Geography and Development in Bolivia

Migration, Urban and Industrial Concentration, Welfare, and Convergence: 1950-1992

A study for the Inter-American Development Bank Research Network

December, 1999

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Acknowledgements

We thank the Inter-American Development Bank and the Catholic University for the release time and resources they provided for this study. Luis Antonio Boza, Carlos Machicado, Mario Morales, Marcela Aparicio, Manuel Contreras and Justo Espejo provided the necessary support throughout the project.

For valuable comments we thank Carmen Choque, Manuel Contreras, John Gallup, Alejandro Gaviria, Eduardo Lora, Rolando Morales, Máximo Torero, and all participants at the IDB seminar on Geography and Development.

Bernardo Requena and the UDAPE staff provided assistance with information requirements. Carlos Garafulic and INE supplied data and relevant publications as part of a broader cooperation agreement with MpD. Additionally, we are grateful to: Jaime Montaño for help with the migration data; Boris Arias for supplying digital maps; Viviana Caro for helping us track down transport costs; and Hugo Dorado for supplying industrial sector information.

Werner Hernany and Marcelo Olguín provided excellent research assistance.

All remaining errors are our own.

I. Introduction

In recent years, several papers have reconsidered the impact of geography on development, adding it to a hypothetical consensus list of factors explaining growth (Fischer, 1993; Barro, 1997). In empirical cross-country studies that focus on geographical factors, one could characterize Bolivia as a "well-behaved" observation. For instance, a tropical geographical location, landlocked status, limited agricultural productivity, and high tropical disease burdens are among key factors Gallup, Sachs, and Mellinger (1998) identify as obstacles to development. Bolivia displays all these traits, and simultaneously, has the lowest GDP per capita and Human Development Index in South America.

This paper argues, however, that considering the impact of geographical variables within Bolivia makes feasible a considerably richer analysis. The picture that emerges is occasionally not entirely consistent with the international evidence, but nonetheless points toward a systematic and significant impact of geography on development.

The key observation behind this focus on within-country variation is that in Bolivia, geographical regions are defined not by *latitude*, as in most cross-country studies, but by *altitude*, or somewhat equivalently, longitude. This happens because altitude variations have endowed what would otherwise be a rather homogenous "tropical" country with at least three distinct geographical areas. The general goal of this research is to study how this division has affected the country's economic development since 1950.

With this objective, the paper first defines and characterizes the three geographical areas used in the analysis: the Andean, Sub-Andean or Valley, and Lowland regions. It seeks to establish that there are significant, geographically-induced differences among them. These are found along dimensions as varied as climate traits, agricultural production and disease patterns, and the languages predominantly used by the local population.

These inter-regional differences motivate an analysis of how geography has influenced what may be the central aspect of Bolivian development since 1950: a significant shift of population and productive activities from the Andean (and to a lesser extent the Sub-Andean) region to the Lowlands. This event is associated with the emergence of three dominant urban centers, one in each of the areas discussed.

In studying these developments, the paper focuses on the following topics and arguments:

1) *The distribution of population*. This section first describes the migration flows that account for a significant portion of the Lowlands' growth. It also presents results suggesting these flows have been responsive to differences in income levels.

2) *Observed urbanization patterns.* This part of the analysis argues that partially due to migration, Bolivia displays peculiar urban concentration patterns, at least relative to most of its neighbors and comparable developing countries. Namely, since 1950 Bolivia has not urbanized around a dominant city, and in fact the usual concentration measures have evolved in unexpected ways.

3) *The distribution of productive activity.* This section first describes the significant shift in economic activity from the Andean (and Sub-Andean) to the Lowland region, an expected result given the mentioned migration and

urbanization patterns. In trying to account for this development, the section explores:

a) The way in which natural endowments help explain this shift, paying special attention to the agricultural products around which (particularly the early) Lowlands growth was concentrated;
b) The transfers of private and public financial capital which, combined with the human capital movements described, have made this region's growth feasible;
c) How transport costs appear to influence the geographical distribution of industrial and other productive activities across Bolivia, highlighting the role of natural resources and urban economies.

4) *The distribution of welfare*. The focus here is on the extent to which geographical variables explain regional welfare levels, as measured by GDP per capita and social development indices. A robust result is that in Bolivia, contrary to the usual cross-country evidence, more tropical (lower altitude), further inland areas have higher welfare levels.

5) *Convergence*. This final section considers whether there has been inter-regional convergence along these dimensions, and how the lowlands' growth may have affected the distribution of welfare. No robust conclusions emerge here. Some welfare measures suggest no clear tendency, whereas a specific poverty measure suggests there has in fact been some divergence between regions.

Drawing on these results and observations, a final section presents some conclusions and discusses policy implication. Additionally, this section highlights some areas for further research.

II. A basic characterization of geographical regions in Bolivia

Because of its location in the tropic of Capricorn, cross-country studies often (at least implicitly) characterize Bolivia as a homogenous tropical country. Map 1 in the appendix shows the country's location in South America, highlighting the fact that beyond its tropical situation, Bolivia is also landlocked.

In making use of within-country variation in geographical characteristics, however, most sections in this paper assume that Bolivia in fact consists of three distinct regions: the *Andean* or "mountainous" area, the *Sub-Andean*, or Valley region, and the *Lowland* area. Map 2 illustrates this division. Although the map does not show this fact, the classification of a given area into one of these regions depends mainly on its altitude, as discussed below.

Needless to say, analytically dividing the country into these regions entails considerable simplification, and indeed geographers often object to this step, arguing it conceals important within-area variation in topographical and climate-related traits. This paper will make use of the division not only because it is standard in much of the local literature, but also because, in the absence of extensive GIS-type information, it is the basic format in which much of the relevant data is available.

This, and the fact that much information is produced on a political unit basis, makes it essential to consider how political divisions map into geographic regions. A first point to note, as shown in Maps 3 and 4, is that Bolivia consists of nine *departments*, which are in turn divided into about 100 *provinces* (the number of these has not been constant throughout the period analyzed). Few provinces, let al.one departments, can be said to be located entirely within one of the three geographic regions. For several types of data, however, departmental aggregation is the only one available, so that some type of correspondence must be established. Fortunately, the assignment used here is standard in the literature on Bolivia:

1) Andean region: La Paz, Oruro, Potosí.
2) Sub-Andean or Valley region: Chuquisaca, Cochabamba, Tarija.
3) Lowland region: Beni, Pando, Santa Cruz.

This same correspondence will be used when data is available for only the nine departmental capitals. Additionally, when considering provincial rather than departmental level-data, this document makes use of the National Statistics Institute's standard matching scheme.[1]

With this background on data issues, Table 1 displays a basic characterization of the three regions considered. Here and in later tables, some rows will repeat information if it is available at more than one level of aggregation. In such instances, the accompanying notes indicate the geographical or political units the information is derived from.

Table 1
Basic regional geographic characterization

Characteristic	**Region**		
	Andean	Sub-Andean	Lowland
Mean altitude [a]	3,770	2,405	267
Mean altitude [b]	3,970	2,150	291
Mean temperature (Celsius) [a]	15.0	21.8	27.3
Mean temperature (Farenheit) [a]	59.0	71.2	81.1
Maximum temperature (Celsius) [d]	19.2	34.9	35.8
Minimum temperature (Celsius) [d]	-4.7	6.6	13.4
% of total area [d]	28	13	59
% of total forested lands [d]	11	13	77
% of total permanent snow and ice-covered areas [d]	100	0	0
% of total humid areas [d]	1	2	97

Source: Publications and data from National Statistics Institute and the National Geographic Military Institute.
Notes: a – Derived from city-level data (departmental capitals).
b – Derived from departmental data.
c – Derived from provincial level information.
d – Information based on actual characterizations of the relevant area-types, as provided by the Geographic Military Institute.

The first two rows present information on altitudes, and it is immediately apparent that this variable is highly correlated with other basic characteristics covered in this table. To illustrate, note that the Andean region is located at a mean altitude greater than 3,700 meters above sea level.[2] This high elevation is due to the fact that it straddles two sections of the Andean mountain range.

[1] Not surprisingly, this scheme does not always assign every province within a given department to the same geographic region.
[2] Four thousand meters is roughly equivalent to 12,000 feet.

Despite being in the geographical tropics, the Andean region therefore contains areas with decidedly non-tropical climates. At higher elevations, for instance, snowfall is a common occurrence. Not surprisingly, the table indicates that although it accounts for only 28 percent of total area, the Andean region contains all snow and ice-covered areas, and only 11 percent of forested lands.

At the other extreme, the Lowlands' mean altitude is close to sea level, and temperatures are what would be expected given its latitudinal location. This region is the largest, accounting for 59 percent of the country's total area. It contains 97 and 77 percent of all humid and forested lands, respectively.

Finally, the table shows that along all the basic characteristics considered, the Sub-Andean region is between the Andean and Lowland observations. As mentioned before, this reflects the fact that both in mean altitude and approximate longitudinal location, this area fits between the others.

As one would expect, these significant geographic differences translate into inter-regional variation in agricultural production patterns, as illustrated in Table 2. For instance, more than 90% of potato production takes place in the Andean or Sub-Andean regions, while almost the same percentage of rice production is located in the Lowland area. Grape, tomato, and coffee production show similarly skewed patterns.

This table also illustrates that geographic differences give rise to variation in disease patterns. For instance, even though the Andean region (defined using departmental-level data) contains 45 percent of the population, it accounts for only 7 percent of total cholera and malaria cases. At the other extreme, the Lowland region concentrates 52 percent of the cases with only 26 percent of the population.

Table 2
Selected regional shares in the production of selected products

Characteristic	**Region**		
	Andean	Sub-Andean	Lowland
% of total population (1992)	45.0	28.9	26.1
Rice production, % of total 1994-1995 crop	6.0	5.8	88.2
Potato production, % of total 1994-1995 crop	48.7	42.8	8.4
Coffee production, % of total 1994-1995 crop	96.4	1.1	2.5
Grape production, % of total 1994-1995 crop	23.9	73.2	2.9
Tomato production, % of total 1994-1995 crop	5.7	6.6	87.7
Cholera and malaria, % of total 1995 cases	7.1	41.0	51.9
% who speak Aymara	39.7	3.7	2.0
% who speak Quechua	24.8	49.9	11.2

Source: INE (1997a) and INE (1997b).
Notes: all information derived from departmental data.

These variations may partially explain an important fact of long-term development in Bolivia: that different pre-Columbian cultures came to dominate each geographical area. Specifically, the variation in regional characteristics may have facilitated different groups' ability to gain and retain control in different areas.

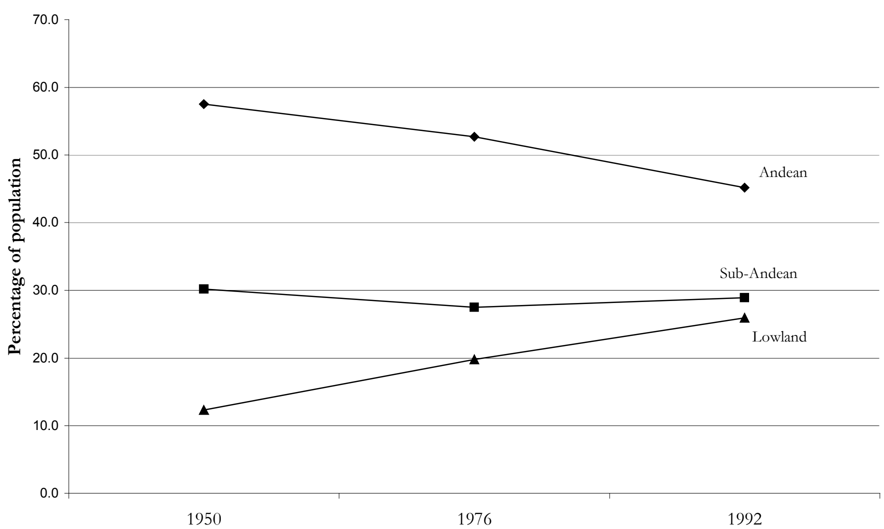
This is reflected in the prevalence of native languages within each region, also shown in Table 2. Aymara is the most common native language in the Andean region, while Quechua, the language of the Incas, has greater influence in the Sub-Andean region.[3] The Lowlands have a low prevalence of native-language speakers in general, but they do display the highest incidence of Guaraní (not shown in the table), a native language that is common in areas of Paraguay and Brazil.

With this background on regions and their characteristics, the following section describes changes in the distribution of population observed since 1950.

III. The regional distribution of population

Historically, the greater share of Bolivia's population has been located in the Andean region, with the Sub-Andean and Lowland regions coming next, in that order. As Figure 1 shows, however, the Lowlands have been gaining importance since 1950, almost equaling the Sub-Andean regions' share by 1992. This figure is based on the censuses of 1950, 1976, and 1992, the three available for the period under study.[4]

Figure 1: Population distribution by region



This pattern is also reflected in Table 3, which presents net migration and population growth rates by department. As the table shows, the two highest 1976-1992 growth rates are in Lowland region departments, while the two lowest, one of them negative, are in the Andean area.

This differential growth is due to variations in fertility rates, but also to migration patterns. Table 3 also shows that all three Andean departments have negative net migration rates at least during the 1987-1992 period, while all Lowland ones have

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[3] Casual observation suggests that the area around which the Sub-Andean region is centered, Cochabamba, bears great similarity in climate and agricultural production patterns to the valleys around Cuzco, the capital of the Inca empire.

[4] Although this work focuses on the 1950-1992 period, earlier population information indicates that the trend towards and increasing share for the lowlands did begin around the 1950s and is not an earlier phenomenon. See Urquiola (1999).

positive rates at least during the same years. As in most other aspects, the Sub-Andean results are "sandwiched" between the other two.

In light of the significant migration flows suggested by this evidence, it is interesting to explore how responsive these have been to income levels. Unfortunately, this type of analysis can only be carried out in the case of urban-bound migration, since detailed data on migrants' characteristics is available from household surveys carried out only in the nine departmental capitals.[5] Additionally, this section focuses on urban-urban migration, because an "adequate" characterization of migrants' regions of *origin* and regions of *destination* is available only at this level.

Table 3
Net migration and growth rates by department: 1971-1992
(migration rates are per 1000 people)

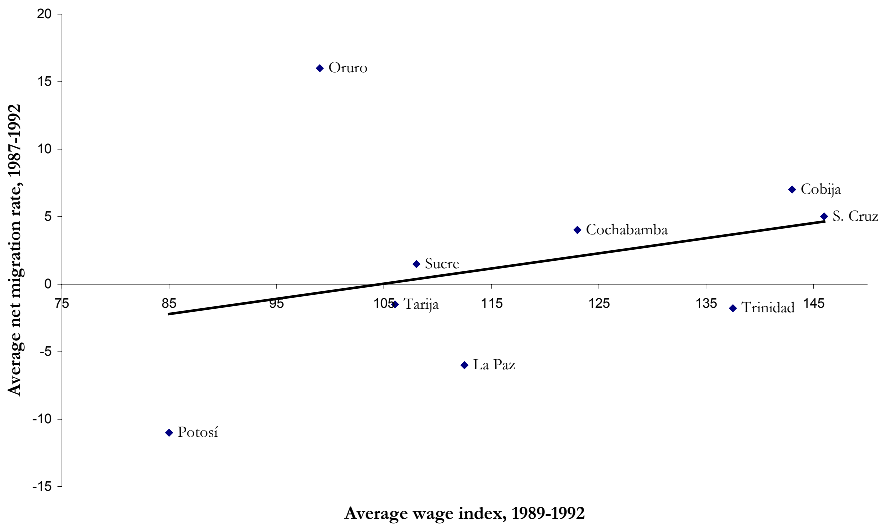
Region	**Department**	**Net Migration**		**1992-1976 total growth (%)**
		1971-76	1987-92	
Andean	La Paz	1.4	-1.4	16.6
	Oruro	2.4	-12.5	5.8
	Potosí	-3.1	-12.4	-1.2
Sub-Andean	Chuquisaca	-4.7	-3.7	15.0
	Cochabamba	3.1	4.7	27.5
	Tarija	10.6	6.4	28.2
Lowland	Beni	-2.1	0.6	31.6
	Pando	14.1	2.3	6.3
	Santa Cruz	6.7	19.0	41.6

Source: INE (1997a).

The analysis uses a conventional regression framework seeking to relate wage levels and net migration rates across cities. Providing some introductory information in this regard, Figure 2 plots net migration rates against wage indices for the nine departmental capitals in Bolivia.[6] Apart from one outlier, Oruro, there appears to be the expected relation between wage levels and net migration rates.

[5] This sort of analysis, albeit with somewhat fewer control variables, could also be feasible using individual-level census information.
[6] This figure is derived from the authors' calculations using the National Household surveys, and also from Instituto Nacional de Estadística (1997).

Figure 2: Net migration rates and wage indices for cities (1987-1992)



To explore this issue systematically, Table 4 presents a probit regression, where a migration indicator is regressed on a set of *individual* characteristics (age, years of education, marital status, and ethnicity), a set of characteristics of the city of *origin* (unemployment rate, wage level, and poverty incidence), and an analogous set of *destination* descriptors. The default value of the dependent variable is 0, and it is 1 if the individual has moved from one of the major nine cities to another within the last five years. The sample is restricted to heads of households.

Table 4
Probit migration results: 1994

Category	Variable	Coefficient
Individual Characteristics	Constant	3.291
	Age	-0.024***
	Years of schooling	0.022***
	Married	-0.092
	Aymara speaker	-0.133
	Quechua speaker	-0.007
Origin Characteristics	Unemployment rate	0.243
	Wage index	-0.037
	Poverty incidence	0.007
Destination Characteristics	Unemployment rate	-0.307
	Wage index	0.021
	Poverty incidence	-0.050
Pseudo R^2		0.181
Observations		5,705

Source: Authors' calculations using Encuesta Integrada de Hogares, 1994.

Note: Regressions adjust for clustering at the city level. See Moulton (1986).

* - significant at the 10 percent level.
** - significant at the 5 percent level.
*** - significant at the 1 percent level.

As is often the case in these settings, the results suggest that, all else equal, younger, more educated people are more likely to migrate. The other individual-level characteristics are not statistically significant.

Focusing on the origin and destination characteristics, the coefficients are all of the expected sign, suggesting people are more likely to migrate to areas with higher wage and lower unemployment and poverty levels. These variables, however, are not significant.[7]

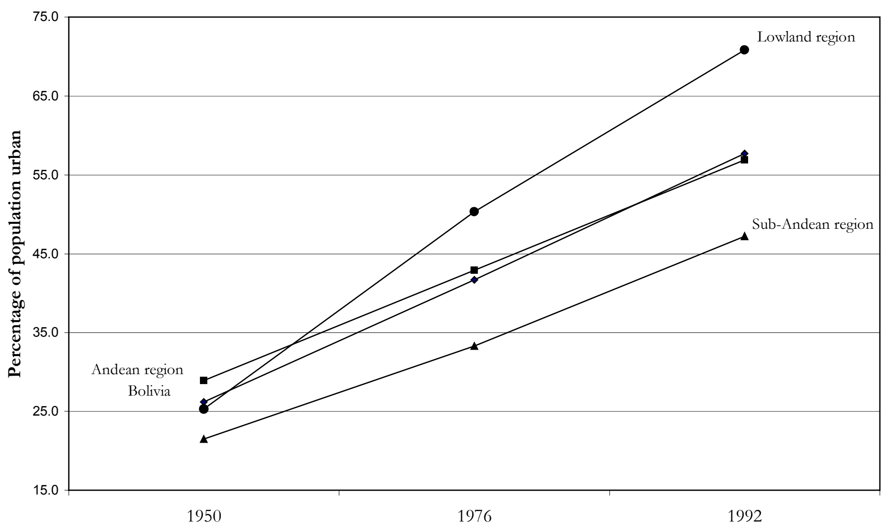
To summarize, this section has presented basic information on the significant changes in the geographic distribution of population that took place in Bolivia since the 1950s. The main finding is the declining importance of the Andean area and the rising participation of the Lowland region. These changes are the product not only of differential fertility rates, but also of significant migration, which at least at an urban level appears to be potentially responsive to economic conditions. This last aspect that will be important in linking these developments to the shifts in the distribution of economic activity discussed in later sections.

[7] These coefficients would be significant were it not for the Moulton (1986) correction for clustering, in this case, at the city level. To see why this is relevant, note that the regression has more than five thousand observations. This implies that, in theory, individual-level control variables could take on as many different values. Destination or origin characteristics, however, can have only one of nine values here (the number of cities included in the sample), and additionally, observations are grouped by these values. This structure will tend to underestimate standard errors. Moulton in fact singled out geographically-based empirical analyses as a prime example of when a correction for such grouping would be necessary.

IV. Urbanization Patterns

The association between growth and urbanization is one of the central empirical regularities in development. As Figure 3 shows, Bolivia's experience in this realm is qualitatively consistent with the international evidence: there have been persistent increases in national and region-specific urbanization rates during the period under study. While no region had an urbanization rate higher than 50% in 1950, two of them did by 1992. The most rapid increase and highest urbanization level is observed in the Lowlands.

Figure 3: Urbanization rates by region



Nevertheless, geographical factors and the migration patterns discussed in the previous section may account for the fact that in one aspect of urbanization, Bolivia displays relatively idiosyncratic characteristics, at least if its neighbors' experience is taken as a benchmark. Namely, unlike Argentina, Chile, Paraguay, and Peru, the country has not urbanized around a clearly dominant city (this list excludes Brazil, the remaining neighboring country). In other terms, urban concentration, by any of the usual measures, is lower in Bolivia than in comparable countries.

To illustrate this, consider Wheaton and Shishido (1981), who provide evidence on this topic for 38 developing countries. Their results are consistent with the level of development having at first a positive and then a negative effect on urban concentration. In their sample, Bolivia would clearly be in the segment where this relationship is positive.

In order to measure urban concentration, these authors introduce a number of measures. The first is the Urban Primacy Index, simply the ratio of the population in the

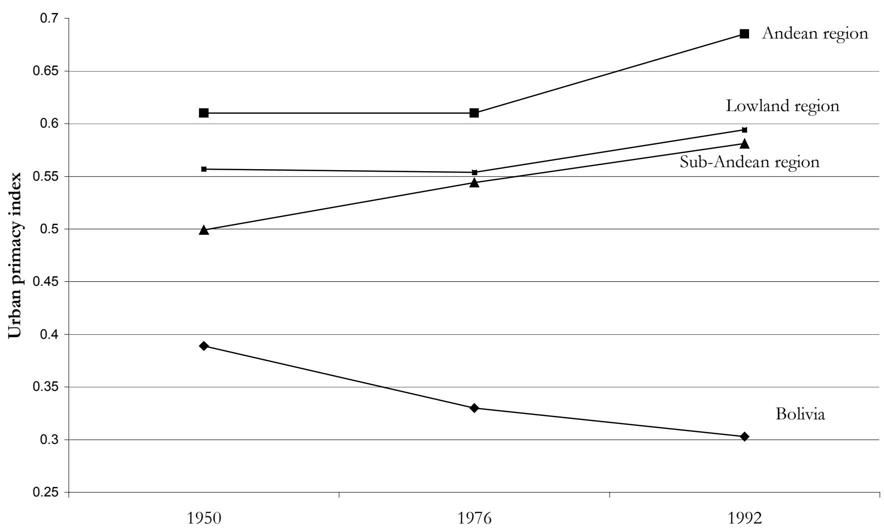
largest city (P_1) to the total urban population (P).[8]

[8] In Bolivia, the urban population is defined as that living in towns or cities with a population above two thousand. The same definition is used here, consistently applied to the 1950, 1976 and 1992 censuses. None of the results presented in this section proved sensitive to using a threshold of ten or twenty thousand instead.

$$UP=P_1/P$$

Figure 4 shows the evolution of this measure both at a national and regional-specific level. The lower part of the figure indicates that the relative importance of the largest city, La Paz, has declined: from containing almost 40% of the urban population in 1950, the city's share declined to slightly over 30% in 1992. In contrast to the international experience, therefore, economic development has been associated with declining urban concentration, at least by this measure.

Figure 4: Urban primacy indices by region



The upper part of this figure shows, however, that while the emergence of smaller cities may partially account for this declining concentration, it also reflects the *rising dominance of one city within each of the three regions* discussed. These are La Paz in the Andean, Cochabamba in the Sub-Andean, and Santa Cruz in the Lowland region. The growth of these three cities accounts for why all within-region urban primacy indices have increased since 1950.

These three cities have also grown faster than all others combined: the percentage of the urban population contained in these metropolitan areas has gone from about 55 in 1950 to 65 percent in 1992. Thus, their growth accounts for a disproportionate share of the general urbanization observed in Figure 3.

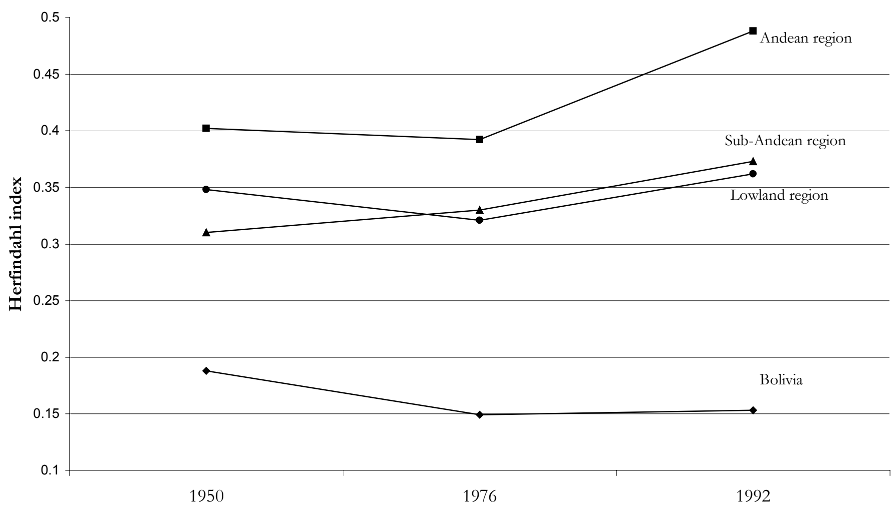
Because the behavior of the Urban Primacy Index is dominated by only the largest city in the area under study, the literature also tries to achieve a more balanced picture using the Herfindahl concentration index, drawing from Industrial Organization. If P_i is the population of city i, and P is the total urban population in the area under consideration, the Herfindahl index is given by:

$$H=\Sigma(P_i / P)^2$$

As Figure 5, shows, qualitatively similar results emerge when this measure is used instead.

It is relevant to note that Figures 4 and 5 are based on Metropolitan Area (MA) rather than city-level data. This distinction matters only for two cities: La Paz and Cochabamba, and mainly in the first case. The La Paz metropolitan area consists of the cities of El Alto and La Paz. The former contains about 40% of their combined population. If city rather than MA data is used, the only qualitatively important change arises in Figure 5, because the Herfindahl index in the Andean region no longer rises between 1976 and 1992. Because El Alto and La Paz are contiguous cities with integrated labor markets, this distinction does not seem important.

Figure 5: Hefindahl indices of urban concentration by region



An alternate way to consider urban concentration has recently received more attention, namely Zipf's "law" or the so-called rank-size rule. Put shortly, this rule states cities' populations should be inversely proportional to their rank. In other words, the n^{th} largest city in the country should have a population size roughly equal to *1/n* that of the largest city.

In regression terms, this "rule" posits that the estimated coefficient of an equation relating the log of city rank to the log of city population size should be equal to approximately −1. Several authors have noted this "rule" works remarkably well. Krugman (1986) points out that for the 130 largest metropolitan areas in the United States, estimation yields a coefficient of −1.003 with a standard error of only 0.01. He suggests Zipf's law does not work as precisely in other developed countries, but that it still provides a good fit if the "primal" city (e.g., London and Paris in the case of the United Kingdom and France, respectively) is removed from the sample.

To explore this issue in the Bolivian context, Table 5 presents simple rank-size rule regressions, using data on the 20 largest urban centers in 1950, 1976, and 1992.[9] As the table shows, Bolivia does not quite adjust to the expectation. Even in 1950, the coefficient of interest *is significantly different from one*, and its divergence increases with each census, reaching a point estimate of −1.6 in 1992. Eliminating the largest or the three largest cities does not have uniform effects on these results, although in the

[9] These results are not qualitatively different when the sample includes a different number of cities or explicit population size cutoffs. A subsequent version of this document will explore this issue in greater detail.

last two periods it moves them closer to expectation. When the three largest cities are removed, the coefficient of interest changes to –1.53, -1.40, and –1.43, respectively.

Table 5
Regressions of log city size on log city rank – 1950, 1976, 1992

	1950	1976	1992
Constant	5.4*** (0.07)	5.9*** (0.04)	6.2*** (0.05)
Log of city rank	-1.43*** (0.07)	-1.49*** (0.04)	-1.60*** (0.05)
R2	0.980	0.984	0.979
N	20	20	20

Source: authors' calculations using census information.
Note: * - significant at the 10 percent level.
** - significant at the 5 percent level.
*** - significant at the 1 percent level.

Though the reasons behind the relative "failure" of Zipf's "law" in Bolivia are hard to ascertain, its worsening performance can at least be partially traced to the growing and converging importance of the three largest metropolitan areas: La Paz, Santa Cruz, and Cochabamba. As indicated above, these three centers' share of the urban population increased from 55 to 65% between 1950 and 1992, and the three are clearly much larger than all other Bolivian cities.

Table 6 shows this was not always the case, and is suggestive of how these cities' growth affects the rank size rule's performance. For each census year, this table features the seven largest cities and their respective populations.

Table 6
Seven largest cities and populations by census years
(populations are in thousands)

1950			1976			1992			Total 1992/50 Growth (%)
	City	Pop.		City	Pop.		City	Pop.	
1	La Paz	267.0	1	La Paz	635.3	1	La Paz	1,118.9	319
2	Cochabamba	86.5	3	Cochabamba	229.7	3	Cochabamba	515.7	496
3	Oruro	58.6	4	Oruro	124.2	4	Oruro	183.4	213
4	Potosí	43.3	5	Potosí	77.4	6	Potosí	112.1	159
5	Santa Cruz	41.5	2	Santa Cruz	254.7	2	Santa Cruz	697.3	1,580
6	Sucre	38.4	6	Sucre	63.6	5	Sucre	131.8	243
7	Tarija	16.4	7	Tarija	38.9	7	Tarija	90.1	449

Source: Authors' calculations using census information.

A first point to note is that while La Paz and Cochabamba have been on the "top three" list since 1950, Santa Cruz only joined in 1976, moving straight from fifth to second place between these two census years. This partially reflects the strong west-east net migration patterns described above. The final column in Table 6 shows each city's population growth rate. The two cities with the highest growth rates are Santa

Cruz and Cochabamba, which has determined that they have been able to approach La Paz in size.

While La Paz was 3.1 and 4.6 times as large as the second and third largest cities in 1976, these ratios had fallen to 1.6 and 2.2 by 1992. Particularly when regressions focus on larger cities, these two observations alone account for part of the rank-size rule's worsening performance.

Another notable point about Table 6 is the relatively high "flexibility" in rankings. Of the seven cities considered, only two, La Paz and Tarija, have not experienced a change in their position between 1950 and 1992. As a subsequent section will argue, many of these changes, including of course the rising importance of Santa Cruz, can be explained by making reference to natural resources and their impact on shifts in the distribution of economic activity.

Returning to urban concentration, an interesting question is whether Zipf's rule "does better" within regions. Table 7 presents evidence in this regard, focusing on the 15 largest cities within each area.[10] An interesting result is that in this case the coefficient estimates are even further from –1. This result is particularly strong in the Sub-Andean region, where the coefficient on the log of city rank approaches –2.

Table 7
Regressions of log city size on log city rank – 1950, 1976, 1992

	Andean Region	Sub-Andean Region	Lowland Region
Constant	13.4^{***} (0.2)	13.2^{***} (0.2)	12.6^{***} (0.2)
Log of city rank	-1.84^{***} (0.11)	-1.98^{***} (0.08)	-1.41^{***} (0.12)
R2	0.956	0.981	0.911
N	15	15	15

Source: Authors' calculations using census information.
Note: * - significant at the 10 percent level.
** - significant at the 5 percent level.
*** - significant at the 1 percent level.

To summarize all results on urban concentration, the following points can be made:

1) As a preliminary and well-established fact, and consistent with the international experience, Bolivia has experienced a rapid urbanization process in the period under study.
2) At a national level and at least since 1950, however, Bolivia does not display a positive *growth/urban concentration* association that is frequent in developing countries in general, and among its neighbors in particular. This seems to be mainly due to the relative decline of La Paz as a population center, and the rise of Cochabamba and particularly Santa Cruz as alternate cities.
3) *Within* each geographic area identified in this paper, however, urban concentration is clearly on the rise and significant. In none of these areas is the urban primacy rate below 0.5, and in the Andean region it is above 0.7.

[10] Once again, using other criteria did not affect the qualitative conclusions these results suggest.

4) When the rank-size rule is used to explore urban concentration in Bolivia, the results are not entirely consistent with the expectation, and in fact seem to have been diverging from it over time. A partial reason for this, once again, appears to be the relative rise of Cochabamba and Santa Cruz with respect to the historical primacy of La Paz.
5) Finally, the ranking of Bolivia's cities by size appears to be relatively "flexible", with five of the seven largest cities changing their position in the period under study.

The following section begins to relate changes in the distribution of population, on the one hand, and urbanization patterns, on the other, with natural resources and the distribution of economic activity in general.

V. The distribution of productive activity: Accounting for the growth of the Lowlands and Santa Cruz

Population shifts of the magnitude implied by the previous sections are likely to be associated with changes in the location of economic activity. As Table 3 showed, the department with the greatest net migration and growth rates has been Santa Cruz. Additionally, Table 8 demonstrates its share in total and agricultural GDP has surged in the period under study, tripling between 1950 and 1995 in the first case, and doubling between 1970 and 1995 in the second.

Table 8
Santa Cruz: Percentage shares in GDP

Year	Mining % share in GDP	Santa Cruz % share in:	
		Total GDP	Agricultural GDP
1950	24.4	9.0	N/A
1970	12.5	16.3	18.3
1980	13.8	18.7	22.5
1990	11.2	26.8	31.0
1995	11.2	27.9	39.2

Source: CEPAL (1957), Arrieta (1994), and INE.

Such a shift of course reflects the growth of Santa Cruz, but it is also indicative of the decline in mining, one of the Andean region's historically most important activities, as suggested by the second column of Table 8. Indeed, this is reflected in the relative decline of Potosí and especially Oruro, the two traditional mining cities, in the urban rankings reviewed in Table 6.

In contrast, the activities related to Santa Cruz's natural resources have been on the increase since 1950. A substantial part of them is related to relatively large-scale agricultural production, favored by the fertile land that exists in parts of this department. Interestingly, however, agricultural growth since 1950 has not been associated with a single crop, but rather with a series of foodstuffs that, each at its own turn, have given Santa Cruz several "booms" that increased growth. Roughly chronologically, these crops have been rice, cotton, sugar cane, and soybean.

These assertions are illustrated in Table 9. The first column shows the significant growth in total area under cultivation that has taken place since 1950: total hectares increased by more than 1500% between 1950 and 1997. This compares very favorably with the total area under cultivation in the Andean region, which has remained stagnant since 1950.

Table 9
Santa Cruz: Crops' shares in the total area under cultivation

Period	Total area under cultivation (hectares)	Rice	Cotton	Sugar Cane	Soybean	Other
1950	58,242	17.4	0.2	18.1	0.0	64.3
1958	125,000	10.8	0.6	12.0	0.0	76.6
1964	154,370	16.1	2.3	16.4	0.0	65.3
1969-71	173,612	22.8	6.8	17.3	0.5	52.6
1971-75	217,618	16.8	22.5	17.7	1.9	41.0
1975-80	258,332	13.3	12.2	23.8	7.6	43.1
1980-84	263,464	15.9	3.6	21.0	13.5	46.0
1990-94	573,058	14.7	3.2	11.6	39.6	30.9
1994-97	945,244	9.1	4.3	7.7	48.8	30.0

Source: Arrieta et al. (1994) and UDAPE (1998).

The remaining columns indicate the percentage of the total area accounted for by particular crops. One cell is highlighted in each column, corresponding to when the crop in question reached its highest share in the total cultivated area. As can be seen, each of these products has, *in successive periods*, had a significant role in the growth of the agricultural sector in Santa Cruz, accounting for at least 20% of all cultivated area during at least one period. Interestingly, no product, except for soybean, has held such a position for more than one of the periods considered.

Soybean also displays a particular pattern because it has reached the highest participation of any product, almost 50%, in the last period. This is also reflected in the last column, which shows the declining importance of "other products" over time. Increasingly, the Lowlands' agricultural growth has been concentrated in the crops the table considers individually.

Beyond these agricultural booms, Santa Cruz has also experienced an oil and especially gas-related boom, despite the fact that a substantial part of the oil industry is actually located in two other departments, Tarija and Cochabamba. Santa Cruz has also benefited from the industry headquarters' recent relocation to its capital city.

Of course, natural resource potential and migration may be necessary, but are not sufficient, conditions for the rapid growth displayed by Santa Cruz. Additionally, capital for the necessary investments must be forthcoming. In the Bolivian case, both the public and private sectors have been its source. Table 10 illustrates the private sector's contribution. Because relatively little historical information is available, the table focuses only on the 1988-97 period, showing the departmental distribution of commercial bank deposits and loans by department.

Throughout this entire period, Santa Cruz has been a net recipient of resources, displaying at least a 10-point differential between its share in loans and deposits, a gap which widens to almost 15 percent by 1995-97. Cochabamba and particularly La Paz (as well as the aggregate of other departments) have made net transfers.

Table 10
Distribution of bank deposits and loans among departments

Period	La Paz	Santa Cruz	Cochabamba	Other departments
Deposits:				
1988-89	46.3	25.8	16.7	11.2
1990-94	44.2	27.3	16.1	12.4
1995-97	41.8	27.9	17.0	13.3
Loans:				
1988-89	39.6	36.5	11.7	12.2
1990-94	37.8	40.6	13.0	8.6
1995-97	36.9	42.3	14.4	6.3

On the public sector side, this resource transfer is also apparent in the distribution of tax receipts and public investment shown in Table 11. Historically, the department of La Paz in the Andean region has contributed the greatest portion of the central government's revenue, but has received a comparatively smaller share of its investment. In contrast, Santa Cruz, but also Cochabamba and the aggregate of the other departments, have been net recipients. This situation changes in the period 1995-97, however, when, as the Table shows, Santa Cruz was no longer a net recipient.

Table 11
Departmental distribution of tax receipts and public investment by periods

Period	La Paz	Santa Cruz	Cochabamba	Other departments
Tax Receipts:				
1975-79	75.74	16.57	15.95	11.74
1980-84	66.15	13.39	12.11	8.35
1985-89	58.89	16.04	15.71	9.37
1990-94	57.73	20.99	13.91	7.39
1995-97	53.96	24.23	13.65	8.17
Public Investment:				
1987-89	11.80	22.84	12.99	52.37

1990-94	14.72	24.81	15.17	45.30
1995-97	21.75	16.23	22.03	39.97

Also in the public realm, the Lowlands in general and Santa Cruz in particular benefited from special attention by the national government in the 1940s and 50s, partially as a result of recommendations made by a commission lead by Merwin Bohan (hence the name "Bohan plan" or "Bohan report"). After studying the Bolivian economy, this group recommended what could be described as an inward and Lowlands-oriented growth strategy.[11]

This led to the construction of an improved Cochabamba-Santa Cruz road, and various minor within-Lowlands connections. As part of this effort, the government also granted incentives for the production of rice and sugar in Santa Cruz, and of cattle ranching in Beni. State banks, particularly the Agricultural Bank, also favored Santa Cruz in their credits. Between 1950 and 1990, an (unweighted) average of 40% of this bank's credit went to Santa Cruz.[12] There is also evidence of poor repayment records for these (and other state bank) loans, signaling significant transfers to the Lowlands region.

Summarizing the arguments made in the previous sections, this paper has made reference to the following, geographically-related, key developments:

1) The increasing importance of the lowland region in the distribution of population in Bolivia;
2) The decline in urban concentration the country has experienced partially as a result of the growth of two cities: Cochabamba (Sub-Andean) and particularly Santa Cruz (Lowland);
3) The increasing importance of three urban centers (La Paz, Cochabamba, and Santa Cruz) in terms of concentrating their respective regional populations.

Naturally, the growth of Santa Cruz and the lowlands is an important part of all these developments, and this section has attempted to give some simple background on the natural resource characteristics and physical capital developments that have made it feasible.

As indicated previously, the aspect described in point 3 makes Bolivian development somewhat idiosyncratic, at least with respect to most neighboring countries in which the urban population and productive activities tend to be concentrated in a single large city. The following section uses an analysis based on transport costs to provide a possible explanation for this aspect.

VI. Transport costs and the concentration of productive activities

Economists have put forth a number of factors as possible explanations for observed concentrations of industrial or other productive activities. One prominent source has been the existence of agglomeration externalities which may originate in a) the availability of concentrated labor pools, b) the presence of a lower cost supply of industry-specific inputs, and c) possible technological spillovers between firms in the same industry or productive area.

The literature has also identified "urbanization" economies, by which local firms benefit from the diversity and scale made possible by urbanization. In this case, the

[11] See Pacheco (1999).

[12] Authors' calculations based on Arrieta (1994).

concentration of economic activity is a function of agglomeration itself: the availability of a concentrated market.

As Henderson, Kuncoro, and Turner (1995) have pointed out, if agglomeration externalities are predominant and firms take advantage of them, cities will tend to specialize. In contrast, if urbanization economies are the more prevalent ones, diversified cities will instead be the rule.

The concentration process is additionally affected by transportation costs. When these are high, industrial activity will tend to locate closer to market. Thus, all else being equal, high transport costs will tend to be associated with less specialization and exchange among urban centers.

Finally, the existence of natural resources also affects the organization of industrial production. As emphasized by North (1955), this may be especially relevant in areas that have developed relatively late, and where much production is organized around exports toward more developed countries. As North discusses, in this situation cities may become "nodes" whose existence revolves around the export activity.

In order to explore these issues, this part of the paper is divided into two subsections. The first focuses on transport costs, theoretically one of the main determinants of the concentration of industrial and productive activities. It includes some simple data on shipping costs for comparison purposes. The next subsection presents characterizations of industrial concentration in Bolivia, at different levels of aggregation and for different periods. Wherever possible, the observed concentrations are related to the transport cost profile discussed in the previous subsection.

VI.A. Transport costs

As suggested by the very basic characterization presented in previous sections, Bolivia has at least three significantly different geographical areas. Because altitude gives rise to this diversity, elevation differences have also contributed to the relatively high transport costs the country exhibits. Road construction is expensive in the Andean and Sub-Andean regions because of the highly mountainous topography. Soft soils and abundant rain make the construction and particularly the maintenance of reliable paved roads expensive in the lowlands as well. Revuelta (1994) points out that the combination of these factors determines that once roads are built, transport costs are in fact lower in the Andean than in the Lowland regions.

Map 5 provides a basic characterization of the available transport network. Though the map includes only the "main" roads, it covers almost the entire available links, especially if one restricts attention to those open on a year-round basis. Even these main connections, furthermore, experience periodical closures, and there are systematic problems with the durability of paved surfaces.

The scant transportation infrastructure is reflected in Table 12, which presents some cross-country indicators. As evident, Bolivia has the lowest "road density" (km per million inhabitants) of any of the countries featured. Despite a large increase between the 1960s and 1990s, it still has the least amount of km of paved roads.

Table 12
Selected cross-country road indicators

Country	Pop. 1997 (mill.)	Land Area Km.^{2}	GDP per capita $US	Density	% paved	% in good cond.	Km paved by 1960s	Km paved by 1990s

				Inhab. per Km^2	Km. per million inhab				
Bolivia	8	1,099	950	7	198	6	21	569	2,933
Perú	25	1,285	2460	19	347	10	24	4,016	7,500
Brazil	164	8,512	4720	19	704	9	30	12,703	161,503
Paraguay	5	407	2010	12	NA	10	NA	254	3,000
Argentina	36	2,767	8570	13	858	29	35	22,712	57,280
Chile	15	757	5020	19	753	14	42	2,604	10,983
Ecuador	12	284	1590	41	336	13	53	719	6,322
Colombia	38	1,139	2280	35	309	12	42	2,998	10,329

Source: 1994 World Development Report.

For an initial description of the impact this has on transport costs, Table 13 presents inter-city truck freight rates between eight of the nine departmental capitals.

Table 13
Inter-city per kilometer truck freight rates
(cents $U.S. per ton)

Cities	Oruro	Potosí	Cocha-bamba	Sucre	Tarija	Santa Cruz	Trinidad
La Paz	3.21	4.17	3.20	5.11	3.74	4.39	12.06
Oruro		4.81	4.00	6.30	3.91	4.60	8.44
Potosí			4.60	3.05	3.13	4.93	7.09
Cocha.				5.25	4.22	4.84	6.48
Sucre					3.44	4.29	5.85
Tarija						8.40	8.03
Santa Cruz							7.55

Source: Revuelta (1994)

Though the specific information is not presented here, two factors that may account for the cases with relatively low costs are: the presence of reliably paved surfaces (e.g., La Paz-Cochabamba), and location in highland regions (e.g., La Paz-Oruro). At the other extreme, non-paved roads in heavy-rainfall areas of the lowlands (e.g., all Trinidad-bound routes) exhibit the highest costs.

To put these figures in context, the top segment of Table 14 presents truck freight rates from the seven largest cities to frontier locations. The bottom segment then lists the rates from these frontier locations to the ports (located in Peru, Chile, and Argentina) that they serve as links to.

To illustrate, in the case of freight bound for the port of Matarani (Peru) from La Paz, the cost of getting the cargo to the border is 5.83 cents per km, and increases to 5.98 per km within Peru. Costs are also higher after crossing Tambo Quemado into Chile. In part, the relatively short distances left within each country may account for these differences. In contrast, per kilometer costs within Argentina are significantly lower than in the within-Bolivia portions that lead to ports in this country.

Table 14
Inter-city per kilometer truck freight rates
(cents $US per ton)

		Border locations			
		Desaguadero (Bolivia/Perú)	Tambo Quemado (Bolivia/Chile)	Villazón (Bolivia/ Arg.)	Yacuiba (Bolivia/Arg.)
Seven largest cities	La Paz	5.83	5.84	5.30	--
	Oruro	5.12	5.78	5.99	--
	Potosí	4.66	5.99	7.20	--
	Cochabamba	4.76	5.75	5.63	--
	Sucre	5.67	6.62	5.87	--
	Santa Cruz	3.97	5.57	--	8.83
	Trinidad	9.06	8.38	--	7.96
Intern a- tional ports	Matarani/Peru	5.98	--	--	--
	Arica/Chile	--	9.39	--	--
	Rosario/Arg.	--	--	3.24	3.31
	Bs.As./Arg.	--	--	2.95	2.88

Source: Revuelta (1994)

In the realm of railroad transportation, Map 5 also shows that the two main railroad networks, one serving the eastern part and the other the western part of the country, are not connected. Because of this, railroad transport is generally more important for export rather than internal trade purposes. In this area however, differences in costs between Bolivia and neighboring countries tend to be larger. To illustrate this point, Table 15 presents data on railroad shipping costs in a format analogous to that of Table 14. The only difference is that in this case the port of Santos, Brazil, joined by railroad link to Santa Cruz, Bolivia, is included in the table.

A difference with respect to the truck freight comparison is that in this case costs per km in Peru are substantially lower than in Bolivia. In the case of Chilean ports, per km fares are once again slightly higher. As also happened in the trucking results, segments within Argentina and Brazil display substantially lower prices per km, approximately a quarter of the charges within Bolivia.

Table 15
Inter-city per kilometer railroad freight rates
(cents $US per ton)

	Guaqui (Bolivia / Perú)	Charaña (Bolivia / Chile)	Avaroa (Bolivia / Chile)	Villazón (Bolivia / Arg.)	Yacuiba (Bolivia / Arg.)	Puerto Suárez (Bolivia / Brazil)
La Paz	24.0	13.0	6.9	7.1		
Oruro	11.2	9.1	8.0	9.6		
Potosí	7.6	7.1	8.8	8.7		
Cochabamba	8.3	7.9	7.2	7.4		
Sucre	7.2	7.0	7.9	7.9		
Santa Cruz					8.0	7.5
Matarani/Peru	4.6					
Arica/Chile		10.5				
Antofa./Chile			8.0			
Rosario/Arg.				2.6	3.1	
Parana./Brazil						1.9
Santos/Brazil						2.2

Source: Revuelta (1994)

These numbers on truck and railroad costs do suggest transport costs are on average higher in Bolivia than in neighboring countries, but they do not suggest this in an entirely unqualified manner or as dramatically as is generally assumed.

To the extent that Bolivian roads and other links are less reliable than those in other countries, however, these comparisons may understate the difference. For instance, in 1999 rains, apparently poor construction quality, and lack of maintenance, contributed to the simultaneous closure of the two roads linking Cochabamba and Santa Cruz, effectively cutting off trade among the three largest cities in the market. Additionally, these freight costs in general will reflect only the variable costs of transportation, not, for instance, the fixed costs of road construction. The latter, for instance, would be easier to observe in a privatized roads/full cost tolls setting.

Navigation-based transportation does not really improve this situation. The country has three river systems that influence transportation possibilities both between and within geographical regions. The first of these, the “Amazon” river system, is located predominantly in the northeastern part of the tropical or lowlands region (bordering on Brazil) and contains several at least seasonably navigable waterways. This part of the country, however, contains only a small portion of the population and economic activity.

The second, the “Central” or “Lake” system, is entirely within the Andean region, and is centered on Lake Titicaca, generally considered the highest navigable lake in the world. Aside from lake-based navigation (mainly for tourism and fishing), this system does not serve as a significant transport link. Finally, the “La Plata” or “Southern” river system covers areas both in the Sub-Andean and Lowlands region, but is only seasonably navigable in the latter. Thus, navigation within parts of each geographical area is possible, but is rarely feasible between them and in any case is not a major transportation mode.

VI.B. Productive activity concentration measures

In order to characterize concentration levels and where possible relate them to transport costs, this subsection makes use of two measures. The first is Krugman’s regional specialization measure. Applied to location pairs, this index is defined as:

$$SI_{jk}= \Sigma_i \mid E_{ij}/E_j - E_{ik}/E_k \mid,$$

where E_{ij} is employment in industry *i* in region *j*, E_j is total employment in region j, and E_{ik} and E_k are analogous figures for region *k*. This index ranges between zero and two, where the former indicates regions are identical or lack any specialization, and the latter denotes completely specialized regions.

Another measure is Hildebrand’s localization index, defined as:

$$L_{ij}= (E_{ij}/E_{it}) / (E_j/E_t),$$

where E_{it} is employment in industry *i* in the entire country, and E_t is total employment in the country as a whole. If this measure is greater than one, then region *j* has a greater percentage of its labor force in industry *j* than the rest of the country.

As discussed by Kim (1995), implementing these measures requires the specification of a relevant definition of region. The literature has generally taken two approaches regarding this task. The first is based on a homogeneity principle and seeks to specify regions such that they contain similar areas. If the homogeneity principle is applied in the expectation that a region’s endowments would determine its economic activity patterns, it might be more logical to use the division used above, utilizing Andean, Sub-Andean, and Lowland areas.

Another approach is based on a functionality notion that generally attempts to identify urban nuclei and their respective areas of influence. If this notion is applied in Bolivia, one might define the nine departments as regions, each with a capital and its area of influence. On the other hand, one could conceive of the central axis, composed of the three largest cities and enjoying the best transportation and communication links, as one unit, with perhaps all other parts of the country as components of other regions. This subsection implements these two notions, testing how results vary when one or another is used.

A final note before proceeding to discuss the data used is that one should keep in mind that more disaggregated data will naturally tend to indicate greater specialization. As is generally the case in the literature, the following results focus on two and three-digit level indicators.

VI.C. Data and results on concentration

There are two types of data sources available for implementing these measures. Each of them allows identification of sectors using codes up to a certain number of digits of detail. The first type is population census data for 1976 and 1992, which in both cases covers the entire urban and rural areas. For the former year, however, information is available only at the one-digit level. Additionally, for 1992 there is the Census of Industrial Activities, which includes only the nine departmental capitals. In this case, the activities classified are, of course, strictly those in industry and do not cover aspects such as agriculture, as in the census case.

For an overview of basic concentration levels, Table 16 relies on 1992 census information and presents results using the Krugman measure for a one-digit aggregation.[13] This table suggests that on average there is little specialization, and that in fact most activities show up in all departments. Although analogous 1976 census data is not included here, the average concentration index did increase slightly between these two years, moving from 0.33 in 1976 to 0.35 in 1992.

Given the emphasis on natural resources in the previous sections, it might not be surprising that these "first pass" results suggest that several of the smallest differences in production structures are found within geographical regions, as implied by the homogeneity principle. In contrast, the highest value appears in 1992 for the Santa Cruz/Potosí pair, departments in the Lowland and Andean regions, respectively.

Table 16
Concentration indices by department: 1992

	Oruro	Potosi	Cocha.	Chuqui.	Tarija	Sta. Cruz	Beni	Pando
La Paz	0.1585	0.6100	0.1607	0.5511	0.1707	0.1782	0.1268	0.4332
Oruro	--	0.5084	0.0977	0.4496	0.2048	0.2515	0.2350	0.3161
Potosi	--	--	0.4604	0.1212	0.5479	0.7477	0.6359	0.2035
Cochabamba	--	--	--	0.4343	0.1876	0.2952	0.2058	0.3060
Chuquisaca	--	--	--	--	0.4944	0.6889	0.5771	0.1683
Tarija	--	--	--	--	--	0.3268	0.1122	0.3661
Santa Cruz	--	--	--	--	--	--	0.2796	0.5641
Beni	--	--	--	--	--	--	--	0.4450

Source: authors' calculations based on 1992 census data

On the other hand, this sort of within/between region comparison does not always come out as expected. This could reflect that in some but not all cases transportation costs will be the lowest within regions, facilitating a certain degree of specialization.

[13] For comparability, the classification scheme used in both periods is that which existed in 1976. This broad ordering includes the following activities: agriculture, livestock, hunting and fishing, mining and quarrying, manufacturing, electricity, water and gas, construction, commerce, restaurants and hotels, transport, storage and communications, financial, insurance, real estate and enterprise-related services, and community, social, and personal services.

As mentioned, industrial concentration might be better gauged by defining regions as the Andean, Sub-Andean, and Lowland areas. This approach, featured in Table 17, does not produce qualitatively different results. In this case there is also a slight increase in average concentration, albeit from a lower level, which goes from 0.22 in 1976 to 0.23 in 1992. A notable point, however, is the fact that the difference between the Andean and Sub-Andean region goes from 0.21 in 1976 to 0.09 in 1992. In contrast, the Sub-Andean/Lowland index increases in this period.

Table 17
Concentration indexes by geographical regions: 1976 and 1992

Region	Lowland	Sub-Andean
1976:		
Lowland	--	0.2740
Andean	0.1901	0.2151
1992:		
Lowland	--	0.3430
Andean	0.2608	0.0958

Using the central axis/all other regions distinction, the (sole) index goes from 0.33 to 0.36 between 1976 and 1992, which as in the other cases, suggests relatively low concentration.

For 1992, more detailed information is available if one uses the industrial activities census, which covers only departmental capitals. Table 18 presents the two and three-digit results using this data source. An interesting observation when focusing on industry is that the three "central axis" cities (La Paz, Cochabamba, and Santa Cruz) display among the lowest inter-city differences. In the case of the two-digit classification, only three city pairs have lower concentration figures. Interestingly, the three cities with the most extensive transportation and communication links have developed the least differentiation.

Table 18
Industrial concentration indices by department: 1992

	Oruro	Potosi	Cocha.	Chuqui.	Tarija	Sta. Cruz	Beni	Pando
2 digit								
La Paz	0.6603	0.5331	0.5398	0.4231	0.5652	0.4927	0.8971	1.1293
Oruro	--	0.6644	0.6150	0.7502	0.8101	0.6697	1.0435	1.2822
Potosi	--	--	0.6250	0.5313	0.4752	0.6233	0.7870	1.0390
Cochabamba	--	--	--	0.5505	0.6259	0.3418	0.8814	1.1574
Chuquisaca	--	--	--	--	0.2592	0.4964	0.6176	0.9205
Tarija	--	--	--	--	--	0.4728	0.440	0.784

							4	6
Santa Cruz	--	--	--	--	--	--	0.7801	0.9648
Beni	--	--	--	--	--	--	--	0.9115
3 digits	--	--	--	--	--	--	--	--
La Paz	0.8009	0.7191	0.7971	0.6880	0.9230	0.7792	1.0654	1.5481
Oruro	--	0.7612	0.8715	0.9250	1.0897	0.9285	1.2035	1.5643
Potosi	--	--	0.8560	0.7066	0.8453	0.9125	1.0453	1.5454
Cochabamba	--	--	--	0.6760	0.7877	0.5788	0.9694	1.4046
Chuquisaca	--	--	--	--	0.4603	0.6606	0.6689	1.2528
Tarija	--	--	--	--	--	0.7516	0.6452	1.2819
Santa Cruz	--	--	--	--	--	--	0.8844	1.3749
Beni	--	--	--	--	--	--	--	1.3414

A possible explanation for this might be that since each of these cities is the "core" of a geographical area with a particular set of natural endowment characteristics, it concentrates in a series of industrial activities that "service" its hinterland's productive activities. Another possibility is that, despite having the best connections, transportation costs may still be large enough to have facilitated this lack of differentiation. Another result that has appeared before is that, in general, the greatest differences are between cities which are not located on the central axis but lie in different geographical regions, while those between "secondary" cities in the same region tend to be small.

Some of these observations can be complemented by looking at Hildebrand's localization indices constructed with census data at the one-digit level. These are presented in Table 19, which shows the index according to activities found in each department.

Table 19
Hildebrand location indices by sector and department: 1992

	Andean Region			**Sub-Andean Region**			**Lowland Region**			**Var.**
	La Paz	Oruro	Potosi	Cocha	Chuq.	Tarija	Sta. Cruz	Beni	Pando	
Agricult.	0.8466	0.8821	1.5045	1.0814	1.5898	0.9882	0.7205	0.8646	1.3568	0.0881
Mining	1.1808	2.6958	3.1225	0.3191	0.2366	0.2574	0.4243	0.2391	1.5978	1.1279
Manufact.	1.1024	0.9777	0.4104	1.1248	0.6964	0.7909	1.1767	1.2264	0.5789	0.0752
Electricity	0.9631	0.9778	0.4803	1.0517	0.6610	1.3671	1.3315	1.0205	0.5020	0.0929

Services	1.1138	1.0330	0.6244	0.9271	0.6044	1.0430	1.2045	1.1102	0.7936	0.0425

These suggest that agricultural activities tend to be concentrated in Potosí, Chuquisaca, and Pando, one department in each geographical region. Additionally, mining is heavily concentrated in Oruro and Potosí, the traditional extraction areas in the Andean region. Manufacturing activities do not show as skewed a distribution. Nevertheless, the "central axis" departments of La Paz, Cochabamba, and Santa Cruz have three of the four highest indices in this realm.

To summarize the results presented, it would appear that in Bolivia industrial concentration is influenced by three different factors:

1) The characteristics of the regions departments or cities are in. This aspect may reflect the influence of natural resources on production patterns, as in the case of mining in the Andean region, or oil extraction in the other two.
2) The fact that each region contains one "core" city that concentrates manufacturing and other activities that "service" other parts of its respective region. This characterization is indeed not that far from that proposed by North (1955) for export-centered economies.
3) Transport costs.

The results produced are in some cases suggestive of the presence of these forces, but they are not sufficient to effectively isolate and ascertain the impact of one or another. Additionally, all of these forces are consistent with the sort of arguments given for the increasing importance of Santa Cruz and the Lowland regions.

VII. Geography and welfare

Moving beyond the distribution of population and productive activities that the document has considered, this section focuses on the impact of geography on the level and distribution of welfare. This is particularly interesting in the context of the rising importance of the Lowlands, and the brief evidence given in Figure 2 indicating that wage levels in the capital cities in this region are higher.

To address this topic, this part of the paper first lists the welfare measures that are available, briefly detailing the advantages and disadvantages of each. It distinguishes these along two dimensions: *time series availability* and *geographical specificity.* The section then makes use of these measures to analyze two issues: i) the impact of geographical variables on welfare levels in a cross-sectional setting, and ii) the extent to which regional convergence or divergence has been observed in Bolivia between 1976 and 1992 (the two most recent census years). In both cases the analysis moves from the most to the least geographically aggregated evidence.

VII.A. Available welfare measures

The most standard welfare measure available is GDP per capita. Unfortunately, in the Bolivian context it has two disadvantages: a) the National Statistics Institute calculates GDP only down to the departmental level which, as indicated, does not provide the best approximation to the regions of interest, and b) at this level of geographic detail, the measure is available only for 1976 and 1989-1995. In light of this, the analysis below uses only departmental GDP per capita data, and only for 1976 and 1992.

Also in the realm of income measures, household surveys administered by the National Statistics Institute provide estimates of wages and other components of individual-level incomes. While this data is of course much richer, it covers only the nine departmental capitals. Additionally, a consistent series only exists since 1989. Because of this limited time-series availability, this section uses this information for cross-sectional analyses only.

Moving beyond income-related indicators, two other welfare measures are available. The first is the Human Development Index (HDI), calculated by the United Nations Development Program. For 1976 and 1992, the HDI is available at a departmental and provincial level. In the latter case, however, a key disadvantage is that the UNDP had to estimate income per capita for individual provinces (the National Statistics Institute does not produce such data), which may reduce the measure's reliability. For these reasons, this paper focuses only on departmental-level HDI for 1976 and 1992.

The second, a poverty-related welfare measure, is the Unsatisfied Basic Needs (UBN) Index calculated by the Bolivian government for 1976 and 1992. This measure is purely census-based, and therefore achieves significant geographic detail, reaching down to the provincial and even municipal level.[14] Also because of this, it is strictly comparable between years, and, unlike the HDI, does not rely on estimates for key variables, building them instead directly from household-level data. This section makes use of the UBN index for 1976 and 1992 at the departmental and provincial levels. Because it is the focus of several exercises it undertakes, it is relevant to briefly describe this measure.

The UBN is based on a number of variables that seek to measure households' command of various welfare-generating services. These include the following criteria and specific components:

1) Access to housing
    a) Number of occupants per room and
    b) Quality of construction materials
2) Access to basic services
    a) Running water availability
    b) Sanitary system availability
    c) Type of waste disposal system
    d) Electricity availability
    e) Type of cooking fuel used
3) Education
    a) Attainment
    b) School enrollment if members are school age
    c) Literacy
4) Health and Social Security
    a) Access and assistance to formal health services

Based on their characteristics along these four dimensions, households may be classified as having their basic needs satisfied or not. Households in the latter situation are considered as poor, and serve as a basis to calculate a number of standard headcount and intensity poverty measures. For ease of interpretation, this paper only makes use of the simplest headcount measure, the proportion of households that are poor in a given geographical unit.

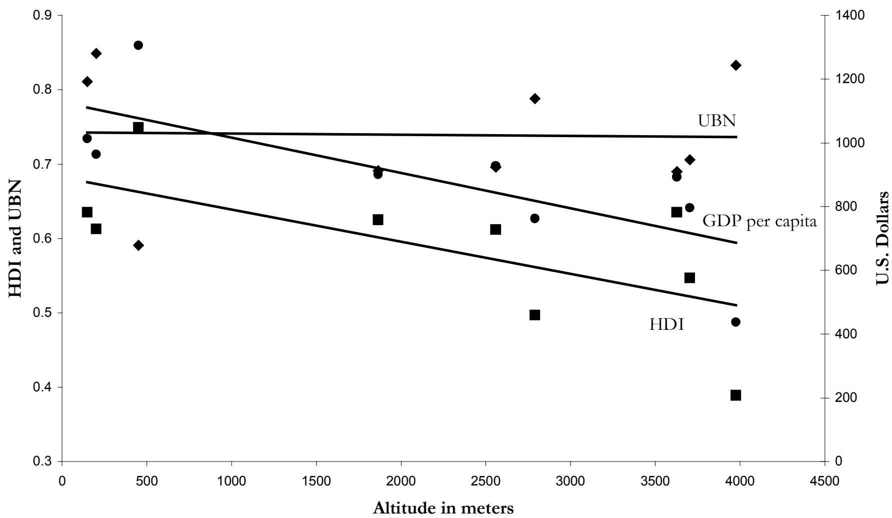
[14] Municipios (municipalities), of which the country contains roughly 300, are a more specific geographical unit than provinces. As discussed below, in recent years a decentralization process has given them significantly greater funding and responsibilities.

VII.B. Cross-sectional evidence at the departmental level

Making use of the welfare measures described, departmental data provides a "first pass" look at the influence of geographical factors on the distribution of welfare. Using such data, Figure 6 explores how altitude, one of the central geographical variables in Bolivia, is related to regional levels of GDP per capita, HDI, and UBN. This figure involves significant simplification because each department is assigned the mean altitude of its capital city, abstracting from within-department variation.

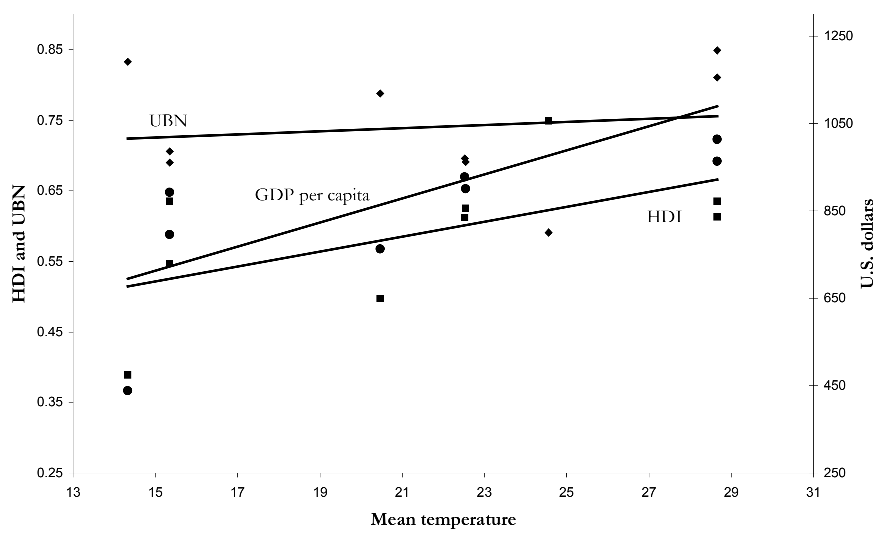
As evident, for two of the three measures, GDP per capita and the HDI, there is a negative correlation between altitude and welfare, suggesting areas at greater altitude are worse off. Note that the slight upward slope in the case of UBN is qualitatively consistent with this, since higher UBN (Unsatisfied Basic Needs) levels correspond to higher poverty and therefore lower welfare. While the HDI and GDP per capita seem to be highly correlated, it may be a concern that UBN has somewhat of a different pattern.

Figure 6: altitude, GDP per capita, and the HDI and UBN measures



Because of the inverse relation between mean altitude and temperatures, this result is counter to the usual international evidence suggesting that tropical areas in fact have lower incomes. Additionally, in this case the tropical area also is the one furthest from the coast. To confirm this assertion, Figure 7 presents similar graphical evidence, except that the independent variable used is now mean temperature instead of altitude.

Figure 7: Temperature, GDP per capita, and the HDI and UBN measures



It is not surprising to see that again for two measures there is a positive association between mean temperature and welfare levels. In this case, however, the point estimate for the UBN index would be positive, suggesting more tropical areas would be poorer.

Though not presented here, similar results obtain for rainfall. The combination of all these outcomes suggests that, as already suggested above, altitude is an effective "summary" geographical variable in Bolivia.

These figures provide a suggestive first impression of the behavior present in the data. Needless to say, however, they supply no evidence of a *direct* causal link between geography and welfare levels. Focusing on income data, for instance, one could argue that welfare is higher in the lower lands simply because these contain more productive people.

To further explore these issues, the remainder of this subsection also covers departmental-level evidence, but makes use of individual-level income observations, which of course allow for a much wider set of controls. Subsequent subsections then move on to more geographically detailed information, such as that available at the provincial level.

Table 20 displays results with individual-level data when the geographical variable considered is altitude. As above, other geographical variables yield similar results. The first column regresses the log of income on only a constant and altitude. The point estimate is consistent with the above results in that higher altitude is associated with lower incomes. This result, however, is not statistically significant.

Table 20
Regressions of personal income on regional and personal characteristics: 1994

	(1)	(2)	(3)	(4)
Constant	1.11***	1.05***	0.29***	1.00***
Altitude (thousands of meters)	-0.069 (0.047)	0.034 (0.137)	-0.104 (0.086)	-0.106 (0.091)
Altitude2	--	-0.025 (0.039)	0.006 (0.025)	0.003 (0.025)
Years of Scholing	--	--	0.085***	0.096***
Experience	--	--	--	0.045***
Experience^2	--	--	--	-0.0006***
Female	--	--	--	-0.272***
Ethnic origin	--	--	--	-0.25
Mining	--	--	--	0.26**
Utility	--	--	--	0.24**
Construction	--	--	--	0.11***
Trade	--	--	--	-0.01
Hotel	--	--	--	0.04
Transportation	--	--	--	0.36***
Finance	--	--	--	0.59***
Enterprise services	--	--	--	0.23***
Public Administration	--	--	--	0.08**
Community services	--	--	--	-0.29***
Social services	--	--	--	0.05
R2	0.011	0.012	0.266	0.386
N	9,201	9,201	9,201	9,201

Source: authors' calculations using Encuesta Integrada de Hogares, 1994.

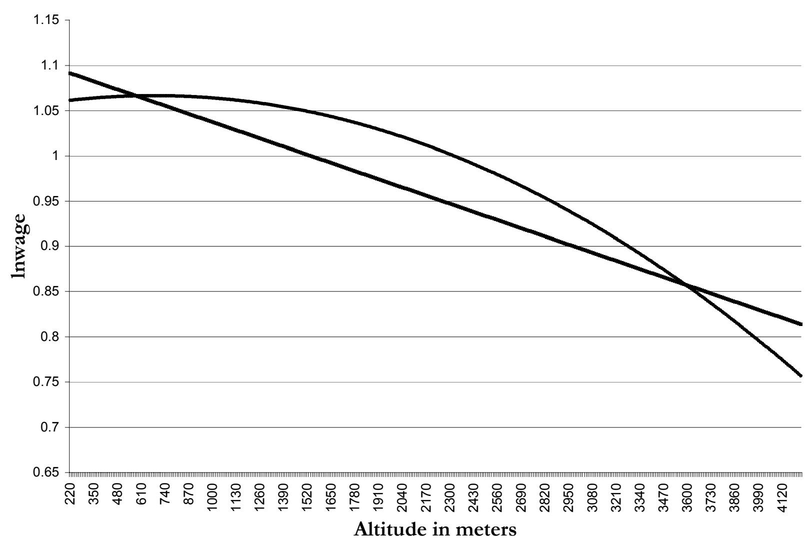
Note: Regressions adjust for clustering at the city level. See Moulton (1986).

* - significant at the 10 percent level.
** - significant at the 5 percent level.
*** - significant at the 1 percent level.

To explore possible nonlinearities in this relationship, regression (2) incorporates a squared term in altitude. This does in fact suggest such behavior, with altitude raising income up to an internal maximum at approximately 700 meters of altitude. Past this income level, higher altitude is still associated with lower income levels, at least if one goes by the point estimate.

For comparison with the previous graphs, the basic relation between altitude and the log of personal income is summarized in Figure 8, which displays fitted value of log income using the coefficients in columns (1) and (2). The straight and curved lines correspond to these columns, respectively.

Figure 8: Altitude and lnwage - fitted values



As indicated, a problem with the regressions presented thus far is that the coefficients on geographical variables may be biased by correlations between geographical variables and personal characteristics that also affect welfare levels.

Regression (3) begins to address such concerns by introducing just the years of schooling for each person. Consistent with other studies in the Bolivian setting, the coefficient suggests a return to education of about 9%. Though the altitude variables remain insignificant, it is interesting to note that the point estimate on altitude goes back to being negative, and in fact is larger than in the first regression. This in fact suggests that omitting schooling alone in fact lowers the point estimate of altitude on income. Finally, column (4) incorporates a series of other controls, and the results are similar to those in the previous regression.

VII.C. A Fields decomposition using geographical variables

An alternate way of looking at how geography affects personal welfare is applying a decomposition technique to check how geographical variables contribute to income inequality. Previous work in Bolivia points to the influence of standard variables, such as education, in explaining income inequality, but does not focus on geographical factors.[15]

A convenient way of decomposing inequality measures is presented in Fields (1997). It is easily applied in a standard earnings regression framework just like that presented in Table 22. The methodology essentially requires multiplying each coefficient estimate with the standard deviation of the explanatory variable and the correlation between this variable and the dependent variable. The resulting relative factor inequality weights are scaled to sum to one. In other terms, this methodology answers the question: "*of all the variation in earnings our regression can explain, what is proportion due to each factor or set of factors*?"

This technique was applied using individual income data for the nine departmental capitals. Table 21 presents results for the first 8 rounds of the Integrated Household Survey. The regressions that underlie these results are completely analogous to those presented in Table 20, the only difference being that they include a greater number of control variables. The table includes entries for the percentage of the variation that is accounted for by six groups of variables, each of which in turn contains one or more specific independent variables:

1) Education
   - Years of schooling.
2) Experience
   - Experience.
   - Experience squared.
3) Sex
   - Female dummy.
4) Ethnicity
   - Indicator variable for native language speakers.
5) Sector of work
   - Sector of work indicators: agriculture, mining, utilities, construction, trade, hotels, transportation, finance, enterprise services, public administration.
6) Geography
   - Indicators for residence in all capital cities but one.

The following table presents summary results in the sense that only the percentage of R^2 accounted for by each set of variables is included.

[15] See Urquiola (1993) and Fields et al. (1998).

Table 21
Fields decomposition: Percentage of R^2 explained by selected variables

Explanatory Variable	Round 1 March 1989	Round 3 September 1990	Round 4 November 1991	Round 5 November 1992	Round 6 July-Dec. 1993	Round 7 July-Dec. 1994	Round 8 June 1995
Education	53.0	41.8	56.6	61.8	61.4	68.9	66.2
Experience	12.9	15.3	14.8	6.2	7.8	2.4	3.6
Gender	7.5	13.6	8.4	8.8	6.4	8.4	5.8
Ethnicity	6.3	4.3	--	--	1.7	0.7	--
Sector	9.1	16.8	11.5	10.5	14.3	10.6	12.4
Geography	11.1	8.9	8.8	12.7	8.5	9.0	12.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
R^2	0.294	0.267	0.309	0.385	0.425	0.402	0.335
N	5,533	9,092	8,123	7,708	5,985	9,210	8,526

The explanatory power of all these regressions, as measured by R^2, ranges from 0.267 to 0.425. As in previous studies, schooling is the single most important variable, accounting for, on average, 59% of total explanatory power. Next in importance are three variables, experience, sector of work, and geography, each with about a 10% share in R^2. Experience however, displays a secular decline, so that by the final round the share of geographical and sector of work variables are about four times that of experience. In an inter-temporal sense, there appears to be no trend to the percentage of inequality explained by geographical variables.

In a sense, these regressions place an upper bound on the ability of geography to explain income inequality. This is because the city indicator variables used, beyond capturing departmental capitals' geographical characteristics, may be proxying for unrelated city-specific traits like phone availability.

To address this issue, Table 22 presents the Fields decomposition for the final year, 1995, when only altitude is used as the geographic explanatory variable.

Table 22
Fields decomposition for altitude

Explanatory Variable	**Round 8 June 1995**
Education	70.7
Experience	3.7
Gender	5.8
Ethnicity	--
Sector	12.2
Altitude	7.6
Total	100.0
R^2	.323
N	8,526

Source: authors' calculations using household survey information.
Note: * - significant at the 10 percent level.
** - significant at the 5 percent level.
*** - significant at the 1 percent level.

Not surprisingly, the "geography effect" is now smaller, accounting for only 7.6% of total R^2. Nevertheless, on average this is more than 60% of the power achieved by the dummy parameterization, showing the relative importance of geographical variables in the Bolivian context. This share comes in above those found for experience and gender. Despite this narrowing down of the "geographical variable", however, these estimates can still not be given a causal interpretation.

VII.D. Cross-sectional evidence at the provincial level

The previous section presented aggregate and individual-level information at the *departmental* (and departmental capital) level. Since there are only nine departments, this does not allow the most variation in geographical characteristics. It is possible, therefore, that geographically-related variables have not been more significant simply because the useful variation has been limited. To address this issue, this section presents results using provinces as the relevant units of observation.

Before presenting the results, it is relevant to note that Bolivia currently has 112 provinces. Most of the analyses below, however, cover only 99 of them. This is because this was the number in existence during the 1976 census, which is kept for purposes of comparison. Achieving a consistent set of geographical units is feasible despite this adjustment, mainly because in all cases new provinces resulted simply from the separation of original ones into two, so that "re-aggregating" the data is a simple task.

Table 23 presents results on the impact of geographical variables on provincial-level UBN poverty indices. To interpret these correctly, it is necessary to keep in mind that higher UBN levels indicate greater poverty (or lower welfare) levels.

Table 23
Geographical variables and provincial-level UBN poverty levels

	(1)	(2)	(3)	(4)	(5)
Constant	0.807***	0.824***	0.843***	0.857***	0.731
Altitude	0.023** (0.010)	-0.008 (0.039)	-0.017 (0.038)	-0.012 (0.032)	-0.032** (0.016)
Altitude^2	--	0.008 (0.009)	0.009 (0.009)	0.008 (0.008)	0.011** (1.004)
Border Crossing	--	--	-0.118** (0.049)	-0.132*** (0.041)	-0.137*** (0.021)
Regional center	--	--	--	-0.422*** (0.064)	-0.095*** (0.053)
Dep. Capital	--	--	--	--	-0.135*** (0.029)
% Agriculture	--	--	--	--	0.188*** (0.019)
Density	--	--	--	--	-0.009 (0.001)
R^2	0.021	0.059	0.113	0.393	0.850
N	99	99	99	99	99

Source: authors' calculations using data from INE (1994).
Note: * - significant at the 10 percent level.
** - significant at the 5 percent level./*** - significant at the 1 percent level.

The first column suggests a result seen before: areas at higher elevations have larger poverty incidences or lower welfare levels. This basic specification was replicated using rainfall instead of altitude as the central independent variable. The results are essentially the same: they suggest that, all else equal, areas with greater rainfall (more tropical areas) have greater incomes. This result is not surprising, because at the provincial level altitude and rainfall display a negative correlation of -0.84.[16]

In the case of provincial UBN data, there is a stronger prima facie case for nonlinearities in the altitude-welfare relation. This is because one can observe clusters of relatively high UBN (high poverty) provinces both at very low and very high altitudes. The relationship this suggests is that at the provincial level poverty is reduced at greater altitudes, but begins increasing past a certain point. A similar tendency is observed in 1992. Regression (2) explores this aspect with a nonlinear specification, but both altitude and its square come in insignificant.

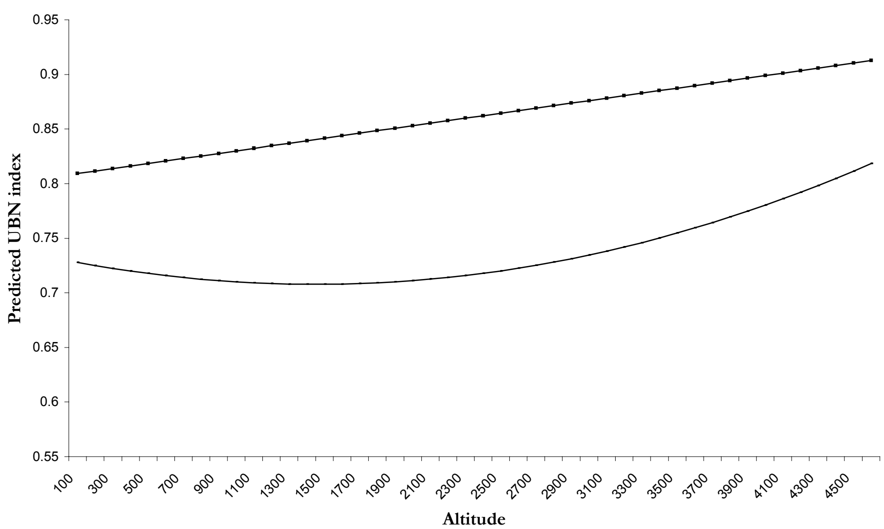
Columns (3) and (4) add controls for whether provinces contain a major border crossing into a neighboring country, essentially, whether they contain the within-Bolivia endpoint of an export route. The coefficient on this dummy is always negative and significant, suggesting such "trade-corridor" provinces have higher welfare levels.

These two regressions also add a control for whether a province is a regional center, essentially whether it contains one of the three largest cities in the country. As expected, the negative coefficient on this variable is statistically and economically significant. It is relevant to note that adding these simple controls increases the magnitude of the coefficient on altitude.

Finally, column (5) also adds controls for whether provinces contain a departmental capital, the percentage of their labor force devoted to agriculture, and their population density. In this case, the altitude-related findings in columns (2)-(4) are reinforced, and are now significant.

To graphically summarize some results in this section, Figure 9 presents fitted values for the altitude-related coefficients in regressions (1) and (5).

Figure 9: Fitted values for UBN provincial level data



As evident, if a linear specification is used, the data suggest that areas with higher elevation have greater poverty levels. This result, however, was shown not to be statistically significant. When non-linear specifications are used, results resemble that for the second curve in the figure. Poverty at first declines with altitude, but then increases. In part, this nonlinearity reflects the fact that one of the "best-off"

[16] These results are also not included because rainfall data is not available for a few provinces.

provinces in Bolivia, that containing the city of Santa Cruz, is not at an altitude as low as that of poorer provinces in the lowland departments. While this may be absorbed by the regional center dummy, the effect of nearby provinces may weigh in as well.

Summarizing and relating these results to previous sections in the paper, one could make the following observations:

1) A relatively robust finding is that welfare is higher in areas that are at lower elevations, and are therefore more tropical and more distant from the Pacific coast.
2) The nonlinear character of this regression strongly suggests this is a "Santa Cruz effect". In other words, the department and province that contain Santa Cruz have the highest welfare levels, and while certainly being at a low altitude relative to the Andean and Sub-Andean regions, are not as low as other areas in the departments of Beni and Pando.
3) That the Lowlands in general, and Santa Cruz in particular, would have the highest welfare levels should not seem surprising. Firstly, if migration is responsive to income, as Figure 2 and Table 4 suggest, then the significant migration rates, implicit in Figure 1 and shown in Table 3, would not be observed if these areas were in fact poorer. Secondly, the previous section showed some of the sources of rapid economic growth that should have made this region attractive to migrants.
4) As is often pointed out, one would expect "access" poverty measures like the UBN index to be lower in urban areas. This is consistent with the fact, shown in Figure 3, that urbanization rates are highest in the Lowland region.

VIII. Convergence

The previous sections have focused on the impact of geographical variables on the levels of different welfare measures across regions. Another important question is whether the welfare of poorer provinces has tended to converge towards that of wealthier ones. There have traditionally been two ways to address this question, one focusing on dispersion and the other on differential growth rates given initial welfare levels. Before moving on to these, this section begins with a general description of the evidence at the aggregate departmental level.

VIII.A. Is there convergence at the departmental level?

If dispersion is measured using the standard deviation of the available welfare measures, there is a clear divergence result in the sense this measure increased for each index. This is shown in Table 24.

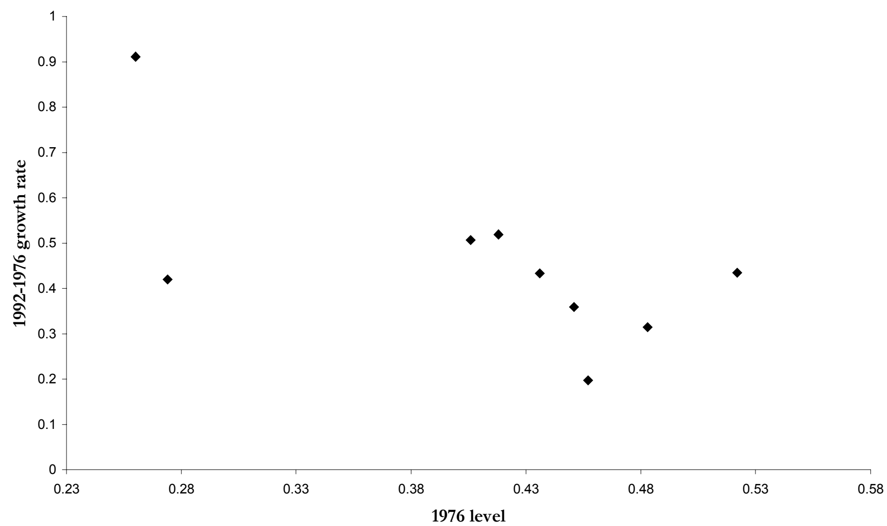
Table 24
Standard deviation of available welfare measures across departments

	Standard Deviation	
Welfare Measure	**1976**	**1992**
GDP per capita	0.19	0.30
Human Development Index (HDI)	0.09	0.10
Unsatisfied Basic Needs Index (UBN)	0.05	0.09

Source: authors' calculations.

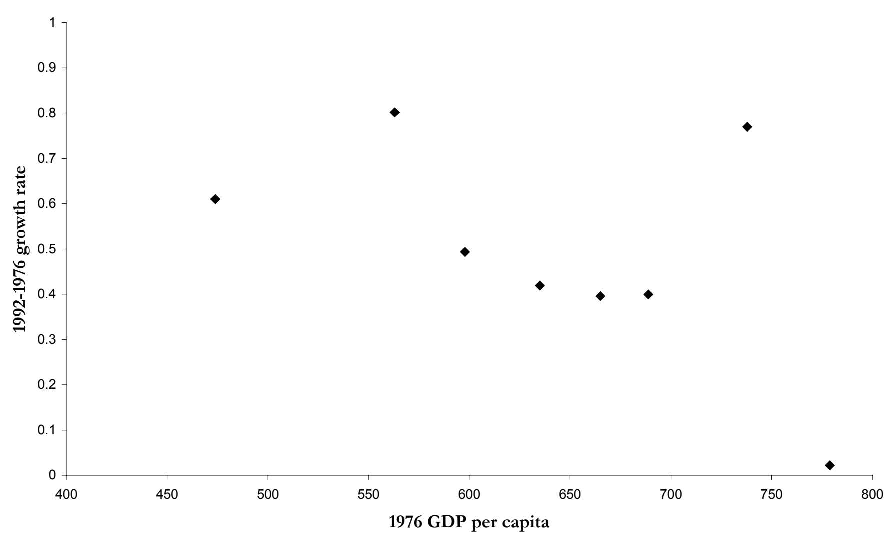
On the other hand, if one considers how the 1976 levels for these variables have affected their growth rates, consistent results are not available. To illustrate this at a "first pass" level the following three figures plot departmental levels and changes for the three welfare measures considered. Beginning with HDI, Figure 10 is generally suggestive of convergence: departments with greater HDI in 1976 have experienced smaller increases in this measure than less "well-off" departments.

Figure 10: HDI levels and growth rates - 1976/1992



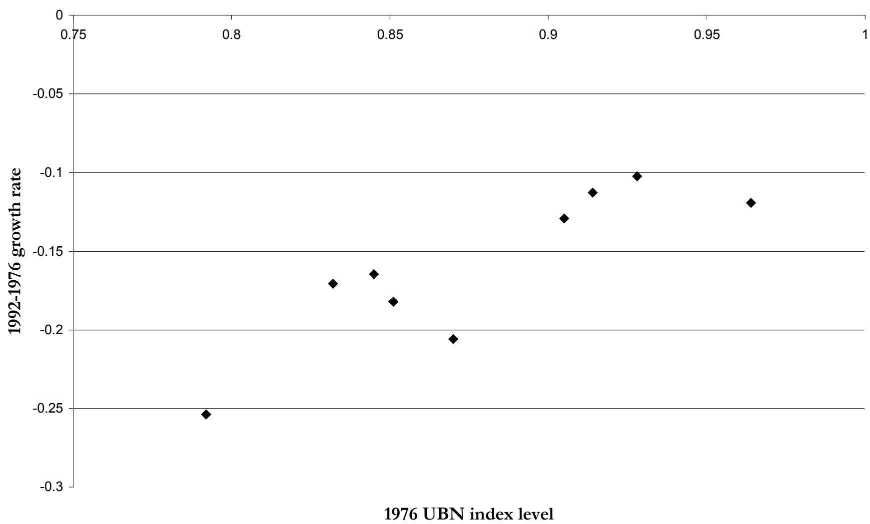
Data on departmental GDP per capita, shown in Figure 11, give a more neutral view, as there is no discernible pattern.

Figure 11: GDP per capita level and growth rates - 1976/1992



Finally, Figure 12, which is based on data on the UBN indicator, suggests divergence. In this case one can observe that in fact areas with lower UBN levels to start with have managed to reduce these at a faster rate.

Figure 12: UBN index levels and growth rates - 1976/1992



To summarize, the simplest evidence on convergence at a departmental level is inconclusive: different welfare indicators suggest different conclusions. Because of the significant aggregation it implies, however, departmental evidence may be providing a biased view.

To address this issue, the following subsection presents evidence at the provincial level. Because of data availability restrictions, however, it only focuses on the UBN index. The advantage with this, however, may be that the UBN is the only measure that is truly comparable between 1976 and 1992. Additionally, because its inputs derive exclusively from household level census information, it is less prone to estimation problems. A graphical characterization of provincial UBN poverty levels is shown in Map 6 in the appendix.

VIII.B. Is there convergence among provinces?

If only the standard deviations of inter-provincial UBN levels is considered, there was divergence in Bolivia: this figure increased from 0.085 in 1976 to 0.137 in 1992. Table 25 explores the issue in a regression framework. Column (1) repeats the basic result underlying Figure 12. As suggested, this is consistent with provinces that had higher unsatisfied basic needs (higher poverty rates) in 1976 achieving smaller reductions in poverty (smaller declines in the incidence of poverty). This result is significant at the 10% level.

Building on this baseline, Column (2) introduces geographically-related control variables. These explore whether provinces' geographical characteristics have affected the rates at which they experienced reductions in poverty indices. The divergence result is now significant at the 1% level. The coefficient on altitude suggests that once controls are considered, the effect of altitude on the reduction rate of UBN also has non-linear characteristics. Provinces located in border areas with important transportation links through them have done better as well.

Table 25
Regressions of UBN index 1992/1976 growth rates

	(1)	(2)
Constant	-0.835* (-16.90)	-0.557*** (0.056)
UBN 76	0.795* (15.14)	0.423*** (0.067)
Altitude	--	-0.018* (0.101)
Altitude2	--	0.006*** (0.002)
% of labor force in agriculture	--	0.90*** (0.142)
Border dummy	--	-0.066*** (-0.014)
R2	0.70	0.82
N	99	99

Source: authors' calculations using data from INE (1994).
Note: * - significant at the 10 percent level.
** - significant at the 5 percent level.
*** - significant at the 1 percent level.

IX. Conclusions

Unlike much of the empirical literature in this area, this paper has focused on *within-country* variation to analyze the effects of geography on development. The motivating observation behind this has been that altitude variations have endowed Bolivia, which would otherwise be a relatively homogenous tropical country, with at least three distinct geographical regions. In several instances, the results presented have suggested that altitude can indeed serve as an effective "summary variable" in this setting.

More specifically, this research explored how the country's division into three distinct areas has affected various aspects of development. In this effort, the document has made several points, some common knowledge (at least in the Bolivian setting), and others relatively unexpected:

1) One of the central "facts" of development in the period considered is the shift in population from the Andean (and to a lesser extent the Sub-Andean), to the lowland region.
2) This event has been associated with the emergence of three dominant urban centers (La Paz, Cochabamba, and Santa Cruz), one in each geographic region. As a result, not only has Bolivia's urban concentration been historically low relative to comparable countries, but it has also in fact fallen since 1950.
3) Additionally, the country displays remarkable flexibility in its ordering of cities by size, five of its seven largest urban centers having changed position at least once in the 1950-1992 period.

4) Beyond these population shifts and associated urbanization patterns, several factors explain the economic rise of the Lowlands:
    a) the succession of "booms" in agricultural production, associated with crops like rice, cotton, sugar cane, and soybean,
    b) the growth of the petroleum industry,
    c) the transfer of private and public capital towards the region, and
    d) public policies which oriented growth towards Santa Cruz.
5) As far as the distribution of productive activities is concerned, the general evidence suggests that regions in Bolivia do not display much specialization, an observation consistent with the sparse transport network and with the usual assumption that the country exhibits high transport costs.
6) Beyond these costs, when differential concentration patterns were found, the results seem consistent with two factors affecting the distribution of productive and industrial activities:
    a) inter-regional differences, reflected in natural resource endowments, account for some specialization, and
    b) a "regional center" effect, whereby the central cities in the Andean, Sub-Andean, and Lowland areas appear to engage in industrial and other activities that "serve" the natural resource-related production within each region.
7) Finally, when welfare levels are analyzed, a relatively consistent result contrary to the usual international evidence emerges: tropical areas have higher welfare levels in Bolivia. Additionally, other geographically related traits are found to be relevant. For instance, provinces that contain a border city on a major export route were found to be significantly less poor, as were the three regional centers.
8) When using the most reliable and geographically detailed welfare measure, the Unsatisfied Basic Needs index (UBN), a highly significant and simple divergence result is found: provinces that were less poor in 1976 have managed to reduce their poverty levels at faster rates.

Taken together, these findings suggest geographical factors have had a significant impact on Bolivia's development. Several of the findings discussed here had not been previously explored in the literature, and further investigation as to whether they reflect causal impacts remains for future research.

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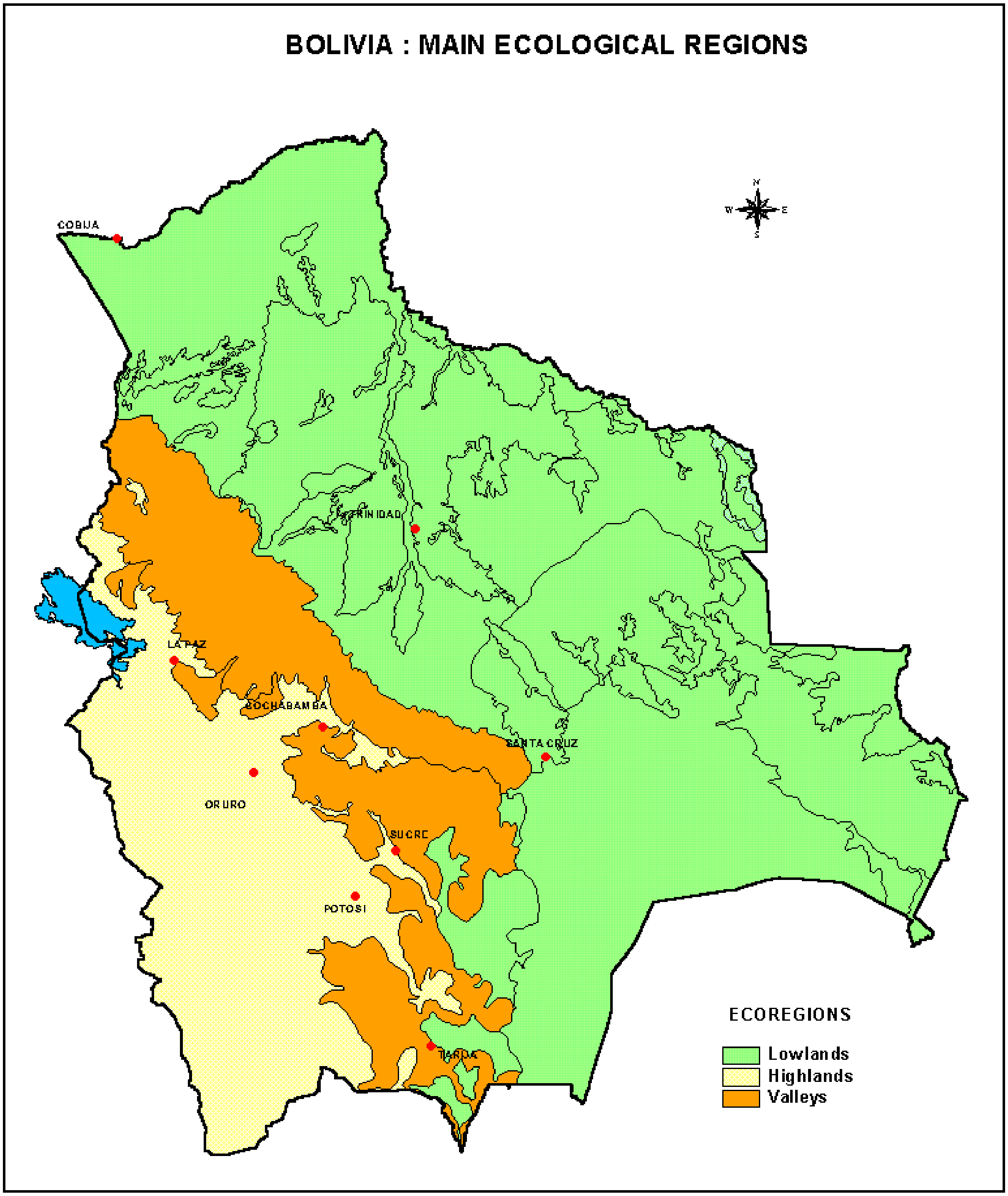
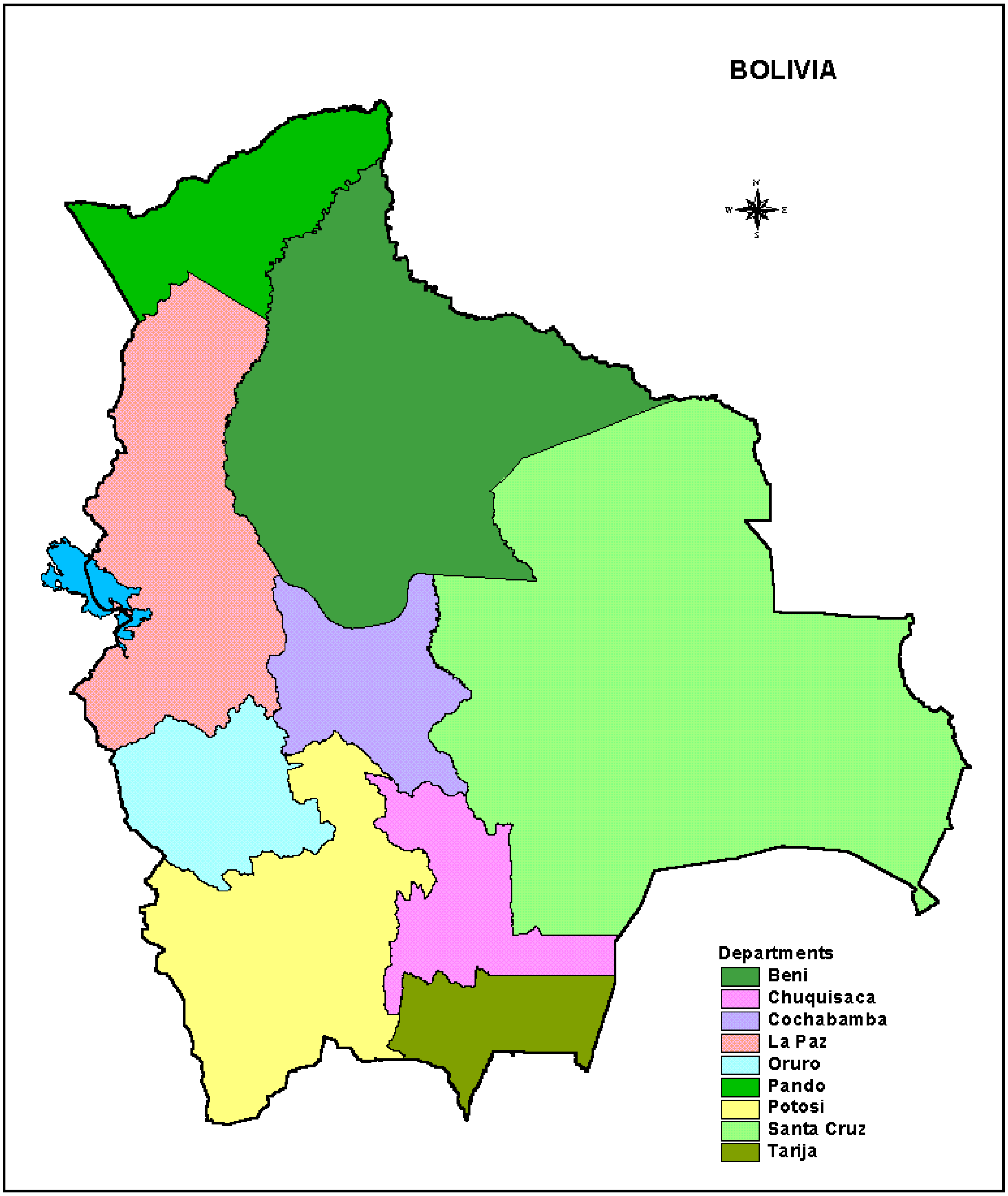
Maps

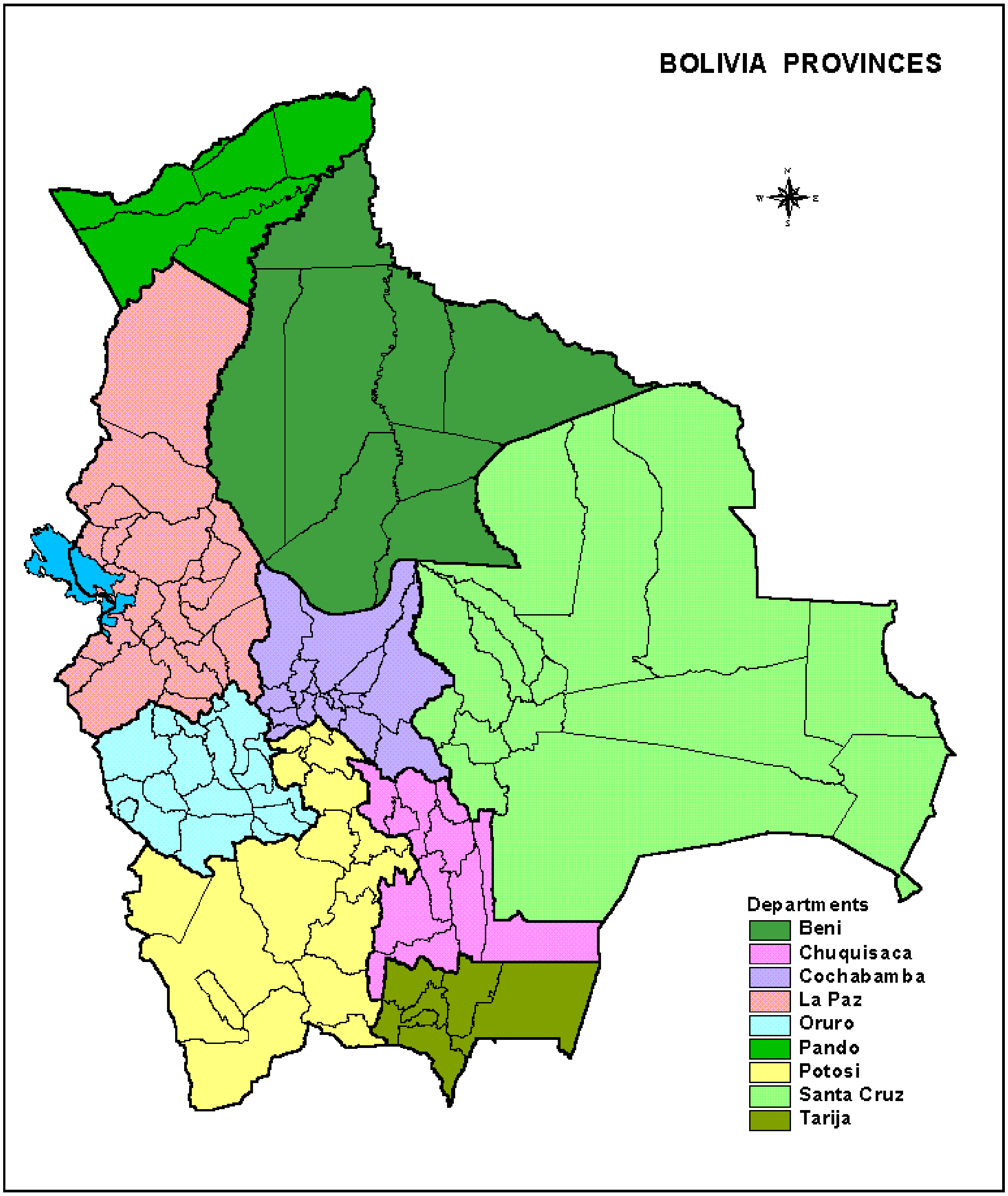
Map 2


BOLIVIA : MAIN ECOLOGICAL REGIONS
COBIJA
TRINIDAD
LA PAZ
COCHABAMBA
SANTA CRUZ
ORURO
SUCRE
POTOSI
TARIJA
ECOREGIONS
Lowlands
Highlands
Valleys

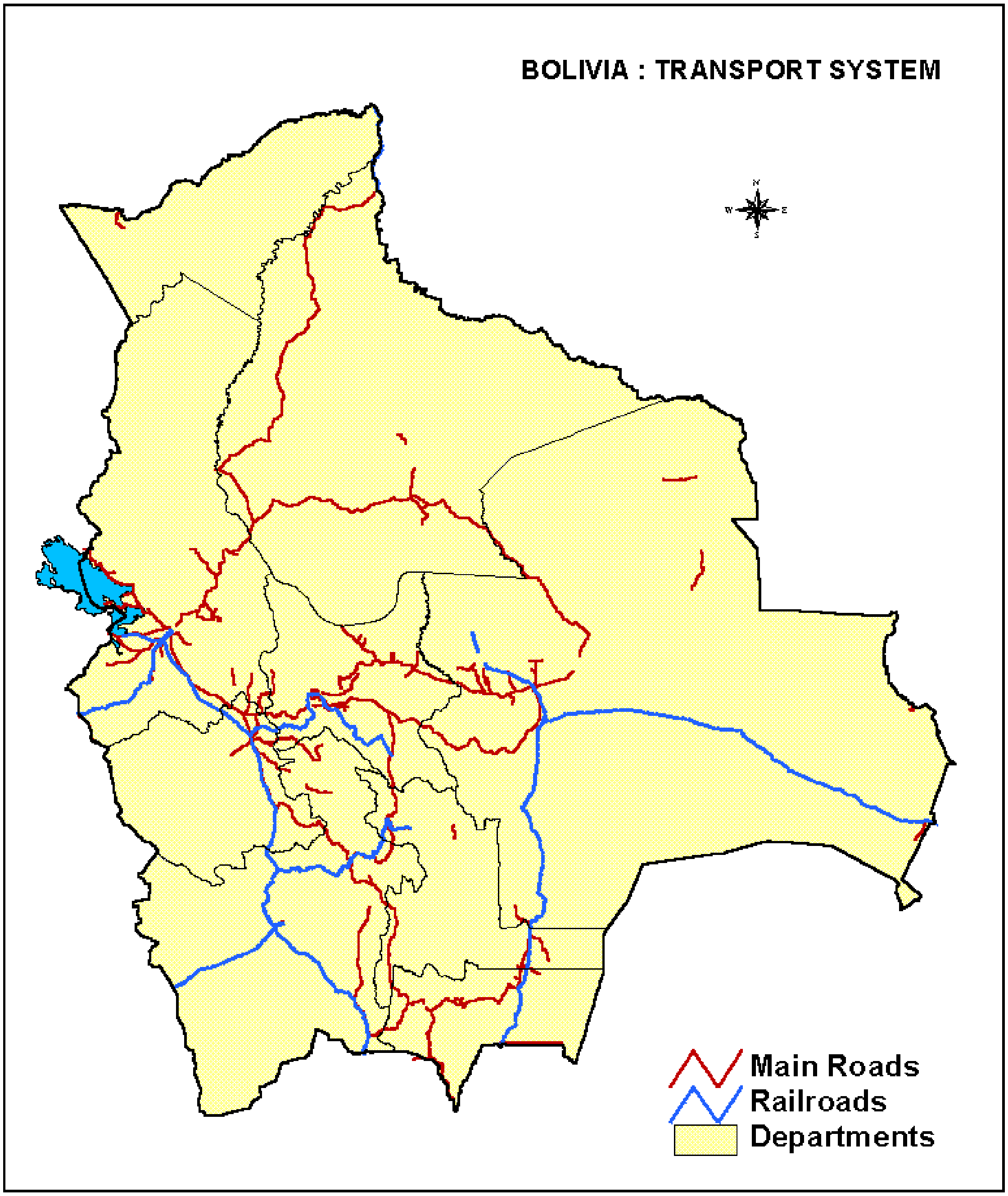
Map 3


BOLIVIA
N
W
E
S
Departments
Beni
Chuquisaca
Cochabamba
La Paz
Oruro
Pando
Potosi
Santa Cruz
Tarija

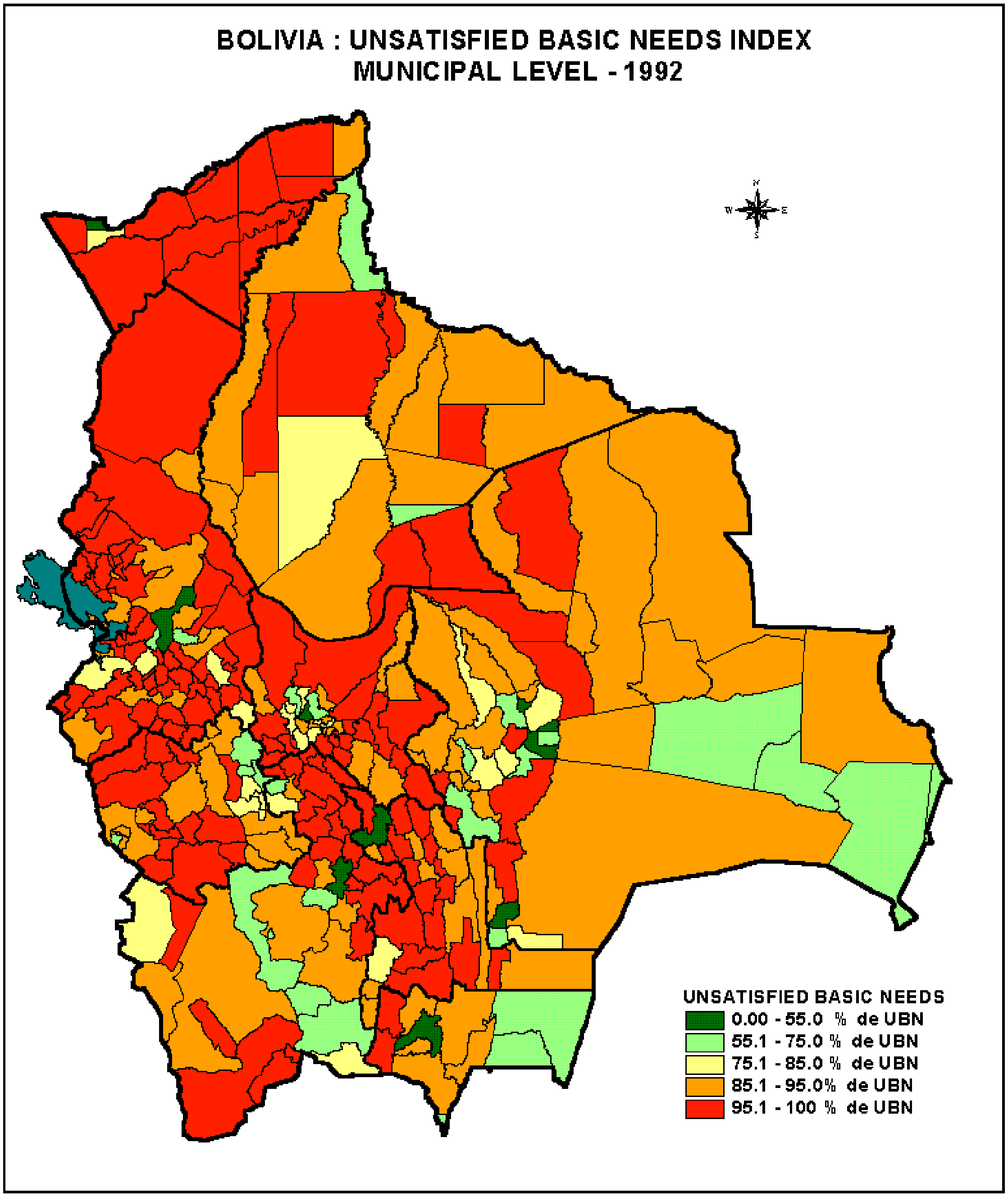
Map 4


BOLIVIA PROVINCES
Departm ents
Beni
Chuquisaca
Cochabam ba
La Paz
Oruro
Pando
Potosi
Santa Cruz
Tarija

Map 5


BOLIVIA : TRANSPORT SYSTEM
Main Roads
Railroads
Departments

Map 6


BOLIVIA : UNSATISFIED BASIC NEEDS INDEX
MUNICIPAL LEVEL - 1992
UNSATISFIED BASIC NEEDS
0.00 - 55.0 % de UBN
55.1 - 75.0 % de UBN
75.1 - 85.0 % de UBN
85.1 - 95.0% de UBN
95.1 - 100 % de UBN