Spatial Inequality in Chile: Stasis and Change*

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Introduction

For the most part, the 1990's were very good to Chile. GDP growth was about seven percent per year amidst an economy featuring even more rapid increases in exports, increasing consumption power, and unprecedented foreign investment (Cademartori 2003). Poverty was on the decline as well. The incidence of indigence (deep poverty) fell 10 percent in the early 1990s, and the proportion of the population living in poverty decreased 25 percent in relative terms from the late 1980s to early 1990s (Contreras, Larranaga, Litchfield, & Valdes, 2001; Contreras, 2003). The macroeconomic improvements of the "golden decade" (roughly 1987 – 1997) have been credited to neoliberal policies -- market liberalization, privatization, reduction in trade barriers -- developed and adopted in the early post-dictatorship years (Escobar 2003). These trends only contributed to Chile's regional supremacy along basic development indicators. Chile's life expectancy (76), adult literacy rate (96%), and gross school enrolment ratio (79) give rise to a "high" Human Development Index that is 43rd internationally, and 2nd only to Argentina in the region (UNDP, 2005).

Interestingly, opinion polls regarding the Chilean public's views of the state of the nation have not been so sanguine, with worries about an increasing inequality, overwork, educational inequality, and an "overall deterioration in family and community life" (Cademartori 2003: 79). In short, economic growth has spurred concerns about social equity (Berardi 2001). In more recent years, the economy has experienced recession,

raising anew concerns about those possibly left out of the new Chilean economy. Indeed, there is evidence that income inequality is a significant and growing problem in Chile, with the richest 20 percent of the population receiving 17 and 19 times more income than does the poorest 20 percent in 1995 and 2000, respectively. This compares with ratios in 1995 of 11 in Peru and 8 of United States (UNDP, 2005; 1995). The point is clear, economic growth seemed to have lifted all the boats, but left those at the bottom further behind and, many would say, faced with exhausting work schedules as the only way to eke out a living (Cademartori, 2003).

While the issues of income distribution and poverty in Chile have been the subject of some empirical analysis (Contreras et al., 2001; Barton & Murray, 2002; Soto & Torche, 2004), to date less attention has been paid to the spatial distribution of poverty and other indicators of well-being, and to changes in spatial inequality over time. Just as economic growth did not benefit Chileans equally at the individual level, Soto and Torche (2004) suggest that development has not benefited regions and their population equally. Although poverty rates have declined overall, both social welfare differences across people and regional income inequality persist in Chile. In fact, Barton and Murray (2002) go so far as to propose that the last decade of Twentieth Century should mark end to a key chapter in the Chilean transition and auger in a new era in which the Chilean development can become more equitable and sustainable, and in which the focus is placed more squarely on those who have not benefited from the Chilean "miracle." In this context it is especially important to understand the dynamics of poverty and its correlates in Chile during this period. This paper investigates the spatial distribution of

poverty and related well-being measures, and pays special attention to patterns of spatial segregation and change between 1990 and 2000.

Poverty and inequality in Chile: 1990-2000

Due to a lack of suitable survey data, that is, those with sufficient sample sizes, geographic coverage and the correct content, few studies of poverty and income inequality in Chile have been conducted before 1985, when the Ministry of Planning and Cooperation (MIDEPLAN) carried out the first *Caracterización Socieconómica Nacional* (CASEN) through the Department of Economics at the University of Chile. The CASEN is widely regarded as the best available source of social, economic and demographic information on households in Chile, and it is broadly used in the literature on poverty and income distribution (Pizzolitto 2005).

The evolution of poverty

There is a consensus in the literature that poverty in Chile has been reduced as the country has developed economically, and MIDEPLAN has been at the forefront of documenting and studying these trends (Pizzolitto 2005). Government publications indicate that between 1990 and 2000, moderate poverty decreased from 38.6 to 20.6 percent, while extreme poverty fell from 12.9 to 5.7. Such substantial decreases were registered in rural areas as well. Hojman (1996) likewise documents declining poverty prevalence since the late 1980's, and proposed a tightening of the labor market and the appreciation of Chilean peso as two major factors contributing to the drop. Hojman shows also that since 1990, Chile's total government expenditures have been expanding at approximately the same rate as its national output. While "social expenditures" constitute about two-thirds of total spending according to Hojman, the redistribution of

income from the top quintile to the bottom one, in terms of money transfers, education, health, housing benefits, and subsidies, amounted to only 10 percent of the total sum social expenditures. The implication is that social expenditures are not sufficiently directed to the alleviation of poverty. Similarly, a quantitative analysis of poverty between 1987 and 1995 using the CASEN survey (Valdes, 1999), concluded that the principal factor behind the changes in poverty was the integration of the poor into the labor market, since it was increases in labor income (rather than non-labor income) that was at play. Valdes attributes these trends to economic growth, and concluded that continued rapid economic growth in Chile should be the principal tool to reduce poverty. A World Bank report (2001) likewise provided a comprehensive portrait of the levels and trends in poverty in Chile and concluded that the nation had made impressive progress in reducing the incidence, severity, and the depth of poverty during the period 1987-1998.

Litchfield (2001) applied a range of statistical techniques to the CASEN data to estimate the level and trend in poverty with adjustments for family size and composition. His estimates suggested higher rural poverty and lower national poverty than other estimates, but nonetheless were consistent with other studies in documenting a sizable overall decline. While tangential to the topic at hand, it is noteworthy that research on the etiology of poverty at the individual level yields results one would expect (Bank, 2001). For example, large families and those headed by women or more likely to be poor, while education, especially secondary schooling, reduces poverty risks. The ameliorative effect of education is stronger in urban than rural areas.

To reiterate, while overall poverty trends are well documented, less is known about regional differences within Chile in the patterns of change. Contreras (2001) finds

that the poverty-reduction pattern varies by region within Chile due to dissimilar economic trajectories, and suggests that this reflects the sectoral composition of growth across regions, with areas dominated by export-oriented activities enjoying greater poverty reduction.

The dynamics of inequality

A useful review of the literature on Chilean inequality by Pizzolitto (2005) suggests evidence on trends is mixed owing to differences in period covered, geographic focus, and methodological issues. Londono and Szekely (1997) reported the Gini coefficient for total household income rose in the late 1980s, and became stable after 1994. De Gregorio and Cowan (1996) also emphasized that the high level of income inequality in Chile has been relatively stable over time. They remarked that the changes in the distribution of monetary incomes were closely associated with changes in labor market and the economic activity. A World Bank report (2001) also documented stable inequality from 1987 to 1998. Further, this report indicated that when income inequality is adjusted to account for social expenditures (by adding to household income imputed values of government subsidies in health, education, and housing), measured inequality declined between 1990 and 1998. This suggests that social policies in Chile aimed toward ameliorating poverty may also have reduced income inequality as well.

Contreras (2003) measured inequality with three different indices: the Gini coefficient, the coefficient of variation, and the standard deviation of the logarithm of income. For each inequality indicator, an increase in the population of the lowest and highest income levels generally increases inequality, while an increase in the middle income groups generally decreases it. Nevertheless, each measure has different

properties. For example, the standard deviation of the logarithm of income is most sensitive to changes in the lower end of the distribution, while the Gini indicator weights the groups with middle income shares more heavily. Results indicate that the Gini coefficient remained flat between 1990 and 1996. The same lack of trend was found for the other indicators as well. Contreras concluded inequality in Chile is one of the highest in the world, and that inequality has remained constant during the last decade of twentieth century.

In contrast to ample evidence at the national level, few articles explore trends in income inequality at the sub-national (e.g., regional) level. Contreras and Ruiz-Tagle (1997), analyzing household income adjusted for food needs by household age and sex structure, examined inequality for the different regions in Chile. Not only did they document increasing inequality between 1990 and 1994, they also discovered important dissimilarities in the magnitude of inequality indices across regions. Contreras and Ruiz-Tagle attributed this heterogeneity to geographic variation in the evolution of labor demand for skilled and unskilled workers. In addition, Soto and Torche (2004) similarly proposed that the uneven path of regional development had important effects on regional inequality and poverty because the economic growth from 1975 to 2000 was not a smooth process and economic sectors contributed differentially.

In sum, Chile prospered significantly during the 1990's as indicated by declines in measured poverty rates. However, income inequality remained comparatively stagnant if not increasing, suggesting that those at the bottom were no closer to those in the middle or upper part of the economic hierarchy, and may have fallen further behind. Less is known, however, about how these dynamics have played out when viewed in terms of

spatial inequality. If the benefits of the economic prosperity of the 1990's were distributed unevenly as has been suggested, spatial inequality may have increased. This has implications not only for inequality in the prevalence of poverty across places, but perhaps more importantly, for inequality in key correlates of poverty such as health. We attempt to make a small contribution to this literature by providing a descriptive analysis that addresses the following questions. First, what is the spatial distribution of poverty and related well-being indicators in Chile? Second, in particular, are there identifiable clusters of poverty and deprivation? Third, how has this changed during the last decade of Twentieth Century, a time of declining poverty but stable and high inequality? Finally, what is the spatial relationship *between* these well-being indicators?

Data and Methods

To answer our research questions we analyze data from the 1990 and 2000 *Encuestas de Caracterización Socioeconómica Nacional* (CASEN), a series of nationally representative surveys of over 40,000 Chilean households and 150,000 individuals residing within them. Based on the World Bank living standards measurement survey methodology, the CASENs contain nearly 300 variables describing individuals and families within the basic domains of household characteristics, education, health, employment and income. Conducted in November by the Ministry of Planning and Cooperation (MIDEPLAN), the CASEN surveys provide basic information needed to help government planners reduce poverty, improve quality of life, and to help integrate excluded sectors into the development process. To that end, the CASEN employs a complex stratified sample design that, given the large overall sample size, allows for reliable local as well as national population parameters. Geopolitically, Chile is divided

into 13 regions, 50 provinces and 336 *comunas*. To enable users to compute local area estimates, the CASENs contain geocodes down to the *comuna* level. While not all 336 *comunas* are represented in the samples, the data nonetheless allow for meaningful analysis of spatial inequality using *comunas* as units of analysis. Two CASEN household survey data sets, 1990 and 2000, supply information. The CASEN includes 304 *comunas* in 2000, but only 151 are covered in 1990. In some of the analyses reported below, data for only those 147 *comunas* that are represented in both the 1990 and 2000 surveys are analyzed.

Measures of well-being. The principal focus of the analysis is the distribution of poverty which, in the CASEN, is measured as an absolute (versus relative) and income-based (rather than consumption-based) poverty measure. The variable has three categories, non-poor, poor and indigent, with the latter group consisting of those who are in deep poverty. We take advantage of all three categories in this analysis. We also are interested in various correlates of poverty. Here we use literacy, measured as the ability to read and write. Subjective health also is asked in the CASEN which we have dichotomized and coded as being in fair or poor health. We also examine two measures of material household well-being, measured here as the presence of indoor plumbing and an indoor bathroom. Table 1 indicates the availability of these measures by the year of the survey.

Table 1. Measures of well-being employed by survey year

Measures	1990	2000
Poverty Status	Available	Available
Indigence Status	Available	Available
Illiteracy	Available	Available
Indoor Bathroom	Available	Available
Indoor Plumbing	Not Available	Available
Health Status	Not Available	Available

Measures of spatial inequality and segregation. In this paper we map and use exploratory data spatial analysis (ESDA) to provide an initial portrait of the distribution of poverty and other measures of well-being in Chile for the years 1990 and 2000. To measure segregation we use the dissimilarity index (D) and the information theory index (H), in both their two-group and multi-group forms. The multi-group formulae follow, and we present both the two- and multi-group measures in the analysis.

$$D = \sum_{m=1}^{M} \sum_{j=1}^{J} \frac{t_j}{2TI} \mid \pi_{jm} - \pi_m \mid$$

$$H = \sum_{m=1}^{M} \sum_{j=1}^{J} \frac{t_j}{TE} \pi_{jm} \ln(\frac{\pi_{jm}}{\pi_m})$$

where

t_j = number of cases in geographical unit j

T = total number of cases ($\sum_{\text{j}} (t_j / T) = 1$)

π_m = total proportion in group m (e.g., proportion of the poor)

π_{jm} = proportion in group m, of unit j

$$\text{I} = \sum_{m=1}^{M} \pi_m (1 - \pi_m)$$

$$\text{E} = \sum_{m=1}^{M} \pi_m \ln(\frac{\pi_{jm}}{\pi_m})$$

While commonly used in the segregation literature both D and H are aspatial measures, meaning that they do not adequately account for spatial relationships between locations (*comunas*). Here we use ESDA approaches to both map and report on global and local indicators of spatial association to better visualize and understand spatial inequality. Specifically we use GeoDa (Anselin, 2003) to calculate and visualize spatial autocorrelation based on both the global Moran's I statistic (a test for clustering) and the Local Indicators of Spatial Association (LISA) statistics (tests for clusters) (Anselin, 1995, Anselin et al. 2006).

Moran's I provides an indication of the relationship between a vector of observed values, y, and a weighted average of values that neighbor, or are contiguous to, y. The latter are often referred to as the 'spatial lag of y', and is expressed as W_y, where W stands for the spatial weights matrix. The calculated value of Moran's I is the slope coefficient of a regression of W_y on y. Moran's I can be visualized by means of a Moran scatterplot (Anselin, 1996), with its significance based on a permutation test. The scatterplot of individual components of Moran's I, measured in standard deviations, permits the visualization of the 'contributions' that each observation make to the calculated statistic. The four quadrants represent the four types of spatial association that

exist: high values of y surrounded by similarly high values (High-High); low values of y surrounded by dissimilarly high values (High-Low); low values of y surrounded by similarly low values (Low-Low); and high values of y surrounded by dissimilarly low values (High-Low).

The traditional univariate Moran scatterplot has been extended to depict bivariate spatial autocorrelation as well, i.e., the correlation between one variable at a location, and the weighted average of different spatially lagged variable at all neighboring locations as defined by the spatial weights matrix (Anselin et al. 2002, cited in Anselin et al. 2006).

The advantage of the global Moran's I inheres in its simplicity, but a limitation is that it aggregates (glosses over) local variation in the strength of spatial autocorrelation. This limitation has prompted the development of a local indicator of spatial association. Anselin's LISA (1995) can be seen as the local equivalent of Moran's I. It can capture the local level of spatial autocorrelation in order to identify areas where values of the variable are both extreme and geographically homogeneous. This enables us to identify so-called hot-spot areas where the concerned phenomena are extremely pronounced across localities.

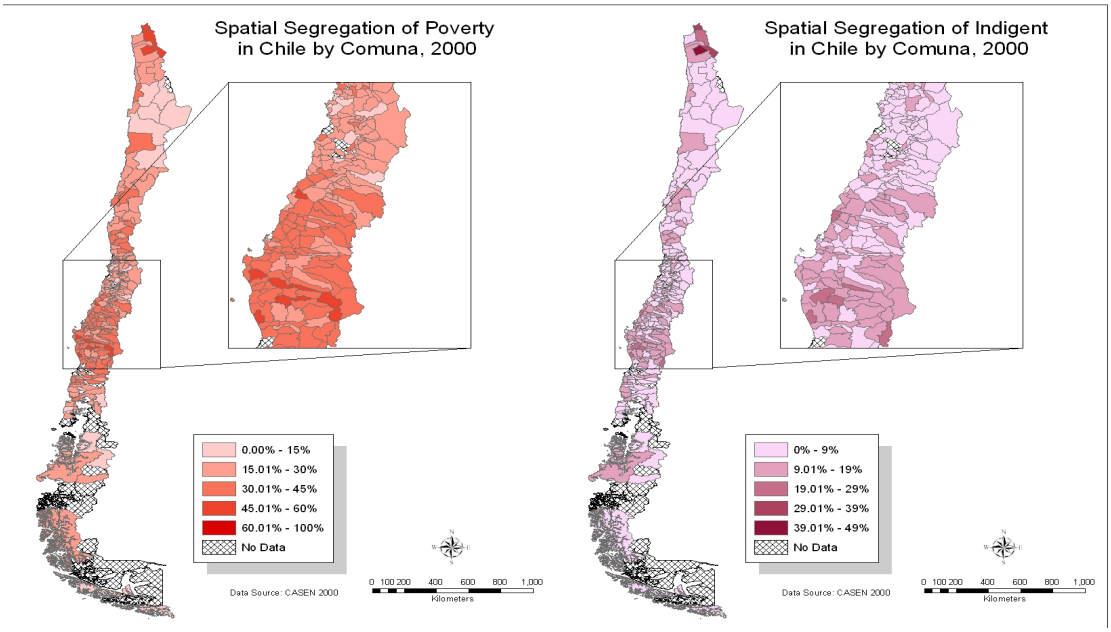
In GeoDa the Local Moran statistic is visualized in the form of significance and cluster maps which depict the locations with significant Local Moran statistics (LISA significance maps) and classify those locations by type of association (LISA cluster maps), where the types of association correspond to the four quadrants in the Moran scatter plot. *Comunas* where the LISA is not significant are not color coded (left white) on the LISA cluster map.

In this paper we include examples of both the univariate and bivariate Moran's scatterplots as well as LISA cluster maps. Our descriptive analysis uses a queen criterion first-order spatial lag to define the spatial weights matrix. (The queen criterion determines neighboring *comunas* as those that have any point in common, including both common boundaries and common corners/vertexes.)

Findings

First we describe how poverty is distributed spatially by showing *comuna*-level maps of poverty rates (percentage poor). As seen in Figure 1 which shows poverty rates in 2000, *comunas* with high poverty rates concentrate in central Chile, especially around three major cities, Santiago, Valparaiso, and Concepcion. The mountain and south coast areas also demonstrate a high poverty rate. Not surprisingly, the geographic distribution of indigence (deep poverty) is similar to that of poverty, with the areas around the same three cities standing out for their high rates of indigence. Thus, the most populous areas of Chile had higher poverty rates, with Concepcion and Valparaiso standing out for their high poverty rates, and areas around Santiago somewhat lower. Interestingly, there are instances of *comunas* with higher rates that have neighbors with lower poverty, an example being Iquique in the far north. While missing *comuna* data is a larger problem in 1990, the corresponding map for that year (not shown) reveals the same basic pattern. To round out our descriptive treatment of changing poverty rates in 1990 and 2000, Table 2 shows that for the full 147 *comunas* included in both CASEN surveys, over 90 percent registered declines in the rates of poverty and indigence. This finding is consistent with overall population trends and may reflect the benefits of income growth and/or enhanced social programs.

Figure 1. The distribution of poverty and indigence (deep poverty), 2000



Similarly, we also examined the spatial distribution of literacy (not shown). The near north region has consistently low literacy rates over the decade, and, in 2000, *comunas* with higher rates intertwine with those having lower rates in central Chile, where higher illiteracy rates prevail. The proportion of households without a bathroom has the same spatial pattern as that of illiteracy, and the near north has generally low rates along this indicator. In 1990, high rates of illiteracy appear more in central Chile and the phenomenon persists in 2000. We similarly mapped two other indicators available only in 2000, households without indoor plumbing and the prevalence of ill-health. Coquimbo and Concepcion both have a higher proportion of households without indoor plumbing, and the rate has a U-shaped pattern; higher in far north and central Chile and relatively low in the near north. Compared to the poverty and illiteracy, the people living around Iquique, and central cities tend to report being less healthy; but the near north areas, around Antofagasta have the lower reported prevalence of self-reported ill-health.

Table 2. Rates of poverty and indigence in Chile from 1990 to 2000

Poverty	1990	2000	Increased	Decreased
Maximum	84.21%	59.94%	18.26%	56.17%
Minimum	4.71%	0.25%	0.21%	0.61%
Average[a]	41.18% (147)	23.79% (147)	7.67% (8)	18.83% (139)
Indigence				
Maximum	38.82%	21.04%	5.49%	34.10%
Minimum	0.00%	0.00%	0.72%	0.04%
Average[a]	14.24% (147)	6.45% (147)	3.33% (13)[b]	9.01% (132)[b]

a: Number of *comunas* in parentheses. b: Two *comunas* have no change during this decade.

Aspatial measures of segregation

While these maps are suggestive of patterns of spatial heterogeneity in well being, they cannot confirm whether spatial inequality exists nor, if so, quantify its magnitude. Two different measures of segregation are employed to provide this more quantitative assessment (Table 3). The dichotomous dissimilarity index can be interpreted as the proportion of one group that would have to be redistributed in order for both groups to have identical distributions. Regardless of the total number of *comunas* in each survey, the segregation between the poor and non-poor increases. By contrast, segregation with respect to literacy and existence of an indoor bathroom suggests a narrowing trend. In contrast to other indicators, the dissimilarity index for presence of indoor plumbing is quite high. That is, over 60 percent of household with plumbing have to be redistributed in order to eliminate the spatial inequality. Extracting the *comunas* included in both surveys and recalculating, the changes over time in the various well-

being indicators still hold. Further, taking advantage of the trichotomous poverty variable (non-poor, poor, indigent), the multi-group dissimilarity index provides information on spatial inequality across these three categories. Generally, the higher the dissimilarity index is, the greater the segregation. The results suggest that among these three groups, the segregation widens over time. Again, the implication is that at the *comuna* level in Chile, the poor, near poor and non-por became more segregated from each other during the economic boom of the 1990s. This appears to be particularly due to the increasing segregation of the non-poor relative to the other groups.

Table 3. Aspatial measures of segregation across well-being indicators

Measure of segregation	1990*	2000**	1990***	2000***
Dissimilarity Index				
Two Group				
Poor/ Non Poor[1]	.2115	.2318	.2096	.2271
Illiterate/ Non Illiterate	.3619	.3481	.3608	.3168
Indoor Bathroom/ Without	.6327	.5351	.6326	.4676
Indoor Plumbing/ Without	N/A	.6001	N/A	.4550
Unhealthy/ Healthy	N/A	.1376	N/A	.1230
Multiple Group				
Indigent/ Poor/ Non Poor	.1973	.2287	.1957	.2240
Information Index (H)				
Two Group				
Poor/ Non Poor[1]	.0590	.0595	.0597	.0581
Illiterate/ Non Illiterate	.1002	.0848	.1007	.0717
Indoor Bathroom/ Without	.4047	.2457	.4055	.1938
Multiple Groups				
Indigent/ Poor/ Non Poor	.0521	.0553	.0526	.0536

1 The poor includes those in deep poverty (the indigent).
*The values are calculated on the basis of CASEN 1990 comprising 151 *comunas*.
** The values are calculated on the basis of CASEN 2000 comprising 304 *comunas*.
*** The values are calculated on the basis of matched data including 147 *comunas*.

Next we turn to results for the information index which confirms the decreasing segregation with respect to illiteracy and prevalence of having indoor bathroom. However, when comparing the poor and non-poor, the information index suggests little

change. Indeed, when attention is restricted to those *comunas* for which we have data in both 1990 and 2000, the information index for poverty actually declines. In order the better understand the slight discrepancy between the information index and the dissimilarity index with respect to poverty, pair-wise comparisons among non-poor, poor, and indigent are also conducted (see table 4). With the same observations, the segregation between the indigent and poor declines, but the non-poor are more clustered and segregated from the other two groups. In other words, the *comunas* with more non-poor increasingly clustered, and did so especially far away from *comunas* with a higher prevalence of extremely poor households. This conclusion also finds support in the increasing multiple group information index noted above (Table 3), which again suggests increasing spatial segregation of poverty groups from the well-to-do in Chile over the 1990's. That poverty would become more spatially segregated but other well-being indicators (e.g. literacy) less so is a provocative possibility that we discuss further below.

Table 4. Multigroup information index for the poverty trichotomy

Poverty Comparison	1990***	2000***
Indigent vs. Poor	0.0837	0.0340
Indigent vs. Non Poor	0.0331	0.0681
Poor vs. Non Poor	0.0487	0.0531

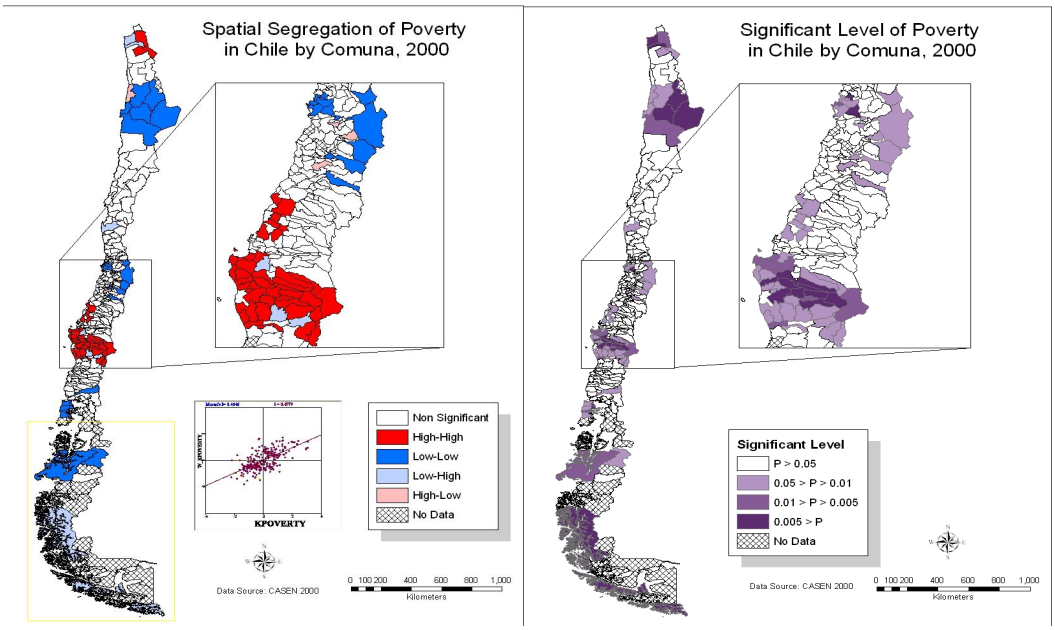
*** The values are calculated on the basis of matched data including 147 *comunas*.

Spatial segregation measures: Poverty and well-being

To this point we have only examined global measures of spatial segregation, though the descriptive maps did provide initial clues about how poverty and its correlates cluster spatially. To take the analysis a step further and explore this clustering more rigorously, Figure 2 maps both the Moran's I and LISA statistics for the distribution of poverty in Chile in 2000. The five possible relationships noted above (high-high (so-

called hot spots), low-low (cold spots), high-low, low-high and no data/relationship) are depicted in the map on the left side of Figure 2.

Figure 2. Spatial segregation of poverty in Chile, 2000



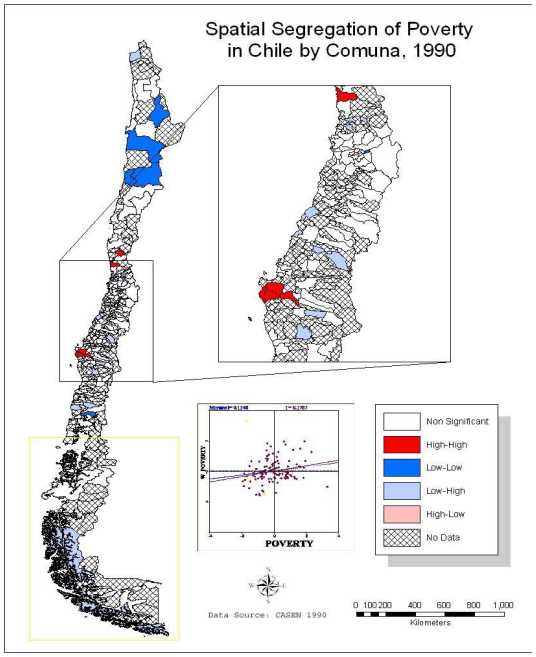
Moran's I= 0.4606 p=0.001
Moran's I= 0.4779 p=0.001

The hot spots, places were high poverty rates cluster spatially, suggests a concentration in Concepcion and a band stretching to the east, and in the far north. By contrast, Santiago and Antofagasta have a relative low-low cluster. Since the southern islands provide less information, excluding should have negligible impact on our overall findings. The yellow rectangle in Figure 2 shows the excluded areas,[1] and the second Moran's I statistic (also in yellow text) indicates the value after recalculating. Note that the difference in the Moran's I is minimal. The right hand side of Figure 2 is a LISA significance map and is mapping the local Moran. The results suggest that within the hot

[1] We should note that the calculation of Moran's I and LISA is based on the weight matrix of adjacency. Most missing data are from the southern islands. Their inclusion will cause the discontinuity of the matrix and thus weaken the association in space.

spit (high-high) there is a "core" areas with very high poverty. Finally, we note again that missing data are a significant problem in the 1990 data. Nonetheless the same exercise was carried out with data for that year (Figure 3). In the year, the only red zone appears in Concepcion and the near north is advantaged. Comparing both years, the global Moran's I increases partly because more data are available in 2000.

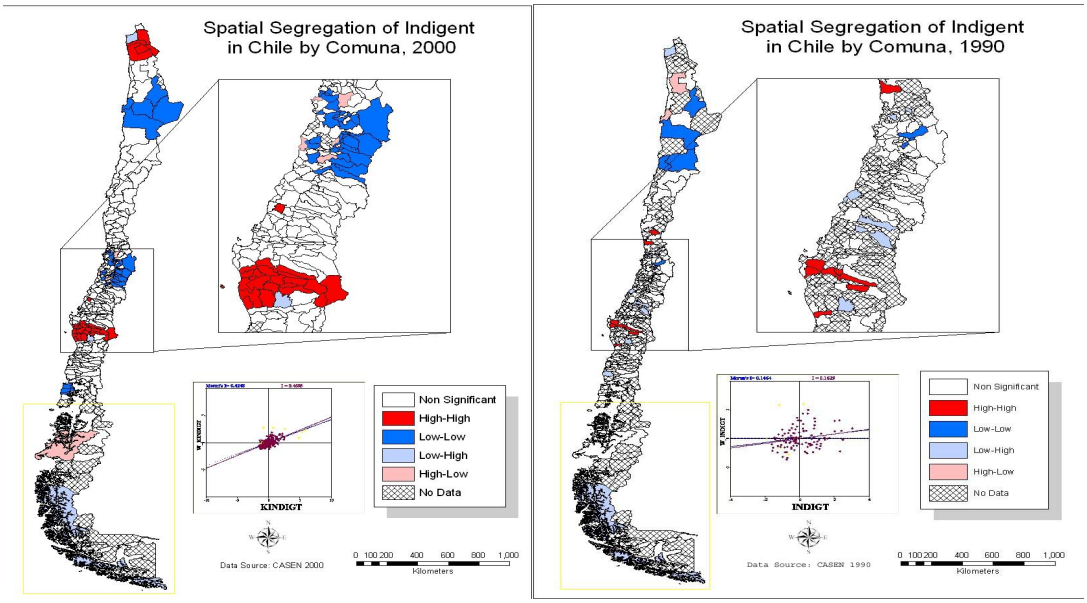
Figure 3. Spatial segregation of poverty in Chile, 1990



Moran's I= 0.1384 p=0.039
Moran's I= 0.1787 p=0.037

As indicated in Figure 4, that pattern for indigence (deep poverty) reveals a pattern of segregation that is similar to that of poverty. However, in the far north areas, more *comunas* are included in the hot zone, and the cold zone around Santiago is also more expansive. Again, when excluding the southern *comunas* from the analysis, the Moran's I becomes larger. That is, the spatial correlation of poverty and indigence is stronger when the southern areas are excluded.

Figure 4. Spatial segregation transition of indigence in Chile, 1990 and 2000



Moran's I= 0.4248 p=0.001
Moran's I= 0.4695 p=0.001

Moran's I= 0.1464 p=0.028
Moran's I= 0.1629 p=0.020

Next we turn to other well-being indicators. No statistically significant autocorrelation is found for prevalence of indoor bathrooms in 1990, but two major low-low clusters are discovered in 2000, one in the near north and the other around Santiago. In addition, several hot spots scatter nearby Concepcion and the far north Chile. Chile's high Human Development Index is partly a results of its high literacy rate. Thus, there are low-low spatial agglomerations (e.g., in the near north Chile and Santiago) but no high-high clusters of illiteracy. The patterns for the remaining two indicators (indoor plumbing and health) suggests disadvantages in the far north and advantages in the near north.

By way of summary, Table 5 shows all the Moran's I statistics for all *comunas* and for just the non-southern areas. The results suggest that poverty and indigence are

moderately correlated with location and after excluding the southern islands, the association becomes stronger. That the spatial autocorrelation of the prevalence of an indoor bathroom becomes significant in 2000 partly reflects the availability of additional observations in that year, but may also indicate the spatial unevenness of economic development. As noted, with regard to literacy it is cold spots that account for the significance of the global Moran's I. Moreover, it is clear that the spatial segregation of poverty and indigence is more serious than that along other indicators of well-being and, based on our earlier analysis, seems to have increased significantly during the 1990's. In general, the *comunas* of the far north and around Concepcion are disadvantaged, while the near north and Santiago areas are consistently advantaged.

Table 5. Global Moran's I for measures of well-being segregation

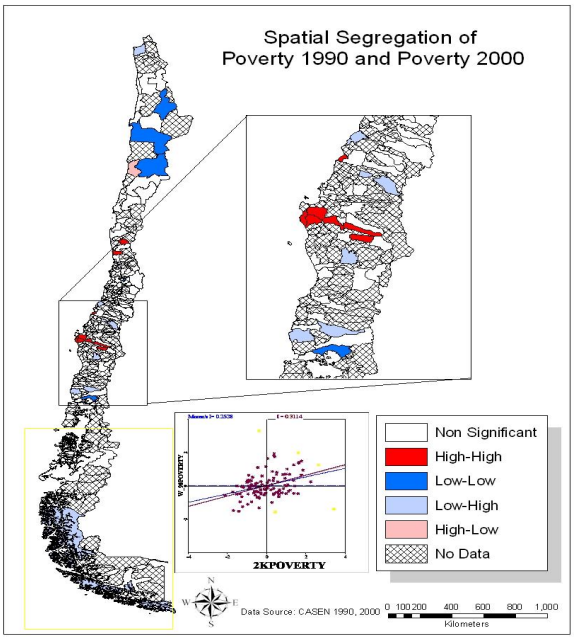
Well-being Indicators	Global Moran's I (all *comunas)*	P-value	Global Moran's I (south excluded)	P-value
Poverty				
1990	0.1384	0.039	0.1787	0.037
2000	0.4646	0.001	0.4779	0.001
Indigence				
1990	0.1464	0.028	0.1629	0.020
2000	0.4248	0.001	0.4695	0.001
Indoor Bathroom				
1990	0.0330	0.306	0.0325	0.310
2000	0.3471	0.001	0.3577	0.001
Illiteracy				
1990	0.2670	0.002	0.2936	0.002
2000	0.3995	0.001	0.4108	0.001
Indoor Plumbing				
1990	N.A	N.A	N.A	N.A
2000	0.3638	0.002	0.3675	0.003
Unhealthy				
1990	N.A	N.A	N.A	N.A
2000	0.2964	0.004	0.3027	0.004

Bivariate spatial associations

The spatial measures of segregation above where univariate in nature. They indicated, for example, the relationship between poverty in a place with that of poverty in contiguous places. There is no reason, however, why the relationship between poverty in a place could not be correlated with other characteristics of surrounding areas. A poverty cluster is simply a place with high poverty surround by other such places. But more substantively intriguing questions arise from comparing the poverty of places to that of other areal characteristics. In this final analytic section we begin to explore these issues by presenting a series of maps showing "bivariate" spatial segregation.

We begin by examining poverty in 1990 and poverty in 2000 as depicted in Figure 5. In this case, a hot spot (or red zone) would be one in which high poverty in 1990 correlates positively with high poverty *for surrounding comunas* in 2000. In a sense, they mark persistent poverty clusters, just as the cold spots (in blue) demark persistently low poverty clusters. We stress the following. A hot spot of disadvantage continues to be seen in Concepcion and stretching eastward. No cold spot of advantage appears near Santiago, perhaps a surprise. However, a low-low area of consistent advantage is seen in the near north region. Finally, we note that the smaller size of these hot and cold spots (relative to the univariate LISA maps shown earlier) reflect both data limitations and inherent economic fluctuation over time in the fortunes of individual locales.

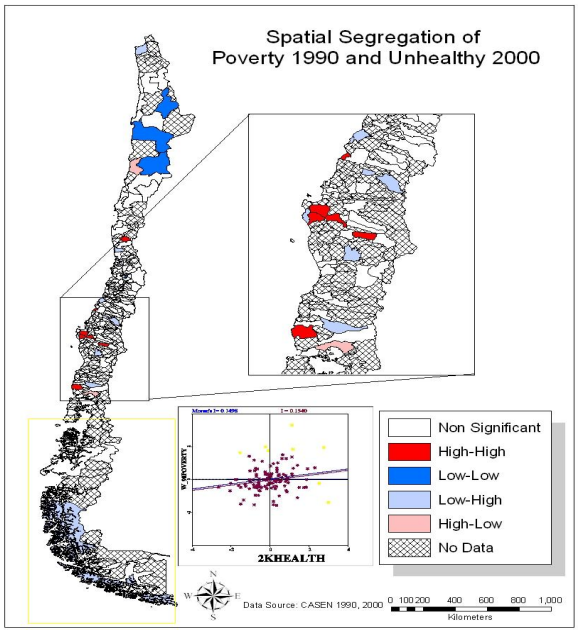
Figure 5. Bivariate spatial segregation of poverty in 1990 and 2000[a]



Moran's I = 0.2528 p=0.001
Moran's I= 0.3114 p=0.001

A similar pattern obtains when poverty of 1990 is related to health status in 2000. Here the question is, what is the spatial correlation between poverty at time 1, and the health status of surrounding areas at time 2. Concepcion areas had a relatively high poverty in 1990 and prevalence of ill-health in 2000, with the near north shows a more advantaged clustering of poverty and subsequent health. Missing data in 1990 constrains this analysis, and we recognize that an equality interesting question might be the relationship between poverty at time 2 and health at time 1. Subjective health was not asked in the 1990 CASEN.

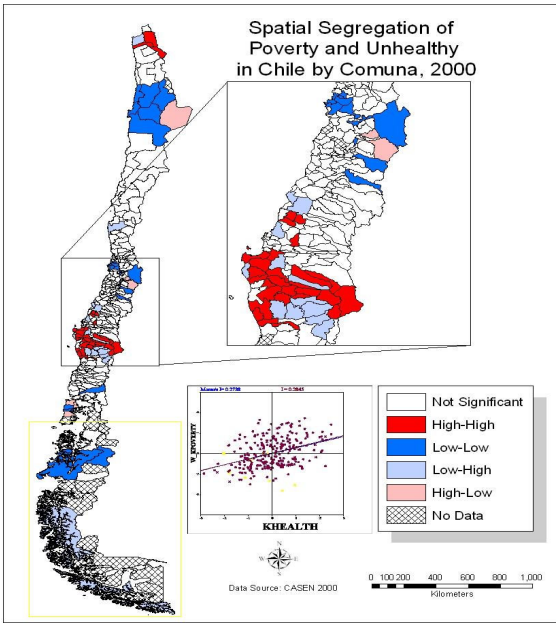
Figure 6. Bivariate spatial segregation of 1990 poverty and ill-health in 2000[a]



Moran's I = 0.1489 p=0.024
Moran's I = 0.1540 p=0.030

We can, however, examine the spatial clustering of poverty and health in 2000 (see Figure 7). Here, the hot spots and outliers intertwine in central Chile, suggesting that *comunas* with low poverty and prevalence of ill-health are contiguous to those with high rates. The Santiago region is mixed in this way. Concepcion has a high-high spatial segregation pattern of poverty and poor health in 2000, while the north and south evince a low-low pattern. The red zone in the far north is accompanied by a *comuna* with low rates.

Figure 7. Bivariate spatial segregation of poverty and ill-health in 2000[a]



Moran's I = 0.2738 p=0.001
Moran's I = 0.2845 p=0.001

Summary and Conclusion

If economic growth and declines in absolute poverty are valid indicators of overall economic development, then the 1990's were a decade of unquestioned progress in Chile. This improvement occurred, however, in a country where the overall level of measured inequality is rather high, indicating that the benefits of this decadal improvement would have been reaped principally by the well-to-do. Indeed, there is evidence that while recognition of economic growth is widespread, there also is popular discontent with the prevailing level of inequality, and with the increasing difficulty of making ends meet. While there is ample evidence on these issues at the micro level, in this analysis we have begun to examine the spatial dimensions of inequality and its change in Chile.

Like any country, Chile is marked by geographic diversity in the prevalence of poverty and its correlates. Areas of significant clustering of economic distadvantage include Concepcion and the Bio Bio region, in a band stretching to the east that is known for its high concentration indigenous people. A second notable clustering of high poverty and disadvantage is found in the far northern desert area east of Iquique. Clusters of comparative advantage along poverty and other well-being indicators include metropolitan Santiago and its environs, and an area stretching from Antofogasta to the east. While data limitations prevent as complete an understanding of change as we would like, our evidence suggests that this pattern of spatial inequality in Chile has persisted over time. And the pattern is consistent with evidence on the spatial variation in the beneficial impact of social programs (Contreras 2003).

While the visual pattern of spatial inequality has remained the same, we do find some evidence of provocative changes. Chile's decline in poverty but stagnant and high inequality over the 1990's at the household level is seen also in this *comuna*-level analysis. That is poverty rates for *comunas* did decline, but aspatial measures of inequality were stagnant or increasing. Particularly noteworthy are the differences in the multi-group information index for poverty (Table 4) which suggested the non-poor pulling apart from the near-poor and the indigent. What is interesting is that aspatial measures of inequality in other well-being indicators declined. The poor may have been pulling apart from the non-poor, but the benefits of literacy and having access to an indoor bathroom – a rough indicator of material well-being – were more evenly spread.

In future research we plan to extend this analysis in a number ways. While we sought to achieve to portrait of what occurred between 1990 and 2000, an important

decade in Chile, the lower geographic coverage of the 1990 survey suggests using additional CASEN surveys (e.g., 1992 and 2003) to achieve more complete and reliable estimates. We also plan to include additional contextual indicators (e.g., industrial distribution, human capital, ethnic composition) to both get a more complete portrait of the many dimensions of spatial inequality, and to better account for geographic differences and trends. Both additional bivariate LISA statistics and spatial regression models will be estimated. Finally, we hope to more fully explore in the implications of place characteristics on poverty and other outcomes by employing hierarchical linear modeling on the analysis of the CASEN data.

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