Session Number: Session 2B
Session Title: *Improving Estimates from Survey Data*
Session Organizer(s): Stephen Jenkins, University of Essex, Colchester, UK, and Holly Sutherland, University of Essex, Colchester, UK
Session Chair: Holly Sutherland, University of Essex, Colchester, UK

Paper Prepared for the 29th General Conference of
The International Association for Research in Income and Wealth

Joensuu, Finland, August 20 – 26, 2006

CREATING NATIONAL POVERTY PROFILES AND GROWTH INCIDENCE CURVES WITH INCOMPLETE INCOME OR CONSUMPTION EXPENDITURE DATA: AN APPLICATION TO BOLIVIA

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Creating National Poverty Profiles and Growth Incidence Curves with Incomplete Income or Consumption Expenditure Data: An Application to Bolivia

Abstract:

In many developing countries, there does not exist a time series of nationally representative household budget or income surveys, while there often are surveys of regions as well as nationally representative Demographic and Health Surveys (DHS) which lack information on incomes. This makes an analysis of trends and determinants of poverty and inequality impossible. This is also the situation in Bolivia where there exist urban household surveys and nationally representative DHS since 1989, while nationally representative household income surveys only exist since 1997. In this paper, we adjust a technique developed for poverty mapping exercises to link urban household income surveys with DHS data to generate a time series of household income data from 1989 to 2002. Our technique performs well on validation tests, is superior to imputing incomes from assets in the DHS, and is able to generate new information on poverty and inequality in Bolivia.

Key Words: Microsimulation, survey matching, poverty, inequality, pro-poor growth, poverty profile, growth incidence curve, Bolivia

***JEL*-Codes**: C81, D31, I31, I32, O54

Acknowledgements:
This paper was produced as part of the World Bank-DFID-AfD-BMZ-GTZ-KfW coordinated process on operationalizing pro-poor growth. We would like to thank Juan-Carlos Aguilar, Annette Langhammer, Louise Cord, Berk Özler, Omar Arias, Fernando Landa, Wilson Jimenez, Sara Calvo, Andrey Launov, participants and discussants at workshops at the World Bank, in Frankfurt, in La Paz, and at the Symposium on Poverty, Inequality, and Policy in Latin America in Göttingen for valuable comments and discussion. Special thanks go to Francisco H. G. Ferreira and Peter Lanjouw. Funding from the German Federal Ministry for Economic Cooperation and Development via the KfW Entwicklungsbank (KfW Development Bank) is gratefully acknowledged.

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1 Introduction

In many developing countries, it is not possible to obtain a time series of household income surveys for poverty and inequality analyses. Nationally representative surveys often only started very recently (e.g. with the support of the World Bank living standard measurement survey (LSMS) program), and before there are often only regional, frequently urban, income surveys available. At the same time, many developing countries have participated in the program of Demographic and Health Surveys (DHS) since the late 1980s and often now have 2-4 such surveys available. Unfortunately, these DHS data do not contain information on household incomes or expenditures. In order to use these data nevertheless for poverty analysis, asset indices have often been created and used to assess poverty differentially and poverty trends over time (Sahn and Stiefel 2000, 2003; Filmer and Pritchett 2001). While these asset indices are often well-correlated with income, it is not clear how well they are able to reproduce poverty trends over time.

To explore the trends in the urban-rural divide as well as other dimensions of poverty in more depth and detail irrespective of the above mentioned data constraints, we set up a dynamic cross-survey microsimulation methodology. In Section 2, we start by developing the methodology and describing the data used. The empirical application for the case of Bolivia in Section 3 is carried out in three steps. First, we generate an inter-temporally comparable microdata set of simulated incomes for total Bolivia (i.e., departmental capitals, other urban areas, and rural areas) between 1989 and 2002, and check the consistency between observed and simulated incomes where the former are available. Second, we use the simulated incomes to estimate detailed national poverty profiles by place of residence and by household characteristics to track the evolution of poverty for different subgroups of the population over time. Third, we evaluate the "pro-poorness" of the simulated 1989-to-2002 income changes with the help of growth incidence curves. In Section 4, sensitivity analyses are performed (a) to check the robustness of our results to alternative model specifications and (b) to compare our results with those derived from the asset-index (or wealth-index) approach developed by Filmer and Pritchett (2001), and Sahn and Stifel (2000, 2003). Section 5 discusses the results.

2 Data and Approach

Our methodology to create national poverty profiles and growth incidence curves with incomplete income or consumption expenditure data builds upon the static cross-survey microsimulation methodology of Hentschel et al. (2000) and Elbers et al. (2003). Their objective is to analyze the spatial dimension of poverty in detailed poverty maps of national coverage for Ecuador. Their problem is that the Ecuadorian LSMS did not collect consumption expenditures for all households but only for a nationally representative sample of two-stage randomly selected households. The two-stage sample design, first selecting clusters and then households within the selected clusters, generates a sample in which the households are not randomly distributed over space, but are geographically grouped. Their solution to this problem is to combine the LSMS data with concurrent unit-record Census data of all Ecuadorian households and impute consumption expenditures for those municipalities which were not included in the LSMS sample. To this end, they estimate a consumption expenditure model in the LSMS data restricting the set of covariates to those which are also available in the Census data. Then they multiply for each household in the Census its covariates with the corresponding regression coefficient from the consumption expenditure model and add a randomly distributed error term.

We have a similar objective but face more severe data constraints. The pre-1997 LSMS of Bolivia are not only not nationally representative, but furthermore cover only the departmental capitals. Additionally, the concurrent Bolivian rounds of LSMS and Census are only available for 1992 and 2001. To overcome these data constraints, we extend the static cross-survey microsimulation methodology of Hentschel et al. (2000) and Elbers et al. (2003) by a dynamic

component and replace the Census data by DHS data. The analysis proceeds in three steps. First, we choose a base period *t* in which we dispose of a nationally representative LSMS as well as a nationally representative DHS, and develop an empirical model of a monetary welfare indicator *y* (hereafter referred to as *income*) using the LSMS data. Similar to above, the set of covariates *X* is restricted to those which are also available in the corresponding DHS. The choice of the covariates is further guided by (a) the highest possible consistency between LSMS and DHS data as well as over time, and (b) the best possible fit of the regression model. We then construct a 3 x 3 block diagonal structure of the covariates by interacting them with three regional dummies, and run the weighted standard log-linear OLS regression model

$$\begin{pmatrix} y_t^C \\ y_t^T \\ y_t^R \end{pmatrix} = \begin{bmatrix} X_t^C & 0 & 0 \\ 0 & X_t^T & 0 \\ 0 & 0 & X_t^R \end{bmatrix} \cdot \begin{pmatrix} \beta_t^C \\ \beta_t^T \\ \beta_t^R \end{pmatrix} + \varepsilon_t, \qquad (1)$$

where the indices *C, T,* and *R* stand for departmental capitals, other urban areas, and rural areas, respectively, β are coefficient vectors, and ε is an independent error term. We account for heteroskedasticity using the covariance matrix estimator proposed by White (1980).[1]

Second, we check the consistency between the observed incomes of the LSMS and the simulated incomes of the DHS in period *t*. To this end, we apply the coefficient estimates $\hat{\beta}$ from regression model (1) to the DHS covariates $\tilde{X}$ and generate simulated incomes

$$\begin{pmatrix} \tilde{y}_t^C \\ \tilde{y}_t^T \\ \tilde{y}_t^R \end{pmatrix} = \begin{bmatrix} \tilde{X}_t^C & 0 & 0 \\ 0 & \tilde{X}_t^T & 0 \\ 0 & 0 & \tilde{X}_t^R \end{bmatrix} \cdot \begin{pmatrix} \hat{\beta}_t^C \\ \hat{\beta}_t^T \\ \hat{\beta}_t^R \end{pmatrix} + \begin{pmatrix} u_t^C \\ u_t^T \\ u_t^R \end{pmatrix}. \qquad (2)$$

Since the regression model explains only a fraction of the variance, we add the realization of normally distributed random variables u^C, u^T, and u^R with mean zero and a variance equal to the variance of the error term in the respective region. This simulation procedure is repeated 200 times to create 200 nationally representative samples of simulated incomes. Letting $P(\tilde{y})$ be a poverty or inequality measure based on the simulated income distribution, we can then generate the conditional distribution of $P(\tilde{y})$, in particular, its mean point estimate and its prediction error, from the 200 samples of simulated incomes. The fit of the imputation can be evaluated by comparing the poverty and inequality measures estimated from observed incomes of the LSMS, $P(y)$, with those estimated from simulated incomes of the DHS, $P(\tilde{y})$.

Third, we choose an earlier period *t*–1 in which the LSMS covers only the departmental capitals and partially re-run our regression model

$$y_{t-1}^C = X_{t-1}^C \cdot \beta_{t-1}^C + \varepsilon_{t-1}^C \qquad (3)$$

to obtain the coefficient estimates and the variance of the error term for the departmental capitals in period *t*–1. We assume that the absolute differences in the regression coefficients between departmental capitals on the one hand, and other urban areas and rural areas on the other hand,

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1 Unfortunately, the primary sample units (or clusters) of the pre-1997 LSMS are not available in Bolivia so that we cannot split the error term into a spatial and an idiosyncratic component as in Elbers et al. (2003).

remain constant between period t–1 and t,[2] and arrive at the coefficient estimates for other urban areas and rural areas, respectively, in period t–1

$$\hat{\beta}^{T}_{t-1} = \hat{\beta}^{C}_{t-1} + (\hat{\beta}^{T}_{t} - \hat{\beta}^{C}_{t}) \quad \text{and} \quad \hat{\beta}^{R}_{t-1} = \hat{\beta}^{C}_{t-1} + (\hat{\beta}^{R}_{t} - \hat{\beta}^{C}_{t}). \tag{4}$$

In a similar vein, by assuming that the relative change in the variances of the error terms between period t–1 and t is identical for all three regions, we obtain the variances of the error terms for other urban areas and rural areas, respectively, in period t–1

$$\text{var}(\varepsilon^{T}_{t-1}) = \text{var}(\varepsilon^{T}_{t}) \cdot \frac{\text{var}(\varepsilon^{C}_{t-1})}{\text{var}(\varepsilon^{C}_{t})} \quad \text{and} \quad \text{var}(\varepsilon^{R}_{t-1}) = \text{var}(\varepsilon^{R}_{t}) \cdot \frac{\text{var}(\varepsilon^{C}_{t-1})}{\text{var}(\varepsilon^{C}_{t})}. \tag{5}$$

Repeating the simulation exercise (2) with the coefficient estimates from equations (3) to (5) and the DHS data in period t–1, we can create 200 nationally representative samples of simulated incomes in period t–1. Again we can compare the poverty and inequality measures between the two household surveys. In contrast to above, however, this exercise is only possible for the departmental capitals where observed incomes are available. After this consistency check, we can use the simulated incomes (a) to construct inter-temporally comparable poverty profiles of national coverage for Bolivia and (b) to evaluate the "pro-poorness" of changes in the distribution of simulated incomes over time with the help of growth incidence curves.

Our set of LSMS consists of four multi-purpose household surveys conducted by the *Instituto Nacional de Estadísticas de Bolivia* (National Statistical Office of Bolivia): the 2nd round (Nov. 1989) and the 7th round (July to Dec. 1994) of the *Encuesta Integrada de Hogares* (EIH), and the 1st round (Nov. 1999) and the 4th round (Nov. 2002) of the *Encuesta Continua de Hogares* (ECH). The EIH cover only the departmental capitals of Bolivia, while the ECH are nationally representative. Two-stage sampling techniques were used in selecting the sample of households, and sampling was done in a way to ensure self-weighting. The purpose of the LSMS is to collect individual, household, and community level data to measure the welfare level of the sampled population and its changes over time. In addition to income and/or expenditure data, the LSMS provide information on demographics, asset ownership, education, employment, and health.

In order to be able to compare our results with earlier empirical studies, we largely use household members as analysis unit. As welfare indicator, we use monthly consumption expenditures (including own consumption, but excluding annualized costs for durable consumer goods) for rural areas, and monthly labor income (excluding fringe benefits)[3] plus monthly capital income for urban areas. The choice of the mixed measurement unit, which is common for Bolivia (see, for instance, INE-UDAPE 2002), can be justified by that (a) an all-expenditure specification is not possible since the EIHs collected only income but no expenditure data, and (b) an all-income specification is not preferable since incomes only poorly reflect the long-term welfare in rural areas due to large seasonal income fluctuations and a high degree of own consumption in agricultural households[4] (Deaton and Zaidi 2002). In order to account for non-declaration of incomes, we apply a statistical matching approach similar to Hernany (1999). By contrast, we do not adjust for sub-

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2 We check the robustness of our results to an alternative assumption on the evolution of the regression coefficients between period t–1 and t in Section 4.1.

3 Only if we exclude fringe benefits is the measurement unit inter-temporally comparable between 1989 and 2002. This is because the EIHs collected, if at all, only the incidence and type of fringe benefits but not their monetary equivalent. As a consequence, our poverty estimates for 1999 and 2002 are somewhat higher than the official figures provided by INE (var. iss.).

4 In 1999, for example, per capita income in rural areas was only two-thirds compared to per capita consumption.

declaration (under-reporting) of incomes (i.e. we do not scale up the mean income and mean consumption expenditures in the LSMS to those in the national accounts) because (a) it is a priori not clear whether national account data or LSMS data are more accurate, and (b) Bolivia does not report separate national account data for departmental capitals, other urban areas, and rural areas.[5]

To identify the poor, we use the two sets of poverty lines provided by the *Unidad de Análisis de Políticas Sociales y Económicas* (UDAPE) (Table 1). The extreme poverty lines are given by the costs of food baskets which reflect (a) the nutritional requirements of adults, and (b) the local eating habits of the middle quintile of the income distribution. The moderate poverty lines additionally include the costs of non-nutritional basic needs and are obtained by multiplying the extreme poverty lines by the inverse of local Engel coefficients. Since no rural poverty lines are available for 1989 and 1994, we extrapolate the relative difference between the rural poverty line and the weighted average urban poverty line of 1999.

Table 1 — Poverty Lines for Bolivia (in current Bolivianos)

	Moderate Poverty Line					Extreme Poverty Line				
	1989[a]	1994	1999	2002	2002 cpi[c]	1989[a]	1994	1999	2002	2002 cpi[c]
Urban Areas										
Chuquisaca	138.5	241.8	335.4	335.6	395.5	73.3	127.9	169.4	169.5	209.2
La Paz (Capital City)	135.3	227.9	324.0	327.0	383.3	75.2	126.6	180.1	181.8	214.6
La Paz (El Alto)	116.6	192.6	270.4	272.6	332.9	70.7	116.7	164.1	165.5	201.8
Cochabamba	142.1	253.2	351.1	351.3	405.8	71.8	127.6	177.3	177.4	204.9
Oruro	123.0	207.1	294.7	297.4	351.1	75.2	126.6	163.9	165.3	214.6
Potosí	113.1	190.5	271.0	273.5	323.0	75.2	126.6	150.7	152.1	214.6
Tarija	144.3	257.3	356.8	351.3	412.1	71.8	127.9	178.6	177.4	204.9
Santa Cruz	141.8	237.8	354.7	343.9	404.8	72.0	120.7	180.2	174.7	205.5
Beni	141.8	237.8	354.7	343.9	404.8	72.0	120.7	180.2	174.7	205.5
Pando	141.8	237.8	354.7	343.9	404.8	72.0	120.7	180.2	174.7	205.5
Urban Pop. Weighted Av.	135.4	231.7	344.7	344.3	392.9	73.4	124.8	176.4	175.5	208.9
Rural Areas	96.9[b]	164.4[b]	233.6	233.4	276.6	55.2[b]	93.4[b]	131.2	133.0	157.6
Pop. Weighted Average	119.5	204.8	299.3	298.1	351.2	65.9	112.3	160.6	160.3	190.5

Notes: [a] Since no poverty lines are available for the 2nd round (Nov. 1989) of the EIH, they are constructed as the arithmetic mean of the poverty lines for the 1st round (March 1989) and the 3rd round (Sept. 1990) of the EIH. – [b] Constructed by extrapolating the relative difference between the rural poverty line and the weighted average urban poverty line of 1999. – [c] 1989 poverty lines inflated with the CPI.

Source: Own compilation based on unpublished data of UDAPE.

Our set of Demographic and Health Surveys (DHS) consists of the first three Bolivian rounds which were conducted in 1989, 1994, and 1998.[6] Two-stage sampling techniques were used to select nationally representative samples of women aged between 15 and 49 who serve as respondents of the DHS. The main objective of the DHS is to collect information on health and fertility trends. Additionally, the questionnaire includes some questions on the educational attainment and the employment situation of the respondent and her partner, as well as on the asset ownership of the household.

The covariates taken from the two data sources and their sample means are listed in Tables A1 and A2 in the Appendix. They can be grouped into five categories: information on (a) demographics of the household, (b) asset ownership of the household, (c) educational attainment of

5 For an description and evaluation of, and an analysis of the sensitivity of poverty measures to, different adjustment methods, see Székely et al. (2000).

6 The fourth Bolivian DHS round, which was conducted in 2003, has not been made publicly available when finishing this study.

adult men and women, (d) employment situation of adult men and women, and (e) health situation of children. By choosing suitable variables and dummy categories, we obtained a high degree of consistency both across surveys and over time.

3 Empirical Results

We build our methodology around the base period 1999 and then apply it to the earlier periods 1989 and 1994. Additional data constraints impede our empirical analysis in three respects. First, to create inter-temporally comparable samples of simulated incomes for Bolivia it would be ideal to use a set of covariates which is available in all three pairs of concurrent household surveys of 1989, 1994, and 1999. At the same time, however, the availability of covariates in the LSMS and the DHS changes over time due to changes in their questionnaires. In order to avoid too small a set of covariates we, thus, decided to use three different sets of covariates to (a) check the consistency between the LSMS and the DHS data in 1999, (b) to create 200 samples of simulated incomes in the DHS 1989 data, and (c) to create 200 samples of simulated incomes in the DHS 1994 data.[7]

Second, since no Bolivian DHS round was conducted in 1999, we have to use the DHS 1998 data for our consistency check. That is, we compare the poverty and inequality measures based on observed incomes of the LSMS 1999 with those based on simulated incomes of the DHS 1998, assuming that the distribution of the covariates remained reasonably constant in between. By contrast, for 1989 and 1994 we dispose of concurrent rounds of LSMS and DHS. Third, due to its focus on health and fertility trends, the DHS data only include households with at least one woman of reproductive age (i.e., aged between 15 and 49). We, thus, have to replicate this implicit sample selection in the LSMS data.[8]

3.1 Consistency Check

In Tables 2 and 3, we provide four sets of poverty and inequality measures: (a) their point estimates from observed incomes of all households in the LSMS, (b) their point estimates from observed incomes of households with at least one woman of reproductive age in the LSMS, (c) their mean point estimates and standard deviations from 200 samples of predicted incomes in the LSMS, and (d) their mean point estimates and standard deviations from 200 samples of simulated incomes in the DHS.[9] Taking differences between successive members of this series enables us to decompose the overall difference between observed and simulated poverty and inequality measures into three components related to (a–b) the implicit sample selection in the DHS data, (b–c) the specification of the error term in the underlying regression model, and (c–d) differences in the distribution of the covariates between LSMS and DHS.

For 1989 and 1994, for which the consistency check is limited to departmental capitals, the results are very encouraging. Restricting the sample to households with at least one woman of reproductive age does not induce a serious bias in estimating poverty and inequality measures.

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7 To put it more formally, we only require that the set of covariates is identical for the LSMS and the DHS in period t–1 as well as for the LSMS in period t. To check for robustness, we also performed our subsequent empirical analysis for the smaller set of common covariates. While, as expected, the consistency check performed worse, the empirical results did not change qualitatively.

8 For 1994 and 1998 (but not for 1989), the DHS provide an additional data module on – and responded by – male adults. We opted against using this data module for two reasons: (a) the information was only collected for the husbands and partners of all women included in the main module (but not for men in households with no woman in reproductive age) so that we also would have had to reduce the sample size and possibly would have introduced another sample-selection bias, and (b) our microdata set of simulated incomes would no longer be inter-temporally comparable over the whole observation period from 1989 to 2002.

9 The underlying regression results are not reported here, but are available upon request.

Table 2 — Comparison of Poverty Indices Based on Observed and Simulated Incomes

	1989				1994				1999			
	LSMS Data			DHS Data	LSMS Data			DHS Data	LSMS Data			DHS Data
	All Hh.	Sample	Predic-tion	Simu-lation	All Hh.	Sample	Predic-tion	Simu-lation	All Hh.	Sample	Predic-tion	Simu-lation[a]
Moderate Poverty Line												
Departmental Capitals												
Headcount	66.60	67.21	65.42* (0.70)	64.81 (0.83)	58.09	59.49	58.06 (0.64)	57.35 (0.75)	48.73	51.05	50.53* (1.49)	48.05 (0.68)
Gap	33.31	32.92	33.14* (0.43)	32.92* (0.52)	25.15	25.74	25.92* (0.31)	25.33* (0.41)	20.28	21.02	22.48* (0.87)	21.28* (0.37)
Squared Gap	20.78	19.96	20.62* (0.35)	20.57* (0.42)	13.91	14.16	14.67 (0.23)	14.25* (0.30)	11.39	11.60	12.82* (0.68)	12.17 (0.28)
Other Urban Areas												
Headcount	n.a.	n.a.	n.a.	81.05 (1.32)	n.a.	n.a.	n.a.	75.13 (1.16)	66.92	69.09	67.59* (2.32)	64.17 (1.12)
Gap	n.a.	n.a.	n.a.	51.31 (0.92)	n.a.	n.a.	n.a.	44.68 (0.69)	33.64	34.70	35.25* (1.51)	33.59* (0.67)
Squared Gap	n.a.	n.a.	n.a.	37.28 (0.82)	n.a.	n.a.	n.a.	31.38 (0.58)	20.71	21.12	22.52* (1.23)	21.69* (0.53)
Rural Areas												
Headcount	n.a.	n.a.	n.a.	89.66 (0.59)	n.a.	n.a.	n.a.	89.55 (0.47)	81.64	83.37	84.31* (1.10)	79.07 (0.62)
Gap	n.a.	n.a.	n.a.	58.30 (0.50)	n.a.	n.a.	n.a.	60.90 (0.34)	46.02	47.71	48.74* (0.82)	43.10 (0.41)
Squared Gap	n.a.	n.a.	n.a.	42.21 (0.49)	n.a.	n.a.	n.a.	45.83 (0.33)	30.39	31.85	32.47* (0.79)	27.67 (0.34)
Total Bolivia												
Headcount	n.a.	n.a.	n.a.	76.88 (0.50)	n.a.	n.a.	n.a.	72.37 (0.45)	63.69	65.21	65.03* (0.92)	60.33 (0.43)
Gap	n.a.	n.a.	n.a.	45.45 (0.35)	n.a.	n.a.	n.a.	41.89 (0.25)	31.85	32.53	33.67 (0.58)	30.06 (0.27)
Squared Gap	n.a.	n.a.	n.a.	31.37 (0.31)	n.a.	n.a.	n.a.	28.94 (0.21)	19.85	20.19	21.22 (0.49)	18.52 (0.20)
Extreme Poverty Line												
Departmental Capitals												
Headcount	39.44	39.38	39.62* (0.73)	38.78* (0.92)	28.04	28.78	29.66* (0.54)	28.34* (0.73)	23.01	24.22	25.30* (1.53)	23.10* (0.65)
Gap	16.26	15.29	16.19 (0.36)	15.92* (0.43)	9.47	9.58	10.26 (0.25)	9.66* (0.29)	8.00	8.00	9.01* (0.70)	8.24* (0.27)
Squared Gap	9.30	8.05	8.77 (0.26)	8.65 (0.30)	4.57	4.51	4.90 (0.16)	4.56* (0.18)	4.20	3.94	4.43* (0.45)	4.06* (0.16)
Other Urban Areas												
Headcount	n.a.	n.a.	n.a.	62.84 (1.44)	n.a.	n.a.	n.a.	53.31 (1.22)	33.10	34.31	39.51 (2.60)	38.09 (1.28)
Gap	n.a.	n.a.	n.a.	34.10 (0.90)	n.a.	n.a.	n.a.	27.02 (0.63)	13.93	13.97	16.56 (1.26)	16.60 (0.52)
Squared Gap	n.a.	n.a.	n.a.	22.52 (0.71)	n.a.	n.a.	n.a.	17.17 (0.49)	8.29	8.01	9.26* (0.89)	9.54 (0.35)
Rural Areas												
Headcount	n.a.	n.a.	n.a.	74.59 (0.92)	n.a.	n.a.	n.a.	76.05 (0.62)	57.93	59.98	62.58* (1.51)	54.79 (0.76)
Gap	n.a.	n.a.	n.a.	39.13 (0.58)	n.a.	n.a.	n.a.	43.33 80.38)	25.88	27.37	27.87* (0.93)	22.94 (0.37)
Squared Gap	n.a.	n.a.	n.a.	24.59 (0.47)	n.a.	n.a.	n.a.	28.84 (0.34)	14.55	15.65	15.58* (0.71)	12.32 (0.25)
Total Bolivia												
Headcount	n.a.	n.a.	n.a.	56.24 (0.61)	n.a.	n.a.	n.a.	50.43 (0.45)	37.48	38.35	40.58 (1.00)	35.43 (0.46)
Gap	n.a.	n.a.	n.a.	27.53 (0.34)	n.a.	n.a.	n.a.	25.21 (0.22)	15.52	15.73	16.79 (0.53)	14.16 (0.20)
Squared Gap	n.a.	n.a.	n.a.	16.78 (0.25)	n.a.	n.a.	n.a.	15.79 (0.17)	8.66	8.68	9.09* (0.38)	7.51 (0.13)

Notes: Poverty indices are calculated using income data for departmental capitals and other urban areas, expenditure data for rural areas, and mixed income-expenditure data for total Bolivia. Standard errors of the poverty indices in brackets (only applicable to those based on predicted and simulated incomes). – [a] The covariates for the simulation exercise are taken from the third Bolivian DHS round, which was conducted in 1998. – * denotes that the 95-percent confidence interval includes the corresponding index value in the "Sample" column.

Source: Own calculations.

Table 3 — Comparison of Inequality Indices Based on Observed and Simulated Incomes

	1989				1994				1999			
	LSMS Data			DHS Data	LSMS Data			DHS Data	LSMS Data			DHS Data
	All Obs.	Sample	Predic-tion	Simu-lation	All Obs.	Sample	Predic-tion	Simu-lation	All Obs.	Sample	Predic-tion	Simulat ion[a]
						Departmental Capitals						
Gini	0.512	0.505	0.492*	0.497*	0.493	0.481	0.470	0.455	0.487	0.480	0.491*	0.488*
			(0.007)	(0.008)			(0.005)	(0.006)			(0.011)	(0.006)
A(0.5)	0.222	0.211	0.196	0.200*	0.202	0.190	0.179	0.166	0.197	0.188	0.195*	0.193*
			(0.006)	(0.007)			(0.004)	(0.005)			(0.009)	(0.005)
A(1.0)	0.348	0.364	0.350*	0.357*	0.341	0.329	0.318*	0.300	0.340	0.340	0.350*	0.348*
			(0.008)	(0.009)			(0.006)	(0.007)			(0.014)	(0.007)
A(2.0)	0.568	0.582	0.566*	0.574*	0.537	0.523	0.513*	0.495	0.646	0.650	0.568	0.570
			(0.008)	(0.010)			(0.007)	(0.008)			(0.017)	(0.008)
						Other Urban Areas						
Gini	n.a.	n.a.	n.a.	0.547	n.a.	n.a.	n.a.	0.537	0.457	0.455	0.482*	0.500
				(0.015)				(0.012)			(0.020)	(0.010)
A(0.5)	n.a.	n.a.	n.a.	0.244	n.a.	n.a.	n.a.	0.236	0.176	0.171	0.189*	0.204
				(0.014)				(0.012)			(0.017)	(0.009)
A(1.0)	n.a.	n.a.	n.a.	0.428	n.a.	n.a.	n.a.	0.419	0.312	0.323	0.345*	0.371
				(0.018)				(0.014)			(0.024)	(0.011)
A(2.0)	n.a.	n.a.	n.a.	0.667	n.a.	n.a.	n.a.	0.668	0.615	0.626	0.580*	0.615*
				(0.017)				(0.013)			(0.029)	(0.012)
						Rural Areas						
Gini	n.a.	n.a.	n.a.	0.475	n.a.	n.a.	n.a.	0.497	0.436	0.423	0.444*	0.443*
				(0.010)				(0.006)			(0.012)	(0.006)
A(0.5)	n.a.	n.a.	n.a.	0.184	n.a.	n.a.	n.a.	0.199	0.155	0.145	0.159*	0.158
				(0.009)				(0.006)			(0.009)	(0.005)
A(1.0)	n.a.	n.a.	n.a.	0.321	n.a.	n.a.	n.a.	0.349	0.281	0.267	0.283*	0.284
				(0.011)				(0.007)			(0.013)	(0.006)
A(2.0)	n.a.	n.a.	n.a.	0.510	n.a.	n.a.	n.a.	0.545	0.471	0.458	0.459*	0.465*
				(0.012)				(0.008)			(0.016)	(0.007)
						Total Bolivia						
Gini	n.a.	n.a.	n.a.	0.555	n.a.	n.a.	n.a.	0.550	0.530	0.525	0.538*	0.531*
				(0.006)				(0.004)			(0.008)	(0.005)
A(0.5)	n.a.	n.a.	n.a.	0.250	n.a.	n.a.	n.a.	0.248	0.232	0.225	0.234*	0.229*
				(0.006)				(0.004)			(0.008)	(0.004)
A(1.0)	n.a.	n.a.	n.a.	0.433	n.a.	n.a.	n.a.	0.443	0.400	0.399	0.410*	0.404*
				(0.007)				(0.005)			(0.010)	(0.005)
A(2.0)	n.a.	n.a.	n.a.	0.657	n.a.	n.a.	n.a.	0.689	0.658	0.661	0.632	0.629
				(0.006)				(0.004)			(0.011)	(0.005)

Notes: Inequality indices are calculated using income data for departmental capitals and other urban areas, expenditure data for rural areas, and mixed income-expenditure data for total Bolivia. Standard errors of the inequality indices in brackets (only applicable to those based on predicted and simulated incomes). For comparison, the observed Gini coefficients (in the sense of the "Sample" column) for 2002 are 0.540 in capital cities, 0.452 in other urban areas, 0.421 in rural areas, and 0.551 in total Bolivia. – [a] The covariates for the simulation exercise are taken from the third Bolivian DHS round, which was conducted in 1998. – * denotes that the 95-percent confidence interval includes the corresponding index value in the "Sample" column.

Source: Own calculations.

Using a normally distributed error term (rather than drawing observed residuals) to create 200 samples of predicted incomes in the LSMS, only slightly understates the poverty headcount, renders a very close fit for the poverty gap, and only slightly overstates the squared poverty gap.[10] It also only slightly understates income inequality as evidenced by lower values of the Gini coefficient and the Atkinson indices. The transition from LSMS data to DHS data does, if at all, only slightly reduce the poverty and inequality measures.

10 This is because the distributions of the error terms is slightly skewed to the right. The kernel density graphs of the errors terms are not reported here, but available upon request.

For 1999, the situation is somewhat less favorable. Only the inequality measures continue to be unbiased by sample selection, while the poverty measures seem to be upward biased. Our specification of the error term seriously underestimates the Atkinson index with $\varepsilon = 2$ in departmental capitals. Most striking, however, are the large differences between predicted and simulated poverty indices, particularly so in rural areas. The underlying reason is most probably the lack of consistency with respect to the collection period of the two underlying household surveys. The DHS 1998 data, the covariates of which were used to create the simulated incomes, were collected during an economic boom. By contrast the observed incomes of the LSMS 1999 were collected after a sharp economic downturn when Bolivia experienced strongly negative growth in GDP per capita.

These inconsistencies notwithstanding, we are confident that the conditions for applying our dynamic cross-survey microsimulation methodology are fulfilled for the case of Bolivia. First, the simulations can accurately reproduce the observed poverty trends in departmental capitals, where we have observed incomes for comparison. The differences between observed and simulated poverty measures are small compared to their changes over time. Second, the DHS 1998 data, which are least consistent to those of the corresponding LSMS, are not used in the subsequent analysis. Only the poverty profiles and growth incidence curves for 1989 and 1994 draw on simulated incomes of the DHS. Those for 1999 and 2002 are based on observed incomes of the LSMS.

In Section 2, we assumed that the absolute difference in the regression coefficients between departmental capitals on the one hand, and other urban areas and rural areas on the other hand, remained constant between 1989 and 1999. If this assumption does not hold, i.e., if the coefficients in rural areas deteriorated relative to those in urban areas, the decline in poverty in rural areas shown in the subsequent analysis would be overstated. We address this potential bias in Section 4.1. Another factor that may contribute to overstating the decline in poverty – albeit in this case not limited to rural areas – is that the degree of underreporting, which is common to all income and expenditure surveys, may have fallen over time due to improvements in the questionnaire design. Taken together, we, thus, caution to treat the reduction in poverty as an upper bound, and particularly so in rural areas.

3.2 Poverty Profiles

After having completed this consistency check, we can proceed to construct inter-temporally comparable poverty profiles of national coverage for Bolivia to get an understanding of where and who the poor are. Where possible – in departmental capitals throughout the entire observation period and in the rest of the country for 1999 and 2002 – we use poverty measures estimated from observed incomes of the LSMS. The remaining gaps are filled with the mean point estimates and the standard deviations of poverty measures from 200 samples of simulated incomes in the DHS. In what follows, we focus on delineating major poverty trends of Bolivia from the late 1980s onward. The discussion of their underlying causes is deferred to Section 5.

We start our empirical analysis with a disaggregation of the poverty headcount by place of residence in Table 4.[11] Between 1989 and 2002, total Bolivia experienced a significant reduction in the incidence of poverty. Moderate poverty decreased from three-quarters to two-thirds of the population. The reduction in extreme poverty was even more spectacular; it decreased by 17 percentage points. Yet, the picture is not all favorable. In the late 1990s, the poverty trend reversed and the incidence of moderate and extreme poverty in total Bolivia started to increase again.

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[11] The corresponding tables for the poverty gap and the squared poverty gap are not shown here, but available upon request.

As expected, rural households were more likely to be poor than those in departmental capitals and other urban areas even after controlling for local cost-of-living differences. What is more of concern here is that rural households did not fully participate in the reduction of moderate poverty between 1989 and 1999. Departmental capitals and other urban areas could reduce the incidence of moderate poverty by 16 and 12 percentage points, respectively. In rural areas, this reduction was only 6 percentage points – despite starting from a higher level of poverty.[12] By contrast, households in departmental capitals were most affected by the economic downturn in the late 1990s, accounting for almost the entire increase in the incidence of moderate and extreme poverty in total Bolivia between 1999 and 2002. Taken together, the poverty trends suggest that rural areas were quite detached from improvements and deteriorations in the overall economic environment.

Table 4 — Spatial Disaggregation of the Poverty Headcount in Bolivia, 1989 to 2002

	Moderate Poverty Line				Extreme Poverty Line			
	1989	1994	1999	2002	1989	1994	1999	2002
Total	76.88	72.37	65.21	67.22	56.24	50.43	38.35	39.24
	(0.50)	(0.45)			(0.61)	(0.45)		
By Region								
Departmental Capitals	67.21	59.49	51.05	55.13	39.38	28.78	24.22	27.03
Other Urban Areas	81.05	75.13	69.09	67.70	62.84	53.31	34.31	36.65
	(1.32)	(1.16)			(1.44)	(1.22)		
Rural Areas	89.66	89.55	83.37	83.83	74.59	76.05	59.98	57.24
	(0.59)	(0.47)			(0.92)	(0.62)		
By Department								
Chuquisaca	88.09	86.02	84.15	79.66	73.14	73.18	64.34	64.28
	(0.97)	(1.06)			(1.39)	(1.12)		
La Paz	78.48	69.52	68.55	69.05	57.12	45.82	46.33	42.53
	(0.99)	(0.87)			(1.28)	(0.89)		
Cochabamba	74.04	74.27	64.69	70.66	51.82	49.34	31.70	42.58
	(1.21)	(1.32)			(1.29)	(1.36)		
Oruro	82.01	80.96	68.64	71.61	63.07	64.22	47.63	43.64
	(1.16)	(1.00)			(1.39)	(1.25)		
Potosí	91.85	88.18	84.66	82.68	83.27	79.39	63.01	59.55
	(0.83)	(0.91)			(1.19)	(1.01)		
Tarija	81.44	81.67	61.68	65.36	60.49	58.75	26.39	30.52
	(1.06)	(1.22)			(1.25)	(1.32)		
Santa Cruz	61.62	58.11	50.59	56.26	35.64	31.14	21.66	25.55
	(1.33)	(1.14)			(1.31)	(1.00)		
Beni & Pando	80.22	80.35	53.00	63.87	56.38	59.56	14.73	27.29
	(1.28)	(1.22)			(1.46)	(1.43)		

Notes: Poverty indices are calculated using income data for departmental capitals and other urban areas, expenditure data for rural areas, and mixed income-expenditure data for total Bolivia. Standard errors of the poverty indices in brackets (only applicable to those based on simulated data).

Source: Own calculations.

There are also substantial differences in the incidence of poverty across the nine departments of Bolivia. The moderate poverty headcount in 1989 ranged from 62 percent in Santa Cruz to 92 percent in Potosí. The corresponding figures for the extreme poverty headcount were 36 percent and 83 percent, respectively. The departmental distribution of the poverty headcount index was also very stable in Bolivia. While Santa Cruz, which is a major host of commercial agriculture and food-processing industry, had the lowest incidence of poverty throughout the entire observation

12 That is, in relative terms, the performance of rural areas was even worse. As concerns extreme poverty, rural areas also experienced the lowest absolute (!) reduction the poverty headcount index between 1989 and 1999.

period, it was highest in Potosí, followed by Chuquisaca, which are particularly dependent on subsistence agriculture.

To gain insights into other dimensions of poverty, we proceed with a disaggregation of the poverty headcount index by household characteristics for Bolivia in Table 5.[13] By far the most important determinant of poverty and its change over time is education. Households where the average education of adult members was primary schooling or less (i.e., 5 years or below) rarely escaped poverty, even in departmental capitals. Secondary schooling (i.e., 6 to 12 years) and tertiary schooling (i.e., 13 years and above) substantially reduced the likelihood of poverty. Over time, the distribution of the poverty headcount indices across schooling groups changed significantly. While the incidence of poverty fell in all three schooling groups, the returns to secondary schooling declined somewhat while the returns to tertiary schooling increased substantially.

We find that a large number of children is also an important factor in shaping the distribution of poverty, namely in two respects. First, large households were on average poorer than small households and the relationship between poverty and household size strengthened over time, above all in rural areas where large households did not participate at all in the overall reduction of poverty. Second, households where the share of members in working age was below 50 percent were more likely to be poor than other households. When disaggregating by region (not shown here) we find that the relationship between the age composition of households and poverty is strongest in the departmental cities and weakest in rural areas, but its strength increased over time in all three regions.

To analyze the impact of employment on poverty, we first look at the profession of the principal wage earner.[14] Given the large differences between the sectoral employment shares and the sectoral GDP shares (not shown here), it is not surprising to find a steep gradient in the poverty incidence across professions. White-collar workers were by far least likely to be poor in 1989, followed by workers in sales & services.[15] At the other end of the spectrum were agricultural and blue-collar workers. Like above, we find that the differences in the poverty incidence across professions increased over time. The absolute (!) poverty headcount index of the relatively rich white-collar workers and workers in sales & services fell more than twice as much as the poverty headcount index of the relatively poor agricultural and blue-collar workers.

Second, we turn to female labor market participation. Households where no adult woman had gainful employment were more likely to be poor than other households in departmental capitals and other urban areas, but less likely to be poor than other households in rural areas (except in 1989). Female labor market participation, thus, seemed to be a successful strategy to lift households out of poverty in the former two regions. By contrast, in rural areas, poverty seemed to have forced women to work.

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13 The corresponding tables for the poverty gap and the squared poverty gap are not reported here but available upon request.

14 Unfortunately, data constraints prevent us from further disaggregating the professional categories. Our disaggregation is most problematic in the case of “sales & services” where we have to lump together bankers with street vendors. For the exact definition of the term “principal wage earner” see the notes of Table 5.

15 It could be argued that the poverty headcount index in the latter category is downward biased since the incomes of self-employed, who are over-represented in sales & services, may not always be measured net of costs. However, we find the same ranking in rural areas, where we use consumption expenditures rather than incomes.

Table 5 — Disaggregation of the Poverty Headcount in Bolivia by Household Characteristics, 1989 to 2002

	Moderate Poverty Line				Extreme Poverty Line			
	1989	1994	1999	2002	1989	1994	1999	2002
Total	76.88	72.37	65.21	67.22	56.24	50.43	38.35	39.24
	(0.50)	(0.45)			(0.61)	(0.45)		
By Hh Size								
<=3	71.41	61.72	47.35	43.30	47.91	37.16	22.02	17.91
	(1.25)	(1.14)			(1.45)	(1.00)		
4-6	74.47	71.56	61.01	63.87	53.03	49.16	34.28	35.25
	(0.67)	(0.59)			(0.79)	(0.56)		
>=7	85.08	83.83	80.35	80.84	67.84	65.29	52.61	52.93
	(0.80)	(0.75)			(1.12)	(0.87)		
By % of Hh Members between 15 and 65 years								
<= 50	83.41	81.71	74.93	78.70	64.85	60.94	48.79	50.69
	(0.59)							
> 50	67.94	60.50	53.64	53.64	44.46	37.07	25.91	25.69
	(0.82)	(0.74)			(0.89)	(0.71)		
By Age of Hh Head								
<=34	79.12	74.00	67.29	69.44	58.06	50.05	39.02	39.95
	(0.91)	(0.73)			(1.00)	(0.78)		
35-49	76.99	72.98	66.97	69.39	56.92	51.90	40.43	42.67
	(0.77)	(0.69)			(0.90)	(0.66)		
50-65	74.54	67.96	57.86	58.72	53.17	47.04	31.56	31.28
	(1.16)	(1.10)			(1.34)	(1.03)		
>=66	70.80	70.43	63.66	68.30	50.96	53.27	39.13	33.41
	(2.45)	(1.90)			(2.30)	(1.62)		
By Language of Hh Head								
Spanish	70.69	63.72	51.27	54.20	47.07	38.00	22.27	23.98
	(0.62)	(0.60)			(0.69)	(0.59)		
Indigenous	94.59	92.57	79.75	79.31	82.51	79.48	55.11	53.42
	(0.66)	(0.54)			(1.14)	(0.75)		
By Gender of Hh Head								
Male	77.50	73.15	65.64	68.66	57.27	51.59	38.82	40.31
	(0.54)	(0.48)			(0.68)	(0.51)		
Female	73.69	68.57	62.82	58.38	50.98	44.82	35.73	32.69
	(1.26)	(1.17)			(1.38)	(1.12)		
By Average Years of Schooling of Adults[a]								
<=5	90.76	89.61	86.04	85.61	74.54	74.37	61.53	60.68
	(0.55)	(0.50)			(0.83)	(0.67)		
6-12	68.89	67.15	63.14	63.60	42.61	38.71	32.01	31.02
	(0.94)	(0.82)			(1.04)	(0.79)		
>=13	34.50	28.69	20.11	24.61	13.91	9.68	4.65	5.57
	(2.17)	(1.44)			(1.51)	(0.97)		
By Profession of Principal Wage Earner[b]								
White-Collar Worker	49.67	37.11	33.84	28.96	26.81	15.88	14.82	9.68
	(1.31)	(1.42)			(1.07)	(0.92)		
Blue-Collar Worker	78.39	73.86	69.23	70.42	53.99	45.55	30.80	37.81
	(1.08)	(0.93)			(1.28)	(1.10)		
Agriculture	95.22	94.80	88.11	87.15	83.51	84.40	65.56	61.91
	(0.54)	(0.42)			(1.03)	(0.65)		
Sales & Services	68.87	63.49	53.30	45.69	42.87	34.01	29.74	19.81
	(1.48)	(1.30)			(1.53)	(1.20)		
Not Employed	80.14	71.16	53.82	62.95	58.06	44.73	32.02	31.45
	(1.30)	(1.55)			(1.63)	(1.53)		
By % of Adult Women[c] in Employment								
> 0	59.57	69.72	63.95	65.55	35.46	49.02	37.27	38.47
	(1.14)	(0.55)			(1.02)	(0.51)		
= 0	84.30	77.94	67.95	70.77	65.15	53.39	40.69	40.89
	(0.53)	(0.82)			(0.75)	(0.92)		

Notes: Poverty indices are calculated using mixed income-expenditure data. Standard errors of the poverty indices in brackets (only applicable to those based on simulated data). – [a] Women aged between 15 and 49 and their husbands and partners. – [b] In the case of DHS: Husband or partner of the oldest woman aged between 15 and 49. If she is single, this woman herself. In the case of LSMS: Household head. – [c] Women aged between 15 and 49.

Source: Own calculations.

The role of the age of the household head in shaping the distribution of poverty is small and not straightforward. Between 1989 and 2002, households with heads aged between 50 and 65 outperformed the other age groups. As expected, the incidence of poverty was smaller among households with Spanish-speaking heads. Additionally, their welfare seemed to be more volatile.

They benefited more from the economic boom between 1989 and 1999, but also suffered more from the subsequent economic downturn. The explanatory power of the gender of the household head is negligible. If at all, households headed by women were slightly better off, a finding common to many Latin American countries (Marcoux 1998). But we caution that female-headed households represent a very heterogeneous group (e.g., single female elderly, single female professionals, divorced women, and women of migrant workers) so that it may well be that sub-groups of female-headed households are particularly vulnerable to poverty.

3.3 Growth Inequality Decomposition and Growth Incidence Curves

Poverty profiles are suitable means to track the evolution of the incidence, intensity, and severity of poverty for different subgroups of the population over time. However, they can only poorly disentangle to what extent the observed poverty trends are due (a) to changes in mean income or (b) to changes in the relative income distribution. Two ways to provide further insights about the links between poverty, inequality, and growth trends: the first is to do a growth inequality decomposition of the observed poverty reduction (Datt and Ravallion 1992) and the second is to estimate the rates of pro-poor growth and the growth incidence curves (Ravallion and Chen 2003).

The decomposition of the observed poverty reduction into a growth and an inequality contribution (and an interaction term which cancels if one calculates the average of a 'forward' and 'backward' decomposition) is using the methods proposed by Datt and Ravallion (1992). As discussed in detail in Grimm and Günther (2004), the distribution component in this decomposition also implicitly includes the impact of changes in the real value of the poverty line (i.e., how prices paid by the poor have moved relative to the overall price level). As shown in Table 1, the prices paid by the poor (in particular food prices) have risen somewhat less than the overall price level (particularly in recent years) so that the purchasing power of the poor has increased by more than suggested by the change in their real incomes.[16] This is implicitly captured in the decomposition as a distributional shift favoring the poor.

The result of the decomposition analysis (Table 6) for the entire period show that about two-thirds of the 10 percentage points decline in moderate poverty for total Bolivia is attributable to growth, and about one-third to a distributional shift favoring the poor. As the income distribution hardly shifted between the two periods (Table 3), most of this distributional shift is actually due to the poverty line effect which increased the real purchasing power of the poor.[17] Considering sub-periods and different parts of the country shows a more differentiated picture. In the period 1989-1999 both the growth and redistribution (and/or poverty line) effect served to reduce poverty in all parts of the country. In the latter three years, the picture has changed drastically. Now poverty has increased nationally, and particularly in departmental capitals where 60 percent is due to falling incomes and 40 percent due to adverse distributional shifts.

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16 This means that the column for the poverty lines of 2002 has lower values than the column labeled 2002cpi which is the poverty line of 1989 inflated with the overall CPI in Table 1.

17 When we additionally split out the poverty line effect (results are not shown here, but available upon request), we find for the period 1989 to 1999 the "pure" redistribution to contribute to poverty reduction in departmental capitals and other urban areas and zero for rural areas in the case of the moderate poverty line. For the extreme poverty line, the "pure" redistribution also becomes positive in rural areas. From 1999 to 2002, the "pure" redistribution effect leads to a poverty increase in all regions for both poverty lines. For the whole period from 1989 to 2002, the "pure" redistribution was poverty increasing in nearly all regions, except using the extreme poverty line for other urban areas and rural areas. The "poverty line shift" redistribution is poverty decreasing in all areas for all periods and both poverty lines. As explained above, this is due to the slower increase of food prices compared to overall prices.

Table 6 — Growth Inequality Decomposition of Poverty Changes

	Moderate Poverty			Extreme Poverty		
	1989–1999	1999–2002	1989–2002	1989–1999	1999–2002	1989–2002
			Total Bolivia			
Change in poverty	-0.118	0.020	-0.099	-0.181	0.008	-0.173
Growth component	-0.080	0.018	-0.064	-0.090	0.019	-0.075
Redistribution component	-0.038	0.002	-0.035	-0.091	-0.011	-0.098
			Departmental Capitals			
Change in poverty	-0.163	0.040	-0.123	-0.157	0.027	-0.130
Growth component	-0.105	0.025	-0.080	-0.077	0.015	-0.073
Redistribution component	-0.057	0.015	-0.043	-0.079	0.012	-0.056
			Other Urban Areas			
Change in poverty	-0.117	-0.015	-0.132	-0.270	0.021	-0.250
Growth component	-0.067	0.017	-0.074	-0.136	0.038	-0.080
Redistribution component	-0.050	-0.032	-0.058	-0.135	-0.017	-0.170
			Rural Areas			
Change in poverty	-0.068	0.005	-0.064	-0.157	-0.027	-0.184
Growth component	-0.041	-0.005	-0.039	-0.056	-0.008	-0.071
Redistribution component	-0.028	0.010	-0.025	-0.100	-0.020	-0.113

Notes: Calculated using the Datt-Ravaillion (1992) method of growth inequality decomposition.

Source: Own calculations.

For the extreme poverty line, the growth component seems to be less important in poverty reduction, but the redistribution component becomes more important. In the period 1989-2002, of the 17 percentage points poverty reduction, more than one-half is due to redistribution (and/or the poverty line effect which is even larger here) and less than one-half is due to growth.

To evaluate whether the simulated income changes over time were "pro-poor" in the sense that the poor benefited more from economic growth than the rich, we apply the methodology of growth incidence curves (GIC) developed by Ravallion and Chen (2003). Comparing two periods, t–1 and t, the growth incidence curve plots the cumulative share of the population (depicted on the x-axis) against the income growth rate of the ξ-th quantile (depicted on the y-axis) when the analysis units are ranked in ascending order of their income. It is given by

$$g_t(\xi) := \frac{y_t(\xi)}{y_{t-1}(\xi)} - 1 = \frac{\bar{y}_t}{\bar{y}_{t-1}} \cdot \frac{L_t'(\xi)}{L_{t-1}'(\xi)} - 1, \tag{6}$$

where $L'(\xi)$ is the slope of the Lorenz curve at the ξ-th quantile, and $\bar{y}$ is the mean income. It can be shown that the area under the GIC up to the poverty headcount index P^0 gives (minus one times) the rate of change of the Watts index over time

$$-\frac{dW_t}{dt} = \int_0^{P_t^0} \frac{d \log y_t(\xi)}{dt} \cdot d\xi = \int_0^{P_t^0} g_t(\xi) \cdot d\xi \,. \tag{7}$$

The desirable axiomatic properties of the Watts index motivate evaluating the "pro-poorness" of economic growth by comparing the growth rate of mean income with the mean of the income growth rates of the poor in period t–1

$$PPG_t := \frac{1}{P_{t-1}^0} \cdot \int_0^{P_{t-1}^0} g_t(\xi) \cdot d\xi \tag{8}$$

which Ravallion and Chen (2003) coined the "rate of pro-poor growth".[18]

Table 7 — Annual Average Income Growth per Capita, 1989 to 2002

	1989–1999	1999–2002	1989–2002
		Total Bolivia	
Growth Rate of Mean Income	2.23	-1.29	1.41
Mean of Income Growth Rates of			
Extremely Poor	3.39	-0.88	2.16
Moderately Poor	3.21	-2.22	1.85
All	2.98	-2.56	1.67
		Departmental Capitals	
Growth Rate of Mean Income	2.01	-1.51	1.19
Mean of Income Growth Rates of			
Extremely Poor	2.56	-6.30	0.44
Moderately Poor	2.58	-6.44	0.48
All	2.50	-5.01	0.69
		Other Urban Areas	
Growth Rate of Mean Income	2.89	-1.90	1.76
Mean of Income Growth Rates of			
Extremely Poor	6.23	0.48	4.70
Moderately Poor	5.80	-0.22	4.22
All	5.25	-1.03	3.75
		Rural Areas	
Growth Rate of Mean Income	0.94	0.59	0.87
Mean of Income Growth Rates of			
Extremely Poor	2.31	1.86	2.07
Moderately Poor	2.18	0.99	1.86
All	1.99	0.86	1.73

Notes: Annual average income growth rates are calculated using income data for departmental capitals and other urban areas, expenditure data for rural areas, and mixed income-expenditure data for total Bolivia.

Source: Own calculations.

The comparison of the growth rates[19] is shown in Table 7.[20] Between 1989 and 1999, economic growth in Bolivia can be classified as pro-poor. For both poverty lines and for all three regions, the rates of pro-poor growth exceeded the growth rate of mean income suggesting that economic growth was accompanied by falling inequality.[21] For departmental capitals, the income distribution of 1999 even first-order dominates the income distribution of 1989 as evidenced by that the GIC lies above 0 for all ξ (Figure A2 in the Appendix). For other urban areas and rural areas, this condition is met at least for all poor (Figures A3 and A4). That is, abstracting from individual

18 Alternative approaches of measuring pro-poor growth can be found in Klasen (2004) and Son (2003).

19 For the corresponding growth incidence curves see Figures A1 to A12 in the Appendix.

20 In the sensitivity analysis shown in Table 9, we apply the assumptions described in Chapter 4.1. With these assumptions, we find that growth and pro-poor growth are somewhat smaller in total Bolivia and more significantly so in rural areas which hardly experienced any growth mean income growth between 1989 and 2002; but the rates of pro-poor growth remain between 1.2 percent and 1.4 percent suggesting that the poor were able to make some gains over the period.

21 The particularly high growth rate of mean income for total Bolivia (2.23 percent) is due to a shift in the composition of the population from poorer rural areas to richer urban areas.

income mobility across quantiles, the welfare of all citizens in departmental capitals, and of all poor citizens in the rest of the country, improved during the 1990s.

Between 1999 and 2002, the economic growth performance differed substantially between the three regions. The departmental capitals experienced a strongly anti-poor contraction (Figure A6), which wiped out a substantial part of the gains the poor had made in the previous ten years. In other urban areas, this contraction was pro-poor (Figure A7) so that, despite negative growth rates in mean income, the poor could more or less keep their living standard. In rural areas, consumption even continued to rise (albeit very slowly), and consumption growth continued to be somewhat higher for the poor than for the non-poor. Given that (a) most income is generated in urban areas, but (b) most poor live in rural areas, economic growth in total Bolivia was negative between 1999 and 2002, but only slightly anti-poor or even pro-poor depending on the choice of the poverty line.

With the exception of the strongly anti-poor contraction in departmental capitals in recent years, economic growth in Bolivia has been pro-poor since 1989, and particularly so in rural areas. This result seems to be at odds with Table 4 which shows only slowly falling poverty rates in rural areas since 1989. However, this puzzle resolves when taking into account that the depth of poverty in rural areas is so large that even substantial pro-poor growth did not lift the poor above the poverty line.[22] Hence, the prime concern is not that economic growth in the 1990s was anti-poor, but that it was so low and that the initial income inequality was so high that the poor remained poor despite some welfare improvements. It would take another decade of such economic growth to make serious inroads into poverty. Unfortunately, the future prospects are even bleaker. If the meager growth performance of the Bolivian economy since 1999 continues, rural poverty will decline even less and urban poverty will rise sharply.

4 Sensitivity Analyses

Before drawing conclusions, we perform two sensitivity analyses. First, we check the robustness of our results to alternative assumptions on the dynamics of the cross-survey microsimulation methodology. Second, we contrast our results with those derived from the asset-index (or wealth-index) approach developed by Filmer and Pritchett (2001) and Sahn and Stifel (2000, 2003).

4.1 Accounting for Growth Differentials in GDP per Capita between Urban and Rural Areas

One of the basic assumptions of our dynamic cross-survey microsimulation methodology is that the absolute difference in the regression coefficients between departmental capitals on the one hand, and other urban areas and rural areas on the other hand, remained constant between 1989 and 1999. The widening of the urban-rural divide during that time is, thus, entirely attributed (a) to changes in the endowment of covariates in favor of urban areas, and (b) to nationwide changes in the return to covariates in favor of those covariates which are relatively abundant in urban areas. If this assumption does not hold, i.e., if additionally (c) the returns to covariates in rural areas deteriorated relative to those in urban areas, the widening of the urban-rural divide would be understated. To get an idea of the possible size of this bias we have to simulate the opposite scenario where we assume that the widening of the urban-rural divide between 1989 and 1999 is entirely due to a deterioration of the returns to covariates in rural areas relative to those in urban areas. Since it is a priori not clear which covariates are affected and to what extent, we take a rather simple approach and attribute the regional growth differentials in GDP per capita to growth differentials in the regression coefficients of the regional dummies.

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22 But it did reduce the poverty gap in rural areas.

This sensitivity analysis proceeds in three steps. First, we impute the 1989-to-1994 and the 1994-to-1999 cumulative growth differentials in GDP per capita between departmental capitals on the one hand, and other urban areas and rural areas on the other hand.[23] We find that the economic growth performance was nearly identical across the three regions in the first half of observation period, but it differed substantially thereafter. Between 1989 and 1994, departmental capitals (cumulatively) grew by only 0.3 percent faster than other urban areas and also by only 0.3 percent faster than rural areas. The corresponding figures for the period from 1994 to 1999 are 2.13 percent and 9.19 percent, respectively. Second, we sterilize the growth differentials in GDP per capita by adding (a) for other urban areas and (b) for rural areas, the 1994-to-1999 growth differential in GDP per capita (relative to departmental capitals) to the 1994 regression coefficient of the corresponding regional dummy, and sum of the 1989-to-1994 and the 1994-to-1999 growth differential in GDP per capita (relative to departmental capitals) to the 1989 regression coefficient of the corresponding regional dummy. Third, we partially re-run our simulation with the adjusted coefficients to generate an adjusted spatial disaggregation of the poverty headcount in Bolivia in Table 8.

Comparing the results with the corresponding entries in Table 4 reveals that the bias of neglecting a possible deterioration of the returns to covariates in rural areas relative to those in urban areas is small. Sterilizing the regional growth differentials in GDP per capita reduces the incidence of moderate poverty in rural areas in 1989 by less than 2 percentage points and the incidence of extreme poverty by less than 4 percentage points. This implies that the inferior performance of rural areas in reducing the poverty headcount index is not primarily due to urban-rural growth differentials in GDP per capita. Instead, due to high initial inequality, only relatively few rural households were initially just below the poverty lines so that a given growth of GDP per capita between 1989 and 2002 lifted only relatively few rural households over the poverty lines.

Table 8 — Adjusted Spatial Disaggregation of the Poverty Headcount in Bolivia, 1989 to 2002

	Moderate Poverty Line				Extreme Poverty Line			
	1989	1994	1999	2002	1989	1994	1999	2002
Total	75.96	71.60	65.21	67.22	54.62	49.21	38.35	39.24
	(0.48)	(0.46)			(0.58)	(0.45)		
By Region								
Departmental Capitals	67.21	59.49	51.05	55.13	39.38	28.78	24.22	27.03
Other Urban Areas	80.69	74.34	69.09	67.70	62.10	52.56	34.31	36.65
	(1.26)	(1.15)			(1.61)	(1.21)		
Rural Areas	87.76	87.81	83.37	83.83	70.88	73.18	59.98	57.24
	(0.60)	(0.49)			(0.90)	(0.65)		

Notes: Only poverty indices based on simulated data changed relative to Table 4. Poverty indices are calculated using income data for departmental capitals and other urban areas, expenditure data for rural areas, and mixed income-expenditure data for total Bolivia. Standard errors of the poverty indices in brackets (only applicable to those based on simulated data).

Source: Own calculations.

Table 9 calculates the corresponding rates of pro-poor growth for the various regions. Due to lower growth in rural areas and other urban areas, overall (mean) growth in Bolivia is now smaller between 1989 and 1999, and the growth is also less pro-poor as the rate of growth in rural areas, whose population predominates among the poor, is now estimated to have been lower. But the qualitative results from above do not change.

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23 We impute the separate growth rates of GDP per capita for departmental capitals, other urban areas, and rural areas by multiplying for each economic sector the average annual growth rate of value added per capita over the respective period (taken from the national accounts) by the employment shares of those sectors in departmental capitals, other urban areas, and rural areas, respectively (estimated from the LSMS 1999).

Table 9 — Adjusted Annual Average Income Growth per Capita, 1989 to 2002

	1989–1999	1999–2002	1989–2002
		Total Bolivia	
Growth Rate of Mean Income	2.02	-1.29	1.25
Mean of Income Growth Rates of			
Extremely Poor	2.81	-0.88	1.74
Moderately Poor	2.74	-2.22	1.49
All	2.56	-2.56	1.34
		Departmental Capitals	
Growth Rate of Mean Income	2.01	-1.51	1.19
Mean of Income Growth Rates of			
Extremely Poor	2.56	-6.30	0.44
Moderately Poor	2.58	-6.44	0.48
All	2.50	-5.01	0.69
		Other Urban Areas	
Growth Rate of Mean Income	2.64	-1.90	1.58
Mean of Income Growth Rates of			
Extremely Poor	6.01	0.48	4.53
Moderately Poor	5.55	-0.22	4.03
All	5.00	-1.03	3.56
		Rural Areas	
Growth Rate of Mean Income	0.02	0.59	0.17
Mean of Income Growth Rates of			
Extremely Poor	1.39	1.86	1.40
Moderately Poor	1.28	0.99	1.18
All	1.06	0.86	1.02

Notes: Annual average income growth rates are calculated using income data for departmental capitals and other urban areas, expenditure data for rural areas, and mixed income-expenditure data for total Bolivia.

Source: Own calculations.

4.2 The Asset Index Approach

The asset-index approach to construct national time series of basic poverty measures goes back to Filmer and Pritchett (2001) and Sahn and Stifel (2000, 2003). To proxy welfare in the absence of income or expenditure data, they assume that the asset ownership of households closely reflects their living standard. Using DHS data, they define a set of assets[24] and construct a metric asset index

$$AI_j = \frac{s_1\left(a_{j1} - \bar{a}_1\right)}{\sigma_1} + \ldots + \frac{s_k\left(a_{jk} - \bar{a}_k\right)}{\sigma_k} + \ldots + \frac{s_n\left(a_{jK} - \bar{a}_K\right)}{\sigma_K}, \qquad (10)$$

where s_k is the "scoring factor" or the weight of the asset k, a_{jk} takes the value of 1 if household j owns asset k and 0 otherwise, $\bar{a}_k$ is the mean value of a_{jk} over all households, and σ_k is its standard deviation.

24 The asset definition is rather broad and includes not only real estate and financial assets, but also consumer durables and the household's endowment with human capital.

Following Filmer and Pritchett (2001), we use the principal component analysis (rather than the closely related factor analysis as in Sahn and Stifel (2000, 2003)) to determine the asset weights s_k. The underlying idea is to find a linear combination of the variables – the principal component or the asset index – which contains most of the common information of the variables and is interpreted as a background variable contained in all of them. Hence, the asset-index approach is valid if (and only if) welfare is indeed the main determinant of asset variability among households. We apply the asset-index approach to track the evolution of poverty between period *t*–1 and *t*. Since the mean value of the asset index is zero by construction, we do not estimate equation (10) for each period separately but over a pooled sample of the periods *t*–1 and *t*.

In contrast to our dynamic cross-survey microsimulation methodology, the creation of national poverty profiles on the basis of the asset index requires a common set of assets for all observation years. Unfortunately, there was a change in the DHS questionnaire design: the DHS 1994 and 1998 collected information on more and other assets than the DHS 1989.[25] The set of common assets over all three Bolivian DHS rounds would have been very small so that we decided to restrict our empirical analysis to the years 1994 and 1998. The derivation of the asset index and the summary statistics of the assets included therein are shown in Table 10. We use 25 assets – 17 tangible assets and 8 human capital variables – to capture the welfare of households.[26] The eigenvalues of the principal component analysis suggest that the asset index is indeed an important determinant for the asset distribution among households. The first principal component explains 21.7 percent of total asset variability.

Since all tangible assets are dummy variables, their scoring factors have a simple interpretation. A move from "non-ownership" to "ownership" of the asset changes the asset index by s_k / σ_k. For example, having private telephone connection increases the asset index by 0.83 in 1994 and 0.59 in 1998.[27] In the case of the human capital variables, s_k / σ_k gives the change in the asset index if the average education of adult household members switches from the reference state "less than complete basic schooling or unknown" to the respective schooling category.

As expected, consumer durables, such as telephone, radio, television, and fridge, have high scoring factors suggesting that they are powerful welfare predictors. By contrast, the ownership of a house or of a plot of agricultural land indicates poverty, which can mainly be explained by the widespread subsistence agriculture in rural areas of Bolivia. The quality of the dwelling unit also provides information on the welfare of households. Access to public utilities, high quality cooking materials, high quality toilet facilities, high quality floor materials, and a large number of sleeping rooms all increase the asset index. The scoring factors of the human capital variables are more difficult to reconcile. We find negative returns to schooling up to lower secondary schooling (9 years of schooling), which we attribute to that (a) our reference state includes "unknown" and that (b) the returns to basic and secondary schooling are indeed very small in Bolivia.

The asset-index value of the individual household is obtained by multiplying the deviation of the households asset endowment from the mean asset endowment with the vector of normalized scoring factors according to equation (10). Aggregating the asset-index values over all households, we find an increase in the mean asset index from –0.37 in 1994 to 0.38 in 1998 suggesting a favorable development of the living standard in Bolivia. Based on the estimates of the asset-index

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25 The lack of consistency applies especially to consumer durables (Table A2 in the Appendix).

26 To check the robustness of our empirical results, we also estimated the asset index without human capital variables. The empirical results, which are available upon request, do not change qualitatively.

27 The reduction in the asset weight reflects the fact that private telephone connection has become more affordable and, thus, more widespread in Bolivia (from 11 percent of all households in 1989 to 25 percent in 1998).

values at household level, we can carry out two consistency checks between our dynamic cross-survey microsimulation methodology and the asset-index approach of Filmer and Pritchett (2001) and Sahn and Stifel (2000, 2003). First, we rank the households according to (a) their simulated incomes and (b) their asset-index values, and calculate the Spearman rank correlation coefficient between the two welfare indicators. We find a close relationship between the simulated incomes and the asset-index values. The Spearman rank correlation coefficient is 0.834 in 1994, and 0.792 in 1998.

Table 10 — The Derivation of the Asset Index, 1994 and 1998

	1994				1998			
	$\bar{a}_k$	σ_k	s_k	s_k / σ_k	$\bar{a}_k$	σ_k	s_k	s_k / σ_k
Tangible Assets								
Telephone	0.106	0.308	0.254	0.826	0.250	0.433	0.254	0.587
Radio	0.852	0.355	0.180	0.508	0.881	0.324	0.180	0.557
Television	0.582	0.493	0.351	0.711	0.684	0.465	0.351	0.755
Fridge	0.297	0.457	0.285	0.625	0.377	0.485	0.285	0.589
House	0.671	0.470	-0.109	-0.233	0.650	0.477	-0.109	-0.229
Plot of Agricultural Land	0.285	0.451	-0.299	-0.662	0.213	0.409	-0.299	-0.730
In-house Access to Electricity	0.676	0.468	0.342	0.731	0.757	0.429	0.342	0.798
In-house Access to Public Water	0.561	0.496	0.307	0.618	0.698	0.459	0.307	0.668
Use of Other (Non-open) Water Source	0.143	0.350	-0.084	-0.239	0.109	0.312	-0.084	-0.268
High-quality Cooking Material[a]	0.641	0.480	0.335	0.699	0.718	0.450	0.335	0.745
Shared Toilet	0.358	0.480	-0.002	-0.005	0.194	0.396	-0.002	-0.006
Private Toilet	0.240	0.427	0.243	0.570	0.483	0.500	0.243	0.487
Cement Floor	0.326	0.469	0.098	0.209	0.376	0.484	0.098	0.202
Brick Floor	0.117	0.322	0.055	0.171	0.076	0.265	0.055	0.208
Other (Non-earth) Floor	0.180	0.384	0.197	0.511	0.260	0.439	0.197	0.448
2-3 Sleeping Rooms	0.411	0.492	0.102	0.208	0.346	0.476	0.102	0.215
>= 4 Sleeping Rooms	0.057	0.232	0.113	0.487	0.062	0.240	0.113	0.470
Human Capital								
% of Adult Men[b] with								
Complete Basic Schooling	0.119	0.321	-0.084	-0.261	0.095	0.290	-0.084	-0.289
Lower Secondary Schooling	0.136	0.341	-0.033	-0.098	0.115	0.316	-0.033	-0.106
Higher Secondary Schooling	0.242	0.425	0.092	0.215	0.235	0.420	0.092	0.218
Tertiary Education	0.107	0.307	0.193	0.629	0.156	0.360	0.193	0.536
% of Adult Women[c] with								
Complete Basic Schooling	0.125	0.315	-0.075	-0.238	0.101	0.287	-0.075	-0.261
Lower Secondary Schooling	0.137	0.326	-0.012	-0.036	0.133	0.317	-0.012	-0.037
Higher Secondary Schooling	0.254	0.410	0.198	0.483	0.301	0.427	0.198	0.464
Tertiary Education	0.080	0.255	0.185	0.726	0.139	0.325	0.185	0.570
Asset Index	-0.371	2.281			0.383	2.317		

Notes: [a] Gas, kerosene, and electricity. – [b] Husbands and partners of women aged between 15 and 49. – [c] Women aged between 15 and 49.

Source: Own calculations.

Second, we construct poverty profiles based on asset-index values and compare them to those in Section 3.2. To this end, we again rank the households according to their asset-index values and calibrate the thresholds (i.e., poverty lines) between extremely poor, moderately poor, and non-poor so as to ensure that the incidence of poverty at the aggregated national level (i.e., in the first line of the poverty profile) in 1994 coincides with the one of the dynamic cross-survey

microsimulation methodology, which is shown in Table 4.[28] We keep this threshold level for the asset-index poverty line of 1994 constant and apply it also to the 1998 data. The spatial poverty profile based on asset-index values is shown in Table 11.

Although the direction of change and determinants are qualitative similar to our findings using the microsimulation approach, there are some differences. The most striking difference between the asset index and the microsimulation methodology is that overall poverty reduction from 1994 to 1998 appears much stronger using the asset index. Keeping the threshold of 1994 constant yields a 5.1 percentage points higher poverty reduction using the moderate poverty line and 2.0 percentage points using the extreme poverty line compared to the results shown in Table 4. We suspect that this sharper reduction in poverty using the asset index is due to a combination of changes in preferences favoring some assets (e.g. telephones and televisions), relative price reductions of some assets (e.g. telephones), and public investments in education which have not (yet) translated into income gains. Thus the sharper poverty reduction using the asset index says more about developments in preferences and in non-income dimensions of well-being than being the most reliable proxy for the income dimension.

Table 11 — Spatial Disaggregation of the Poverty Headcount Based on Asset-Index Values in Bolivia, 1994 and 1998

	Moderate Poverty Line		Extreme Poverty Line	
	1994	1998	1994	1998
Total	72.37	60.13	50.44	36.40
By Type of Municipality				
Departmental Capitals	51.20	38.61	19.14	8.91
Other Urban Areas	71.06	57.87	36.21	22.74
Rural Areas	98.17	97.01	92.27	88.37
By Department				
Chuquisaca	78.57	70.48	68.54	57.60
La Paz	69.91	61.15	46.57	33.08
Cochabamba	76.08	56.72	57.65	37.05
Oruro	69.75	58.27	39.92	28.18
Potosí	83.92	76.74	67.85	54.99
Tarija	65.99	55.54	45.61	34.82
Santa Cruz	66.40	51.38	39.11	26.42
Beni & Pando	81.25	66.04	62.69	47.00

Source: Own calculations.

Furthermore, taking the corresponding results of the dynamic cross-survey microsimulation methodology in Table 4 as reference point, we find that the asset-index approach strongly underpredicts poverty in departmental capitals and other urban areas, and strongly overpredicts poverty in rural areas as the asset endowments there are much lower. In doing so, the results of the asset-index approach are closer to those of the unsatisfied-basic-needs approach[29] than those of the dynamic cross-survey microsimulation methodology. Additionally, not only the level but also the

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28 The distribution of the assets among extremely poor, moderately poor and non-poor are given in Table A3 in the Appendix.

29 The unsatisfied-basic-needs approach is very similar to the asset-index approach. It generates a weighted average of welfare indicators (e.g., educational attainment, housing quality, access to public utilities, and access to basic health services, in the case of Bolivia) and classifies households as poor if their weighted average indicator value is below a certain threshold. In contrast to the asset-index approach, the indicator weights are set arbitrarily. For a more detailed description of the unsatisfied-basic-needs approach and its application to Bolivia, see Hernany (1999).

change in the incidence of poverty is more unevenly distributed across the three regions. While, according to the dynamic cross-survey microsimulation methodology rural areas participated – albeit less than proportionately – in the overall poverty reduction, they experienced nearly no progress in reducing poverty according to the asset-index approach. These differences are partly due to that only the dynamic cross-survey microsimulation methodology accounts for differences in the local price levels (Table 1); they also show that progress in improving the asset base in rural areas have been much slower in the 1990s.

By contrast, Table 11 shows less variation in the incidence of poverty across departments. The 1994 moderate poverty headcount index ranged only from 66 percent in Santa Cruz and Tarija to 84 percent in Potosí. For comparison, the corresponding figures of the dynamic cross-survey microsimulation methodology were 58 percent and 88 percent, respectively. As concerns the departmental poverty ranking, we find greater consistency between the two approaches.[30] Santa Cruz is the richest department and Potosí and Chuquisaca are the poorest departments. The notable exception is Oruro, which is relatively poor according to the dynamic cross-survey microsimulation methodology, and relatively rich according to the asset-index approach.

The disaggregation of the poverty headcount index based on asset-index values by household characteristics is shown in Table 12. To facilitate the comparison with the corresponding results of the dynamic cross-survey microsimulation methodology in Table 5, we calibrate the thresholds between extremely poor, moderately poor, and non-poor for each poverty profile anew. The poverty profile for total Bolivia is calibrated to match the poverty headcount index for total Bolivia in 1994 (keeping the threshold constant for 1998), while the poverty profiles for departmental capitals, other urban areas, and rural areas are calibrated to match the poverty headcount indices in the respective region in 1994 (results for departmental capitals, other urban areas, and rural areas not shown here).

Education continues to be the most important determinant of poverty and its changes over time.[31] The distribution of the headcount index across schooling groups is even more polarized according to the asset-index approach. By contrast, we find a strikingly different pattern for the changes in the distribution of the headcount indices across schooling groups between 1994 and 1998. For tertiary schooling, not only did the returns to schooling decrease over time, we also find that the incidence of poverty among household where the average education of adult members was 13 years of schooling or more rose in absolute terms. However, especially concerning tertiary education, the sample size in some cases becomes very small, so one should not interpret the numbers carefully.

The impact of household size on poverty is found to be smaller for asset-index values than for simulated per-capita incomes. The relationship between poverty and household size is U-shaped in departmental capitals and other urban areas. In rural areas, large households continue to be poorer than small households, but the relationship was relatively weak in 1994, and became even weaker (not stronger as in the dynamic cross-survey microsimulation methodology) in 1998. We attribute these inconsistencies, which cannot be reconciled by the use of realistically defined equivalent scales, to that the strong reliance on tangible assets in the asset-index approach may overstate the economies of scale within the household. As concerns the age composition of the household, the asset-index approach corroborates the earlier findings. Households where the share

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30 This result becomes even more obvious when we compare the departmental disaggregation of the poverty headcount by quintiles rather than only at the thresholds between extremely poor, moderately poor, and non-poor (results are not reported here, but are available upon request).

31 This finding continues to hold if we exclude the human capital variables from the estimation of the asset-index values.

of members in working age was below 50 percent were more likely to be poor – particularly so in departmental capitals and less so in rural areas. Additionally, we again find that this relationship strengthened over time.

Table 12 — Disaggregation of the Poverty Headcount Based on Asset-Index Values in Total Bolivia by Household Characteristics, 1994 and 1998

	Moderate Poverty Line		Extreme Poverty Line	
	1994	1998	1994	1998
Total	72.37	60.13	50.44	36.40
By Hh Size				
<=3	71.95	63.03	49.29	35.21
4-6	69.40	56.49	46.57	33.41
>=7	79.40	66.22	60.12	44.88
By % of Hh Members between 15 and 65 Years				
<= 0.5	79.39	71.45	58.06	47.08
> 0.5	63.46	47.72	40.75	24.69
By Age of Hh Head				
<=34	76.42	70.97	51.84	39.53
35-49	72.56	57.58	50.98	35.95
50-65	66.18	49.51	47.37	32.16
>=66	61.63	47.87	46.02	34.30
By Language of Hh Head				
Spanish	61.06	50.06	33.05	22.68
Indigenous	98.82	96.78	91.08	86.37
By Gender of Hh Head				
Male	72.96	61.15	51.48	37.62
Female	69.52	55.32	45.42	30.63
By Average Years of Schooling of Adults[a]				
<=5	97.36	93.43	83.82	72.45
6-12	64.29	51.37	32.08	21.41
>=13	8.77	9.19	1.22	1.93
By Profession of Principal Wage Earner[b]				
White-Collar Worker	28.06	18.38	10.61	6.83
Blue-Collar Worker	79.94	68.08	45.51	27.81
Agriculture	99.00	96.86	95.32	90.93
Sales & Services	64.54	49.38	29.67	15.84
Not Employed	52.39	44.43	26.99	19.55
By % of Adult Women[c] out of Employment				
< 100	72.71	56.34	51.61	33.41
= 100	71.66	66.95	47.97	41.78

Notes: [a] Women aged between 15 and 49 and their husbands and partners. – [b] Husband or partner of the oldest woman aged between 15 and 49. If she is single, this woman herself. – [c] Women aged between 15 and 49.

Source: Own calculations.

With respect to the impact of employment on poverty, there is also much agreement between the dynamic cross-survey microsimulation methodology and the asset-index approach. First, the incidence of poverty and its change over time are more favorable for white-collar workers and workers in sales & services than for agricultural and blue-collar workers. Second, female labor market participation was a successful strategy to lift households out of poverty in departmental capitals and other urban areas, but not in rural areas. However, like in the case of education, we find that the distribution of the poverty headcount index across professions was more accentuated according to the asset-index approach.

The asset-index approach depicts the poverty incidence of households with old heads in a more favorable light than the dynamic cross-survey microsimulation methodology. From a static

perspective, the gradient in the poverty incidence based on asset-index values of 1994 was steeper across age groups in departmental capitals and other urban areas, and the relationship between poverty and the age of the household was flat rather than increasing in rural areas. From a dynamic perspective, we find that households with heads aged 34 or below only less than proportionately participated in the overall poverty reduction between 1994 and 1998. A plausible explanation for these differences between the dynamic cross-survey microsimulation methodology and the asset-index approach is that household heads may accumulate tangible assets over the life cycle so that once they are old they possess more but less valuable assets.[32] With respect to the other characteristics of the household head, we find more similarities between the two approaches. Being Non-Spanish speaking substantially increases the likelihood of being poor. The gradient in the poverty incidence between Spanish and Non-Spanish speaking household heads was again even steeper according to the asset-index approach. The explanatory power of the gender of the household head continues to be negligible; if anything it confirms the finding from above that female headed households have a slightly lower incidence of poverty.

5 Discussion

In this paper, we developed a new methodology to create national poverty profiles and growth incidence curves with incomplete income or expenditure data, and applied it to the case of Bolivia between 1989 and 2002. We show that our extension of the poverty mapping methodology is able to reproduce trends in differential in poverty well where we have comparable data. It also appears superior to the use of asset indices for measuring trends in poverty which might more reflect changes in preferences, prices, and non-income indicators. As such it of considerable use for situations where nationally representative income surveys are lacking, but DHS data are available.

Substantively, the analysis revealed that there are four main determinants of poverty and its changes over time. First, there is evidence for a large urban-rural divide in Bolivia. Following the historical settlement patterns, Bolivia's poor are still concentrated in the rural areas of the highlands (*altiplano* and *valles*), where they face difficult ecological and climatic conditions for agricultural production, and suffer from the proliferation of tiny plots.

Second, a large number of children has become an increasingly powerful poverty predictor in Bolivia as evidenced by that (a) the incidence of poverty was higher among large households and among households with few members in working age, and that (b) these relationships strengthened over time. These trends reflect the considerable fertility decline in Bolivia over the past 20 years, which is now clearly visible in the age structure of the population where the absolute number of 0-4 year olds has recently begun to decline. If the fertility decline continues, the country can expect two types of welfare improvements: (a) Bolivia is likely to enter the phase which has been referred to as "demographic gift" by Bloom and Williamson (1998), where the share of the working age population will be particularly large. Under these conditions, the country can save more, invest more in physical and human capital, and, if sufficient employment opportunities are available, spur growth of GDP per capita; (b) economic growth is likely to become more pro-poor as it is particularly the poor who are now in the process of further reducing their household size and of benefiting from lower dependency rates (Klasen 2004; Eastwood and Lipton 2000).[33] Once the fertility decline has reached the poor in Bolivia, it can be a major driving force of poverty reduction, as it was elsewhere in recent years (e.g., in East Asia and Brazil).

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[32] The DHS data do not contain information on the age of the tangible assets so that we cannot check the validity of this hypothesis.

[33] The poor still have much larger families. Using the unsatisfied-basic-needs approach and applying it to the 2001 Census, extremely poor households in Bolivia had a total fertility rate of 6.9, compared to 2.1 for households with satisfied basic needs.

Third, average education of adult household members strongly shaped the likelihood of being poor. There is a steep gradient in the poverty headcount index between basic, secondary, and tertiary schooling, which is by far the most important predictor of poverty (although the extent of the gradient and its development over time differs between the two methods for simulating incomes).

Fourth, we find that the explanatory power of the profession of the principal wage earner has considerably increased since 1989. The poverty headcount index of the relatively rich white-collar workers and workers in sales & services fell more than twice as much as the poverty headcount index of the relatively poor agricultural and blue-collar workers.

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6 Appendix

Table A1 — Sample Means of the Variables Taken from the Living Standard Measurement Surveys

	Total Bolivia			Deparatmental Capitals			Other Urban Areas			Rural Areas		
	EIH89	EIH94	ECH99	EIH89	EIH94	ECH99	EIH89	EIH94	ECH99	EIH89	EIH94	ECH99
Demographics												
Place of Residence												
City	n.a.	n.a.	49.31	100.00	100.00	100.00	n.a.	n.a.	0.00	n.a.	n.a.	0.00
Town	n.a.	n.a.	15.70	0.00	0.00	0.00	n.a.	n.a.	100.00	n.a.	n.a.	0.00
Rural	n.a.	n.a.	34.99	0.00	0.00	0.00	n.a.	n.a.	0.00	n.a.	n.a.	100.00
Department												
Chuquisaca	n.a.	n.a.	6.95	4.59	4.59	5.01	n.a.	n.a.	0.92	n.a.	n.a.	12.39
La Paz	n.a.	n.a.	29.09	40.48	39.63	38.41	n.a.	n.a.	12.26	n.a.	n.a.	23.51
Cochabamba	n.a.	n.a.	18.06	14.70	14.22	15.23	n.a.	n.a.	18.77	n.a.	n.a.	21.74
Oruro	n.a.	n.a.	4.48	6.71	6.19	6.48	n.a.	n.a.	1.34	n.a.	n.a.	3.06
Potosí	n.a.	n.a.	8.95	4.30	3.81	4.55	n.a.	n.a.	6.40	n.a.	n.a.	16.30
Tarija	n.a.	n.a.	4.84	3.18	3.24	2.71	n.a.	n.a.	10.93	n.a.	n.a.	5.10
Santa Cruz	n.a.	n.a.	22.44	23.90	26.29	22.96	n.a.	n.a.	41.90	n.a.	n.a.	12.97
Beni and Pando	n.a.	n.a.	5.20	2.14	2.04	4.65	n.a.	n.a.	7.49	n.a.	n.a.	4.93
Number of												
Elderly (age>=66 or unknown)	n.a.	n.a.	0.09	0.10	0.09	0.08	n.a.	n.a.	0.10	n.a.	n.a.	0.11
Adult Men (15>=age>=65)	n.a.	n.a.	1.43	1.48	1.49	1.53	n.a.	n.a.	1.42	n.a.	n.a.	1.29
Adult Women (15>=age>=65)	n.a.	n.a.	1.63	1.76	1.74	1.73	n.a.	n.a.	1.79	n.a.	n.a.	1.42
Youngsters (6>=age>=14)	n.a.	n.a.	1.58	1.55	1.40	1.37	n.a.	n.a.	1.59	n.a.	n.a.	1.88
Children (age<=5)	n.a.	n.a.	0.96	0.95	0.98	0.71	n.a.	n.a.	1.04	n.a.	n.a.	1.29
All household members	n.a.	n.a.	5.70	5.84	5.70	5.42	n.a.	n.a.	5.94	n.a.	n.a.	5.99
Age Composition of Hh[a]	n.a.	n.a.	56.33	57.18	58.74	61.94	n.a.	n.a.	56.45	n.a.	n.a.	48.37
Language of Hh Head (Spanish)	n.a.	n.a.	51.06	58.00	55.75	67.07	n.a.	n.a.	65.36	n.a.	n.a.	22.10
Gender Hh Head (Female)	n.a.	n.a.	15.14	12.38	13.85	17.32	n.a.	n.a.	16.01	n.a.	n.a.	11.66
Age of Household Head												
<=24	n.a.	n.a.	4.63	3.73	4.51	4.47	n.a.	n.a.	6.74	n.a.	n.a.	3.92
25 - 34	n.a.	n.a.	21.99	26.32	25.57	21.17	n.a.	n.a.	22.05	n.a.	n.a.	23.10
35 - 44	n.a.	n.a.	32.28	33.37	32.60	33.85	n.a.	n.a.	29.87	n.a.	n.a.	31.16
45 - 54	n.a.	n.a.	26.92	20.73	22.89	26.42	n.a.	n.a.	24.48	n.a.	n.a.	28.71
55 - 65	n.a.	n.a.	9.48	11.52	10.31	9.91	n.a.	n.a.	11.08	n.a.	n.a.	8.14
>=66 or Unknown	n.a.	n.a.	4.70	4.33	4.12	4.17	n.a.	n.a.	5.78	n.a.	n.a.	4.97
Tangible Assets												
Water Source												
Inhouse Access to Public Water	n.a.	n.a.	66.05	71.75	79.05	93.39	n.a.	n.a.	77.72	n.a.	n.a.	22.28
Open Water Source	n.a.	n.a.	27.12	7.62	4.93	2.02	n.a.	n.a.	18.07	n.a.	n.a.	66.55
Other Water Source	n.a.	n.a.	6.83	20.63	16.02	4.60	n.a.	n.a.	4.21	n.a.	n.a.	11.17

Table A1 continued

	Total Bolivia			Deparatmental Capitals			Other Urban Areas			Rural Areas		
	EIH89	EIH94	ECH99	EIH89	EIH94	ECH99	EIH89	EIH94	ECH99	EIH89	EIH94	ECH99
Toilet Facility												
No Toilet	n.a.	n.a.	31.50	32.79	25.34	11.38	n.a.	n.a.	17.55	n.a.	n.a.	66.11
Shared Toilet	n.a.	n.a.	16.66	67.21	26.24	26.99	n.a.	n.a.	12.61	n.a.	n.a.	3.94
Private Toilet	n.a.	n.a.	51.84	n.a.	48.42	61.63	n.a.	n.a.	69.84	n.a.	n.a.	29.95
House	n.a.	n.a.	67.37	58.94	56.02	56.91	n.a.	n.a.	63.35	n.a.	n.a.	83.92
Electricity	n.a.	n.a.	72.94	n.a.	95.76	98.65	n.a.	n.a.	96.54	n.a.	n.a.	26.12
Telephone	n.a.	n.a.	25.30	n.a.	20.34	43.02	n.a.	n.a.	23.91	n.a.	n.a.	0.93
Radio	n.a.	n.a.	79.57	n.a.	89.19	86.91	n.a.	n.a.	78.97	n.a.	n.a.	69.51
Television	n.a.	n.a.	66.15	n.a.	91.59	94.86	n.a.	n.a.	84.42	n.a.	n.a.	17.47
Fridge	n.a.	n.a.	35.24	n.a.	46.36	52.79	n.a.	n.a.	45.33	n.a.	n.a.	5.97
Car	n.a.	n.a.	11.48	18.82	n.a.	18.24	n.a.	n.a.	9.13	n.a.	n.a.	3.00
Family Land	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Main Floor Material												
Earth	n.a.	n.a.	34.82	n.a.	11.41	7.59	n.a.	n.a.	24.76	n.a.	n.a.	77.69
Cement	n.a.	n.a.	37.67	n.a.	43.47	49.17	n.a.	n.a.	51.86	n.a.	n.a.	15.10
Brick	n.a.	n.a.	5.95	n.a.	10.79	6.80	n.a.	n.a.	10.81	n.a.	n.a.	2.56
Other Floor	n.a.	n.a.	21.57	n.a.	34.33	36.44	n.a.	n.a.	12.57	n.a.	n.a.	4.64
High-quality Cooking Material[b]	n.a.	n.a.	66.56	n.a.	96.98	97.40	n.a.	n.a.	81.28	n.a.	n.a.	16.48
Number of Sleeping Rooms												
0 - 1	n.a.	n.a.	58.35	n.a.	43.28	47.18	n.a.	n.a.	57.19	n.a.	n.a.	74.61
2 - 3	n.a.	n.a.	35.58	n.a.	46.01	42.55	n.a.	n.a.	38.18	n.a.	n.a.	24.58
>= 4	n.a.	n.a.	6.07	n.a.	10.71	10.27	n.a.	n.a.	4.63	n.a.	n.a.	0.81
Educational Attainment of Adults												
Men												
No Schooling	n.a.	n.a.	5.18	2.72	1.27	0.67	n.a.	n.a.	3.75	n.a.	n.a.	11.96
Incomplete Basic Schooling	n.a.	n.a.	25.82	15.66	13.08	12.54	n.a.	n.a.	24.46	n.a.	n.a.	44.53
Complete Basic Schooling	n.a.	n.a.	11.41	11.86	10.88	8.98	n.a.	n.a.	10.15	n.a.	n.a.	15.27
Lower Secondary Schooling	n.a.	n.a.	15.33	16.60	17.55	14.39	n.a.	n.a.	15.07	n.a.	n.a.	16.74
Higher Secondary Schooling	n.a.	n.a.	28.36	32.28	35.75	39.28	n.a.	n.a.	36.01	n.a.	n.a.	10.14
Tertiary Education	n.a.	n.a.	13.90	20.89	21.47	24.14	n.a.	n.a.	10.56	n.a.	n.a.	1.36
Women												
No Schooling	n.a.	n.a.	12.52	6.35	4.52	3.82	n.a.	n.a.	4.89	n.a.	n.a.	28.22
Incomplete Basic Schooling	n.a.	n.a.	23.08	18.79	15.62	13.84	n.a.	n.a.	17.97	n.a.	n.a.	38.41
Complete Basic Schooling	n.a.	n.a.	9.43	9.36	10.24	7.62	n.a.	n.a.	9.27	n.a.	n.a.	12.04
Lower Secondary Schooling	n.a.	n.a.	14.65	14.37	15.37	15.42	n.a.	n.a.	19.27	n.a.	n.a.	11.50
Higher Secondary Schooling	n.a.	n.a.	28.52	35.79	39.89	38.57	n.a.	n.a.	39.70	n.a.	n.a.	9.35
Tertiary Education	n.a.	n.a.	11.80	15.34	14.36	20.74	n.a.	n.a.	8.90	n.a.	n.a.	0.49

Table A1 continued

	Total Bolivia			Deparatmental Capitals			Other Urban Areas			Rural Areas		
	EIH89	EIH94	ECH99	EIH89	EIH94	ECH99	EIH89	EIH94	ECH99	EIH89	EIH94	ECH99
Employment												
Men												
High-skilled White Collar	n.a.	n.a.	7.54	10.50	12.12	11.90	n.a.	n.a.	6.45	n.a.	n.a.	2.04
Medium-skilled White Collar	n.a.	n.a.	8.89	8.48	11.46	13.39	n.a.	n.a.	8.76	n.a.	n.a.	2.83
Skilled Manual	n.a.	n.a.	27.49	34.32	33.33	34.94	n.a.	n.a.	37.93	n.a.	n.a.	12.84
Unskilled Manual	n.a.	n.a.	5.10	2.71	7.95	5.99	n.a.	n.a.	5.62	n.a.	n.a.	3.64
Agriculture: Employed	n.a.	n.a.	5.15	1.10	0.85	1.17	n.a.	n.a.	6.02	n.a.	n.a.	10.21
Agriculture: Self-employed	n.a.	n.a.	23.97	2.44	0.53	0.11	n.a.	n.a.	4.48	n.a.	n.a.	64.92
Sales & Services	n.a.	n.a.	17.49	24.38	26.91	26.26	n.a.	n.a.	25.53	n.a.	n.a.	2.07
Never Worked / Don't Know	n.a.	n.a.	4.37	16.06	6.84	6.25	n.a.	n.a.	5.21	n.a.	n.a.	1.45
Women												
High-skilled White Collar	n.a.	n.a.	3.39	1.83	2.31	5.15	n.a.	n.a.	3.55	n.a.	n.a.	0.83
Medium-skilled White Collar	n.a.	n.a.	5.13	8.77	9.12	7.93	n.a.	n.a.	4.30	n.a.	n.a.	1.55
Skilled Manual	n.a.	n.a.	6.92	5.08	7.40	7.22	n.a.	n.a.	11.64	n.a.	n.a.	4.36
Unskilled Manual	n.a.	n.a.	6.75	0.84	9.34	9.72	n.a.	n.a.	8.27	n.a.	n.a.	1.87
Agriculture: Employed	n.a.	n.a.	3.42	0.23	0.30	0.34	n.a.	n.a.	0.57	n.a.	n.a.	9.04
Agriculture: Self-employed	n.a.	n.a.	18.53	0.36	0.13	0.33	n.a.	n.a.	2.65	n.a.	n.a.	51.31
Sales & Services	n.a.	n.a.	15.48	26.89	23.45	22.30	n.a.	n.a.	17.72	n.a.	n.a.	4.87
Never Worked / Don't Know	n.a.	n.a.	40.39	55.99	47.95	47.00	n.a.	n.a.	51.29	n.a.	n.a.	26.17
Health												
>=1 Hh Member Covered by Social Security	n.a.	n.a.	23.70	34.01	n.a.	34.05	n.a.	n.a.	28.02	n.a.	n.a.	7.19
Birth in Last 12 Months	n.a.	n.a.	15.72	15.63	15.25	10.40	n.a.	n.a.	16.22	n.a.	n.a.	23.00
thereof: Attended by Doctor	n.a.	n.a.	55.47	65.00	72.26	83.65	n.a.	n.a.	82.06	n.a.	n.a.	29.00
thereof: Delivered in Hospital	n.a.	n.a.	40.97	52.53	58.36	61.35	n.a.	n.a.	55.18	n.a.	n.a.	23.52
Child under 4 Years	n.a.	n.a.	46.56	48.06	46.03	37.28	n.a.	n.a.	49.21	n.a.	n.a.	58.47
thereof: Has First Polio Vaccination	n.a.	n.a.	89.22	88.60	n.a.	89.30	n.a.	n.a.	93.29	n.a.	n.a.	87.60
thereof: Has Triple DPT Vaccination	n.a.	n.a.	71.13	33.69	n.a.	75.19	n.a.	n.a.	67.85	n.a.	n.a.	68.74
thereof: Incidence of Diarrhea	n.a.	n.a.	31.49	16.25	8.28	22.45	n.a.	n.a.	35.09	n.a.	n.a.	38.24
thereof: Incidence of Cough/Fever	n.a.	n.a.	48.73	16.46	16.32	45.09	n.a.	n.a.	43.55	n.a.	n.a.	53.96

Notes: [a] Ratio of hh members aged between 15 and 65 to all hh members. – [b] Gas, kerosene or electricity.

Source: Own calculations.

Table A2 — Sample Means of the Variables Taken from the Demographic and Health Surveys

	Total Bolivia			Deparatmental Capitals			Other Urban Areas			Rural Areas		
	DHS 89	DHS 94	DHS 98	DHS 89	DHS 94	DHS 98	DHS 89	DHS 94	DHS 98	DHS 89	DHS 94	DHS 98
Demographics												
Place of Residence												
City	47.55	47.96	53.46	100.00	100.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00
Town	11.24	12.06	14.46	0.00	0.00	0.00	100.00	100.00	100.00	0.00	0.00	0.00
Rural	41.21	39.98	32.08	0.00	0.00	0.00	0.00	0.00	0.00	100.00	100.00	100.00
Department												
Chuquisaca	5.68	5.96	6.61	3.25	4.16	5.20	3.25	1.34	1.97	9.15	9.50	11.05
La Paz	36.05	31.94	30.60	42.47	40.72	38.77	21.16	13.15	11.77	32.70	27.07	25.49
Cochabamba	17.20	17.55	17.31	16.45	14.30	14.14	11.77	11.89	23.49	19.55	23.15	19.81
Oruro	6.28	6.20	4.97	6.93	7.00	6.26	5.20	7.68	4.26	5.82	4.80	3.15
Potosí	9.79	9.72	9.01	3.87	4.50	4.35	18.88	10.37	10.93	14.13	15.80	15.92
Tarija	3.90	4.50	5.31	2.93	3.15	4.32	8.04	10.07	9.30	3.88	4.43	5.16
Santa Cruz	18.25	20.91	22.04	22.44	24.49	24.77	23.25	33.83	26.57	12.06	12.72	15.45
Beni and Pando	2.87	3.22	4.14	1.67	1.67	2.20	8.46	11.67	11.70	2.72	2.52	3.97
Number of												
Elderly (age>=66 or unknown)	0.10	0.09	0.11	0.11	0.08	0.10	0.11	0.11	0.14	0.09	0.10	0.11
Adult Men (15>=age>=65)	1.30	1.21	1.25	1.38	1.24	1.31	1.25	1.26	1.24	1.21	1.16	1.15
Adult Women (15>=age>=65)	1.53	1.48	1.53	1.64	1.56	1.65	1.52	1.52	1.52	1.39	1.38	1.34
Youngsters (6>=age>=14)	1.42	1.32	1.29	1.35	1.17	1.09	1.50	1.48	1.46	1.49	1.46	1.55
Children (age<=5)	1.00	1.02	0.93	0.84	0.88	0.76	0.99	1.01	0.95	1.18	1.19	1.20
All household members	5.35	5.12	5.10	5.32	4.93	4.91	5.37	5.38	5.31	5.36	5.29	5.35
Age Composition of Hh [a]	56.30	56.54	58.23	59.41	60.11	63.22	55.48	55.34	55.86	52.94	52.63	50.96
Language of Hh Head (Spanish)	74.13	70.04	78.46	93.30	92.79	96.27	88.14	89.50	91.05	48.18	36.88	43.09
Gender Hh Head (Female)	15.14	17.15	17.45	18.17	18.38	19.08	16.02	19.78	19.71	11.40	14.89	13.71
Age of Household Head												
<=24	6.04	8.62	7.37	5.75	8.95	7.81	5.82	8.11	6.34	6.45	8.38	7.10
25 - 34	26.82	28.91	26.36	27.33	29.84	25.86	24.55	28.17	26.33	26.84	28.02	27.21
35 - 44	30.17	28.01	30.52	29.93	27.67	30.13	31.98	30.16	30.70	29.97	27.76	31.10
45 - 54	19.92	20.04	20.41	19.40	20.04	21.23	20.56	19.60	19.69	20.34	20.18	19.35
55 - 65	10.67	9.65	9.63	10.68	9.47	9.67	10.61	8.55	10.01	10.67	10.21	9.40
>=66 or Unknown	6.38	4.77	5.71	6.90	4.03	5.29	6.48	5.41	6.94	5.74	5.46	5.84
Tangible Assets												
Water Source												
Inhouse Access to Public Water	47.36	56.08	69.75	67.63	77.03	88.48	58.86	79.09	84.05	20.84	24.01	32.09
Open Water Source	29.39	29.63	19.31	6.72	4.93	1.76	12.73	11.94	8.49	60.09	64.60	53.44
Other Water Source	23.24	14.29	10.94	25.64	18.04	9.76	28.40	8.98	7.47	19.07	11.39	14.48

Table A2 continued

	Total Bolivia			Deparatmental Capitals			Other Urban Areas			Rural Areas		
	DHS 89	DHS 94	DHS 98	DHS 89	DHS 94	DHS 98	DHS 89	DHS 94	DHS 98	DHS 89	DHS 94	DHS 98
Toilet Facility												
No Toilet	49.72	40.19	32.25	26.51	26.32	16.27	40.46	26.29	22.60	79.02	61.02	63.22
Shared Toilet	50.28	35.83	19.41	73.49	30.03	28.04	59.54	53.57	21.37	20.98	37.43	4.15
Private Toilet		23.98	48.34	n.a.	43.65	55.69	n.a.	20.14	56.02	n.a.	1.55	32.63
House	63.83	67.06	64.98	53.02	52.54	54.55	59.58	60.65	60.97	77.46	86.43	84.18
Electricity	n.a.	67.61	75.73	n.a.	95.00	98.41	n.a.	86.17	90.43	n.a.	29.16	31.31
Telephone	n.a.	10.59	24.96	n.a.	20.20	40.87	n.a.	6.66	19.89	n.a.	0.25	0.74
Radio	n.a.	85.17	88.08	n.a.	94.74	95.64	n.a.	85.74	88.93	n.a.	73.53	75.11
Television	n.a.	58.19	68.39	n.a.	88.32	93.46	n.a.	72.15	81.03	n.a.	17.83	20.91
Fridge	n.a.	29.69	37.67	n.a.	45.56	53.36	n.a.	35.91	43.32	n.a.	8.78	8.96
Car	12.07	n.a.	n.a.	19.60	n.a.	n.a.	10.80	n.a.	n.a.	3.73	n.a.	n.a.
Family Land	n.a.	28.46	21.27	n.a.	0.95	0.55	n.a.	9.77	6.63	n.a.	67.10	62.40
Main Floor Material												
Earth	n.a.	37.63	28.84	n.a.	14.56	7.42	n.a.	26.30	19.89	n.a.	68.73	68.58
Cement	n.a.	32.64	37.57	n.a.	41.62	43.51	n.a.	39.76	51.01	n.a.	19.72	21.62
Brick	n.a.	11.72	7.58	n.a.	15.98	9.36	n.a.	21.61	11.08	n.a.	3.62	3.04
Other Floor	n.a.	18.01	26.01	n.a.	27.84	39.71	n.a.	12.33	18.02	n.a.	7.93	6.76
High-quality Cooking Materialb	n.a.	64.10	71.77	n.a.	96.22	98.29	n.a.	75.18	83.92	n.a.	22.22	22.09
Number of Sleeping Rooms												
0 – 1	n.a.	53.15	59.25	n.a.	47.39	50.19	n.a.	49.94	58.85	n.a.	61.02	74.55
2 – 3	n.a.	41.13	34.60	n.a.	44.48	40.11	n.a.	42.87	36.57	n.a.	36.58	24.52
>= 4	n.a.	5.73	6.16	n.a.	8.13	9.70	n.a.	7.19	4.58	n.a.	2.40	0.97
Educational Attainment of Adults												
Men												
No Schooling	14.21	5.48	4.24	9.55	2.27	1.92	11.98	4.23	2.69	19.99	9.74	8.64
Incomplete Basic Schooling	23.99	22.84	24.18	11.33	11.10	13.69	18.90	20.12	22.28	39.39	37.79	41.84
Complete Basic Schooling	17.67	14.12	11.29	14.68	10.67	7.25	18.89	15.23	11.58	20.62	17.91	17.64
Lower Secondary Schooling	13.34	16.16	13.71	16.22	14.66	14.12	13.97	15.58	16.40	9.99	18.15	11.85
Higher Secondary Schooling	17.77	28.74	28.03	25.58	39.58	34.81	27.08	34.97	30.67	6.58	13.72	16.01
Tertiary Education	13.02	12.67	18.55	22.64	21.72	28.21	9.18	9.87	16.39	3.45	2.69	4.02
Women												
No Schooling	18.69	13.43	9.32	8.03	4.65	3.13	12.22	9.94	4.94	32.74	25.01	21.62
Incomplete Basic Schooling	29.75	27.02	23.33	21.17	18.09	14.70	26.22	22.95	18.15	40.60	38.97	40.05
Complete Basic Schooling	13.87	12.49	10.10	13.54	9.63	7.02	15.60	12.11	9.61	13.77	16.04	15.46
Lower Secondary Schooling	14.12	13.74	13.29	18.63	14.65	12.72	19.11	17.35	16.98	7.57	11.55	12.58
Higher Secondary Schooling	16.38	25.36	30.09	25.94	38.84	40.82	20.66	31.54	38.33	4.19	7.33	8.50
Tertiary Education	7.19	7.96	13.86	12.68	14.14	21.61	6.19	6.11	11.98	1.12	1.10	1.80

Table A2 continued

	Total Bolivia			Deparatmental Capitals			Other Urban Areas			Rural Areas		
	DHS 89	DHS 94	DHS 98	DHS 89	DHS 94	DHS 98	DHS 89	DHS 94	DHS 98	DHS 89	DHS 94	DHS 98
Employment												
Men												
High-skilled White Collar	9.56	6.70	8.68	16.82	12.18	13.89	8.31	4.96	7.19	1.89	0.66	0.98
Medium-skilled White Collar	8.45	9.11	8.63	12.54	13.41	11.16	10.95	12.09	9.45	3.24	2.98	4.20
Skilled Manual	25.04	25.79	24.91	32.95	35.13	31.12	33.97	28.75	27.82	13.86	13.65	13.67
Unskilled Manual	5.06	4.29	4.16	6.91	5.67	5.75	6.35	4.59	4.88	2.64	2.54	1.27
Agriculture: Employed	4.37	6.01	4.33	0.48	0.98	0.77	4.10	8.95	6.91	8.77	11.14	8.91
Agriculture: Self-employed	27.55	25.12	22.26	2.15	0.76	0.99	9.92	9.62	8.32	60.47	59.31	62.58
Sales & Services	16.85	19.34	20.29	23.50	26.54	27.71	24.87	27.21	26.11	7.32	8.19	5.81
Never Worked / Don't Know	3.11	3.64	6.73	4.65	5.33	8.61	1.52	3.83	9.31	1.83	1.53	2.59
Women												
High-skilled White Collar	1.43	1.42	3.07	2.58	2.39	4.93	0.67	1.34	2.40	0.31	0.30	0.28
Medium-skilled White Collar	5.39	7.14	8.17	8.38	11.30	11.29	8.29	8.90	9.37	1.16	1.61	2.41
Skilled Manual	3.58	6.53	6.99	3.93	8.25	8.18	3.43	7.10	7.53	3.22	4.30	4.76
Unskilled Manual	0.42	9.47	7.95	0.23	14.18	11.10	1.94	11.69	8.19	0.23	3.15	2.60
Agriculture: Employed	0.50	6.32	0.92	0.13	0.42	0.01	0.25	1.54	0.91	1.01	14.85	2.43
Agriculture: Self-employed	0.80	15.01	12.18	0.04	0.13	0.10	0.10	2.26	1.40	1.86	36.70	37.15
Sales & Services	13.59	17.21	19.09	18.75	21.96	25.06	18.81	24.69	24.77	6.22	9.26	6.59
Never Worked / Don't Know	74.28	36.89	41.64	65.97	41.37	39.33	66.52	42.48	45.42	85.99	29.83	43.80
Health												
>=1 Hh Member Covered by Social Security	21.44	n.a.	21.31	29.19	n.a.	31.11	30.19	n.a.	23.18	10.10	n.a.	4.12
Birth in Last 12 Months	19.83	18.64	17.08	16.30	15.57	14.15	20.22	18.61	15.58	23.80	22.34	22.63
thereof: Attended by Doctor	40.29	42.06	56.73	63.31	63.20	76.54	49.36	57.50	72.66	20.00	20.50	31.24
thereof: Delivered in Hospital	36.86	31.17	42.62	56.56	46.37	51.45	50.79	40.73	60.59	17.98	16.03	27.79
Child under 4 Years	51.02	50.08	47.31	43.90	44.75	41.27	50.64	49.26	45.08	59.34	56.73	58.39
thereof: First Polio Vaccination	70.64	56.13	76.16	76.67	62.39	79.23	72.35	56.31	76.86	65.07	50.13	72.31
thereof: Triple DPT Vaccination	30.22	26.32	44.09	39.50	32.54	48.46	30.65	27.49	46.58	22.19	20.13	38.07
thereof: Incidence of Diarrhea	29.26	21.45	20.84	28.38	21.34	19.02	30.98	24.08	19.92	29.61	20.84	23.29
thereof: Incidence of Cough/Fever	40.93	30.35	48.17	37.31	31.80	47.13	39.71	31.85	46.78	44.29	28.56	49.89

Notes: [a] Ratio of hh members aged between 15 and 65 to all hh members. – [b] Gas, kerosene or electricity.

Source: Own calculations.

Table A3 — Asset Endowment Among Extremely Poor, Moderately Poor and Non-poor (in Percent), 1994 and 1998

	1994			1998		
	Extremely Poor	Moderately Poor	Non-poor	Extremely Poor	Moderately Poor	Non-poor
Tangible Assets						
Telephone	0.02	0.29	37.58	0.40	2.13	67.81
Radio	72.93	79.67	99.59	73.19	82.63	98.31
Television	21.55	42.39	99.57	21.85	51.90	99.31
Fridge	4.57	11.58	77.13	4.46	12.82	84.28
House	79.91	72.17	53.70	77.45	66.27	62.57
Plot of Agricultural Land	54.95	39.07	0.67	53.36	32.34	0.50
In-house Access to Electricity	36.51	55.28	99.93	37.04	62.82	99.95
In-house Access to Public Water	22.72	40.27	97.49	31.25	54.53	98.30
Use of Other (Non-open) Water Source	22.19	19.18	1.46	21.36	16.12	1.22
High-quality Cooking Material[a]	31.59	50.76	99.06	30.04	56.99	99.50
Shared Toilet	36.73	39.73	25.61	9.58	21.27	15.92
Private Toilet	0.71	6.80	69.00	26.91	30.64	81.54
Cement Floor	20.43	30.14	39.19	22.20	37.85	37.06
Brick Floor	5.10	9.24	18.23	4.88	8.20	6.42
Other (Non-earth) Floor	6.83	9.15	41.23	6.05	10.29	55.50
2-3 Sleeping Rooms	32.74	36.04	54.44	20.10	23.45	55.51
>= 4 Sleeping Rooms	1.93	2.00	15.49	0.84	1.12	15.62
Human Capital						
% of Adult Men[b] with						
Complete Basic Schooling	16.85	15.49	2.43	16.25	13.31	2.29
Lower Secondary Schooling	16.69	17.14	4.34	11.49	14.00	6.84
Higher Secondary Schooling	12.71	19.51	36.44	13.55	20.84	28.61
Tertiary Education	1.27	2.15	32.98	1.86	3.65	37.95
% of Adult Women[c] with						
Complete Basic Schooling	17.14	16.00	3.28	16.71	14.08	2.64
Lower Secondary Schooling	13.24	16.01	7.78	14.63	16.41	7.45
Higher Secondary Schooling	6.33	13.80	55.66	7.22	19.76	49.48
Tertiary Education	0.23	1.09	25.96	0.86	2.99	34.25

Notes: [a] Gas, kerosene, and electricity. – [b] Husbands and partners of women aged between 15 and 49. – [c] Women aged between 15 and 49.

Source: Own calculations.

Figure A1 — Growth Incidence Curve for Bolivia, 1989 to 1999

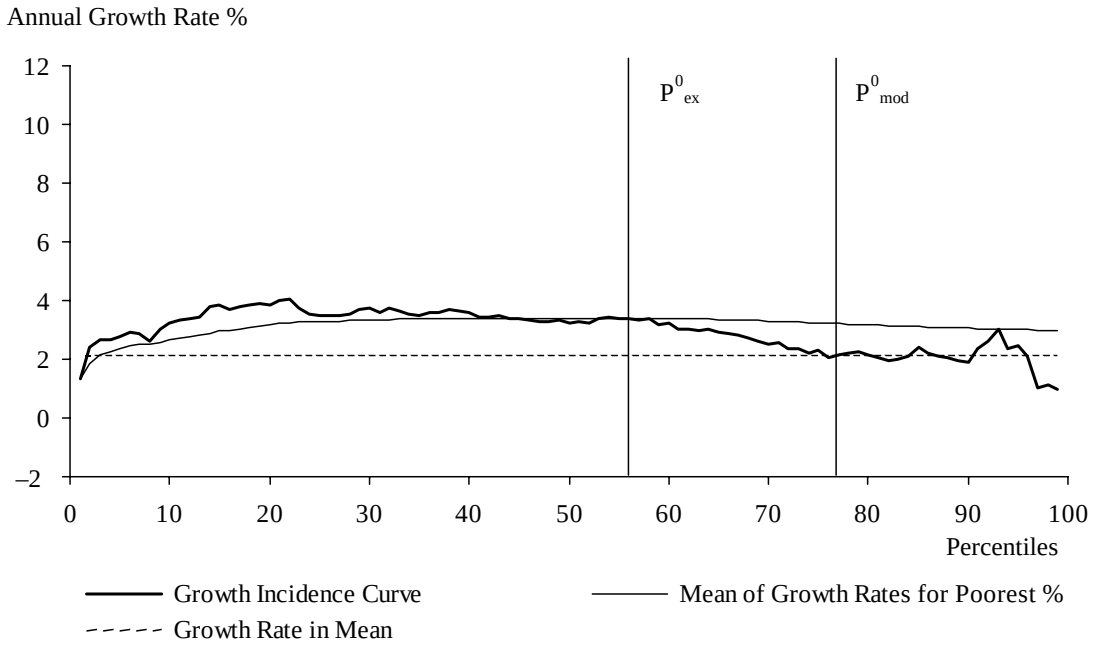

Figure A2 — Growth Incidence Curve for the Departmental Capitals of Bolivia, 1989 to 1999

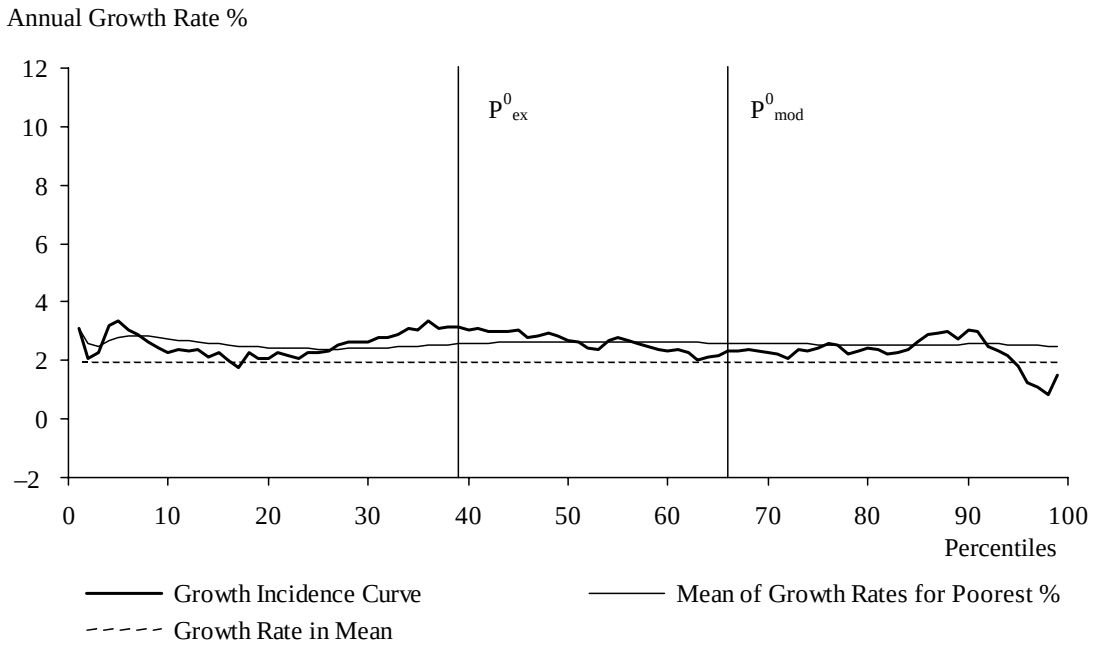

Figure A3 — Growth Incidence Curve for Other Urban Areas of Bolivia, 1989 to 1999

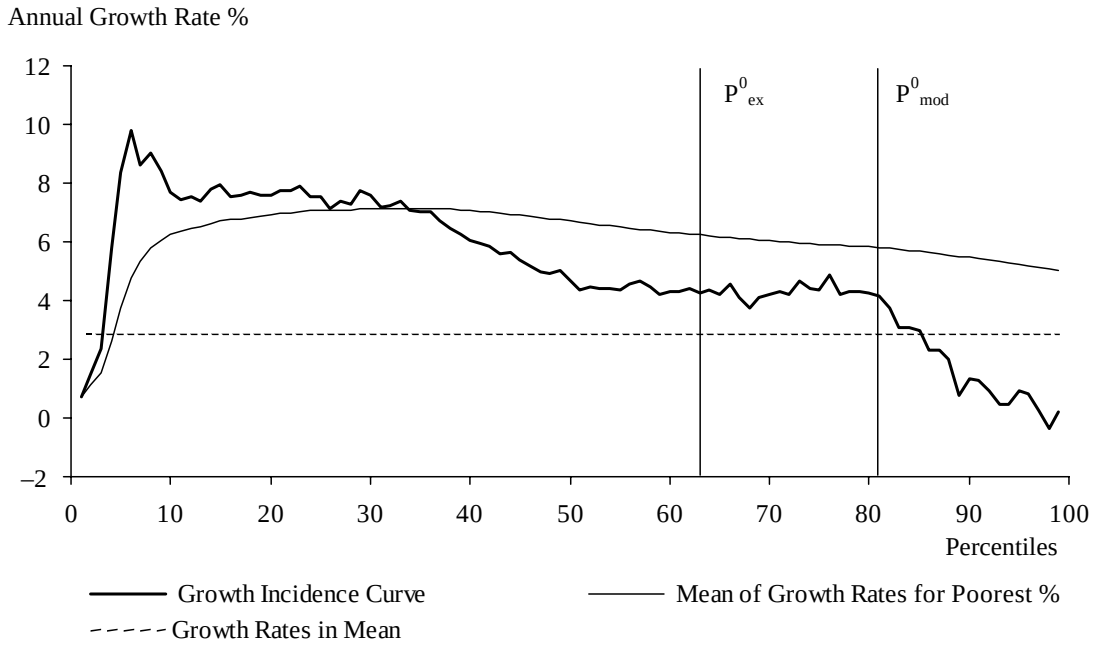

Figure A4 — Growth Incidence Curve for Rural Areas of Bolivia, 1989 to 1999

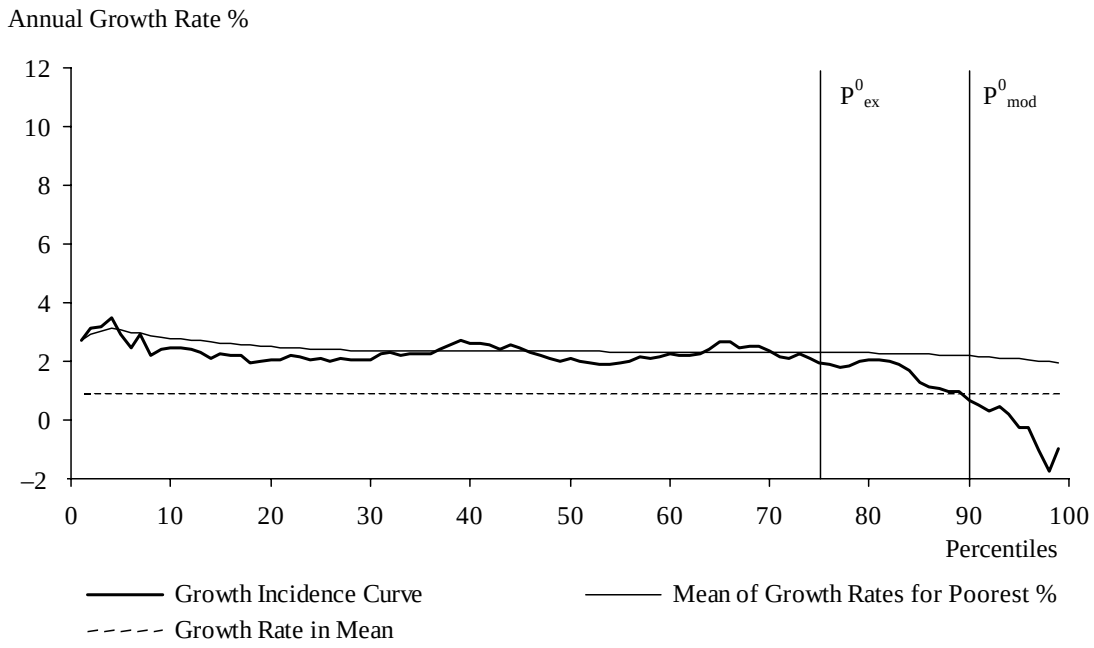

Figure A5 — Growth Incidence Curve for Bolivia, 1999 to 2002

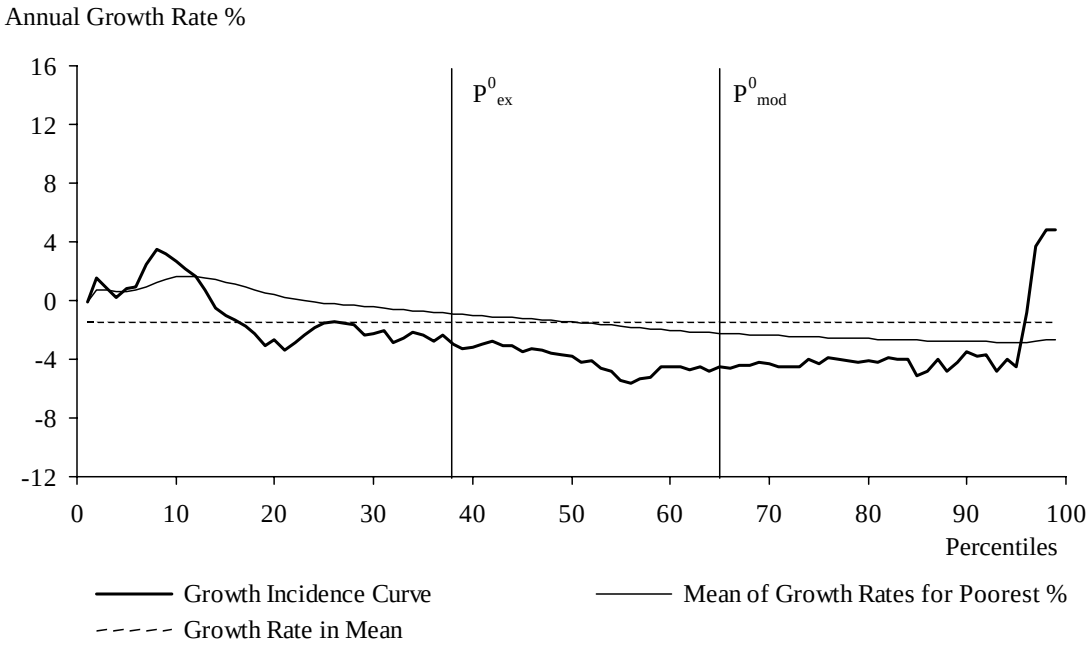

Figure A6 — Growth Incidence Curve for the Departmental Capitals of Bolivia, 1999 to 2002

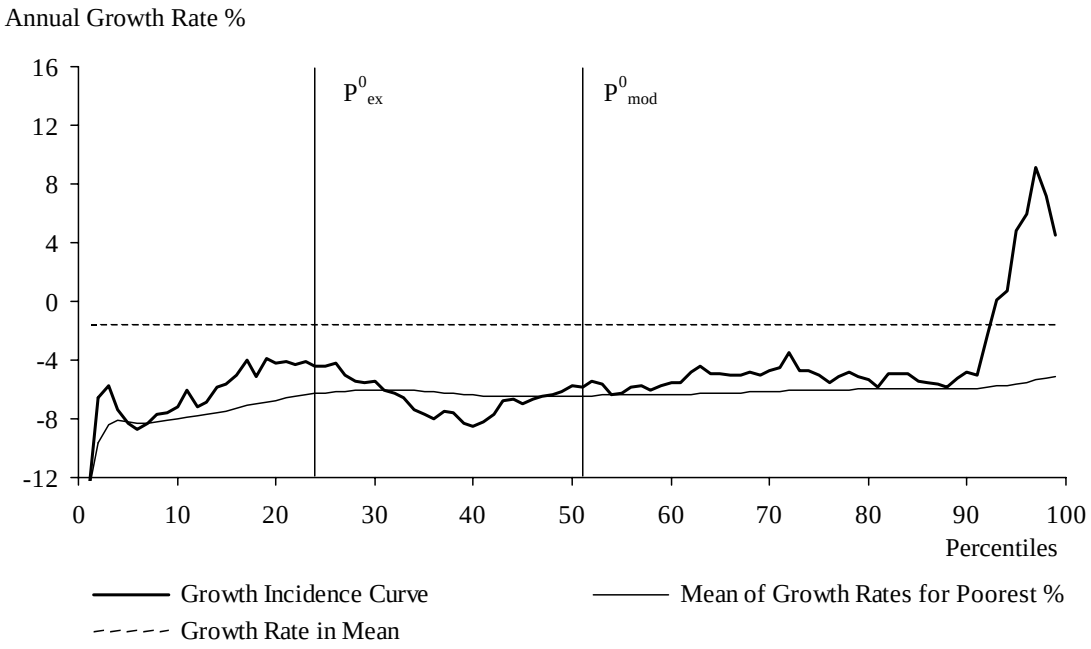

Figure A7 — Growth Incidence Curve for Other Urban Areas of Bolivia, 1999 to 2002

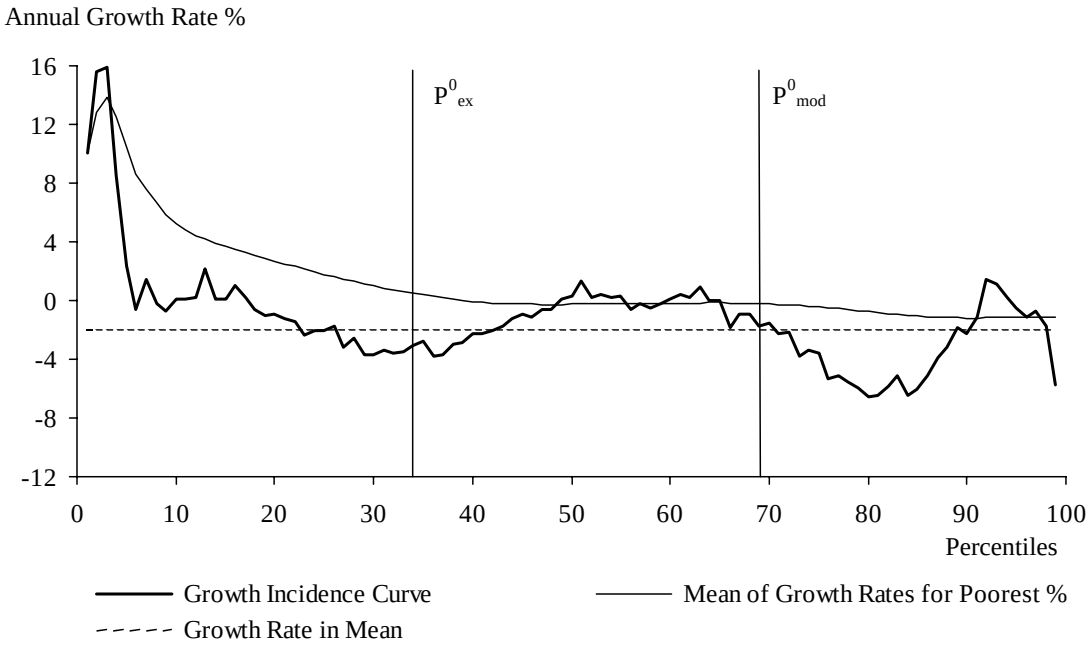

Figure A8 — Growth Incidence Curve for Rural Areas of Bolivia, 1999 to 2002

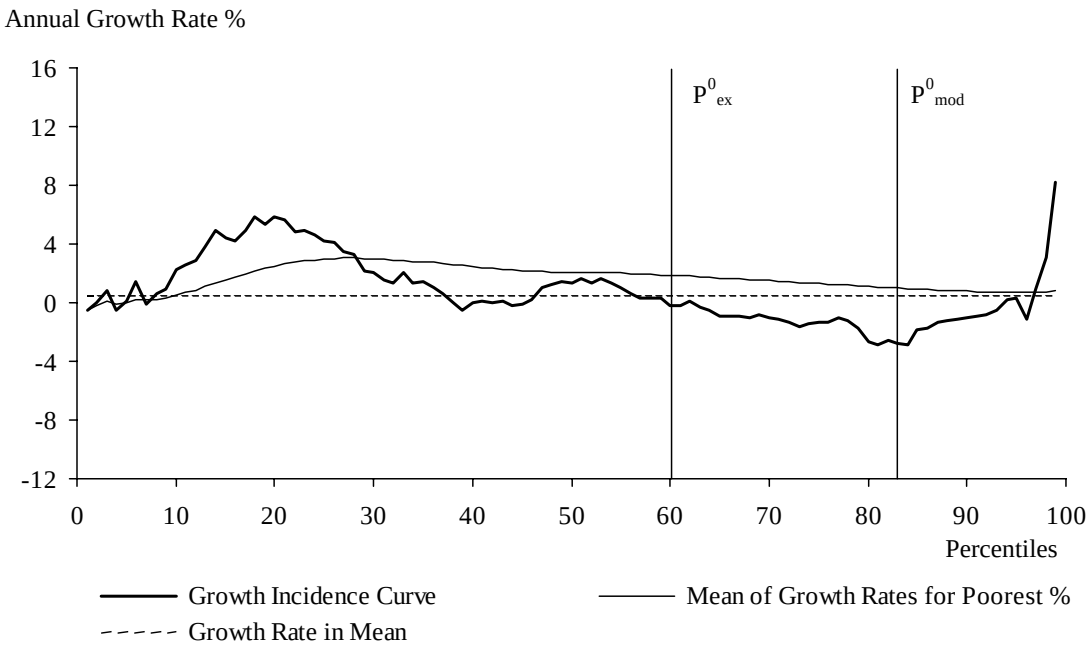

Figure A9 — Growth Incidence Curve for Bolivia, 1989 to 2002

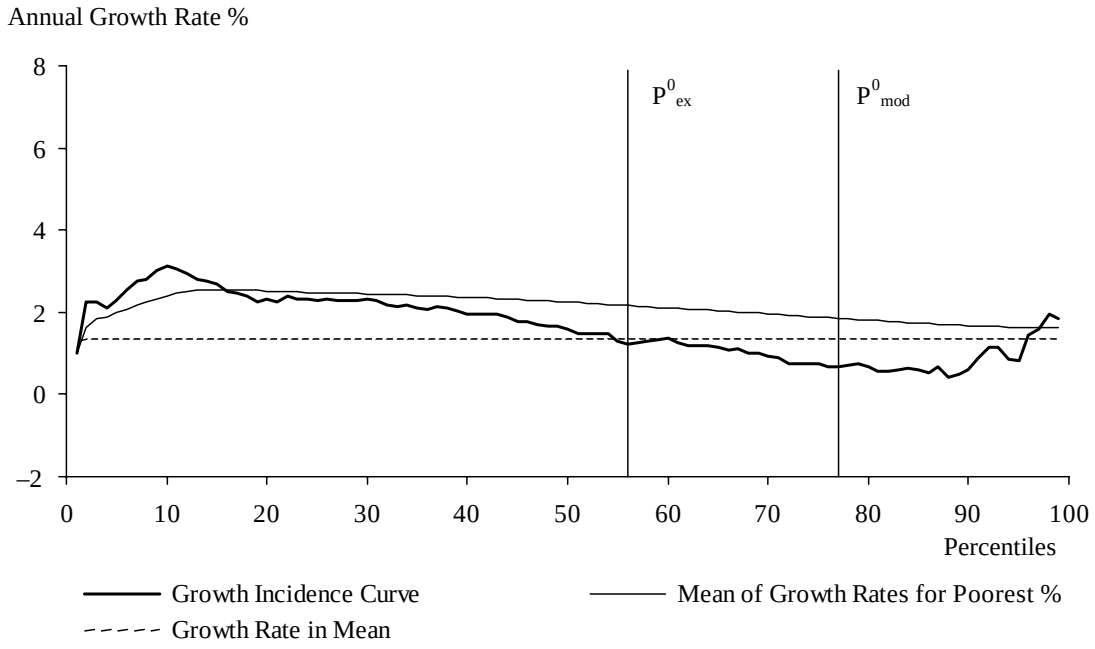

Figure A10 —Growth Incidence Curve for the Departmental Capitals of Bolivia, 1989 to 2002

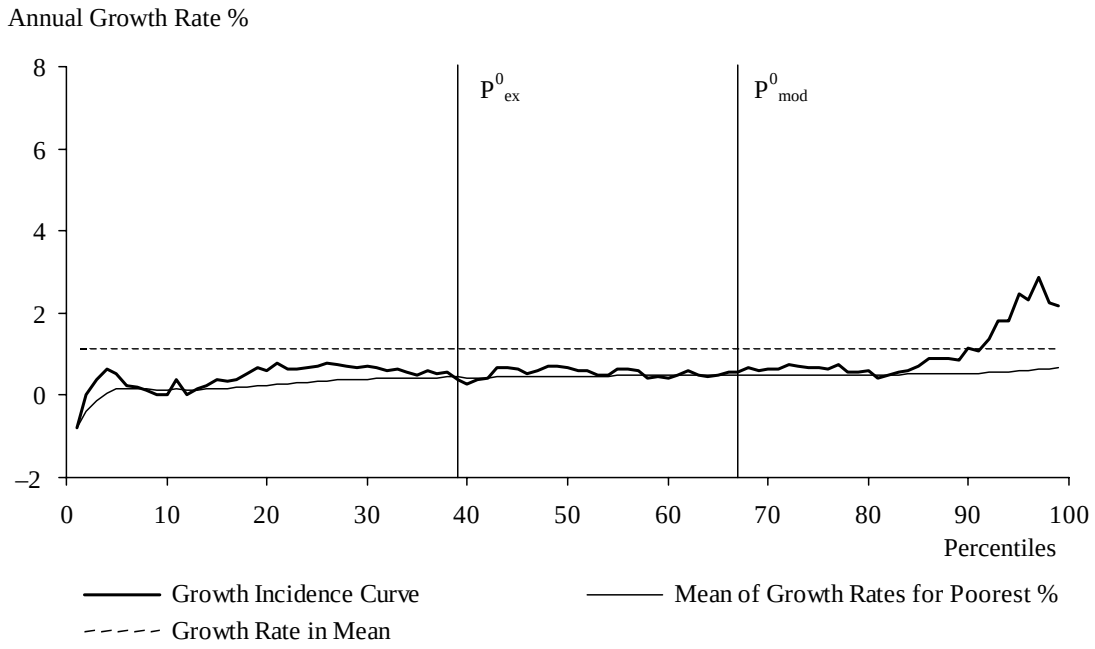

Figure A11 —Growth Incidence Curve for Other Urban Areas of Bolivia, 1989 to 2002

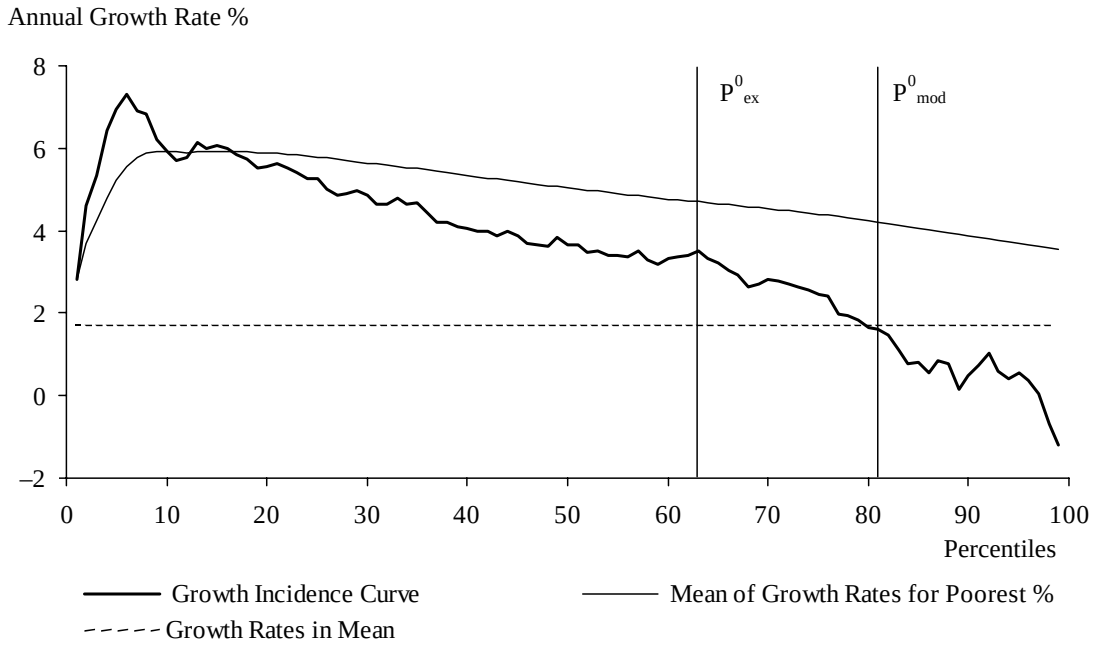

Figure A12 —Growth Incidence Curve for Rural Areas of Bolivia, 1989 to 2002