

A Spatial Decomposition of Income Inequality in Chile

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Abstract: Previous literature identifies the high and persistent income inequality of Chile, but the geographic heterogeneity of this inequality is still unexplored. This lack of discussion motivates the existence of spatially blind policies that ignore the interaction between individual and spatial inequality. To evaluate its magnitude, we propose spatial decomposition at regional, province and county level. Our decomposition indicates that between 1992 and 2009, 21% of the total inequality is attributable to geographical scale. The results show that spatial inequality is a relevant magnitude to be considered by policy makers.

Keywords: income inequality, three stage nested Theil index, spatial, Chile.

JEL classification: C8, O15, O21, O18, O51, R11, R12.

1. Introduction

The recent Organization for Economic Cooperation and Development (OECD) report¹ estimates a Gini coefficient of 0.5 for Chile, the highest level among the countries included, and much higher than the OECD average (0.31). However, the reported income inequality is not a surprise. According to Solimano and Torche (2008), the Gini coefficient was persistently high between 1987 (0.58) and 2006 (0.55). This persistence is robust, even for alternative inequality indicators. For example, the RAZ ratio of the richest 20% of the population is 17 times the average income of the poorest 20%, compared with 9:1 in the United States and 10:1 in Peru (PNUD, 1995). Contreras (1999) also suggests that this ratio remained unaltered between 1990 and 1996, although the author identifies a slight increase of the income variance during the same period. Chile is thus well established as a country with one of the highest income inequalities in the world (Lopez and Miller, 2008).

This high and persistent inequality contrasts with the outstanding economic performance of Chile. As Schmidt-Hebbel (2006) notes, the Chilean GDP per capita grew at an annual average rate of 4.1% between 1991 and 2005, a rate that was significantly higher than the world average. Moreover, between 1985 and 1997, a period called the *Golden Age*, Chile achieved a growth rate of 7.1%, and its per capita income is doubled for the this period (De Gregorio, 2005). Consequently, the country showed improvements in social indicators such as a reduction in poverty rate, from 40% in 1987 to 15% in 2011². This economic success made Chile a model among Latin American countries, with other countries adopting similar macroeconomic policies to those implemented by Chile in the 80s (Contreras, 1996).

This combination of strong economic growth and increasing income inequality in Chile has triggered a new wave of research. Lopez and Miller (2008) suggest that low levels of fiscal expenditure, caused mainly by low tax revenues, has not permitted the provision of a public

education system that would be effective in increasing the quality of human capital in the poor – medium income class. They suggest that the tax structure contains several loopholes (especially in the payment of direct taxes) have been used to increase the concentration of income in the richest portion of the population. The deficiency of this revenue source implies that the government must use indirect taxes as a main revenue source to finance the public expenditure. Given that the indirect taxes are mainly provided by low and medium income level households, then the fiscal structure reinforces the income inequality. This is on the hypothesis to understand how Chile achieves strong and sustained economic growth, but one of the most unequal economies in the world.

Beyond fiscal explanations, the spatial distribution of the inequality may be fundamental in understanding the reasons for persistent inequality and in designing appropriate policies (Beenstock and Felsenstein, 2008). In the absence of a high level of mobility of labor to geographically concentrated areas of economic growth and opportunity, pockets of relative poverty and slow growth may persist³. This paper explores this largely unknown and, perhaps, misunderstood dimension of the inequality income in Chile – its economic geography (Rodriguez-Pose and Gill, 2006). That is, how much of the income inequality among individuals is attributable to the inequality among the regions/places of residence?

Mainstream economics rarely incorporates geography even when each of the agents under study is mandatorily located on a spatial scale such as a county, province or region. Accordingly, the income inequality among individuals is, thus far, assumed to be an isolated process disconnected from the spatial location. This implies that traditional studies on income inequality curiously ignore the oldest law of geography, “everything is related to everything else, but near things are more related than distant things” (Tobler, 1970). Moreover, while the spatial disparities are in the core of the public policy for countries as (Yang, 2004), United States (Yakamoto, 2008) or UK (Rice and Venables, 2003), the discussion in Chile still does not consider this dimension and

consequently, the design and application of regional policies are still ignored in the public agenda (See Aroca, 2009).

We decompose the income inequality of Chile into a spatial and individual component. We follow Gustafsson and Shi (2002) and Akita (2003) who suggest two stages decomposition: between provinces and between regions. Given that Chile owns three spatial scales, namely counties, provinces and regions, we push Akita's idea with a three-stage decomposition. We use the micro data from National Socio-Economic Characterization Survey CASEN (*Encuesta de Caracterizacion Socio Economica Nacional*) from 1992, 1994, 1996, 1998, 2000 2003, 2006 and 2009. This type of spatial-time dynamic has not been previously reported in the literature, and then the estimation becomes a base line for future research on this area.⁴ We test our estimated Theil index to determine whether the spatial inequality is a significant portion of the total inequality. This procedure is carried out using spatial bootstrapping with simulations to identify if the estimated spatial disparity is an "anomalous" result in comparison when a complete random process is observed. As far as we know, the previous decomposition of spatial disparity provided by the literature has not tested this significance (see Rey (2001) for a more formal discussion).

Our results confirm the importance of geographic location in disentangling the determinants of income inequality in Chile. On average, 21% of the total inequality in Chile is related to the income inequality among spatial units, while 79% of the inequality is related to other individual characteristics. According to Novotný (2007), a prudent threshold to assign a high level of spatial inequality is a share greater than 6%. Using this criterion, Chile is not only a country with one of the highest inequalities among individuals, but it also has one of the highest levels of inequality among spatial units. Further, this spatial inequality has remained stable over time.

The rest of the paper is structured as follows: the next section presents the case of Chile and the main features of its income inequality. In Section 3, the decomposition method and statistical test are described. We present descriptive data and some features of the geography of Chile in

Section 4. Section 5 contains our main results. Section 6 describes some policy implications with conclusion following in Section 7.

2. Literature review and spatial inequality in Chile.

Paradoxically, inequality is an inherent characteristic of geography (Shorrocks & Wan, 2005, Gustafsson & Shi, 2002). On one hand, regional science suggests the unbalanced development of spatial units as a stylized fact (Myrdal 1957, Hirschmann 1958). The existence of a core periphery structures implies that the spatial scale affects individual inequality (Novotný, 2007). On the other hand, urban economics defines spatial labor sorting as the outcome in which skilled labor forces tend to be spatially clustered in core areas, while the peripheral zones are occupied by the labor force with lower skill (Combes, 2011). This fact implies that previous hypothesis about the role of human capital to explain the income inequality at individual level proposed by Lopez and Miller (2008), also could play a spatial version to explain the potential spatial disparities. Given that most educated population prefer to access to some amenities which are generally located in main metropolitan areas, the spatial income disparity is reinforced by the spatial location of human capital. This causal mechanism would explain what the Metropolitan Region of Santiago (MR), with the 2% of the total territory, has increased its concentration of population from 15.7% in 1907 until 40.3% in 2012. As far as geographical location is an inherent characteristic of an individual, income inequality needs to be examined from new spatial perspectives (Venables, 2005). These argument highlights that the literature of spatial disparities must not be considered as a substitute of the individual inequality, but rather those sources previously considered, such as educational system and unequal human capital, could be also are operating behind the spatial disparities. In other words, the income inequality at individual level and its spatial version must be complementary approaches to understand the complete case of Chile.

This complementary perspective as been largely present in literature of economic development, but has recovered some interest from the regional science and urban economics. The

unequal nature of economic development is a stylized fact identified by interpersonal differences and spatial disparities (Cowell, 1995). Regarding interpersonal differences, Kuznets (1955) suggests an inverted U pattern for the concentration of income and the evolution of economic development. This process implies an early stage of development with high-income concentration in few a social groups, with this concentration diminishing as development proceeds. As Rey (2001) indicates, this inverted U pattern also has a spatial interpretation.. Williamson (1965) proposes that unequal initial endowments imply spatial income disparity, but market mechanisms, mainly through labor and firm mobility, lead to the decline of regional disparity in the long run. This idea is also formalized by leading theories in the field of regional science such as the New Economic Geography (Fujita et al., 2001) and the New Economic Geography and Growth (Baldwin et al. 2005) where the spatial disparity is a plausible outcome of a spatial equilibrium model.

Regrettably, the empirical validation of the inverted U requires comparing a series of data over a long period of time. The implied data requirements pose a binding constraint for developing countries such as Chile. Despite the lack of data, some insights can be obtained using the available information between 1990 and 2009. Considering counties to be observations, Figure 1 shows the ratio between the 10th percentile and the 90th (10/10) and the 5th and 95th percentiles (5/5). Both series show the same pattern with a ratio that falls between 1992 and 2009. However, the level of the ratio must be carefully interpreted. For example, the spatial ratios (5/5) and (10/10) seem to be much lower than previously reported by the literature when the observations are persons (approximately 15:1 for 2009).

Even when the difference among spatial and individual ratio is high, the spatial ratio has an additional mechanism that does not exist at the individual level: the adjustment dynamics of the regional labor markets. The continuous flows of migration, capital and firms, are expected (theoretically) to contribute to the reduction of spatial wage disparities in the long run⁵. This mechanism implies that regions will exhibit lower disparity than individuals due to interregional

resource mobility (Niebuhr et. al, 2012). Nevertheless, even when this adjustment mechanism could operates among regional labor market; Chile shows a spatial ratio of approximately 3.5 between the percentile 5 and 95. The high ratio is perhaps especially surprising in light of the fact that Chile has a similar minimum wage throughout the country. Additionally, the country does not own regional compensation or any another premium by geographical zones, avoiding wage differential by spatial compensation⁶. This fact conveys to think about how the regional markets can adjust the wage differentials, especially to think about how real is the assumption of free mobility in a country with 4000 kilometers. Summing up, this ratio seems to even highlight the potential existence of geographical characteristics to argue the existence of spatial income inequality in Chile.

<<INSERT FIGURE 1 HERE>>

One of the problems with the Figure 1 is that this percentile ratio is not a standard inequality index used by the literature. Also, the lack of confidence intervals does not permit to evaluate the significance of the change across the time. For this reason, in the Figure 2, the Theil index includes a confidence interval computed with bootstrapping that is used to evaluate the null hypothesis of no change between any pair of years. As shown, there is no statistical evidence to argue that the spatial income inequality diminished between 1990 and 2009. All of the lower confidence bounds are below any upper bound for any given year. This result then infers that spatial income inequality has been persistent for the available period of data.

<<INSERT FIGURE 2 HERE>>

The above descriptive analysis reveals a coincidence between the widely discussed income inequality at the individual level and spatial income inequality, both persistent over the past 20 years. Assuming that Chile is at an early to medium stage of economic development, Williamson's hypothesis would suggest that Chile could start a spatial de-concentration process. That means that the spatial concentration is generating negatives externalities such as congestion, reduction of

quality of living among other consequences. If this threshold has been reached, then the spatial concentration is not a efficient equilibrium anymore. Despite the restricted data, there is no statistical evidence of a significant reduction of spatial income inequality. This result seems consistent with the current social environment in Chile. During the last three years, a number of social movements have raised concerns about income inequality, especially with a territorial perspective (Aigner, 2011). Contreras and Macias (2002) suggest a strong spatial imbalance of educational performance that is intimately related to income inequalities. Particularly, they highlight the fact that the Metropolitan Region of Santiago (MR) has a significantly higher educational performance than the rest of the regions. This inequality has been one of the main topics in current educational movements in Chile, and the entire educational system is being challenged because its intrinsic design could be a potential source of spatial inequalities. While the link between the education system and income inequality at individual level has been documented by Lopez and Miller (2007) and Contreras (1996), these articles do not mention the consequences of education inequality on the spatial disparities. Given that the spatial disparity seems to be significant and persistent, the spatial sorting of human capital could be also an interesting factor to explain this result (See Paredes, 2012b).

However, spatial educational inequality is not the only factor to explain spatial income disparities in Chile. The disparity is apparent in other areas such as regional development. Strong critiques on the lack of regional policies (Aroca, 2009), the absence of policies to correct for local price inflation (Paredes, 2011 and Paredes & Iturra, 2012) and the absent of migration flows among labor regional markets (Paredes, 2012a). Altogether, the literature has been strongly focused on income inequality at the individual level, even though geographic inequality is highly persistent, with potentially negative consequences for the equity, and likely on the efficiency of the economic system (Armstrong & Taylor, 2000).

3. Methodology

Although this paper draws geography into the analysis of the Chilean situation, it does not intend to open a novel perspective on the current analysis but rather move a step further with the existing diagnostic. We do not consider the role of geography as an estimation of indexes at a smaller spatial scale than the national scale⁷; we want to reinterpret the current inequality by considering its spatial component. Akita (2003) suggests this idea in an excellent application on China and Indonesia by decomposing the Theil index in two stages: within provinces, between provinces and between regions. We push Akita's idea further in two aspects. First, we propose a three-stage decomposition in which the county scale is added. This proposition differs from other decomposition works such as that of Gustafsson and Shi (2002) in that we provide a detailed explanation about how to perform this decomposition. In particular, these authors do not explain how the mathematical decomposition is constructed but instead empirically evaluate the case of China. The absence of an explanation affects the application of the tool for other contexts, especially in cases where the methodology needs to be extended. Second, Akita (2003) uses a district average as the lowest observation scale (within provinces). Here, we propose to use household incomes as observations as did Gustafsson and Shi (2002). Therefore, we do not assume a representative income by a spatial unit but define the observations at the lowest level – households. In this way, we assume that inequality comes from two sources, individual and spatial⁸. This change allows us to compare our results with the existing literature on individual inequality in Chile. Thus, our strategy is not proposed to be an alternate analysis to the current literature of Chile. Instead, we offer a complementary analysis to evaluate the role of the spatial scale.

The relevance of this three-stage decomposition is strongly justified from a policy perspective. Firstly, the proposed approach does not require imposing a particular spatial scale to analyze the spatial inequality. The one-stage decomposition, provinces, for example, implies that this selected scale (province) is where the spatial inequality is operative. In contrast, the two-stage decomposition includes another spatial dimension that allows the researcher to evaluate which one

is more relevant. However, it is not obvious how we must proceed when there are more than two spatial scales⁹. This problem is relevant for the increasing number of countries in which the administrative space contains at least three levels. In particular, Chile already disposes of disaggregated information at three spatial scales, and undoubtedly, policy makers cannot ignore this information. For these cases, a detailed three-stage decomposition would be a powerful tool for the determination of territorial policies (Shankar and Sha, 2003). Thus, this methodology can be used as an empirical tool to estimate the magnitude of the spatial inequality at different geographical layers.

3.1. One stage Theil decomposition method

Akita (2003) proposes the “region-province” as the basis of the hierarchical structure of a country. The economic agents are located in a province that is nested in a region. The overall regional income inequality (T_p) (or equivalently, the total income inequality for this case) is measured by the following Theil index (T):

$$T_p = \sum_r \sum_p \left(\frac{Y_{rp}}{Y} \right) \log \left(\frac{Y_{rp}/Y}{N_{rp}/N} \right) \quad (1)$$

where Y_{rp} is the income of province p in region r , Y is the total income of all provinces of all regions ($= \sum_r \sum_p Y_{rp}$) or the national income, N_{rp} is the total population of province p in region r , and N is the total population of all provinces ($= \sum_r \sum_p N_{rp}$) or the national population. From Eq. (1) we can define (see Appendix A):

$$T_p = \sum_r \left(\frac{Y_r}{Y} \right) T_{pr} + \sum_r \left(\frac{Y_r}{Y} \right) \log \left(\frac{Y_r/Y}{N_r/N} \right) \quad (2)$$

$$T_p = T_{WR} + T_{BR}, , ,$$

where the overall regional income inequality (T_p) can be decomposed into: within region income inequality (T_{WR}) and between region income inequality (T_{BR}).

3.2. Three-stage nested Theil decomposition method

We extend the one-stage decomposition to a region-province-county-individual structure. In this case, the individual is the underlying unit; overall regional income inequality is measured by the following Theil index:

$$T_i = \sum_r \sum_p \sum_c \sum_i \left(\frac{y_{rpci}}{Y} \right) \log \left(\frac{y_{rpci}/Y}{n_{rpci}/N} \right) \quad (3),$$

where y_{rpci} is the income of individual i in county c in province p in region r , Y is the total income of all individuals ($= \sum_r \sum_p \sum_c \sum_i y_{rpci}$), n_{rpci} is the individual i in county c in province p in region r , and N is the total population ($= \sum_r \sum_p \sum_c \sum_i n_{rpci}$). T_i is the standard index of inequality, reported by the literature at the individual level. Following Eq. (3), we can define T_{ir} as follows to measure between individual income inequality for region r :

$$T_{ir} = \sum_p \sum_c \sum_i \left(\frac{y_{rpci}}{Y_r} \right) \log \left(\frac{y_{rpci}/Y_r}{n_{rpci}/N_r} \right) \quad (4)$$

Then, T_i in equation (3) will be decomposed into:

$$T_i = \sum_r \left(\frac{Y_r}{Y} \right) T_{ir} + \sum_r \left(\frac{Y_r}{Y} \right) \log \left(\frac{Y_r/Y}{N_r/N} \right) = \sum_r \left(\frac{Y_r}{Y} \right) T_{ir} + T_{BR} \quad (5)$$

Therefore, the overall regional income inequality T_i is the sum of the within region component and between region component. Next, we define T_{cr} as follows to measure within county income inequality for county c in province p in region r :

$$T_{cr} = \sum_i \left(\frac{y_{rpci}}{Y_{rpc}} \right) \log \left(\frac{y_{rpci}/Y_{rpc}}{n_{rpci}/N_{rpc}} \right),$$

And T_{ir} in Eq. (4) can be decomposed into:

$$\begin{aligned}
T_{ir} &= \sum_p \left[\sum_c \left(\frac{y_{rpc}}{Y_{rp}} \right) T_{rc} + \sum_c \left(\frac{y_{rpc}}{Y_{rp}} \right) \log \left(\frac{y_{rpc}/Y_{rp}}{n_{rpc}/N_{rp}} \right) \right] \\
&= \sum_p \left[\sum_c \left(\frac{y_{rpc}}{Y_{rp}} \right) T_{rc} + T_{cr} \right] \\
&= \sum_p \sum_c \left(\frac{y_{rpc}}{Y_{rp}} \right) T_{rc} + \sum_p \left(\frac{y_{rp}}{Y_r} \right) T_{cr} + \sum_p \left(\frac{y_{rp}}{Y_r} \right) \log \left(\frac{y_{rp}/Y_r}{n_{rp}/N_r} \right) \\
&= \sum_p \sum_c \left(\frac{y_{rpc}}{Y_{rp}} \right) T_{rc} + \sum_p \left(\frac{y_{rp}}{Y_r} \right) T_{cr} + T_{pr} \quad (6)
\end{aligned}$$

where T_{cr} measures the income inequality between counties in region r , and T_{pr} measures the income inequality between provinces in region r . By substituting T_{ir} in Eq. (6) into Eq. (5), we obtain:

$$\begin{aligned}
T_i &= \sum_r \sum_p \sum_c \left(\frac{y_{rpc}}{Y_{rp}} \right) T_{rc} + \sum_r \sum_p \left(\frac{y_{rp}}{Y_r} \right) T_{cr} + \sum_r \left(\frac{y_r}{Y} \right) T_{pr} + T_{BR} \\
&= T_{WC} + T_{BC} + T_{BP} + T_{BR} \quad (7)
\end{aligned}$$

Eq. (7) is the three-stage Theil inequality decomposition. Note how this decomposition incorporates the geography as a component of individual inequality. Specifically, we can still estimate the Theil index at the individual level similar to the rest of the literature, but now we can know the extent to which the value of this coefficient that can be attributed to the interaction among the spatial scales of the individual's location.

3.3. Hypothesis testing of the spatial decomposition of the Theil index.

The incorporation of geography implies that the researcher needs statistical evidence to evaluate whether the spatial contribution to the total inequality is significant. This idea has been largely discussed by the literature of spatial econometrics, but its application is still unconsidered by the

previous literature of spatial income inequality. According to Rey (2001), the test is required to verify whether the spatial inequality index is significantly different from that for a similar index computed under a random spatial process, that is, people randomly relocated into particular spatial units. The procedure requires that the observations be randomly assigned (with permutations) to a new county, province and region, and then a new decomposition such as Eq. 7 is computed. These steps are repeated k times. Rey (2001) states that the global inequality T_i is the same for any permutation in a given period of time, but the values of T_{WC} , T_{BC} , T_{BP} and T_{BR} vary across the permutations. In this way, the empirical average of the inequality measured for a random spatial assignment is obtained as follows:

$$\bar{T}_{WC} = \frac{1}{K} \sum_{p=1}^K T_{WC}^p \quad (8)$$

Finally, assuming that the empirical sampling distribution is approximately normal, the standard deviation can be computed as:

$$S_{T_{WC}} = \frac{1}{K} \sum_{p=1}^K (T_{WC}^p - \bar{T}_{WC}) \quad (9)$$

The confidence interval for each level of inequality is estimated using $S_{T_{WC}}$. In this way, it is possible to find out whether the actual value of inequality measured is significantly different that which would result from a random distribution in space.

4. Data

The data are obtained from the National Socio-Economic Characterization Survey CASEN (Encuesta de Caracterizacion Socio Economica Nacional). CASEN is available from the mid-80s, but the lack of consistency in some variables makes it difficult to estimate using all the surveys simultaneously. This problem has been improved with the new versions of CASEN, but linking surveys is still a complex process. This paper approaches this problem with an exhaustive analysis

of each variable to connect all the available surveys. The final output generates a data with the CASENs for 1992, 1994, 1996, 1998, 2000, 2003, 2006 and 2009.

The Theil index is computed using two household income measures. The first one is defined as autonomous income, which is the total household income without considering government transferes. The second one is the total income, which is the autonomous income plus transfers. Obviously, we expect a lower inequality with total than autonomous income. We estimate both variables using per capita income (household income divided by the number of persons in the household) to avoid the scale effects (Contreras, 1999; Soto and Torche, 2008). Hereafter, both dependent variables are simply referred to as the autonomous and total incomes. Both autonomous and total household incomes are used to test the robustness of our results.

<<TABLE 1 HERE>>

Table 1 shows the number of households for each year and observations with zero income. The table also shows the administrative division used in the analysis. Chile is divided into thirteen regions¹⁰, which are the highest-level administrative units. The second-level administrative units are the provinces and finally the counties at the third level (Figure 3). Differences among years regarding the number of provinces and counties are basically explained by the geographic scope of CASEN for each year. As Shorrocks & Wan (2005, p.66) suggest, a larger number of subgroups k would increase the inequality among these k groups. This fact implies that our between county inequality could be higher than our between province inequality only by an effect of k and not by a group effect itself. This problem should be inherent to any spatial analysis in which the administrative units are hierarchically nested. However, Novotný (2007) also indicates, *“Although this proposition seems to be intuitively apparent, it has yet to have been fully analyzed formally”*. For this reason, this paper provides a confidence interval for each inequality indicator to reduce the potential distortions imposed by the number of spatial units. Thus, the estimations incorporate the potential bias effect generated by the number of regions. Finally, Figure 3 also shows two more

maps of Chile; their shapes are adjusted by counties density and counties autonomous income, respectively. The uneven distribution of the Chilean population, mainly concentrated around the Metropolitan Region, as well as that of the autonomous income, is evident. The maps show the systematic spatial pattern for the economic activity and social indicators in Chile: a high concentration around the MR

<<FIGURE 3 HERE>>

5. Results

According to previous estimates, the income inequality in Chile has decreased slightly during recent years (Solimano and Torche, 2008). We replicate these estimates, but also include recent data for 2009. Our results identify the same pattern; the grey line of Figure 4 indicates that autonomous income inequality has fallen since 1992. To evaluate the statistical significance of this reduction, the index is complemented with a confidence interval estimated using bootstrapping. For this case, the confidence interval suggests that Chile achieved a significant reduction during 2009 in comparison with any previous year, consistent with previous results. However, the income variable only provides a partial perspective of the general problem. In particular, the autonomous income does not allow us to assess the role of social policy because it does not incorporate the transfers from the government. For this reason, Figure 4 also includes the total income Theil index.

<<FIGURE 4 HERE>>

The monetary and autonomous income show very similar patterns; the reduction in inequality is significant only for 2009. The effect of social policies seems relevant because the inequality of total income is always lower than the estimated autonomous income; however, the significance depends on the confidence intervals. Bootstrapping suggests that the social policy was effective only for 2009 because the confidence intervals do not overlap for this period. Despite the fact that the objective of this paper is not related to any policy evaluation, these results are suggestive of the role

played by policies oriented to reduce inequality. Our results indicate that they are, at least, insufficient for almost the complete period.

The incorporation of new data, such as that for 2009, increases the understanding of the income inequality in Chile. However, this analysis continues to preclude important features about the spatial location of families and their effect on the income inequality. This point is captured by the three-stage nested Theil decomposition proposed in Eq. 7 and shown in Figures 5 and 6 with the autonomous and total incomes. Because the two income measures have a similar pattern they may be analyzed together. Between 1992 and 1998, around 23% of the individual inequality for both incomes is explained by the spatial location of those individuals. This spatial inequality exhibited a significant reduction in 2000 (15%), but then became stable at approximately 17% until 2009.

<<FIGURE 5 HERE>>

<<FIGURE 6 HERE>>

A number of interesting patterns are revealed. First, income inequality is due not only to individual differences, but also to differences between geographic areas. On average, 21% of the observed inequality exists due to spatial inequalities, an aspect of inequality in Chile so far ignored in the mainstream literature. A second feature, and maybe the most interesting one, is that the reduction of inequality (Figure 4) is not due to the reduction of the disparity among individuals, but rather a consequence of the reduction in the inequality among spatial units. If we combine Figures 4 and 5, total inequality has diminished since 1992, but its components do not follow the same pattern. Inequality within counties (or individual level) grew from 76% in 2003 to 83% in 2009, while inequality among counties fell by approximately 6%. This result suggests that the reduction of inequality cannot be only credited to policies directed at individuals. Some other mechanisms operating on a spatial scale are also responsible. According to Figure 6, this result is stable for both

autonomous and total income, that is, the spatial dimension affects income inequality regardless whether or not transfers are included.

We now focus on the contribution of each spatial scale, which is shown in Figures 7 and 8. Undoubtedly, counties income differences play the most important role in income inequality, regardless of the type of income considered. More than 60% of the spatial income inequality is related to counties differences from 1992 to 2000, and it decreases to approximately 50% after that point. While the counties dimension seems to be decreasing across time, the regional dimension has increased since 1992. At the beginning of period, more than 20% of the spatial income inequality was related to regional disparities, and it has increased steadily, reaching approximately 35% in 2009.

These results raise interesting research areas for understanding the role of geography in income inequality in Chile. First, the low contribution of the provincial level to spatial income inequality is expected because this administrative scale possesses almost no policy role. Actually, Chile does not have a particular policy oriented to reduce the disparities among provinces, but it has some initiatives at the regional and county levels. For counties, the Income Funding County is the solitary mechanism of redistribution of income among municipalities (counties). All of the municipalities contribute a portion of their incomes, but the richer municipalities contribute a larger portion. After the collection of incomes, the total amount is divided among the municipalities, and higher portions are reserved for poorer municipalities. This instrument is constructed to provide resources public expenditures in lagging municipalities (Horst, 2009). According to the results shown in Figures 7 and 8, this policy seems to reduce the spatial disparities among counties. A different situation affects regions. In this case, the country owns a Funding for Regional Development that pursues the harmonic and balanced growth among the regions, but its distribution has been largely criticized by the literature (Anne-Laure Szary, 1997; Atienza y Aroca, 2012).

These criticisms seem to be supported by the evolution of regional income inequality that has significantly increased during the last 20 years.

<<FIGURE 7 HERE>>

<<FIGURE 8 HERE>>

In summary, the results indicate two important issues related to income inequality in Chile between 1992 and 2009. First, as the previous literature states, income inequality has decreased slightly since 1992, but it is still high compared to other countries. Second, this decrease is not a consequence of social policies oriented to individual income differences, except in the last year. When the total inequality is decomposed into individual and county level, then the evolution of both inequalities is different. While the inequality within counties (individual level) differences have increased between 1992 and 2009, the role of spatial inequality has been stable during the period.

Finally, we assess the statistical significance of the spatial inequality. The objective is to determine whether the estimated spatial inequality is statistically significantly different from random permutations of persons across the space. This process is undertaken through bootstrapping among individual observations (consumer or firms for example) and geographical units. For this reason, the bootstrapping requires to spatially permute the workers across the space and to estimate the spatial index several times. Based on this procedure, confidence intervals were constructed for each Theil component using permutations. The results are shown in Figure 9. Clearly the estimated spatial inequality is significantly different from random experiments. This implies that the estimated spatial Theil is a realization located far away from the random distribution, implying a high p-value for rejecting the null hypothesis of zero spatial inequality.

<<FIGURE 9 HERE>>

6. Policy Implications

The spatial inequality seems to be a direct consequence of the economic growth and development. This paper shows that this process also has affected to Chile during the last 20 years. The continuous spatial inequality evidences that the adjustment of regional labor markets can generate equilibrium with significant spatial disparities. Given that the public policy must warranty the equity and social justice among individuals and spatial units, then some analysis about the spatial policy in Chile is necessary. If we think that labor mobility among regional labor markets could reduce the spatial disparity (among other factors obviously), what kind of explicit policy is considered for the Chilean case? Moreover, given the natural barrier presented by the geographical shape of Chile, then this public policy raising its significance. This section discusses some potential ideas.

6.1. Spatial concentration of high quality educational institutions

By 2005, the 47% of the Chilean students are enrolled in a university located at the Metropolitan Region of Chile where, simultaneously, are concentrated 8 of the 15 best universities of the country¹¹. Alternatively, the unique two Chilean universities present in the Shanghai Jiao Tong University Ranking 2011 are the Universidad de Chile and Pontificia Universidad Católica de Chile, both located at the MR. This prestigious implies that both universities capture, in average, around of the 35% of the students with highest SAT scores in the country. The rest of the regional universities cannot compete in equal conditions with these institutions and the cumulative causation of the process implies a divergence between the human capital generated at the MR and the rest of regional universities. This fact does not implies that the quality of these universities must be modified, but rather the public policy should warranty a significant budget to improve the quality of the regional universities in order to retain the talent of local human capital. Otherwise, the market dynamic of expectations and incentives motivates to the young and talent student to move toward the MR with evident increments in the spatial inequality. The continuous and effective regional

policies on the educational system could help to reduce the out migration of students, reducing also the spatial inequality in the long run.

6.2. Amenities and local incomes

The high skilled human capital prefers cities with high level of amenities, especially those related with cultural and recreational activities. For the case of Chile, each county cannot compete through more and better amenities because the autonomous expenditure by county is extremely low (Horst, 2009). According to the OECD, each spatial unit should freely dispose of, at least, a 30% of its budget for promoting expenditure oriented to increase the quality of live of its inhabitants. In Chile, this proportion is not over 6%. The highly centralized political system implies that each county cannot compete through the modifications of housing taxes or local subsidies. Any change in this sense must be strictly considered by the national government that clearly does not maintain the same level of information about the local requirement as the local government (Rodriguez-Pose & Ezcurra, 2010). This situation implies that a new institution for regional policy must incorporate the decentralization process as a necessary condition, where each county can collect their own resources to compete in the attraction of qualified labor force.

6.3. Labor market conditions of mining sector

A well-known characteristic of Chile is its leading position as a copper producer in the world. Given that during the last two years the copper price has achieved historical magnitudes, the wages and production of this sector has been significantly increased (Rivera and Aroca, 2012). This scenario would be perfect to reduce the spatial inequality because the main copper mining are located on the north extreme of the country, far away from the MR. However, this mechanism has not warranted an out migration toward this north area. This result is because the mining sector is authorized to use a special labor system where the workers spend some days working at the mining center and the rest days can be used in the residential region. Simultaneously, the firms

cover the most of these transportations costs. This fact plus the lack of local amenities in the north region generate a scenario labeled as Long Distance Commuting (LDC) (Aroca & Atienza, 2011). This process permits the dynamic Fly-in-Fly-Out and a significant proportion of workers can live in the central area of the country while the work in the extremes. This process incentives to stay concentrated in the place with more amenities, namely the MR, which increases also the spatial inequality of wages given that qualified workers of mining sector prefer to enjoy the amenities of the MR. This situation implies that regional policy also must act on the labor regulations in order to incentive the migration toward zones that require the multiplier effect of the local wages. A reduction of the maximum number of days worked at the mining industry or an active expenditure on local amenities could incentive to reduce the LDC, which has doubled the inter-regional migration during the last years.

7. Conclusion

The aim of this paper was to determine the portion of Chile's well-documented income inequality that can be attributed to the spatial unit in which the individual is located. Our results indicate that there is an undeniable geographical dimension of income inequality in the Chilean case. Behind the persistent and high inequality in Chile, geographic location seems to play an interesting role. On average, more than 20% of the income inequality is related to differences among spatial units.

Three main conclusions emerge from our results. First, the reduction of income inequality in Chile between 1990 and 2009 is primarily a result of a reduction in inequality among counties. Second, while inequality among counties has decreased, differences among regions have increased over time. These results are of special relevance for policy makers to assess the efficiency of the designed to reduce individual inequality both nationally and at different spatial levels (See Meliciani (2006) for a discussion in the case of Europe). Finally, despite the fact that Chile has three administrative divisions, only two of them seem to be relevant for understanding the income inequality in Chile, and these are regions and counties. Thus, Chile has to address two important

sources of inequality; the first is related to differences among individuals, the most important objective of national policy, and the second is the differences that arise due to geography. Since both dimensions play a significant role in income inequality, serious attempts to address inequality will be based on an understanding of the reasons for both.

Such as it was above discussed, the methodology is enough flexible to analyze the inequality at different spatial scales. While between regions inequality has increased during the last twenty years, between counties inequality has decreased. These results provide interesting observations for the evaluation and design of policies oriented to reduce spatial inequality in Chile. In particular, the future design of public policy must be sensible to the scale where it is operating, especially when the estimations show that this inequality follows different levels and patterns along the time. Our results include different income measurements, and the spatial components are statistically significant for the whole period. This exercise provides important insights for understanding income inequality in Chile and highlights the need to delve deeper into the analysis of the spatial perspective of this phenomenon.

8. References

- Agostini, C & Brown, P., 2007. Desigualdad Geográfica en Chile. *Revista de Análisis Económico*, Vol 22, N°1, pp,3-33.
- Aigner, M., 2011 La Protesta Estudiantil En Chile. *La Sociología En Sus Escenarios*, No. 24.
- Akita, T., 2003. Decomposing regional income inequality in China and Indonesia using two-stage nested Theil decomposition method. *The Annals of Regional Science*, 33:55-77.
- Anne-Laure S., 1997. Regiones ganadoras y regiones perdedoras en el retorno de la democracia en Chile: poderes locales y desequilibrios territoriales. *EURE*, doi: 10.4067/S0250-71611997007000004.
- Armstrong, H., & Taylor, J. (2000). *Regional Economics and Policy*. Wiley-Blackwell.
- Aroca, P., 2009. Las Desigualdades Regionales en Chile. *Foreign Affairs Latinoamérica*. Vol. 9, N°1, pp.53-62.
- Aroca, P., & Atienza, M. (2011). Economic implications of long distance commuting in the Chilean mining industry. *Resources Policy*, 36(3), 196–203. doi:10.1016/j.resourpol.2011.03.004
- Baldwin, R., Forslid, R., Martin, P., Ottaviano, G. I. P., & Robert-Nicoud, F. (2005). *Economic Geography and Public Policy*. Princeton University Press.
- Beenstock, M., & Felsenstein, D. (2008). Regional heterogeneity, conditional convergence and regional inequality. *Regional Studies*, 42(4), 475–488.
- Combes, P., Duranton, G., Gobillon, L., 2011. The identification of agglomeration economies. *Journal of Economic Geography* 11, pp. 253-266.

Contreras, D., 1996. Pobreza y desigualdad en Chile: 1987-1992. Discurso, metodología y evidencia empírica. Estudios Públicos N°64.

Contreras, D., Macías, V., 2002. Desigualdad educacional en Chile: geografía y dependencia. Cuadernos de Economía, 39, 118, pp. 395-421

Cowell, F.A., 1995. Measuring Inequality. Prentice Hall, London.

Contreras, D., 1999. Distribución del ingreso en Chile. Nueve hechos y algunos mitos. Perspectivas. Santiago, Vol 2, Num 2.

De Gregorio, J., 2005. Crecimiento Económico en Chile: Evidencia, Fuentes y Perspectivas. Estudios Públicos, 98.

Fujita, M., Krugman, P. R., & Venables, A. J. (2001). *The Spatial Economy: Cities, Regions, and International Trade* (pp. 1–380). The MIT Press.

Gustafsson, B., & Shi, L. (2002). Income inequality within and across counties in rural China 1988 and 1995. *Journal of Development Economics*, 69(1), 179-204. doi:10.1016/S0304-3878(02)00058-5.

Hirschmann, A., 1958. *The Strategy of Economic Development*, New Haven: Yale University Press.

Horst, B. (2009). Fuentes de Financiamiento para Gobiernos Subnacionales y Descentralización Fiscal. En C. p. Estado, Un Mejor Estado para Chile (págs. 207 - 240). Santiago de Chile: Pontificia Universidad Católica.

Kuznets, S., 1955. Economic growth and income inequality. *American Economic Review*, 45:1-28

López, R and Miller, S. 2008. Chile: the Unbearable Burden of Inequality. *World Development* 36, no. 12:, pp. 2679–2695.

Myrdal, G., 1957. *Economic Theory and Under-Developed Regions*. Methuen University Paperbacks, London.

Granato, N., Haas, A., Hamann, S., & Niebuhr, A. (2011). Does labour mobility reduce disparities between regional labour markets in Germany? *Regional Studies*.

Meliciani, V. (2006). Income and employment disparities across European regions: The role of national and spatial factors. *Regional Studies*, 40(1), 75–91.

Novotný, J., 2007. On the measurement of regional inequality: does spatial dimension of income inequality matter?. *Annals of Regional Science*. 41:563-580. Doi 10.1007/s00168-007-0113-y.

Paredes, D., 2011. A methodology to compute a regional housing price index using matching estimator methods. *Annals of Regional Science*, Vol 46, pp 139-157.

Paredes, D., 2012a. Alternative theories for explaining the spatial wage inequality: a multilevel competition among human capital, NEG and amenities. Working paper WP2012-06, Department of Economics, Universidad Catolica del Norte.

Paredes, D. 2012b. Spatial wage differentials and the role of spatial sorting Working paper WP12012-14. Department of Economics, Universidad Catolica del Norte.

Paredes, D., & Iturra, V., 2012. Substitution Bias and the construction of a spatial cost of living index. *Papers in Regional Science*. DOI: 10.1111/j.1435-5957.2011.00408.x.

Ramírez, E., Tartakowsky, A., and Mondrego, F., 2009. La importancia de la desigualdad geográfica en Chile. Working Paper N° 30, Rimisp- Centro Latinoamericano para el Desarrollo Rural.

Ramírez, E., Tartakowsky, A. and Modrego, F. 2009. “La importancia de la desigualdad geográfica en Chile”. Documento de Trabajo N° 30. Programa Dinámicas Territoriales Rurales. Rimisp, Santiago, Chile.

Rey, S., 2001. Spatial Analysis of Regional Income Inequality. Regional Economics Applications Laboratory, University of Illinois, Working Paper.

Rice, P., & Venables, A. (2003). Equilibrium regional disparities: theory and British evidence. *Regional Studies*, 37(6-7), 675–686.

Rivera, N., and Aroca, P., 2012. Escalas de Producción y Propiedad del Capital en Economías Mineras. El Caso de Chile. Working paper.

Roback, J. (1982). Wages, rents, and the quality of life. *The Journal of Political Economy*, 1257–1278.

Rodríguez-Pose, A., and Ezcurra, R., 2010. Does decentralization matter for regional disparities? A cross- county analysis. *Journal of Economic Geography*, pp.619-644.

Rodríguez-Pose, A and Gill, N., 2006. How Does Trade Affect Regional Disparities?,” *World Development* 34, no. pp. 1201–1222.

Schmidt-Hebbel, K., 2006. El crecimiento económico de Chile. Central Bank of Chile Working Paper N° 365.

Shankar, R and Shah, A., 2003. Bridging the Economic Divide Within Countries: a Scorecard on the Performance of Regional Policies in Reducing Regional Income Disparities, *World Development* 31, no. 8, pp. 1421–1441.

Shorrocks, a., & Wan, G. (2005). Spatial decomposition of inequality. *Journal of Economic Geography*, 5(1), 59-81. doi:10.1093/jnlecg/lbh054

Solimano, S & Torche, A 2008. La distribución del ingreso en Chile 1987-2006: Análisis y consideraciones de política. Central Bank of Chile Working Paper, N° 480.

Tobler W., 1970. "A computer movie simulating urban growth in the Detroit region". *Economic Geography*, 46(2): 234-240

Venables, A., 2005. Spatial disparities in developing countries: cities, regions, and international trade. *Journal of Economic Geography*, 5, pp. 3-21.

Willianson, J., 1965. Regional inequality and the process of national development. *Economic Development and Cultural Change*, 4:3-47.

Yang, D. T. (2004). What has caused regional inequality in China? *China Economic Review*, 13(4), 331–334.

Yamamoto, D. (2008). Scales of regional income disparities in the USA, 1955–2003. *Journal of Economic Geography*, 8(1), 79–103.

Zhang, X & Kanbur, R., 2001. What difference do polarization measures make? An application to China. *Journal of Development Studies*, 37, pp. 85-98.

9. Figures

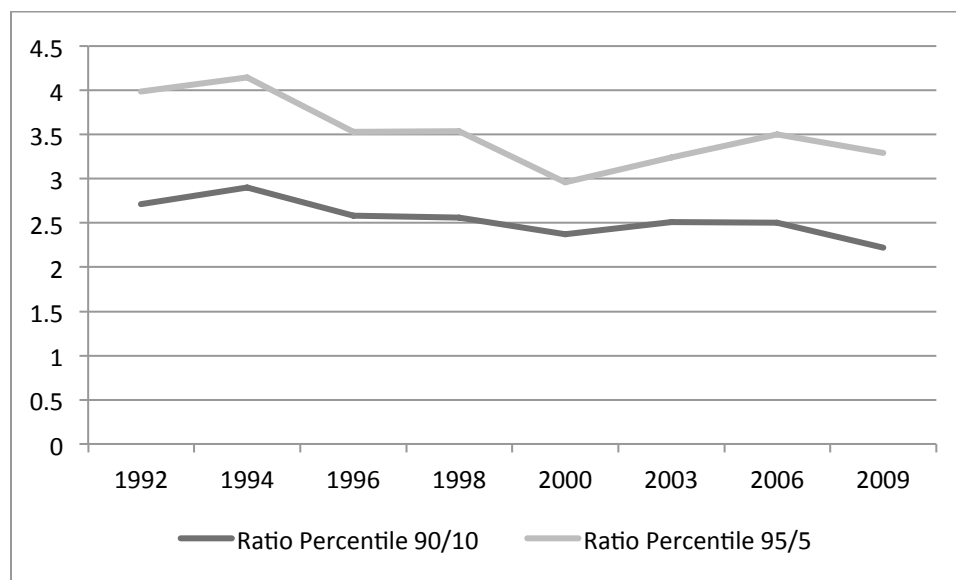


Figure 1: 10/10 and 5/5 ratio for Chilean counties for the period 1990-2009.

Source: Authors

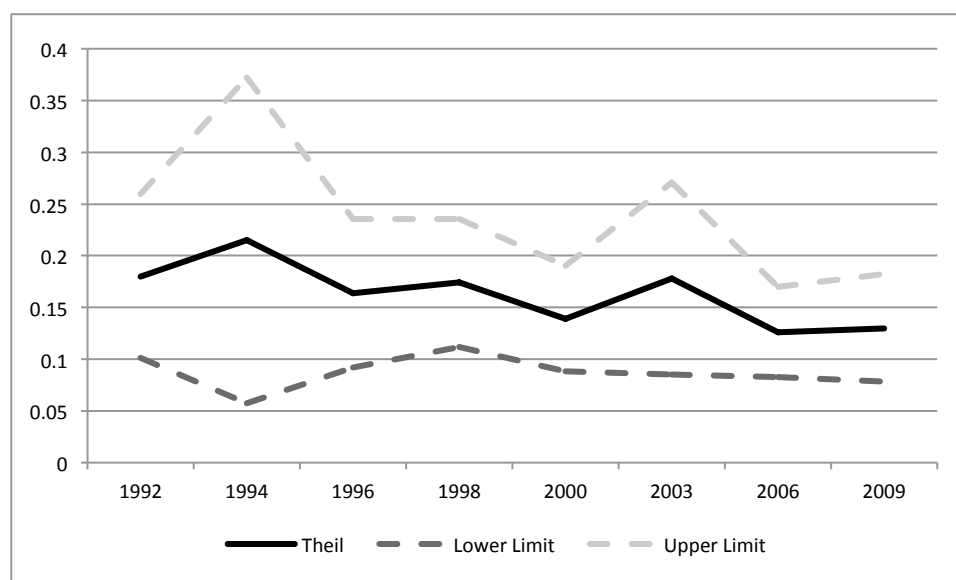


Figure 2: Theil index among Chilean counties for the period 1990-2009.

Source: Authors

Chilean Political Divisions: Regions and Municipalities



Gastner-Newman's Cartograms:

Municipal Population Density



Municipal Mean Household Autonomous Per Capita Income



Gastner, M.T. and Newman, M. (2004). Diffusion-based method for producing density equalizing maps. *Proceedings of the National Academy of Sciences of the United States of America*. 101(20): 7499-7504

Figure 3: Map of Chile

Source: Authors

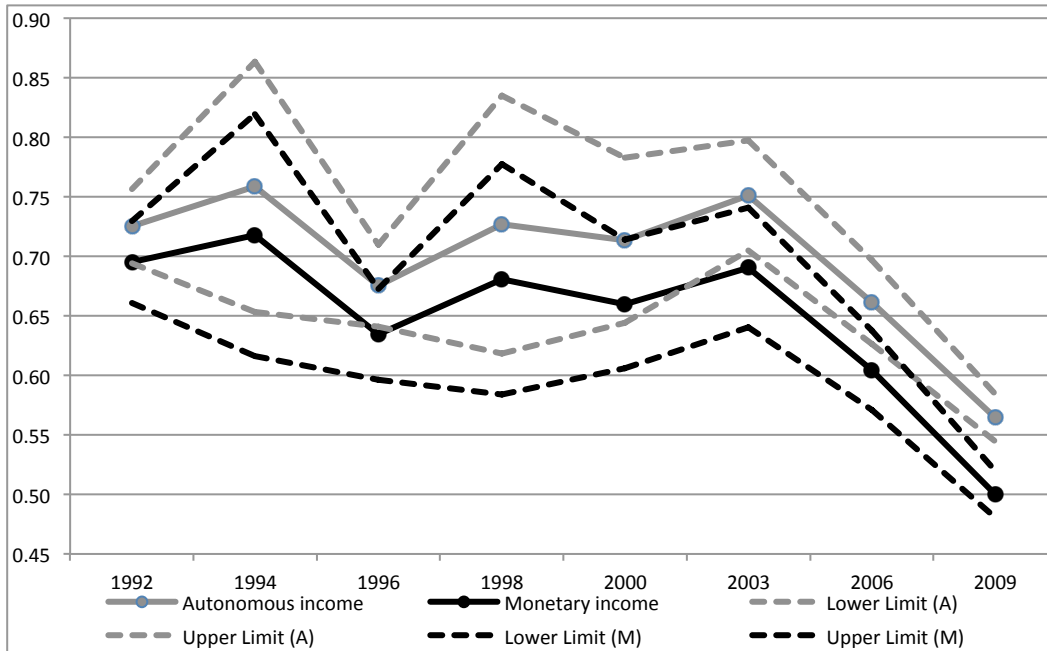


Figure 4: Theil index for Chile from 1992-2009: Autonomous and Total income.

Source: Authors

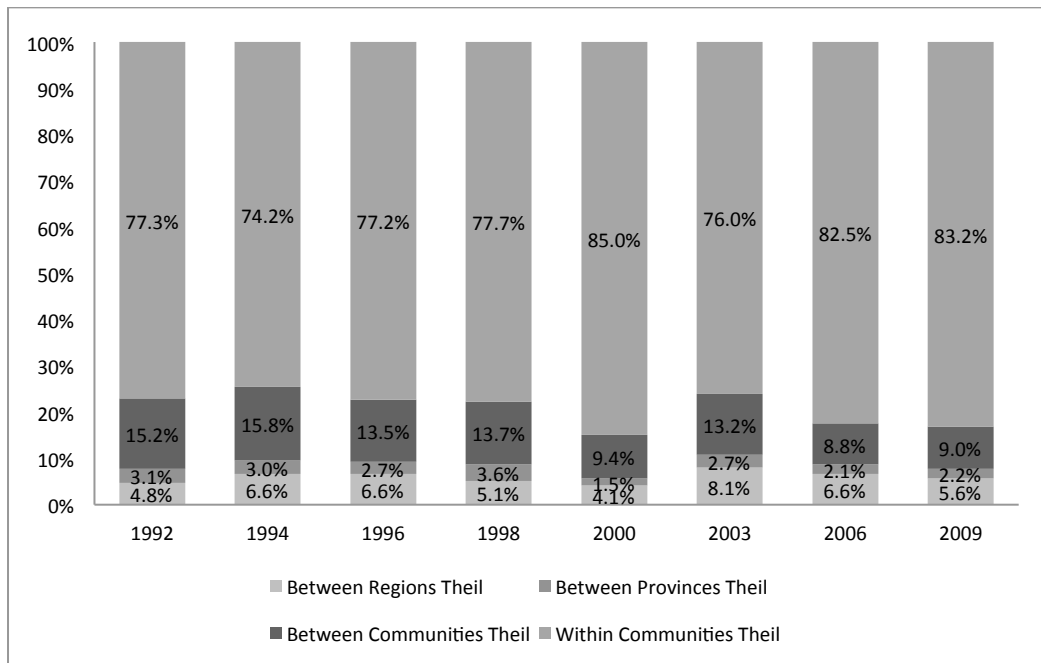


Figure 5: Three stage inequality decomposition by Theil index for Chile from 1992-2009:
Autonomous Income.

Source: Authors

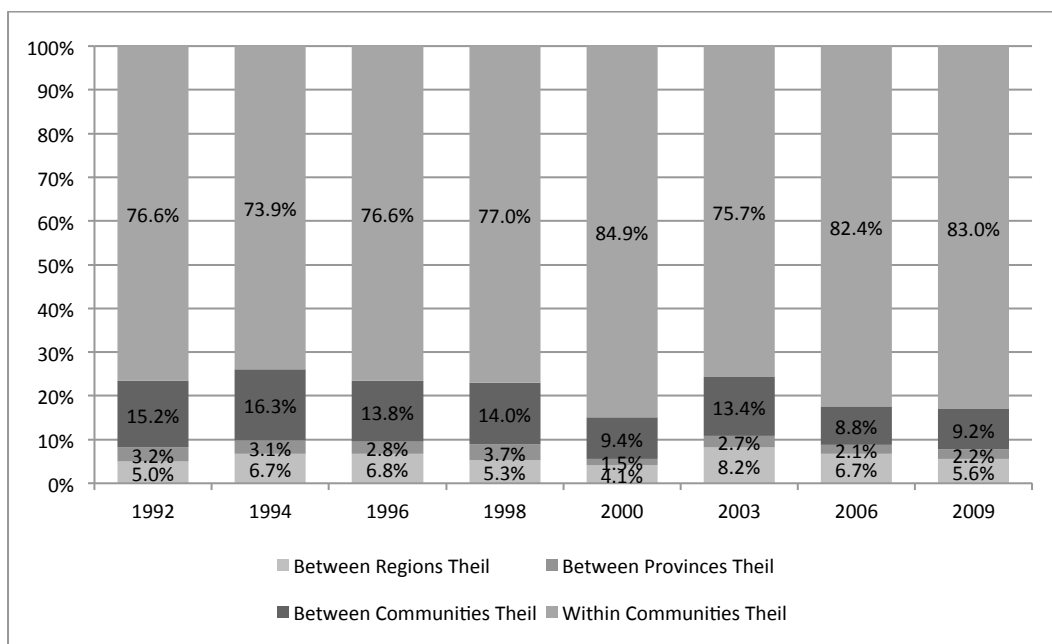


Figure 6: Three stage inequality decomposition by Theil index for Chile from 1992-2009: Total
income.

Source: Authors

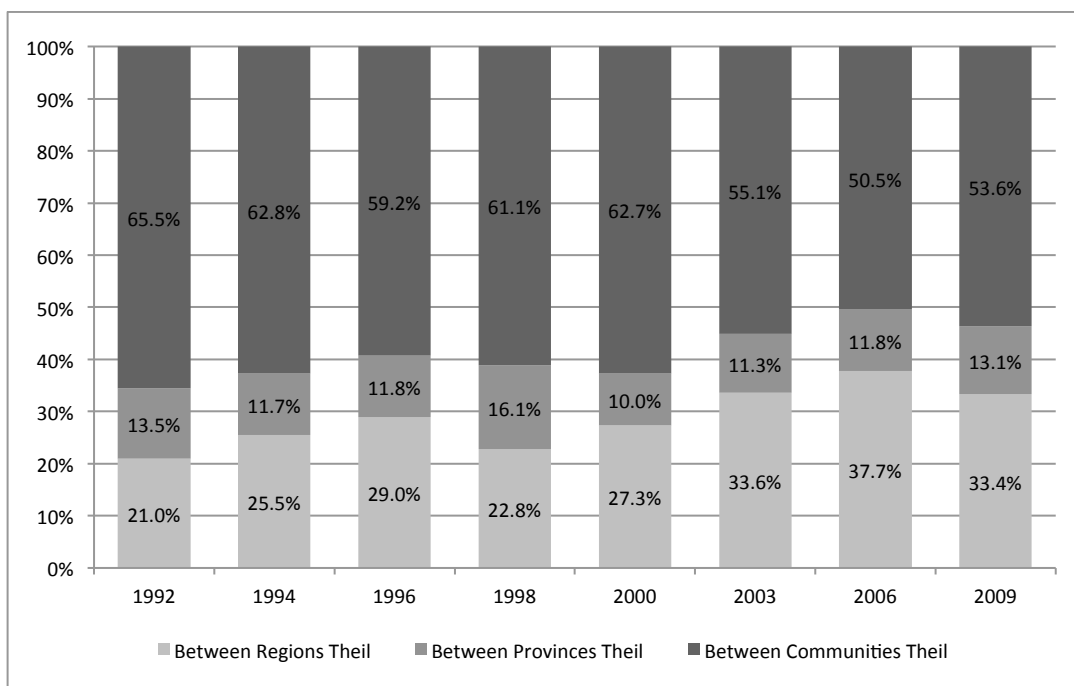


Figure 7: Relative importance of spatial dimension on income inequality for Chile from 1992-2009:
Autonomous Income.

Source: Authors

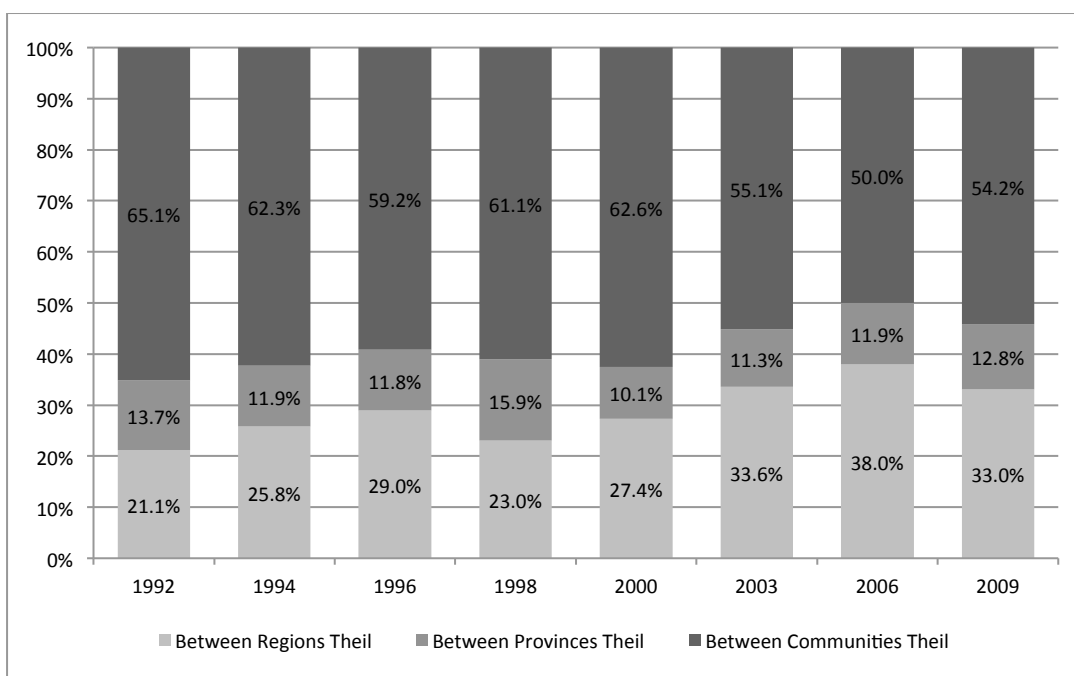


Figure 8: Relative importance of spatial dimension on income inequality for Chile from 1992-2009:
Total income.

Source: Authors

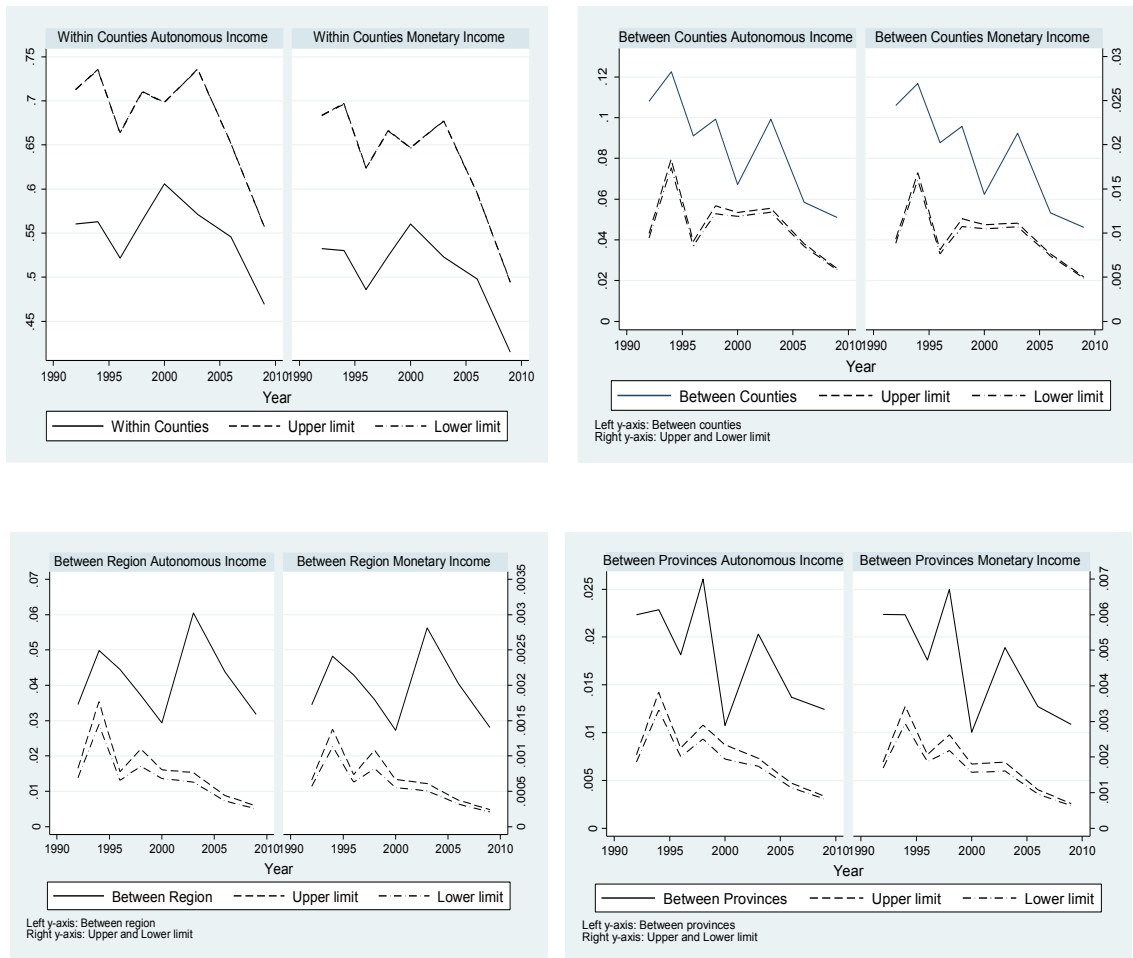


Figure 9: Hypothesis testing of the spatial decomposition for the Theil index: Autonomous and Monetary household Income per capita¹²

10. Tables

Table 1: Number of households and spatial units

	1992	1994	1996	1998	2000	2003	2006	2009
Number of Households	35,941	45,374	33,631	48,107	65,036	68,153	73,720	71,459
Zero Autonomous Income	603	863	465	868	1,011	1,595	1,917	3,757
Zero Total income	112	229	88	129	173	179	133	271
Number of Counties	216	245	204	243	304	313	335	334
Number of Provinces	45	46	49	48	49	49	50	52
Number of Regions	13	13	13	13	13	13	13	13

Source: Authors based on CASEN 1992-2009.

Appendix A

$$T_p = \sum_r \sum_p \left(\frac{Y_{rp}}{Y} \right) \log \left(\frac{Y_{rp}/Y}{N_{rp}/N} \right) \quad (1)$$

Equation (1) can be decomposed as follow:

$$\begin{aligned} \sum_p \left(\frac{Y_{rp}}{Y} \right) \log \left(\frac{Y_{rp}/Y}{N_{rp}/N} \right) &= \left(\frac{Y_r}{Y} \right) \left(\frac{Y}{Y_r} \right) \sum_p \left(\frac{Y_{rp}}{Y} \right) \left[\log \left(\frac{Y_{rp}/Y}{N_{rp}/N} \right) \left(\frac{Y_r/Y}{N_r/N} \right) / \left(\frac{Y_r/Y}{N_r/N} \right) \right] \\ &= \left(\frac{Y_r}{Y} \right) \sum_p \left(\frac{Y_{rp}}{Y_r} \right) \left[\log \left(\frac{Y_{rp}/Y_r}{N_{rp}/N_r} \right) + \log \left(\frac{Y_r/Y}{N_r/N} \right) \right] \\ &= \left(\frac{Y_r}{Y} \right) \sum_p \left(\frac{Y_{rp}}{Y_r} \right) \log \left(\frac{Y_{rp}/Y_r}{N_{rp}/N_r} \right) + \left(\frac{Y_r}{Y} \right) \sum_p \left(\frac{Y_{rp}}{Y_r} \right) \log \left(\frac{Y_r/Y}{N_r/N} \right) \\ &= \left(\frac{Y_r}{Y} \right) \sum_p \left(\frac{Y_{rp}}{Y_r} \right) \log \left(\frac{Y_{rp}/Y_r}{N_{rp}/N_r} \right) + \left(\frac{Y_r}{Y} \right) \log \left(\frac{Y_r/Y}{N_r/N} \right) \\ &= \left(\frac{Y_r}{Y} \right) \left[\sum_p \left(\frac{Y_{rp}}{Y_r} \right) \log \left(\frac{Y_{rp}/Y_r}{N_{rp}/N_r} \right) + \log \left(\frac{Y_r/Y}{N_r/N} \right) \right] \\ &= \left(\frac{Y_r}{Y} \right) \left[T_{pr} + \log \left(\frac{Y_r/Y}{N_r/N} \right) \right], \quad (2) \end{aligned}$$

Where T_{pr} measures between-province income inequality for region r . Then Theil index in Eq. (1) can be decomposed into:

$$T_p = \sum_r \left(\frac{Y_r}{Y} \right) T_{pr} + \sum_r \left(\frac{Y_r}{Y} \right) \log \left(\frac{Y_r/Y}{N_r/N} \right) \quad (2)$$

$$T_p = T_{WR} + \square_{BR}$$

Appendix B

Table B1: Three stage decomposition by Theil index for Chile 1992-2009: Autonomous Income per capita

Component	1992	1994	1996	1998	2000	2003	2006	2009
Within Counties	0.560	0.563	0.522	0.564	0.606	0.571	0.546	0.469
(% Contribution to total)	77.3%	74.2%	77.2%	77.7%	85.0%	76.0%	82.5%	83.2%
Between Counties	0.108	0.123	0.091	0.099	0.067	0.099	0.059	0.051
(% Contribution to total)	14.9%	16.2%	13.5%	13.7%	9.4%	13.2%	8.8%	9.0%
Between Provinces	0.022	0.023	0.018	0.026	0.011	0.020	0.014	0.012
(% Contribution to total)	3.1%	3.0%	2.7%	3.6%	1.5%	2.7%	2.1%	2.2%
Between Regions	0.035	0.050	0.045	0.037	0.029	0.060	0.044	0.032
(% Contribution to total)	4.8%	6.6%	6.6%	5.1%	4.1%	8.1%	6.6%	5.6%
Total	0.725	0.758	0.675	0.727	0.713	0.751	0.662	0.564

Source: Authors

Table B2: Three stage decomposition by Theil index for Chile 1992-2009: Total income per capita

Component	1992	1994	1996	1998	2000	2003	2006	2009
Within Counties	0.532	0.530	0.486	0.524	0.560	0.523	0.498	0.415
(% Contribution to total)	76.6%	73.9%	76.6%	77.0%	84.9%	75.7%	82.4%	83.0%
Between Counties	0.106	0.117	0.088	0.096	0.062	0.092	0.053	0.046
(% Contribution to total)	15.2%	16.3%	13.8%	14.0%	9.4%	13.4%	8.8%	9.2%
Between Provinces	0.022	0.022	0.018	0.025	0.010	0.019	0.013	0.011
(% Contribution to total)	3.2%	3.1%	2.8%	3.7%	1.5%	2.7%	2.1%	2.2%
Between Regions	0.034	0.048	0.043	0.036	0.027	0.056	0.040	0.028
(% Contribution to total)	5.0%	6.7%	6.8%	5.3%	4.1%	8.2%	6.7%	5.6%

Total	0.695	0.718	0.634	0.681	0.660	0.690	0.604	0.500
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Source: Authors

Table B3: Hypothesis testing of the spatial decomposition for the Theil index: Autonomous household Income per capita

Year	Effects	Theil computed	Theil Average (permutation)	Stan.dev	Lower limit	Upper limit
1992	Between Region	0.0346	0.0008	0.0004	0.0007	0.0008
	Between Provinces	0.0223	0.0020	0.0005	0.0019	0.0021
	Between Counties	0.1080	0.0097	0.0013	0.0095	0.0100
	Within Counties	0.5603	0.7128	0.0014	0.7125	0.7131
1994	Between Region	0.0499	0.0016	0.0008	0.0014	0.0018
	Between Provinces	0.0229	0.0036	0.0013	0.0033	0.0038
	Between Counties	0.1226	0.0179	0.0025	0.0174	0.0184
	Within Counties	0.5631	0.7354	0.0019	0.7350	0.7358
1996	Between Region	0.0445	0.0007	0.0003	0.0007	0.0008
	Between Provinces	0.0181	0.0021	0.0006	0.0020	0.0023
	Between Counties	0.0911	0.0088	0.0012	0.0086	0.0090
	Within Counties	0.5217	0.6637	0.0014	0.6635	0.6640
1998	Between Region	0.0371	0.0010	0.0006	0.0009	0.0011
	Between Provinces	0.0261	0.0027	0.0010	0.0025	0.0029
	Between Counties	0.0993	0.0126	0.0023	0.0122	0.0131
	Within Counties	0.5643	0.7104	0.0022	0.7100	0.7108
2000	Between Region	0.0293	0.0007	0.0003	0.0007	0.0008
	Between Provinces	0.0108	0.0021	0.0010	0.0019	0.0023
	Between Counties	0.0672	0.0121	0.0011	0.0119	0.0123
	Within Counties	0.6061	0.6984	0.0011	0.6982	0.6986
2003	Between Region	0.0605	0.0007	0.0003	0.0006	0.0008
	Between Provinces	0.0203	0.0019	0.0006	0.0017	0.0020
	Between Counties	0.0992	0.0126	0.0012	0.0124	0.0128
	Within Counties	0.5710	0.7359	0.0011	0.7357	0.7361
2006	Between Region	0.0438	0.0004	0.0002	0.0004	0.0004
	Between Provinces	0.0137	0.0012	0.0003	0.0011	0.0013
	Between Counties	0.0585	0.0086	0.0008	0.0085	0.0088
	Within Counties	0.5456	0.6513	0.0008	0.6512	0.6515
2009	Between Region	0.0317	0.0003	0.0001	0.0003	0.0003
	Between Provinces	0.0124	0.0009	0.0002	0.0008	0.0009
	Between Counties	0.0509	0.0059	0.0004	0.0058	0.0060
	Within Counties	0.4693	0.5574	0.0005	0.5573	0.5575

Source: Authors

Table B4: Hypothesis testing of the spatial decomposition for the Theil index: Monetary household

Income per capita

Year	Effects	Theil computed	Theil Average (permutation)	Stan.dev	Lower limit	Upper limit
1992	Between Region	0.0344	0.0006	0.0002	0.0006	0.0007
	Between Provinces	0.0224	0.0018	0.0004	0.0017	0.0019
	Between Counties	0.1060	0.0091	0.0012	0.0089	0.0093
	Within Counties	0.5324	0.6837	0.0012	0.6835	0.6840
1994	Between Region	0.0483	0.0013	0.0006	0.0011	0.0014
	Between Provinces	0.0223	0.0032	0.0013	0.0029	0.0034
	Between Counties	0.1168	0.0164	0.0021	0.0160	0.0168
	Within Counties	0.5302	0.6967	0.0020	0.6963	0.6971
1996	Between Region	0.0429	0.0007	0.0003	0.0006	0.0007
	Between Provinces	0.0176	0.0020	0.0005	0.0019	0.0021
	Between Counties	0.0878	0.0079	0.0012	0.0076	0.0081
	Within Counties	0.4860	0.6238	0.0013	0.6235	0.6240
1998	Between Region	0.0360	0.0010	0.0007	0.0008	0.0011
	Between Provinces	0.0250	0.0024	0.0011	0.0022	0.0026
	Between Counties	0.0956	0.0112	0.0023	0.0107	0.0116
	Within Counties	0.5240	0.6661	0.0019	0.6657	0.6665
2000	Between Region	0.0272	0.0006	0.0003	0.0006	0.0007
	Between Provinces	0.0100	0.0017	0.0006	0.0016	0.0018
	Between Counties	0.0623	0.0107	0.0012	0.0105	0.0109
	Within Counties	0.5604	0.6469	0.0011	0.6467	0.6471
2003	Between Region	0.0563	0.0006	0.0003	0.0005	0.0006
	Between Provinces	0.0189	0.0017	0.0006	0.0016	0.0019
	Between Counties	0.0924	0.0109	0.0010	0.0107	0.0111
	Within Counties	0.5229	0.6773	0.0010	0.6771	0.6775
2006	Between Region	0.0405	0.0003	0.0001	0.0003	0.0004
	Between Provinces	0.0127	0.0010	0.0003	0.0010	0.0011
	Between Counties	0.0533	0.0075	0.0006	0.0074	0.0076
	Within Counties	0.4979	0.5954	0.0006	0.5953	0.5956
2009	Between Region	0.0281	0.0002	0.0001	0.0002	0.0002
	Between Provinces	0.0109	0.0007	0.0002	0.0006	0.0007
	Between Counties	0.0460	0.0050	0.0004	0.0049	0.0050
	Within Counties	0.4152	0.4943	0.0004	0.4942	0.4944

Source: Authors

More information at <http://www.oecd.org>

² It is still a preliminary rate reported by the Chilean government.

³ The low spatial mobility is explained by the geography of Chile. This point is explained in section 2.

⁴ Solimano and Torche (2008) provide an excellent discussion, but the analysis estimated only up to 2006. We add new information including 2009.

⁵ We recognize the sound criticism of the neoclassical perspective, especially regarding how it incorporates the role of the geographical space. However, we are not supporting the market mechanism as the unique instrument to guarantee the reduction of spatial disparities, but rather we are incorporating a mechanism that is absent in the individual inequality analysis.

⁶ An exception is the zone premium given to some workers in the public sector who are located in extreme areas of the country. However, the participation of this group is marginal in the total labor force.

⁷ For example Agostini and Brown (2007) or Ramirez et al. (2009) provide an excellent discussion about how to estimate inequality coefficients for intra-national units. While we recognize the relevance and importance of this research, the objective of this paper is to complement individual income inequality with a spatial component.

⁸ We do not ignore other types of inequalities such as urban-rural, gender, or industrial. However, this paper is focused on the particular role played by the inequality attributable to geographical space.

⁹ It is important to recognize that administrative division does not necessarily coincide with the functional dimension in which economic geography applies. Regrettably, even when we declare the weakness of our administrative division, Chile does not have any functional divisions of the national territory. In this sense, the results obtained in this paper could initiate a discussion to include the role of geography on the public agenda.

¹⁰ Since October 2007, Chile has been divided into 15 regions, but we continue to use 13 regions in 2009 for comparative purposes.

¹¹ <http://rankings.americaeconomia.com/2011/mejores-universidades-chile/ranking-universidades.php>

¹² Ninety-nine permutations were performed.