

# Institute for Advanced Development Studies



## Development Research Working Paper Series

**No. 03/2003**

### Population and Poverty Projections for Nicaragua 1995 - 2015

by:

Lykke E. Andersen

June 2003

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Lykke E. Andersen

La Paz, 12 June 2003

## **CONTENTS:**

<b>PREFACE AND ACKNOWLEDGEMENTS.....</b>	<b>4</b>
<b>CHAPTER 1: INTRODUCTION AND SUMMARY.....</b>	<b>5</b>
<b>CHAPTER 2: METHODOLOGY.....</b>	<b>7</b>
2.1. THE MULTI-STATE COHORT-COMPONENT MODEL .....	7
2.2. CHOICE OF RELEVANT “STATES” .....	7
2.3. SOCIAL MOBILITY .....	8
2.4. SOCIAL MOBILITY AND SOCIO-DEMOGRAPHIC FACTORS.....	12
2.5. LINKS BETWEEN SOCIAL MOBILITY, ECONOMIC GROWTH AND INEQUALITY: .....	14
2.6. COMBINING ECONOMIC AND SOCIO-DEMOGRAPHIC FACTORS IN A SET OF TRANSITION MATRICES: .....	19
2.7. FERTILITY AND FAMILY FORMATION ASSUMPTIONS FOR THE CENTRAL SCENARIO ..	20
2.8. MORTALITY ASSUMPTIONS FOR THE CENTRAL SCENARIO.....	24
2.9. INTERNATIONAL MIGRATION ASSUMPTIONS FOR THE CENTRAL SCENARIO .....	27
2.10. INTERNAL MIGRATION ASSUMPTIONS FOR THE CENTRAL SCENARIO .....	29
2.11. EDUCATION ASSUMPTIONS FOR THE CENTRAL SCENARIO .....	31
<b>CHAPTER 3: SIMULATION RESULTS FOR THE CENTRAL SCENARIO.....</b>	<b>33</b>
3.1. POPULATION STRUCTURE .....	33
3.2. POVERTY.....	35
<b>CHAPTER 4: COUNTERFACTUAL SIMULATIONS.....</b>	<b>37</b>
4.1. COUNTERFACTUAL SCENARIO WITH NO RURAL-URBAN MIGRATION.....	37
4.2. COUNTERFACTUAL SCENARIO WITH NO INTERNATIONAL MIGRATION .....	38
4.3. COUNTERFACTUAL SCENARIO WITH NO CHANGES IN FERTILITY .....	38
4.4. COUNTERFACTUAL SCENARIO WITH NO CHANGES IN EDUCATION .....	40
4.5. COUNTERFACTUAL SCENARIO WITH NO CHANGES IN THE GINI COEFFICIENT.....	41
4.6. COUNTERFACTUAL SCENARIOS WITH NO PER CAPITA GDP GROWTH.....	42
<b>CHAPTER 5: THE RELATIVE IMPORTANCE OF DIFFERENT SOCIO- ECONOMIC AND DEMOGRAPHIC FACTORS.....</b>	<b>44</b>
5.1. RURAL-URBAN MIGRATION .....	44
5.2. INTERNATIONAL MIGRATION .....	46
5.3. FERTILITY .....	48
5.4. EDUCATION.....	52
5.5. CHANGES IN THE INCOME DISTRIBUTION .....	54
5.6. PER CAPITA GDP GROWTH RATES .....	55
5.7. THE RELATIVE IMPORTANCE OF DIFFERENT SOCIO-ECONOMIC AND DEMOGRAPHIC FACTORS .....	57
5.8. PROBABILISTIC ANALYSIS OF MAIN ENDOGENOUS VARIABLES .....	58
<b>CHAPTER 6: CONCLUSIONS .....</b>	<b>62</b>
<b>CHAPTER 7: REFERENCES.....</b>	<b>64</b>

<b>APPENDIX A: CHOICE OF RELEVANT STATES .....</b>	<b>65</b>
7.1. AREA/REGION OF RESIDENCE .....	65
7.2. NUMBER OF CHILDREN IN HOUSEHOLD.....	68
7.3. NUMBER OF ADULTS IN HOUSEHOLD .....	70
7.4. GENDER .....	71
7.5. EDUCATION LEVEL IN THE HOUSEHOLD.....	72
7.6. AGE.....	73
<b>APPENDIX B: BI-PROPORTIONAL ADJUSTMENT OF SOCIAL MOBILITY MATRICES.....</b>	<b>76</b>

## **PREFACE AND ACKNOWLEDGEMENTS**

This document is the final report of a consulting project made by Lykke E. Andersen for UNFPA/EAT in Mexico about integrating social mobility, poverty and population projections for Nicaragua. Ralph Hakkert at UNFPA/EAT provided the basic ideas and secured funding for the project and for that he deserves the most profound thanks.

The author is also extremely grateful to Jorge Campos, Tomás Jiménez, Medea Morales, and Alvaro Martin de Vega at the UNFPA office in Managua for their inputs, support and hospitality.

The statistical assistance received from Oscar Estrada and Santiago Mejía at INEC (the National Statistical Institute of Nicaragua) was indispensable, and the author is heavily indebted to both.

Discussions with Eduardo Baumeister on migration were most helpful, as were the comments, ideas, and census tabulations made by Jorge Rodríguez at CEPAL. Several meetings and conferences arranged by FNUAP in Mexico City and Managua provided me with a wealth of ideas for simulations.

Finally, I am thankful to Jorge Escobari at UDAPE in La Paz for showing me how to make sensitivity analyses in EXCEL using the program Crystal Ball.

## **CHAPTER 1: INTRODUCTION AND SUMMARY**

The overall purpose of this project is to make detailed population and poverty projections that take into account expected demographic changes (in terms of fertility, mortality, migration, and education) as well as differentials in social mobility by household type.

Such projections could be useful for a variety of purposes ranging from assessment of necessary social investments (education facilities, health facilities, pension systems, etc), projections of the size of the working age population who will demand jobs, targeting of poverty alleviation policies, projections of migration flows, to negotiations with external donors and creditors.

The purpose of this report is to present the methodology used to make the model and to present a series of simulation results. Chapter 2 presents the methodology applied as well as all the assumptions used for the central scenario population and poverty projections. Chapter 3 presents the predictions arising from the central scenario in terms of poverty, working age population, etc over the period 1995-2015. Chapter 4 investigates the impact of different socio-economic and demographic factors by comparing the central scenario with alternative scenarios with other assumptions about migration, fertility, education, GDP growth, inequality, etc. Chapter 5 makes a sensitivity analysis on main assumptions using bootstrapping methods. It also assesses the relative importance of different socio-economic and demographic factors in affecting poverty. Finally, Chapter 6 concludes. Appendix A provides a poverty and social mobility analysis of all the factors considered to define relevant population sub-groups, but several of these were found to be of little relevance (such as sex, sex of the head of household, number of adults in the household, and age) in terms of poverty and social mobility. Appendix B includes some technical details.

The results show that at the individual level, the level of education in the household is by far the most important characteristic determining the level of poverty, the degree of vulnerability, and the degree of upward social mobility. Number of children below 15 in the household is also an important determinant of poverty, with many children (4 or more) causing higher poverty, higher vulnerability, and less upward mobility. Location is also important with people in rural areas generally being more poor and more vulnerable. There are exceptions to this rule, however. Individuals living in rural households with high levels of education (at least one person with 4 years of secondary) and few children (3 or less) are very unlikely to become worse off over time and very likely to improve their situation (low vulnerability and high upward social mobility).

Gender was found to have no influence on neither poverty nor social mobility. Poverty and vulnerability were found to decrease with age, and upward mobility to increase with age. This makes sense since people build up assets (both human, physical, and social) over their lives, and this should make them less poor and less vulnerable. This result may be somewhat exaggerated, however, because of the lack of use of equivalence scales in the calculation of poverty lines. In essence, the 4<sup>th</sup> child in a household is assumed to

need the same amount of resources as the first adult, which is clearly not the case. This means that the degree of poverty is generally exaggerated in households with many members (usually many children).

At the national level, the most important variables determining poverty and social mobility are changes in the income distribution and economic growth. Thus, growth is essential for the reduction of poverty in Nicaragua, and the more pro-poor, the better. An important supporting measure, that help reduce poverty is to help families avoid having too many children. Education improvements is also a very important policy initiative, which is particularly pro-poor.

Rural-urban migration is found to help reduce aggregate poverty, but it contributes to increasing urban poverty. This means that special attention is needed to secure that the new migrants arriving to urban areas get adequately and quickly integrated into the urban society with all basic services and as well as job possibilities.

Job creation is going to be a big challenge over the coming decades, as the working age population in Nicaragua will grow dramatically from 2.2 million people in 1995 to about 4.1 million in 2015. This means that around 95,000 new jobs are needed every year in order to keep the population occupied, and 74,000 of these will be needed in urban areas.

The number of children under 15, is expected to reach a maximum of 2.1 million in 2005 and then start falling slowly to just under 2 million in 2015. This does not imply that the need for schools will fall, however, since there is ample room to increase the enrollment rates.

The size of the population of people over 65 is still very small in Nicaragua, but it is expected to more than double from 152 thousand in 1995 to 313 thousand in 2015.

The rapid growth of the working age population together with the fall in number of children and the moderate increase in people over 65, implies that the dependency burden in Nicaragua is destined to fall dramatically. This is a one-time advantage caused by the demographic transition that the country is undergoing, and it is going to help reduce poverty during the coming couple of decades.

However, even under the most favorable conditions, there is no way poverty could be reduced by half by 2015. Actually, anything more than a 10 percent reduction seem unrealistic given the present structure of the population and the economy. Extreme poverty could be reduced by up to 30 percent under the most favorable conditions, but a 15 percent reduction seem more realistic.

## CHAPTER 2: METHODOLOGY

### 2.1. *The multi-state cohort-component model*

Population projections are made using a multi-state cohort-component model with 5-year age groups.

The cohort-component model is somewhat extended compared to the traditional demographic accounting system, since we take into account “migration” not only in geographic terms, but also in terms of poverty, and other relevant socio-demographic factors. Thus, for each sub-group we have the following equation:

$$P1 = P0 + B - D + DNM + INM + POV + SOCIO$$

where:

P1 = population at the end of the period

P0 = population at the beginning of the period

B = births during the period

D = deaths during the period

DNM = domestic net migration during the period

INM = international net migration during the period

POV = net “migration” to other poverty groups

SOCIO = net “migration” to other socio-demographic group

This model is able to treat demographic and socioeconomic changes simultaneously while jointly predicting changes in population composition and poverty.

### 2.2. *Choice of relevant “states”*

The first step is to identify which “states” are relevant, i.e. which individual or household characteristics affect fertility, mortality, migration, poverty and social mobility in a significant way. Appendix A presents poverty and social mobility information for many possible characteristics, such as education level, gender, area of residence, number of children in the household, gender of the head of household, age, and region. Three characteristics were found to be very important determinants of poverty and social mobility: Education level in the household, number of children in the household, and rural/urban location. Table 2.1 shows the distribution of individuals between poverty groups for individuals from different types of households defined by location (rural, urban), highest education level in household (less than four years of secondary, four or more years of secondary), and number of children below 15 years of age (three or less, four or more).



Table 2.1: Poverty distributions for individuals from different household types, 1998 and 2001 (%)

Household type (% in 2001)	1998			2001		
	Extreme Poverty	Moderate Poverty	Non-Poor	Extreme Poverty	Moderate Poverty	Non-Poor
Urban, low edu, few kids (18.3%)	5.7	23.2	71.1	5.0	26.5	68.5
Urban, low edu, many kids (10.6%)	22.0	48.0	30.0	22.4	45.2	32.4
Urban, high edu, few kids (24.9%)	1.1	8.3	90.6	0.3	10.4	89.3
Urban, high edu, many kids (4.2%)	9.0	25.0	66.0	5.7	38.1	56.2
Rural, low edu, few kids (19.9%)	18.5	42.4	39.1	20.5	42.9	36.6
Rural, low edu, many kids (16.2%)	48.1	39.5	12.4	43.9	42.2	13.9
Rural, high edu, few kids (4.0%)	1.1	25.8	73.1	1.8	20.2	78.0
Rural, high edu, many kids (1.8%)	15.9	41.5	42.6	8.5	41.7	49.8
Total (100%)	17.2	30.4	52.4	15.1	30.8	54.2

Note: Author's estimations based on 22793 individuals in EMNV 1998 and 22810 individuals in EMNV 2001 using the expansion factor PESO2.

It is clear that urban households are generally less poor than rural households, but there are very important differences within each area. Individuals from households where at least one person has achieved 4 years of highschool are substantially less poor than individuals from households where the highest education level attained is three years of highschool or less. For example, in 2001 only 1.8 percent of rural individuals from families with few kids and high education were extremely poor, while this was the case for 20.5 percent of rural individuals from families with few kids and low education levels.

Within each location-education combination it is clear that the individuals from households with few children are substantially less poor than individuals from households with many children. For example, the probability of being extremely poor is 5.0 percent for urban individuals with low education and few kids in the household, while it is 22.4 percent for similar individuals from households where there are 4 or more children.

There has been some overall reduction in poverty between 1998 and 2001, but it was very unevenly distributed. Many sub-groups even experienced increases in poverty, and most dramatically so the group of urban individuals from households with high education levels and many kids (the percentage of non-poor dropped from 66.0% to 56.2%). Individuals from rural households with high education levels experienced the largest reductions in poverty, but these comprise less than 6 percent of the total population. In general the overall decrease in poverty of 2.2 percent was due more to "migration" to more favorable groups, than to improvements within groups.

### 2.3. Social Mobility

Very little is known about what influences social mobility, since adequate data has not been available until the release of the Encuesta de Medicion de Niveles de Vida (EMNV) 2001, which tracks most of the individuals that were interviewed in the EMNV 1998. Using those two data sets it is possible to estimate the degree of social mobility for

different types of individuals.

Social mobility can be represented by Markov Transition Matrices, an example of which is shown in Table 2.2. This matrix shows that the probability that an extremely poor individual in Nicaragua in 1998 remain extremely poor in 2001 is 51.2%. The probability that he will be only moderately poor in 2001 is 39.7%, and the probability of escaping poverty altogether is 9.1%. Similarly, the probability that a non-poor individual in 1998 will end up in poverty in 2001 is 1.8% + 16.7% = 18.5%.

*Table 2.2: Markov Transition Matrix for individuals in Nicaragua, 1998-2001*

<i>Poverty classification in 1998</i>	<i>Poverty classification in 2001</i>			
	<b>Extreme Poverty</b>	<b>Moderate Poverty</b>	<b>Non-Poor</b>	<b>Total</b>
<b>Extreme Poverty</b>	0.512	0.397	0.091	<b>1.000</b>
<b>Moderate Poverty</b>	0.173	0.500	0.327	<b>1.000</b>
<b>Non-Poor</b>	0.018	0.167	0.815	<b>1.000</b>

*Note:* Author's estimations based on 13491 matched non-migrant individuals from EMNV 1998 and 2001 using the expansion factor PESO2. Has undergone a bi-proportional adjustment procedure to make the marginal poverty distributions coincide with the actual distributions for the whole population.

These transition probabilities vary greatly between household types, however. Individuals from rural households are generally more vulnerable (downward mobility) than individuals from urban households and individuals from households with many children are generally more vulnerable than individuals from households with fewer children. The level of education in the household is also found to be a very important determinant of social mobility, whereas the sex and age of the head of household are irrelevant as is the number of adults in the household. Since location, education, and number of children are highly correlated it is difficult to say which factors are really important in determining social mobility and which factors are associated with social mobility just because they are associated with those main factors.

In order to find the truly important characteristics, transition matrices were estimated for all the different combinations of the three most important household characteristics: Residence ("rural" or "urban"), number of children in the household ("3 or less" or "4 or more"), and the highest education level in the household<sup>1</sup> ("three years of secondary or less" or "four years of secondary or more"). The results are given in Table 2.3.

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<sup>1</sup> We cannot use the education level of the individual because of the large number of children and young people who are still in school. The highest level of education those kids will eventually get is better approximated by the highest level of education found in the household than by their current level of education.

Table 2.3: Adjusted Markov Transition Matrices for individuals from different household types, 1998-2001

<i>Household type in 1998</i>	<i>Poverty classification in 1998</i>	<i>Poverty classification in 2001</i>			
		<b>Extreme Poverty</b>	<b>Moderate Poverty</b>	<b>Non-Poor</b>	<b>Total</b>
<b>Urban Little education Few children</b>	<b>Extreme Poverty</b>	0.359	0.466	0.175	<b>1.000</b>
	<b>Moderate Poverty</b>	0.094	0.516	0.390	<b>1.000</b>
	<b>Non-Poor</b>	0.011	0.167	0.822	<b>1.000</b>
<b>Urban Little education Many children</b>	<b>Extreme Poverty</b>	0.571	0.332	0.097	<b>1.000</b>
	<b>Moderate Poverty</b>	0.192	0.549	0.259	<b>1.000</b>
	<b>Non-Poor</b>	0.021	0.384	0.596	<b>1.000</b>
<b>Urban More education Few children</b>	<b>Extreme Poverty</b>	0.021	0.187	0.792	<b>1.000</b>
	<b>Moderate Poverty</b>	0.008	0.513	0.480	<b>1.000</b>
	<b>Non-Poor</b>	0.002	0.065	0.932	<b>1.000</b>
<b>Urban More education Many children</b>	<b>Extreme Poverty</b>	0.189	0.757	0.054	<b>1.000</b>
	<b>Moderate Poverty</b>	0.133	0.594	0.273	<b>1.000</b>
	<b>Non-Poor</b>	0.010	0.249	0.741	<b>1.000</b>
<b>Rural Little education Few children</b>	<b>Extreme Poverty</b>	0.529	0.399	0.072	<b>1.000</b>
	<b>Moderate Poverty</b>	0.205	0.532	0.263	<b>1.000</b>
	<b>Non-Poor</b>	0.052	0.332	0.616	<b>1.000</b>
<b>Rural Little education Many children</b>	<b>Extreme Poverty</b>	0.628	0.332	0.039	<b>1.000</b>
	<b>Moderate Poverty</b>	0.307	0.503	0.190	<b>1.000</b>
	<b>Non-Poor</b>	0.124	0.510	0.366	<b>1.000</b>
<b>Rural More education Few children</b>	<b>Extreme Poverty</b>	0.001	0.287	0.712	<b>1.000</b>
	<b>Moderate Poverty</b>	0.070	0.466	0.464	<b>1.000</b>
	<b>Non-Poor</b>	0.000	0.107	0.893	<b>1.000</b>
<b>Rural More education Many children</b>	<b>Extreme Poverty</b>	0.008	0.869	0.123	<b>1.000</b>
	<b>Moderate Poverty</b>	0.202	0.524	0.274	<b>1.000</b>
	<b>Non-Poor</b>	0.000	0.144	0.856	<b>1.000</b>

*Nota:* Author’s estimations based on 13491 matched non-migrant individuals from EMNV 1998 and 2001 using the expansion factor PESO2. Have undergone bi-proportional adjustment procedures to make the sample marginal poverty distributions coincide with the actual marginal distributions for the respective sub-populations.

To facilitate easier comparison of transition matrixes we create an index of downward mobility (vulnerability) and an index of upward mobility. The first is calculated as the sum of the three probabilities of moving to a lower economic level and the second as the sum of the three probabilities of moving up one or two categories between 1998 and 2001. These two indices are shown in Table 2.4 for the eight different household types.

The most common household type is “urban, more education, few children” which is also the most desirable category. Individuals from this category have the lowest degree of vulnerability and the highest degree of upward mobility.

*Table 2.4: Indices of Vulnerability and Upward Mobility, by household type, 1998-2001*

<i>Household type in 1998</i>	<i>% of population</i>	<i>Index of Downward Mobility</i>	<i>Index of Upward Mobility</i>
Urban, little education, few children	18.3	0.272	1.030
Urban, little education, many children	10.6	0.596	0.688
Urban, more education, few children	24.9	0.075	1.459
Urban, more education, many children	4.2	0.393	1.084
Rural, little education, few children	19.9	0.588	0.735
Rural, little education, many children	16.2	0.941	0.562
Rural, more education, few children	4.0	0.177	1.462
<b>Rural, more education, many children</b>	<b>1.8</b>	<b>0.345</b>	<b>1.266</b>

*Note:* Author's estimation based on 13491 matched non-migrant individuals from EMNV 1998 and 2001 using the expansion factor PESO2.

The most vulnerable individuals are the ones from the following household types:

- Rural, low level of education, many children (0.941)
- Urban, low level of education, many children (0.596)
- Rural, low level of education, few children (0.588)

The most upwardly mobile individuals are the ones from the following types of households:

- Rural, high level of education, few children (1.462)
- Urban, high level of education, few children (1.459)
- Rural, high level of education, many children (1.266)

And the individuals with the lowest probabilities of improving their situation are the ones from the following types of households:

- Rural, low level of education, many children (0.562)
- Rural, low level of education, few children (0.735)
- Urban, low level of education, many children (0.688)

It is clear from this simple analysis that by far the most important determinant of social mobility is education, while area of residence and number of children in household is of secondary importance.

Within each location-education combination, the individuals living in households with many children are always more vulnerable and less upwardly mobile than individuals from households with few children.

## 2.4. Social Mobility and Socio-demographic factors

In order to make these mobility matrices more flexible for later use, we will parameterize them in the following way. A matrix consists of nine transition probabilities which we will call  $A_1, A_2, \dots, C_3$ , like this:

	<i>Poverty classification in 2001</i>			
<i>Poverty classification in 1998</i>	<b>Extreme Poverty</b>	<b>Moderate Poverty</b>	<b>Non-Poor</b>	<b>Total</b>
<b>Extreme Poverty</b>	$A_1$	$A_2$	$A_3$	<b>1.000</b>
<b>Moderate Poverty</b>	$B_1$	$B_2$	$B_3$	<b>1.000</b>
<b>Non-Poor</b>	$C_1$	$C_2$	$C_3$	<b>1.000</b>

All probabilities can only take on values between 0 and 1. In addition, we have the following three constraints on the values:

$$\begin{aligned} A_1 + A_2 + A_3 &= 1 \\ B_1 + B_2 + B_3 &= 1 \\ C_1 + C_2 + C_3 &= 1. \end{aligned}$$

In order to make one parameterized matrix out of the 8 matrices in Table 3, we estimate the parameters of the following set of equations:

$$\begin{aligned} A_1 &= \alpha_1 + \alpha_2 \cdot \text{AREA} + \alpha_3 \cdot \text{KIDS} + \alpha_4 \cdot \text{EDU} \\ A_2 &= \alpha_5 + \alpha_6 \cdot \text{AREA} + \alpha_7 \cdot \text{KIDS} + \alpha_8 \cdot \text{EDU} \\ A_3 &= 1 - (A_1 + A_2) \\ B_1 &= \beta_1 + \beta_2 \cdot \text{AREA} + \beta_3 \cdot \text{KIDS} + \beta_4 \cdot \text{EDU} \\ B_2 &= \beta_5 + \beta_6 \cdot \text{AREA} + \beta_7 \cdot \text{KIDS} + \beta_8 \cdot \text{EDU} \\ B_3 &= 1 - (B_1 + B_2) \\ C_1 &= \gamma_1 + \gamma_2 \cdot \text{AREA} + \gamma_3 \cdot \text{KIDS} + \gamma_4 \cdot \text{EDU} \\ C_2 &= \gamma_5 + \gamma_6 \cdot \text{AREA} + \gamma_7 \cdot \text{KIDS} + \gamma_8 \cdot \text{EDU} \\ C_3 &= 1 - (C_1 + C_2), \end{aligned}$$

where AREA is a variable that can take on the value 0 (rural) or 1 (urban), KIDS is a variable that can take on the value 0 (3 children or less in household) or 1 (4 children or more in household), and EDU can take on the value 0 (less than four years of secondary in household) or 1 (four years of secondary education or more in household).

When estimating this system by minimizing the total sum of squared differences between predicted values and the observed values in Table 3 we get the following results:

$$A_1 = 0.464 - 0.007 \cdot \text{AREA} + 0.122 \cdot \text{KIDS} - 0.467 \cdot \text{EDU}$$

(7.0) (-0.1) (1.8) (-7.1)

$$A_2 = 0.282 - 0.036 \cdot \text{AREA} + 0.238 \cdot \text{KIDS} + 0.143 \cdot \text{EDU}$$

$$(1.6) \quad (-0.2) \qquad (1.4) \qquad (0.8)$$

$$A_3 = 1 - (A_1 + A_2)$$

$$B_1 = 0.216 - 0.133 \cdot \text{AREA} + 0.013 \cdot \text{KIDS} - 0.022 \cdot \text{EDU}$$

$$(3.2) \quad (-2.0) \qquad (0.2) \qquad (-0.3)$$

$$B_2 = 0.489 + 0.037 \cdot \text{AREA} + 0.036 \cdot \text{KIDS} - 0.001 \cdot \text{EDU}$$

$$(21.0) \quad (1.6) \qquad (1.5) \qquad (-0.0)$$

$$B_3 = 1 - (B_1 + B_2)$$

$$C_1 = 0.057 - 0.033 \cdot \text{AREA} + 0.023 \cdot \text{KIDS} - 0.049 \cdot \text{EDU}$$

$$(2.4) \quad (-1.4) \qquad (0.9) \qquad (-2.0)$$

$$C_2 = 0.300 - 0.057 \cdot \text{AREA} + 0.154 \cdot \text{KIDS} - 0.207 \cdot \text{EDU}$$

$$(5.3) \quad (-1.0) \qquad (2.7) \qquad (-3.7)$$

$$C_3 = 1 - (C_1 + C_2),$$

where the numbers in parantheses are t-values. Many of the coefficients could not be accurately estimated (t-values less than 2) and it is better to stay with the original 8 matrices in Table 3. Since the table includes all possible combinations (rural, urban, high education, low education, few kids, many kids) little is gained by this parameterization.

However, the parameterization allows us to see how our Downward and Upward Mobility Indices (DMI and UMI) depend on location, education level, and number of children in household.

$$\begin{aligned} \text{DMI} &= B_1 + C_1 + C_2 \\ &= 0.216 - 0.133 \cdot \text{AREA} + 0.013 \cdot \text{KIDS} - 0.022 \cdot \text{EDU} \\ &\quad + 0.057 - 0.033 \cdot \text{AREA} + 0.023 \cdot \text{KIDS} - 0.049 \cdot \text{EDU} \\ &\quad + 0.300 - 0.057 \cdot \text{AREA} + 0.154 \cdot \text{KIDS} - 0.207 \cdot \text{EDU} \\ &= 0.573 - 0.223 \cdot \text{AREA} + 0.190 \cdot \text{KIDS} - 0.278 \cdot \text{EDU} \end{aligned}$$

It is seen that downward mobility (vulnerability) is smaller in urban areas, bigger in households with 4 or more children under 15 and smaller if there is at least one person in the household that has completed four years of secondary education. The effect of education is the strongest of thee three.

$$\begin{aligned} \text{UMI} &= A_2 + A_3 + B_3 = A_2 + 1 - A_1 - A_2 + 1 - B_1 - B_2 = 2 - A_1 - B_1 - B_2 \\ &= 2 - (0.464 - 0.007 \cdot \text{AREA} + 0.122 \cdot \text{KIDS} - 0.467 \cdot \text{EDU}) \\ &\quad - (0.216 - 0.133 \cdot \text{AREA} + 0.013 \cdot \text{KIDS} - 0.022 \cdot \text{EDU}) \\ &\quad - (0.489 + 0.037 \cdot \text{AREA} + 0.036 \cdot \text{KIDS} - 0.001 \cdot \text{EDU}) \end{aligned}$$

$$= 0.831 + 0.103 \cdot \text{AREA} - 0.171 \cdot \text{KIDS} + 0.490 \cdot \text{EDU}.$$

Similarly, living in urban areas adds to upward mobility as does living in a household where at least one person has completed four years of highschool. Living in a household with 4 children or more reduces upward mobility. The high coefficient on EDU indicates that the education level is substantially more important for upward mobility than than location and number of children in the household.

### *2.5. Links between social mobility, economic growth and inequality:*

Between 1998 and 2001, Nicaragua experienced an average annual growth rate in per capita GDP of 2.4% per year and a simultaneous reduction in the GINI coefficient of approximately 1 percentage point per year<sup>2</sup>. The resulting changes in poverty was an overall decrease in poverty of 0.67 percentage points per year and an overall decrease in extreme poverty of 0.73 percentage points per year. The corresponding poverty transition probabilities for the whole population and the eight main sub-groups are found in Table 2 and 3 above.

These matrices were generated over a three-year period, but we need to apply them on 5-year periods in our poverty-population simulations later. In order to do that we assume that a 2.4% annual growth rate over 3 years corresponds to a 1.5% growth rate over 5 years in terms of poverty reduction. Similarly, we assume that a 1 percentage point annual decrease in Gini per year over 3 years corresponds to 0.5 percentage point annual decrease over 5 years.

This gives us a base 5-year transition matrix corresponding to average annual growth of per capita GDP of 1.5% and an average annual reduction in the Gini coefficient of half a percentage point per year.

Little is known about how the social transition matrix would change under alternative assumptions about growth and inequality. A recent investigation into the relationships between growth, income distribution, and poverty in Latin America suggests that poverty is much more responsive to changes in the income distribution than to changes in GDP growth (IPEA 2002). Their estimates for Nicaragua suggest that a reduction in the Gini coefficient of 1 percentage point would achieve the same reduction in extreme poverty as an increase in per capita GDP of 3% - 12%, depending on what poverty line is used (IPEA 2002, Figure 15). Their National Poverty Line (114\$/month in 1999) can be interpreted as the general poverty line and their International Poverty Line (37.2\$/month in 1999) can be interpreted as the extreme poverty line. Thus, we find that a one percentage point decrease in the Gini coefficient would generate the same reduction in extreme poverty as a 12% increase in GDP per capita and the same reduction in general

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<sup>2</sup> The GINI coefficient based on consumption decreased from 0.446 in 1998 to 0.418 in 2001 (calculated from EMNV 1998 and 2001) and the GINI coefficient based on income decreased from 0.603 in 1998 to 0.56 in 2001 (Indice de Desarrollo Humano 2001 and Informe Final del Millenium Development Goals de Nicaragua).

poverty as a 3% increase in GDP per capita. Thus, the effect of inequality changes is about 4 times stronger on extreme poverty than on poverty. Economic growth, on the other hand, has approximately the same effect on poverty and extreme poverty.

These results, however, are not consistent with the observed changes between 1998 and 2001. With approximately a 1 percentage point reduction in Gini per year during the period we would have expected to see extreme poverty fall much more than general poverty, and in fact the difference was only marginal (2.2 percentage points versus 2.0 percentage points).

So instead we assume that changes in the Gini coefficient work only twice as strongly on extreme poverty as on general poverty. If, in addition, we assume that zero growth in per capita GDP combined with zero changes in the income distribution would lead to no reductions in poverty and no reductions in extreme poverty, we can generate a set of plausible relationships between growth, inequality, and poverty reduction as indicated in Table 2.5.

*Table 2.5: Possible relationships between GDP growth, income distribution and poverty reduction.*

Per capita GDP growth rate (% per year)	Change in GINI coefficient (%-points per year)	Reduction in poverty (%-points per year)	Reduction in extreme poverty (%-points per year)
0	0	0	0.0
0	-0.5	0.2	0.4
0	-1.0	0.4	0.8
1.5	0	0.2	0.2
1.5	-0.5	0.4	0.6
1.5	-1.0	0.6	1.0
3	0	0.4	0.4
3	-0.5	0.6	0.8
3	-1.0	0.8	1.2

Note: A compromise between observed macro-values and micro-simulations from IPEA (2002).

These 9 growth-distribution-poverty combinations have been translated into 9 different transition matrices using a bi-proportional adjustment procedure to secure that the implied poverty reductions inherent in the matrices coincide with the targets in Table 2.5. The 9 new transition matrices are shown in Table 2.6.



Table 2.6: Adjusted Markov Transition Matrices for individuals from different household types, 1998-2001

<i>Annual per capita GDP growth rate</i>	<i>Annual change in GINI</i>	<i>Poverty classification in 1998</i>	<i>Poverty classification in 2001</i>			
			<b>Extreme Poverty</b>	<b>Moderate Poverty</b>	<b>Non-Poor</b>	<b>Total</b>
<b>0.0</b>	<b>0.0</b>	<b>Extreme Poverty</b>	0.564	0.364	0.076	<b>1.000</b>
		<b>Moderate Poverty</b>	0.207	0.488	0.306	<b>1.000</b>
		<b>Non-Poor</b>	0.023	0.179	0.797	<b>1.000</b>
<b>0.0</b>	<b>-0.5</b>	<b>Extreme Poverty</b>	0.515	0.401	0.085	<b>1.000</b>
		<b>Moderate Poverty</b>	0.176	0.502	0.322	<b>1.000</b>
		<b>Non-Poor</b>	0.019	0.177	0.804	<b>1.000</b>
<b>0.0</b>	<b>-1.0</b>	<b>Extreme Poverty</b>	0.464	0.441	0.095	<b>1.000</b>
		<b>Moderate Poverty</b>	0.148	0.515	0.336	<b>1.000</b>
		<b>Non-Poor</b>	0.015	0.175	0.810	<b>1.000</b>
<b>1.5</b>	<b>0.0</b>	<b>Extreme Poverty</b>	0.540	0.378	0.082	<b>1.000</b>
		<b>Moderate Poverty</b>	0.191	0.489	0.320	<b>1.000</b>
		<b>Non-Poor</b>	0.021	0.174	0.806	<b>1.000</b>
<b>1.5</b>	<b>-0.5</b>	<b>Extreme Poverty</b>	0.507	0.403	0.090	<b>1.000</b>
		<b>Moderate Poverty</b>	0.171	0.495	0.335	<b>1.000</b>
		<b>Non-Poor</b>	0.018	0.169	0.813	<b>1.000</b>
<b>1.5</b>	<b>-1.0</b>	<b>Extreme Poverty</b>	0.437	0.460	0.104	<b>1.000</b>
		<b>Moderate Poverty</b>	0.134	0.515	0.351	<b>1.000</b>
		<b>Non-Poor</b>	0.013	0.169	0.818	<b>1.000</b>
<b>3.0</b>	<b>0.0</b>	<b>Extreme Poverty</b>	0.517	0.394	0.090	<b>1.000</b>
		<b>Moderate Poverty</b>	0.176	0.489	0.335	<b>1.000</b>
		<b>Non-Poor</b>	0.018	0.168	0.814	<b>1.000</b>
<b>3.0</b>	<b>-0.5</b>	<b>Extreme Poverty</b>	0.465	0.434	0.101	<b>1.000</b>
		<b>Moderate Poverty</b>	0.148	0.502	0.349	<b>1.000</b>
		<b>Non-Poor</b>	0.015	0.166	0.820	<b>1.000</b>
<b>3.0</b>	<b>-1.0</b>	<b>Extreme Poverty</b>	0.408	0.478	0.113	<b>1.000</b>
		<b>Moderate Poverty</b>	0.120	0.514	0.366	<b>1.000</b>
		<b>Non-Poor</b>	0.012	0.164	0.825	<b>1.000</b>

Source: Author's estimations.

By comparing Table 2.3 and Table 2.6 it is seen that the differences due to economic factors (GDP growth and changes in the income distribution) are much smaller than the differences due to socio-demographic factors (education, residence, and number of children). This suggests that socio-demographic factors are extremely important in the determination of poverty.

In order to make these mobility matrices more flexible for later use, we will parameterize them in the following way. We call the nine transition probabilities  $X_1, X_2, \dots, Z_3$ , like this:

	<i>Poverty classification in 2001</i>			
<i>Poverty classification in 1998</i>	<b>Extreme Poverty</b>	<b>Moderate Poverty</b>	<b>Non-Poor</b>	<b>Total</b>
<b>Extreme Poverty</b>	$X_1$	$X_2$	$X_3$	<b>1.000</b>
<b>Moderate Poverty</b>	$Y_1$	$Y_2$	$Y_3$	<b>1.000</b>
<b>Non-Poor</b>	$Z_1$	$Z_2$	$Z_3$	<b>1.000</b>

All probabilities can only take on values between 0 and 1. In addition, we have the following three constraints on the values:

$$\begin{aligned} X_1 + X_2 + X_3 &= 1 \\ Y_1 + Y_2 + Y_3 &= 1 \\ Z_1 + Z_2 + Z_3 &= 1. \end{aligned}$$

In an attempt to make one parameterized matrix out of the 9 matrices in Table 2.6, we estimate the parameters of the following set of equations:

$$\begin{aligned} X_1 &= \mu_1 + \mu_2 \cdot \text{GDP} + \mu_3 \cdot \text{GINI} \\ X_2 &= \mu_4 + \mu_5 \cdot \text{GDP} + \mu_6 \cdot \text{GINI} \\ X_3 &= 1 - (X_1 + X_2) \\ Y_1 &= \pi_1 + \pi_2 \cdot \text{GDP} + \pi_3 \cdot \text{GINI} \\ Y_2 &= \pi_4 + \pi_5 \cdot \text{GDP} + \pi_6 \cdot \text{GINI} \\ Y_3 &= 1 - (Y_1 + Y_2) \\ Z_1 &= \omega_1 + \omega_2 \cdot \text{GDP} + \omega_3 \cdot \text{GINI} \\ Z_2 &= \omega_4 + \omega_5 \cdot \text{GDP} + \omega_6 \cdot \text{GINI} \\ Z_3 &= 1 - (Z_1 + Z_2). \end{aligned}$$

Where GDP is a variable indicating the average annual growth rate of per capita GDP and GINI is a variable indicating the average annual percentage point change in the Gini coefficient.

Estimating this system by minimizing the squared differences between predicted values and the observed values in Table 2.6 yields the following results:

$$X_1 = 0.568 - 0.017 \cdot \text{GDP} + 0.104 \cdot \text{GINI}$$

$$(116.3) \quad (-8.5) \quad (17.4)$$

$$X_2 = 0.360 + 0.011 \cdot \text{GDP} - 0.081 \cdot \text{GINI}$$

$$(85.7) \quad (6.5) \quad (-15.8)$$

$$X_3 = 1 - (X_1 + X_2)$$

$$Y_1 = 0.207 - 0.010 \cdot \text{GDP} + 0.057 \cdot \text{GINI}$$

$$(92.0) \quad (-10.5) \quad (20.8)$$

$$Y_2 = 0.488 + 0.0000 \cdot \text{GDP} - 0.026 \cdot \text{GINI}$$

$$(276.7) \quad (0.0) \quad (-12.0)$$

$$Y_3 = 1 - (Y_1 + Y_2)$$

$$Z_1 = 0.023 - 0.0013 \cdot \text{GDP} + 0.0073 \cdot \text{GINI}$$

$$(56.1) \quad (-8.4) \quad (14.8)$$

$$Z_2 = 0.179 - 0.0037 \cdot \text{GDP} + 0.0043 \cdot \text{GINI}$$

$$(270.9) \quad (-13.6) \quad (5.4)$$

$$Z_3 = 1 - (Z_1 + Z_2).$$

Unlike the parameterization in the previous section, these parameters are very precisely estimated, and the parameterization is useful as it will allow the user to choose combinations of growth and inequality changes that are not already shown in Table 2.6.

The coefficients in the X-equations are much bigger than the coefficients in the Y-equation and Z-equation, which indicates that the extremely poor are much more sensitive to changes in GDP growth and changes in the income distribution. Thus, if the economy is doing well, the extremely poor tend to benefit relatively more than the moderately poor and the non-poor. But they also tend to suffer more if the economy is doing bad.

Since the Downward Mobility Index (DMI) is calculated as  $Y_1 + Z_1 + Z_2$ , we can rearrange the equations above and see that vulnerability decreases with increases in per capita GDP growth rates and increases with increases in the GINI coefficient in the following way:

$$\text{DMI} = Y_1 + Z_1 + Z_2 = 0.509 - 0.0150 \cdot \text{GDP} + 0.0686 \cdot \text{GINI}.$$

It is clear that a 1 percentage point decrease in the Gini coefficient has a much higher impact on vulnerability than a 1% increase in per capita GDP.

Similarly, we can calculate an equation for the Upward Mobility Index (UMI):

$$UMI = X_2 + X_3 + Y_3 = 0.737 + 0.007 \cdot GDP - 0.135 \cdot GINI.$$

Again it is clear that changes in the Gini coefficient have a much larger impact on upward mobility than growth of per capita GDP.

## 2.6. Combining economic and socio-demographic factors in a set of transition matrices:

In order to combine socio-demographic factors and economic factors into the same transition matrix we will use the 8 complete socio-demographic transition matrices of Table 2.3 as constant terms and use the estimated parameters  $\mu_2, \mu_3, \mu_5, \mu_6, \pi_2, \pi_3, \pi_5, \pi_6, \omega_2, \omega_3, \omega_5,$  and  $\omega_6$  to adjust for changes in GDP and GINI. GDP growth and changes in the GINI coefficient have to be measured relative to the base values (1.5 percent growth and -0.5 percentage point change in GINI per year).

For example, the transition probabilities for urban individuals living in households with few kids and a high level of education in a period with average per capita GDP growth rates of 4.5% per year (3.0% more than the base) and an annual reduction in the Gini coefficient of 1.5 percentage point (1 percentage point better than the base case) would be the following:

	<i>Poverty classification in 2001</i>			
<i>Poverty classification in 1998</i>	<b>Extreme Poverty</b>	<b>Moderate Poverty</b>	<b>Non-Poor</b>	<b>Total</b>
<b>Extreme Poverty</b>	0.021 - 0.017·3 - 0.104·1 = 0.000	0.187 + 0.011·3 + 0.081·1 = 0.301	1 - 0.000 - 0.301 = 0.699	<b>1.000</b>
<b>Moderate Poverty</b>	0.008 - 0.010·3 - 0.057·1 = 0.000	0.513 + 0.000·3 + 0.026·1 = 0.539	1 - 0.000 - 0.539 = 0.461	<b>1.000</b>
<b>Non-Poor</b>	0.002 - 0.0013·3 - 0.0073·1 = 0.000	0.065 - 0.0037·3 - 0.0043·1 = 0.050	1 - 0.000 - 0.050 = 0.950	<b>1.000</b>

whereas persons from rural households with many kids and little education under the same economic conditions would have the following transition matrix:

	<i>Poverty classification in 2001</i>			
<i>Poverty classification in 1998</i>	<b>Extreme Poverty</b>	<b>Moderate Poverty</b>	<b>Non-Poor</b>	<b>Total</b>
<b>Extreme Poverty</b>	0.628 - 0.017·3 - 0.104·1 = 0.473	0.332 + 0.011·3 + 0.081·1 = 0.446	1 - 0.473 - 0.446 = 0.081	<b>1.000</b>
<b>Moderate Poverty</b>	0.307 - 0.010·3 - 0.057·1 = 0.220	0.503 + 0.000·3 + 0.026·1 = 0.529	1 - 0.220 - 0.529 = 0.251	<b>1.000</b>
<b>Non-Poor</b>	0.124 - 0.0013·3 - 0.0073·1 = 0.113	0.510 - 0.0037·3 - 0.0043·1 = 0.495	1 - 0.113 - 0.495 = 0.392	<b>1.000</b>

In the case of less favorable economic conditions (GDP growth of 1.5% and an increase in the Gini coefficient of 0.5 percentage point per year) the transition matrix for the latter persons would be:

	<i>Poverty classification in 2001</i>			
<i>Poverty classification in 1998</i>	<b>Extreme Poverty</b>	<b>Moderate Poverty</b>	<b>Non-Poor</b>	<b>Total</b>
<b>Extreme Poverty</b>	0.628 - 0.017·0 + 0.104·1 = 0.732	0.332 + 0.011·0 - 0.081·1 = 0.251	1 - 0.732 - 0.251 = 0.017	<b>1.000</b>
<b>Moderate Poverty</b>	0.307 - 0.010·0 + 0.057·1 = 0.364	0.503 + 0.000·0 - 0.026·1 = 0.477	1 - 0.364 - 0.477 = 0.159	<b>1.000</b>
<b>Non-Poor</b>	0.124 - 0.0013·0 + 0.0073·1 = 0.131	0.510 - 0.0037·0 + 0.0043·1 = 0.514	1 - 0.131 - 0.514 = 0.355	<b>1.000</b>

In some extreme cases some of these transition probabilities may turn slightly negative using these equations. In those cases they are set at zero, since transition probabilities can never be negative.

## *2.7. Fertility and family formation assumptions for the central scenario*

For our simulation model, we need age-specific fertility rates for the main categories of women in our model.

Table 2.7 shows that the age specific fertility rates vary dramatically by education level and area of residence. The education level is particularly important for teenage fertility with rates substantially lower for women with secondary education. Location is particularly important for the fertility rates for women of 35 or older. Rural women with

little education keep having high fertility rates after their 35<sup>th</sup> year, while for the three other groups the rate falls dramatically.

*Table 2.7: Age-specific Fertility Rates, by location and education level, 1998-2001*

Age groups	Category				Total
	Urban, low edu.	Urban, high edu.	Rural, low edu.	Rural, high edu.	
15-19	179	70	178	89	119
20-24	194	130	241	163	178
25-29	125	117	190	165	145
30-34	91	88	150	93	108
35-39	44	36	115	46	64
40-44	19	7	51	5	26
45-49	3	0	13	0	6

*Note:* Births per 1000 women per year in the 36 months preceding the survey.

*Source:* Special tabulations made by Oscar Estrada at INEC based on ENDESA 2001 using the 3 years previous to the survey.

These fertility rates were estimated for the 1998-2001 period, but for the simulation program we need rates for the 1995-2000 period. If we increase all numbers in Table 2.7 by 10% we get fertility rates that are slightly lower than the official estimates based solely on 1995 census information, but compatible with the ENDESA 2001 given the rapidly declining fertility trend indicated by this survey.

Table 2.8 shows the recent trends in age-specific fertility rates as calculated from the ENDESA 2001. These numbers indicate that fertility reductions have been larger for older age-groups than for younger age groups.

*Table 2.8: Trends in age-specific fertility rates, ENDESA 2001*

Mother's age at birth	Number of years preceding the survey				Average rate of reduction (% per 5-year period)
	0-4	5-9	10-14	15-19	
15-19	119	150	163	173	11%
20-24	182	242	257	289	14%
25-29	149	210	227	280	18%
30-34	114	158	175	[ 225	20%
35-39	67	95	[ 128	na	28%
40-44	28	[ 50	na	na	-
45-49	[ 6	na	na	na	-

*Notes:* Age-specific fertility rates are per 1,000 women.

Estimates preceded by a bracket are truncated.

na= not applicable.

*Source:* INEC & MINSA (2001) Table 4.3.1.

For the central scenario we therefore depart from the 4 age-specific fertility tables in Table 2.7 (+10%) and reduce the fertility in each age-group by the following percentages each 5-year period:

15-19: 11%  
 20-24: 14%  
 25-29: 18%  
 30-34: 20%  
 35-39: 28%  
 40-44: 28%  
 45-49: 28%

We do not have evidence to suggest that the pattern of fertility reduction would be different between the four main sub-groups, so the same rates of reduction are used for all types of women.

We will use the same boy/girl birth-ratio as INEC (n.d.): 1.050.

The number of children under 15 in each household is closely linked to fertility rates, and with falling fertility rates we would expect the proportion of people living in households with 4 or more children would fall. Fertility rates are not the only determinant of household size, however. A decreasing tendency to live in three generation or extended households, for example, would accelerate the drop in the proportion of people living in households with many children. The same holds for an increase in divorce rates.

Table 2.9 shows that urban households on average have 5.0 members, while rural households have 5.7 members. There is quite a lot of variation, however, and we need this variation to create sub-groups with many children and few children. Households with 9 members or more are more frequent in rural areas than households with only 3 members.

*Table 2.9: Household composition by residence, ENDESA 2001*

Number of household members	Residence		
	Urban	Rural	Total
1	4.4	2.8	3.8
2	8.4	6.4	7.6
3	14.3	11.8	13.3
4	21.0	16.3	19.1
5	16.7	16.1	16.4
6	12.4	13.5	12.9
7	8.2	11.4	9.5
8	5.4	7.6	6.3
9+	9.0	14.0	11.0
Total	100.0	100.0	100.0
Number of households	6,761	4,567	11,328
Average number of members	5.0	5.7	5.3

Note: Table is based on de jure members, i.e., usual residents.

Source: INEC & MINSA (2002), Table 2.2.1.

The variable that is important for our projections is the number of children younger than 15 in the household. Actually, all we need to know is the percentage of people living in households that have 4 children or more. Table 2.10 shows that this percentage has decreased from 44.7% in 1995 to 32.6% in 2001.

The total reduction in population living in households with 4 or more children has been larger than the reduction within each of the 4 sub-groups. This is due to the fact that there has been a simultaneous movement of population towards sub-groups with fewer children (i.e. urban and high education).

Table 2.10: Trends in household size, 1995-1998-2001

Year	% of individuals who live in a household with 4 or more children (< 15 years old)				
	Rural		Urban		Total
	Low edu.	High edu.	Low edu.	High edu.	
1995 (censo)	56.4	39.9	43.8	27.2	44.7
1998 (EMNV)	47.4	36.1	43.0	23.8	35.8
2001 (EMNV)	46.6	34.7	38.8	20.8	32.6
Average annual growth rate in the population living in households with 4 or more children (%)	-3.1	-2.3	-2.0	-4.4	-5.1

Source: Author's calculations based on all individuals in EMNV 98 and EMNV 2001.

If the trends observed between 1995 and 2001 continue, we will have the following percentages of individuals living in households with 4 children or more in 2015:

- Rural, low education: 29.9%
- Rural, high education: 25.1%
- Urban, low education: 29.2%
- Urban, high education: 11.1%

These trends are not only the result of decreasing fertility, but also a result of changes in the patterns of living arrangements.

In order to link fertility rates with the proportion of the population living in households with 4 or more children we make a simple interpolation between the above-mentioned central scenario combination and an alternative combination with zero reductions in fertility rates and zero changes in household size. Thus, if fertility rates on average are lower than in the central scenario, the proportion of people in households with few children in each location-education category would be higher, and vice versa.



## 2.8. Mortality assumptions for the central scenario

Mortality rates are estimated and projected separately for under-fives and the rest.

### Under-five mortality

Table 2.11 shows recent trends in infant and child mortality rates as calculated from the ENDESA 2001. Infant mortality rates have decreased at an average rate of 26% per 5-year period and child mortality rates have decreased at an average rate of 20% leading to an overall reduction in the under-5 mortality rate of about 24% per 5-year period. The reduction was much larger between 1987-91 and 1992-96 (30%) than between 1992-96 and 1997-2001 (18%). It therefore seems reasonable to assume that the rate of reduction in under-five mortality is slowing down.

*Table 2.11: Trends in infant and child mortality, ENDESA 2001*

Years preceding the survey	Approximate calendar year <sup>1</sup>	Infant mortality (1Q0)	Child mortality (4Q1)	Under-five mortality (5Q0)
0-4	1997-2001	31	9	40
5-9	1992-1996	39	11	49
10-14	1987-1991	57	14	70

*Notes:* <sup>1</sup> Because survey fieldwork was conducted from September 12 through December 10, the rates for the five-year period 1997-2001 actually apply to the calendar period from November 1996 to November 2001. Similarly for the other rates.

*Source:* INEC & MINSA (2002), Table 8.1.

If we assume that the under-five mortality rate will continue to be reduced by 15% for each 5-year period the under-five mortality rate will fall from 40 deaths per thousand births now to 25 per thousand births in 2015.

Again, there are big differences between sub-groups. Table 2.12 shows that mortality is much higher in rural areas than urban areas and that mortality is very sensitive to the level of education of the mother.

*Table 2.12: Infant and child mortality by background characteristics, ENDESA 2001*

Background characteristic	Infant mortality (1Q0)	Child mortality (4Q1)	Under-five mortality (5Q0)
Urban, low edu.	36	9	44
Urban, high edu.	20	4	24
Rural, low edu.	44	14	58
Rural, high edu.	29	2	31
Total	35	10	45

*Note:* Calculated for the 10-year period before the survey, approximately 1991-2001.

*Source:* Special tabulation made by Oscar Estrada at INEC based on ENDESA 2001.

For the central scenario, we assume that each of these are reduced by 15% per 5-year period.

### **Over-five mortality**

For the general trend in mortality, we will use the projections by INEC (n.d.) presented here in Table 2.13:

*Table 2.13: Projections for life-expectancy at birth in Nicaragua*

	Men	Women	Difference
1995-2000	65.65	70.36	4.71
2000-2005	67.15	71.92	4.76
2005-2010	68.65	73.48	4.81
2010-2015	69.85	74.74	4.86

*Source:* INEC (n.d.)

INEC (n.d.) also presents corresponding model life tables (see Table 2.14). We will use these survival probabilities for all our groups of age 5 and older. Only for under-fives will we assume different mortality patterns by household type.

*Table 2.14: Model life tables from INEC, Nicaragua 1995-2015.*

Men				
Age group	1995-2000	2000-2005	2005-2010	2010-2015
0-4	0.95113	0.95645	0.9619	0.96609
5-9	0.98983	0.99128	0.99229	0.99308
10-14	0.99609	0.99664	0.99701	0.9973
15-19	0.99395	0.99482	0.99541	0.99587
20-24	0.98889	0.99051	0.99161	0.99245
25-29	0.98522	0.98731	0.98875	0.98985
30-34	0.98243	0.98479	0.98643	0.9877
35-39	0.97869	0.98134	0.98325	0.98472
40-44	0.97311	0.97616	0.97846	0.98023
45-49	0.96583	0.96924	0.97199	0.97411
50-54	0.95564	0.95937	0.9627	0.96527
55-59	0.9399	0.94405	0.94828	0.95154
60-64	0.91685	0.92142	0.92688	0.93109
65-69	0.88297	0.88798	0.89514	0.90067
70-74	0.83502	0.8404	0.84968	0.85683
75-79	0.76969	0.7753	0.7868	0.79566
80+	0.52635	0.53503	0.54787	0.55769

Women				
Age group	1995-2000	2000-2005	2005-2010	2010-2015
0-4	0.9618	0.96581	0.96996	0.97314
5-9	0.99146	0.99263	0.99352	0.9942
10-14	0.99639	0.99689	0.99726	0.99754
15-19	0.99572	0.99632	0.99675	0.99708
20-24	0.99395	0.99479	0.9954	0.99586
25-29	0.99278	0.99376	0.99446	0.99501
30-34	0.99115	0.9923	0.99315	0.9938
35-39	0.98859	0.99001	0.99109	0.99191
40-44	0.98453	0.98638	0.9878	0.9889
45-49	0.97809	0.98059	0.98259	0.98411
50-54	0.96844	0.97188	0.9747	0.97686
55-59	0.95479	0.95946	0.96344	0.96649
60-64	0.93401	0.94042	0.94618	0.95059
65-69	0.90327	0.91201	0.9203	0.92666
70-74	0.86028	0.87166	0.8833	0.89223
75-79	0.80075	0.81471	0.83053	0.84266
80+	0.55263	0.56615	0.58359	0.59676

Source: INEC (n.d.).

## 2.9. International migration assumptions for the central scenario

Table 2.15 shows a dramatic increase in the number of Nicaraguans living abroad from less than 50,000 in the 1970s to more than 500,000 in the 1990s. This corresponds to annual net-migration flows in the order of 20,000 people. Some sources suggest even higher figures.

*Table 2.15: Nicaraguans living abroad, 1970-2000*

Country	1970s	1980s	1990s	2000
Costa Rica	23,331	45,918	310,000	350,000
Canada	ND	270	8,545	ND
United States	16,125	44,166	168,659	178,000
Total	49,126	107,153	503,366	628,000
Population in Nicaragua	2,498,000	3,404,000	4,426,000	5,074,000
% living abroad	2.0	3.1	11.4	12.4

Source: Baumeister (2002), Table 11.

While international migration flows are difficult to measure accurately, they are even more difficult to predict.

The projections by INEC(n.d.) are very crude:

1995-2000:	60,000 persons
2000-2005:	30,000 persons
2005-2010:	20,000 persons
2010-2015:	10,000 persons

The main reason for the expected reductions in out-migration is an expected increase in in-migration restrictions in receiving countries.

These projections are not in agreement with Baumeister (2002) who suggests that Nicaragua has a big potential for generating migrants in the coming decades. He lists several reasons. First, the rate of growth of the working age population in Nicaragua will be among the highest in the world, and much higher than in the main receiving countries: Costa Rica, United States, Mexico and Canada. Second, domestic generation of jobs is unlikely to be able to keep up with the growth in the working age population. Third, demographic changes in receiving countries will increase the demand for cheap labor. For our central scenario we will assume that net international migration stays at 60,000 per five-year period.

Differences in migration patterns by household type can be investigated using the ENDESA surveys. Table 2.16 indicates that the migrants to Costa Rica generally come from less educated households while migrants to United States come from households with more than average education. These differences tend to average out so that there is no reason to estimate separate migration tables by education level.

*Table 2.16: Distribution of households, by migration status and education level of the head of household, ENDESA 1998*

Education of head of household	All households	Households with migrants in Costa Rica	Households with migrants in United States	Households with migrants in CR or USA
None	31.0	35.7	17.7	29.0
Alphabetized	2.5	2.2	1.2	1.8
Primary	43.1	45.5	40.4	43.6
Secondary	16.0	13.3	24.2	17.4
Technical or more	7.4	3.3	16.5	8.2
Total	100.0	100	100	100.0
(obs)	(12296)	(857)	(508)	(1365)

Source: Baumeister (2002), Table 7.

Migration probabilities are almost equal by sex but vary dramatically by age. INEC (n.d.) presents useful estimates of the sex and age-structure of migrants, which we can apply to the expected aggregate number of migrants within each of our sub-groups. See Table 2.17.

*Table 2.17: Estimated sex and age-structure of international migrants*

Age-group	Men	Women
0-4	1.10	1.06
5-9	3.10	3.00
10-14	3.40	3.30
15-19	7.20	5.00
20-24	10.00	7.50
25-29	9.00	7.40
30-34	6.60	5.00
35-39	4.80	4.30
40-44	3.00	3.00
45-49	1.90	2.10
50-54	1.50	1.80
55-59	0.80	0.90
60-64	0.50	0.54
65-69	0.40	0.40
70-74	0.30	0.30
75-79	0.20	0.20
80+	0.20	0.20
Total	54.00	46.00

Source: INEC (n.d.).

## 2.10. Internal migration assumptions for the central scenario

The distribution of the population between the three macro-regions of Nicaragua has been remarkably stable during the last 50 years. Table 2.18 shows that the Pacific region, which includes Managua, has increased its share only slightly from 55.7% in 1950 to 57.7% in 1995. There has been some migration from the Central region to the Atlantic region associated with the eastward expansion of the agricultural frontier. However, for this study I suggest that we ignore the movement of the agricultural frontier, and concentrate on rural-urban migration<sup>3</sup>.

*Table 2.18: Distribution of population across macro-regions, 1950-1995*

Year	Pacific	Central	Atlantic
1950	55.7	37.0	7.3
1995	57.7	29.8	12.5

Source: Baumeister (2002), Table 1.13.

Rural-urban migration has been important. Table 2.19 shows that the proportion of the population living in urban areas increased from 35.2% in 1950 to 54.4% in 1995, with the growth of other urban areas than Managua accounting for most of the growth, especially after 1971.

*Table 2.19: Proportion of population in urban areas, 1950-1995*

Year	Managua (%)	Other urban Areas (%)	Urban (%)
1950	15.4	19.8	35.2
1963	20.8	20.1	40.9
1971	25.9	21.8	47.7
1995	20.9	33.5	54.4

Source: Baumeister (2002), Table 3.2.

Baumeister (personal communication) predicts that urbanization will continue so that the degree of urbanization will reach 65% in 2015. We will therefore use the following projections for the urbanization rate to estimate overall rural-urban migration flows in the central scenario:

- 1995: 54.4%
- 2000: 57.1%
- 2005: 59.7%
- 2010: 62.4%
- 2015: 65.0%

---

<sup>3</sup> The movement of the agricultural frontier and its implications in terms of deforestation and agricultural productivity is much better analyzed in a geographically explicit framework using information from satellite images combined with municipal level data on economic variables. This has been done with great success for the Brazilian Amazon by Eustáquio J. Reis and others at IPEA in Rio de Janeiro.

Table 2.20 shows that the 126,266 people who had moved in the five-year period before the 1995 census were slightly better educated than those who had not moved. The difference, however is small and in the model we will assume that different education groups have the same migration probabilities.

*Table 2.20: Average years of education by migration status and gender, 1995*

Sex	Migrant (1990-1995)	Non-migrant (1990-1995)	Total 1995
Men	3.80	3.62	3.62
Women	4.06	3.85	3.86
Total	3.94	3.73	3.74

*Source:* Special tabulations made by Jorge Rodriguez at CEPAL using the 1995 census.

Table 2.21 shows that women have a slightly higher migration propensity than men, but again the differences are so small that it is not necessary to take it into account in the simulation model.

*Table 2.21: Gender distribution of migrants, 1990-1995*

Sex	Migrant (1990-1995)	Non-migrant (1990-1995)	Total 1995
Men	47.2%	49.0%	48.9%
Women	52.8%	51.0%	51.1%
Total	100.0%	100.0%	100.0%

*Source:* Special tabulations made by Jorge Rodriguez at CEPAL using the 1995 census.

Table 2.22 shows that the age-groups 0-4, 15-24, and 30-39 are over-represented among the migrants, whereas children of primary school age (5-14) are under-represented. People over 40 are also generally under-represented among the migrants. This seems quite reasonable, so we will use the estimated age-distribution for Migrants in Table 23 to distribute our total number of rural-urban migrants among age-groups.

*Table 2.22: Age distribution of rural migrants and rural non-migrants, 1998*

Age group 1998	Migrant (1998-2001)	Non-migrant (1998-2001)	Total rural 1998
0-4	17.4	14.3	15.5
5-9	15.1	16.0	15.7
10-14	12.3	14.6	13.7
15-19	12.7	12.2	12.4
20-24	10.3	7.8	8.8
25-29	6.4	6.6	6.5
30-34	5.3	4.6	4.8
35-39	5.1	4.6	4.8
40-44	3.2	3.9	3.7
45-49	2.4	3.4	3.0
50-54	2.4	3.2	2.9
55-59	1.9	2.5	2.3
60-64	1.7	1.5	1.6
65-69	1.4	1.3	1.3
70-74	0.7	0.9	0.8
75-80	0.5	0.7	0.6
80+	1.3	1.0	1.1
Total	100.0	100.0	100.0

*Source:* Author's calculations based on EMNV 98 and EMNV 2001.

### *2.11. Education assumptions for the central scenario*

Table 2.23 shows the percentage of individuals who live in households where at least one person has completed 4 years of high school. Overall this percentage increased from 29.2% in 1995 to 34.9% in 2001. This corresponds to an average annual increase of 3.0%, but with the largest increases taking place in rural areas.

*Table 2.23: Trends in education levels, 1995-1998-2001*

Year	% of individuals who live in a household where at least one person has completed high school		
	Rural	Urban	Total
1995	9.0	46.3	29.2
1998	14.4	46.6	31.9
2001	13.8	50.1	34.9
Average annual increase 1995- 2001 (%)	7.4	1.3	3.0

*Source:* Author's calculations based on all individuals in EMNV 98 and EMNV 2001.

For the central scenario, we will assume that education levels keep improving at these rates. This will imply that about 37% of rural individuals and 60% of urban individuals



will live in households with at least 4 years of secondary education in 2015. This does not seem unrealistic.

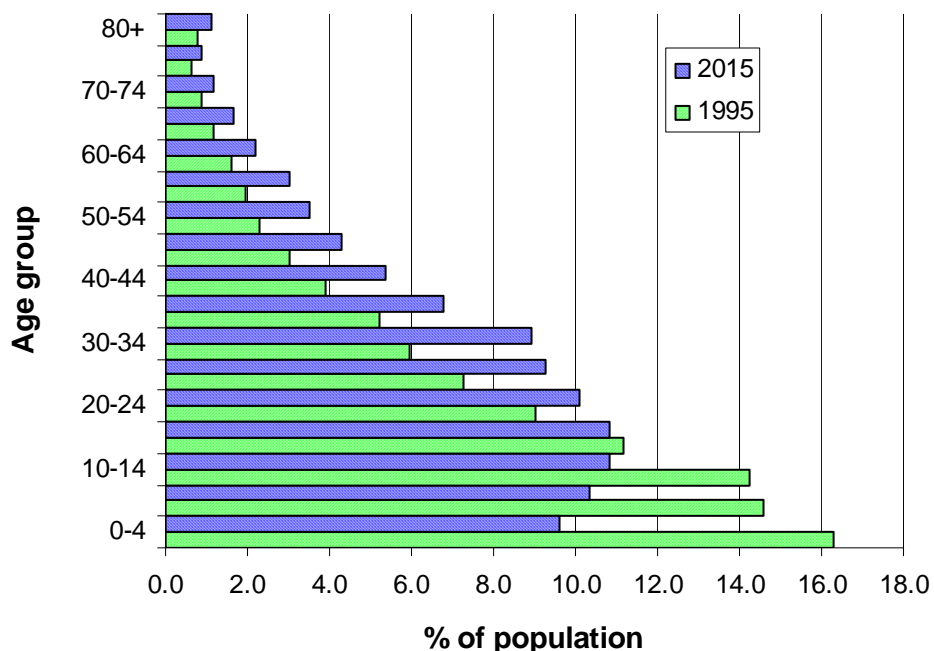
## CHAPTER 3: SIMULATION RESULTS FOR THE CENTRAL SCENARIO

The central scenario assumptions presented in the previous chapter are considered the “most likely” and in this section we present the predictions that arise from these assumptions. Per capita GDP growth is fixed at an average of 2.0 percent per year, while the improvement in the income distribution is fixed at an average of –0.3 GINI points per year, amounting to a reduction in the GINI coefficient of 6 percentage points over the 20 year period from 1995 to 2015. These and other important assumptions are subjected to a thorough sensitivity analysis in Chapter 5.

### 3.1. Population structure

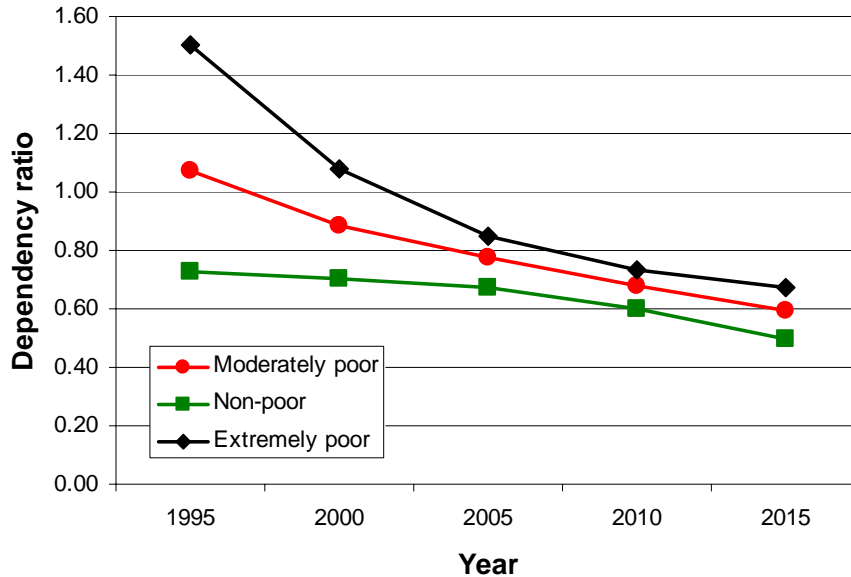
The expected continued fall in fertility combined with lower mortality will cause a significant change in the age pyramid over the 1995-2015 period. The share of the population of age 0-14 year olds will decrease from 45.1 percent in 1995 to 30.8 percent in 2015 (see Figure 3.1). The age groups of 65 + will increase, but only from 3.5 percent of the population to 4.9 percent of the population. Overall a dramatic decrease in the dependency burden is predicted.

Figure 3.1: Age distribution of the population in the base scenario, 1995-2015.



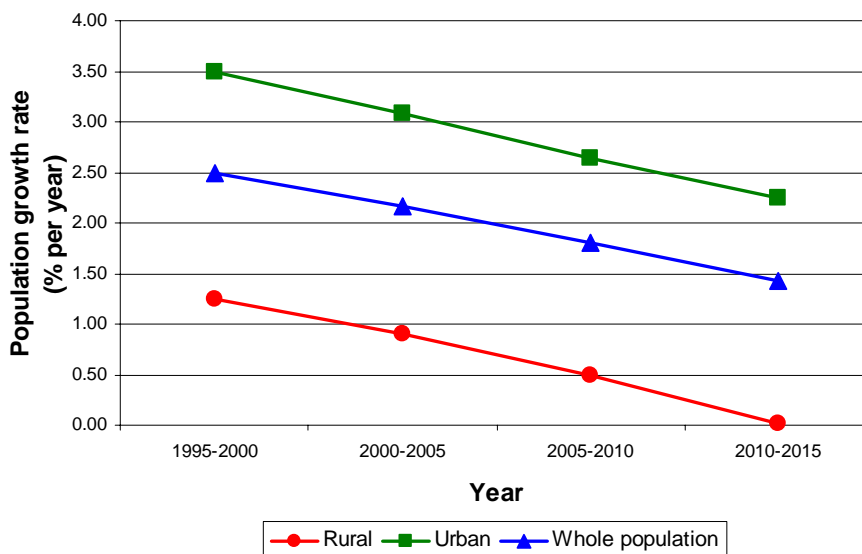
The dependency burden is predicted to fall from 0.95 in 1995 to 0.55 in 2015, but the most dramatic fall is expected among the extremely poor, where we will see a fall from 1.50 in 1995 to 0.67 in 2015 (see Figure 3.2).

Figure 3.2: Dependency burdens in the base scenario, by poverty group, 1995-2015



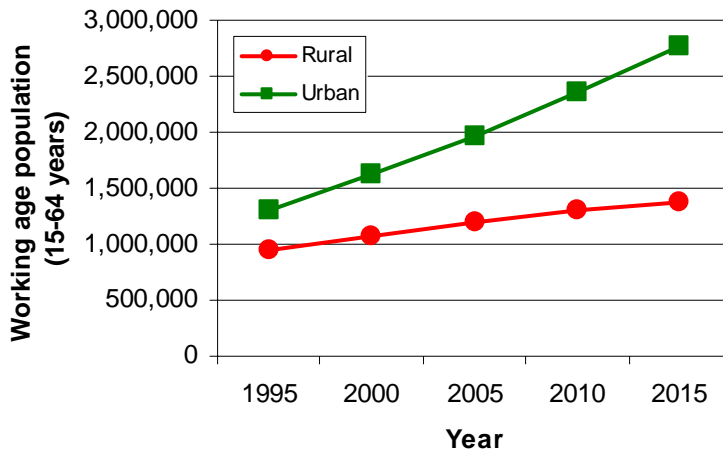
The expected fall in fertility rates in the base scenario will cause the crude birth rate to fall from an average of 31.9 births per 1000 people during the period 1995-2000 to 19.9 during the period 2010-2015 and the overall population growth rate is predicted to fall from 2.5 percent per year in 1995-2000 to 1.4 in 2010-2015. Due to rural-urban migration, the growth rate of the urban population is much higher than the growth rate of the rural population (see Figure 3.3). During the 2010-2015 period the rural population is expected to experience no growth at all.

Figure 3.3: Population growth rates in the base scenario, by location, 1995-2015



The population of working age (15-64 years) will increase dramatically from 2.2 million in 1995 to 4.1 million in 2015. This means that an average of 95,000 new jobs are needed every year to keep the population occupied. By far the most of the new jobs are needed in urban areas where the working age population increases by an average of 73,500 persons per year. The rural working age population only increases by an average of 21,600 persons per year (see Figure 3.4).

Figure 3.4: Working Age Population in the base scenario, by location, 1995-2015

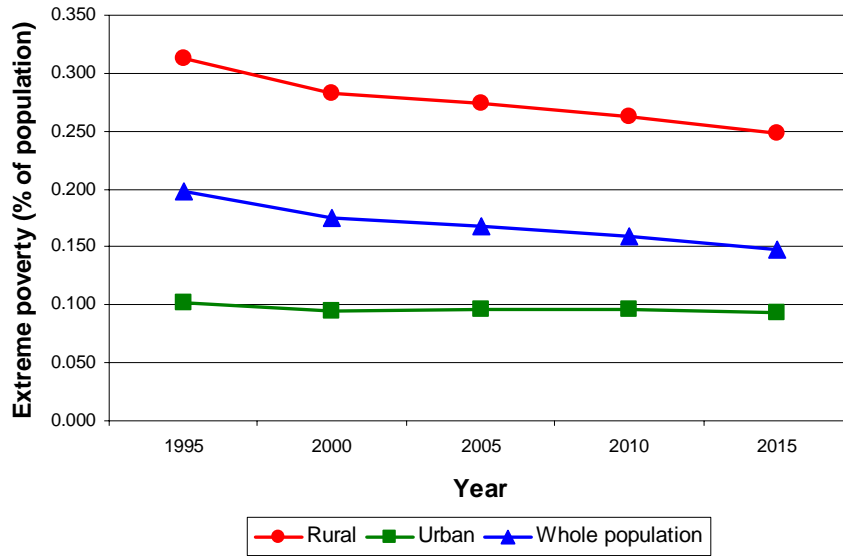


The population group including school starters (5-9 year olds) is predicted to increase from 635 thousand in 1995 to 712 thousand in 2005. Thereafter it is predicted to start falling, getting down to 666,000 in 2015. Despite a stagnating number of births, there will be an increasing demand for schooling, especially in urban areas, due to increasing enrollment rates.

### 3.2. Poverty

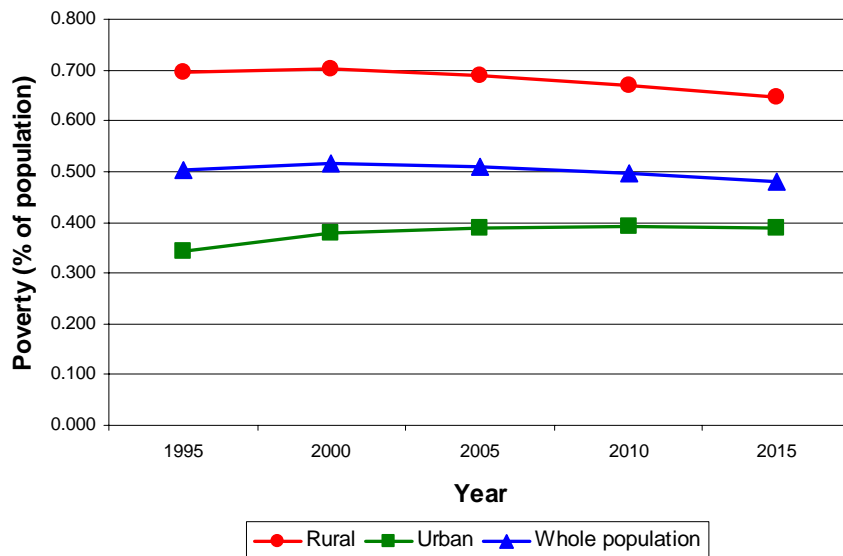
Due to social mobility, rural-urban migration, improvements in education, and the fall in fertility, extreme poverty as well as poverty in general are predicted to fall over the 1995-2015 period. In rural areas, extreme poverty is predicted to fall from 31.3 percent in 1995 to 24.9 percent in 2015. In urban areas a much smaller reduction is predicted from 10.1 percent to 9.4 percent (see Figure 3.5). Overall extreme poverty is predicted to fall from 19.8 percent in 1995 to 14.8 percent in 2015 under the central scenario.

Figure 3.5: Extreme poverty in the base scenario, by location, 1995-2015



Poverty in general (extreme poverty plus moderate poverty) is unfortunately not predicted to fall much, and in urban areas it is actually predicted to increase from 34.3 percent in 1995 to 38.8 percent in 2015. In rural areas the poverty rate is expected to fall from 69.5 percent in 1995 to 64.5 percent in 2015 (see Figure 3.6). Overall the expected fall in the poverty rate is expected to be from 50.4 in 1995 to 47.9 in 2015.

Figure 3.6: Poverty rates in the central scenario, by location, 1995-2015.



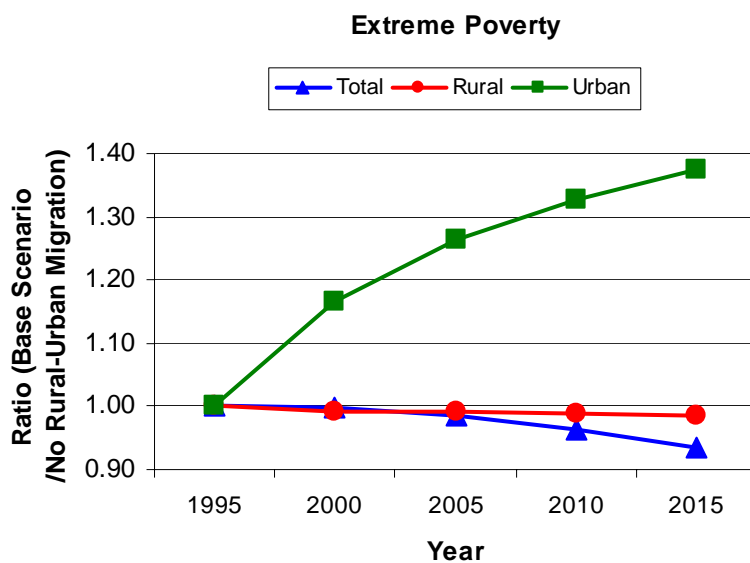
## CHAPTER 4: COUNTERFACTUAL SIMULATIONS

In this chapter we will try to disentangle the effects of migration, education, fertility changes, and macroeconomic performance on the evolution of poverty and other key variables. This is done by running counterfactual simulations and comparing them with the base scenario.

### 4.1. Counterfactual scenario with no rural-urban migration

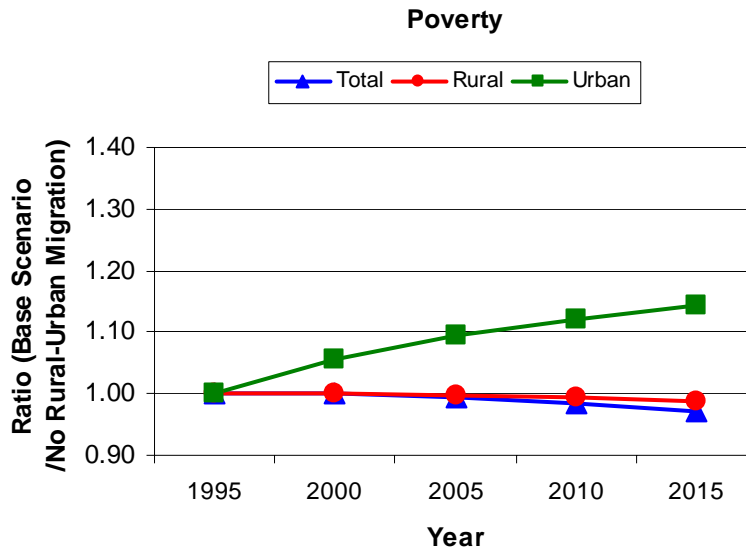
In order to evaluate the effect of migration we run a counterfactual simulation where rural-urban migration is set at zero and compare the results with the base scenario. Figure 4.1 shows that total extreme poverty is 6.6 percent lower in 2015 when rural-urban migration is allowed compared to the situation where rural-urban migration is artificially prevented. *Urban* extreme poverty, however, is 37.5 percent *higher* in 2015 with migration than it would have been if rural-urban migration was prevented.

Figure 4.1: The effect of rural-urban migration on extreme poverty, 1995-2015.



A similar, but less extreme, effect is noted on overall poverty which decreases by 2.9 percent when rural-urban migration is allowed, while urban poverty increases by 14.5 percent (see Figure 4.2).

Figure 4.2: The effect of rural-urban migration on poverty, 1995-2015.



#### 4.2. Counterfactual scenario with no international migration

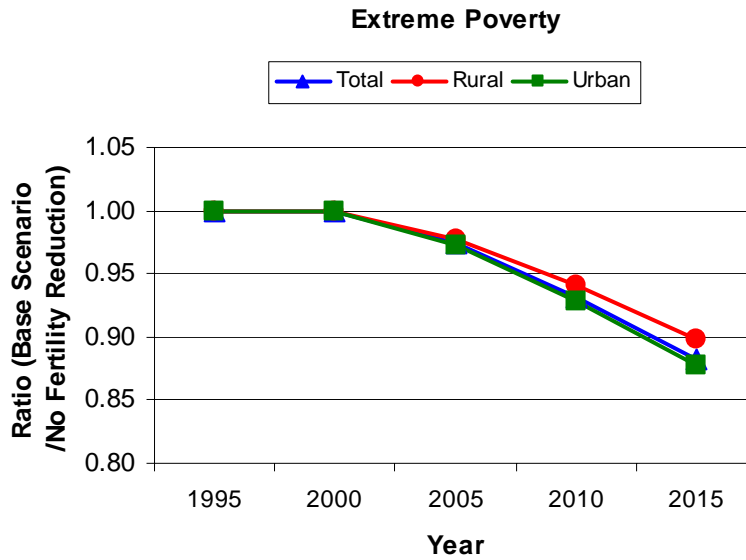
International migration has virtually no effect on poverty and extreme poverty as the propensity to migrate is approximately the same for poor and non-poor.

It does have a significant effect on the size of the working age population in Nicaragua, however. The total working age population would be about 218,000 persons (or 5.3 percent) larger in 2015 if international migration was not allowed, compared to the central scenario of net international migration of 60,000 people per five-year period.

#### 4.3. Counterfactual scenario with no changes in fertility

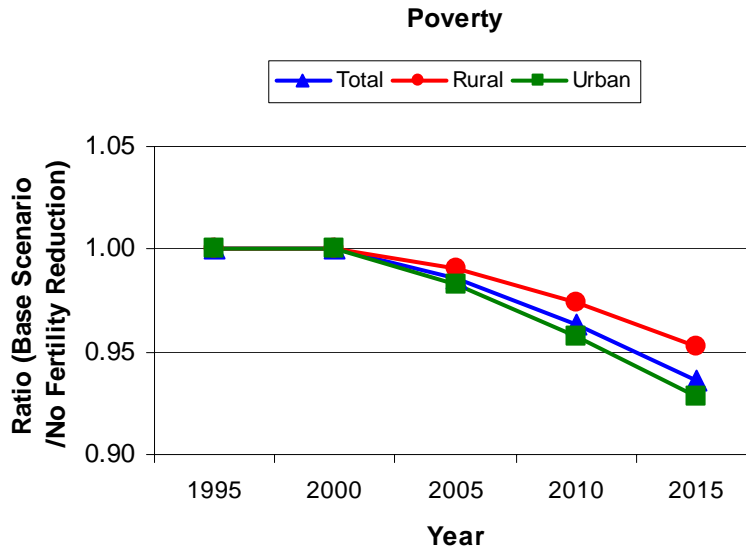
The expected fertility reductions in the base scenario has a large impact on poverty. When the base scenario is compared to a scenario where fertility rates are maintained constant at the 1995-2000 levels, we see in Figure 4.3 that extreme poverty is predicted to be 12.8 percent lower in 2015 due to the fertility reduction. The advantage of the fertility reductions are slightly larger in urban areas than in rural areas.

Figure 4.3: The effect of fertility reductions on extreme poverty, 1995-2015.



The effect of fertility reductions on overall poverty is similar, but slightly smaller in magnitude. The expected fertility reductions are predicted to reduce poverty by 6.4 percent in 2015 compared to a scenario where no fertility reductions occur.

Figure 4.4: The effect of fertility reductions on poverty, 1995-2015.



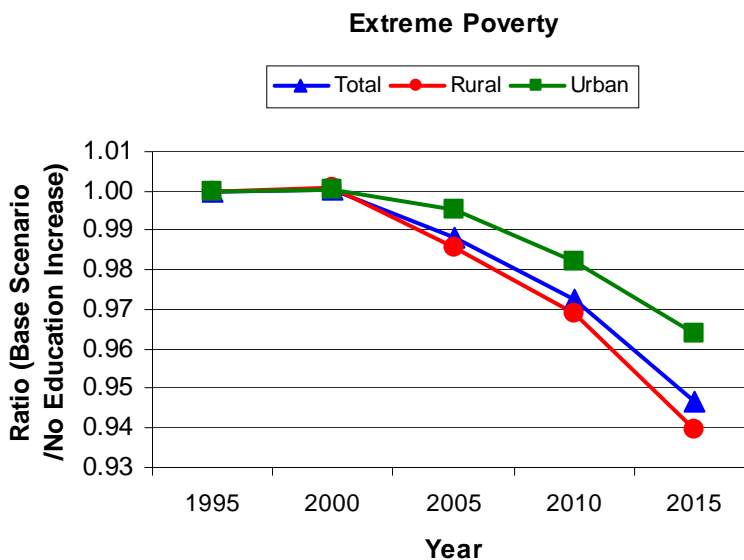
Due to the 15-year lag, fertility reductions will only affect the working age population towards the end of our prediction period, and the effect is very small compared to the effect of international migration.



#### 4.4. Counterfactual scenario with no changes in education

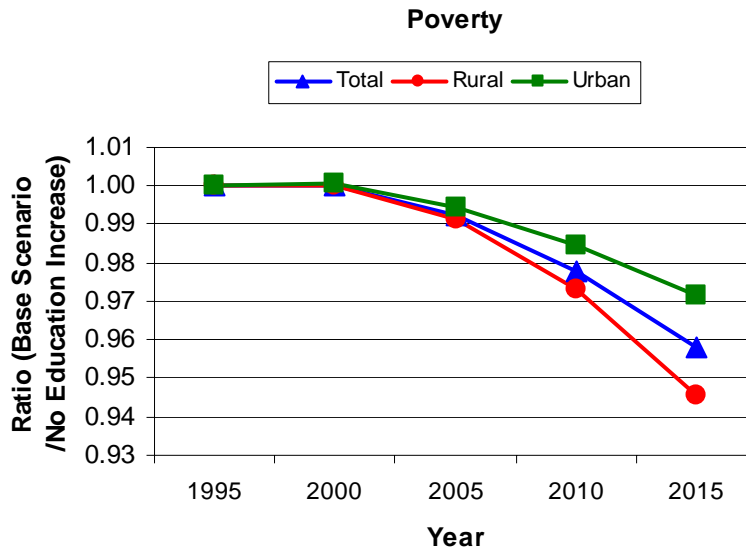
In order to evaluate the effect of education improvements we compare the base scenario with a scenario where the proportion of people living in households with high education levels is kept constant at the 1995 level. We see in Figure 4.5 that the expected improvements in education would reduce extreme poverty by 5.3 percent in 2015 compared to the scenario where no education improvements take place. The effect of education improvements is bigger in rural areas, since the education improvements are assumed to be larger there as indicated by past experience (see Section 2.11).

Figure 4.5: The effect of education improvements on extreme poverty, 1995-2015.



The effect of education on overall poverty is very similar with a 4.2 percent reduction in poverty in 2015 attributable to education improvements (see Figure 4.6).

Figure 4.6: The effect of education improvements on poverty, 1995-2015.

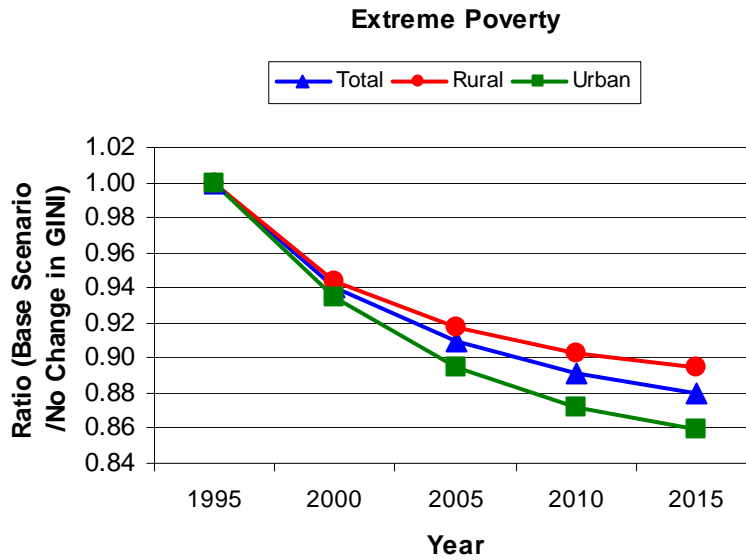


#### 4.5. Counterfactual scenario with no changes in the GINI coefficient

In order to evaluate the importance of changes in the income distribution on the incidence of poverty we compare the base scenario which assumed a 0.3 percentage point reduction in the GINI coefficient per year with a scenario where there are no changes in the GINI coefficient.

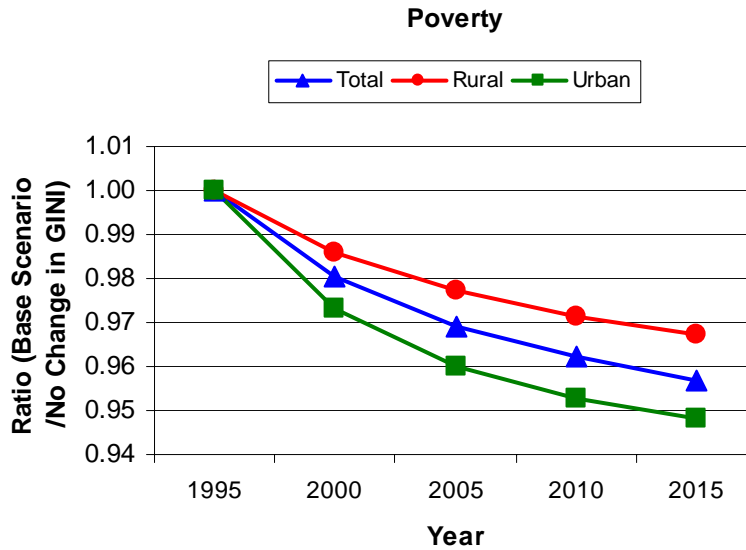
Figure 4.7 shows that the assumed reduction of the GINI coefficient in the base scenario has a large effect on extreme poverty. With just a 0.3 point reduction in the GINI coefficient each year, extreme poverty would be 12.1 percent lower in 2015 than in the scenario with no change in the GINI coefficient. The effect of the improvements in the income distribution is predicted to be slightly higher in urban areas than in rural areas.

Figure 4.7: The effect of changes in the GINI coefficient on extreme poverty, 1995-2015.



As expected, the effect of improvements in the income distribution is less dramatic on poverty than on extreme poverty. Poverty in 2015 is expected to be 4.3 percent lower due to improvements in the income distribution (see Figure 4.8).

Figure 4.8: The effect of changes in the GINI coefficient on poverty, 1995-2015.



#### 4.6. Counterfactual scenarios with no per capita GDP growth

In the base scenario we assumed a per capita GDP growth rate of 2.0 percent per year. To see the effect of general growth, we compare the base scenario to a scenario with zero growth.

The difference of 2.0 percentage points per capita GDP growth are predicted to cause a 13.9 percent difference in extreme poverty and a 5.0 percent difference in overall poverty (see Figures 4.9 and 4.10). The effect of growth is more important in urban areas than in rural areas.

Figure 4.9: The effect of GDP growth on extreme poverty, 1995-2015.

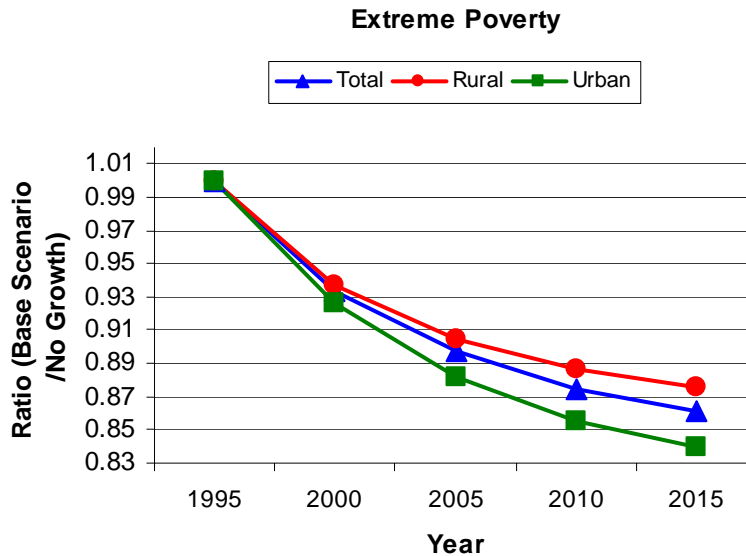
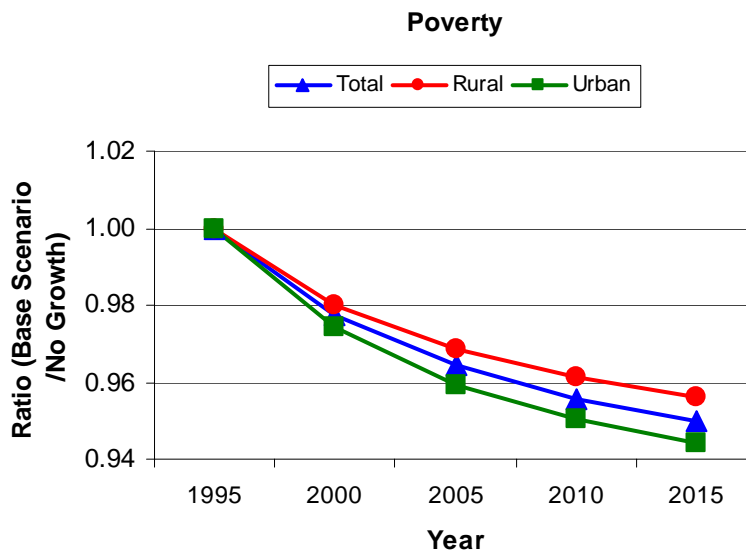


Figure 4.12: The effect of GDP growth on poverty, 1995-2015.



## CHAPTER 5: THE RELATIVE IMPORTANCE OF DIFFERENT SOCIO-ECONOMIC AND DEMOGRAPHIC FACTORS

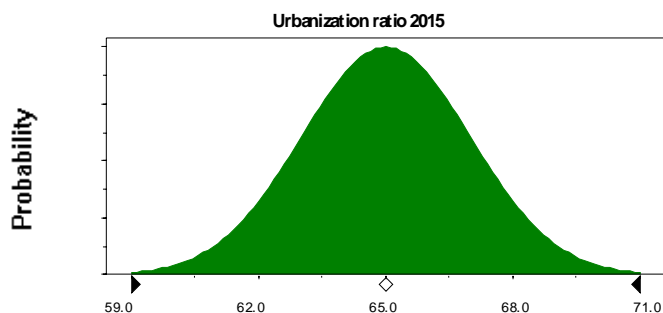
This chapter evaluates the relative importance of the different socio-economic and demographic factors considered in the simulation model. At the same time it conducts a sensitivity analysis on the most important assumptions in model.

For each of the main factors determining population growth and poverty, we determine plausible probability distributions for the exogenous variables and through bootstrapping we determine the associated probability distribution for endogenous variables, such as extreme poverty incidence in 2015, poverty incidence in 2015, size of the working age population in 2015, size of the population aged 5-9 in 2015, etc.

### 5.1. Rural-urban migration

The rural-urban migration parameter to be chosen in the model is the target urbanization ratio in 2015. In the central scenario we have fixed this parameter at 65.0 percent, but below we will attach a Normal probability distribution with mean 65.0 and a standard deviation of 2.0. This results in a probability distribution for this parameter as depicted in Figure 5.1.

Figure 5.1: Probability distribution for the urbanization ratio in 2015.



If we randomly draw a large number of target urbanization ratios in 2015 from this probability distribution and insert each of those in the simulation model one at a time, we can obtain probability distributions for the endogenous variables of interest. Figure 5.2, for example, shows the resulting probability distribution for the Extreme Poverty Incidence in 2015. We see that the mean is 14.8 as predicted in the central scenario. In 95 percent of the cases extreme poverty was predicted to fall within the range from 14.4 to 15.2 percent, which is a relatively short range spanning only 0.8 percentage points. This indicates that the speed of urbanization is not a main determinant of extreme poverty, at least not within a plausible range of urbanization ratios.

Figure 5.2: Probability distribution for extreme poverty in 2015, given the probability distribution for the urbanization ratio in 2015 shown in Figure 5.1.

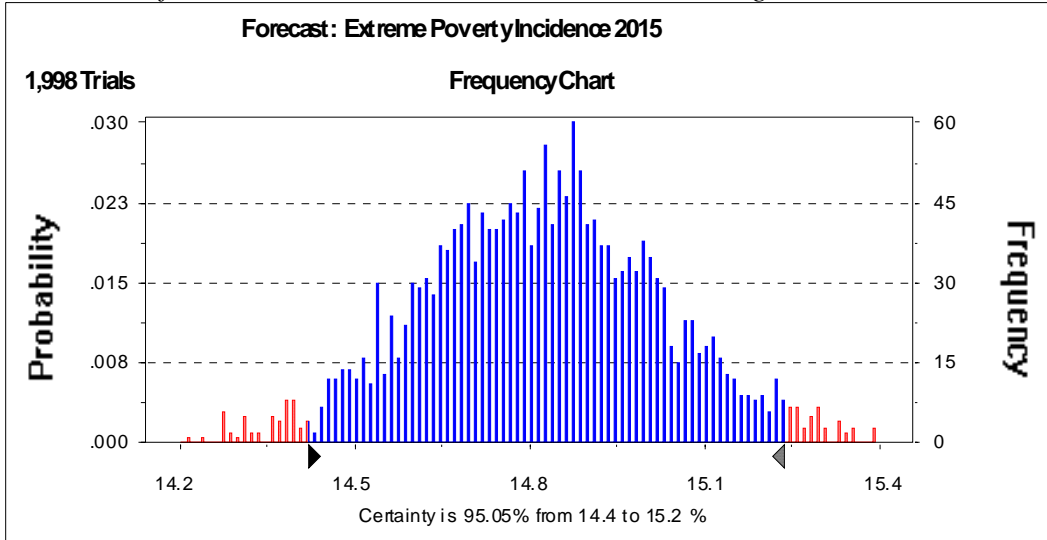
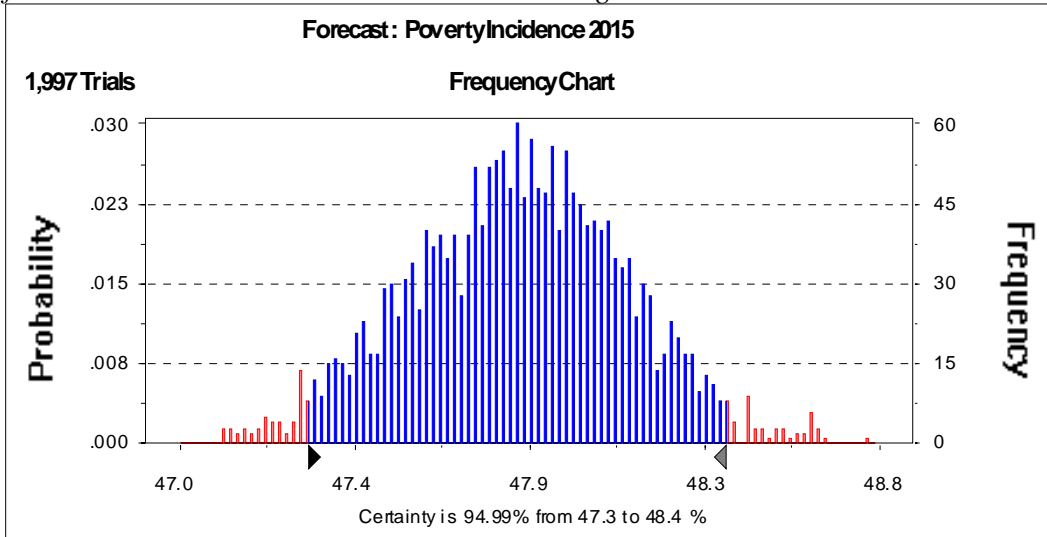


Figure 5.3 shows the corresponding probability distribution for the general poverty incidence in 2015. The mean is 47.9 percent as predicted in the central scenario, and in 95 percent of the cases the poverty incidence fell in the range 47.3 to 48.4. The range is thus 1.1 percentage point, and we will use this number later in this chapter, when assessing the relative importance of the different socio-economic and demographic factors in the explanation of the extent of poverty.

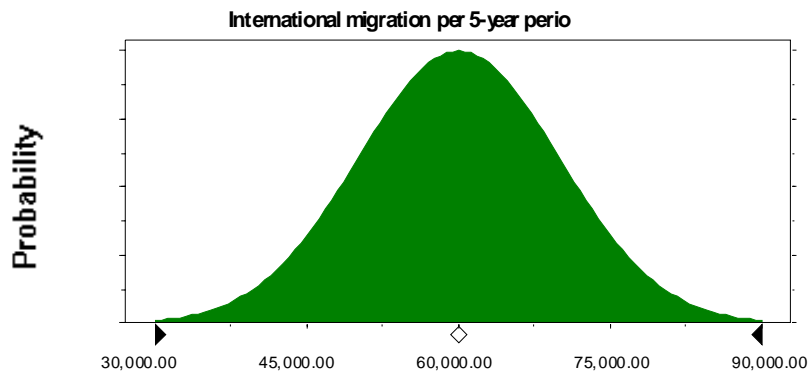
Figure 5.3: Probability distribution for poverty in 2015, given the probability distribution for the urbanization ratio in 2015 shown in Figure 5.1.



## 5.2. International migration

The parameters determining international migration in the model are the number of net migrants for each of the 5-year periods 1995-2000, 2000-2005, 2005-2010, and 2010-2015. In the central scenario we have assumed net international migration to stay at 60,000 per 5-year period until 2015. Here we will assume a Normal probability distribution with mean 60,000 and standard deviation 10,000 reflecting the large uncertainty about migration in the future. This results in a probability distribution as depicted in Figure 5.4 for each 5-year period. The probabilities are assumed to be perfectly correlated, so that if we have high net migration in one five-year period, we would also have high net-migration in the following.

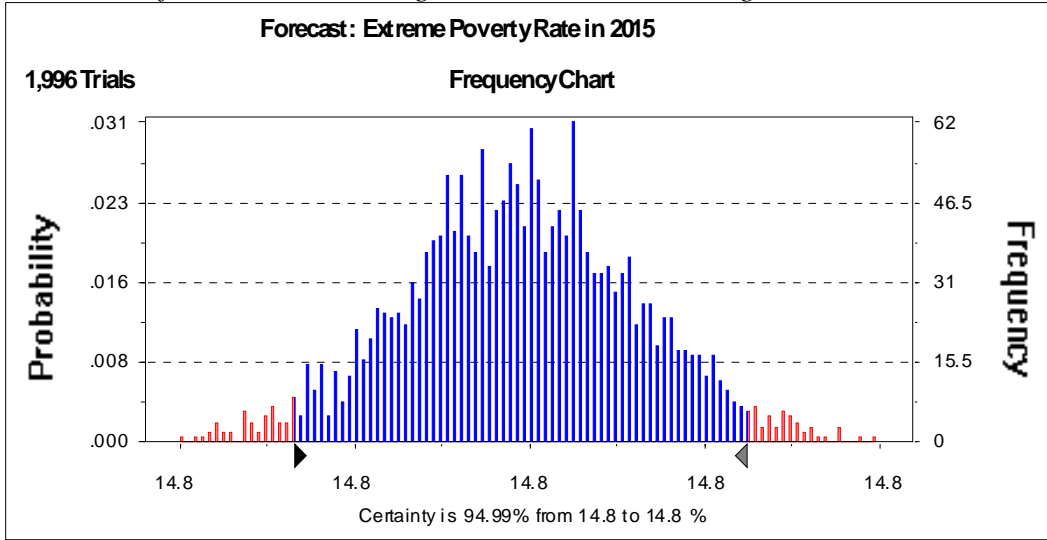
Figure 5.4: Probability distribution for the average number of net international migration per 5-year period



Since the propensity to migrate is very similar across different poverty groups and household types, international migration do not affect poverty rates in a significant manner. Figure 5.5 shows the resulting probability distribution with a mean of 14.8 percent and a very small variance, that does not even register when measured with the accuracy of only one decimal.

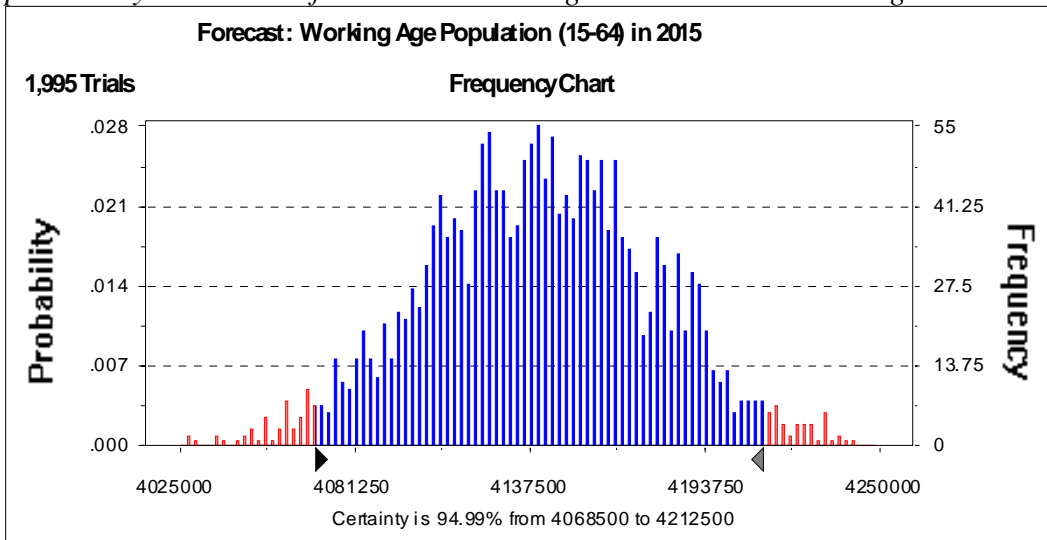
Although international migration is not important for overall poverty rates in Nicaragua, it may be important for the individuals who migrate. It may also be important for the families who are left behind, if they receive substantial remittances. This topic has not been explored in this report, although it is potentially very important for Nicaragua.

Figure 5.5: Probability distribution for extreme poverty in 2015, given the probability distribution for international migration rates shown in Figure 5.4.



While international migration does not affect the overall poverty rates in our model, it does affect the size of the working age population in Nicaragua. Figure 5.6 shows that alternative migration rates may result in a working age population in 2015 ranging from 4,069 thousand to 4,213 thousand. With low net migration rates we would need about 150,000 more jobs in Nicaragua in 2015 than we would with high net migration rates.

Figure 5.6: Probability distribution for working age population in 2015, given the probability distribution for international migration rates shown in Figure 5.4.

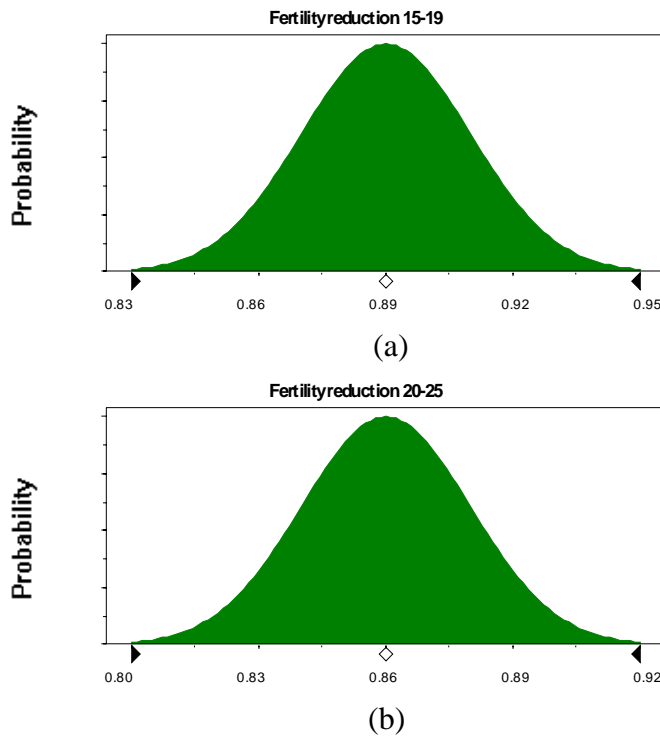


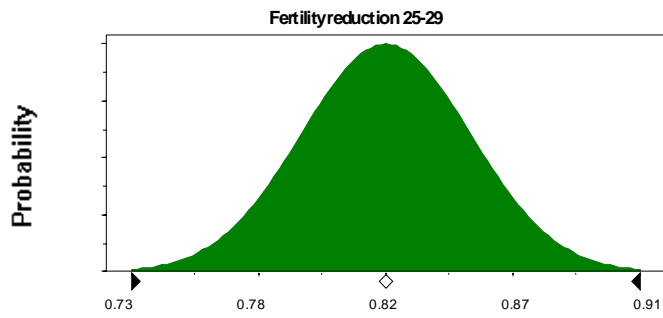


### 5.3. Fertility

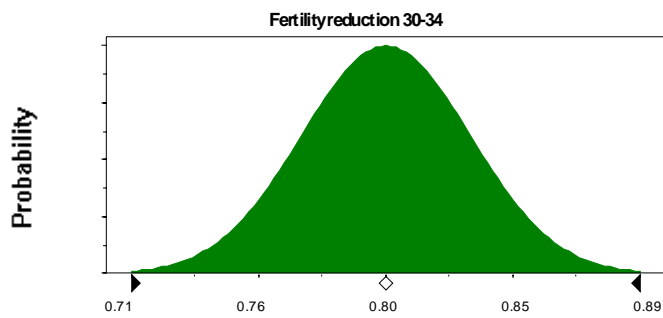
The changes in fertility over time are governed by 5 parameters indicating (one minus) the rate of fertility reduction for 15-19 year old women, 20-24 year old women, 25-30 year old women, 30-34 year old women, and women of 35 years or more, respectively. In the central scenario fertility reduction was 11 percent per 5-year period for 15-19 year olds, 14 percent for 20-24 year olds, 18 percent for 25-29 year olds, 20 percent for 30-34 year olds, and 28 percent for women of 35 or more. We use the central scenario parameters as means for the probability distributions of these parameters and choose the standard deviation to be 0.02 for the first two age groups and 0.03 for the remaining. This leads to the distributions shown in Figures 5.7a-e. The fertility reduction for 15-19 year olds were assumed to be independent from the fertility reductions of the other age groups, whereas the fertility reductions of the other five age-groups were assumed to be highly correlated (with a correlation coefficient of 0.75).

Figure 5.7a-e: Probability distribution for age-specific fertility reduction factors per 5-year period

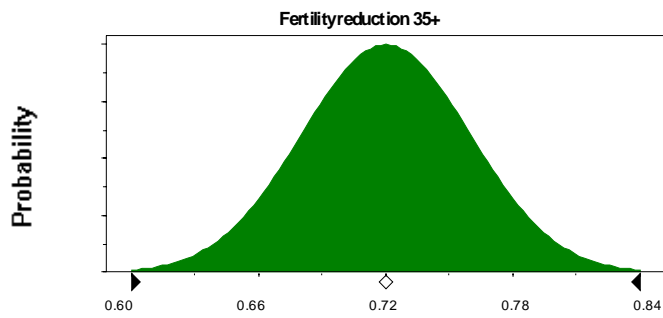




(c)



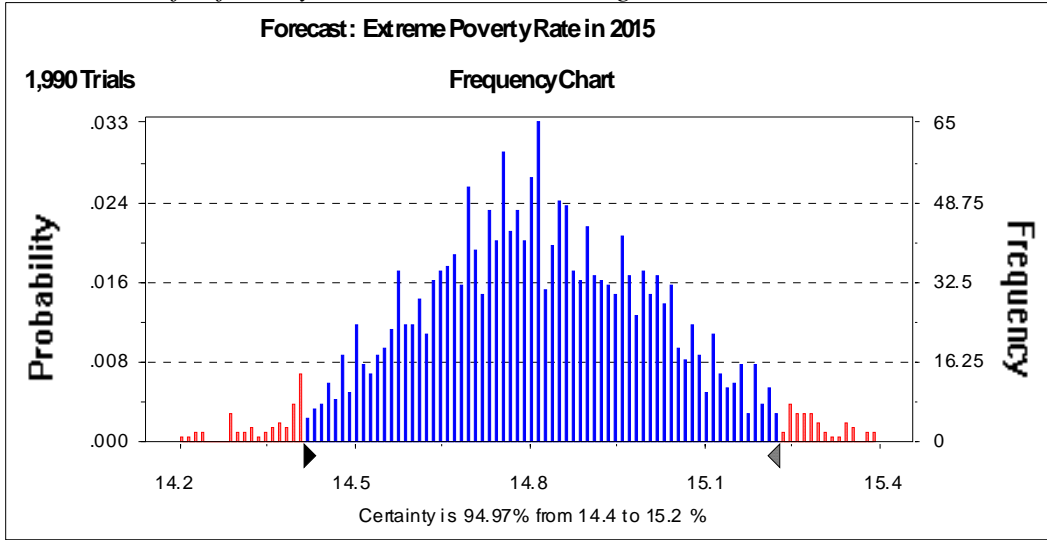
(d)



(e)

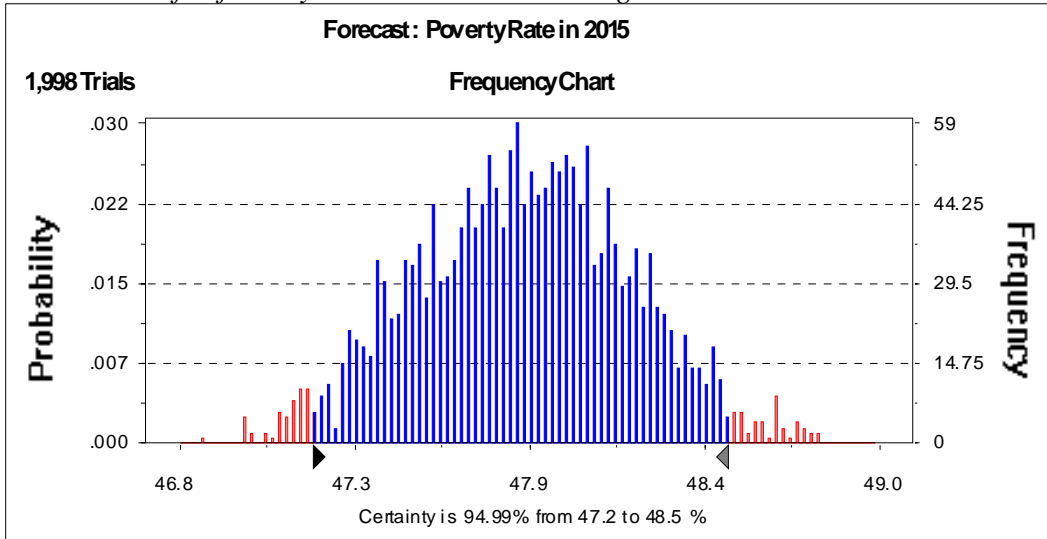
Figure 5.8 shows the resulting probability distribution for the extreme poverty incidence in 2015. The mean is 14.8 percent as in the central scenario, and the 95 percent confidence interval is goes from 14.4 to 15.2 percent.

Figure 5.8: Probability distribution for extreme poverty in 2015, given the probability distributions for fertility reductions shown in Figure 5.7.



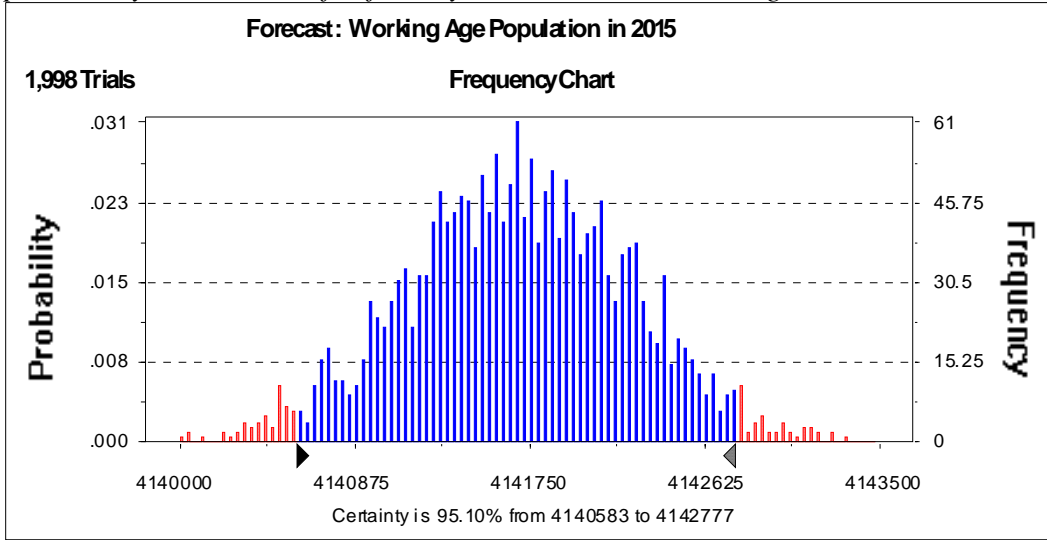
The corresponding probability distribution for overall poverty in 2015 is presented in Figure 5.9 with a mean of 48.5 and a 95 percent confidence interval ranging from 47.9 to 48.5.

Figure 5.9: Probability distribution for poverty in 2015, given the probability distributions for fertility reductions shown in Figure 5.7.



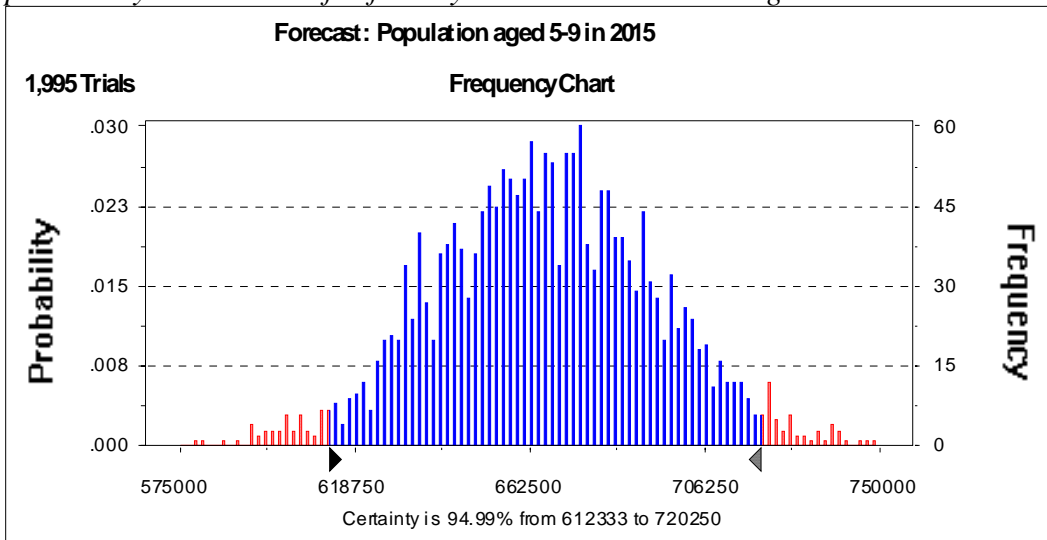
Because of the 15 year lag before fertility reductions shows its effect on the size of the working age population, alternative fertility assumptions will not provide large discrepancies in the working age population within our prediction period of only 20 years. The probability distribution for the working age population is presented in Figure 5.10, which shows that 95% of the cases fall within the short range of 4,141 thousand and 4,143 thousand.

Figure 5.10: Probability distribution for working age population in 2015, given the probability distributions for fertility reductions shown in Figure 5.7.



The size of the population group starting school around 2015 (the 5-9 year olds), on the other hand, is much more sensitive to fertility assumptions. Figure 5.11 shows the probability distribution for the size of this age-group in 2015. It has a mean of 667 thousand, but the 95 percent confidence interval is quite large ranging from 612 thousand to 720 thousand.

Figure 5.11: Probability distribution for the number of 5-9 year olds in 2015, given the probability distributions for fertility reductions shown in Figure 5.7.

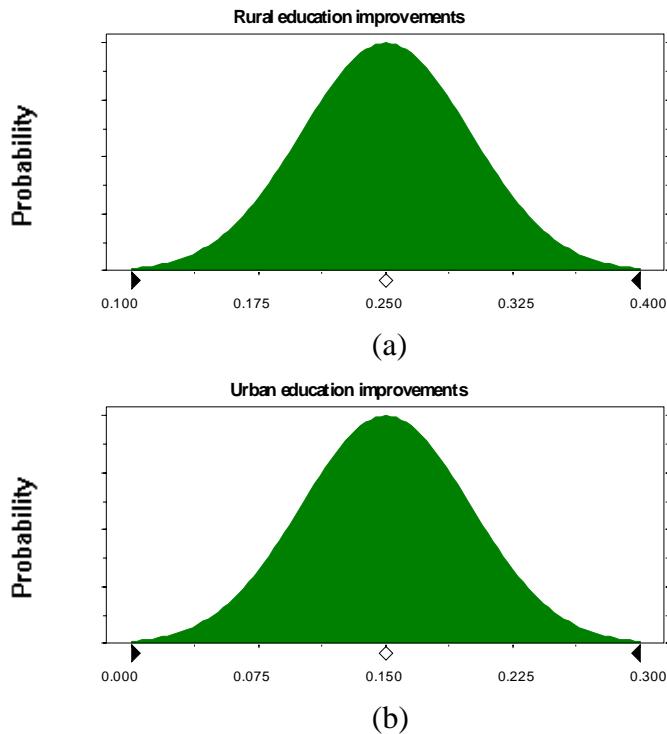


## 5.4. Education

In the base scenario we assume that the number of persons living in households with high education levels increases by 36.9 percent per five year period in rural areas and by 6.6 percent in urban areas. This assumption is based on a continuation of the trends observed during the 1995 – 2001 period.

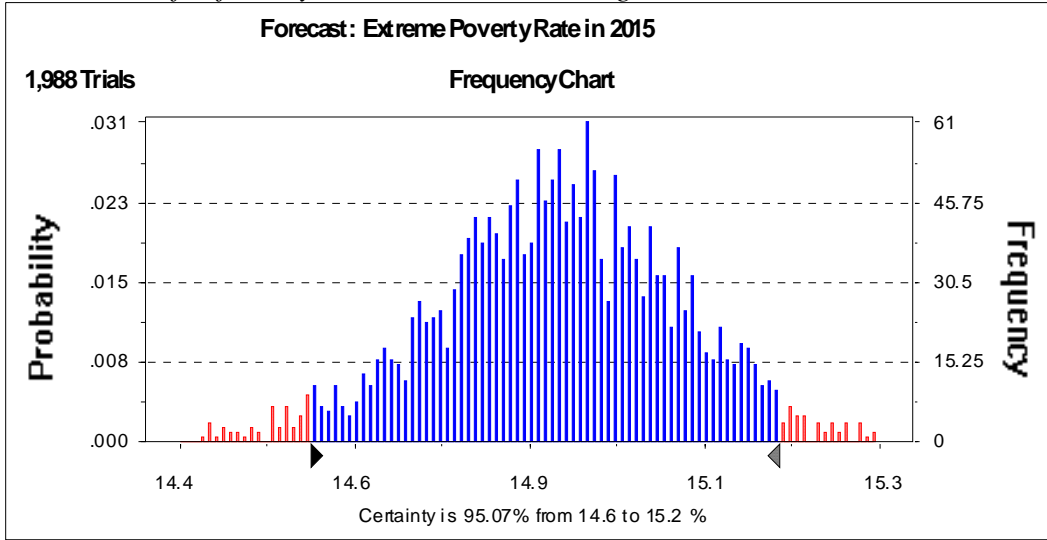
In the present sensitivity analysis, however, we assume that the large difference between rural and urban areas observed in the period 1995-2001 was partly due to random variation, and we will choose probability distributions that have a mean of 25.0 percent for rural areas and 15.0 percent for urban areas. For both locations, we will choose standard deviations of 0.05, which then results in the probability distributions depicted in Figure 5.12a-b.

*Figure 5.12a-b: Probability distribution for education improvement factors in rural and urban areas per 5-year period*



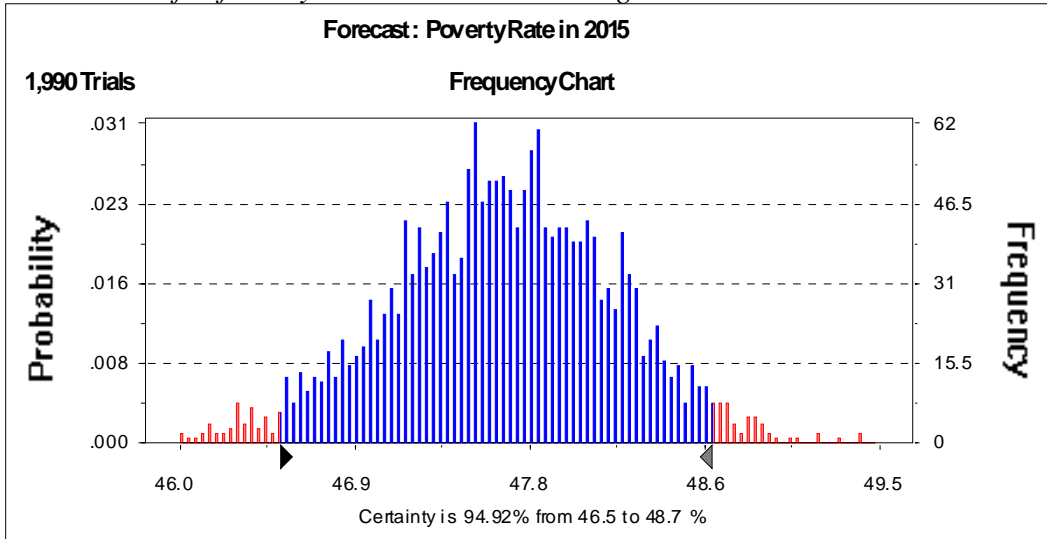
These assumptions result in a probability distribution for extreme poverty in 2015 as depicted in Figure 5.13. The mean extreme poverty incidence is 14.9 percent (slightly larger than the 14.8 percent in the central scenario and in 95 percent of the cases extreme poverty fell in the short range from 14.6 to 15.2.

Figure 5.13: Probability distribution for extreme poverty in 2015, given the probability distributions for fertility reductions shown in Figure 5.12.



The corresponding probability distribution for overall poverty in 2015 is given in Figure 5.14. The mean is 47.6 percent with a 95 percent confidence interval ranging from 46.5 to 48.7.

Figure 5.14: Probability distribution for poverty in 2015, given the probability distributions for fertility reductions shown in Figure 5.12.

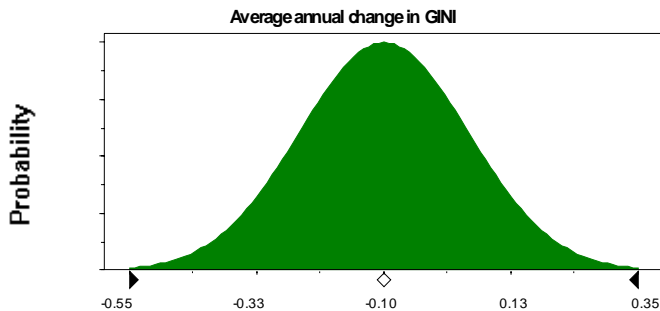


The simulations indicate that education is more effective in reducing moderate poverty than extreme poverty.

### 5.5. Changes in the income distribution

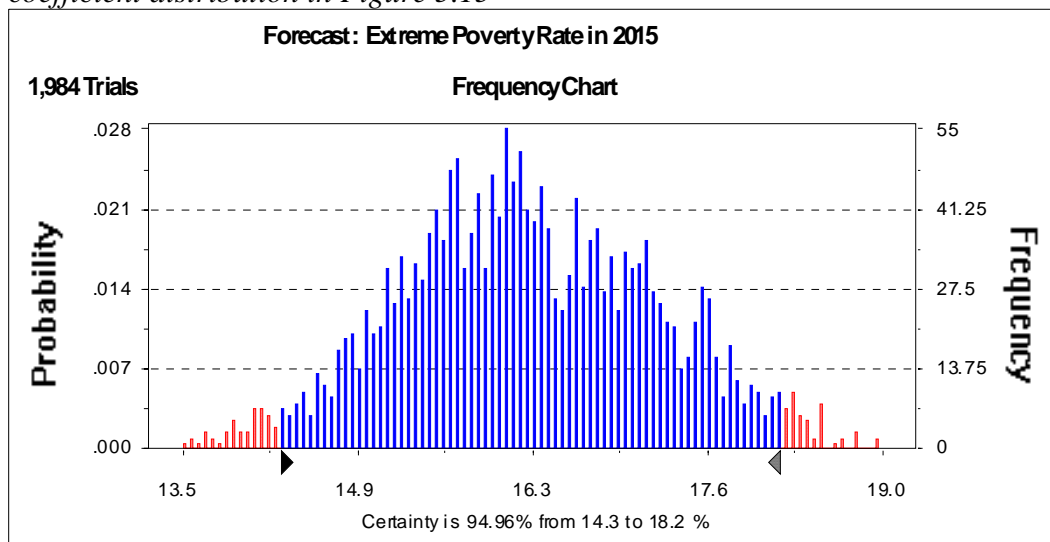
To evaluate the impact of changes in the income distribution, we assume of Normal probability distribution for the average annual percentage point change in the GINI coefficient. We assume the mean to be  $-0.10$  and standard deviation to be  $0.15$ , which would result in a distribution as pictured in Figure 5.15.

Figure 5.15: Probability distribution for the annual change in the GINI coefficient



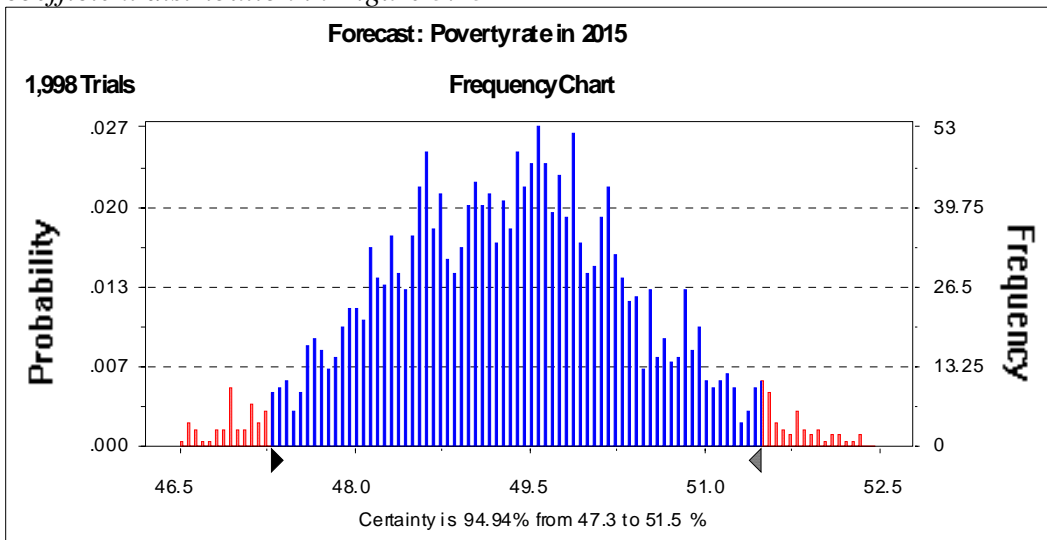
The impact on extreme poverty in 2015 of alternative values for the changes in the GINI coefficient is shown in Figure 5.16. The mean is 16.2 percent, which is larger than the mean for the central scenario (14.8) because the mean reduction in GINI is assumed to be less than in the central scenario. The 95 percent confidence interval is large, ranging from 14.3 to 18.2 percent.

Figure 5.16: Probability distribution for extreme poverty in 2015 given the GINI coefficient distribution in Figure 5.15



The corresponding distribution for the overall poverty rate in 2015 is presented in Figure 5.17. In 95 percent of the cases, the overall poverty rate fell in the range 47.3 to 51.5, and the mean was 49.3 percent.

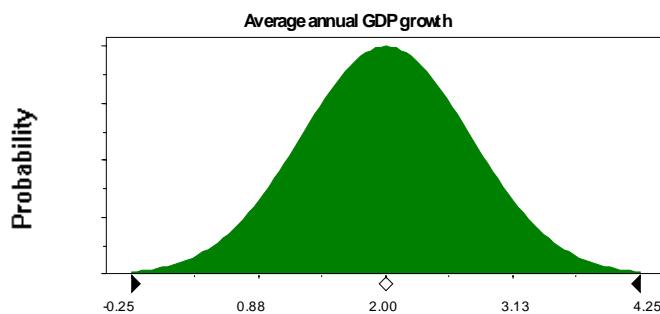
Figure 5.17: Probability distribution for the overall poverty rate in 2015 given the GINI coefficient distribution in Figure 5.15



### 5.6. Per capita GDP growth rates

In the past Nicaragua has experienced both prolonged periods of high per capita GDP growth rates and prolonged periods of negative growth rates. In the central scenario we have assumed average per capita GDP growth rates over 20 years of 2.0 percent per year. We will choose this as the mean for our probability distribution. Combined with a standard deviation of 0.75, this secures that negative growth rates are possible, but not very likely, and that a sustained growth of 4 percent per year over 20 years is possible, but not very likely. See Figure 5.18.

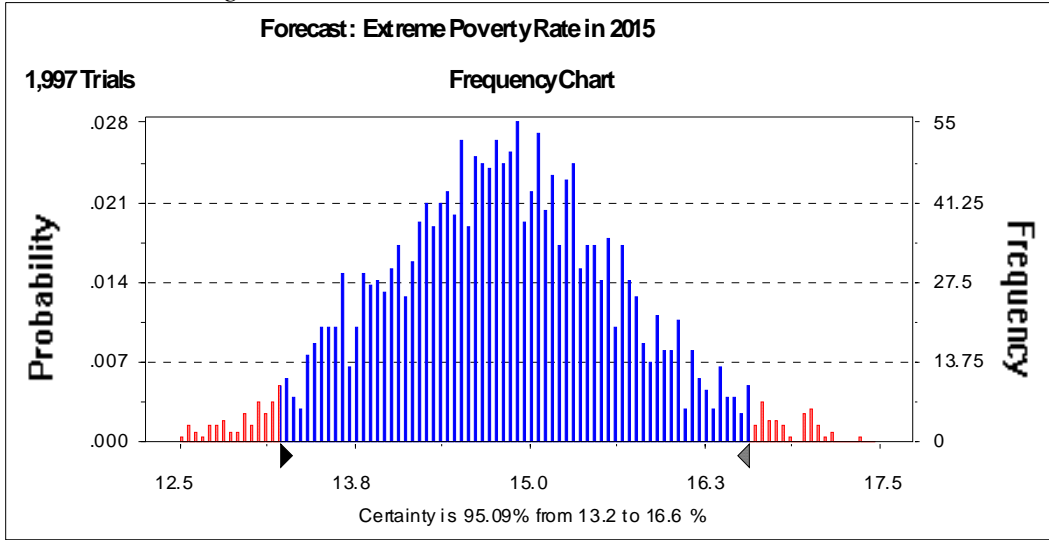
Figure 5.18: Probability distribution for annual per capita GDP growth rate, 1995-2015.



By drawing random growth rates from this probability distribution and simulating extreme poverty for each of these we get a probability distribution for the extreme poverty incidence in 2015 as shown in Figure 5.19. The mean is 14.8 percent and 95 percent of the cases fell in the range 13.2 to 16.6 percent.

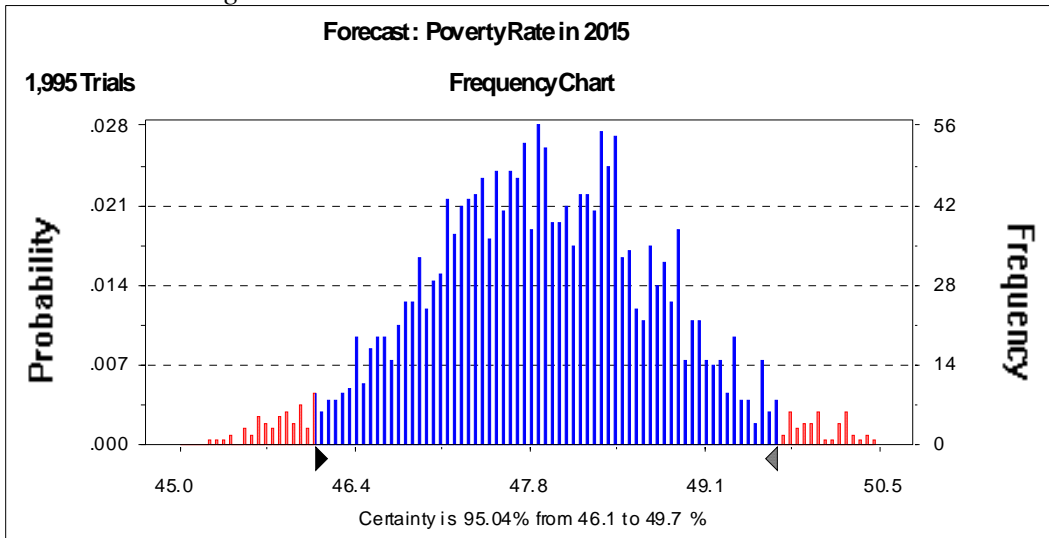


Figure 5.19: Probability distribution for extreme poverty in 2015 given the growth distribution in Figure 5.18



Using the same growth probability distribution and simulating the overall poverty rate in 2015 gives the probability distribution for the poverty rate in 2015 as depicted in Figure 5.20. The mean is 47.9 and 95 percent of the cases fell in the range between 46.1 and 49.7 percent.

Figure 5.20: Probability distribution for the poverty rate in 2015 given the growth distribution in Figure 5.18



### 5.7. *The relative importance of different socio-economic and demographic factors*

In this section we will summarize the influence of each of the factors analyzed in this chapter and compare their relative importance. Table 5.1 lists the 6 main factors that have been analyzed together with the predicted range of extreme poverty and poverty that alternative plausible assumptions about each factor would generate.

The results indicate that changes in the GINI coefficient and general economic growth are the two most important factors, since alternative plausible values for these variables generate the widest range of possible values for the poverty rate in 2015.

Education improvements and fertility reductions come out as the third and fourth most influential factors.

Rural-urban migration has an effect on poverty that is relatively limited, which is mostly the result of the limited range of plausible urbanization rates in 2015. Urbanization is destined to proceed at a steady pace, and it is most unlikely to be reversed. Thus, the level of uncertainty surrounding the rate of urbanization is much smaller than the uncertainty surrounding the changes in income distribution.

Finally, international migration is not found to have any significant impact on the overall poverty rate in 2015.

*Table 5.1: The relative importance of different socio-economic and demographic factors*

<b>Factor</b>	<b>Extreme Poverty Range [95% confidence interval]</b>	<b>Poverty Range [95% confidence interval]</b>
GINI changes	3.9 / [14.3:18.2]	4.2 / [47.3:51.5]
GDP growth	3.4 / [13.2:16.6]	3.6 / [46.1:49.7]
Education improvement	0.6 / [14.6:15.2]	2.2 / [46.5:48.7]
Fertility reduction	0.8 / [14.4:15.2]	1.3 / [47.2:48.5]
Rural-urban migration	0.8 / [14.4:15.2]	1.1 / [47.3:48.4]
International migration	0.0 / [14.8:14.8]	0.0 / [47.9:47.9]

Thus, while education, location, and number of children in the household all are very important factors determining poverty at the individual level, these factors do not have a large impact on aggregate poverty, simply because at the aggregate level these factors can vary only little (compared to GDP growth and changes in the income distribution). For example, the urbanization ratio in 2015 is going to be somewhere close to 65 percent, conceivably it could be as low as 60 percent or as high as 70, but the uncertainty about the urbanization ratio in 2015 is much smaller than the uncertainty about the average change in the GINI coefficient between 1995 and 2015.

## 5.8. Probabilistic analysis of main endogenous variables

So far in this chapter, we have varied each parameter one at a time to see how its influence is on key endogenous variables. Now we will vary them all at the same time in order to establish overall confidence intervals for key variables. We use exactly the same probability distributions as shown in Figures 5.1, 5.4, 5.7, 5.12, 5.15, and 5.18 above. The only parameters that were assumed to be correlated was the fertility reductions, as explained in section 5.3. The rest were assumed to vary independently.

Several other parameters in the model, such as survival probabilities, are assumed be known relatively accurately, compared to the abovementioned 11 parameters, so that we can assume zero variance on these for the purposes of this report.

When drawing a large number of values from each of the 11 probability distribution and inserting them in the simulation model, we get a large number of values for each of the endogenous variables that we can use to create overall probability distributions.

Figure 5.21 shows the resulting overall probability distribution for the extreme poverty incidence in 2015. The mean is 16.2 percent and the 95 percent confidence interval ranges from 13.6 percent to 19.0 percent, and from the analysis above we know that this wide range is mainly caused by the uncertainty surrounding changes in the income distribution and the rate of per capita GDP growth.

*Figure 5.21: Probability distribution for the extreme poverty incidence in 2015 given the 11 probability distributions in Figures 5.1, 5.4, 5.7, 5.12, 5.15, and 5.18.*

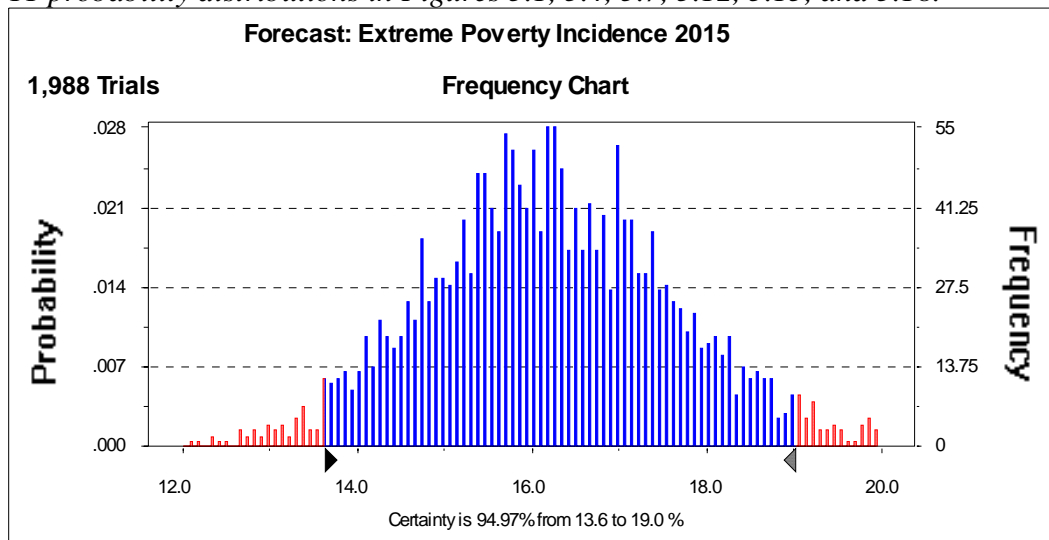
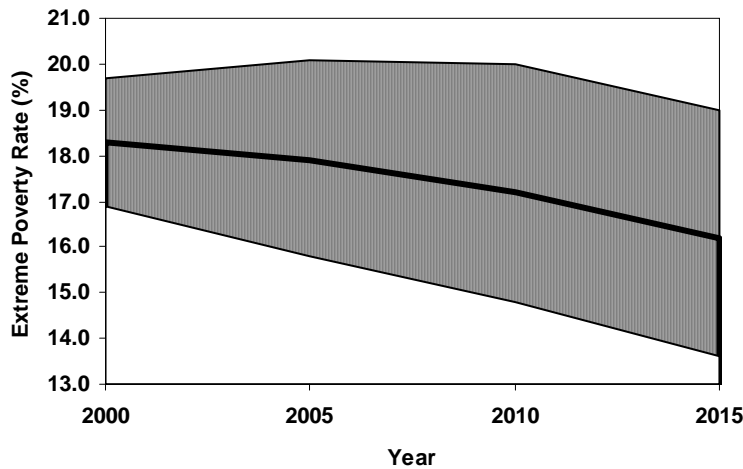


Figure 5.22 shows the predicted mean and 95% confidence interval for extreme poverty over time. Extreme poverty is expected to fall, but the 95% confidence interval is so large that it includes the possibility of no reduction at all, if several conditions conspire against it.

Figure 5.22: Predicted mean and 95% confidence interval for the extreme poverty incidence, 2000-2015, given the 11 probability distributions in Figures 5.1, 5.4, 5.7, 5.12, 5.15, and 5.18.



The expected reduction in overall poverty is even less than the expected reduction in extreme poverty, and Figure 5.23 shows that a 50% reduction is completely out of the question. Anything more than a 10 percent reduction in poverty between 1995 and 2015 appear to be unrealistic, given the present structure of the population and economy of Nicaragua.

Figure 5.23: Predicted mean and 95% confidence interval for the overall poverty rate, 2000-2015, given the 11 probability distributions in Figures 5.1, 5.4, 5.7, 5.12, 5.15, and 5.18.

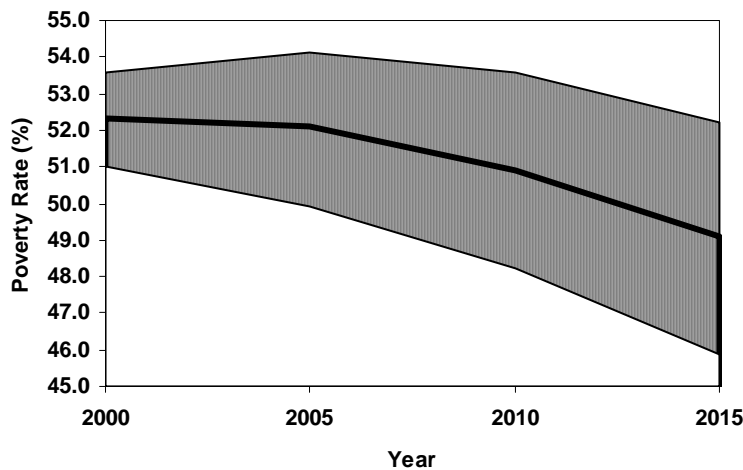
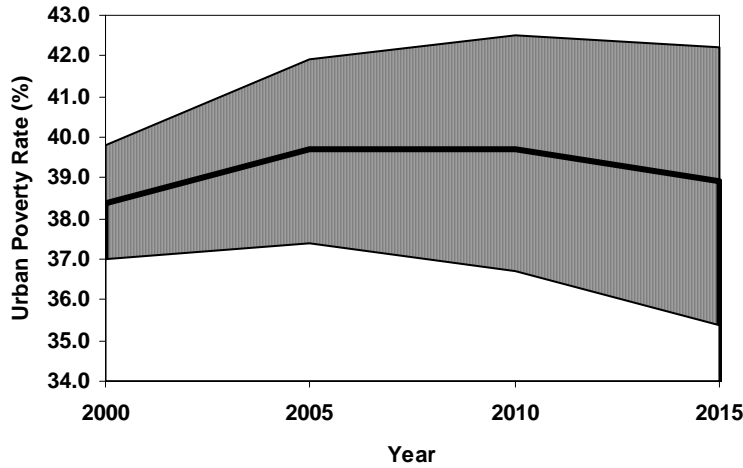


Figure 5.24 shows that urban poverty is very unlikely to fall over the next 15 years, given the influx of poor, uneducated people from rural areas. Providing adequate basic services and jobs for the rapidly growing urban population should be an important priority over the coming decades, in order to prevent urban poverty from increasing.

Figure 5.24: Predicted mean and 95% confidence interval for the urban poverty rate, 2000-2015, given the 11 probability distributions in Figures 5.1, 5.4, 5.7, 5.12, 5.15, and 5.18.



While there is quite large uncertainty associated with poverty rates, the size of the working age population and the dependency ratios can be quite accurately predicted.

Figure 5.25 shows the dramatic increase in the size of the working age population, from 2,239 thousand in 1995 to around 4,140 thousand in 2015. In order to keep these people occupied, an average of 95,000 new jobs would have to be created per year. At least 80 percent of the new jobs should be located in urban areas, as that is where the most rapid increase in working age population is expected.

Figure 5.25: Predicted mean and 95% confidence interval for the size of the working age population, 2000-2015, given the 11 probability distributions in Figures 5.1, 5.4, 5.7, 5.12, 5.15, and 5.18.

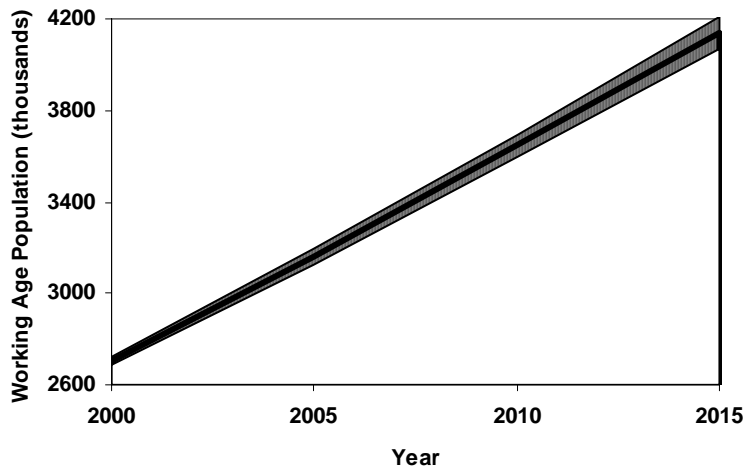
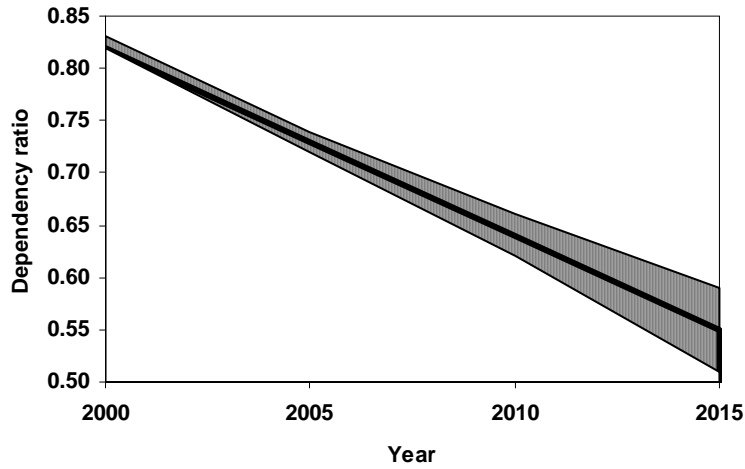


Figure 3.26 shows the dramatic fall in the dependency ratio predicted by the model. The dependency ratio was 0.95 in 1995, and by 2015 it will have fallen below 0.60.

Figure 5.26: Predicted mean and 95% confidence interval for the dependency ratio, 2000-2015, given the 11 probability distributions in Figures 5.1, 5.4, 5.7, 5.12, 5.15, and 5.18.



## **CHAPTER 6: CONCLUSIONS**

This report has presented the methodology used to make simultaneous poverty and population projections for Nicaragua.

The results show that at the individual level, the level of education in the household is by far the most important characteristic determining the level of poverty, the degree of vulnerability, and the degree of upward social mobility. Number of children below 15 in the household is also an important determinant of poverty, with many children (4 or more) causing higher poverty, higher vulnerability, and less upward mobility. Location is also important with people in rural areas generally being more poor and more vulnerable. There are exceptions to this rule, however. Individuals living in rural households with high levels of education (at least one person with 4 years of secondary) and few children (3 or less) are very unlikely to become worse off over time and very likely to improve their situation (low vulnerability and high upward social mobility).

Gender was found to have no influence on neither poverty nor social mobility. Poverty and vulnerability were found to decrease with age, and upward mobility to increase with age. This makes sense since people build up assets (both human, physical, and social) over their lives, and this should make them less poor and less vulnerable as they get older. This result may be somewhat exaggerated, however, because of the lack of use of equivalence scales in the calculation of poverty lines. In essence, the 4<sup>th</sup> child in a household is assumed to need the same amount of resources as the first adult, which is clearly not the case. This means that the degree of poverty is generally exaggerated in households with many members (usually many children).

At the national level, the most important variables determining poverty and social mobility are changes in the income distribution and economic growth. Thus, growth is essential for the reduction of poverty in Nicaragua, and the more pro-poor, the better. An important supporting measure that would contribute to reducing poverty is to help families avoid having too many children. Education improvements is also a very important policy initiative, which is particularly pro-poor.

Rural-urban migration is found to help reduce aggregate poverty, but it contributes to increasing urban poverty. This means that special attention is needed to secure that the new migrants arriving to urban areas get adequately and quickly integrated into the urban society with all basic services and as well as job possibilities.

Job creation is going to be a big challenge over the coming decades, as the working age population in Nicaragua will grow dramatically from 2.2 million people in 1995 to about 4.1 million in 2015. This means that around 95,000 new jobs are needed every year in order to keep the population occupied, and 74,000 of these will be needed in urban areas.

The number of children under 15, is expected to reach a maximum of 2.1 million in 2005 and then start falling slowly to just under 2 million in 2015. This does not imply that the

need for schools will fall, however, since there is ample room to increase the enrollment rates.

The size of the population of people over 65 is still very small in Nicaragua, but it is expected to more than double from 152 thousand in 1995 to 313 thousand in 2015.

The rapid growth of the working age population together with the fall in number of children and the moderate increase in people over 65, implies that the dependency burden in Nicaragua is destined to fall dramatically. This is a one-time advantage caused by the demographic transition that the country is undergoing, and it is going to help reduce poverty during the coming couple of decades.

However, even under the most favorable conditions, there is no way poverty could be reduced by half by 2015. Actually, anything more than a 10 percent reduction seem unrealistic given the present structure of the population and the economy. Extreme poverty could be reduced by up to 30 percent under the most favorable conditions, but a 15 percent reduction seem more realistic.



## **CHAPTER 7: REFERENCES**

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## APPENDIX A: CHOICE OF RELEVANT STATES

This appendix analysis poverty and social mobility by:

- Area/region of residence
- Number of children in the household
- Number of adults in the household
- Sex
- Sex of the head of household
- Education level in the household
- Age

The most important characteristics were found to be:

- Education level in household
- Area of residence
- Number of children in the household.

Below are detailed estimates of poverty incidences and social mobility for all classifications considered.

### 7.1. Area/region of residence

Tables A1 and A2 show that rural individuals are substantially more poor than urban individuals and that rural individuals are much more vulnerable and less upwardly mobile than urban individuals. Thus, area of residence is an important characteristic to take into account.

*Table A1: Poverty at the individual level, by area of residence, 2001*

<i>Poverty classification in 2001</i>	<i>Area of residence in 2001</i>		
	<b>Urban</b>	<b>Rural</b>	<b>Total</b>
<b>Extreme Poverty</b>	0.062	0.273	<b>0.150</b>
<b>Moderate Poverty</b>	0.239	0.404	<b>0.308</b>
<b>Non-Poor</b>	0.699	0.323	<b>0.542</b>
<b>Total</b>	<b>1.000</b>	<b>1.000</b>	<b>1.000</b>

*Note:* Based on the 22810 individuals of the EMNV 2001 using the expansion factor PESO2.

Table A2: Markov Transition Matrices, by area of residence, 1998-2001

<i>Household type in 1998</i>	<i>Poverty classification in 1998</i>	<i>Poverty classification in 2001</i>			
		<b>Extreme Poverty</b>	<b>Moderate Poverty</b>	<b>Non-Poor</b>	<b>Total</b>
<b>Urban</b>	<b>Extreme Poverty</b>	0.437	0.408	0.155	<b>1.000</b>
	<b>Moderate Poverty</b>	0.116	0.499	0.385	<b>1.000</b>
	<b>Non-Poor</b>	0.005	0.111	0.884	<b>1.000</b>
<b>Rural</b>	<b>Extreme Poverty</b>	0.507	0.402	0.091	<b>1.000</b>
	<b>Moderate Poverty</b>	0.187	0.476	0.337	<b>1.000</b>
	<b>Non-Poor</b>	0.038	0.252	0.710	<b>1.000</b>

Note: Author's estimation based on 13491 matched non-migrant individuals from EMNV 1998 and 2001 using the expansion factor PESO2. Not adjusted.

Table A3 shows the variation in poverty levels across the 7 major regions of Nicaragua. The Managua region is the least poor and the rural Atlantic region the most poor. Extreme poverty is highest in the rural Central region. In general the four urban regions are less poor than the three rural regions, and the rural-urban dichotomy seems a reasonable simplification.

Table A3: Poverty at the individual level, by region, 2001

<i>Region</i>	<i>Poverty classification in 2001</i>			
	<b>Extreme Poverty</b>	<b>Moderate Poverty</b>	<b>Non-Poor</b>	<b>Total</b>
<b>Managua</b>	0.025	0.178	0.798	<b>1.000</b>
<b>Pacific urban</b>	0.062	0.296	0.641	<b>1.000</b>
<b>Pacific rural</b>	0.147	0.409	0.444	<b>1.000</b>
<b>Central urban</b>	0.121	0.230	0.649	<b>1.000</b>
<b>Central rural</b>	0.339	0.366	0.295	<b>1.000</b>
<b>Atlantic urban</b>	0.129	0.300	0.572	<b>1.000</b>
<b>Atlantic rural</b>	0.269	0.496	0.235	<b>1.000</b>

Note: Based on the 22810 individuals of the EMNV 2001 using the expansion factor PESO2.

Tables A4 and A5 show that the two regions where people are most vulnerable (prone to downward mobility) is the rural Atlantic region and the rural Central region. People in the rural Pacific region are much less vulnerable and more upwardly mobile, so much so that they are more similar to urban individuals in terms of social mobility. People are most upwardly mobile in the Pacific region, both in rural and urban areas. This means that the rural-urban dichotomy is not so good in terms of social mobility.

Table A4: Markov Transition Matrices, by region, 1998-2001

<i>Region</i>	<i>Poverty classification in 1998</i>	<i>Poverty classification in 2001</i>			
		<b>Extreme Poverty</b>	<b>Moderate Poverty</b>	<b>Non-Poor</b>	<b>Total</b>
<b>Managua</b>	<b>Extreme Poverty</b>	0.387	0.451	0.163	<b>1.000</b>
	<b>Moderate Poverty</b>	0.078	0.473	0.449	<b>1.000</b>
	<b>Non-Poor</b>	0.000	0.111	0.889	<b>1.000</b>
<b>Pacific urban</b>	<b>Extreme Poverty</b>	0.300	0.557	0.143	<b>1.000</b>
	<b>Moderate Poverty</b>	0.096	0.523	0.381	<b>1.000</b>
	<b>Non-Poor</b>	0.010	0.135	0.855	<b>1.000</b>
<b>Pacific rural</b>	<b>Extreme Poverty</b>	0.348	0.518	0.134	<b>1.000</b>
	<b>Moderate Poverty</b>	0.124	0.470	0.407	<b>1.000</b>
	<b>Non-Poor</b>	0.025	0.216	0.759	<b>1.000</b>
<b>Central urban</b>	<b>Extreme Poverty</b>	0.594	0.313	0.093	<b>1.000</b>
	<b>Moderate Poverty</b>	0.176	0.413	0.411	<b>1.000</b>
	<b>Non-Poor</b>	0.007	0.102	0.891	<b>1.000</b>
<b>Central rural</b>	<b>Extreme Poverty</b>	0.641	0.300	0.059	<b>1.000</b>
	<b>Moderate Poverty</b>	0.260	0.458	0.282	<b>1.000</b>
	<b>Non-Poor</b>	0.071	0.260	0.669	<b>1.000</b>
<b>Atlantic urban</b>	<b>Extreme Poverty</b>	0.538	0.263	0.199	<b>1.000</b>
	<b>Moderate Poverty</b>	0.127	0.612	0.261	<b>1.000</b>
	<b>Non-Poor</b>	0.016	0.197	0.787	<b>1.000</b>
<b>Atlantic rural</b>	<b>Extreme Poverty</b>	0.363	0.501	0.136	<b>1.000</b>
	<b>Moderate Poverty</b>	0.153	0.597	0.250	<b>1.000</b>
	<b>Non-Poor</b>	0.062	0.390	0.547	<b>1.000</b>

Note: Author's estimation based on 13491 matched non-migrant individuals from EMNV 1998 and 2001 using the expansion factor PESO2. Not adjusted.

Table A5: Indices of Vulnerability and Upward Mobility, by region, 1998-2001

<i>Household type in 1998 (number of observations)</i>	<i>Index of Downward Mobility</i>	<i>Index of Upward Mobility</i>
Managua	0.189	1.063
Pacific urban	0.241	1.081
Pacific rural	0.365	1.059
Central urban	0.285	0.817
Central rural	0.591	0.641
Atlantic urban	0.340	0.723
Atlantic rural	0.605	0.887

Note: Author's estimation based on 13491 matched non-migrant individuals from EMNV 1998 and 2001 using the expansion factor PESO2.

## 7.2. Number of children in household

Table A6 shows that there is a clear relationship between number of children in the household and the level of poverty. The extreme poverty incidence is more than 10 times higher for individuals living in households with 5 or more children under 15 years of age than for individuals living in households with no children at all.

This may be partly deceptive, however, since the poverty level is calculated under the assumption that each individual in the household needs the same amount of resources, which is obviously not true. The marginal expenses necessary to house, feed, and dress the third or fourth child in a household are much smaller than the marginal expenses necessary to house, feed, and dress a single adult.

In order to get a more accurate picture of the importance of children in the household poverty lines should be set using equivalence scales, which attach weights less than one to additional household members. In this report, however, we stay with the official poverty lines from INEC, which do not use equivalence scales.

*Table A6: Poverty at the individual level, by number of children in household, 2001*

<i>Poverty classification in 2001</i>	<i>Number of children younger than 15 years of age in household in 2001</i>				
	<b>0</b>	<b>1-2</b>	<b>3-4</b>	<b>5 or more</b>	<b>Total</b>
<b>Extreme Poverty</b>	0.031	0.064	0.175	0.360	<b>0.150</b>
<b>Moderate Poverty</b>	0.130	0.245	0.361	0.457	<b>0.308</b>
<b>Non-Poor</b>	0.839	0.692	0.464	0.183	<b>0.542</b>
<b>Total</b>	<b>1.000</b>	<b>1.000</b>	<b>1.000</b>	<b>1.000</b>	<b>1.000</b>

*Note:* Based on the 22810 individuals of the EMNV 2001 using the expansion factor PESO2.

Table A7 shows that there is not a strong relationship between social mobility and number of children in the household, but that households with more children tend to be more vulnerable than households with less children.

Table A7: Markov Transition Matrices, by number of children in household, 1998-2001

<i>Household type in 1998</i>	<i>Poverty classification in 1998</i>	<i>Poverty classification in 2001</i>			
		<b>Extreme Poverty</b>	<b>Moderate Poverty</b>	<b>Non-Poor</b>	<b>Total</b>
<b>No children in household</b>	<b>Extreme Poverty</b>	0.523	0.214	0.263	<b>1.000</b>
	<b>Moderate Poverty</b>	0.110	0.412	0.478	<b>1.000</b>
	<b>Non-Poor</b>	0.024	0.162	0.814	<b>1.000</b>
<b>1 or 2 children in household</b>	<b>Extreme Poverty</b>	0.404	0.460	0.135	<b>1.000</b>
	<b>Moderate Poverty</b>	0.142	0.470	0.388	<b>1.000</b>
	<b>Non-Poor</b>	0.010	0.090	0.900	<b>1.000</b>
<b>3 or 4 children in household</b>	<b>Extreme Poverty</b>	0.522	0.352	0.126	<b>1.000</b>
	<b>Moderate Poverty</b>	0.163	0.486	0.351	<b>1.000</b>
	<b>Non-Poor</b>	0.013	0.196	0.791	<b>1.000</b>
<b>5 children or more in household</b>	<b>Extreme Poverty</b>	0.490	0.429	0.081	<b>1.000</b>
	<b>Moderate Poverty</b>	0.177	0.507	0.316	<b>1.000</b>
	<b>Non-Poor</b>	0.035	0.333	0.632	<b>1.000</b>

Note: Author's estimation based on 13491 matched non-migrant individuals from EMNV 1998 and 2001 using the expansion factor PESO2. Not adjusted.

Because of the weak evidence of relationships between number of children in household and poverty and social mobility, we choose to limit the number of categories to two: three children or less, and four children or more. The results are given in Tables A8 and A9.

Table A8: Poverty at the individual level, by number of children in household, 2001

<i>Poverty classification in 2001</i>	<i>Number of children younger than 15 years of age in household in 2001</i>		
	<b>3 or less</b>	<b>4 or more</b>	<b>Total</b>
<b>Extreme Poverty</b>	0.077	0.301	<b>0.150</b>
<b>Moderate Poverty</b>	0.250	0.426	<b>0.308</b>
<b>Non-Poor</b>	0.673	0.273	<b>0.542</b>
<b>Total</b>	<b>1.000</b>	<b>1.000</b>	<b>1.000</b>

Note: Based on the 22810 individuals of the EMNV 2001 using the expansion factor PESO2.

Table A9: Markov Transition Matrices, by number of children in household, 1998-2001

<i>Household type in 1998</i>	<i>Poverty classification in 1998</i>	<i>Poverty classification in 2001</i>			
		<b>Extreme Poverty</b>	<b>Moderate Poverty</b>	<b>Non-Poor</b>	<b>Total</b>
<b>3 children or less in household</b>	<b>Extreme Poverty</b>	0.490	0.362	0.148	<b>1.000</b>
	<b>Moderate Poverty</b>	0.144	0.459	0.397	<b>1.000</b>
	<b>Non-Poor</b>	0.013	0.120	0.868	<b>1.000</b>
<b>4 children or more in household</b>	<b>Extreme Poverty</b>	0.493	0.419	0.089	<b>1.000</b>
	<b>Moderate Poverty</b>	0.175	0.513	0.312	<b>1.000</b>
	<b>Non-Poor</b>	0.024	0.298	0.678	<b>1.000</b>

Note: Author's estimation based on 13491 matched non-migrant individuals from EMNV 1998 and 2001 using the expansion factor PESO2. Not adjusted.

### 7.3. Number of adults in household

Table A10 shows the counterintuitive result that the more adults there are in the household the higher the level of poverty. This, however, can probably also be explained by the failure to use equivalence scales in the calculation of poverty lines.

*Table A10: Poverty at the individual level, by number of adults in household, 2001*

<i>Poverty classification in 2001</i>	<i>Number of adults (18 years or older) in household in 2001</i>			<b>Total</b>
	<b>0 or 1</b>	<b>2</b>	<b>3 or more</b>	
<b>Extreme Poverty</b>	0.080	0.124	0.164	<b>0.150</b>
<b>Moderate Poverty</b>	0.220	0.297	0.316	<b>0.308</b>
<b>Non-Poor</b>	0.701	0.579	0.520	<b>0.542</b>
<b>Total</b>	<b>1.000</b>	<b>1.000</b>	<b>1.000</b>	<b>1.000</b>

*Note:* Based on the 22810 individuals of the EMNV 2001 using the expansion factor PESO2.

Table A11 shows that there is no clear relationship between social mobility and number of adults in the household. This variable is consequently not taken into account in our main analysis.

*Table A11: Markov Transition Matrices, by number of adults in household, 1998-2001*

<i>Household type in 1998</i>	<i>Poverty classification in 1998</i>	<i>Poverty classification in 2001</i>			
		<b>Extreme Poverty</b>	<b>Moderate Poverty</b>	<b>Non-Poor</b>	<b>Total</b>
<b>0 or 1 adult in household</b>	<b>Extreme Poverty</b>	0.465	0.418	0.117	<b>1.000</b>
	<b>Moderate Poverty</b>	0.131	0.742	0.127	<b>1.000</b>
	<b>Non-Poor</b>	0.025	0.201	0.774	<b>1.000</b>
<b>2 adults in household</b>	<b>Extreme Poverty</b>	0.482	0.404	0.114	<b>1.000</b>
	<b>Moderate Poverty</b>	0.172	0.512	0.315	<b>1.000</b>
	<b>Non-Poor</b>	0.017	0.165	0.818	<b>1.000</b>
<b>3 or more adults in household</b>	<b>Extreme Poverty</b>	0.496	0.403	0.101	<b>1.000</b>
	<b>Moderate Poverty</b>	0.154	0.469	0.377	<b>1.000</b>
	<b>Non-Poor</b>	0.014	0.145	0.842	<b>1.000</b>

*Note:* Author's estimation based on 13491 matched non-migrant individuals from EMNV 1998 and 2001 using the expansion factor PESO2. Not adjusted.

## 7.4. Gender

Tables A12 and A13 shows that women are not more poor and not more vulnerable than men in Nicaragua. If anything, they are slightly less poor and slightly less vulnerable than men, but the differences are small and therefore we do not need to make separate assumptions for men and women in our main analysis.

*Table A12: Poverty at the individual level, by sex, 2001*

<i>Poverty classification in 2001</i>	<i>Sex</i>		
	<b>Male</b>	<b>Female</b>	<b>Total</b>
<b>Extreme Poverty</b>	0.157	0.145	<b>0.150</b>
<b>Moderate Poverty</b>	0.315	0.301	<b>0.308</b>
<b>Non-Poor</b>	0.528	0.555	<b>0.542</b>
<b>Total</b>	<b>1.000</b>	<b>1.000</b>	<b>1.000</b>

*Note:* Based on the 22810 individuals of the EMNV 2001 using the expansion factor PESO2.

*Table A13: Markov Transition Matrices, by sex, 1998-2001*

<i>Sex</i>	<i>Poverty classification in 1998</i>	<i>Poverty classification in 2001</i>			
		<b>Extreme Poverty</b>	<b>Moderate Poverty</b>	<b>Non-Poor</b>	<b>Total</b>
<b>Male</b>	<b>Extreme Poverty</b>	0.493	0.410	0.097	<b>1.000</b>
	<b>Moderate Poverty</b>	0.160	0.488	0.353	<b>1.000</b>
	<b>Non-Poor</b>	0.019	0.160	0.821	<b>1.000</b>
<b>Female</b>	<b>Extreme Poverty</b>	0.491	0.397	0.113	<b>1.000</b>
	<b>Moderate Poverty</b>	0.149	0.483	0.358	<b>1.000</b>
	<b>Non-Poor</b>	0.012	0.147	0.574	<b>1.000</b>

*Note:* Author's estimation based on 13491 matched non-migrant individuals from EMNV 1998 and 2001 using the expansion factor PESO2. Not adjusted.

Tables A14 and A15 shows that individuals living in female headed households are significantly less poor and less vulnerable than individuals living in male headed households. However, given the tendency to choose the husband as default head of household if he exists and is reasonable capable, this classification contains an inherent bias, and it is therefore not advisable to take the gender of the head of household into account in our main analysis.



Table A14: Poverty at the individual level, by sex of the head of household, 2001

<i>Poverty classification in 2001</i>	<i>Sex of the head of household</i>		
	<b>Male</b>	<b>Female</b>	<b>Total</b>
<b>Extreme Poverty</b>	0.164	0.115	<b>0.150</b>
<b>Moderate Poverty</b>	0.315	0.289	<b>0.308</b>
<b>Non-Poor</b>	0.522	0.596	<b>0.542</b>
<b>Total</b>	<b>1.000</b>	<b>1.000</b>	<b>1.000</b>

Note: Based on the 22810 individuals of the EMNV 2001 using the expansion factor PESO2.

Table A15: Markov Transition Matrices, by sex of the head of household, 1998-2001

<i>Sex of the head of household</i>	<i>Poverty classification in 1998</i>	<i>Poverty classification in 2001</i>			
		<b>Extreme Poverty</b>	<b>Moderate Poverty</b>	<b>Non-Poor</b>	<b>Total</b>
<b>Male</b>	<b>Extreme Poverty</b>	0.507	0.401	0.092	<b>1.000</b>
	<b>Moderate Poverty</b>	0.170	0.473	0.357	<b>1.000</b>
	<b>Non-Poor</b>	0.016	0.163	0.821	<b>1.000</b>
<b>Female</b>	<b>Extreme Poverty</b>	0.443	0.410	0.147	<b>1.000</b>
	<b>Moderate Poverty</b>	0.124	0.528	0.349	<b>1.000</b>
	<b>Non-Poor</b>	0.012	0.128	0.860	<b>1.000</b>

Note: Author's estimation based on 13491 matched non-migrant individuals from EMNV 1998 and 2001 using the expansion factor PESO2. Not adjusted.

### 7.5. Education level in the household

Since our sample includes a large number of children who are still under education or has not even initiated schooling yet, we cannot use the education levels of each individual as a variable in our analysis. Instead we use the maximum level of education found in the household, which is a good indicator for the future level of education of the children.

Tables A16 and A17 show that the education level in the household is extremely important both for the level of poverty and for the degree of social mobility. Secondary education is a rather good insurance against extreme poverty: Only 1.5% of the individuals living in households where at least one member has achieved 4 years of secondary education are extremely poor, while this is the case for 22.3% of the individuals living in households where nobody has reached 4 years of secondary education.

Table A16: Poverty at the individual level, by education level in the household, 2001

<i>Poverty classification in 2001</i>	<i>Highest education level in the household</i>		
	<b>Less than 4 years of secondary</b>	<b>4 years of secondary or more</b>	<b>Total</b>
<b>Extreme Poverty</b>	0.223	0.015	<b>0.150</b>
<b>Moderate Poverty</b>	0.385	0.165	<b>0.308</b>
<b>Non-Poor</b>	0.392	0.820	<b>0.542</b>
<b>Total</b>	<b>1.000</b>	<b>1.000</b>	<b>1.000</b>

Note: Based on the 22810 individuals of the EMNV 2001 using the expansion factor PESO2.

Table A17 shows that education is also excellent as a means of reducing vulnerability and increasing upward mobility. The downward mobility index is  $0.183+0.030+0.239=0.452$  for individuals living in households with low levels of education whereas it is only  $0.042+0.000+0.065=0.107$  for individuals living in households with high levels of education. Similarly, the upward mobility index is only  $0.391+0.092+0.322=0.805$  for individuals from low education households whereas it is  $0.628+0.343+0.522=1.493$  for individuals from high education households.

Table A17: Markov Transition Matrices, by sex of the head of household, 1998-2001

<i>Highest education level in the household in 1998</i>	<i>Poverty classification in 1998</i>	<i>Poverty classification in 2001</i>			
		<b>Extreme Poverty</b>	<b>Moderate Poverty</b>	<b>Non-Poor</b>	<b>Total</b>
<b>Less than 4 years of secondary</b>	<b>Extreme Poverty</b>	0.518	0.391	0.092	<b>1.000</b>
	<b>Moderate Poverty</b>	0.183	0.495	0.322	<b>1.000</b>
	<b>Non-Poor</b>	0.030	0.239	0.731	<b>1.000</b>
<b>4 years of secondary or more</b>	<b>Extreme Poverty</b>	0.029	0.628	0.343	<b>1.000</b>
	<b>Moderate Poverty</b>	0.042	0.436	0.522	<b>1.000</b>
	<b>Non-Poor</b>	0.000	0.065	0.935	<b>1.000</b>

Note: Author's estimation based on 13491 matched non-migrant individuals from EMNV 1998 and 2001 using the expansion factor PESO2. Not adjusted.

## 7.6. Age

Table A18 shows that poverty decreases systematically with age. Individuals under 20 years of age are much more likely to be poor than grown ups. Elderly people are the least likely to be poor.

However, some of the excessive poverty amongst children and young people may again be due to the failure to use equivalence scales in the calculation of poverty lines. All the children living in large households are not as poor as they appear when using the simple poverty lines, and this means that children on average are not as poor as it appears in Table A18.

Table A18: Poverty at the individual level, by age, 2001

<i>Poverty classification in 2001</i>	<i>Age (years)</i>					<b>Total</b>
	<b>0-9</b>	<b>10-19</b>	<b>20-39</b>	<b>40-59</b>	<b>60+</b>	
<b>Extreme Poverty</b>	0.196	0.171	0.117	0.113	0.108	<b>0.150</b>
<b>Moderate Poverty</b>	0.364	0.313	0.287	0.258	0.252	<b>0.308</b>
<b>Non-Poor</b>	0.440	0.516	0.596	0.629	0.640	<b>0.542</b>
<b>Total</b>	<b>1.000</b>	<b>1.000</b>	<b>1.000</b>	<b>1.000</b>	<b>1.000</b>	<b>1.000</b>

Note: Based on the 22810 individuals of the EMNV 2001 using the expansion factor PESO2.

Table A17 shows that there is not a strong relationship between age and social mobility.

Table A19: Markov Transition Matrices, by age, 1998-2001

<i>Age (in 1998)</i>	<i>Poverty classification in 1998</i>	<i>Poverty classification in 2001</i>			
		<b>Extreme Poverty</b>	<b>Moderate Poverty</b>	<b>Non-Poor</b>	<b>Total</b>
<b>0-9</b>	<b>Extreme Poverty</b>	0.507	0.401	0.093	<b>1.000</b>
	<b>Moderate Poverty</b>	0.175	0.502	0.323	<b>1.000</b>
	<b>Non-Poor</b>	0.016	0.187	0.798	<b>1.000</b>
<b>10-19</b>	<b>Extreme Poverty</b>	0.491	0.400	0.110	<b>1.000</b>
	<b>Moderate Poverty</b>	0.165	0.479	0.356	<b>1.000</b>
	<b>Non-Poor</b>	0.015	0.158	0.827	<b>1.000</b>
<b>20-39</b>	<b>Extreme Poverty</b>	0.468	0.433	0.099	<b>1.000</b>
	<b>Moderate Poverty</b>	0.154	0.495	0.351	<b>1.000</b>
	<b>Non-Poor</b>	0.013	0.137	0.850	<b>1.000</b>
<b>40-59</b>	<b>Extreme Poverty</b>	0.489	0.405	0.106	<b>1.000</b>
	<b>Moderate Poverty</b>	0.137	0.439	0.424	<b>1.000</b>
	<b>Non-Poor</b>	0.012	0.149	0.839	<b>1.000</b>
<b>60+</b>	<b>Extreme Poverty</b>	0.480	0.326	0.194	<b>1.000</b>
	<b>Moderate Poverty</b>	0.114	0.480	0.407	<b>1.000</b>
	<b>Non-Poor</b>	0.025	0.105	0.871	<b>1.000</b>

Note: Author's estimation based on 13491 matched non-migrant individuals from EMNV 1998 and 2001 using the expansion factor PESO2. Not adjusted.



## APPENDIX B: BI-PROPORTIONAL ADJUSTMENT OF SOCIAL MOBILITY MATRICES.

*Table B1a: Non-adjusted Markov Transition Matrix for individuals in Nicaragua, 1998-2001*

	<i>Poverty classification in 2001</i>			
<i>Poverty classification in 1998</i>	<b>Extreme Poverty</b>	<b>Moderate Poverty</b>	<b>Non-Poor</b>	<b>Total</b>
<b>Extreme Poverty</b>	0.492	0.403	0.105	<b>1.000</b>
<b>Moderate Poverty</b>	0.159	0.485	0.356	<b>1.000</b>
<b>Non-Poor</b>	0.015	0.153	0.832	<b>1.000</b>

*Note:* Author's estimations based on 13491 matched non-migrant individuals from EMNV 1998 and 2001 using the expansion factor PESO2. Non-adjusted.

*Table B1b: Adjusted Markov Transition Matrix for individuals in Nicaragua, 1998-2001*

	<i>Poverty classification in 2001</i>			
<i>Poverty classification in 1998</i>	<b>Extreme Poverty</b>	<b>Moderate Poverty</b>	<b>Non-Poor</b>	<b>Total</b>
<b>Extreme Poverty</b>	0.512	0.397	0.091	<b>1.000</b>
<b>Moderate Poverty</b>	0.173	0.500	0.327	<b>1.000</b>
<b>Non-Poor</b>	0.018	0.167	0.815	<b>1.000</b>

*Note:* Author's estimations based on 13491 matched non-migrant individuals from EMNV 1998 and 2001 using the expansion factor PESO2. Has undergone a bi-proportional adjustment procedure to make the sample marginal poverty distributions coincide with the actual distributions for the whole population.

Table B2a: Unadjusted Markov Transition Matrices for individuals from different household types, 1998-2001

<i>Household type in 1998</i>	<i>Poverty classification in 1998</i>	<i>Poverty classification in 2001</i>			
		<b>Extreme Poverty</b>	<b>Moderate Poverty</b>	<b>Non-Poor</b>	<b>Total</b>
<b>Urban Little education Few children</b>	<b>Extreme Poverty</b>	0.389	0.424	0.187	<b>1.000</b>
	<b>Moderate Poverty</b>	0.103	0.475	0.422	<b>1.000</b>
	<b>Non-Poor</b>	0.011	0.145	0.844	<b>1.000</b>
<b>Urban Little education Many children</b>	<b>Extreme Poverty</b>	0.537	0.355	0.108	<b>1.000</b>
	<b>Moderate Poverty</b>	0.174	0.548	0.278	<b>1.000</b>
	<b>Non-Poor</b>	0.018	0.362	0.620	<b>1.000</b>
<b>Urban More education Few children</b>	<b>Extreme Poverty</b>	0.000	0.109	0.891	<b>1.000</b>
	<b>Moderate Poverty</b>	0.000	0.357	0.643	<b>1.000</b>
	<b>Non-Poor</b>	0.000	0.035	0.965	<b>1.000</b>
<b>Urban More education Many children</b>	<b>Extreme Poverty</b>	0.073	0.833	0.094	<b>1.000</b>
	<b>Moderate Poverty</b>	0.043	0.557	0.400	<b>1.000</b>
	<b>Non-Poor</b>	0.000	0.177	0.823	<b>1.000</b>
<b>Rural Little education Few children</b>	<b>Extreme Poverty</b>	0.542	0.359	0.099	<b>1.000</b>
	<b>Moderate Poverty</b>	0.205	0.464	0.331	<b>1.000</b>
	<b>Non-Poor</b>	0.047	0.263	0.700	<b>1.000</b>
<b>Rural Little education Many children</b>	<b>Extreme Poverty</b>	0.515	0.409	0.076	<b>1.000</b>
	<b>Moderate Poverty</b>	0.204	0.503	0.293	<b>1.000</b>
	<b>Non-Poor</b>	0.069	0.442	0.489	<b>1.000</b>
<b>Rural More education Few children</b>	<b>Extreme Poverty</b>	0.000	0.309	0.691	<b>1.000</b>
	<b>Moderate Poverty</b>	0.047	0.501	0.452	<b>1.000</b>
	<b>Non-Poor</b>	0.000	0.121	0.879	<b>1.000</b>
<b>Rural More education Many children</b>	<b>Extreme Poverty</b>	0.000	0.697	0.303	<b>1.000</b>
	<b>Moderate Poverty</b>	0.104	0.340	0.556	<b>1.000</b>
	<b>Non-Poor</b>	0.000	0.047	0.953	<b>1.000</b>

*Nota:* Author's estimations based on 13491 matched non-migrant individuals from EMNV 1998 and 2001 using the expansion factor PESO2. Have not yet undergone the bi-proportional adjustment procedure.

Table B2b: Adjusted Markov Transition Matrices for individuals from different household types, 1998-2001

<i>Household type in 1998</i>	<i>Poverty classification in 1998</i>	<i>Poverty classification in 2001</i>			
		<b>Extreme Poverty</b>	<b>Moderate Poverty</b>	<b>Non-Poor</b>	<b>Total</b>
<b>Urban Little education Few children</b>	<b>Extreme Poverty</b>	0.359	0.466	0.175	<b>1.000</b>
	<b>Moderate Poverty</b>	0.094	0.516	0.390	<b>1.000</b>
	<b>Non-Poor</b>	0.011	0.167	0.822	<b>1.000</b>
<b>Urban Little education Many children</b>	<b>Extreme Poverty</b>	0.571	0.332	0.097	<b>1.000</b>
	<b>Moderate Poverty</b>	0.192	0.549	0.259	<b>1.000</b>
	<b>Non-Poor</b>	0.021	0.384	0.596	<b>1.000</b>
<b>Urban More education Few children</b>	<b>Extreme Poverty</b>	0.021	0.187	0.792	<b>1.000</b>
	<b>Moderate Poverty</b>	0.008	0.513	0.480	<b>1.000</b>
	<b>Non-Poor</b>	0.002	0.065	0.932	<b>1.000</b>
<b>Urban More education Many children</b>	<b>Extreme Poverty</b>	0.189	0.757	0.054	<b>1.000</b>
	<b>Moderate Poverty</b>	0.133	0.594	0.273	<b>1.000</b>
	<b>Non-Poor</b>	0.010	0.249	0.741	<b>1.000</b>
<b>Rural Little education Few children</b>	<b>Extreme Poverty</b>	0.529	0.399	0.072	<b>1.000</b>
	<b>Moderate Poverty</b>	0.205	0.532	0.263	<b>1.000</b>
	<b>Non-Poor</b>	0.052	0.332	0.616	<b>1.000</b>
<b>Rural Little education Many children</b>	<b>Extreme Poverty</b>	0.628	0.332	0.039	<b>1.000</b>
	<b>Moderate Poverty</b>	0.307	0.503	0.190	<b>1.000</b>
	<b>Non-Poor</b>	0.124	0.510	0.366	<b>1.000</b>
<b>Rural More education Few children</b>	<b>Extreme Poverty</b>	0.001	0.287	0.712	<b>1.000</b>
	<b>Moderate Poverty</b>	0.070	0.466	0.464	<b>1.000</b>
	<b>Non-Poor</b>	0.000	0.107	0.893	<b>1.000</b>
<b>Rural More education Many children</b>	<b>Extreme Poverty</b>	0.008	0.869	0.123	<b>1.000</b>
	<b>Moderate Poverty</b>	0.202	0.524	0.274	<b>1.000</b>
	<b>Non-Poor</b>	0.000	0.144	0.856	<b>1.000</b>

*Nota:* Author's estimations based on 13491 matched non-migrant individuals from EMNV 1998 and 2001 using the expansion factor PESO2. Have undergone bi-proportional adjustment procedures to make the sample marginal poverty distributions coincide with the actual marginal distributions for the respective sub-populations.