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Social Exclusion: Residential Segregation in Bolivian Cities

by

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Abstract*

This study analyzes the impact of ethnic-based residential segregation on income and education outcomes in Bolivian cities. Three results stand out in the analysis. First, we find significant and negative segregation effects on income generation in both across-city and intra-city comparisons. Second, we find individual and neighborhood-level interactions between ethnicity and segregation to be significantly and negatively correlated with income and schooling attainment. Finally, we find positive social capital effects for recent migrants and young workers and negative human capital effects for non-migrants and older workers. We attempt to control for selection biases with three instruments for residential segregation. We also include potential intergenerational determinants of income and schooling through expanded measures of parental human and social capital.

Key words: Exclusion, segregation, poverty, income, schooling.

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Contents

1. Introduction

Rapid demographic growth and urbanization are changing Bolivia's poverty profile. Between 1992 and 2000, an estimated 1.7 million people moved from rural to urban areas, causing the number of poor households living in urban areas to exceed that in rural areas.[1] A side-effect of rapid urbanization, often neglected by current research on poverty in Bolivia, is a measurable increase in residential segregation by income, ethnicity and other social and cultural identifiers.[2] Neighborhoods that link first and second-generation migrants though economic as well as cultural ties also increase pressure on available labor markets, housing, and other public services.

Qualitative evidence on rural-to-urban migration in La Paz and El Alto suggests that, like middle-class residential segregation, much of the new segregation is self-selected (see Albó, 1998; Sandóval 1996). Migrants seek out neighborhoods and social networks established by relatives and peers. Established networks are then used to get a foothold in formal and informal labor markets. Although qualitative studies largely skirt identification issues, they do raise concerns regarding current analyses of urban poverty in Bolivia. By describing the social context of demographic change, they point to neighborhood effects, both positive and negative, on income generation, labor and educational achievement. Beyond the disadvantages of interpersonal discrimination, residential segregation poses a secondary tier of potential social exclusion.

This study attempts to measure the impact of residential segregation on the opportunities and resources of the poor. We focus on three questions. First, we consider the across-city effects of residential segregation on an array of outcomes using a nationally representative MECOVI 1999 household survey. We proxy residential segregation with alternative measures of residential sorting, measuring the ratio of indigenous residents in each neighborhood to the overall proportion of indigenous residents in a given city. Second, we consider the impact of intra-city residential segregation on income and educational attainment, using a new survey covering 800 households and 43 neighborhoods of La Paz and El Alto. In both cases, we address

[1] See UDAPE (2000) and INE (2000).

[2] Recent studies of urban poverty based on household surveys include Jiménez and Yañez (1997); Pérez de Rada (1997); Fields *et al.* (1997); Vos, Lee and Mejía (1998) and Gray-Molina, Jiménez, Pérez de Rada and Yañez (1999).

potential self-selection problems by instrumenting for segregation with historical, demographic and geographic proxies. We also address potential omitted variable biases by including intergenerational controls on paternal migration, human and social capital.

Third, we consider mechanisms that might explain the effects of residential segregation on selected outcomes. In theory, residential segregation could have a positive or negative effect on an array of outcomes. We posit positive social capital effects related to extended access to informal labor and credit markets, and negative human capital and labor market effects, accruing from intergenerational and public goods externalities in segregated neighborhoods. The recent literature on neighborhood and peer group effects considers an array of hypotheses concerning the analysis of urban decline and renewal in the United States (Case and Katz, 1991; Borjas, 1995; Cutler and Glaeser, 1997; Glaeser, Kahn and Rappaport, 2000; Borjas, 1997). We select key hypotheses from the literature and add additional questions that might be relevant to the analysis of residential segregation in Latin America.

Finally, we consider the policy and research implications of residential segregation. On the research side, we hope to provide an accurate measurement of the effects and dynamics of residential segregation that corrects for biases emerging from omitted variables and self-selection. Such a focus aims to make an original contribution to the Bolivian literature on poverty and exclusion, complementing studies of segregation conducted from a sociological and anthropological perspective. On the policy side we hope to provide a policy handle to the assessment of urban poverty and exclusion. While ethnic and class segregation are likely to affect multiple channels of access to economic resources and opportunities, residential segregation might be particularly amenable to policy intervention through urban development, planning and schooling policies.

2. Analytical Framework

A growing literature on urban poverty provides a basic analytical framework to assess the effects of residential segregation on income, labor and educational achievement outcomes (see Borjas, 1997; Cutler and Glaeser, 1997; Glaeser, Kahn and Rappaport, 2000). Two types of questions have been considered in recent empirical work. The first set of studies focuses on estimating the marginal effect of ethnicity-based residential segregation on an

array of outcomes (see Holzer, 1991; Kain, 1992). Most studies use intra-city comparisons that consider whether minorities living in predominantly minority neighborhoods have worse outcomes than those who live in mixed neighborhoods. A serious identification problem hinders intra-city comparisons. To the extent that residence is self-selected, any direct measure of segregation is likely to be biased. Instruments correlated with segregation but unrelated to outcomes are required to disentangle dual causality.

The second question considered by recent work is whether outcomes for minorities as a whole are better or worse in cities that are more racially segregated compared with cities that are less segregated (Cutler and Glaeser, 1997; Glaeser, Kahn and Rappaport, 2000). This approach avoids intra-city selection problems, but faces other problems linked to the potential for reverse causality—where poor outcomes lead to increased segregation—and the potential bias from sorting of more or less successful minorities across a city. As with intra-city comparisons, across-city comparisons require instruments to address selection problems. In this study we focus on both intra-city and across-city comparisons of residential segregation by collecting new data that correct for potential self-selection and omitted variable biases.

Basic Model

We begin with a spatial equilibrium model developed by Cutler and Glaeser (1997) to analyze the effects of residential segregation across and within cities. The Cutler-Glaeser model, adapted to the analysis of segregation in Bolivian cities takes the form:

$$(1)\ Outcome = X'\beta + \beta_1\, segregation + \beta_2\, segregation*indigenous + e$$

Where *outcomes* are measured at the individual level, $X'\beta$ represents an array of individual and household controls, and s*egregation* is a neighborhood measure of the separation of ethnic groups. The coefficient β_1 measures the effect of segregation on non-indigenous, and β_2 is the differential effect for indigenous relative to non-indigenous. We measure *segregation* at the level of census section tracts, contiguous groups of households settled in an area equivalent to 8-10 city blocks. Indexing tracts by *i,* we define residential segregation within a city as:

(2) *Segregation* = ½ $\sum_{i=1}$|indigenous$_i$ /indigenous – nonindigenous$_i$/nonindigenous|

Where *indigenous* $_i$ is the number of people speaking an indigenous language (Aymara, Quechua or other) in tract *i*, and *indigenous* is the total number of indigenous-speaking people in each city. If indigenous-speaking residents are evenly distributed throughout metropolitan areas, the term in absolute value brackets will be zero for each census tract and zero for the metropolitan area as a whole. If indigenous and non-indigenous speakers never reside in the same census tract, the measure of residential segregation will be one. This measure estimates the share of the indigenous population that would need to change census tracks to even the spatial distribution of ethnic groups within a metropolitan area.

Addressing Self-Selection Bias

The Cutler-Glaeser model requires three adjustments to account for self-selection, omitted variable bias and mobility across neighborhoods. The first adjustment concerns self-selection bias. Residential segregation might be the result rather than the cause of poor economic outcomes. In this case, successful indigenous-speaking residents will choose to live in richer and non-indigenous neighborhoods, rather than settle randomly. We propose to instrument for segregation with three sets of variables. The first instrument uses historical data on residential settlements 25 years ago. While historical segregation is likely to be partially correlated to income-based selection, we are interested in testing whether pre-migration settlement patterns vary systematically from post-migration settlements that today make up half of the population in capital cities. The second instrument uses information on residential sorting before and after a drought-induced migratory shock. The residential sorting of rural migrants from the 1982-1985 highland drought tends to be evenly distributed among high and low-income neighborhoods. The third instrument uses historical figures for population density to approximate geographic features that account for natural occurrences of segregation in the cities of La Paz and El Alto—neighborhoods separated by geographic fault lines, rivers and gorges.

Addressing Omitted Variable Bias

The second adjustment leads to a reformulated model controlling for omitted parental and community characteristics correlated with segregation. In this case, the measure of success for indigenous-speaking residents might overstate the effect of individual-level characteristics. We propose to introduce questions on parental and community-level human and social capital to avert this bias. Omitted variables that account for intergenerational and peer advantages and disadvantages are likely to play a key role in explaining proposed segregation effects.

Controlling for Geographic Mobility

A third adjustment concerns intra-city mobility. If we assume mobility, then even if segregation does lead to poor outcomes, intra-city comparisons may not pick up the negative effect. With intra-city mobility we expect outcomes for similar people to be the same regardless of place of residence. One way to control for mobility is to contrast young age cohorts, who presumably have not made their residential decision yet, with older ones. Another is to control for migrant versus non-migrant households. We propose to control for both age cohorts and migration in our intra-city analysis.

Key Hypotheses

In theory, residential segregation might lead to positive or negative effects on an array of outcomes. Recent research on peer and neighborhood effects suggests that the mechanisms that link segregation to outcomes might include human capital, social capital and ethnic capital externalities. In this section we posit a set of positive- and negative-effect hypotheses that might explain observed outcomes. We consider positive social capital and political effects and negative human capital and public goods effects.

Positive Effects

Recent economic and sociological work on social capital (Glaeser, Laibson and Sacerdote, 2000; Alesina and LaFerrara, 2000; Portes, 1998; Portes and Landolt, 2000), is converging toward individual-based models of social capital formation. The new approach contrasts with the earlier wave of group-based research led by James Coleman

(Coleman 1988; 1990) and Robert Putnam (Putnam 1993; Putnam 2000) which focused on networks and communities. Two consequences of the shift are a more careful account of causality and clearer linkages with household and individual decision-making models.

Among positive social capital effects, we identify three transmission mechanisms that link residential segregation and individual-level outcomes. First, we posit positive intergenerational effects accruing from parental social capital, in the form of expanded social networks and access to an array of intergenerational "weak ties." Parental social capital is likely to be most valuable for second or third-generation migrants who have cultivated a network of neighborhood and extra-neighborhood contacts. Labor, credit and political ties are mobilized by neighborhood contacts.

Second we posit income and labor effects accruing from individual membership in local groups, associations and networks. Personal membership captures unobserved characteristics that proxy for mobility, thrift and outward-orientation. Not all membership affiliations will be outward-looking however. We propose to discriminate between outward and inward-riented groups to capture positive "weak tie" effects rather than potentially negative "strong tie" effects. Sports, political and labor affiliations might proxy outward-looking ties; ethnic, cultural and religious ties might proxy inward-looking ties (see Gray-Molina, Jiménenz, Pérez de Rada and Yañez, 1999).

Third, we posit positive political effects through more effective neighborhood voice. Segregated neighborhoods might initiate collective action easier than non-segregated neighborhoods by mobilizing ethnic or cultural ties. Under decentralized decision-making, neighborhood associations have a significant impact on public investment and public services decisions (see Gray-Molina, 2000). Over the past five years, annual participatory planning rounds have mobilized over 17,000 territorial grassroots organizations, 1,200 of which are from the La Paz/El Alto Metropolitan area alone. Although political effects might be indirect and lagged, we propose to include them to account for neighborhood voice since 1995 (see Gray-Molina, Pérez de Rada and Yañez, 1999a).

Negative Effects

The recent literature on urban poverty (Borjas, 1995; Borjas, 1997; Cutler and Glaeser, 1997; Glaeser, Kahn and Rappaport, 2000) suggests a number of negative effects through peer or neighborhood interactions. Places of residence are important arenas for learning valuable individual and social skills. Residential segregation tends to restrict the social and labor interactions to restricted pools of human capital and public goods.

We identify two main negative transmission mechanisms. First, we posit negative peer and intergenerational human capital effects from residential segregation. Human capital endowments among poor and first or second-generation rural migrants are likely to be significantly lower than in non-segregated neighborhoods. The spatial mismatch between indigenous and non-indigenous neighborhoods hurts both present and future outcomes through intergenerational effects. The aggregation of intergenerational effects might also result in damaging externalities on individuals and households in segregated areas. Recent research suggests a great deal of persistence of ethnic segregation (see Borjas, 1997).

Second, we posit negative neighborhood-wide effects through public goods externalities. Residential segregation is likely to hurt outcomes of the poor if the quality of neighborhood-specific public goods, such as schools or health centers, varies along segregated lines. Heterogeneous public goods and services will influence human capital formation and reinforce peer and parental effects. We propose to use available school and health district-level data on service performance to account for neighborhood differences.

Our hypotheses focus on individual, parental and neighborhood-wide mechanisms for human capital and labor market exclusion. Alternative specifications of the rural segregation measure and interactions with selected variables described above should provide a reliable estimate of the effects of residential segregation on income, labor and educational achievement outcomes. A shortcoming of our framework is that across-city estimates are likely to omit key parental and community characteristics. Intra-city comparisons will attempt to correct for these but will also fall short in capturing the externality effects of ethnicity-based segregation in non-segregated areas. Segregation is likely to hurt indigenous citizens *regardless* of their place of residence. We assume observed and unobserved individual characteristics of indigenous residents in mixed

neighborhoods will pick up citywide externalities, but we cannot establish the extent of this effect.

3. Residential Segregation in Ten Bolivian Cities

This section considers the effect of residential segregation on income across ten Bolivian cities. We use available data from the MECOVI 1999 survey and construct residential segregation variables from 1976 and 1992 census-tract data. We attempt to control for self-selection and omitted variable bias with available data on labor insertion and parental ethnicity and schooling. We measure individual-level ethnicity in terms of self-identification and neighborhood-level ethnicity through language spoken.

Data

The MECOVI (Mejoramiento de Encuestas de Condiciones de Vida) survey includes data from 3,800 households and 13,131 individuals collected in November/December 1999. The survey is nationally representative and also representative of highland, valley and lowland subregions. The survey includes expanded sections on ethnicity (language and self-identification) and demographic indicators. It also includes modules on health and morbidity, education, labor characteristics, labor and non-labor income, food and non-food expenditures, housing conditions, durable and non-durable assets as well as special modules on agricultural production and consumption in rural areas. The survey is designed to collect panel data on a yearly basis.

Table 1 shows the distribution of residential segregation across Bolivian cities in 1992. The Duncan index presented in the last column measures the proportion of the population that would have to move from a segregated to a non-segregated neighborhood, for the population to be equally distributed within cities. The most segregated cities, according to the index, include the cities of La Paz, El Alto, Santa Cruz and Cochabamba, also the largest urban settlements in the country.

Table 1. Duncan Index, Residential Segregation 1992

	Population age 5 or older %	Speaks Spanish %	Speaks Native Language (monolingual and bilingual) %	Duncan Index (a)
Sucre	110327	39.0	61.0	0.203
La Paz	614529	55.1	44.9	0.225
Cochabamba	319730	28.7	71.3	0.584
Oruro	155415	49.5	50.5	0.141
Potosí	92638	30.6	69.4	0.198
Tarija	75603	84.7	15.3	0.251
Santa Cruz	572235	84.9	15.1	0.239
Trinidad	46656	91.4	8.6	0.163
Cobija	8299	88.7	11.3	0.065
El Alto	332065	36.0	64.0	0.214

(a) See Cutler and Glaeser (1997).
Source: 1992 Census

Results

The data used in this section focus on urban households in nine departmental capitals and the city of El Alto. The analysis is based on 2,059 urban heads of household. Table 2 shows two OLS and one IV regressions. The first regression presents basic OLS results for a human capital specification. We find expected signs for education, experience, experience squared and sex. The second specification shows OLS results for an augmented human capital specification that includes the 1992 residential sorting proxy for segregation. We find that indigenous-language speakers are significantly worse off than non-indigenous speakers and that living in an indigenous neighborhood is negatively correlated with income. A third specification instruments for segregation with a measure of drought-induced settlement and adds an interaction term for individual and neighborhood-level ethnicity. Indigenous-speakers who live in predominantly indigenous-speaking neighborhoods (language*segregation) are worse off then those who live in less-segregated neighborhoods. This result coincides with much of the literature on residential segregation. The third specification includes an expanded measure of ethnicity to test whether language or self-identification ethnicity measures have a

different impact. We find that ethnic self-identification is also negatively and significantly correlated with income.

Table 2. Results on Residential Segregation in Ten Cities

	(1) OLS 1992 Census	(2) OLS 1992 Census	(3) IV Migrant Shock
Schooling	0.112	0.104	0.105
	23.57	20.99	19.54
Experience	0.033	0.035	0.032
	7.75	8.56	6.44
Experience squared	-0.000	-0.000	-0.000
	-4.37	-5.01	-4.68
Female	-0.310	-0.317	-0.339
	-7.65	-7.85	-7.37
Bilingual Indigenous (a)		-0.242	-0.106
		5.31	-0.31
Monolingual Indigenous (a)		-0.319	-0.010
		-0.67	-0.02
Residential Segregation		-0.002	-0.046
		-2.63	-2.38
Residential Segregation Squared			0.000
			2.75
Language*Segregation			0.007
			0.62
Indigenous Self-Identification			-0.109
			-1.96
Constant	1.467	1.732	2.626
	20.37	21.39	5.48
Observations	2057	2048	1904
R-squared	0.28	0.29	0.27

Source: Authors' calculations based on MECOVI 1999 and 1992 Census.

While the across-city specifications suggest initial negative effects of segregation on income, the MECOVI surveys do not allow us to test additional instrumental variables or control for potential omitted variables biases. In particular, we are unable to control for intergenerational human capital and social capital effects that may account for lagged effects on income generation.

Hypothesis Testing

Table 3 tests two hypotheses on the causal mechanism behind peer effects in segregated neighborhoods. First, we consider the effects of residential segregation on migrant and non-migrant populations. We find that for migrants from birth, residential segregation has a smaller (when contrasted to non-migrants) but significant negative correlation with income. For five-year migrants, residential segregation is statistically insignificant. Both results bolster suggested by Cutler and Glaeser (1997) and Borjas (1995) that the effects of residential segregation work through intergenerational transmission of income-generating opportunities. For the ten cities studied, segregation conspires against income generation over a long period of time but has no significant impact in the short run. Second, we consider the effects of segregation on different age groups. Our results are inconclusive. We do not find any significant differences between young and old age groups. We return to this hypothesis in the following section.

Table 3. Results by Migrant Status and Age Group

	By Place of Birth		By Residence Last 5 years		Age Group	
	Non-Migrant	Migrant	Non-Migrant	Migrant	25 years or less	25 or older
Schooling	0.115	0.095	0.103	0.114	0.120	.0888
	12.45	12.73	16.34	7.88	10.52	14.67
Experience	0.033	0.033	0.033	0.067	0.020	.0232
	4.33	5.39	6.85	5.04	0.79	3.687
Experience Squared	-0.000	-0.000	-0.000	-0.001	0.003	-.0002
	-1.61	-3.90	-3.95	-3.74	2.02	-2.32
Female	-0.184	-0.413	-0.286	-0.443	-0.208	-.2957
	-2.77	-6.00	-5.64	-3.27	-2.65	-6.33
Segregation	-0.005	-0.003	-0.004	-0.002	-0.001	-.001
	-3.87	-2.78	-4.74	-0.94	-1.36	-1.69
Segregation* Indigenous Language a/	-0.003	-0.003	-0.003	-0.007	-0.0005	-.002
	-1.78	-2.99	-2.57	-2.36	-0.27	-1.71
Constant	1.595	1.886	1.756	1.551	1.225	1.743
	11.98	14.31	17.13	7.02	6.85	12.10
Observations	972	1085	1863	194	450	1609
R-squared	0.29	0.32	0.29	0.46	0.36	0.39

a/ Indigenous Language includes both monolingual and bilingual indigenous speakers.
Source: Authors' calculations based on MECOVI 1999 and 1976 Census.

4. Residential Segregation in La Paz and El Alto

This section considers the effects of intra-city residential segregation on income and educational achievement. In addition to self-selection and omitted variables biases faced in across-city analysis of residential segregation, intra-city estimates face the added problem of geographic mobility within a bounded metropolitan area. In order to control for all three problems we collect new data and focus on relatively young and non-mobile cohorts of the population.

Data

Our survey collects income, labor, human and social capital data from 801 households in 43 neighborhoods in the cities of La Paz (24 neighborhoods) and El Alto (19 neighborhoods). The sample is representative of the entire metropolitan area and is further stratified by high, average and low levels of ethnic-based residential segregation. Together, sampled neighborhoods (zonas censales) hold a population of close to 200,000 (in a metropolitan area of approximately 1.4 million), with an average of approximately 4,000 citizens per neighborhood.

The contents of the survey largely draw from the 1999 MECOVI household survey. Questions on demographic characteristics, educational achievement, labor insertion and income are identical to those on the MECOVI survey. The survey also collects detailed information on parental ethnic, language, human and social capital information and includes expanded questions on social capital and perceptions of segregation from heads of household and spouses.

Measures of Intra-City Segregation

Four measures of intra-city of segregation are used in the regressions. First, we use 1976 census residential sorting patterns, as described in Section 2 above. The 1976 data show a photograph of La Paz/El Alto previous to the wave of rural to urban migration that doubled the population in the intercensal period. The pre-migration data allow us to test whether longstanding residential segregation is systematically different from migration-induced segregation. The 1976 data show a wide variation between neighborhoods. The

average neighborhood had an Aymara-language speaking population of 74%, with a maximum of 100% and a minimum of 33%. Neighborhoods from the city of El Alto are noticeably more Aymara-speaking than in the city of La Paz. Second, we use 1992 census residential sorting patterns. The intercensal period is marked by rapid demographic growth, the creation of new neighborhoods and Aymara language loss. The average neighborhood in 1992 included an Aymara-speaking population of approximately 56%, 18 percentage points less than in the previous census period. The distribution of Aymara speakers across neighborhoods also decreases to a maximum of 81% and a minimum of 25%. Seven neighborhoods that did not exist in 1976 are included in the 1992 sample. Third, we use demographic proxies for geographic segregation. Data on population density provides an instrument for geographic and topographical accidents that separate neighborhoods by mountain ravines, gorges and rivers in the La Paz/El Alto metropolitan area. We find highly dense areas in both high-income and low-income neighborhoods across the metropolitan area. Fourth, we use a shock-induced proxy for randomized residential settlements in the 1980s. The 1982-1985 drought induced a wave of rural migrant households that settled in 36 of the 43 neighborhoods sampled in our survey. We analyze the impact of this scattered residential settlement pattern on income and schooling outcomes

Income Outcomes

Table 4 presents four specifications for the basic residential segregation model. The first specification presents basic OLS results using a 1992 residential sorting proxy for segregation. We find the expected signs for education, experience, experience squared and sex variables. We also find that Aymara speakers are significantly worse off than non-Aymara Speakers, and that living in an Aymara neighborhood is negatively correlated with income. Aymara-speakers who live in predominantly Aymara-speaking neighborhoods (Aymara*segregation) are significantly worse off then those who live in less segregated neighborhoods.

Table 4. Income OLS and IV results

	(1)	(2)	(3)	(4)
	OLS 1992 Segregation Pattern	IV1 1976 Segregation Pattern	IV2 Geographic Segregation Proxy	IV3 Randomized Settlement Proxy
Var dep.	**lny**	**lny**	**lny**	**lny**
Schooling	0.063	0.130	0.089	0.124
t-stat	4.966	8.217	3.25	2.884
Experience	0.033	0.073	0.020	0.085
t-stat	1.905	2.407	1.93	2.271
Experience Sq	-0.000	-0.001	-0.000	-0.001
t-stat	-1.568	-1.369	-2.01	-1.102
Female	0.015	0.025	-0.401	0.048
t-stat	1.59	2.014	-3.24	3.663
Aymara	-0.009	-0.037	-0.041	-0.078
t-stat	-9.247	-2.146	-2.691	-5.618
Aymara*Segreg	-0.001	-0.046	-0.002	-0.040
t-stat	-2.146	-5.418	-1.67	-2.975
Segregation	-0.024	-0.008	-0.034	-0.029
t-stat	-1.874	-3.096	-2.09	-1.978
Parental Social Capital				0.011
t-stat				1.269
Parental Schooling				0.148
t-stat				0.256
Own Social Capital				0.269
t-stat				2.780
Constant	1.246	0.003	3.569	0.591
t-stat	6.899	0.022	(2.76)	0.735
Number of obs	488	488	546	489
F	154.09	21.73	30.43	30.01
Prob > F	0	0	0	0
R-squared	0.2258	0.1937	0.305	0.289
Root MSE	0.636	0.934	0.960	0.932

Source: Authors' survey, 2001.

The second specification partially controls for self-selection by instrumenting segregation with a historical measure of segregation from 1976. We find that the historical measure is even more significant than the present-day measure and exhibits the same signs. Individuals living in what was a highly segregated neighborhood in 1976 are significantly worse off than those living in a historically non-segregated neighborhood.

Aymara-speakers living in a 1976 segregated neighborhood are also significantly worse-off than those living in a historically non-segregated neighborhood. The 1976 segregation data provide a useful but limited instrument for present-day segregation. Historical segregation is likely to be correlated to historical income distribution that is behind the present-day self-selection problem. We test, therefore, for additional instruments of residential segregation.

The third specification instruments segregation with neighborhood level population density, a proxy of geographic segregation. In the La Paz/El Alto metropolitan area, population density is relatively spread out across high and low-income neighborhoods. We find that geographical segregation is negatively and significantly related to income. The fourth specification instruments segregation with a proxy for random residential settlement. Drought-induced migrants resided in 36 of 43 neighborhoods in the La Paz/El Alto metropolitan area. To the extent that drought migrants settled equally in high and low-income neighborhoods they provide an interesting control group against non-migrants. We find that migrants' residence in segregated neighborhoods is negatively and significantly correlated with income. We also include own and parental human and social capital variables that control for intergenerational endowments of income-generating skills and networks. We find that controlling for omitted variables confirms previous findings: residential segregation has a negative and significant effect on income.

Education Outcomes

Table 5 shows results for three specifications on determinants of schooling. The first regression is a standard OLS specification. We find that income, parental education and being female are significantly and negatively correlated with schooling attainment. We further find that speaking Aymara and living in a segregated neighborhood are also significantly and negatively correlated to schooling attainment. The second specification instruments segregation with a historical measure of segregation. The significance of language segregation and historical segregation are slightly lower than in the OLS specification, but they are also negative and significant. Finally, a third specification instruments segregation with a proxy for randomized settlement. This specification also

supports the results observed in the first two specifications. In each case, segregation is a significant barrier to schooling attainment, controlling for parental and own characteristics.

Table 5. Schooling OLS and IV Results

	(1)	(2)	(3)
	OLS 1992 Segregation Pattern	IV1 1976 Segregation Pattern	IV2 Randomized Settlement Proxy
Var dep.	**Schooling /1**	**Schooling/1**	**Schooling /1**
ln y of household	0.002	0.002	0.011
t-stat	3.617	3.553	10.715
Father's schooling	0.031	0.031	0.033
t-stat	16.107	15.425	6.047
Mother's schooling	0.002	0.000	0.017
t-stat	0.598	0.22	0.696
Sex	0.024	0.023	-0.018
t-stat	1.056	1.007	-1.227
Currently employed	-0.013	-0.013	-0.081
t-stat	-4.32	-4.181	4.576
Language	-0.050	-0.017	-0.013
t-stat	-10.69	-8.229	-8.445
Segregation	-0.001	-0.001	-0.064
t-stat	-2.839	-2.37	-2.672
Language*Segreg.	-0.000	-0.000	-0.003
t-stat	-0.667	-0.174	-1.964
Constant	-0.098	-0.127	-0.706
t-stat	-1.385	-1.57	-0.692
Number of obs	1976	1976	1976
Fisher	24.42	23.94	28.16
Adj R-squared	0.245	0.274	0.287

Source: Authors' survey, 2001.
/1: Where education is the education adequation index:
EAI = (years of schooling / (age – 6))

Hypothesis Testing

In order to control for intra-city mobility and test hypotheses concerning positive and negative effects of residential segregation we run regressions on young and old cohorts and migrants and non-migrants. The basic rationale for dividing the sample by age and mobility is to analyze whether the negative link between segregation and income

generation holds across different subgroups of the population, particularly those who have not yet made the decision to reside in a certain neighborhood. We find two surprising results presented in Table 6.

First, we find that residential segregation has a *positive* and significant effect on migrant income. The relationship reverses for second generation migrants and non-migrants. We hypothesize that positive effect works through social capital networks established by recent migrants, which provide access to informal labor markets. As migrants settle, and the positive effects of informal networks wear out, the negative peer effects identified by Cutler and Glaeser, low levels of human capital and social networks linked to lower skilled labor markets, may reverse the impact of residential segregation over time.

Second, we find that ethnic-based residential segregation also has a *positive* effect on younger age groups (younger than 25 years old). The sign switches once we run the regression on older groups. As with the previous specification, we hypothesize that residential segregation might provide young workers with ethnic-based peer advantages over young workers from non-segregated neighborhoods. In addition, we find that parental schooling is strongly and positively correlated with young workers' income. By controlling for intergenerational human capital effects, we hope to isolate the net effect of residential segregation on the income-generating capacity of younger age groups.

Table 6. Effects of Residential Segregation by Age and Migrant Status

	Migrant Status		Age Groups	
	Non-Migrant	Migrant	25 Years and Younger	Older than 25 Years
dep. Var	Lny	lny	lny	Lny
Schooling	0.134	0.088	0.137	0.097
t-stat	4.232	3.976	3.535	5.098
Experience	0.032	0.045	0.406	0.069
t-stat	-2.223	1.801	2.074	2.374
Experience Sq	-0.002	-0.006	-0.006	-0.000
t-stat	-1.226	-1.232	-1.082	-1.424
Female	0.019	0.017	0.027	0.0138
t-stat	3.878	2.026	1.682	4.961
Aymara	-0.207	-0.052	-2.892	-0.041
t-stat	-1.905	-4.157	-3.041	-5.389
Aymara*Segreg	-0.034	0.064	-0.216	-0.054
t-stat	-2.643	2.083	-2.637	-4.108
Segregation	-0.059	0.045	-0.018	-0.031
t-stat	-3.167	2.057	-1.237	-3.34
Parental Social Capital	-0.005	0.011	0.012	-.0909
t-stat	-1.009	5.207	0.995	-3.206
Parental Schooling	0.107	0.121	0.146	0.116
t-stat	2.917	2.148	3.28	3.401
Own Social Capital	0.0743	0.128	-0.054	0.115
t-stat	4.132	1.677	-1.449	2.056
_cons	-0.604	-0.147	-0.558	-0.285
t-stat	-1.454	-0.554	-0.381	-1.32
Number of obs	249	191	120	320
F	7.96	18.29	170.33	29
Prob > F	0	0	0	0
R-squared	0.317	0.227	0.135	0.238
Root MSE	0.877	1.023	0.871	0.969

Source: Authors' survey, 2001.

5. Research and Policy Implications

Although research on poverty and income distribution in Bolivia has reported differential wage effects between indigenous and non-indigenous households (see Chiswick, Patrinos and Hurst, 2000; Rivero and Jiménez 1999; Vos, Lee and Mejía, 1998; Pérez de Rada 1997; Fields *et al*., 1997; Jiménez and Yañez, 1997), few studies have focused on the

effects of residential or neighborhood segregation. In this study we consider the marginal effects of living in a segregated indigenous neighborhood for urban indigenous residents. Three results stand out in the analysis. First, we find significant and negative effects on income generation in both across-city and intra-city comparisons. Second, we find individual and neighborhood-level interactions between ethnicity and segregation by ethnicity to be significantly and negatively correlated with income. Finally, we find positive "social capital effects" for migrants and young workers and "negative human capital effects" for second-generation migrants, non-migrants and older workers living in segregated neighborhoods.

Our analysis has aimed to test whether residential segregation has any measurable effect on income outcomes and to explore alternative causal mechanisms on how segregation results in costs and benefits for urban households. First, we find that residential ethnic segregation has a negative and significant effect on personal income. To control for potential self-selection biases, we test this relationship with three types of instruments: a measure for historical residential sorting patterns, a proxy for geographic segregation and a proxy for randomized residential patterns. We find the three instruments to be significantly and negatively related to personal income. Second, we run three additional specifications on schooling attainment. We find parental education, household income and being female to be significant determinants of schooling attainment. We also find segregation, as measured by the OLS and IV specifications, to correlate negatively and significantly with schooling. In addition, we test the effect of potential omitted variables such as intergenerational human and social capital endowments and find significant positive effects of both on income and schooling attainment.

Second, we consider alternative explanations to account for these results. We find that residential segregation has a *positive* and significant effect on income for recent migrants and a *negative* and significant effect on second-generation migrants or non-migrants. We posit a positive social capital effect to explain the beneficial effects of ethnic segregation for first-generation migrants who gain a foothold by moving to Aymara neighborhoods close to relatives and migrant peers. This advantage disappears over time as first-generation migrants either leave the neighborhood or stay and face

negative peer effects. We also find that residential segregation has a *positive* and significant effect on younger age cohorts, particularly workers under the age of 25. We hypothesize that this might be explained by differences in labor force participation between poor and non-poor groups. Labor participation tends to be high for the poor, which might explain why the income gap lessens for young and older workers as a whole. Both of these findings are premised on the possibility of controlling for self-selection, omitted variable bias and identification problems that might emerge from intra-city and across-city mobility. We believe a careful examination of the available data have allowed us to correct for the most important omitted variable and self-selection biases. From a research perspective, we believe the quantitative analysis reported in this study makes a substantial addition to a literature that has almost exclusively depended on sociological and anthropological evidence in the past.

From a policy perspective, the analysis of residential segregation provides insights into the current debate on Bolivia's shifting poverty profile. First, because the urban poor now outnumber the rural poor. As urbanization accelerates and the demographic profile changes, a window of opportunity arises to achieve gains in savings and productivity. However, a growing and younger population requires complementary opportunities to insure productive insertion into labor markets. Among these, human capital, training and public services are key. Residential segregation may decrease opportunities for human capital development and lower the quality of public service access. The measurement of segregation effects will provide a yardstick to assess the costs of policy-induced segregation. Second, the analysis of residential segregation provides a policy handle on the more general problem of exclusion and discrimination. While social and political discrimination has been hard to identify, let alone address, residential segregation is amenable to an array of policy interventions including urban planning and development norms and school and health district mapping. Although this study aims primarily at getting the analysis right, we hope to contribute to a more informed policy debate through accurate and useful empirical work.

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ANNEX 1

CIUDAD DE EL ALTO
POBLACION DE 5 Y MAS AÑOS 1976-1992

			1976	1992	Diferencia	var% anual
	290	Ciudad Satélite Sur	5,342	7,166	1,824	1.9%
300-301		Ciudad Satélite Sur	4,596	6,881	2,285	2.6%
310-311		Ciudad Satélite Sur	5,267	8,337	3,070	2.9%
270-281		V. Santiago 1ro.	5,821	16,648	10,827	6.7%
170-172		Villa Dolores	6,555	11,097	4,542	3.4%
261 / 190		V. 12 De Octubre - Villa Boliv	6,263	6,996	733	0.7%
240-242		A. Puerto - Villa Adela - Vill	5,994	14,457	8,463	5.7%
150-151		Villa 16 De Julio	5,685	7,317	1,632	1.6%
	152	Villa 16 De Julio	7,369	8,921	1,552	1.2%
101/140		Villa Los Andes - Villa Espera	2,894	11,310	8,416	8.7%
	91	Villa Ballivian	3,371	9,468	6,097	6.6%
	81	Villa Ballivian	4,736	6,905	2,169	2.4%
070-071		A. Lima - H. Potosi - T. Katary	6,365	6,520	155	0.2%
	60	Villa Alto Lima	6,455	22,886	16,431	8.1%
	10	V. Ingenio 1ra. Sección	-	3,894	3,894	--
	11	V. Ingenio 2da. Sección	-	3,781	3,781	--
	20	V. Huayna Potosi	-	4,814	4,814	--
	21	V. Huayna Potosi	-	4,921	4,921	--
	30	V. Germán Busch V Ingavi	-	2,736	2,736	--
	31	V. Busch Mercurio E Ingavi	-	3,225	3,225	--
	100	V. Tupac Katari	-	3,545	3,545	--
	110	V. Tahuantinsuyo - V. Ingenio	-	4,502	4,502	--
	111	Villa Tahuantinsuyo	-	4,094	4,094	--
	120	V. Yunguyo-V.Oriental-Rio Seco	-	4,754	4,754	--
	130	Villa Tunari	-	6,137	6,137	--
	131	Villa Tunari	-	3,928	3,928	--
	132	Villa Tunari	-	3,976	3,976	--
	161	Barrio Petrolero	-	5,154	5,154	--
	180	Centro 12 De Octubre	-	3,764	3,764	--
	181	Centro 12 De Octubre	-	3,031	3,031	--
	200	V. 6 De Agosto V Murillo Marca	-	3,629	3,629	--
	210	V. Tamayo 23 De Marzo	-	5,173	5,173	--
	220	Vivienda Conavi - Rio Seco	-	3,768	3,768	--
	221	Vivienda Conavi - Rio Seco	-	3,288	3,288	--
	222	Vivienda Conavi - Rio Seco	-	2,971	2,971	--
	230	Sud Yungas -25 De Julio-16 De Febrero	-	3,987	3,987	--
	250	V. Antofagasta-V. Illimani-V. Dolores F	-	4,126	4,126	--
	251	V. Bolívar - V. San Pedro	-	3,585	3,585	--
	252	Vill Bolívar "C"	-	3,932	3,932	--
	260	Villa Bolívar	-	3,024	3,024	--
	320	V. Exaltación	-	4,895	4,895	--
	321	V. Santa Rosa	-	3,675	3,675	--

		1976	1992	Diferencia	var% anual
330	Villa Rosas Pampa	-	3,704	3,704	--
331	Nuevos Horizontes "1" V. 21 De Diciembre	-	5,458	5,458	--
340	Villa Santiago 2do.	-	5,845	5,845	--
341	Villa Santiago 2do.	-	5,436	5,436	--
350	V. Nuevos Horizontes "3"	-	4,504	4,504	--
351	V. Nuevos Horizontes "3" - V. El Carmen	-	5,378	5,378	--
360	V. Pacajes-V. San Luis Tasa	-	3,844	3,844	--
361	V. Juliana - V. Primavera	-	3,487	3,487	--
362	Cosmos 77	-	3,618	3,618	--
370	Villa Paraíso	-	3,374	3,374	--
371	Cosmos 79 A Y B	-	3,625	3,625	--
372	Cosmos 79 C. Quishuaras	-	2,189	2,189	--
380	Villa 1ro. De Mayo	-	4,149	4,149	--
381	V. San Luis Pampa	-	3,649	3,649	--
382	V. Romero Pampa	-	3,094	3,094	--
390	El Kenko	-	4,864	4,864	--
391	V. Las Delicias- V. Oro Negro	-	5,004	5,004	--
		76,713	332,522	255,809	9.4%

Nota: (--) indica que la zona no existía en 1976

CIUDAD DE LA PAZ:
POBLACION DE 5 Y MAS AÑOS 1976-1992

		1976	1992	Dif	Var% anual
540-551	Huayra Pata - El Tejar	12,710	17316	4,606	2.0%
150-152	La Portada - V. Antofagasta	7,982	10555	2,573	1.8%
160-161	Munaypata	7,274	10269	2,995	2.2%
170-171	Munaypata	8,792	8879	87	0.1%
180	Villa Victoria	4,623	6472	1,849	2.2%
190	Villa Victoria	5,680	5346	-334	-0.4%
200	Pura - Pura	5,387	5689	302	0.4%
210-212	Pura - Pura	4,956	12081	7,125	5.7%
220	Achachicala - Autopista	4,250	6635	2,385	2.9%
230-231	Achachicala Bajo	5,631	7725	2,094	2.0%
240	Zarzuela	3,881	6264	2,383	3.1%
250-251	German Busch	7,478	9963	2,485	1.8%
260-263/264	Santa Rosa Grande - Delicias	14,251	15449	1,198	0.5%
270-273/ 290-291	La Merced - El Carmen	15,531	17708	2,177	0.8%
280-281	Villa Fatima	9,830	11668	1,838	1.1%
290-291	Alto Miraflores	7,569	10103	2,534	1.9%
300-301	Alto Miraflores	7,130	8482	1,352	1.1%
310-311	Miraflores Norte	8,170	7839	-331	-0.3%
320-321	Miraflores Sud	6,661	6044	-617	-0.6%
330	Miraflores Sud	6,152	6115	-37	0.0%
360-361	Pampajasi - C. Del Niño	3,394	9648	6,254	6.7%
370	Villa San Antonio	3,708	6152	2,444	3.2%
380/390	Villa San Antonio	6,767	9413	2,646	2.1%
381/391	Villa San Antonio	4,263	9233	4,970	5.0%
400-401	Villa Copacabana	5,107	11249	6,142	5.1%
410-412	Villa Copacabana	6,848	9614	2,766	2.2%
420-421	San Juan	7,751	9071	1,320	1.0%
430-440	Villa Pabon	5,464	10496	5,032	4.2%
450	Agua De La Vida	5,588	3964	-1,624	-2.2%
451	V. De La Cruz - A. Calvario	5,664	4084	-1,580	-2.1%
460	Norte	4,347	3236	-1,111	-1.9%
470	Norte	4,540	4002	-538	-0.8%
480	Callapampa	6,255	6284	29	0.0%
490	San Sebastian	6,208	5216	-992	-1.1%
500	Callampaya	5,124	4387	-737	-1.0%
510	Callampaya	4,969	4882	-87	-0.1%
520/530	Mariscal Santa Cruz	6,440	7988	1,548	1.4%
521/531	Mariscal Santa Cruz	6,344	7014	670	0.6%
561/570-571	S. Corazon - Faro De Murillo	4,911	8506	3,595	3.5%
560	Sagrado Corazon	8,168	8594	426	0.3%
580-581	Obispo Indaburo	7,351	7122	-229	-0.2%
590-591	14 De Septiembre	4,310	7507	3,197	3.6%
600-610	14 De Septiembre	5,147	7890	2,743	2.7%

			1976	1992	Dif	Var% anual
	620	Rosario	6,219	4865	-1,354	-1.6%
	630	Santa Barbara	7,736	6367	-1,369	-1.3%
	640	Belen	4,218	3058	-1,160	-2.1%
	650	Belen	4,454	3518	-936	-1.5%
	660	Gran Poder	5,952	5389	-563	-0.6%
	670	Villa Nueva Potosi	4,796	4366	-430	-0.6%
	680	Villa Nueva Potosi	4,327	4165	-162	-0.2%
	690	Villa Nueva Potosi	6,126	6226	100	0.1%
	700	Villa Nueva Potosi	3,597	4991	1,394	2.1%
710-711		Villa Nueva Potosi	6,293	6999	706	0.7%
	720	San Pedro Alto	3,841	3467	-374	-0.7%
	730	San Pedro Alto	4,564	4152	-412	-0.6%
740-741		San Pedro Alto	6,142	6664	522	0.5%
	750	Bello Horizonte	4,811	3770	-1,041	-1.6%
	760	Bello Horizonte	4,399	4856	457	0.6%
	770	Tembladerani	5,451	6080	629	0.7%
780-781		Tembladerani	6,648	8067	1,419	1.2%
790-793		Tembladerani - Las Lomas - Pasanke	6,804	14510	7,706	4.9%
800-802		Tacagua	6,937	12133	5,196	3.6%
	810	Sopocachi Alto	6,841	7623	782	0.7%
812-821		Sopocachi Alto	6,380	11817	5,437	4.0%
830-831		Sopocahi Bajo	5,756	5801	45	0.0%
840-841		Sopocachi Bajo	6,029	5435	-594	-0.7%
850-851		Kantutani	5,984	6655	671	0.7%
341/860-863		Obrajes - Alto Obrajes	9,159	19190	10,031	4.7%
870-873		B. Vista - Seguencoma Alto - B	8,797	17883	9,086	4.6%
880-883		Irpavi - Bolognia - Achumani	5,816	19969	14,153	7.9%
890-891		Calacoto - Florida - Aranjuez	5,782	9117	3,335	2.9%
900-905		San Miguel - Cota-Cota	5,837	21062	15,225	8.2%
	340	Villa Armonia	0	4479	4,479	
	350	Villa Armonia	0	3788	3,788	
	351	Villa Armonia-San Isidro	0	4823	4,823	
	362	Kupini Callapa	0	4839	4,839	
	363	Chinchaya-Chicani-Pampahasi-Ci	0	4318	4,318	
					0	
		Total	452302	616596	164,294	2.0%