

## 5. The impact of policy reforms on rural poverty in Brazil: evidence from three states in the 1990s

**Steven M. Helfand and Edward S. Levine**

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### INTRODUCTION

This chapter analyzes the puzzle of what happened to rural poverty in Brazil in the 1990s and why. The 1990s were a period of considerable policy reform and economic change. In response to the debt crisis and the exhaustion of the import substitution model, beginning in 1988 the Brazilian government rapidly liberalized trade. Throughout the 1990s the state reduced the extent and scope of its interventions and deregulated many markets. Simultaneously, the Brazilian economy struggled with hyperinflation, and the government adopted numerous stabilization plans between 1986 and 1994, when the Real Plan finally succeeded in taming inflation. Interestingly, the agricultural sector outperformed the manufacturing sector in the context of the debt crisis of the 1980s, and outperformed both manufacturing and services in the neoliberal environment of the 1990s. The positive performance of agriculture as a whole is one factor that might have led us to expect a decline in rural poverty in the 1990s.

There were a number of forces however that suggested an increase in rural poverty or at least a more nuanced assessment. Firstly, agricultural growth was extremely heterogeneous across regions, crops and farm sizes (Helfand, 2004). The Center-West for example, where extremely large farms produce many exportables, was a booming region in the 1990s. Increased demand for labor in this region might have contributed to reducing rural poverty. The South, in contrast, experienced substantial problems of competitiveness. This is a region where small and medium-sized farms produce many importables. Thus whatever the net effect on rural poverty for Brazil as a whole, it is unlikely that there is a single story that can adequately describe the multiple experiences of growth, adjustment and poverty the 1990s.

Secondly, in part due to the appreciation of the real exchange rate, real agricultural prices fell by over 50 per cent between the mid-1980s and the late 1990s.<sup>1</sup> Trade liberalization and exchange rate appreciation also contributed to

lowering input prices by a similar magnitude. There is evidence that large farms were able to take advantage of falling input prices to a greater extent than small farms, and that they achieved much more rapid productivity gains in the 1990s than did small farms (Helfand, 2004). There is also evidence that only on large farms was output able to grow fast enough to compensate for falling prices and to keep revenue from declining. Thus, on average, income from agricultural production appears to have fallen for small farms in the 1990s and this is likely to have increased poverty in rural areas.

Finally, there was a substantial decline in the rural population and in the labor force employed in agriculture in the 1990s. According to the demographic censuses of 1991 and 2000, the rural population fell by 11 percent, and according to the national household surveys (PNAD), agricultural employment (including the self-employed and their unpaid family members) fell by 14 percent between 1992–93 and 2001–02. The decline in employment in agriculture was driven by both the crisis of competitiveness of small farms and the adoption of labor-saving technologies on large farms. An exodus of this proportion suggests that employment growth did not keep up with population growth, and it could easily have been a reflection of an increase in rural poverty. Paradoxically, rapid migration out of rural areas could also contribute to reducing rural poverty if the poor leave disproportionately, or if out-migration occurs randomly, but at a faster rate than the decline in income received by the poor.

Two recent papers in Brazil shed some light on the evidence regarding poverty. They both conclude that poverty in agriculture fell substantially in the 1990s. Corrêa (2003), using family income per capita of those people employed in agriculture, reports a decline in the headcount ratio of 9.5 percentage points between 1992 and 1998. Using a similar measure, Barros et al. (2004) estimate a decline of 7.6 percentage points between 1992 and 2001. For rural – rather than agricultural – families, these authors estimate an even larger reduction in poverty (9.8 percentage points).

In this chapter we seek to understand this rather surprising decline in rural poverty. In the next section we discuss a number of explanations of why poverty declined in the 1990s. In contrast to the analysis of Barros et al. (2004), we suspect that migration out of rural areas is likely to have played an important role in reducing rural poverty in this period. We also believe that because of the heterogeneity of regional experiences in the 1990s it is essential to study the determinants of changes in rural poverty at not only a national, but especially a sub-national level. The third section presents evidence on income, poverty and inequality in rural areas of Brazil in the 1990s. Using micro data from the demographic censuses of 1991 and 2000, and a county level unit of analysis, in the next section we present several tests of the hypotheses discussed earlier for three states in Brazil. The final section provides conclusions and thoughts for future research.

## ALTERNATIVE EXPLANATIONS OF CHANGES IN RURAL POVERTY IN THE 1990s

There are three groups of explanations of the decline in rural poverty that we would like to investigate in this chapter. They relate to out-migration from rural areas, the importance of different sources of household income (such as government transfers or non-agricultural earned income), and macroeconomic forces. Although we believe that macroeconomic events were important, for reasons discussed below we are not able to address them satisfactorily with the data that we are using here. We emphasize that the explanations are not mutually exclusive. Thus, we seek to quantify their relative importance.

Although out-migration is likely a reflection of high or rising rates of rural poverty, if it happens fast enough it can also contribute to a reduction in poverty. Because out-migration took place on such a large scale in the 1990s, a key hypothesis that we wish to test is that migration out of rural areas contributed to a decline in rural poverty. There are a number of mechanisms through which this could have occurred. Firstly, it could be that migration occurs disproportionately from the bottom end of the income distribution. Thus if poor families leave rural areas at a faster rate than non-poor families, the poverty rate could fall and average income could rise without a single household experiencing income growth. Secondly, and this is what Barros et al. (2004) focus on in relation to migration, the demographic characteristics of the families that remain in rural areas could change in such a way that contributes to reducing poverty. For example there could be an increase in the share of working-age adults in poor households.<sup>2</sup> Thirdly, if the initial situation involved low-productivity 'surplus' labor within small farms, migration of family members could have come at little or no cost in terms of output. As a result, household income per capita would rise. Fourthly, migration could lead to an inward shift of the labor supply curve and, consequently, an increase in wages paid in rural areas. Finally, to the extent that some family members migrate from rural areas while others stay behind, it is likely that remittances will flow to the remaining rural family members at some point in the future and thus contribute to reducing poverty. In such cases, it may be that both those who leave and those who remain behind experience lower rates of poverty. In the empirical section of this chapter we simply test for a significant effect of migration. If we find that it contributes to reducing poverty, future research should seek to identify the relative importance of the mechanisms discussed above.

The second set of explanations for the decline in rural poverty relates to differential growth of alternative sources of income. Graziano da Silva and Del Grossi (2001) and Ferreira and Lanjouw (2001) for example argue that the growth of non-agricultural sources of earned income in rural areas has been a fundamental force contributing to lowering poverty rates. Delgado and Cardoso

Jr. (2000), Beltrão et al. (2002) and others have emphasized the importance of increased social security benefits for reducing rural poverty in the 1990s. Social security benefits grew considerably in rural areas in the early 1990s as a result of changes in the 1988 Constitution. Finally, in regions such as the Center-West where agriculture has been especially dynamic, it is likely to have had a positive effect on rural poverty through its impact on the demand for agricultural labor. Thus we seek to quantify the relative importance of these income sources and to explore whether they have played different roles in different regions of the country.

The third explanation of a decline in rural poverty relates to macroeconomic factors. The Real Plan succeeded in bringing inflation (as measured by the CPI) down from an average of over 1000 percent per year between 1988 and 1994 to around 20 percent in 1995 and under 10 percent in 1996. To the extent that hyperinflation disproportionately harmed the poor, stabilization should have contributed to reducing poverty in rural and urban areas. In addition to lower inflation, five years of respectable rates of growth between 1993 and 1998, and a 15 percent increase in the real minimum wage in 1995–99 relative to 1990–94, should have helped to raise the incomes of the poor. Urban and rural poverty rates did in fact fall markedly in 1995 relative to 1993 ([www.ipeadata.gov.br](http://www.ipeadata.gov.br); Barros et al., 2004). While we would like to explore the relative importance for poverty reduction of the individual factors discussed here, and of the macro factors as a group in relation to the determinants discussed above (migration, government transfers and so on), the census data we use are drawn from only two points in time: 1991 and 2000. Time-series or panel data would be necessary to identify the importance of macroeconomic factors in the 1990s. For this purpose the annual household surveys would be a more appropriate source. The household surveys however are only representative at a state level. Because we have chosen to focus on migration, the demographic censuses have the advantage of being representative at a county level. Thus for now we implicitly adopt the assumption that macroeconomic factors had a similar impact across counties in the 1990s. If so, the discrete decline in poverty that occurred between 1993 and 1995 will be absorbed in the intercepts of our county level regression models.

## EVIDENCE ON RURAL INCOME, POVERTY, AND INEQUALITY IN THE 1990s

In this section of the chapter we provide an overview of trends in poverty and related variables in the 1990s at a national level and for three states. The states – Alagoas, Santa Catarina and Mato Grosso – had very different experiences with rural poverty reduction in the 1990s and are located in different regions of

the country. Thus we chose them to capture some of the heterogeneity in performance in this period. We do not however claim that these states are statistically representative of the national experience. In future research we intend to extend the analysis to the rest of the country. We begin this section with a brief discussion of the data and the methodology used to construct the variables. We then analyze the evolution of income, poverty and inequality in the 1990s.

### **Data and Methodology**

The data used to construct the measures of income, poverty and inequality come from the long form of the Demographic Censuses of 1991 and 2000. Approximately 10 percent of the Brazilian population answered this questionnaire in both years. Income is measured as domicile income per capita. As is common in studies of poverty in Brazil, we exclude (1) collective domiciles (such as prisons and hospitals); (2) domestic employees and their family members (to avoid double counting their income); and (3) people who pay rent to the domicile head to live in the domicile. Income includes earnings from all sources, government transfers and other forms of unearned income. One of the most important limitations of the definition of income in the Demographic Censuses is that it does not include non-marketed production for own consumption. For small farmers who consume a significant portion of what they produce, this is likely to lead to a significant underestimation of their true incomes. If own consumption is relatively constant over time, then it should not have a large impact on the measured change in income between 1991 and 2000.<sup>3</sup>

Poverty and extreme poverty are measured in relation to uniform national poverty lines. While it would be preferable to use poverty lines that take account of differences in the cost of living across regions and rural–urban areas, existing poverty lines that incorporate these difference are based on outdated data from the 1980s (and in some cases the 1970s). Thus we have adopted the same poverty lines as the recently released *Atlas of Human Development* (2003). The poverty and extreme poverty lines were set at one-half and one-quarter of an August 2000 minimum wage per person. With a minimum wage of 151 reais, this translated into a poverty line of approximately US\$1.33 per person per day in that month. While a uniform national poverty line is likely to overstate poverty in some areas, such as in the rural North-East, the changes in poverty between 1991 and 2000 are much less sensitive to this problem.

The Gini Coefficient is estimated from a piecewise linear Lorenz curve. The Gini is a measure of inequality that lies between zero and one, with larger numbers indicating greater inequality. The Gini measures inequality of total domicile income per capita, that is, income from all sources. In order to identify the contribution of specific income sources to overall inequality – such as agri-

cultural or wage income – we also calculate the concentration ratio for each source of income. The concentration ratio shows the degree of inequality in the distribution of a particular source of income. It is calculated from a ‘pseudo-Lorenz’ curve. The standard Lorenz curve has the cumulative percentage of household income per capita on the vertical axis, and the cumulative percentage of the population ranked by household income per capita on the horizontal axis. The pseudo-Lorenz curve uses the same ranking as the Lorenz curve (rather than the ranking that corresponds to the source of income in question). Thus it measures the cumulative percentage of income from the source in question on the vertical axis, and the cumulative percentage of the population ranked by household income per capita on the horizontal axis.<sup>4</sup> A concentration ratio for a particular source of income – say social security – that is smaller than the Gini is considered to be an equalizing force, because if this source were to grow relative to other sources (and the concentration ratio were to remain unchanged) the Gini would fall. A concentration ratio for a particular source of income – say non-agricultural income – that is larger than the Gini is considered to be a disequalizing force, because if this source were to grow relative to other sources (but holding the concentration ratio constant) the Gini would rise. The Gini can be decomposed into a weighted sum of concentration ratios, where the weights are the shares of each source of income in total income.

### **Income, Poverty and Inequality**

The first row of Table 5.1 shows that – without disaggregating rural from urban areas in Brazil – poverty and extreme poverty both fell substantially in the 1990s. The poverty headcount ratio fell by 21 percent, from 0.40 down to 0.32. Extreme poverty fell by a similar proportion. Table 5.1 also shows that the Gini ratio of inequality rose slightly in this period from 0.63 to 0.65. Thus it appears that the 29 percent increase in household income per capita explains the entire decline in poverty in the 1990s. It is important to note that poverty rose in Brazil as a result of the debt crisis of the 1980s. It was only in the post-stabilization period since 1994 that Brazil finally achieved poverty rates below those that were observed in the late 1970s.<sup>5</sup>

The second row of Table 5.1 shows that the evolution of poverty and extreme poverty in rural Brazil was similar to that of the national level.<sup>6</sup> Poverty fell by 16 percent and extreme poverty fell by 19 percent. In contrast to the national average, rural income grew by more (32 percent versus 29 percent), yet inequality rose by more (7 percent versus 2 percent). Because inequality rose, we must look to the income growth of 32 percent to provide the likely explanation for the decline in poverty. Also the decline of 11 percentage points in the rural population may have contributed to the high income growth and may have prevented inequality from rising even further. In a similar fashion to what happened

Table 5.1 Descriptive statistics, 1991–2000

	Population			Income			Inequality			Poverty (1/2 MW pc)			Extreme Pov. (1/4 MW pc)		
	1991	2000	% ch	1991	2000	% ch	1991	2000	% ch	1991	2000	% ch	1991	2000	% ch
	(Millions)			(R\$ of 1/2002)			(Gini)			(Headcount)			(Headcount)		
Brazil <sup>1</sup>															
Total	147	170	16	255	330	29	0.63	0.65	2	0.40	0.32	-21	0.20	0.15	-23
Rural	36	32	-11	90	119	32	0.58	0.62	7	0.72	0.61	-16	0.45	0.36	-19
Urban	111	138	24	308	379	23	0.61	0.63	3	0.30	0.25	-17	0.12	0.11	-14
Alagoas															
Rural	1.03	0.91	-12	57	59	4	0.48	0.59	24	0.84	0.82	-3	0.55	0.57	3
Urban	1.48	1.92	29	166	201	21	0.63	0.67	7	0.55	0.50	-9	0.27	0.26	-4
Santa Catarina															
Rural	1.33	1.14	-14	141	231	64	0.52	0.53	1	0.48	0.27	-43	0.22	0.11	-50
Urban	3.21	4.22	31	305	430	41	0.53	0.56	6	0.19	0.12	-34	0.06	0.04	-27
Mato Grosso															
Rural	0.54	0.52	-4	136	186	37	0.59	0.63	7	0.58	0.45	-23	0.29	0.22	-22
Urban	1.49	1.99	34	261	356	36	0.58	0.62	6	0.30	0.22	-27	0.10	0.08	-23

Note: 1. We excluded the Northern state Roraima from national level estimates of income, inequality, and poverty due to significant errors in the 1991 data files.

Source: Authors' calculations based on the micro data from the demographic censuses.

with national level poverty in the 1980s and 1990s, Corrêa (2003) reports that poverty among the families of people working in agriculture rose between 1981 and the early 1990s. It then fell markedly in the 1990s. Thus it is likely that the achievements in rural poverty reduction in the 1990s were mostly just eliminating the setbacks of the 1980s.

The remainder of Table 5.1 shows what happened to poverty and related indicators in the three states that we have chosen to analyze in detail. Income per capita in rural Alagoas, a poor state in the North-East of Brazil, was about two-thirds of the national rural average in 1991. As a result, poverty in Alagoas was considerably higher than the national average. Alagoas was also the worst-performing state of the three that we have chosen. Rural poverty barely fell in the 1990s, registering a decline from 0.84 to 0.82, and extreme poverty in rural areas actually rose slightly from 0.55 to 0.57. The reason for the lack of progress in reducing poverty relates to the fact that household income per capita only rose by 4 percent in this decade, and income growth was distributed very unequally. The Gini for rural Alagoas rose by 24 percent. It is possible that without the observed 12 percent decline in the rural population, average income would have grown less or inequality would have grown more, so that poverty would have risen rather than remained roughly constant.

In contrast to Alagoas, the Southern state of Santa Catarina made dramatic gains in poverty reduction in the 1990s. The 43 percent decline in rural poverty in the 1990s was caused by rapid growth in income (64 percent) and virtually no change in inequality (1 percent). It is possible that the 14 percent decline in the rural population contributed to the rapid rate of average income growth, and prevented inequality from rising substantially, therefore facilitating the lowering of the rate of rural poverty.

Mato Grosso, a state in the Center-West of Brazil, represents an intermediate case. Mato Grosso grew in the 1990s, but not by as much as Santa Catarina. Mato Grosso also followed a disequalizing growth path. Rural household income per capita rose by 37 percent, but this was accompanied by a 7 percent increase in the Gini. For both reasons, poverty fell by less than in Santa Catarina, dropping by 23 percent in the period. Unlike in the other two states, the decline in the rural population was only 4 percent. Thus it is unlikely that out-migration had much of an effect on poverty in Mato Grosso.

Given the importance of changes in inequality for explaining the different state level trajectories of poverty reduction in the 1990s, it would be useful to know how the relative importance of different components of income changed over time. Table 5.2 provides this information. For each source of income, the table shows its share in total rural household income, its concentration ratio and its contribution to the Gini index of total rural household income per capita. Table 5.2 shows that the share of agricultural earned income in total rural household income declined in all three states. In 2000 it continued to account for more

Table 5.2 Components of rural household income per capita: concentration ratios and shares

	Alagoas			Santa Catarina			Mato Grosso		
	1991	2000	% ch	1991	2000	% ch	1991	2000	% ch
Gini	0.48	0.59	24%	0.52	0.53	1%	0.59	0.63	7%
Agricultural earned income <sup>1</sup>									
Share	0.57	0.37	-35%	0.51	0.45	-12%	0.62	0.57	-8%
Concentration ratio	0.36	0.45	26%	0.46	0.54	18%	0.51	0.60	18%
Contribution to Gini (%)	43%	28%	-34%	46%	47%	3%	53%	54%	1%
Non-agricultural earned income <sup>1</sup>									
Share	0.29	0.32	9%	0.38	0.36	-5%	0.32	0.30	-7%
Concentration ratio	0.68	0.72	5%	0.61	0.55	-10%	0.72	0.71	-2%
Contribution to Gini (%)	41%	38%	-7%	44%	37%	-16%	39%	34%	-15%
Income from secondary occupations									
Share	0.02	0.02	-7%	0.02	0.02	-1%	0.02	0.01	-63%
Concentration ratio	0.74	0.91	24%	0.67	0.73	8%	0.87	0.80	-8%
Contribution to Gini (%)	3%	3%	-7%	3%	3%	6%	4%	1%	-68%
Income from social security or pensions									
Share	0.10	0.23	124%	0.06	0.13	122%	0.02	0.07	169%
Concentration ratio	0.49	0.64	31%	0.32	0.38	19%	0.43	0.46	6%
Contribution to Gini (%)	11%	25%	137%	4%	10%	161%	2%	5%	166%
Other Income									
Share	0.01	0.06	316%	0.03	0.03	10%	0.01	0.05	298%
Concentration ratio	0.68	0.55	-20%	0.72	0.53	-26%	0.78	0.69	-12%
Contribution to Gini (%)	2%	5%	168%	4%	3%	-20%	2%	6%	227%

Note: 1. Income from principal occupation only.

Source: Authors' calculations based on the micro data from the demographic censuses.

than 50 percent of household income only in Mato Grosso. The concentration ratios for agricultural income were lower than the Gini ratios in each of the three states in 1991, implying that agricultural income played an equalizing role at the beginning of the decade. In the 1990s however agricultural income became a less equalizing force in all states, and in Santa Catarina it even became slightly more concentrated than overall household income. The fourth row of the table shows that in 2000 the contribution of agricultural income to overall income inequality was in the neighborhood of 50 percent in Santa Catarina and Mato Grosso. In these two states, the drop in agriculture's share of rural income approximately balanced out increases in the agricultural concentration ratios, so that the agricultural contribution to overall inequality changed by less than 3 percent in each case. In Alagoas, in contrast, the contribution of agricultural earnings to overall inequality declined markedly in the 1990s – due to the sharp drop in agriculture's share in overall rural income – and only accounted for 28 percent by the end of the decade.

Non-agricultural earned income accounted for around a third of household income in all three states in both periods. It was a highly disequalizing force in Alagoas and Mato Grosso. Income from secondary occupations was the most disequalizing source of all, with concentration ratios between 0.73 and 0.91 in 2000. It is not surprising that income from secondary occupations should be distributed very unequally, given how rare a phenomenon it is. However, in no state did this source of income account for more than 2 percent of total income. Thus its contribution to the overall Gini was less than 3 percent in all states in 2000.

Social security payments to rural residents grew rapidly in the 1990s, and some authors believe that this provides an important part of the explanation for the decline in poverty. Table 5.2 shows that the share of rural income from social security and pensions more than doubled in all three states. In Alagoas it came to represent 23 percent of rural household income in 2000. Unfortunately social security benefits were distributed more unequally than income as a whole in this state. In the other two states, in contrast, social security benefits were a strongly equalizing force. In both cases the concentration ratios were at least 15 percentage points lower than their respective Ginis.

In order to shed light on how income sources differ for the poor and the rich, Table 5.3 reports income shares by source for the bottom and top halves of the rural income distribution. Several important conclusions can be drawn from this table. Firstly, income grew by the same proportion for the bottom and top halves of the income distribution in Santa Catarina, but by much more for the top half of the distribution in Alagoas and Mato Grosso. In Alagoas, income per capita actually fell for the bottom 50 percent. This confirms the pattern of changes observed in the Gini ratios in Table 5.1. Secondly, in the lower half of the income distribution, the share of income coming from agricultural earnings fell by more

Table 5.3 Components of rural household income per capita: bottom and top halves of the income distribution

	Alagoas			Santa Catarina			Mato Grosso		
	1991	2000	% ch	1991	2000	% ch	1991	2000	% ch
<i>Bottom 50%</i>									
Household income per capita <sup>1</sup>	22	14	-34%	47	77	65%	38	44	17%
Earned income in principal occupation	0.90	0.77	-14%	0.88	0.80	-9%	0.95	0.85	-11%
Agricultural	0.77	0.60	-21%	0.66	0.48	-28%	0.82	0.64	-22%
Non-agricultural	0.13	0.16	26%	0.21	0.31	49%	0.14	0.20	44%
Earned income in secondary occupation	0.01	0.00	-76%	0.01	0.01	-24%	0.01	0.00	-49%
Income from social security or pensions	0.09	0.14	57%	0.10	0.16	61%	0.04	0.11	202%
Other Income	0.01	0.09	1097%	0.01	0.03	167%	0.00	0.05	872%
<i>Top 50%</i>									
Household income per capita <sup>1</sup>	92	104	13%	235	384	64%	234	327	40%
Earned income in principal occupation	0.85	0.68	-20%	0.89	0.82	-8%	0.94	0.88	-6%
Agricultural	0.52	0.34	-35%	0.48	0.45	-7%	0.58	0.56	-5%
Non-agricultural	0.33	0.34	3%	0.41	0.36	-11%	0.35	0.31	-11%
Earned income in secondary occupation	0.02	0.02	-9%	0.03	0.03	1%	0.03	0.01	-64%
Income from social security or pensions	0.11	0.25	129%	0.05	0.13	145%	0.02	0.06	165%
Other Income	0.02	0.05	246%	0.03	0.03	-2%	0.01	0.05	267%

Note: 1. Income in constant R\$ of 1/2002.

Source: Authors' calculations based on the micro data from the demographic censuses.

than 20 percent and the share coming from non-agricultural earnings rose by 25 to 50 percent in all three states. Thus in 2000 the poorest half of the rural population in these states received between 36 and 52 percent of their income from sources outside of agriculture. Thirdly, real social security benefits and the share of household income coming from this source grew for the bottom half of the distribution in all three states. Thus although social security became a less equalizing force in the 1990s, considerable benefits flowed to the poor as a result of the expansion of this program.

In addition to the heterogeneity in experiences across states that we have been discussing thus far, it is important to point out that there was substantial variability within states. Two examples should suffice. Although income per capita only rose by 4 percent in rural Alagoas as a whole, in a third of the counties it rose by more than 22 percent. In another third it contracted. Similarly, although the rural population in Alagoas declined by 12 percent, it grew in 40 percent of the counties. It is these differences in county level experiences that we seek to explain in the regression analysis of the next section.

## REGRESSION RESULTS

We can test the hypotheses discussed above using a regression framework and county-level data derived from the demographic census micro data for 1991 and 2000. All measures refer only to the rural population in each county.<sup>7</sup>

We first examine the direct relationship between changes in poverty and changes in per capita income, inequality and population. We note that the incidence of poverty is determined by the average level of income and the distribution of income. Thus we explore the relationship between each of these and poverty. Table 5.4 presents the results of regressions of the change in the headcount poverty ratio on a set of independent variables. In models 1–3, we estimate individually the relationship between changes in poverty and changes in each of: (1) average income, (2) the Gini ratio, and (3) population.<sup>8</sup> Model 4 includes the changes in all three variables, and model 5 controls additionally for their initial levels.

In the first regression, the coefficient on per capita income growth is negative, as we would expect, and statistically significant. On average, counties with higher average income growth experienced greater poverty reduction. On the other hand, the second regression shows no statistically significant relationship between changes in poverty and changes in the county-level Gini ratio. This could be for a combination of two reasons. First, the correlation between changes in the Gini and changes in the level of income is positive, 0.38. Without controlling for average income growth, the estimated coefficient on the Gini in regression 2 picks up the combined effect of a larger increase in inequality and the associated higher per capita income growth. By contrast in regressions 4

Table 5.4 Regression results for change in headcount poverty rate, 1991–2000

	(1)	(2)	(3)	(4)	(5)
<b>Changes in the variables<sup>1</sup></b>					
Income per capita	-0.08 (-6.00)**			-0.14 (-8.39)**	-0.12 (-8.99)**
Gini		0.05 (0.77)		0.59 (8.07)**	0.63 (10.25)**
Population			0.01 (0.50)	-0.01 (-0.32)	-0.02 (-1.54)
<b>Initial levels of the variables<sup>2</sup></b>					
Poverty					-0.36 (-11.84)**
Gini					0.24 (4.95)**
Population					-0.01 (-1.71)
State dummies					
Alagoas	-0.02 (-2.84)**	-0.04 (-3.66)**	-0.04 (-4.26)**	-0.09 (-7.57)**	0.18 (3.24)**
Sta. Catarina	-0.14 (-12.21)**	-0.20 (-25.05)**	-0.20 (-25.03)**	-0.10 (-9.04)**	0.00 (0.09)
Mato Grosso	-0.08 (-5.52)	-0.12 (-8.47)**	-0.12 (-9.05)**	-0.08 (-6.37)**	0.05 (0.86)
Observations	372	372	372	372	372
Adjusted R-squared	0.76	0.68	0.68	0.83	0.89

*Notes:*

1. The changes in income and population are measured as proportional changes, i.e., 0.2 = 20% growth. The change in the Gini is measured as the change in the Gini ratio, which has a range from zero to one.
2. The level of poverty is measured by the headcount ratio. It has a range from zero to one. The natural log of initial population is the measure of initial population level.  
Robust t statistics in parentheses; \* significant at 5%; \*\* significant at 1%.

and 5, the estimated coefficients on both per capita income growth and inequality change have the expected signs and are statistically significant. Thus, controlling for growth in average income and other factors, regressions 4 and 5 suggest that an additional standard deviation (0.11) in the decline in the Gini was associated with an additional 6.6 to 7.2 percentage point decline in poverty. Similarly, an additional standard deviation (0.69) in the rate of per capita income growth was associated with an additional poverty decline of 8.1 to 9.6 percentage points over the nine-year period.

A second possible explanation for the coefficient in regression 2 is that the Gini, a scalar summary statistic, imperfectly captures the changes in the income distribution that matter for poverty. Thus changes in the income distribution in favor of those who are either far above or far below the poverty line are unlikely to affect the incidence of poverty. Poverty will likely only fall when the distribution of income changes in favor of people who previously had incomes close to the poverty line. The state level evidence from Alagoas, where inequality rose substantially but poverty remained largely unchanged, is suggestive of this type of effect.

Regression 3 relates the change in poverty to the rate of population growth, without other controls. We emphasize that we are estimating a reduced-form equation that reflects a potentially simultaneous relationship. In future research, we would like to identify these two relationships separately. For now, we simply estimate the net statistical relationship between poverty change and population growth. Regression 3 shows no statistically significant relationship between the two. Regressions 4 and 5 show a negative relationship, but in neither case is the coefficient statistically significant at the 10 percent level. Thus, either we could treat the coefficient as zero, or we could conclude that it provides weak evidence for a negative impact of population change on poverty (after controlling for the effect of levels and changes in the Gini and average income). A weak negative effect runs contrary to our hypothesis that population decline contributed to poverty reduction. It implies that greater population decreases were associated with a slightly lower poverty reduction. We tentatively call this the 'direct effect' of population change on poverty. It may be however that there exists an indirect relationship between population change and a reduction in poverty via average income growth and/or change in the Gini. An important question then is to determine which of these two effects dominates. We now address this question.<sup>9</sup>

Table 5.5 presents the results of regressions of: (1) per capita income growth, and (2) change in the Gini, on population growth and a set of controls.<sup>10</sup> The statistically significant coefficients on population growth in both equations, each with the expected sign, provide evidence that population decline is significantly associated with both faster per capita income growth and greater decline in inequality. Thus the estimated coefficients suggest that one additional standard deviation (0.32) of population decline is associated with an additional 1.3 percentage point decline in the Gini index, and an additional 5.1 percentage points of average income growth. Both forces should contribute to accelerating the decline in poverty.

Combining the results of Table 5.5 with those in equation 5 of Table 5.4, we can calculate that an additional standard deviation of population decline is associated with improvements in average income and the Gini that together account for an additional 1.4 percentage point reduction in poverty. On the other

Table 5.5 Regression results for changes in Gini and per capita income, 1991–2000

	Change in Gini (1)	Growth of income per capita (2)
<b>Changes in the variables<sup>1</sup></b>		
Population	0.04 (3.34)**	-0.16 (2.15)*
Income per capita	0.08 (12.03)**	
Gini		4.08 (7.02)**
<b>Initial levels of the variables<sup>2</sup></b>		
Population	0.009 (1.62)	-0.092 (2.73)**
Income per capita	-0.011 (0.90)	-0.375 (4.73)**
Gini	-0.523 (10.80)**	1.687 (4.71)**
<b>State dummies</b>		
Alagoas	0.31 (4.11)**	1.20 (2.65)**
Sta. Catarina	0.18 (2.19)*	2.50 (5.33)**
Mato Grosso	0.27 (3.38)**	2.00 (4.16)**
Observations	372	372
Adjusted R-squared	0.69	0.70

*Notes:*

1. The changes in income and population are measured as proportional changes, i.e., 0.2 = 20% growth. The change in the Gini is measured as the change in the Gini ratio, which has a range from zero to one.
2. The level of poverty is measured by the headcount ratio. It has a range from zero to one. The natural log of initial population is the measure of initial population level.  
Robust t statistics in parentheses; \*significant at 5%; \*\*significant at 1%.

hand, if we admit that the coefficient on population change in equation 5 is not zero, the additional standard deviation of population decline also has a direct effect on poverty that leads to an additional 0.6 percentage point increase in poverty. The net impact of the direct and indirect effects is an additional 0.8 percentage point decline in poverty. These findings are consistent with our hypothesis that out-migration contributed to poverty reduction. We are not able to conclude however if it is simply due to removing poorer individuals from the

rural population or by improving the living standards of rural residents who were previously classified as poor.

Finally, we turn to the relationship between changes in income and inequality and the composition of income by source. Table 5.6 reports the results of regressions of per capita income growth and change in the Gini on initial shares of total income from various sources and changes in those shares. The omitted categories are the share and change in share of income from social security and pensions. None of the initial shares is statistically significant in either equation, but all of the changes are statistically significant in the income growth equation (1), and all but the change in the share of income from agriculture is significant in the Gini change equation (2). However the statistical significance of the change in a given share depends on the choice of omitted category. The more interesting question is whether two share changes are statistically significantly different from each other. The coefficients on the share changes are all positive and jointly significant in each regression, relative to the omitted category – the change in the share from social security and pensions. Thus in counties where the share of income from social security increased more, both average income and inequality grew less. Given the dramatic and generalized increase of social security coverage in rural areas over this period, it is likely that the share of income from social security grew faster simply where the denominator – total income – grew slower. However the coefficients in the equation for inequality change are consistent with the concentration ratios reported in Table 5.2, which show that in two out of the three states studied social security income is equalizing, and more equalizing than income earned from the primary occupation.<sup>11</sup>

The changes in shares of income from agricultural and non-agricultural employment are statistically different from each other in the Gini change equation, but not in the per capita income growth equation. In both cases the agricultural coefficient is smaller than the non-agricultural one. Thus counties where the importance of non-agricultural employment income grew relative to that of agricultural employment income experienced a larger increase in inequality. This is consistent with the fact, seen in Table 5.2, that non-agricultural employment income is disequalizing in both census years in every state, and always more disequalizing than agricultural employment income. On the other hand, though not statistically significantly different, the relative size of the two corresponding coefficients in the income growth equation would tend to suggest that greater decline in the agricultural share of employment income, in favor of non-agricultural employment, is associated with greater average income growth. To interpret the coefficients, an additional standard deviation (0.17) decline in the agricultural employment income share, all in favor of non-agricultural employment income, is associated with an additional 8.6 percentage points in per capita income growth and an additional 3.5 point increase in the Gini index over the

Table 5.6 Regression results for effects of income sources on changes in income and inequality, 1991–2000

	Growth of income per capita (1)	Change in Gini (2)
<b>Shares</b>		
Agricultural employment <sup>1</sup>	0.49 (0.40)	-0.12 (0.63)
Non-agricultural employment <sup>1</sup>	-0.01 (0.01)	-0.12 (0.55)
Secondary occupations	2.31 (1.16)	0.04 (0.11)
Other sources	-0.33 (0.10)	0.08 (0.27)
<b>Changes in shares</b>		
Agricultural employment <sup>1</sup>	3.34 (5.30)**	0.17 (1.63)
Non-agricultural employment <sup>1</sup>	3.84 (5.31)**	0.37 (3.29)**
Secondary occupations	5.43 (4.19)**	0.38 (1.47)
Other sources	4.52 (3.12)**	0.55 (3.26)**
<b>State dummies</b>		
Alagoas	0.18 (0.16)	0.22 (1.20)
Sta. Catarina	0.72 (0.61)	0.13 (0.69)
Mato Grosso	0.27 (0.22)	0.16 (0.79)
Observations	372	372
Adjusted R-squared	0.57	0.38

*Notes:*

1. Agricultural and non-agricultural employment refer to income in primary occupation only.  
Robust t statistics in parentheses; \*significant at 5%; \*\*significant at 1%.

nine-year period. According to the coefficients in Table 5.4, these changes are offsetting, so that if anything, poverty would have a slightly greater tendency to increase.

These results do not support the proposition that the shift to non-agricultural sources of earned income is significantly responsible for a reduction in poverty. Future research could further test this relationship by focusing more specifically

on the composition of income of those who are poor or relatively near the poverty line.

## CONCLUSIONS

In this chapter we analyzed the decline in rural poverty in the 1990s. For Brazil as a whole, rural poverty fell by 16 percent in this period. The decline was largely explained by a 32 percent increase in household income per capita. The Gini index of inequality rose by 7 percent and thus partially offset the improvements from income growth. At the state level, the record was much more varied. In one state that we examined, poverty declined by more than twice the national average, due to rapid per capita income growth (64 percent) and virtually no change in inequality. In another state, poverty declined by only 3 percent due to weak income growth and a 24 percent increase in the Gini. Finally, using county-level data from three states, we also found that income growth was the most important factor that contributed to the decline in poverty. Median household income per capita grew by 43 percent at the county level in this period, while the median Gini actually rose by 9 percent.

Brazil also experienced a significant decline in the rural population and in the workforce in agriculture in the 1990s. We found that where the rural population declined at a faster rate, inequality rose less and household income per capita grew more. On the other hand we found that, controlling for population decline's 'indirect' relationship to poverty changes via changes in income level and the Gini, greater population decline was also weakly associated with a greater increase in rural poverty. This 'direct' relationship was likely due to the fact that the Gini imperfectly summarizes the entire income distribution in a single number. The indirect effect dominated however, and on balance population decline was associated with greater poverty reduction. In future research we would like to identify whether this finding was due to poor people migrating disproportionately, or to real improvements in the standard of living of the poor in rural areas of Brazil. In order to overcome problems of endogeneity and have greater confidence in our statistical results, in future research we would also like to move to a simultaneous equations framework that could capture the multiple ways in which changes in poverty, population, income, and inequality mutually determine each other.

There has been considerable debate in Brazil recently about the importance of non-agricultural sources of earned income for the rural poor, and about the potentially beneficial effects of the expansion of the rural social security program in the 1990s. In light of the evidence that agricultural earned income became much more concentrated in the 1990s, both non-agricultural earned income and social security could have played important roles in poverty reduc-

tion. With regard to the distribution of income at a state level however, non-agricultural sources of earned income were a strongly disequalizing force in two of the three states that we analyzed. At a county level, our results suggest that where non-agricultural income increased faster than income from either agriculture or social security, inequality grew at a faster rate. Growth of non-agricultural relative to agricultural earned income was also weakly associated with faster growth. The net effect of an increase in the share of non-agricultural earned income was a slight increase in the rate of growth of poverty.

Income from social security, in contrast, was a strongly equalizing force in two of the three states, but it became less equalizing in all states in this period. For the bottom half of the income distribution, social security benefits grew in real terms in all three states and were likely to have played an important role in reducing poverty. At a county level, the growth in the share of income derived from social security was also associated with slower growth in inequality.

In conclusion, this study of three Brazilian states has important implications for the debate about the causes of the decline in Brazilian rural poverty in the 1990s. Firstly, it is clear that income growth was the driving force behind poverty reduction in this period. The sources of income growth however varied considerably across states, suggesting that there is no single path to rural poverty reduction in Brazil. Secondly, although we found that migration was associated with a decline in the rural poverty rate, the magnitude of the effect was not as large as we had expected. Finally, the expansion of social security benefits in rural areas in the 1990s played a very important role in contributing to poverty reduction. However the concentration of income from this source rose in all three states. Thus although the social security program had a positive impact on poverty, it is likely that a targeted anti-poverty program could have achieved the same reduction at a lower fiscal cost.

## NOTES

1. The decline of agricultural prices was reversed with the floating of the currency in January 1999 and the upward trend in many international commodity prices in the subsequent few years.
2. Barros et al. (2004) do not find a particularly large effect due to demographic changes of this type. They show that although these changes contributed to raising household income, they also increased inequality. As a result, the impact on poverty is overshadowed by other variables in their study.
3. Additional research is necessary to investigate the magnitude of own-consumption, its stability over time, and to develop an approach for estimating total income in rural Brazil. There is no doubt that the exclusion of own consumption biases estimates of poverty upward. In terms of the distribution of income however there are offsetting forces and the net impact is unclear. Hoffman (1999) for example cites the under-reporting of incomes at the upper end of the income distribution as an important limitation of the Census and the household survey (PNAD) data.

4. See Khan and Riskin (2003) for a more detailed discussion of concentration ratios.
5. A time series on national level poverty in Brazil is available at [www.ipeadata.gov.br](http://www.ipeadata.gov.br).
6. There are limitations to analyzing 'rural' vs 'urban' Brazil that stem from how these areas are defined by the Brazilian Institute of Geography and Statistics (IBGE), and from the fact that what might have been classified as rural in 1991 was sometimes reclassified as urban in 2000. Nevertheless the analysis conducted in Barros et al. (2004) shows that the levels, trends, and explanations regarding poverty in the 1990s are similar for households in 'rural' Brazil and households of people who work in agriculture.
7. Because of changes in county boundaries between the two census years, it was necessary to aggregate counties into 'smallest comparable areas' (AMCs in Portuguese) in order to obtain consistent geographic units across the two years. For the three states under study, there were 520 counties in 2000, 409 in 1991, and we aggregated these into 372 AMCs following the guidelines provided to us by the Institute of Applied Economic Research (IPEA) in Rio de Janeiro, Brazil. We thank Marcia Pimentel at IPEA for valuable assistance in this process. For simplicity, in the following discussion we refer to them as 'counties'.
8. All regressions include state dummies to control for the heterogeneity across states that we observed in Table 5.1.
9. The existence of a weak direct relationship between population change and poverty change might be explained by the fact that the Gini imperfectly captures changes in the income distribution as they relate to poverty. Thus, due to the nature of the Gini as a scalar summary of an entire income distribution, it is possible for population change to have a 'direct effect' on poverty rather than only an indirect effect via income and the Gini.
10. Of course, as the table makes clear, the two dependent variables are correlated, and it may be that causation goes in both directions. Although we would ideally find adequate exogenous instruments for each one in order to properly identify and estimate the whole system, our focus here is on the partial correlation between each of these and population growth.
11. Of course, a difference between Tables 5.2 and 5.6 is that the state-level concentration ratios for social security income reported in Table 5.2 reflect both within-county and between-county concentrations.

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