housing	160,687	.0886755	.2842757	0	1
Home lacking basic services	160,816	.1393083	.346269	0	1
Home lacking in surrounding garden/environment	160,969	.0956457	.2941057	0	1
Home lacking in accessibility	160,789	.0976062	.2967823	0	1
Home lacking in good environment conditions	160,810	.0607114	.2388009	0	1
Home lacking in support and social participation	161,031	.0383901	.1921368	0	1
Home lacking in equal conditions	160,361	.0559987	.2299198	0	1
Home lacking in security conditions	161,064	.117146	.3215952	0	1
Multidimensional poverty situation (4 dimensions)	161,064	.0923794	.2895617	0	1
Situación de pobreza multidimensional con entorno y redes (5 dimensiones)	161,064	.0296528	.1696281	0	1

Source: Own elaboration on CASEN Data

In Regions with low density of mining activities 2.9% of families signal situations of poorness in Assistance, while this value is 3.3% in Regions in which density of mining activity is quite relevant. A very similar situation is registered for the school lag observed. Even for this situation, the critic cases are 2.9% vs 3.3% in favour of regions with low density of mining activities.

Malnutrition of child is higher (36.1%) in territories with low mining activities (30% where mining activity is intensive), while there are no sensible differences in affiliation to health system and lacking in home care.

Lacking of occupation (for the familiar nucleus) is a bigger problem in Region with a high density of mining activity (in these territories the value is 4.1% while is 3.4% in region with low mining density).

TABLE 12 REGIONS WITH HIGH DENSITY OF MINING ACTIVITY (REGION 1, 2, 3, 4 AND 5)

Variable	Obs	Mean .	Std. Dev.	Min	Max
Poor in assistance	55,167	.0338246	.180779	0	1
Poor school lag	55,086	.033838	.1808137	0	1
Poor: malnutrition children	54,913	.3035711	.4598038	0	1
Poor: lacking in affiliation to health system	54,664	.065491	.2473925	0	1
Family Lacking in home care	54,771	.0663855	.248957	0	1
Family lacking in occupation	54,691	.0415973	.199669	0	1
Family lacking social security	55,167	.1232077	.3286785	0	1
Family lacking retirement security	54,233	.3315878	.4707881	0	1
Home lacking in habitability	55,167	.1200355	.325006	0	1
Home with overcrowding	54,951	.239941	.4270511	0	1
Household lacking in good condition of housing	55,002	.0987964	.2983912	0	1
Home lacking basic services	55,090	.1703576	.3759501	0	1
Home lacking in surrounding garden/environment	55,143	.0746423	.2628157	0	1
Home lacking in accessibility	54,995	.1120102	.3153818	0	1
Home lacking in good environment conditions	55,010	.0542992	.2266092	0	1
Home lacking in support and social participation	55,131	.0603109	.2380641	0	1
Home lacking in equal conditions	54,802	.0757454	.2645927	0	1
Home lacking in security conditions	55,167	.12725	.3332558	0	1
Multidimensional poverty situation (4 dimensions)	55,167	.1017094	.3022685	0	1
Situación de pobreza multidimensional con entorno y redes (5 dimensiones)	55,167	.0338246	.180779	0	1

Source: Own elaboration on CASEN Data

We do not observe other very relevant differences (and we leave to the reader the full information in Table 11 and Table 12) for other proxy of poverty related to housing, environmental condition of the house and social basic services.

The Multidimensional poverty situation with the same 4 dimensions conducted for Individuals shows that Regions with low density of mining have a lower value (9%) than Regions with high density of mining (10%). If we add as fifth dimension family networks, again, the value for multidimensional poverty situation (5 dimensions) is higher in territories with high density of mining (3.3%) compared with territories with low intensity of mining (2.9%).

The results obtained by Province are quite similar to the one obtained in the analysis by Region. Even in this case, we do not have at a Province level the peculiarities that we observed for individuals working in mining sector in terms of differential in proxy for poverty.
Again, even at a different territorial level, we do not have a sort of spin off effect generated by mining activities in the Region or Provinces where the activities are located.
For completeness of analysis, data at Province level are reported in Table 13 and in Table 14.

TABLE 13 PROVINCES WITH LOW DENSITY OF MINING ACTIVITY

Variable	Obs	Mean	Std. Dev.	Min	Max
Poor in assistance	165,778	.0304262	.1717575	0	1
Poor rezago escolar	165,537	.3590376	.4797197	0	1
Poor: malnutrition children	164,916	.070072	.2552692	0	1
Poor: lacking in affiliation to health system	164,994	.0575536	.2328981	0	1
Family Lacking in home care	164,629	.0349635	.1836878	0	1
Family lacking in occupation					
Family lacking social security	165,877	.1097681	.3126014	0	1
Family lacking retirement security	163,913	.3473916	.4761429	0	1
Home lacking in habitability	165,877	.1102926	.313255	0	1
Home with overcrowding	165,346	.2075829	.4055776	0	1
Household lacking in good condition of housing	165,488	.0918314	.2887887	0	1
Home lacking basic services					
Home lacking in surrounding garden/environment	165,610	.1380351	.3449379	0	1
Home lacking in accessibility	165,774	.0942005	.2921084	0	1
Home lacking in good environment conditions	165,587	.0987396	.298313	0	1
Home lacking in support and social participation	165,617	.0598912	.2372859	0	1
Home lacking in equal conditions	165,833	.04039	.1968728	0	1
Home lacking in security conditions					
Multidimensional poverty situation (4 dimensions)	165,255	.0585156	.2347166	0	1
Situación de pobreza multidimensional con entorno y redes (5 dimensiones)	165,877	.1194198	.3242828	0	1
Poor in assistance	165,877	.0943892	.2923703	0	1
Poor rezago escolar	165,877	.0303779	.1716254	0	1

Source: Own elaboration on CASEN Data

TABLE 14 PROVINCES WITH HIGH DENSITY OF MINING ACTIVITY

Variable	Obs	Mean	Std. Dev.	Min	Max
Poor in assistance	50,295	.0305398	.1720689	0	1
Poor rezago escolar	50,214	.305851	.4607715	0	1
Poor: malnutrition children	49,890	.0639607	.2446854	0	1
Poor: lacking in affiliation to health system	49,937	.0616377	.2404987	0	1
Family Lacking in home care	50,012	.0418899	.2003397	0	1
Family lacking in occupation	50,354	.1301386	.3364592	0	1
Family lacking social security	49,521	.33299	.4712878	0	1
Family lacking retirement security	50,354	.1223537	.3276972	0	1
Home lacking in habitability	50,167	.2374669	.4255349	0	1
Home with overcrowding	50,201	.0893608	.2852666	0	1
Household lacking in good condition of housing	50,296	.1775091	.3821028	0	1
Home lacking basic services	50,338	.0773968	.2672227	0	1
Home lacking in surrounding garden/environment	50,197	.109648	.3124536	0	1
Home lacking in accessibility	50,203	.0563911	.2306776	0	1
Home lacking in good environment conditions	50,329	.0558128	.2295621	0	1
Home lacking in support and social participation	49,908	.0693476	.2540469	0	1
Home lacking in equal conditions	50,354	.1207253	.325811	0	1
Home lacking in security conditions	50,354	.0959805	.2945674	0	1
Multidimensional poverty situation (4 dimensions)	50,354	.0318346	.1755613	0	1
Situación de pobreza multidimensional con entorno y redes (5 dimensiones)					
Poor in assistance					
Poor rezago escolar					

Source: Own elaboration on CASEN Data

APPENDIX

Assessing Chilean well-being per province, considering the impact on the mining sector

5 Introduction

This section contains a preliminary study on well-being efficiency generation. The study will be continued during the following months of the REMIND project and it will be the basis for further international scientific publication.

6 Methodology and data

6.1 Methodology: The Estimation of Wellbeing Synthetic Indicator (WB)

To go beyond the usual income-related aspect of well-being, we need to consider well-being as a multidimensional phenomenon concerning several aspects of people's lives. The multidimensional nature of well-being, however, makes its calculation complex (Ivaldi et al. 2016). Furthermore, although subjective well-being and objective well-being seem to identify the same phenomenon, they are two different measures. Subjective wellbeing is an individual's self-reported perception, whereas objective wellbeing represents the objective conditions (including economic ones) affecting quality of life at a macro level.

The construction of composite indicators is complex because of two principal criticalities. Firstly, the selection of relevant domains of well-being and the weights given to each domain in the aggregation procedure. Secondly, the choice of an adequate method of the aggregation.

In order to try to limit arbitrariness in choosing the well-being dimensions, we consider the insights that emerge from the CASEN 2017 Data. In order to do not incur in the criticism of having chosen in an arbitrary manner the weights of the relevant well-being domains, and to limit the subjectivity in attribution of weights to each domain, we opt for equal weighting. Decancq and Lugo (2013) identify equal weighting as the preferred procedure when the theoretical scheme assigns to each indicator the same adequacy in defining the variable to measure and it does not allow hypotheses consistently derived on differential weightings and when the empirical knowledge is not sufficient for defining specific weights.

We compute, in fact, a composite well-being index, for Chilean Provinces, by using the factorial analysis (FA, hereafter). This latter is as a worthwhile instrument to select a set of variables that explain as much as possible of the phenomenon concerned.

The FA is a statistical technique that aims at simplifying a complex data set by representing it in terms of a smaller number of underlying variables. It allows the study of correlations between large numbers of variables, grouping them around factors, so that they are arranged on factors highly correlated with each other (Dillon and Goldstein 1984). This methodology permits explaining the variance of the phenomenon under

analysis without requesting the estimation of parameters. It can summarize a set of sub-indicators while preserving the maximum possible proportion of the total variation in the original set.
Analytically, the factor analysis can be written as follows. If we have p variables $X_1, \ldots, X_p$ measured on a sample of n subjects, then variable x_s can be written as a linear combination of m factors $F_1, \ldots, F_m$ where $m < p$:

$$x_s = k_{s1}F_1 + \ldots + k_{sm}F_m + w \quad (0)$$

where k_s are the factor loads for variable x_s; w is the part of variable x_s not explained by the factors.
FA condenses the information contained in a matrix of correlation or variance/covariance; it aims to identify statistically the latent, not directly observable dimensions of the observed phenomenon (Ivaldi et al. 2016).
We compute our composite well-being index starting from the variables of CASEN 2017 presented in Table 15

6.2 Methodology: The Well-Being generation function

In our econometric analysis, we consider the Chilean Provinces to obtain the well-being generating function and obtain the ranking by estimating a stochastic frontier in the specification proposed by Battese and Coelli (1995).
The function is estimated by employing the SFA that allows region to be distant from the frontier also for randomness (Aigner et al., 1977; Meeusen and van de Broek, 1977). In this, SFA differs from the Data Envelopment Analysis (DEA), which supposes that the distance from the frontier is entirely due to inefficiency. Again, SFA assigns a distribution to the stochastic component of the model and, thus, allows inference to be made. Inference, however, is not specific to SFA because of advances in bootstrapping in the DEA procedure (Simar and Wilson 2000). A further advantage of SFA derives from the specification of Battese and Coelli (1995), which allows a cleaner efficiency measure to be obtained comparing it with the model where one first estimates inefficiency using a frontier and, second, uses the estimated efficiency-score as the dependent variable in subsequent regression (Greene, 1993). As shown by Lensink and Meesters (2014) and Wang and Schmidt (2002), the standard two-steps approach suffers from the fact that the inefficiency is assumed to be identically and independently distributed in the main frontier equation, while it is determined by other variables in the inefficiency equation.
The following function G(.) indicates the link between the well-being and the dimensions X composing it:

$$WB_{it} = G(X)\, e^{v-u} \quad (1)$$

From equation (1), the rank efficiency (RE) among Provinces derives from the ratio between the well-being observed and that of the best performing Provinces (for which $u = 0$):

$$RE = G(X)\, e^{v-u} / G(X)\, e^{v} = e \quad (2)$$

We use the Cobb-Douglas function to model the frontier. It satisfies the assumptions of non-negativity, concavity and linear homogeneity (Kumbhakar and Lovell 2000). The well-being generating function in the log-linear form is:

$$WB_{it} = \alpha_0 + \Sigma_j\, \alpha_j \ln(X_{jit}) + v_{it} - u_{it} \quad (3)$$

where *WB* is the well-being indicator; X_j represents the *j-th* input, with j=1,…, 12; α is the parameters to be estimated; *u* is the inefficiency; *v* is the random error. Finally, we assume that v_{it} is normally distributed with mean zero and u_{it} is distributed as a truncated normal. Again, v_{it} and u_{it} are independently and identically distributed:

$$v_{it} \sim \text{iid } N(0, \sigma^2_v) \quad (4)$$
$$u_{it} \sim N^{+}(\boldsymbol{z'\eta}, \sigma^2_u) \quad (5)$$

where $\boldsymbol{z'\eta}$ is the linear predictor of inefficiency. The econometric specification of the inefficiency component is:

$$u_{it} = \Sigma_k \eta_k\, z_{kit} + e_{it} \quad (6)$$

where *z*-variables are the explicative regressors of the inefficiency component.

Moreover, e_{it} is the erratic component. Finally, efficiency is time-variant, ensuring a change in relative ranking among Regions. In other words, this accommodates the case where an initially inefficient Region becomes more efficient over time.

6.3 Data

Data used for the wellbeing analysis was taken from the CASEN survey year 2017. Provinces were considered the units of analysis; they are listed in Annex 1. Well-being in the studied provinces was considered to be represented by the dependent variables: total disposable income per household and GINI index. Independent variables chosen to describe wellbeing are grouped in 11 categories, each of them having 1 or more variables that describe it, in total 42 variables are considered. Table 15 presents the categories, variables, codes and the meaning of each of these variables.

TABLE 15 MAIN VARIABLES USED IN THE WB GENERATION PROCESS

Category	#	Variable	CASEN variable code	Variable description or calculation if relevant
Economic	1	Total corrected income per household	ytotcorh	Income of all household members in a year divided by 12 months. Corrected considering family members generating more expense (less than 18 years old, more than 60 years old and those dependent due to health conditions).
	2	Disposable income per capita	ypc	Income of all household members in a year divided by 12 months and by the number of persons in the household. Corrected considering family members generating more expense (less than 18 years old, more than 60 years old and those dependent due to health conditions).
	3	Income distribution	ytotcorh	Total corrected income per household first quintil divided by the total corrected income per household 5th quintil
	4	Property over housing	v9	Property of the house where the family inhabits. 0 none of the below, 1 rent, 2 owner
Education	5	Escolaridad	esc	Years of school attendance
	6	Completeness of schooling attendance	educ	Complete attendance to primary and secondary school 0 Incomplete schooling 1Completed
	7	Literacy	e1	Ability to read and write 0 can't read or write 1 other
	8	Parents´ schooling	r12a	Highest level of education attained by mother
Environmental quality	9	Household without access to a healthy environment	hh_d_medio	Household without access to a healthy environment

	10	Air pollution	v39b	Household has experienced air pollution or bad odours 1 Frequently, always 0 other
	11	Water pollution	v39c	Household has experienced pollution of rivers, streams, channels or similar 1 Frequently, always 0 other
	12	Residues	v39f	Ha presenciado acumulacion de basura en las calles, caminos, veredas...
Health	13	Malnutrition per household	s1	household experiencing malnutrition 1 household malnourished 0 other
	14	Health problems during the last months	s15	Occurrence of accidents or disease during the last three months. 1Yes there was an incident 0 no incident
	15	Current health status	s13	Valuation of health status from 1 to being 7 excellent health status
	16	Permanent health conditions	s31	Conditions include Physical and / or difficulty mobility , Mute or difficult speech , Psychiatric difficulty , Mental or intellectual difficulty ,Deafness or difficulty hearing even if wearing headphones, Blindness or difficulty seeing even if wearing glasses 1 experiencing any of the health conditions 0 none
	17	Infant malnutrition	s1	Nutritional status of the children 1.Malnourished or in risk of malnourishment 0. Other
Labour	18	Employed by the mining sector	rama1	What is the main activity of the business were you work. 1. Mining and quarry exploitation. 0. others
	19	Type of employment	o12	Type of employment 1 permanent, 0 other
	20	Type of contract	o16	Type of contract 1 Indefinite contract 0 other

	21	Number of working hours per week	o10	Number of working hours per week
	22	Business owner	o15	Type of responsibility in the work environment. 1 Boss or owner. 0 Other
	23	Household lacking occupation	hh_d_act	Household were none of the inhabitants has any form of job
	24	Independent worker	o15	Type of dependency relation in the work environment. 1.Independent worker 2. Other
	25	Public sector worker	o15	Type of sector of employment. 1.Public 0. Other
	26	Private sector worker	o15	Type of sector of employment. 1.Private 0. Other
Minimum conditions	27	Housing quality	calglobviv	Overall household quality. 1 acceptable or recoverable , 0 poor quality
	28	Overcrowded housing	hacinamiento	Over crowded housing. 1 overcrowded 0 other
	29	Access to health insurance	hh_d_prevs	Household affiliation to the health system 1 affiliated to the health system. 0 lacking affiliation
	30	House maintenance	v25	Type of house maintenance in the last three years
Security	31	Violence	v38e	Having witnessed shooting 1 On many occasions or always 2 Seldom or not at all
	32	Drugs	v38c	Having witnessed drug trafficking 1 On many occasions or always 2 Seldom or not at all
	33	Security	hh_d_seg	Household lacking security 1 Insecure 0 Secure
	34	Food self-sufficiency	y17	Consumption of agro-products produced at home

Landscape	35	Location: Urban or rural	zona	1 urban 2 rural
Social relationships	36	Participation	hh_d_appart	Household lacking support and public participation 1 Lacking support 0 Not lacking support
	37	Support for sickness	r7a	Possibility to get aid for a sick member of the family in the proximity circle of friends and relatives 1 With support 0 Without support
	38	Support for person with disability	r7b	Possibility to get aid for a child or a member of the family with disability, in the proximity circle of friends and relatives 1 With support 0 Without support
Services quality	39	Lack of access to public services	hh_d_servbas	Household without access to public services 1 Without access 0 With access
	40	Time spent traveling to work	o25a_hr	Time spent to go to work in minutes
	41	Sanitation Index	indsan	Quality level of sanitation services. 1 Acceptable 0 Non-aceptable
Culture	42	Participation in cultural organizations	r6	Participation in cultural organizations during the last 12 months such as vecinal committee, church, sport club, art, cultural identity, women, volunteers, student club, political party, self-help in health, work union, parent associations. 1 Participation . 0 No participation

7 Factor analysis

TABLE 16 FACTOR ANALYSIS SELECTION OF THE RELEVANT FACTOR

Factor analysis/correlation — Number of obs = 53
Method: principal-component factors — Retained factors = 8
Rotation: (unrotated) — Number of params = 228

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	10.62671	7.04188	0.3321	0.3321
Factor2	3.58482	0.49692	0.1120	0.4441
Factor3	3.08790	0.35405	0.0965	0.5406
Factor4	2.73385	0.58036	0.0854	0.6260
Factor5	2.15349	0.57721	0.0673	0.6933
Factor6	1.57628	0.33416	0.0493	0.7426
Factor7	1.24213	0.20670	0.0388	0.7814
Factor8	1.03543	0.11306	0.0324	0.8138
Factor9	0.92236	0.04752	0.0288	0.8426
Factor10	0.87484	0.21725	0.0273	0.8699
Factor11	0.65759	0.05189	0.0205	0.8905
Factor12	0.60570	0.06147	0.0189	0.9094
Factor13	0.54423	0.17273	0.0170	0.9264
Factor14	0.37150	0.01697	0.0116	0.9380
Factor15	0.35453	0.07034	0.0111	0.9491
Factor16	0.28420	0.04226	0.0089	0.9580
Factor17	0.24194	0.04932	0.0076	0.9655
Factor18	0.19262	0.01878	0.0060	0.9716
Factor19	0.17384	0.01329	0.0054	0.9770
Factor20	0.16055	0.01482	0.0050	0.9820
Factor21	0.14573	0.04414	0.0046	0.9866
Factor22	0.10159	0.01166	0.0032	0.9897
Factor23	0.08993	0.02566	0.0028	0.9926
Factor24	0.06426	0.01914	0.0020	0.9946
Factor25	0.04513	0.00793	0.0014	0.9960
Factor26	0.03720	0.01030	0.0012	0.9971
Factor27	0.02689	0.00426	0.0008	0.9980
Factor28	0.02263	0.00178	0.0007	0.9987
Factor29	0.02085	0.00797	0.0007	0.9993
Factor30	0.01287	0.00632	0.0004	0.9997
Factor31	0.00656	0.00470	0.0002	0.9999
Factor32	0.00185	.	0.0001	1.0000

LR test: independent vs. saturated: chi2(496) = 1955.83 Prob>chi2 = 0.0000

TABLE 17 FACTOR LOADING

Factor loadings (pattern matrix) and unique variances

Variable	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7
income	0.6857	0.0402	-0.3916	0.0349	0.4770	-0.0736	0.1278
gini	0.0974	-0.0168	-0.0750	0.1676	0.5553	-0.2345	0.0553
prop_house	-0.1295	-0.6831	-0.3067	0.3013	0.1037	0.0947	0.0913
y_scho	0.8726	-0.0651	-0.1145	-0.1032	0.3233	-0.0185	-0.0655
temp_employ	0.7529	-0.1121	-0.2565	-0.2821	0.0922	-0.2401	0.1540
educ_level	0.6411	0.1114	-0.2177	-0.3079	0.1313	0.1508	0.0090
literacy	-0.7933	-0.0298	0.2038	0.1808	-0.1850	0.0728	0.1092
school_par~s	0.7115	0.0318	-0.3174	-0.3146	0.1516	0.0658	-0.3427
environ	0.4714	0.4918	-0.0883	0.4932	-0.4355	-0.0233	0.0222
air_pollut	0.6670	0.4061	-0.0466	0.3290	-0.3777	-0.2204	-0.0019
water_pollut	0.3735	0.4298	-0.3189	0.4006	-0.5734	-0.0227	0.1117
residues	0.8055	0.2617	0.1429	0.1555	0.2656	-0.0657	0.0339
malnutrition	-0.2549	-0.1480	-0.1783	0.1540	-0.1619	-0.5011	-0.2456
health_pro~s	0.2196	0.4185	-0.1262	-0.4445	-0.0653	0.4485	-0.0440
health_sta~s	0.6927	0.1752	-0.4189	-0.1289	-0.0946	0.2310	0.1756
healtlh_co~s	0.4537	0.0893	-0.0148	-0.4801	-0.2456	-0.1416	0.5109
employment	-0.2995	-0.2370	0.1100	0.3864	0.0131	0.6179	-0.0709
work_hours~k	0.0854	-0.3062	0.0981	-0.5490	-0.4037	-0.0036	0.0958
work_posit~n	0.5761	-0.5791	0.2434	-0.1859	-0.3092	-0.0375	0.0681
housing_qu~y	-0.6370	0.5950	0.2888	-0.2532	0.0558	0.0772	0.1188
overcrowde~g	0.2817	0.6255	0.4526	-0.1898	0.0640	-0.0264	-0.2016
health_insur	-0.1180	0.3424	0.0575	0.3644	0.2850	0.4939	0.2601
violence	0.6738	-0.0479	0.5468	0.2242	0.2542	-0.1268	0.0540
drugs	0.7420	0.1832	0.5606	0.1880	0.0602	-0.0344	-0.0102
security	0.6647	0.1469	0.4966	0.3408	0.1581	-0.1003	0.0026
prod_food_~e	-0.5535	0.0118	-0.3833	0.2333	0.1678	-0.2005	-0.0816
lack_partic	0.3439	-0.0776	0.2318	-0.1958	-0.1753	0.1485	-0.6970
public_ser~s	-0.7450	0.4961	0.0972	-0.2865	0.0979	-0.1823	0.0091
travel_work	0.6644	-0.3031	0.4524	-0.2297	-0.0134	0.1630	0.0962
sanitation	-0.7280	0.5363	0.0843	-0.2700	0.1195	-0.1875	-0.0314
cult_partic	0.8134	0.0285	-0.1565	0.2647	-0.2370	0.0442	-0.1261
support	-0.1178	-0.3893	0.7294	0.0459	-0.0919	-0.1287	0.1606

TABLE 18 UNIQUENESS

Variable	Factor8	Uniqueness
income	-0.0139	0.1241
gini	-0.4609	0.3777
prop_house	0.2083	0.2603
y_scho	0.0445	0.0994
temp_employ	-0.0516	0.1826
educ_level	0.2016	0.3536
literacy	-0.1312	0.2269
school_par~s	0.0031	0.1482
environ	-0.0857	0.0868
air_pollut	-0.0551	0.0854
water_pollut	-0.0894	0.0637
residues	0.0626	0.1581
malnutrition	0.5348	0.2339
health_pro~s	0.1723	0.3261
health_sta~s	0.0795	0.1979
heatlth_co~s	0.0910	0.2058
employment	0.0517	0.3030
work_hours~k	0.2145	0.3697
work_posit~n	-0.1196	0.1230
housing_qu~y	-0.0067	0.0695
overcrowde~g	0.0184	0.2428
health_insur	0.2846	0.2589
violence	0.1725	0.0811
drugs	0.1468	0.0399
security	0.1553	0.1147
prod_food_~e	0.3459	0.2975
lack_partic	-0.0748	0.2395
public_ser~s	0.0577	0.0611
travel_work	-0.0397	0.1716
sanitation	0.0557	0.0488
cult_partic	0.0118	0.1688
support	0.1055	0.2385

8 Stochastic frontier analysis

TABLE 19 STOCHASTIC FRONTIER ANALYSIS 1

Source	SS	df	MS
Model	2.87607876	10	.287607876
Residual	.637536987	42	.015179452
Total	3.51361574	52	.067569534

Number of obs	= 53
F(10, 42)	= 18.95
Prob > F	= 0.0000
R-squared	= 0.8186
Adj R-squared	= 0.7754
Root MSE	= .1232

income	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
gini	1.642169	.5794869	2.83	0.007	.4727174	2.811621
y_scho	.1088896	.0405998	2.68	0.010	.026956	.1908233
temp_employ	2.55108	.5812574	4.39	0.000	1.378055	3.724105
school_parents	-.7212264	.8334011	-0.87	0.392	-2.403098	.9606452
air_pollut	-.0866583	.0725196	-1.19	0.239	-.2330088	.0596921
health_status	.2649566	.1306698	2.03	0.049	.0012543	.5286589
work_hours_week	-.3378703	.1167797	-2.89	0.006	-.5735414	-.1021993
security	-.0024326	.3827425	-0.01	0.995	-.7748383	.769973
sanitation	.0008457	.2558018	0.00	0.997	-.5153832	.5170745
support	-1.599339	1.626143	-0.98	0.331	-4.881029	1.682351
_cons	.3276983	1.998856	0.16	0.871	-3.706157	4.361553

TABLE 20 STOCHASTIC FRONTIER ANALYSIS 2

Stoc. frontier normal/half-normal model — Number of obs = 53
Wald chi2(10) = 8.61e+10
Log likelihood = 52.704653 — Prob > chi2 = 0.0000

income	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
gini	2.258916	.0001705	1.3e+04	0.000	2.258582	2.25925
y_scho	.1890667	.0000138	1.4e+04	0.000	.1890397	.1890937
temp_employ	2.137837	.0003602	5935.62	0.000	2.137131	2.138543
school_parents	-2.009826	.000092	-2.2e+04	0.000	-2.010006	-2.009645
air_pollut	-.0754107	.000019	-3975.94	0.000	-.0754478	-.0753735
health_status	.2884375	.0000578	4987.37	0.000	.2883241	.2885508
work_hours_week	-.3670301	.0000354	-1.0e+04	0.000	-.3670995	-.3669607
security	-.4811778	.0000635	-7578.60	0.000	-.4813023	-.4810534
sanitation	-.1810977	.0001389	-1303.66	0.000	-.18137	-.1808255
support	-1.203321	.0002659	-4524.91	0.000	-1.203842	-1.2028
_cons	.3755973	.0006442	583.00	0.000	.3743346	.37686
/lnsig2v	-37.47688	319.3987	-0.12	0.907	-663.4869	588.5331
/lnsig2u	-3.440438	.1942572	-17.71	0.000	-3.821175	-3.059701
sigma_v	7.28e-09	1.16e-06			8.4e-145	6.3e+127
sigma_u	.179027	.0173886			.1479934	.2165681
sigma2	.0320507	.0062261			.0198478	.0442535
lambda	2.46e+07	.0173886			2.46e+07	2.46e+07

Likelihood-ratio test of sigma_u=0: chibar2(01) = 21.53 Prob>=chibar2 = 0.000

FIGURE 31 EFFICIENCY BY PROVINCE

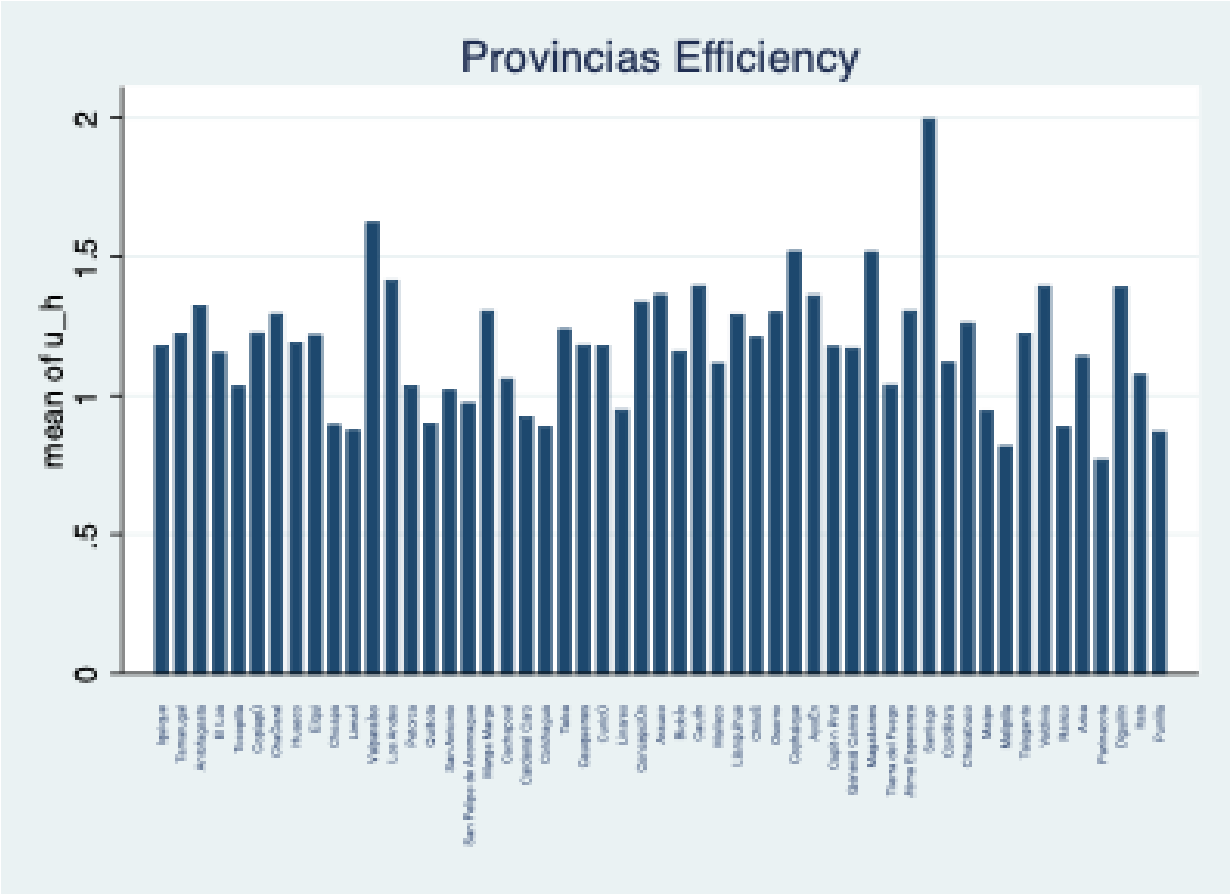


TABLE 21 EFFICIENCY BY CHILEAN PROVINCE

Provincia	Efficiency	Mining
Antofagasta	1.500100293	1
Arauco	1.192316435	0
Arica	1.270105834	1
Aysén	1.242094554	0
Biobío	1.0687249	0
Cachapoal	1.111568134	1
Capitán Prat	1.17813877	0
Cardenal Caro	0.899888345	0
Cauquenes	0.862530603	0
Cautín	1.139952353	0
Chacabuco	1.255298748	0
Chañaral	1.389473242	1
Chiloé	0.886026244	0
Choapa	0.818039216	1
Colchagua	0.933196836	0
Concepción	1.384731578	0
Copiapó	1.226859965	1
Cordillera	1.468595681	0
Coyhaique	1.492817796	0
Curicó	1.174298349	0
Diguillin	1.18622119	0
El Loa	1.478490191	1

Elqui	1.212525849	1
General Carrera	1.064229908	1
Huasco	1.080566182	1
Iquique	1.345599914	1
Itata	0.720869281	0
Limarí	0.924306307	1
Linares	0.917017489	0
Llanquihue	1.265434514	0
Los Andes	1.384942546	1
Magallanes	1.671561466	1
Maipo	1.145336905	0
Malleco	0.846872991	0
Marga Marga	1.422984831	0
Melipilla	0.962561608	1
Osorno	1.169351241	0
Parinacota	0.659707768	0
Petorca	0.869919397	1
Punilla	0.814425142	0
Quillota	0.923925958	1
Ranco	0.872230921	0
San Antonio	1.325603614	0
San Felipe de Aconcagua	0.999030513	1
Santiago	1.928910412	0
Talagante	1.332177313	0

Talca	1.040265004	0
Tamarugal	1.069071345	1
Tierra del Fuego	1.496226891	0
Tocopilla	1.159528135	1
Última Esperanza	1.354974345	0
Valdivia	1.340766798	0
Valparaíso	1.665399788	0

TABLE 22 LIST OF PROVINCES AND THE REGION THEY BELONG TO, CONSIDERED IN THE STUDY.

Province*	Region
Antofagasta	Antofagasta
Arauco	Biobio
Arica	Arica y Parinacota
Aysén	Coyhaique
Biobío	Biobio
Cachapoal	Libertador Bernardo O´Higgins
Capitán Prat	Coyhaique
Cardenal Caro	Libertador Bernardo O´Higgins
Cauquenes	Maule
Cautín	La Araucanía
Chacabuco	Metropolitana
Chañaral	Atacama
Chiloé	Los Lagos
Choapa	Coquimbo
Colchagua	Libertador Bernardo O´Higgins
Concepción	Biobio
Copiapó	Atacama
Cordillera	Metropolitana
Coyhaique	Coyhaique
Curicó	Maule
Diguillin	Ñuble
El Loa	Antofagasta

Elqui	Coquimbo
General Carrera	Coyhaique
Huasco	Atacama
Iquique	Tarapacá
Itata	Ñuble
Limarí	Coquimbo
Linares	Maule
Llanquihue	Los Lagos
Los Andes	Valparaíso
Magallanes	Magallanes y Antartica
Maipo	Metropolitana
Malleco	La Araucanía
Marga Marga	Valparaíso
Melipilla	Metropolitana
Osorno	Los Lagos
Parinacota	Arica y Parinacota
Petorca	Valparaíso
Punilla	Ñuble
Quillota	Valparaíso
Ranco	Los Ríos
San Antonio	Valparaíso
San Felipe de Aconcagua	Valparaíso
Santiago	Metropolitana
Talagante	Metropolitana

Talca	Maule
Tamarugal	Tarapacá
Tierra del Fuego	Magallanes y Antartica
Tocopilla	Antofagasta
Última Esperanza	Magallanes y Antartica
Valdivia	Los Ríos
Valparaíso	Valparaíso
Provincia	Region
Antofagasta	Antofagasta
Arauco	Biobio
Arica	Arica y Parinacota
Aysén	Coyhaique
Biobío	Biobio
Cachapoal	Libertador Bernardo O´Higgins
Capitán Prat	Coyhaique
Cardenal Caro	Libertador Bernardo O´Higgins
Cauquenes	Maule
Cautín	La Araucanía
Chacabuco	Metropolitana
Chañaral	Atacama
Chiloé	Los Lagos
Choapa	Coquimbo
Colchagua	Libertador Bernardo O´Higgins
Concepción	Biobio

Copiapó	Atacama
Cordillera	Metropolitana
Coyhaique	Coyhaique
Curicó	Maule
Diguillin	Ñuble
El Loa	Antofagasta
Elqui	Coquimbo
General Carrera	Coyhaique
Huasco	Atacama
Iquique	Tarapacá
Itata	Ñuble
Limarí	Coquimbo
Linares	Maule
Llanquihue	Los Lagos
Los Andes	Valparaíso
Magallanes	Magallanes y Antártica
Maipo	Metropolitana
Malleco	La Araucanía
Marga Marga	Valparaíso
Melipilla	Metropolitana
Osorno	Los Lagos
Parinacota	Arica y Parinacota
Petorca	Valparaíso
Punilla	Ñuble

Quillota	Valparaíso
Ranco	Los Ríos
San Antonio	Valparaíso
San Felipe de Aconcagua	Valparaíso
Santiago	Metropolitana
Talagante	Metropolitana
Talca	Maule
Tamarugal	Tarapacá
Tierra del Fuego	Magallanes y Antártica
Tocopilla	Antofagasta
Última Esperanza	Magallanes y Antártica
Valdivia	Los Ríos
Valparaíso	Valparaíso

*Missing provinces are Isla de Pascua, Parinacota y Antartica.

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