

**The Impact of Policy Reforms on Rural Poverty in Brazil:
Preliminary Evidence from the 1990s**

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1. Introduction

This paper 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 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. First, agricultural growth was extremely heterogeneous across regions, crops, and farm sizes (Helfand and Rezende, 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.

Second, in part due to the appreciation of the real exchange rate, real agricultural prices fell by over 50% between the early 1980s and the late 1990s. 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 average output per farm able to grow fast enough to compensate for falling prices and to keep revenue from declining. Thus, 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%, and according to the national household surveys (PNAD), agricultural employment (including the self-employed and their unpaid family members) fell by 14% between 1992-93 and 2001-02. The decline in employment in agriculture was driven both by 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 (forthcoming), 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 paper we seek to understand this rather surprising decline in rural poverty. In Section 2 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. Section 3 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 Section 4 we present preliminary tests of the hypotheses discussed in Section 2 for three states in Brazil. Section 5 provides conclusions and thoughts for future research.

2. 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 paper. They relate to out migration from rural areas, the importance of different sources of household income (such as government transfers or non-agricultural 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, the 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. First, and this is what we seek to emphasize, 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. Second, and this is what Barros et al. (2004) focus on, 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.¹ Finally, to the extent that family members migrate from rural areas but leave other family members 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.

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 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

¹ 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. These results could differ, however, at a sub-national level.

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. Poverty rates did in fact fall markedly in 1995 relative to 1993. 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, etc.), the census data we use in Section 4 is 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 are forced to adopt the assumption that macroeconomic factors had a similar impact

across counties in the 1990s. If so, the discrete decline in poverty that occurred in 1995 will be absorbed in the intercepts of our regression models.

3. Evidence on Rural Income, Poverty, and Inequality in the 1990s

In this section of the paper 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.

Using data from the demographic censuses of 1991 and 2000, Table 1 shows that national level poverty and extreme poverty both fell substantially in the 1990s.² The poverty headcount ratio fell by 22 percent, from 0.40 down to 0.33. Extreme poverty fell by a similar proportion. Table 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.³

² The national level data in Table 1 for *total* Brazil, i.e., urban and rural combined, come from the Atlas of Human Development (2003). Using household income per capita as the welfare measure, the poverty and extreme poverty lines were set at 0.5 and 0.25 minimum wages per capita. The national level data in Table 1 for *rural* Brazil come from Barros et al. (2004). It is based on the Brazilian household surveys of 1992 and 2001. The authors use a poverty (extreme poverty) line that is close to 0.5 (0.25) minimum wages, but they adjust it for differences in the cost of living across regions and rural, urban, and metropolitan areas. The data in Table 1 for the three states are our calculations based on the micro data from the demographic censuses of 1991 and 2000. We used the poverty lines from Barros et al. (2004) adjusted for inflation.

³ A time series on national level poverty in Brazil is available at www.ipeadata.gov.br.

Using data from the household surveys of 1992 and 2001, Barros et al. (2004) reach a similar conclusion for rural Brazil.⁴ The first row in Table 1 shows their results for rural Brazil. The rates of poverty and extreme poverty fell by between 20 and 30 percent while inequality remained largely unchanged. Income growth of 22 percent and perhaps the decline of 11 percent in the rural population provide the likely explanations for the decline in poverty. In a similar fashion to what happened with national level poverty in the 1980s and 1990s, Corrêa (forthcoming) reports that poverty among the families of people working in agriculture rose between 1981 and the early 1990s. It then fell markedly in the period 1995-98. 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 1 shows what happened to poverty and related indicators in the three states that we have chosen to analyze in detail.⁵ Income per capita in Alagoas, a poor state in the Northeast of Brazil, was about half the national average in 1991. As a result, poverty in Alagoas was much 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 0.90 to 0.88, and extreme poverty in rural areas remained unchanged at 0.66. The reason for the lack of progress in reducing poverty relates to the fact that household income per

⁴ 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. Thus, although we intend to explore this in more detail in the future, we are confident that our results are not severely biased as a result of how IBGE defines, and redefines, what is rural.

⁵ It is important to recognize that the demographic censuses do not adequately capture all sources of income for rural residents. We think that the most severe limitations relate to the exclusion of the value of agricultural goods produced for self-consumption. Thus, the incomes of subsistence farmers, and small farmers who consume a portion of what they produce, are underestimated. Similarly, non-agricultural incomes relative to agricultural incomes are likely to be overstated. To the extent that these factors are constant over time they should be first differenced out of the variables in our regression models that are in changes. And, to the extent that these factors differ across states, they should be picked up in the state dummies included in our models.

capita only rose by 4 percent in this decade, and income growth was distributed very unequally. The Gini for rural Alagoas rose by 19 percent. It is possible that without the observed 12 percent decline in the rural population, poverty would have risen even further rather than remained roughly constant.

The level of income and rate of poverty in rural Santa Catarina, a state located in the South of Brazil, were both within five percent of the national average in 1991. In contrast to Alagoas, however, Santa Catarina made dramatic gains in poverty reduction in the 1990s. The 39 percent decline in rural poverty in the 1990s was caused by rapid growth in income (64 percent) and virtually no change in inequality (one percent). In addition, it is possible that the 14 percent decline in the rural population contributed to lowering the rate of rural poverty.

Mato Grosso, a state in the Center-West of Brazil, represents an intermediate case. Like Santa Catarina, its income and poverty were quite similar to the national average in 1991. Mato Grosso, however, followed a disequalizing growth path, and its overall performance in the 1990s was not as stellar as that of Santa Catarina. Household income 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 21 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, and how these changes contributed to the observed movement in the Gini indexes. Table 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. The concentration ratio shows the degree of inequality in the distribution of a particular source of income. It is calculated like a Gini from a “pseudo-Lorenz” curve. The only difference with the Gini is that the pseudo-Lorenz has the cumulative percent of income from the source in question on the vertical axis, and the cumulative percent of the population ranked by household income per capita (not by the component of income in question) on the horizontal axis.⁶

Table 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 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 Alagoas, the contribution of agricultural earnings to overall inequality declined markedly in the 1990s—due to the sharp drop in agriculture’s share in over all rural income—and only accounted for 28 percent by the end of the decade. In the other 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 over all inequality changed by only one percentage point in each case.

Non-agricultural 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

⁶ See Khan and Riskin (2003) for a more detailed discussion of concentration ratios.

from secondary occupations was the most disequalizing source of all, with concentration ratios between 0.73 and 0.91 in 2000. However, in no state did this source of income account for more than two percent of total income. Thus, its contribution to the overall Gini was less than 3% in all states in 2000.

Social security payments to rural areas grew rapidly in the 1990s, and some authors believe that this provides an important part of the explanation for the decline in poverty. Table 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 points lower than their respective Ginis.

In order to shed light on how income sources differ for the poor and the rich, Table 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. First, 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 1. Second, in the lower half of the income distribution, the share of income coming from agricultural earnings fell by more 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. Third, 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 the Brazilian average of 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 Section 4.

4. Preliminary Tests of Several Key Hypotheses

We can subject the hypotheses discussed in Section 2 to preliminary tests using a regression framework and county-level data derived from the demographic census micro data for 1991 and 2000.⁷ All measures refer only to the rural population in each county.

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 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

⁷ Because of changes in county boundaries between the two census years, it was necessary to aggregate counties into “smallest comparable areas” (AMCs for their Portuguese name) 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)

income, (2) the Gini ratio and (3) population, without including other controls.⁸ 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'd expect, and statistically significant. 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 Gini ratio, and the sign is negative, opposite what we would expect. 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. On average, the income growth dominates. By contrast in regressions 4 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 (.11) in the decline in the Gini was associated with an additional 5.3 to 6.2 percentage-point decline in poverty. Similarly, an additional standard deviation (.69) in the rate of per capita income growth was associated with an additional poverty decline of 8.2 to 9.1 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. Thus,

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 as well, to control for the heterogeneity across states that was discussed in Table 1.

improvements in the income distribution among those who are either all above or all below the poverty line will not affect the incidence of poverty, absent some change in the distribution *between* those above and below 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. (Changes in population affect changes in poverty and vice versa.) 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. Regression 5, shows a negative relationship that is statistically significant at the 10 percent level. This suggests that, apart from the effect of levels and changes in the Gini and average income, greater population decreases appear to be 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.⁹

Table 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.¹⁰ The statistically significant

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. For example, the Gini might change in ways that don't matter for poverty (redistribution among the poor, or rich), or inequality might change in ways not captured by the Gini. Thus, due to the limitations of the Gini, 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. Thus, we would ideally find adequate, exogenous instruments for each one in order to properly

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 (.32) of population decline is associated with an additional 1.4 point decline in the Gini index, and an additional 5.2 percentage points of average income growth. These findings are consistent with out migration increasing the average income of those left behind and disproportionately the average income of those on the lower end of the income distribution, simply by removing poorer individuals from the rural population.

Combining these results with those in Equation 5 of Table 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 hand, the same additional population decline accounts, on average, for an additional 1 percentage point *increase* in poverty, via the direct channel, that is apart from the relationship between population decline and improvements in income and the Gini. In order to make this calculation with greater confidence, future research should seek appropriate instruments for the endogenous variables in the equations on which these estimates are based.

Finally, we turn to the relationship between changes in income and inequality and the composition of income by source. Table 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

identify and estimate the whole system. However, our focus here is on the partial correlation between each of these and population growth.

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. The coefficient on inequality change is consistent with the concentration ratios reported in Table 2, which show that in 2 out of the 3 states studied social security income is equalizing, and more equalizing than income earned from the primary occupation.

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 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 (.17) decline in the agricultural employment income share, all in favor of non-agricultural employment income, is associated with an additional 8 percentage points in per capita income growth and an additional 3 point increase in the Gini index over the nine year period. According to the coefficients in Table 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 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.

5. Conclusions

In this paper we analyzed the decline in rural poverty in the 1990s. For Brazil as a whole, rural poverty fell by 20 percent in this period. The decline was largely explained by a 22 percent growth in household income per capita. The Gini ratio of inequality only fell by two percent. At the state level, the record was much more varied. In one state that we examined poverty declined by 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 2 percent due to weak income growth and a 19 percent increase in the Gini. Finally, using county level data from three states, we 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 nine 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 rose 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 is otherwise associated with a greater increase in rural poverty. This "direct" relationship is likely due to the fact that the Gini imperfectly summarizes the entire income distribution in a single number. The "direct" and "indirect" relationships between population growth and poverty change largely cancel each other out, so that a simple regression of poverty change on population growth, without other controls, shows no significant relationship. Our statistical analysis, however, suffers from problems of endogeneity and simultaneity. Increased poverty, for example, is likely to have caused increased migration, which in turn could have contributed to reducing poverty. In order to examine the extent of these statistical problems and the robustness of our estimates, in future research we believe that we need 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. One promising path, employed by Hansen (2004) for Mexico, would be to use differences in historical migration rates across space as an instrument for current migration rates.

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. With regard to the distribution of income at a state level, non-agricultural sources of 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 income was also weakly associated with faster growth. The net effect 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.

We are still in the initial stages of this research project on the determinants of changes in rural poverty in the 1990s. In the near future we would like to focus more directly on how non-agricultural income and social security have benefited, or not, the nearly 50 percent of the rural population that still lives in poverty. We also intend to address the statistical problems of endogeneity mentioned above. Finally, we plan to extend the analysis begun here for three states to the rest of Brazil.

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Table 1
Descriptive Statistics: 1991-2000

	Population			Income			Inequality			Poverty1			Extreme Poverty1		
	1991	2000	% ch	1991	2000	% ch	1991	2000	% ch	1991	2000	% ch	1991	2000	% ch
	(Millions)			(R\$ of 1/2002)			(Gini)			(Headcount)			(Headcount)		
Brazil2															
Rural	36	32	-11%	134	171	22%	0.55	0.54	-2%	0.59	0.49	-0.20	0.33	0.25	-30%
Urban	111	138	24%												
Total	147	170	16%	236	305	29%	0.63	0.65	2%	0.40	0.33	-0.22	0.20	0.16	-24%
Alagoas															
Rural	1.03	0.91	-12%	57	59	4%	0.48	0.59	19%	0.90	0.88	-0.02	0.66	0.66	0%
Urban	1.48	1.92	29%	166	201	21%	0.63	0.67	7%	0.68	0.64	-0.06	0.41	0.39	-5%
Santa Catarina															
Rural	1.33	1.14	-14%	141	231	64%	0.52	0.53	1%	0.57	0.35	-0.39	0.28	0.14	-49%
Urban	3.21	4.22	31%	305	430	41%	0.53	0.56	5%	0.31	0.21	-0.32	0.1	0.07	-31%
Mato Grosso															
Rural	0.54	0.52	-4%	136	186	37%	0.59	0.63	7%	0.59	0.47	-0.21	0.31	0.24	-23%
Urban	1.49	1.99	34%	261	356	36%	0.58	0.62	5%	0.37	0.28	-0.26	0.14	0.1	-26%

Notes:

1. The state level headcount ratios use poverty lines from Barros et al. (2004) that are specific for regions, and urban and rural areas.
2. The national level population data (rural, urban and total) come from the Atlas of Human Development (2003).
The national level data for rural Brazil on income, inequality, and poverty come from Barros et al. (2004) and refer to 1992 and 2001.
The national level data for Brazil on total income, inequality, and poverty come from the Atlas of Human Development (2003).

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

Table 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 ¹									
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 ¹									
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%

Notes: 1. Income from principal occupation only.

Source: authors' calculations based on the micro data from the deomgraphic censuses.

Table 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
<u>Bottom 50%</u>									
Household income per capita ¹	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%
<u>Top 50%</u>									
Household income per capita ¹	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%

Notes:

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

Source: authors' calculations based on the micro data from the deomgraphic censuses.

Table 4
Regression Results for Change in Headcount Poverty Rate: 1991-2000

	(1)	(2)	(3)	(4)	(5)
<u>Changes in the variables¹</u>					
Income per capita	-0.09 (6.08)***			-0.13 (7.85)***	-0.12 (8.06)***
Gini		-0.03 (0.47)		0.49 (7.41)***	0.56 (8.80)***
Population			0.00 (0.07)	-0.01 (0.67)	-0.03 (1.89)
<u>Initial levels of the variables²</u>					
Poverty					-0.31 (9.40)***
Gini					0.26 (4.54)***
Population					-0.01 (1.98)**
<u>State dummies</u>					
Alagoas	-0.02 (2.35)**	-0.03 (2.41)**	-0.03 (4.43)***	-0.07 (6.27)***	0.19 (2.97)***
Sta. Catarina	-0.16 (13.61)***	-0.22 (26.55)***	-0.22 (26.75)***	-0.13 (10.86)***	0.00 (0.02)
Mato Grosso	-0.07 (4.71)***	-0.11 (7.57)***	-0.11 (8.41)***	-0.07 (5.22)***	0.05 (0.81)
Observations	372	372	372	372	372
Adjusted R-squared	0.80	0.72	0.72	0.84	0.88

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.
3. Robust t statistics in parentheses; ** significant at 5%; *** significant at 1%.

Table 5
Regression Results for Changes in Gini and Per Capita Income: 1991-2000

	<u>Change in Gini</u>	<u>Growth of income per capita</u>
	(1)	(2)
<u>Changes in the variables¹</u>		
Population	0.04 (3.34) ^{***}	-0.16 (2.15) ^{**}
Income per capita	0.08 (12.03) ^{***}	
Gini		4.08 (7.02) ^{***}
<u>Initial levels of the variables²</u>		
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) ^{***}
<u>State dummies</u>		
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.
3. Robust t statistics in parentheses; ** significant at 5%; *** significant at 1%.

Table 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)
<u>Shares</u>		
Agricultural employment ¹	0.49 (0.40)	-0.12 (0.63)
Non-agricultural employment ¹	-0.01 (0.01)	-0.12 (0.55)
Secondary occupations	2.31 (1.16)	0.04 (0.11)
Other sources	-0.33 (0.16)	0.08 (0.27)
<u>Changes in shares</u>		
Agricultural employment ¹	3.34 (5.30)***	0.17 (1.63)
Non-agricultural employment ¹	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)***
<u>State dummies</u>		
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.
2. Robust t statistics in parentheses; ** significant at 5%; *** significant at 1%.