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CURRENCY EQUIVALENTS

Currency Unit: Cruzeiro

Exchange Rates Effective June 12, 1979

Selling Rate	US$1.00	=	Cr$25.655
	US$1 million	=	Cr$25,655,000
	Cr$1 million	=	US$38,978
Buying Rate:	US$1.00	=	Cr$25.615

Average Exchange Rates

	1970	1971	1972
US$1.00	Cr$ 4.593	Cr$ 5.228	Cr$ 5.934
US$1 million	Cr$ 4,593,000	CR$ 5,228,000	Cr$ 5,934,000
Cr$1 million	US$ 217,723	US$ 191,278	US$ 168,520

	1973	1974	1975
US$1.00	Cr$ 6.126	Cr$ 6.790	Cr$ 8.129
US$1 million	Cr$ 6,126,000	CR$ 6,790,000	Cr$ 8,129,000
Cr$1 million	US$ 163,239	US$ 147,275	US$ 123,016

	1976	1977	1978
US$1.00	Cr$ 10.675	Cr$ 14.144	Cr$ 18.047
US$1 million	Cr$ 10,675,000	CR$ 14,144,000	Cr$ 18,047,000
Cr$1 million	US$ 93,677	US$ 70,701	US$ 55,410,000

PREFACE

This report is based on findings of a mission which was in Brazil in October-November 1977 composed of:

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Annex I: Population	Thomas W. Merrick and Ricardo Moran
Annex II: Employment, Earnings, and Income Distribution	Constantino Lluch
Annex III: Health, Nutrition and Education	Peter T. Knight, Dennis Mahar, and Ricardo Moran
Annex IV: Housing, Water Supply, and Sewerage	Peter T. Knight and Ricardo Moran

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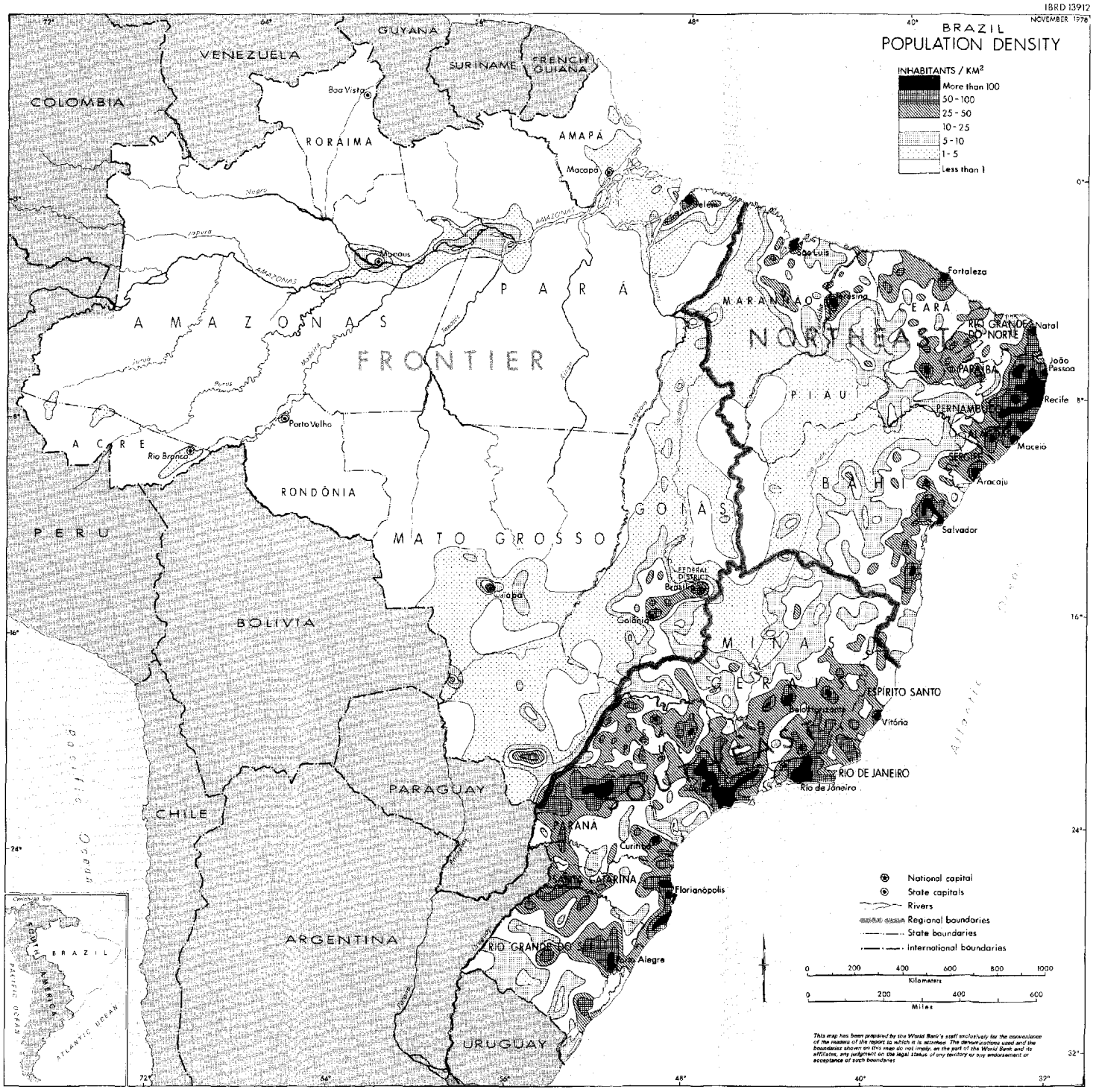


GLOSSARY OF ACRONYMS

BEMFAM	--	Sociedad Civil de Bem - Estar Familiar do Brasil (Civil Society for Family Welfare of Brazil)
ENDEF	--	Estudo Nacional de Despesa Familiar (National Family Expenditure Study)
IBGE	--	Fundacao Instituto Brasileiro de Geografia e Estatistica (Brazilian Institute of Geography and Statistics Foundation)
IPPF	--	International Planned Parenthood Federation
LRPM	--	Long Run Planning Model
PNAD	--	Pesquisa Nacional por Amostra de Domicilios (National Household Sample Survey)
II PNAD	--	II Plano Nacional de Desenvolvimento (Second National Development Plan)

GLOSSARY OF DEMOGRAPHIC TERMS

Crude Birth Rate (CBR): The number of live births, per year, per 1,000 of population.

Crude Death Rate (CDR): The number of deaths, per year, per 1,000 of population.

Rate of Natural Increase (NI): The difference between the crude birth rate and the crude death rate, usually expressed as a percentage.

Rate of Population Growth: The rate of natural increase, adjusted for migration, and expressed as a percentage of the total population in a given year.

Infant Mortality Rate: The number of deaths, per year, of infants aged 0-12 months, per 1,000 live births.

Life Expectancy at Birth: The average number of years newborn children would live if subject to mortality risks prevalent for the cross section of the population at the time of their birth.

General Fertility Rate: The number of live births per year, per 1,000 women, aged 15-49 years.

Total Fertility Rate (TFR): The number of children an average woman would have if during her lifetime her childbearing behavior were the same as that of the cross section of women at the time of observation. The TFR often serves as an estimate of the average number of children per family.

Gross Reproduction Rate (GRR): The number of daughters a woman would have, under prevailing fertility and mortality patterns, who would survive to the mean age of childbearing.

Replacement Level Fertility: A level of fertility equivalent to a Net Reproduction Rate of 1.0--the level at which childbearing women, on the average, have enough daughters to replace themselves in the population.

Stationary Population: A population that for a long time has had a constant replacement-level fertility and therefore also has a growth rate equal to zero and a constant age composition.

Parity: The number of children born to a woman.

Fertility Index A (reference to Part III, C): The cumulative live births to women in a particular category divided by the member of women 15 years and older in the same category who had at least one live birth.

Fertility Index B (reference to Part III, C; also alluded to as "the preferred fertility index" in the context of that section): The number of live births to women in each category, divided by the number of women 15 years and older in each category.

OVERVIEW

Brazilian concern for having sufficient population to control a vast national territory can be traced to colonial times. Since World War II, this concern has been reinforced by the view that a large population, combined with its continental size and a commensurably large national product, would enhance Brazil's position as an emerging world power. Fulfillment of these aspirations for a large population has proceeded at a rapid pace throughout this century. Population growth is likely to continue at a brisk, if gradually slowing rate well into the next century.

The path of Brazilian population growth -- and its demographic components of fertility, mortality, and migration -- has been crucially influenced by the country's historical pattern of economic and social development. Conversely, population factors have helped shape Brazilian economic history. On a less grand, yet no less important scope, differential access to certain basic fruits of development -- goods and services to satisfy basic human needs -- has strongly affected the demographic experience of different population groups. Higher out-migration and mortality rates among the relatively most disadvantaged Brazilians are two such examples. In turn, this different demographic experience across population groups feeds back into the socio-economic realm. For instance, the rapid inflow of rural migrants into urban areas aggravates stress on the infrastructure of urban services.

Reader's Guide

This annex examines the trends and patterns of population growth and its components from the colonial period to the present, including brief references to their broad associations with major features of Brazil's economic history (Chapter I). In particular, some associations between migration and income per worker across regions are presented and relations between public services availability and population growth in urban areas are then discussed (Chapter II).

Other inter-relations between demographic and socio-economic variables are explored in Chapter III:

- how demographic factors may affect standard income distribution measures through changes in the composition of the working age population:
- relations between family income and demographic characteristics at the household level -- based on survey data in a major Brazilian city;
- relations between income, rural-urban location and mortality experience at the household level; and
- socio-economic correlates of fertility at the household level: family income, female educational attainment, female labor force status and female wage earnings.

Brazilian official attitudes and policies towards population growth are discussed in Chapter IV.

The final major section in the Annex (Chapter V) inquires into prospects for the evolution of Brazilian population growth and composition during the coming decades -- especially up to the end of the current century -- and seeks to trace the boundaries within which future evolution is likely to fall. One of the demographic simulation exercises undertaken for this purpose attempts to update and explore in detail the assumptions and implications subsumed in the current official Brazilian population projections. Two other simulations trace out the likely demographic impact of widely diverging paths in the coverage of certain social services -- such as basic education and water supply -- which have been found to be robust statistical correlates of fertility and mortality. One final simulation is performed to explore the effects of inter-regional migration out of the most economically depressed part of Brazil taking place at a much faster pace than officially projected.

This section, and the Annex, then conclude with some remarks on certain implications suggested by the demographic simulation results for Brazilian development beyond the 20th century.

Summary and Conclusions

Demographics

i. From a total of 17 million in 1900, Brazil's population has grown to about 117 million in mid-1978, making it the sixth most populous country in the world. With an annual growth rate of 2.8%, Brazil is currently adding more than 3.3 million persons to its population each year. This represents more than a third of Latin America's contribution to world population growth.

ii. From 2.3% per year in the 1940s, Brazil's rate of population growth accelerated to 3.0% per year in the 1950s and remained virtually unchanged at about 2.9% per year in the 1960s. Demographic projections currently being used in official Brazilian documents, and alternative ones derived for the present report, indicate that population growth for the 1970s may slow another notch to about 2.8% per year and continue to ease gradually towards a range of 2.2-2.4% per year by the end of this century. According to these projections, total population by the year 2000 would lie between 202 and 209 million. Although demographic projections beyond 2000 become increasingly speculative, they indicate a high likelihood that Brazil's total population will continue to grow well into the 21st century and attain a size of no less than 2.5 times its current size.

iii. Rapid as Brazil's total population growth has been during recent decades, its urban population has been increasing much faster. In the 1950s urban areas grew almost 80% faster than total population; in the 1960s more than 70% faster. The differential between the two rates of growth is almost certain to persist, in a converging pattern, throughout the rest of the century. From an urban share of 32% in total population in 1950 and 56% in 1970, this share is projected to lie between 70 and 81% by the year 2000. This range encompasses the current urban share of most OECD countries.

iv. Brazil's well known regional economic disparities have demographic counterparts. Most of the analysis in this annex has been decomposed into three regional units. One corresponds to the lower income Northeastern states. The second comprises higher income Southeastern and Southern states -- labelled here as Southeast. The third includes the remaining national territory, geographically dominated by the sparsely populated Amazonic basin -- it is labelled Frontier.

v. Population growth since 1950 has proceeded at widely diverging rates across these regions. Taking extreme values among regions, population grew almost 90% faster in the Frontier than in the Northeast -- in the 1960s, more than twice as fast. Regional demographic projections indicate that the Frontier will increase its share of national population from less than 10% in 1970 to between 12 and 15% in the year 2000. At the other extreme, the Northeast's share is projected to decline from 30% in 1970 to between 22 and

28% in the year 2000. Thus the Southeast is projected to retain the bulk of the Brazilian population for the remainder of this century. Similarly urbanization rates in the Frontier have been much faster than elsewhere: above 7% a year in both the 1950s and 1960s -- compared with less than 5% in the Northeast.

vi. The virtual stability of Brazil's population growth rate between the 1950s and 1960s was the result of commensurate declines in both its birth and death rates throughout the 20-year period -- international migration having been a negligible demographic factor since the 1940s. The crude birth rate fell from 46 to 41 per thousand between 1950/54 and 1965/69; the crude death rate fell from 17 to 12 per thousand. More refined measures of fertility and mortality that factor out the effect of changing age composition on these crude indices, however, indicate that fertility (measured by the total fertility rate 1/) declined by less than 2% during the 1950s and the 1960s; life expectancy, a sensitive measure of mortality, rose by more than a third. Regional disaggregation of the evolution of the national mortality and fertility rates reveals much sharper differences.

vii. In the Southeast, life expectancy rose from 56 years in the 1950s to 63 in the 1960s. In the Northeast, it rose from 43 to 48 years; and in the Frontier from 47 to 55 years. Published estimates based on official death registration statistics, nevertheless, show substantially increasing infant mortality rates in certain metropolitan areas during the 1960s and early 1970s, most notably in Sao Paulo. But there is controversy on the interpretation of these data. Some analysts argue that the rising trends do not reflect actual increases in infant mortality, but are due to measurement problems. Among those who accept the reliability of the data, no consensus has yet been reached concerning the reasons behind the rising (and more recently, falling) infant mortality rates.

viii. While the fertility rate in the Southeast fell by almost 4% between the 1950s and the 1960s, and by almost 3% in the Frontier, it rose by almost this same percentage in the Northeast. Regional fertility estimates going back to the 1930s trace a monotonically declining trend for the Southeast, a similarly rising one for the Northeast, and an irregularly flat profile for the Frontier. Thus, the best answer to the crucial question of whether Brazil had entered into the sustained fertility decline phase of the demographic transition by the year of its last census (1970), seems to be one that is not strictly congruent: for the Southeast it had; for the Northeast it had not; for the Frontier it is unclear. There is reason to believe, however, that barring an unforeseen reversal of well-affirmed socio-economic development trends in Brazil, Northeastern fertility is likely to have peaked during the 1970s, and the Frontier's to have commenced its downward path. The key to these prospects lies in the presence of seemingly powerful interrelations among fertility, mortality, and certain socio-economic development indices in Brazil.

1/ The definition of this and other demographic terms may be found in the glossary at the beginning of this Annex.

Sources of Urban Growth: 1960-1970

ix. Overall rural-urban migration in the 1960-70 period is estimated at 9.4 million, or 46% of Brazil's 20.2 million urban population growth in the decade -- and about 24% of the rural population in 1960. At the state level, the contribution of migration to urban growth is greater in the Southeastern states, where natural increase is lower. In Sao Paulo state, for example, migration's share is estimated at over two-thirds. Contrary to the popular notion that the Northeast has been the main source of migrants to Southeastern cities, it turns out that rural areas in the Southeast region itself accounted for about 90% of urban growth in the Southeast. (Rural areas of the Southeast, however, were also recipients of some interregional migrants, most of which probably came from the Northeast.) Among the nine largest metropolitan areas in Brazil, migration's contribution to inter-censal growth ranged from about a third in Belem to over 80% in Porto Alegre. Additional evidence suggests the proportion has been declining during the 1970s in Rio de Janeiro and Sao Paulo metropolitan areas. In sum, the demographic evidence supports the view that migration remains a very powerful factor in Brazilian urban growth, particularly in the more highly industrialized Southeastern region. Nevertheless interregional migration plays a rather minor role in this region's urban growth.

Patterns in Age and Sex Composition

x. Although the age and sex composition of the Brazilian population shows only modest change between 1950 and 1970, there were significant differences across regional patterns in the earlier years, and some of them widened during the 20-year interval. Nationwide, the share of 0-14 year olds in total population remained virtually constant at about 42% (compared with about 28% for the US in 1970); those in working ages 15-64, at around 56% (about 62% in the US); those 65 and over, at around 3% (about 10% for the US). The overall sex composition was also stable at roughly equal numbers in each group. Thus, owing largely to the sustained high fertility pattern of Brazilian population growth during the current century, its age composition has been heavily weighted by children, whose consumption of national output far exceeds their contribution to production. According to the demographic simulations, by the year 2000 the share of 0-14 year olds will have somewhat declined to between 35 and 37% of the total.

xi. Most notable interregional differences in the age-sex composition, both in 1950 and in 1970, occur between the more demographically advanced Southeast on one hand and the Northeast and Frontier on the other. For example, in 1950, the share of 0-14 year olds in the Northeast and Frontier was almost 10% higher than in the Southeast. By 1970, it was about 14% higher. According to the demographic simulations, this difference between the Northeast and Southeast will have further increased to within the range of 19 to 23% by the year 2000. Thus, this "demographic burden" to net economic production has been heaviest in the poorest Northeast region, and will likely become even heavier through the duration of this century.

xii. Age- and sex-selectivity of out-migration before 1970 further augmented its demographic dependency problem. Those who left were more likely to be producers of market goods and services (working-age males). Those who stayed, were more likely to be either almost pure consumers (children and the very old) or working age women, whose production activities have typically not been market-oriented. In contrast, migration selectivity into the Frontier has favored working-age males.

Migration and Regional Inequality

xiii. By transferring labor from the lowest wage area of Brazil, the rural Northeast, to the highest wage area, the urban Southeast, and to other intermediate wage areas -- particularly the rural Frontier -- migration has played an important role in dampening interregional wage differentials during past decades. There are some indications that longer term patterns may be changing. This dampening effect appears stronger in the sectors absorbing the greatest share of migrants: services and agriculture. In manufacturing, it may have been swamped by other factors. Northeast to Southeast migration flows during the 1960s were lower than in the 1950s; but a larger share of this reduced flow went into the rural Southeast.

xiv. The initial surge of migration to colonize virgin land in the Frontier during the 1960s seems to have slowed considerably in recent years. Expectations concerning the capacity of organized Amazon colonization to provide an alternative escape valve for population pressure in the Northeast have recently been revised downward. The costs of establishing unskilled migrants in the Amazonian setting were grossly underestimated.

xv. Migration into the larger metropolitan areas seems to have been an important factor in the closely related problem of deficits in basic urban services, such as residential access to piped water. In the six largest Brazilian metropolitan areas in 1970, recent migrants were a much higher share of the population located in peripheral municipalities than in the municipality containing the seat of state government. Correspondingly the percentage of dwellings with piped water in these metropolitan areas was substantially lower in their migrant-heavy peripheral municipalities in all six cases.

xvi. Besides migration, there are other important interrelations between demographic characteristics, income and other indices of socio-economic status discernible in Brazilian data.

Demographic Variables and Income

xvii. Although increases in school attendance have tended to reduce measured labor force participation rates for younger workers in recent years, declines in the proportion of unpaid family workers have tended to have an opposite effect. To the extent that the net effect might have been an increased proportion of younger earners (with lower average earnings), this would have tended to aggravate income inequality as measured by reported earnings. The rising share of female earners has had a similar

effect, because increased female labor force participation has been concentrated in ages 15-24. In part, these findings reflect statistical problems relating to the adequate measurement of earnings in a changing economy.

xviii. More fundamental relations between demographic factors and income patterns must be sought at the household level. For example: Are there systematic differences between household income and household size? Supposing an inverse relation prevails, to what extent does this reflect that lower income households on average have fewer income earners? To what extent does this reflect that income earners in lower income households earn less?

xix. Survey data from 2,445 representative households in the metropolitan area of Belo Horizonte stratified into four income groups show that households in the poorest group contain nearly 1.3 more members than the overall average (5.1 members) and over 2 persons more than the upper middle and highest income groups. Nevertheless, households in the poorest group have fewer earners at lower average earnings than the rest. In terms of household dependency ratios, poor households have 4.5 consumers per earner, compared with 2.3 for rich households and 3.1 for all households in the sample. Children are a higher proportion of dependents in poor households. Additional results based on this survey indicate that despite a larger number of adults (potential earners), poor families have the lowest average number of actual earners per household. Interaction between demographic and other factors in the poverty constellation is also revealed in the relation between dependency and the age of heads of households across income groups. Earnings of heads of poorer households do not increase as much with age as those of higher income groups. The full impact of this flatter age-earning profile is felt as the dependency burden peaks when household heads are in their 30s. By this stage in the life cycle, heads in higher income households have increased their income substantially from younger years, while their poorer counterparts have not. The latter's increased consumption needs arising from demographic factors are not matched by comparably increased income, and consequently their deprivation at this stage is intensified.

Income and Other Mortality Correlates

xx. The effects of economic factors on demographic variables are most poignantly revealed in the empirical associations between indices of income and mortality. One such broad association was suggested above when discussing the historical evolution of life expectancy across regions: for the decade of the sixties, life expectancy in the higher income Southeastern region exceeded that of the economically lagging Northeast by 15 years. Other evidence indicates that:

- Malnutrition, a widely recognized factor in infant mortality, shows a regional pattern of severity that conforms to Brazil's pattern of infant mortality.

- Members of households reporting the rough equivalent of less than US$50 of monthly money income in the 1970 census had a life expectancy averaging 12 years less than their counterparts in households reporting more than US$160.

- When the same categories are broken down by urban-rural household location, the corresponding differences in life expectancy are: for urban locations, 16, and for rural locations, 9 years advantage respectively for the higher income households.

- Further disaggregating the urban category, life expectancy averaged 40 years for the lower income urban households in five central Northeastern states (comprising the bottom 47% of the urban income distribution in those states) and 67 years in Rio Grande do Sul (the bottom 11% of the distribution). By way of comparison, UN estimates of current life expectancy are 46 years for Bangladesh and 73 years for the United States.

Income and Other Fertility Correlates

xxi. Some associations between income and fertility are also found in Brazilian data. Interregional fertility differences mentioned above, show that the fertility rate in the Northeast (7.8) was 2.7 children per women higher than in the higher income Southeastern region. Other evidence on socio-economic correlates of fertility at the household or individual level based on data from the 1970 census, where fertility is measured by two different indices of cumulative births to women in particular groups, is summarized below.

xxii. Income. Urban women in the lowest of three money income classes had over 40% higher fertility than those in the highest group; in the case of rural women, there is no difference between the same two income groups, and it is almost 20% higher for the middle income group. For women in the lowest income group, those living in rural areas show 10% higher fertility than their urban counterparts; the highest rural-urban relative difference, when income is controlled, is at the highest income group, where rural women's fertility is almost 60% greater than for those in urban areas.

xxiii. Years of Schooling. Associations between women's years of schooling and their fertility in both urban and rural areas are the most powerful among the available tabulations. The decline of fertility across six categories of ascending years of schooling is sharp and ever-decreasing in all cases. For example, one of the fertility indices for women without schooling is 5.5 times greater than for those with 13 to 17 years of schooling in urban areas. The corresponding multiple in rural areas is 4.7. Urban-rural differences within each years-of-schooling group are much narrower than when controlling for household income. The widest relative difference among those reported is less than 15% -- for women with 4-5 years of schooling.

xxiv. Labor Market Status. For urban women classified as out of the labor force, fertility is more than twice that of their (urban) counterparts in the labor force. Fertility across six occupational categories of urban women reveals three distinct clusters of values: for the atypical situation of (urban) women engaged in agricultural and related occupations, fertility is more than twice as great as for those engaged in manufacturing and personal services; and around three times as great as for those engaged in commerce, or doing administrative, technical, or artistic work. Finally, among these same working women there is no strong association between their fertility and their labor earnings.

xxv. Conclusions. This evidence on socio-economic correlates of fertility at the household level strongly suggests that if current patterns of association remain reasonably stable over time, and if the ongoing processes toward greater urbanization, female education, and female modern sector employment continue at rates comparable to those in the 1960s and 1970s, fertility will probably decline in the coming decades even in the absence of a more activist official population policy.

xxvi. Given that both mortality and fertility are higher among the poor, an intriguing question is whether their rate of natural increase differs from that of more affluent families. Unfortunately no direct estimates are available to answer this question. Nevertheless analysis of 1970 census data indicates that the difference in fertility across income groups is greater than in mortality. Although caution is required in converting the available measures of total fertility and life expectancy into rates of natural increase, these results suggest that the natural increase of the low-income population has been greater.

Population Policy

xxvii. Official Brazilian policy on population was, until 1974, implicitly pro-natalist. As noted earlier, the traditional official view, dating back to colonial times, had been that Brazil would benefit from a rapidly growing population to complement her vast territory and natural resources.

xxviii. The position articulated by the Brazilian delegation to the 1974 World Population Conference in Bucharest and, at about the same time in the Second National Development Plan, was that population growth -- even at the current rapid rate -- is not a serious threat to economic development. Together with this somewhat weaker reaffirmation of the traditional view, which may be regarded as a perceptible movement from a pro-natalist to a laissez-faire stance, the official statements went on to recognize that the government had a responsibility to provide family planning services to certain individuals. Such persons would be those who wanted, of their own free choice, to plan their families, but were too poor to pay for the privately available services.

xxix. Federal authorities have given tacit approval to a number of state-level family planning programs organized by the Sociedad Civil de Bem-Estar Familiar do Brazil -- BEMFAM (the Brazilian affiliate of the International Planned Parenthood Federation) but it was not until 1977 that the first step was taken by the federal government to provide family planning services to the poor. This was the announcement that the 1978-81 plan for maternal and child health would include family planning in instances where pregnancies would involve a high health risk (e.g., those to women with previous complications of pregnancy, with particular health problems, etc.). The amount earmarked for this purpose was the equivalent of about US$3.3 million to be spread over the four-year plan period, which would allow for coverage of about 54,000 women. Thus, this program can only be regarded as a cautious first move towards implementing the family planning policy enunciated in 1974.

xxx. Should the government resolve to move decisively in the implementation of that family planning policy, it would in all likelihood do so by incorporating birth control services through the network of health services facilities operated by the social security systems. Mexico followed this route, and for Brazil the incremental costs for reaching a sizable share of the population would be comparatively small, since the basic infrastructure for serving the urban population is already largely in place. Meanwhile, the bulk of family planning services rendered in Brazil will probably continue to be delivered by the private sector to those who can afford it and by BEMFAM.

xxxi. BEMFAM was created in 1965 by a group of Brazilian gynecologists with financial support from the International Planned Parenthood Federation and other private foundations. It began by opening clinics in several medical schools and by 1973 it had 86 clinics in operation and 130,000 new acceptors. Since 1973, BEMFAM has been moving towards community based distribution programs organized under agreements with certain state governments. To date, such agreements have been entered with five states: four in the Northeast and one in the Southeast regions. New acceptors increased to over 200,000 by 1976. Data to determine the total number of women covered by BEMFAM programs are not available. Under the most optimistic assumptions, however, it would not amount to more than a tiny share of the estimated 20 million or so Brazilian women who are currently in child-bearing ages and married.

xxxii. At this point, it appears unlikely that BEMFAM will be able to multiply its coverage of the Brazilian fecund population by any large factor during the next decade or so. Similarly, the evolution thus far of official measures to implement the 1974 family planning policy does not warrant forecasts of an imminent major breakthrough in the provision of family planning services by government agencies. The outlook could change if the government which took office in March 1979 were to adopt a more activist policy. But even if it does, the time lags normally involved between operational policy shifts in these matters, the implementation of the new policies and any measurable effect on actual fertility suggest that the path

of the Brazilian birth rate in the coming decade is much more likely to reflect changing socio-economic conditions than any sort of direct public action. This assumption is reflected in the demographic simulations undertaken in connection with this report.

The Future of Brazilian Population Growth

xxxiii. Official Brazilian demographic projections (designated here as the IBGE projections) arrive at state-level population estimates by prorating nationally projected future growth according to each state's share in total growth in the period 1960-70. This technique does not account for interstate and interregional differences in fertility, mortality and migration patterns which, as seen earlier, are very considerable. For this and other reasons spelled out below, alternative demographic simulations ("projections") were done for this report. Far from being forecasts, these are intended as arithmetical exercises to answer "what-would-happen-if" sorts of questions. Various approaches can be taken to the stipulation of the "ifs," or assumptions, depending on the purpose of the simulations. In this case, there are three major objectives:

- To derive certain additional implications from the demographic assumptions underlying the IBGE projections; the "Baseline" simulations serve this purpose.

- To explore the likely demographic impact of alternative paths in the coverage of certain social services -- such as basic education and water supply -- which are important determinants of fertility and mortality. Simulations "A" and "B" address these objectives.

- The third objective arises from the analysis of results derived in pursuit of the first objective. The assumptions underlying the IBGE projections were found to produce a rate of population growth in the Northeast that seems to be beyond the upper bounds of reasonable likelihood. Thus simulations "A-Mig" were prepared assuming faster migration out of the Northeast.

xxxiv. The Baseline projections are intended as a more elaborate version of the IBGE projections in that they incorporate regional assumptions missing in the latter, but these assumptions attempt to follow the perspectives on future fertility, mortality and migration trends underlying the IBGE exercise.

xxxv. Projections A, B and A-Mig are somewhat unusual in that they use fertility and mortality schedules derived from statistical relations based on 1970 state-level data. An example illustrates the nature of this approach.

xxxvi. The literature on socio-economic correlates of mortality suggests that a reasonably stable relationship may exist between infant mortality,

female education, residential access to a safe water supply and the proportion of all births to women over 40 years of age. Indices for these variables available at the state level for Brazil in 1970 were used to estimate a regression equation with the infant mortality rate as the dependent variable. Then, based on historical trends, current official program targets, a measure of unpredictable changes in development priorities and allowance for other "random factors," two sets of schedules were postulated for the future evolution of each of the independent variables: a pessimistic set (incorporated into the A projections) and an optimistic set (incorporated into the B projections).

xxxvii. The guiding principle for deciding how pessimistic or optimistic the schedules would be was that they should approximate boundaries outside of which actual future values for the corresponding indices seem very unlikely to fall - although these boundaries may conceivably be approached. In terms of a specific example, the pessimistic schedule for residential safe water supply coverage in the Northeast takes on a value of 44% of all dwellings in the 1995-2000 period; the optimistic schedule takes a corresponding value of 100%. (In 1970, this index stood at 13%.) The presumption is that the eventual value will fall somewhere between 44% and 100%. By inserting the scheduled index values into the regression equation, an infant mortality schedule is derived for each projection. The infant mortality schedule is then converted to the required corresponding life expectancy schedules using life tables.

xxxviii. Another part of this report (Annex II: "Employment, Earnings and the Distribution of Income") also deals with statistical relations involving fertility and mortality. In the case of Annex II, the main purpose of the exercise is to explore empirical associations between these demographic variables and the mean income of the population of Brazilian states, together with the income share of the poorer members of the labor force. The two sets of regressions (the one in Annex II and the set reported in this annex) serve different purposes and neither of these purposes is to describe or otherwise investigate the nature of causal relations that may underlie such empirical associations.

xxxix. Therefore, the alternative demographic simulations A and B are meant to answer two types of questions: what is the range of likely values for population and other demographic variables in Brazil in the years ahead to 2000? What difference would it make in terms of these demographic variables whether the evolution of certain key socio-economic indices proceeds slowly or very rapidly in the next couple of decades?

xl. Some Results. According to the simulations, the consequences of slow versus rapid evolution of the socio-economic indices on mortality and fertility are substantial, especially in the Northeast. For this region, results show a difference in life expectancy of almost 10 years by the end of the projection period. The difference is even more pronounced in the case of infant mortality, where the rate under projection A is almost twice as great as in B. For the Southeast, at the other extreme, the

corresponding difference in life expectancy is less than 2 years. Total fertility differences between these two projections by the year 2000 range from 18% (lower in projection B) in the Northeast to 7% in the Southeast.

xli. Despite substantial differences in the underlying assumptions, proportional differences in the total population across the four projections are not great. This happens largely because mortality and fertility differences between projections tend to cancel each other out in their effect on population growth. Thus, the largest difference in total population by the year 2000 is between the IBGE (202 million) and projection A (209 million; or less than 4% of the former). Differences in population size that do occur across projections are concentrated in the younger age groups. Thus they are much sharper when comparisons focus on this category. The population aged 0-14 in projection A is nearly 10% greater than in projection B. Such a difference takes on added significance in terms of consumption dependency for the provision of age related services such as education, and later on, for employment opportunities.

xlii. All the projections except A-Mig incorporate the IBGE assumptions on interregional population distribution and result in very large increases in the Northeast population between 1970 and 2000 -- more than doubling in the 30-year period. These assumptions are consistent with Government objectives to reduce migration into the Southeast from 1950 to 1970 levels. If Northeastern cities cannot absorb the large proportion of the population growth indicated in the projections (the equivalent of 125 cities of 200,000 inhabitants), then interregional flows will clearly be much larger than envisaged in official planning documents.

xliii. The possibility that migration out of the Northeast will in fact be much larger than official expectations is explored in projection A-Mig, which assumes a level of interregional migration which is double the amount assumed in the other projections. In A-Mig, the Northeast's share of total population would drop from 30% in 1970 to 22% in 2000, rather than only 28% in the other projections.

xliv. Some Implications. When considered together with officially stated objectives concerning population coverage targets for various social services and productive employment, the current laissez-faire policy towards population growth implies acceptance of the costs required to meet these objectives given the population increases associated with this policy. These aggregate costs will obviously be higher than required to meet the coverage targets for the smaller population increments that would presumably result from an activist policy to slow population growth. Looked at in a slightly different way, to the extent that Brazil is willing and able to allocate a certain quantum of resources to meet the stipulated coverage targets under the laissez-faire regime, an activist and effective population policy would allow it to shorten the time required to meet such targets. While the logic underlying these observations is elementary, the welfare trade-offs they highlight are eminently complex.

xlv. Another important type of trade-off between demographic and other national objectives is also apparent in the Brazilian case: that between interregional population distribution and export growth. A striking illustration bears on the land-use policy for the Frontier region. Current policy for this region emphasizes expansion of export agriculture as an important part of the broader policy to foster export growth. Products (mostly soybeans and cattle) and corresponding technology suitable for this purpose, however, are land and capital intensive; labor use is scant. This militates strongly against the objective of having the Frontier region absorb the bulk of the natural population increase generated in the Northeast -- currently in the order of one million persons per year. If a population policy emphasizing better geographic distribution rather than control of overall growth is to succeed, it has to be coordinated with other policies which have an effect on the carrying capacity of the area in question.

xlvi. As a final reflection on the current laissez-faire policy towards population growth, it is instructive to consider its implications for the future beyond the current century. According to the projections discussed here, Brazil's total population in the year 2000 will be between 202 and 209 million, and its annual rate of growth, between 2.2 and 2.4%. Barring an unforeseen catastrophe of major proportions, it is quite unlikely that these boundaries will be seriously violated under a continuation of the standing policy. Taking also into account the projected ranges of age structure and total fertility for the century's end, demographic theory and experience of other countries virtually guarantee that the Brazilian population will continue to grow at least until the second half of the 21st century and that it will not cease its growth until a population of no less than 300 million is reached. This is more than 2.5 times the estimated size of the current population. It is difficult to imagine how such a staggering increase in population could occur without detrimental effects to Brazil's ecological systems and hence to its environment. Current concerns for air and water pollution in the major metropolitan areas; and for soil leaching and erosion caused by overcropping and overgrazing in many agricultural regions, to name only a few, seem to be fully warranted in light of current conditions. These, in turn, may well be very favorable compared to the quality of the environment that would accompany a much more affluent population than today's and 2.5 times its size.

I. DEMOGRAPHIC TRENDS AND PATTERNS

1. Brazil, like the United States, is one of the few countries in the world to have experienced comparatively high rates of population growth for a century or more. From a total of about 3 million in 1800, Brazil's population expanded to 10 million at the time of the first census in 1872. In the century between 1872 and 1972, there was a tenfold increase to 100 million, implying an average annual rate of growth of 2.3 percent. While a portion of this growth was concentrated in periods of high immigration (1890-1900) and natural increase (1950-1970), growth rates of around 2 percent per annum were sustained over the entire period.

2. The main sources of information about the size, composition, and growth of Brazil's population are the eight censuses, taken irregularly between 1872 and 1920 and every ten years since 1940. A nationwide system for reporting vital statistics was started only in 1974, though data had been collected for several decades. Measures of fertility, mortality, and migration must be estimated indirectly from the censuses. While there is still room for improvement, the last four censuses are of reasonable quality, and the recent publication of final results from the 1960 census fills a major gap in data on current demographic trends.

3. Overall population trends in Brazil result from very diverse demographic characteristics by region. Hence regional disaggregation is fundamental to assessing patterns of demographic and economic change. Brazilian statistical authorities have established sub-national groupings of political and administrative units in their publications of economic and demographic data. The first level consists of the five so-called "macroregions," which group states on the basis of common geographic, economic and social characteristics (see Fundacao IBGE 1977). The regions include the North, the Northeast, the Southeast, the South and Central-West (see map). For our purposes, it is sufficient to group the five macroregions into three:

(i) The first region is Northeast as presently defined in Brazilian statistical publications. It is maintained as a separate region because it already has a large number of states which are relatively homogeneous in their social economic, and demographic characteristics. 1/

(ii) The second consists of the Southern and Southeastern macroregions, which lead Brazil not only in urbanization and industrialization but also in agricultural productivity. This region is referred to as the Southeast. 2/

1/ Includes: Maranhao, Piaui, Ceara, Rio Grande do Norte, Paraiba, Pernambuco, Alagoas, Fernando de Noronha, Sergipe, Bahia.

2/ Includes: Minas Gerais, Espirito Santo, Rio de Janeiro, Guanabara, Sao Paulo, Parana, Sta. Catarina, Rio Grande do Sul.

(iii) The last consists of the Northern and Central-Western macroregions, which are characterized by low population density, but whose share in total population has been increasing in recent decades as a result of frontier settlement and high rates of natural increase that are characteristic of such populations. The combined North and Central-West constitute our Frontier region. 1/

4. Presentation of data will follow this three-way regional breakdown, expanding it when needed to illustrate important intra-regional differentials. Within regions, rural-urban differences will be reported. In most available tabulations, rural-urban comparisons reflect Brazil's generous administrative definition of an urban place, which considers any municipality seat as urban regardless of size and so incorporates a large number of very small towns in the urban category. For some variables we have assembled data for cities and agglomerations with 20,000 or more inhabitants.

A. Growth and Composition of the Population Prior to World War II

5. In 1800, near the end of the colonial period, about a third of the 3 million "settled" population were of European extraction, mostly Portuguese. The remaining two-thirds were of African origin, about three-quarters of these being slaves. There was also an indigenous population, variously estimated at around a quarter of a million (Merrick and Graham, 1977; Chapter 3). Population growth in the first seven decades of the nineteenth century was slow (1.5 percent) compared to later trends, but rapid compared to other countries. European immigration was small, and high mortality among the slave population counteracted the effect of importation on its growth. Manumission (freeing of slaves) was also a major cause of the slave population being about the same size in 1870 as it had been in 1800. Natural growth of the free African population was, as a consequence, a large part of overall population increase in this period (Curtin, 1969).

6. The last quarter of the nineteenth century was an important transition period in Brazilian political, economic and demographic history. The expansion of coffee production into Sao Paulo to meet the growing export demand set a number of fundamental changes in motion. A pivotal problem was the supply of labor. Paulista planters, uncertain of the future of slave labor on the eve of abolition (which occurred in 1888), turned to immigrant labor, mainly Italians, for their field workers. The dynamism of Sao Paulo's coffee expansion contrasts with the Northeast's flagging economy, where ex-slave labor was drifting into share cropping and subsistence agriculture (Furtado, 1966).

1/ Includes: Rondonia, Acre, Amazonas, Roraima, Para, Amapa, Mato Grosso, Goias, Distrito Federal.

7. Between 1872 and 1940 Brazil's population quadrupled (see Table 1). In this period the Southeast (defined below) became the leading region. The period between 1870 and 1940 is very important in understanding the problems of the postwar decades, since many of the regional and social imbalances which now characterize the Brazilian economy have their roots in the events of that time. The Northeast's share of population declined from 48 percent to 35 percent between 1872 and 1940, while the Southeast increased from 48 percent to 58 percent. Industrialization, beginning around 1900, was also concentrated in Sao Paulo, and drew heavily from both the labor and entrepreneurial ability of immigrants and their descendants.

8. Immigration was the variable which most affected the growth of population and its distribution among regions in the coffee export phase. Birth and death rates were quite high, although mortality was far enough below fertility to yield a natural increase of about 18 per thousand (see Figure 1). Immigration raised the total rate of increase above 20 per thousand (2.4 percent in the 1890s). It also contributed to a rise in the share of population for the Southeastern region, especially Sao Paulo.

9. Brazil's population was mostly rural prior to 1940. Estimates based on persons living in cities of 20,000 or more show that urbanization was relatively small prior to 1940 (Table 1). However, export expansion and early industrialization spurred the growth of a few cities, led by Sao Paulo. In just a few decades it grew from a small town to rival Rio de Janeiro, creating Brazil's bi-polar pattern of urban primacy. By 1940, the officially defined urban share was 30 percent (almost twice the share of population living in municipalities of 20,000 or more inhabitants because of Brazil's generous administrative designation of an urban place). The labor force was still predominantly (70 percent) agricultural in 1940, not much changed from nineteenth century levels.

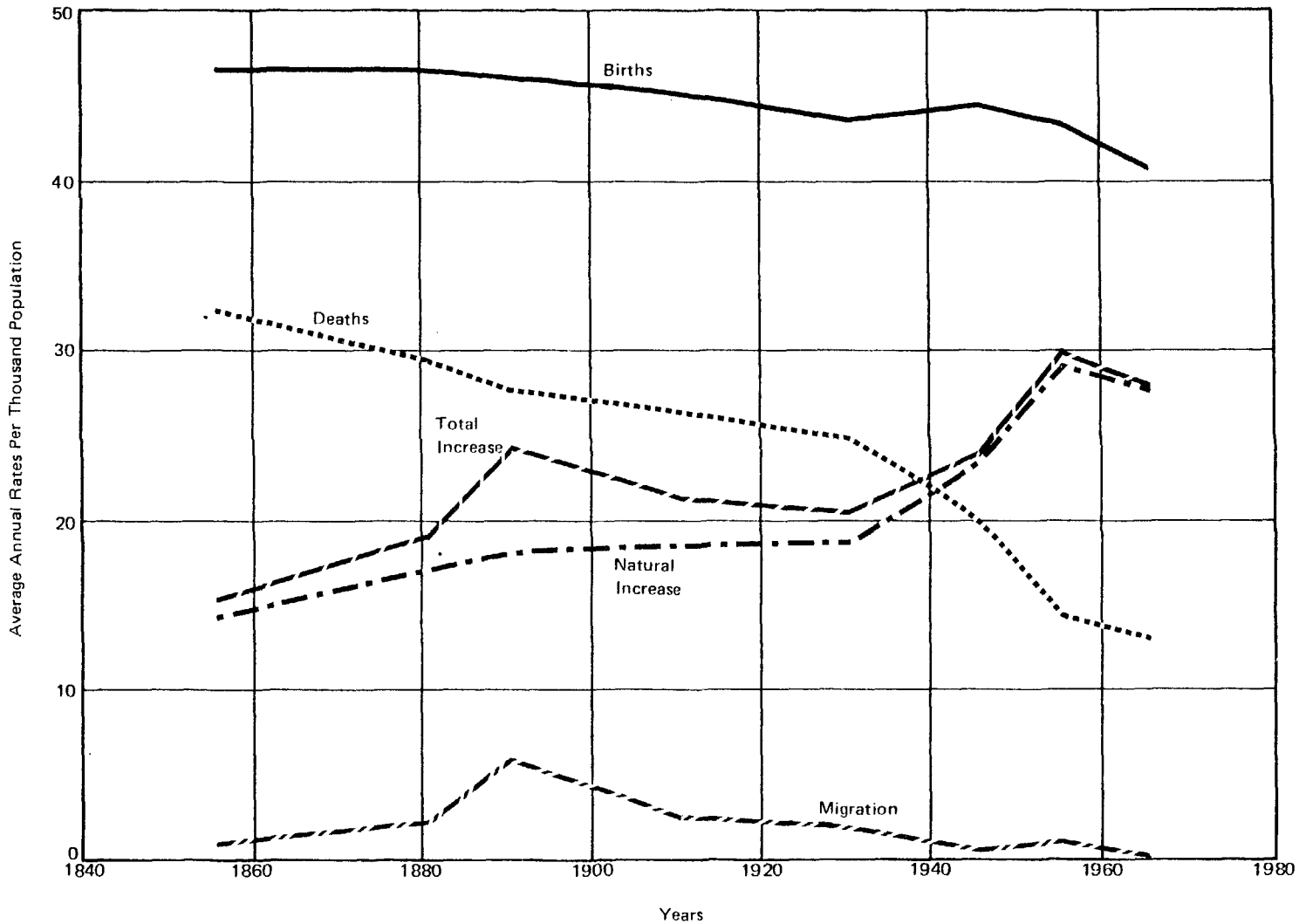
B. Major Demographic Features of the Postwar Period

10. World War II marked another major turning point in Brazil's economic and demographic history. Owing to declining mortality along with continued high fertility, the population growth rate rose to 3 percent (see Table 2). This increase coincided with a major expansion of Brazil's industrial sector, an expansion which generated substantial interregional migration and urban population growth. Both population distribution and a high rate of population growth are major issues in current Brazilian economic-demographic interrelations.

1. Population Growth and Its Components

11. The increase in the population growth rate in the 1930s was more gradual than abrupt. At the national level, mortality declined gradually from the turn of the century to the 1930s, though most of the change was concentrated in the Southeastern region, a reflection of its improving standard of living and possibly also the influence of immigration. Since comprehensive

Figure 1: COMPONENTS OF POPULATION CHANGE IN BRAZIL, 1850–1970



SOURCES: 1840–1900: Mortara, (1941b).
1890–1940: Mortara, in Fundacao IBGE (1975a).
1940–1960: Fundacao IBGE (1969).
1969–1970: Irwin and Spielman (1976).

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Table 1: OVERVIEW OF BRAZILIAN POPULATION, ITS SIZE AND DISTRIBUTION, 1872-1970

	Total Population (Thousands)	Urban Population (Percent of Total)		Regional Distribution of Population (Percent of Total)		
		Official /a Definition	Municipalities of 20,000+	Northeast	Southeast	Frontier
1872	9,931	na	7.9	46.7	47.7	5.6
1900	17,434	na	10.0	38.7	55.2	6.1
1940	41,236	31.2	16.0	35.0	58.4	6.6
1950	51,944	36.2	21.1	34.6	58.5	6.9
1960	70,119	45.6	28.1	31.6	60.5	7.9
1970	93,140	55.9	38.8	30.2	60.5	9.3

Sources: IBGE, various census volumes.

/a Officially, urban places are defined according to political administrtive criteria. This administrative definition leads to a larger urban share than would be the case with a specific size limit, as the data in the third column, based on 20,000 or more inhabitants, indicates.

na Not available.

Table 2: GROWTH AND DISTRIBUTION OF TOTAL AND URBAN POPULATION BY REGION, 1950 - 1970

	1950	1960	1970	1950 - 1960	1960 - 1970
	Population in Thousands			Average Annual Rate of Growth	
a) Total Population					
NORTHEAST	17,973	22,612	28,113	2.32	2.20
SOUTHEAST	30,389	42,018	56,350	3.29	2.98
FRONTIER	3,582	5,489	8,677	4.36	4.69
BRAZIL	51,944	70,119	93,140	3.05	2.88
b) Urban Population (official definition)					
NORTHEAST	4,745 (26.4)*	7,681 (34.0)	11,753 (41.8)	4.93	4.35
SOUTHEAST	13,034 (42.9)	22,288 (52.9)	36,268 (64.4)	5.51	4.99
FRONTIER	1,004 (28.0)	2,036 (37.1)	4,064 (46.8)	7.33	7.16
BRAZIL	18,783 (32.2)	32,005 (45.6)	52,085 (55.9)	5.47	4.99

Note: * numbers in parentheses show urban population as a percent of total population in part (a).

Source: Annuario Estatistico, 1976.

vital registration data are lacking even today, all measures of fertility and mortality for the past have to be derived from the censuses using such indirect estimation techniques as those developed by Brass (United Nations, 1967). Carvalho (1973), using an adaptation of the Brass technique, prepared regional estimates of life expectancy for the period 1930-40 to 1960-70, which are shown in Part A of Table 3. 1/ These estimates indicate that even prior to World War II, the Southeast had a significant advantage over the Northeast. Part B of the Table reveals a similar regional pattern in infant mortality, over five-year intervals since 1950. Infant and child mortality are key determinants of differentials in life expectancy.

12. Mortality decline accelerated from the prewar to postwar period. By the 1950s, the expectation of life had increased to nearly 50, with the gain in expected number of years lived in the Southeast (11.4 years) nearly double that of the Northeast (6 years). Expressed in crude death rates, this meant a decline from 25-26 per thousand in the 1930s to 15-16 per thousand in the 1950s. With the crude birth rate remaining constant, the rate of natural increase rose to 30 per thousand after 1950. Carvalho's regionalized estimates of total fertility, shown in Table 4, reveal the underlying patterns. Total fertility remained virtually unchanged, even into the 1960s. Again, important regional differentials are masked in the national average. A lower, declining total fertility trend appears in the Southeast; but its effect on the national rate is offset by higher and increasing rates in the Frontier and Northeast.

13. Translating these measures of fertility and mortality into crude birth and death rates gives a better sense of their impact on population growth, but is also complicated by the interaction of age structure changes, especially at the regional level, where migration is involved. Internal

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1/ In using Carvalho's estimates, we have chosen from among a number of demographers who have made indirect estimates of life expectancy for Brazil based on census data. Since no comprehensive data on mortality are available, these estimates must rely on child survivorship as reported in the census or on age-specific intercensal survival ratios calculated from successive censuses. Neither approach is entirely satisfactory, since they require the choice of a life table representing the general mortality level on the basis of the limited inferences that can be drawn from census data. Early estimates put life expectancy for the 1960-70 period at about 61 years (both sexes), but have been revised downward with the publication of definitive census results and experimentation with model life tables judged to be more appropriate to the age patterns of mortality in Brazil. Carvalho's work represents the most complete examination of this subject available; see Carvalho (1973) and (1977), also Costa (1976). The most recent estimates show a level of 53-54 years, substantially less than the 61 year figure. We have used Carvalho's (1973) data in Table 3 and in the projections. A review of the various estimates is now being prepared for the U.S. National Academy of Sciences Committee on Demography and will be available with the publication of the report of its Panel on Brazil in 1979.

Table 3: ESTIMATES OF LIFE EXPECTANCY AT BIRTH AND INFANT MORTALITY, BRAZIL AND MAJOR REGIONS, 1930-1970

Region				
A. Expectation of Life	1930-40	1940-50	1950-60	1960-70
Northeast	35.6	37.0	42.5	47.9
Southeast	44.7	49.2	56.1	62.8
Frontier	43.1	46.1	47.4	54.6
Brazil	41.2	43.6	49.6	55.7
B. Infant Mortality	1950-55	1955-60	1960-65	1965-70
Northeast	170.9	158.9	147.4	136.3
Southeast	115.7	101.9	95.5	82.0
Frontier	135.9	127.4	118.8	111.0
Brazil	135.6	122.7	113.6	101.4

Sources: (A) Carvalho, 1973 (B) Derived from projections using Carvalho data.

Table 4: ESTIMATES OF TOTAL FERTILITY[/a], BRAZIL AND MAJOR REGIONS, 1930-40 TO 1960-70

Region	1930-40	1940-50	1950-60	1960-70
Northeast	7.5	7.5	7.6	7.8
Southeast	5.7	5.3	5.3	5.1
Frontier	6.6	6.9	7.1	6.9
Brazil	6.1	5.9	6.0	5.9

/a The definition of this, and other demographic terms, appears in the Glossary of this Annex.

Source: Carvalho (1973).

consistency requires that entries and exits from a population through births, deaths, and migration "add up" to changes in population size and age structure between censuses, provided that reporting in the censuses is accurate. Applying age, sex and region-specific mortality and fertility schedules derived from Carvalho's estimates of life expectancy and total fertility to the population reported in the 1950, 1960 and 1970 censuses is one way of determining the crude birth rates. 1/

14. Table 5 shows region-specific estimates of crude birth and death rates derived in this manner. The national data show a steady but slow decline in the crude birth and death rates from the early 1950s to the late 1960s. The two trends parallel each other so closely that their effect on the rate of natural increase is cancelled out.

15. Comparison of Tables 4 and 5 reveals certain considerable divergences between the regional trends in total fertility and corresponding trends in the crude birth rate. For example, the Northeast's total fertility rate increased from 7.6 in 1950/60 to 7.8 in 1960/70, while its crude birth rate declined from 54.0 in 1950/54 to 51.4 in 1965/70. This is due to changes in age and sex composition resulting primarily from migration. From the ratios in Table 8 it is simple to show that in 1950, the share of women in the 15-39 childbearing age group in the Northeast's population was 20.5%; by 1970 it had declined to 19.3%.

16. An important question for future growth trends is the extent to which Brazil has begun to experience sustained fertility decline. Initial returns from the 1970 census suggested that fertility had started to decline rapidly in the 1960s. Early estimates put the crude birth rate as low as 38 per thousand in 1960-70. Since then, estimates have been revised upward. Though most would agree that a decline is under way, its magnitude has been difficult to establish. Recent returns on questions in the 1973 and 1976 National Sample Survey (Pesquisa Nacional Por Amostragem de Domicilios - PNAD) similar to the ones used in the 1970 census are reported to show that a substantial decline is under way. The representativeness of these results, however, is still being discussed. The issue will continue to be controversial until the 1980 census and until the new vital registration system builds up enough information to establish credible alternative estimates of vital rates.

17. What Table 5 shows in addition is that the declining national fertility trend, to the extent that it exists, is largely a reflection of changes in the Southeast, and that little, if any, change is in evidence

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1/ Some allowance has to be made for reporting errors in the censuses, which are clearly evident in particular age groups (young children, teenage males, and middle aged women). The "slack" caused by reporting error is taken up in interregional migration, which is estimated as the residual population change not accounted for in births and deaths. International migration, which accounted for a very small fraction of total population growth between 1950 and 1970, will be ignored in this discussion.

Table 5: ESTIMATES OF CRUDE BIRTH AND DEATH RATES, AND NATURAL INCREASE, BY REGION, FOR FIVE YEAR PERIODS 1950-1954 TO 1965-1969 (per 1000 Average Population)

Region	1950-54	1955-59	1960-64	1965-69
CRUDE BIRTH RATE				
Northeast	54.0	53.3	52.4	51.4
Southeast	41.7	39.0	36.5	33.9
Frontier	49.9	48.9	48.5	48.9
Brazil	46.4	44.5	42.5	40.6
CRUDE DEATH RATE				
Northeast	23.8	21.7	19.4	17.8
Southeast	12.8	10.7	10.1	8.4
Frontier	16.2	14.4	13.4	12.0
Brazil	16.7	14.6	13.3	11.6
RATE OF NATURAL INCREASE				
Northeast	30.2	31.3	33.0	33.6
Southeast	28.7	28.4	26.4	25.5
Frontier	33.7	34.4	35.1	36.9
Brazil	29.7	29.9	29.2	29.0

Source: Derived from census data using reported age - sex distributions and Carvalho estimates of Total Fertility and Life Expectancy.

elsewhere in Brazil. Because of this, interregional differentials in crude birth and death rates have increased during the 1950-1970 period. The influence of these differentials on future national trends depends, in part, on the relative weights of the three regions in the national total. Out-migration from the Northeast between 1950 and 1970 reduced its weight, but the offsetting increase was shared by the lower fertility Southeast as well as the higher fertility Frontier regions. To the extent that declines in fertility and migration in the Southeast slow its growth rate, the regional differentials are likely to have a dampening effect on overall declines in the rate of population growth.

18. Whatever the timing and magnitude of the decline in fertility, the 1950-70 period will almost certainly rank as the time of most rapid relative population increase in modern Brazilian history. Total population doubled from 50 to 100 million in about 23 years (roughly from 1949 to 1972), and while fertility may be declining, the end of rapid population growth is not in sight. In fact, even greater absolute increases in population are still to come because of the larger base on which future growth will take place.

2. Changes in the Distribution and Composition of Population

19. Postwar industrial expansion and population growth have combined to generate major changes in the composition and geographic distribution of population. The 1950s brought major internal migration flows from the Northeast to the Southeast, and within the Southeast, flows to Sao Paulo and Rio de Janeiro from such neighboring states as Minas Gerais.

20. The variety of internal migration movements which Brazil has experienced as well as limitations of data with which to measure them complicate the discussion of population redistribution. In addition to interregional shifts, there are interstate flows within regions, intermunicipality (roughly equivalent to county) flows within states and metropolitan areas, and rural-urban shifts at all of these levels to consider. This section is focused on the main interregional and interstate movements, and the main rural-urban changes.

21. In the Brazilian census, an individual residing in a municipality other than the one in which he/she was born is considered a migrant in most of the published tables, though information is also provided on interstate migrants. These data are more useful for describing characteristics of the migrant population (so defined) than in accounting for the contribution of migration to the population growth of particular geographic subdivisions of the population over a specific time period. Indirect measures, such as balancing equation and survival ratio techniques, are required for the latter purpose. These techniques measure only net migration, and do not indicate the volume of return or continued migration of individuals who did not stay.

22. Table 6 summarizes available estimates of interregional migration flows in the 1950-1970 period. It is divided into two parts: Part A shows

Table 6: SUMMARY OF DATA ON INTERREGIONAL AND INTERSTATE NET MIGRATION, 1950-1970

Part A: Components of Total Increase, by Region (per 1000 of average population in the decade)	1950-1960 Natural Increase	1950-1960 Net Migration	1950-1960 Total Increase	1960-1970 Natural Increase	1960-1970 Net Migration	1960-1970 Total Increase
NORTHEAST	31.7	-8.6	23.1	34.4	-12.6	21.8
SOUTHEAST	28.5	4.0	32.5	25.9	3.6	29.5
FRONTIER	33.8	9.2	43.0	35.7	10.5	46.2

Part B: Net Migration of Important States and Sub-Regions	Net Migration per Decade as Percent of Base Population				Net migration up to 1970 as percent of 1970 population
	1950-60		1960-70		
	Male (1)	Female (2)	Male (3)	Female (4)	(5)
1. Amazonas, Para, Acre, Amapa, Rondonia, Roraima	.1	-1.6	-1.2	-.5	2.85
2. Maranhao, Piaui	2.5	.9	-13.2	-10.9	-2.62
3. Ceara, Rio Grande do Norte, Paraiba, Pernambuco, Alagoas	-10.6	-8.5	-5.4	-4.0	-14.40
4. Sergipe, Bahia	-6.0	-3.3	-15.0	-16.1	-14.71
5. Minas Gerais, Espirito Santo	-10.9	-11.1	-14.3	-16.1	-22.74
6. Rio de Janeiro, Guanabara	9.5	9.8	8.7	12.2	18.59
7. Sao Paulo	7.9	6.2	7.2	9.1	10.52
8. Parana	27.4	26.9	17.6	14.6	31.44
9. Rio Grande do Sul, Santa Catarina	-8.4	-6.1	-2.0	-2.9	-7.76
10. Mato Grosso, Goias, Fed. Dist.	17.5	14.0	22.6	17.9	28.10

Source: Carvalho (1973).

the net contribution of migration to total population growth in the three major regions, while Part B breaks out particular groups of states within these regions that have figured importantly in intra-regional flows.

23. In part A, the main feature of interregional population redistribution is the contrast between the Northeast's negative net migration and the positive flows to the Southeast and Frontier. Frontier migration increased in importance from the 1950s to the 1960s. Part A of Table 6 also shows that out-migration offset about a third of the Northeast's higher natural increase, and in-migration accounted for the Southeast's total increase exceeding its natural growth. On the Frontier, in-migration combined with high natural increase characteristic of rural settlers, giving this region the highest rate of total increase in Brazil and increasing its share in total population from 6.9 to 9.3 percent in the two decade interval.

24. This broad regional breakdown masks some important intra-regional flows, and changes in these flows from 1950-60 to 1960-70. While the Northeastern region shows a net migration loss and the Frontier and Southeast show gains, specific states within these regions account for the major volume of flows. Part B of Table 6 provides migration estimates for groups of important states within the regions. Survival ratio estimates of net migration, by sex, as a percentage of the sub-region's base year population in 1950-60 and 1960-70 are shown in columns (1) to (4). Column (5) provides an additional index of the total volume of migration in all periods prior to 1970 derived from 1970 census data on persons living in a state other than the one in which they were born.

25. Net migration loss is the main pattern for Northeastern sub-regions, as it was for the region as a whole. Bahia and Sergipe stand out as the main losing states, with increased net percentage losses in the 1960s, relative to the 1950s contrasting with a decline in Pernambuco. Data for the Frontier show that most of the gains in 1950-1970 were concentrated in the sub-regions south of the Amazon River basin, with the momentum shifting from Parana to Mato Grosso and Goias from the 1950s to the 1960s. When we turn to the Southeast, the intraregional picture becomes more complex. Minas Gerais and Rio Grande do Sul both lost to their more urban/industrial neighbors and to Parana, the major destination of rural settlers in south-westerly expansion of coffee production that occurred from the 1940s through the 1960s. Sao Paulo was itself a major source of migration to Parana at the same time that it was gaining migration from its neighbor, Minas Gerais. The composition of migration flows by sex also varies across regions, with a predominance of males in inflows to Frontier regions and with higher rates for females in the flows from Minas Gerais and Bahia to Rio de Janeiro and Sao Paulo.

26. Rural-urban shifts are another major geographic dimension of population change between 1950 and 1970. Cities absorbed a major portion of the period's population growth, with large cities figuring most importantly in this. Cities of 100,000 or more inhabitants accounted for 16 percent of total population in 1950 but 30 percent in 1970; this represented

45 percent of overall population increase between 1950 and 1970. The metropolitan areas of Rio de Janeiro and Sao Paulo alone absorbed 10 million of the 40 million total population growth in the period, and the seven regional metropolitan areas (Belem, Fortaleza, Recife, Salvador, Belo Horizonte, Curitiba and Porto Alegre) accounted for another 5 million. Intrastate migration played a major role in the growth of the metropolitan areas.

27. Table 7 summarizes the main features of urban growth in 1950-70 period, breaking down population by region and city size. The overall and regional urban shares are given according to both the official administrative definition and to one based on agglomerations of 20,000 or more inhabitants. Again it is the Southeast which accounts for the largest share (75 percent) of city growth. Two exceptions are important to note. Growth of the peripheral municipalities (e.g. municipalities other than the one containing the state government administration) of the metropolitan areas is comparatively high in all regions, including the Northeast, particularly during the 1960's; in the case of the Northeast almost all of the periphery increase occurs in Recife, since the peripheries of Fortaleza and Salvador had comparatively little absolute growth up to 1970. Also, urban population increase is high in the Frontier region, indicating a close relation between agricultural and urban development in the region. It may also be true that settlers who came in search of land found it less available than expected and have moved on to Frontier cities rather than return to their place of origin.

28. Brazil's size, regional diversity, and lack of comprehensive vital registration data make it difficult to sort out the demographic components of recent urbanization trends. Added to large regional differentials in rates of fertility and mortality for both urban and rural areas is a rather complex pattern of interregional and rural-urban migration flows. The usual demographic "balancing equation" approach to migration measurement (net migration = total increase - fertility + mortality), using "typical" magnitudes for rural and urban vital data in place of the missing data, must be employed with great caution. Costa (1976) has decomposed urban and rural population increases in 1960-1970 into the shares contributed by migration and natural increase using indirect measures of fertility and mortality derived from census data. His estimates of overall rural-urban migration in the decade is 9.36 million, which amounts to 46 percent of Brazil's 20.2 million increase in the urban population in the decade (and about 24 percent of the rural population in 1960). At the state level, the contribution of migration is greater in such states as Sao Paulo (64 percent) where natural increase is lower. According to Costa's estimates, the Southeast accounted for nearly two-thirds of all net migration to urban areas in the decade. At the same time, the net out-migration from that region's rural areas amounted to 90 percent of its urban inflow. 1/ The balancing equation approach does

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1/ Rural areas of the Southeast (particularly in the state of Parana) were in turn recipients of interregional migrants, most of which probably came from the Northeast (Merrick and Graham).

Table 7: URBAN POPULATION AND ITS GROWTH BY REGION AND CITY SIZE, 1950 - 1970

REGION-CATEGORY		Total Pop (1000s) 1950	1960	1970	Average Annual Growth Rate 1950-60	1960-70
NORTHEAST						
METROPOLITAN	- center	1,139	1,899	2,904	5.24	4.34
(Fortaleza, Recife, Salvador)	- periphery	155	271	657	5.75	9.26
Other 100,000+		781	1,273	2,048	5.01	4.87
20-100,000		501	850	1,393	5.42	5.03
All 20,000+		2,576	4,293	7002	5.24	5.01
Official Urban		4,745	7,681	11,053	4.93	3.71
SOUTHEAST						
LARGE METROPOLITAN	- center	4,430	6,562	10,122	4.01	4.43
(Rio & Sao Paulo)	- periphery	950	1,962	4,563	7.52	8.81
OTHER METROPOLITAN	- center	862	1,655	2,682	6.74	4.95
(Belo Horizonte, Curitiba, Porto Alegre	- periphery	168	253	879	4.18	13.26
Other 100,000+		1,443	2,558	4,329	5.89	5.40
20-100,000		2,008	3,573	5,673	5.93	4.73
All 20,000+		9,861	16,563	28,248	5.32	5.48
Official Urban		12,584	22,288	33,109	5.88	4.04
FRONTIER						
METROPOLITAN	- center	241	375	603	4.52	4.87
(Belem)	- periphery	1	2	3	7.18	4.14
Other 100,000+		168	496	1,331	11.14	11.04
20-100,000		134	290	594	8.03	7.43
All 20,000+		544	1,163	2,531	7.89	8.09
Official Urban		1,004	2,036	4,064	7.33	7.16
BRAZIL						
METROPOLITAN	- center	6,672	10,491	16,311	4.63	4.51
	- periphery	1,274	2,488	6,102	6.92	9.39
Other 100,000+		2,392	4,327	7,708	6.11	5.94
20-100,000		2,643	4,713	7,660	5.95	4.98
All 20,000+		12,981	22,019	37,781	5.43	5.55
Official Urban		18,783	32,005	52,085	5.47	4.99

Source: Derived from Fox (1975).

not provide enough information to determine the extent to which these net gains and losses represent intraregional versus interregional migration flows.

29. Other Brazilian statisticians have prepared estimates of the share of migration in total population growth for the nine metropolitan regions in 1960-70 (Brazil, Ministerio do Interior, 1976). Their estimates range from 34 percent for the migration share in Belem (which had low migration combined with higher natural increase) to 81 percent in Porto Alegre (a contrasting case of higher migration and low natural increase). Merrick's estimates from survey data for Belo Horizonte yielded a migration share of 59 percent for 1960-70, compared with 67 percent reported above (Coelho and Merrick, 1975). This difference occurs because intra-metropolitan area migrants were included in the former estimates, but excluded in the latter. Additional evidence suggests that the migration share has been declining in Rio de Janeiro (Weller et al., 1971) and Sao Paulo (Shaefer and Spindel, 1976).

30. In assessing these trends it is important to note an important effect of migration on city growth: the effect of migrant natural increase. Migrants have added to the weight of higher fertility groups in urban populations, and the reproductive force of the migrants is an increasingly important factor in overall urban growth. When this indirect effect of migration was taken into account in the Belo Horizonte data, for example, the share of growth attributable to migration increased to 82 percent, and is expected to rise to 85 percent in 1970-1980 (Coelho and Merrick, 1975).

31. In addition to geographic distribution, migration and natural increase have affected composition of the population by age and sex, generating important feedbacks on both demographic and socio-economic change. 1/ Table 8 summarizes national and regional trends in age-sex composition from 1950 to 1970. Four age categories summarize the distribution over important phases in the life cycle: childhood (ages 0-14); the earlier (ages 15-40) and later (ages 40-64) stages of the working ages; and older people (over 65 years of age). The sex ratios (males per 100 females) are given for each of the age groups as well as the total. The two measures bear the imprint of recent trends in fertility, mortality and migration, as well as some of the age reporting problems in the census that were mentioned earlier.

32. Migration, most of it concentrated in the early working ages, is also a factor in regional age differentials. Out-migration from the

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1/ A detailed analysis of the effects of the Brazilian age distribution on various social sectors, particularly education, and on labor markets was done by King (1970).

Table 8: DISTRIBUTION OF POPULATION BY AGE AND SEX, BRAZIL AND MAJOR REGIONS, 1950 - 1970

REGION	AGE GROUP	1950		1960		1970	
		PERCENT	SEX RATIO*	PERCENT	SEX RATIO	PERCENT	SEX RATIO
Northeast	0-14	43.9	100.7	44.5	100.8	45.3	100.2
	15-39	38.7	89.1	37.0	85.8	36.4	88.4
	40-64	14.6	99.6	15.3	102.4	15.0	99.0
	65+	2.8	78.4	3.2	92.5	3.3	92.3
	TOTAL	100.0	95.2	100.0	95.4	100.0	95.3
Southeast	0-14	40.4	102.8	41.4	103.2	39.9	102.1
	15-39	41.3	98.0	39.5	98.8	39.6	98.2
	40-64	15.7	108.0	16.2	106.4	17.1	102.0
	65+	2.6	90.3	2.9	95.5	3.4	89.5
	TOTAL	100.0	101.3	100.0	101.5	100.0	100.1
Frontier	0-14	44.0	103.6	45.9	102.1	45.9	101.9
	15-39	40.3	102.6	38.3	104.5	38.4	102.8
	40-64	13.6	115.9	13.8	115.1	13.5	116.9
	65+	2.1	94.8	2.0	104.5	2.2	101.0
	TOTAL	100.0	104.3	100.0	104.7	100.0	104.1
Brazil	0-14	41.9	102.1	42.7	102.7	42.1	101.4
	15-39	40.3	95.3	38.8	95.5	38.5	95.7
	40-64	15.2	105.5	15.8	106.1	16.2	102.2
	65+	2.6	85.9	2.7	93.7	3.2	89.5
	TOTAL	100.0	99.3	100.0	100.1	100.0	99.0

* Sex ratio = males per 100 females

Source: Census data, 1950 to 1970

Northeast has reduced the share of its 15-40 year old age group compared to the Southeast and Frontier. A combination of natural increase and in-migration account for the comparative youthfulness of the Frontier population, 85 percent of which is under 40 years of age. Migration in earlier decades combined with a general aging process has contributed to the Southeast having an older population compared to other regions, though the Northeast also has a comparatively large proportion of persons over-40 population as a result of out-migration of younger people.

33. Further implications of regional migration and natural increase differentials are revealed in the sex distribution of the population, though caution is required in interpreting regional patterns because of sex-specific age reporting errors in the census data. An obvious problem in age misreporting exists among middle-aged women, who tend to understate their age. Added to this is probable underreporting of younger adult males because of their absence from households during the census interviews. The effects of reporting errors on age-sex composition can be seen most clearly in the national level data. The comparatively low sex ratio (males per 100 females) for ages 15-40 reflects both the possible undercounting of males and inclusion of females who were actually older than they admitted in the census. Likewise the higher than expected sex ratio for ages 40-65 reflects a deficit of females, particularly in the 40-44 age category. A further age reporting problem in the 65 and over category in the 1960 census is suggested by its comparatively high sex ratio vis-a-vis 1950 and 1970, which could be due to overstatement of the ages of older males.

34. It is still possible to identify the impact of regional migration patterns on the sex composition if we compare regional results to the national level as a rough control for age reporting problems. Such comparisons show that the Northeast has lost more young adult males than females to the Southeast and Frontier. The male sex-specific bias of migration is especially pronounced for the latter. An important implication of this is that out-migration from the Northeast further augments its demographic dependency problem, since those who left were more likely to be producers of market goods and services and those who stayed more likely to be engaged in home production, including child rearing.

35. Further implications of the age and sex composition effects of national and regional migration and natural increase experience will be explored in other annexes.

II. POPULATION CHANGE AND DEVELOPMENT ISSUES

A. Migration and Regional Imbalances

36. The interdependence between demographic factors (migration as well as natural increase) and social and economic inequality has an important regional dimension in Brazil. While many regional differentials can be traced to the prewar period, the postwar tendency toward concentration of industrial expansion in the urban Southeast has compounded imbalances. Between 1950 and 1970, internal migration helped to reduce average regional income differentials between the Southeast and Northeast, as shown by the decline in the ratio of income per worker in Sao Paulo to that of the Northeast in Table 9. However, sectoral trends in per worker income suggest caution in interpretation of migration's equilibrating role. Regional differentials in income per worker in the industrial sector actually increased in this period, while the narrowing of interregional differentials occurs in services and agriculture. Data for these sectors are poorer in quality than those for industry, raising doubts about the degree to which there actually was any narrowing of overall regional differentials. To the extent that a narrowing has occurred in services, the most likely hypothesis is that it is a reflection of the role that service activities, rather than the more protected industrial sector, have played in absorbing the bulk of migrant labor from the Northeast. Thus, it seems that migration's dampening effect on interregional wage differentials in manufacturing may have been largely swamped by other factors.

37. According to Da Mata et al. (1973) interregional migration flows from the Northeast to the Southeast were lower in the 1960s than in the 1950s. An important dimension of this interchange in the character of interregional migration flows was the growing share of migrants to rural destinations, principally in the state of Parana and in states in the Frontier region. Nearly a third of the 15 million interstate migrants reported in the 1970 census were rural settlers. Initial expectations concerning the capacity of organized Amazon colonization to replicate the settlement experiences of other states (and provide an alternative escape valve for population pressure in the Northeast) have recently been revised downward, at least for the short run (see Katzman, 1977). The costs of establishing unskilled migrants from the Northeast in the Amazonian setting were grossly underestimated, and land distribution policy favoring large owners interested primarily in the region's cattle grazing and mineral resource potential have worsened further the chances for a low-income settler ever succeeding in the Amazon. Even in the Central-west, which is currently absorbing a significant share of Brazil's rural migrants, agricultural policy works against the small settler principally through the incentives that are being given to increase output in such exportable -- and capital-intensive -- agricultural items as cotton, cattle and soybeans. Mechanization and increased capital inputs were used to increase output as quickly as possible in order to finance costly petroleum imports, continued capital goods needs, as well as imports of food staples.

Table 9: SAO PAULO/NORTHEAST DIFFERENTIALS IN INCOME PER WORKER, BY SECTOR, 1950-1970

	1950	1960	1970
Agriculture	4.0	3.4	3.6
Industry	2.9	3.3	4.0
Services	2.2	1.9	1.7
Total	4.7	4.0	4.1

Source: Merrick and Graham, Chapter 6.

Note: These numbers are ratios of sectoral income per worker in Sao Paulo to that in the Northeast.

B. Urban Growth and Urban Problems

38. Imbalances between urban population increase, employment opportunities, and capacity to provide needed urban services have become a major concern of Brazilian authorities (Brasil, Secretaria de Planejamento, 1974). The larger cities have remained attractive in comparison to small towns and rural areas because of their higher relative incomes, among other factors. Migrants continue to move in the expectation that they might obtain a higher paying job (Da Mata, 1973). Another volume of the report deals more extensively with the relations between recent Brazilian economic growth and income distribution.

39. Though a share in the rapid growth of the urban labor force has been absorbed by manufacturing in the public sector, and by more highly capitalized service establishments, substantial numbers sought employment and earnings opportunities in the less capitalized informal or urban traditional sector. Low-skill activities in construction and domestic services have been initial major absorbers of migrant labor (Ozorio de Almeida, 1977). The informal sector plays a variety of roles in the urban economy. It is a major entry point for recent migrants and younger workers and a transition between full activity and retirement for older workers. Though average earnings in the informal sector are lower than in the formal sector, informal employment consists of more than just left over "bad jobs". Its comparative freedom from regulation permits an important subset of workers to earn more than they might have been able to do in a more organized setting. The extent to which lower earnings in most informal activities represent hidden unemployment, or a welcome alternative to agricultural work is still controversial.

40. It is difficult to assign a clear role of cause or effect to migration (and the natural population increase that feeds it) in the problem of urban poverty. Given the pre-existing social structure, especially nearly half a century of stagnation in the rural Northeast prior to 1950 and a postwar industrialization pattern that so clearly favored the urban Southeast, it is hardly surprising that demographic pressures have aggravated adverse effects that would have occurred even in the absence of increased population. Deficits of needed urban services are closely related to the employment and earnings aspect of the urban poverty problem. The problem goes beyond Rio de Janeiro and Sao Paulo to the regional metropolitan areas, especially as intraregional migration flows in the 1960s supplanted the interregional movement which most characterized the 1950s.

41. Municipalities on the peripheries of metropolitan areas, especially in larger cities like Recife, Rio de Janeiro, and Sao Paulo, have a relatively large share of migrants for whom such services as water are comparatively (to the central core) lacking (see Table 10). Within the peripheries, the problem is compounded by the Brazilian tax and revenue sharing system, which bases a substantial part of a municipality's revenues on the manufacturing output produced in it, a system which deprives so-called "bedroom" municipalies of the tax base they need to provide streets,

Table 10: MIGRATION AND ACCESS TO PIPED WATER IN METROPOLITAN AREAS, 1970

Metro Area		Percent Recent (0-4 Years) resident migrants	Percent Households with Water
1. Belem:	(Center	14.3	55.8
	(Periphery	7.9	5.9
2. Fortaleza:	(Center	22.9	12.4
	(Periphery	2.9	6.4
3. Recife:	(Center	9.4	53.1
	(Periphery	26.7	22.5
4. Salvador	(Center	10.5	54.6
	(Periphery	40.3	6.1
5. Belo Horizonte	(Center	19.1	47.9
	(Periphery	28.3	39.7
6. Rio de Janeiro	(Center	9.9	82.8
	(Periphery	22.6	46.5
7. Sao Paulo	(Center	15.9	64.2
	(Periphery	20.5	44.3
8. Curitiba;	(Center	24.4	47.6
	(Periphery	18.5	8.6
9. Porto Alegre	(Center	13.2	83.4
	(Periphery	29.9	34.1

Source: Brasil, Ministerio do Interio, 1976. Mundancas na Composicao do Emprego e Na Distribuicao da Renda. Brasilia: Ministerio do Interior, Secretaria Geral; Population and Industrial Census data.

water, sanitation and other urban infrastructure and services. The recently articulated policy on urban and metropolitan areas is aimed at overcoming some of these obstacles, but the tasks of achieving both institutional changes and finding resources to implement new programs are formidable.

III. DEMOGRAPHIC CHARACTERISTICS AND SOCIO-ECONOMIC FACTORS

42. Demographic factors have affected recent changes in Brazil's income distribution in a number of ways. Langoni (1973) has argued that the changing age-sex structure of the working population has tended to worsen standard (money) income distribution measures among individuals by increasing relative labor supply among the lower paid wage earners. Although increased school attendance has reduced activity rates for young workers in recent years, the relative size of the labor force entry cohort remains large because of high fertility. Also, the share of working individuals in these ages reporting earnings has been rising as a result of declines in the proportion of unpaid family workers. Because younger earners have lower average earnings, this has tended to aggravate income inequality as measured by reported earnings. The rising share of female earners has had a similar effect, since increased female labor force participation has been concentrated in ages 15-24. In part, these findings reflect statistical problems relating to the adequate measurement of earnings in a changing economy. In part they are reflection of the "benefit" to the Brazilian economy in having a relatively young labor force which is less costly to maintain.

43. More fundamental relations of demographic factors to income patterns must be sought at the household level. For example: Are there systematic differences between household income and household size? Supposing there is an inverse relation, to what extent does this reflect that lower income households have, on average, fewer income earners, and to what extent that income earners in lower income houses earn less?

A. Household Composition and Income: The Case of Belo Horizonte

44. Since national data on these relationships are not available, it is useful to turn to survey data for Belo Horizonte (See Sant 'Anna, Merrick, and Mazumdar, 1976). The 2,445 households in that survey were stratified by income level. Household structural characteristics are shown for each of the four income groups, ranging from the poorest to the richest, in Table 11. The poor households contain nearly 1.3 more members than the overall average (5.11 members) and over two persons more than the upper middle and high income-level households. However their earnings capacity (in terms of the number of earners as well as lower average earnings) is less, resulting in a substantially higher dependency burden and lower income per person. Poor households have only 1.41 earners on average, as compared with an overall average of 1.67 and 1.82 for households in the groups just above them. In addition to having a larger number of nonworking adults (1.81 versus the overall average of 1.37 and only 0.91 for the rich) the poor also have more children: an average of 3.15 members aged 14 or less as compared with 2.06 for all households and 1.26 for rich households. Household dependency ratios summarize the economic effects of these differences in household

Table 11: ANALYSIS OF HOUSEHOLD EARNINGS, SURVEY DATA FOR BELO HORIZONTE, 1972

		Household income class[a/]			
		Poor	Low	Middle	High
1.	Family size	6.37	4.93	4.16	3.79
2.	Number of adults	3.22	3.14	2.82	2.53
3.	Number of children	3.15	1.79	1.34	1.26
4.	Number of earners				
	a) Actual	1.41	1.82	1.76	1.62
	b) Predicted	1.51	1.62	1.62	1.59
5.	Earnings (cruzeiros per month)				
	a) Actual	248	601	1,297	2,693
	b) Predicted	394	554	919	1,376
6.	Number of equivalent consumers	5.24	4.26	3.65	3.32
7.	Income[b/] per equivalent consumer (cruzeiros per month)				
	a) Actual	50	144	393	1,080
	b) Predicted	78	133	290	683
8.	Number of households	718	1,116	299	312

a/ Households stratified on basis of monthly cruzeiro income per adult equivalent consumer: poor, less than 100; low, 100 to 368; middle, 368 to 728; high, over 728. In 1972, 1 cruzeiro = US$0.17.

b/ Includes income from sources other than earnings.

Source: Derived from data in Sant'Anna, Mazumdar, and Merrick, appendix Table 2.

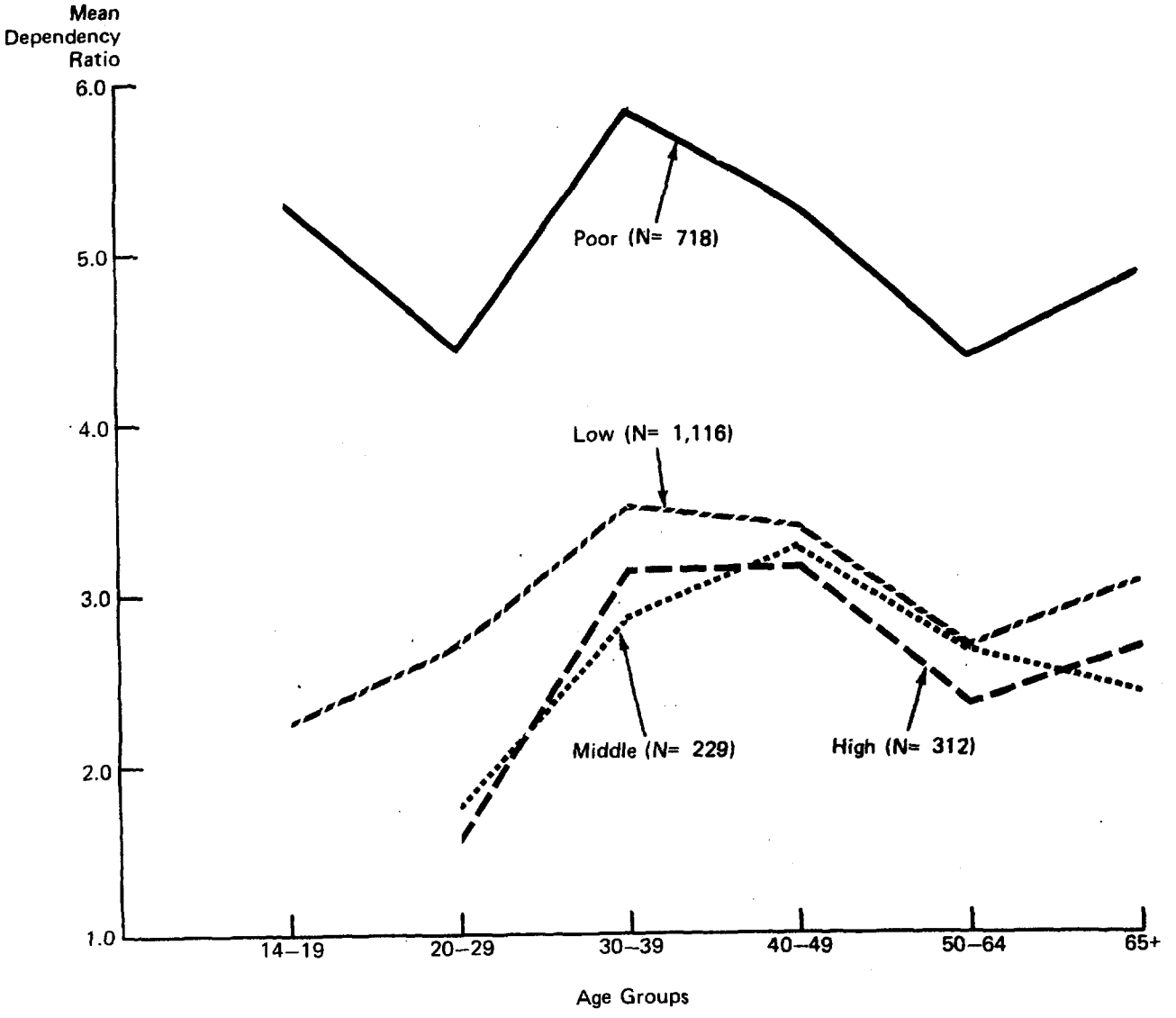
structure. Poor households have 4.51 consumers per earner, as compared with 2.34 for rich households, and 3.06 for all households. A higher proportion of dependents in poor households are children, though these households outnumber others in both adult and child dependency.

45. The survey data were analyzed to determine whether household demographic structure had a direct effect on members' earning capacity. This could occur in two ways: through the influence of structural factors on the ability of members to obtain work, and on their earnings once working. Using multiple regression techniques, estimates of labor force participation and earnings of individual households were computed and grouped by household income group. These were then compared with the observed averages for the same household groups. The results are also summarized in line 4 of Table 11. Despite a larger number of adults (potential earners), poor families actually have the lowest average number of earners per household group. Control for individual's age and education as well as household structure variables in multiple regression analysis (predicted values) suggests that poor households should have more workers than reported. In all other groups, households report as many or more workers than would be predicted on the basis of individual characteristics of adults. The same thing happens with individual earnings, as seen (line 5 of Table 11) in the reported and predicted earnings component of household income. Poor households' workers do worse than even their already lower endowment of human capital would lead us to suspect.

46. Since economic and demographic factors like age, sex, education and household structure explain part, but far from all, of the differential earnings capacity of poorer urban households, additional explaining factors were sought. Analysis using indicators such as access to health services and general network water showed they were an important element in the employment and earnings differences observed. This analysis revealed the circularity of poverty: the poor in Belo Horizonte had lower earnings capacity because they lacked basic necessities like health and sanitation services in addition to their lower level of education, and because of their lower earnings they were not able to obtain these necessities. In sum, the adverse effect of poverty on households is a double one: first the lower earnings power of its members, and then the fact that these members' earnings must be spread further.

47. The interaction between demographic and other factors in the poverty cycle is illustrated further in the relation between dependency and the age of heads of households in the different income groups, as shown in Figure 2. Because of limited education and the other factors just mentioned, earnings of heads of poorer households do not increase as much with age as those of upper income groups. The full impact of this flatter age-earnings profile is felt as the main dependency burden falls in the prime working-age portion of the life cycle. While upper income families have higher incomes to cushion rising consumption needs, poor families have fewer resources with which to provide for their larger numbers.

Figure 2: MEAN DEPENDENCY RATIO (NON-EARNERS/EARNERS) FOR THE HOUSEHOLD BY AGE OF THE HEAD AND HOUSEHOLD INCOME CLASS, BELO HORIZONTE, 1972



Note: See Table 11 for income classification. Data not shown for those aged 14-19 in middle or high income classes since they represent less than 5% of their class.

Source: Taken from Sant'Anna et al (1976).

B. Mortality Correlates

48. One important index of the consequence of poverty relates to mortality. A major puzzle in recent Brazilian mortality patterns is the relatively narrow rural-urban differential underlying the general decline in mortality. Life expectancy (and infant mortality) in urban areas is much closer to that of rural areas than fertility, and is actually greater (and mortality less) in rural areas in a good many states, especially North-eastern ones. Further, published reports indicate that infant mortality increased during the 1960's in some major cities.

49. To what extent do these patterns and trends reflect the deterioration of living conditions among the urban poor and increased pressures on such urban services as water, sanitation and housing caused by migration and rapid urban population increase? Research on the links between infant and child mortality in Brazil and important factors like nutrition and safe water is still sparse. Data limitations, especially the lack of comprehensive and fully reliable trend data on mortality, make interpretation particularly hazardous, especially since coverage has been improving over time, which creates the additional problem of determining what portion of recent changes might be attributable to changes in data quality. This has restricted most of the work that has been done to vital registration data on particular localities and to various indirect estimates derived from sample survey and census data.

50. Comprehensive evidence on the relation between nutrition and child survival in Brazil is not yet available, though the National Survey of Household Expenditure, ENDEF, taken in 1974/75 represents a major potential for research on this question (Fundacao IBGE, 1977). Based on the tabulations published to date, and assuming that the missing rural Frontier region had consumption levels comparable to the urban Frontier (excluding Brasilia), the ENDEF data show average per capita daily calorie consumption in 1975 of 2,249 in rural areas and 2,165 in urban areas, or 2,199 for Brazil as a whole (refer to Annex III, Part II.A). According to calculations described in Annex III, these consumption levels imply an average daily deficit of between 174 and 245 calories per person, depending on which of the alternative FAO/WHO requirement standard is used. This is equivalent to a 7% to 10% shortfall, respectively. These average deficitary consumption levels strongly suggest that the extent of malnutrition among lower income groups must be severe, in light of what is known about the large inequalities in purchasing power that exist.

51. The ENDEF survey also contains anthropometric data that may be used to estimate the extent of malnutrition using the well-known Gomez index and typology: first degree malnutrition, 76-90% of normal weight for age; second degree malnutrition, 61-75% of normal weight; third degree malnutrition, 60% or less of normal weight. Using the FAO/WHO standard of normal weight (the appropriateness of which is carefully argued in Annex III), only 42% of all Brazilian children 17 years of age and younger reached normal weights for their age. Corresponding figures are 32% in the Northeast,

48% in the Southeast and 37% in the Frontier. First degree malnutrition affected about 17% of all children in this age group and regional differences were small. Second degree malnutrition affected 20% of the same age group: 28% in the Northeast, 15% in the Southeast and 23% in the Frontier. About 1% of the population under age 18 fall into the third degree malnutrition range. However, since third degree malnutrition usually leads to death and the ENDEF data cleaning process eliminated from the final tabulations data for persons who were obviously ill or abnormal, this latter percentage probably underestimates the relative incidence of this acute stage of malnutrition over the course of, say, one year. In sum, this preliminary evidence from the ENDEF survey on the nutritional status of the Brazilian population would seem to generally conform with its high infant mortality patterns -- particularly in the Northeast.

52. There has been considerable debate in recent years around the interpretation of data which show rising infant mortality rates in several state capitals, including Sao Paulo. 1/ Data for both Sao Paulo state and Greater Sao Paulo are reproduced in Table 12. If these estimates are accurate, the conventional wisdom regarding "automatic" improvements in mortality associated with growing per capita income (at least with reference to Sao Paulo) may be seriously questioned. Of particular relevance in this respect are the estimates for Greater Sao Paulo which show an abrupt decline in the infant mortality rate during the 1950s, a steady rise during the 1960s and early 1970s, and a slight decline between 1973 and 1976. The Sao Paulo State Secretariat of Planning estimates that the decline in Greater Sao Paulo continued in 1977, reaching 72.2% (24% below the 1973 level). In an effort to explain this pattern, it has been argued that the observed rise in the Sao Paulo infant mortality rate is more apparent than real. Critics of the data suggest that improvements in the registration of deaths coupled with the "death invasion" phenomenon (i.e., mortality rates being calculated on the basis of place of death, rather than place of residence) are major explanatory factors. Indeed, it can be shown that uniform improvements in vital statistics, in a situation where age-specific mortality rates do not change, will worsen estimated mortality rates even though births, as well as deaths, are more completely recorded. Another argument (and one less subject to counter-arguments) is that recent migrants (principally from the Northeast) have brought with them the low health and nutritional standards prevailing in their regions of origin. Therefore, the rising infant mortality rates may only reflect the health conditions of children of families arriving in Sao Paulo during the 1960s and 1970s, and not those of children of long-time residents.

53. Among those who accept the reliability of the data, no consensus has yet been reached concerning the reasons behind the rising (and more recently, falling) infant mortality rates. W. Leser (former health secretary of Sao Paulo), for example, has attributed rising infant mortality to falling real wages (as measured by the minimum wage deflated by the cost of living index) and the resultant negative impact on nutritional standards

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1/ This, and the following paragraph draws heavily on the Sao Paulo data and estimates are considered to be of far better quality than those for other cities, Annex III, Part I,A.

Table 12: INFANT MORTALITY RATES, SAO PAULO, 1950-1976

Year	Sao Paulo State	Sao Paulo Greater Sao Paulo
1950	122.4	160.5
1955	107.4	157.8
1960	82.0	62.9
1965	73.9	69.4
1966	76.8	73.8
1967	78.9	74.4
1968	72.4	75.1
1969	84.1	83.8
1970	83.3	90.9
1971	89.4	94.6
1972	86.4	93.4
1973	89.0	94.6
1974	82.1	88.6
1975	84.4	87.5
1976	78.5	83.6

Sources: J. Yunes and V.S.C. Ronchezel, "Evolucao da Mortalidade Geral, Infantil e Proporcional no Brazil," Revista de Saude Publica, VIII, Supplement (1974), 34-35; Governo do Estado de Sao Paulo, Secretaria de Economia e Planejamento, Boletin da Dados Conjunturais (July 1977); and IBGE, Anuario Estatistico (various years).

(Leser, 1972:27-30). 1/ Others have traced the phenomenon to the public sector's inability to supply adequate sanitation and medical facilities to persons residing in the peripheries of large cities. Conversely, more recent arguments attribute falling mortality rates to a wider dissemination of these facilities. In short, the debate remains open. Closer study of the links between child survival and living conditions among Brazil's low income groups, especially the urban poor, is much needed. It seems reasonable to assume, however, that the rising living standards implied by the national indicators have not been shared equally by everyone.

54. The relationship between life expectancy and household income is explored in a recent analysis of special tabulations of child survival data from the 1970 census by Carvalho and Wood (1976). Their data provide a breakdown of life expectancy by 10, sub-regional state groups for four money income classes: the very lowest group includes households whose money income averaged less than Cr$ 150 per month in 1970 (approximately US$50). The breakdowns reveal a countrywide difference in life expectancy of 12 years (24 percent) between the lowest and highest income categories (49.9 versus 62 years; Table 13). While the average for the lowest group is strongly affected by the comparatively large number of poor in the Northeast (where their life expectancy averages less than 43 years), large differentials are observable in other regions as well: 8 years in Rio-Guanabara and 9 years in Sao Paulo.

55. This study also contains a breakdown of these data by urban-rural location. Recently published partial results from the ENDEF survey indicate that in rural areas non-monetary income is a higher proportion of total household income than in urban areas. Preliminary estimates by Pfeffermann and Webb (World Bank, 1978:9) show shares of non-monetary income in total income in 6 regional and sub-regional groups ranging from approximately 15-20% in urban areas to 35-57% in rural locations -- the maximum share being associated with the (rural) Northeast. Therefore, the urban-rural breakdown in the cross-tabulation of life expectancy by household income group is useful in two ways: by "controlling" for urban/rural environments as well as for urban-rural differences in the money income shares.

56. Proportional differences in life expectancy between the lowest and highest income groups in urban areas are greater for each of the 10 sub-regions than when rural areas are also included (Table 14). For all urban areas, the corresponding difference is 35%, versus 24% when all locations are included. Care, however, should be taken in interpreting these results to mean that the urban poor are worse off than the rural poor, in terms of life expectancy.

57. One reason is the money income share differences between urban and rural locations noted above. Persons in the lowest urban (money) income bracket are, on the average, likely to be poorer than rural persons in the

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1/ Other discussions of this issue are: Yunes and Ronchezel (1974: 3-48) and Yunes, Somenesi and Ronchezel (1976: 112-125).

Table 13: ESTIMATES OF LIFE EXPECTANCY BY HOUSEHOLD MONEY INCOME LEVEL, BY STATE GROUP, 1970

State Group	Average Monthly Income in Cruzeiros 1-150 (1)	151-300 (2)	301-500 (3)	501+ (4)	(4)/(1) (5)
1. Amazonia[a/]	53.4	53.9	54.8	58.2	1.09
2. Maranhao-Piaui	50.0	50.8	52.7	55.7	1.11
3. Central Northeast[b/]	42.8	46.1	50.3	54.4	1.27
4. Bahia-Sergipe	48.9	50.3	51.9	54.9	1.12
5. Minas Gerais - Espirito Santo	53.8	55.4	55.6	62.3	1.16
6. Rio de J. Guanabara	54.1	54.8	57.6	62.1	1.15
7. Sao Paulo	54.7	56.1	58.7	63.9	1.17
8. Parana	54.8	56.5	59.3	63.7	1.16
9. S. Catarina-R.G. Sul	60.5	61.2	63.4	66.9	1.11
10. Central-West[c/]	56.5	57.1	58.2	63.3	1.12
Brazil	49.9	54.5	57.6	62.0	1.24

Note: Number of families in each group are shown in Appendix table C.1.

a/ Includes: Acre, Amazonas, Para, Amapa, Rondonia and Roraima.

b/ " : Ceara, Rio Grande do Norte, Paraiba, Pernambuco, Alagoas and Fernando de Noronha.

c/ " : Goias, Mato Grosso and Federal District.

Source: Carvalho and Wood (1977:126-127).

Table 14: URBAN LIFE EXPECTANCY BY HOUSEHOLD MONEY INCOME LEVEL, BY STATE GROUP, 1970

State Group	Average Monthly Money Income (in Cruzeiros) 1-150 (1)	151-300 (2)	301-500 (3)	501+ (4)	(4)/(1) (5)
1. Amazonia[a/]	52.6	54.3	55.8	59.3	1.13
2. Maranhao-Piaui	47.0	50.2	53.3	57.7	1.23
3. Central Northeast[b/]	40.0	45.9	50.8	54.4	1.36
4. Bahia-Sergipe	45.1	48.8	51.8	55.3	1.23
5. Minas Gerais - Espiritu Santo	49.6	54.5	58.4	62.4	1.26
6. Rio de J. Guanabara	51.2	54.6	57.6	62.1	1.21
7. Sao Paulo	51.9	55.7	58.8	64.0	1.23
8. Parana	51.2	55.5	59.0	64.1	1.25
9. S. Catarina-R.G. Sul	54.6	59.3	62.6	67.1	1.23
10. Central-West[c/]	54.8	55.6	58.5	63.4	1.16
Brazil	46.0	53.7	57.6	62.2	1.35

Source: Carvalho and Wood (1977:126-127).

a/ Includes: Acre, Amazonas, Para, Amapa, Rondonia e Roraima.

b/ " : Ceara, Rio Grande do Norte, Paraiba, Pernambuco, Alagoas. Fernando de Noronha.

c/ " : Goias, Mato Grosso and Federal District.

same (lowest) income bracket. Additional data and further analysis would be required to rule out the possibility that the urban poor die younger than their rural counterparts because they are poorer, rather than due to other factors, peculiar to the urban environment. A second and related caveat is that the number of urban families falling in the lowest money income bracket is smaller than in the case of rural families (Appendix Table C.1). For the country as a whole, 30% of all families in this income class were urban. Note, however, that in the state of Sao Paulo, while this share is 46%, life expectancy of the urban poorest is 8% less than that of the rural poorest category. Also, in 7 out of the 10 sub-regions life expectancy among rural families in the Cr$ 1-150 category was higher than life expectancy among urban families in the Cr$ 151-300 (Appendix Table C.2).

58. Finally, in addition to the usual measurement error reasons for treating point estimates of socio-economic variables with caution, the numbers in this and other tables that follow -- relating historical mortality and, in the following section, reproductive behavior to current status with respect to categories such as income, rural/urban residence, education and labor force situation -- are subject to one further important caveat in the Brazilian context. Owing to considerable mobility of households and individuals across such categories in recent times, some of the vital events that are being synthesized by measures such as life expectancy and total fertility for a substantial proportion of women in certain categories took place while they were actually in a different category. In the case at hand, this methodological problem is surely most acute with respect to urban women in the middle and upper income classes. For the purpose of comparing differences in the mortality and fertility indexes across categories, however, it is fortunate that the inherent biases understate reported differences across categories. Thus, while the specific estimates may be subject to considerable error as indices of mortality and fertility for persons that have been in the reported categories throughout their lives, observed differences between categories are likely to be no less meaningful on account of the bias in question.

C. Socio-Economic Correlates of Fertility

59. Considerable differences in fertility across regions, going back to 1930/40 and persisting to the most recent inter-censal period 1960/70, have been noted in a previous section (see, in particular, Table 4). A subsequent section in this Annex and parts of Annex II examine statistical associations at the state level involving fertility for the purpose simulating alternative future trends. This section deals with relations between fertility and certain socio-economic factors at the individual or household level of observation. These factors are:

1. Income

60. As in most other countries, income and fertility are inversely related in Brazil (Table 15). For rural households, however, the relationship is not monotonic. The fertility index 1/ first increases from the lowest to the middle income class and then declines from the middle to the highest. Within all three income classes for which data is shown, 2/ fertility in rural areas is considerably higher than in urban areas.

61. These results conform to the prevailing pattern among other countries for which comparable data are available. The inverse relationship between income and fertility in urban areas is commonly attributed to the fact that income tends to be associated with certain other socio-economic characteristics of the household, and its members, that impinge on reproductive behavior. Education and labor market status of women, to be dealt with explicitly further on, are two such strong income correlates. Others are infant and child mortality experience of the household and a host of sociological norms, associated with the notion of so-called "modernity", which includes among its patterns, concentrating a great deal of household resources in providing each of a smaller number of children with better medical attention, food, clothing, education and the like. In the terminology of economists, this is referred to as trading off child "quantity" for higher child "qualities".

62. The bell-shaped relationship between income and fertility reported for rural areas also has well known rationales. One is that at very low levels of income couples cannot afford to have as many children as they would like. From these levels, small increments in income allow couples to have additional children. As incomes increase further, the factors underlying the basic negative relationship between income and desired family size mentioned above will tend to dominate. The second rationale is that unsanitary and generally precarious living conditions affecting the household result in substantially higher rates of pathological sub-fecundity through disease and malnutrition. With small increments from the lowest income levels, associated living conditions improve sufficiently to reduce the incidence of involuntary sub-fecundity without a fully compensating decline in desired family size. Consequently, actual fertility rises.

63. The higher fertility for rural women compared to urban women in Brazil are found in other countries. The usual explanation among economists for such difference is that desired family size is strongly affected by the costs and benefits that additional children create for their parents. Owing

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1/ The fertility index in question is defined in a footnote to Table 11a. While far from an optimal index, it is not unreasonable.

2/ The source of this table includes one additional "income class": that of households reporting no income -- which does not seem to be a meaningful category in this context.

Table 15: FERTILITY INDEX[/a] BY HOUSEHOLD INCOME CLASS AND URBAN-RURAL LOCATION: BRAZIL, 1970

Income Class[/b]	Total	Urban	Rural
Cr$ 1 - 251	5.3	5.1	5.7
251 - 1,000	5.0	4.6	6.8
Over 1,000	3.7	3.6	5.7

/a The cumulative number of live births to women in a particular category divided by the number of women 15 years and older in the same category who had at least one live birth.

/b In Cr$ of 1970.

Source: IBGE (1977b), p. 45, Table 19.

largely to the lower costs of feeding and clothing children, and to their greater potential contributions from an early age to the household economy (e.g., by tending animals, fetching wood and water and actually helping in agricultural work) in rural areas compared to the urban environment, the balance between costs and benefits from additional children tends to be attained at a higher number in rural areas. Also, as Ozorio de Almeida (1977) has argued using data for Northeast Brazil, landowners in that region -- and possibly elsewhere in the country -- seem to favor individuals with large families for entering into sharecropping agreements and in stipulating their conditions. This would be an added incentive for current and potential sharecroppers to have numerous children. Since sharecropping was widespread in Brazil during past decades, this could well be another contributing factor to the observed rural-urban fertility differences.

2. Education

64. Associations between the years of formal education attained by Brazilian women and their fertility is very marked (Table 16). The decline of fertility (as measured by index A, as above, and by a second and more conventional index B available for this variable) 1/ across six ascending years-of-schooling categories is sharp and monotonic for both urban and rural areas. For example, the value of index A for women without schooling is 2.4 times greater than those with 13 to 17 years of schooling in urban areas. The corresponding ratio in rural areas is 2.2. Corresponding ratios for the more conventional index B are even greater: 5.5 and 4.7 for urban and rural areas respectively. 2/

65. Indices of female educational attainment are consistently among the strongest correlates of fertility in other countries for which data are available. A great deal has been written in recent years on the theoretical and empirical nature of this education-fertility relationship. The main findings thus far indicate that the relationship operates via three key mechanisms. First, school attendance and pregnancies, particularly in more traditional cultural environments, tend to be incompatible. Thus, those who stay in school longer have delayed first births and usually never catch up in their fertility. Conversely, those who have an early first child drop out of school early and thus have a short educational experience. A first child at an early age correlates strongly with a long sequel. Second, schooling, particularly beyond the early primary level - seems to be an effective agent of "modernization" which, as mentioned before, includes small family norms.

1/ Index B is the number of live births to women in each category, divided by the number of women 15 years and older in each category.

2/ IBGE (1977b), p. 45, Table 19. The corresponding numbers for women in rural areas were 1.0 and 1.5 for indices A and B respectively, but the operational distinction between being in or out of the labor force in the case of rural women is notoriously unsatisfactory.

Table 16: FERTILITY INDICES BY WOMAN'S YEARS OF SCHOOLING AND URBAN-RURAL RESIDENCE: BRAZIL, 1970

Years of Schooling	Fertility Index A			Fertility Index B/a		
	Total	Urban	Rural	Total	Urban	Rural
None	6.1	6.0	6.1	4.3	4.4	4.2
1 - 3 yrs.	5.0	4.8	5.2	3.1	3.2	3.0
4 - 5 "	3.9	3.8	4.3	2.1	2.2	2.0
6 - 9 "	3.0	3.0	3.6	1.1	1.1	1.0
10 - 12 "	2.8	2.8	3.2	1.0	1.0	0.9
13 - 17 "	2.5	2.5	2.8	0.8	0.8	0.9

/a The number of live births to women in a particular category, divided by the number of women 15 years and older in the same category.

Source: IBGE (1977b), p. 45, Table 19.

Third, more schooling usually enchance women's opportunities and motivation to engage in "modern" labor market activities. Such activities tend to conflict in varying degrees with prolific reproduction. There is some empirical evidence for Brazil on this relationship between labor status and fertility.

3. Labor Market Status

66. For urban women classified as being out of the labor force in the 1970 census, fertility index A is 1.2 times greater than their (urban) counterparts in the labor force; this multiple is 2.1 in terms of index B. 1/ As already suggested, however, the type of work a woman does is much more interesting in terms of possible conflicts with child bearing and rearing (and hence, its effect on fertility behavior) than whether she works (for pay or profit) at all. Table 17 shows both fertility indices for 6 occupational categories.

67. For urban locations, fertility index A groups into three distinct orders of magnitude: at a value of nearly 6 for women working in agriculture; between 4.0 and 4.4 for those in other less traditional sectors, between 3.0 to 3.2 for those engaged in "modern", high skilled occupational functions. The pattern for index B is very similar, except that for urban women in commerce the index falls in the lowest order of magnitude. For rural locations, there is no such clear pattern consistently reflected by both indices. It would seem from this, that the sort of job held by a Brazilian woman is highly inter-active with her residential location in determining its effect on her reproductive behavior. Considering the typically greater opportunities for child rearing support for mothers with demanding modern jobs among the more extended family structure in rural areas, this is not surprising.

68. Finally among urban working women, fertility index A is about 1.5 times greater for those earning less than Cr$250 per month in 1970 than for those earnings more than that (Table 18).

69. For rural areas, using this same index, and for urban areas, using index B, differences across the three earnings group reported do not appear significant. For rural areas, index B increases appreciably from the lowest to the highest earning class. From the definitions of the two indices, this rather strange result implies that as earnings increase, the proportion of childless working women in rural areas falls very substantially. This occurrence would be consistent with a high incidence of pathological subfecundity at low-income levels mentioned above. However, considering the very tiny proportion of rural women in the upper earning classes, it is also quite possible that the result in question may be due to sampling or measurement error.

1/ Fertility indices A and B are defined in footnotes to Tables 15 and 16, respectively.

Table 17: FERTILITY INDICES BY WOMAN'S OCCUPATIONAL CATEGORIES AND URBAN-RURAL RESIDENCE: BRAZIL, 1970

Occupational Category	Fertility Index A[/e]			Fertility Index B[/e]		
	Total	Urban	Rural	Total	Urban	Rural
Employed in agriculture[/a]	5.7	5.9	5.7	3.0	3.6	2.8
Employed in manufacturing[/b]	4.4	4.1	5.9	1.9	1.7	2.8
Employed in personal services	4.4	4.4	5.0	1.5	1.5	1.5
Employed in commerce	4.1	4.0	5.3	1.2	1.2	1.9
Administrative occupations[/c]	3.4	3.2	5.8	1.2	1.1	3.7[/d]
Technical, artistic and akin[/c]	3.2	3.0	4.2	1.4	1.2	1.9

/a Includes animal husbandry and extractive industries.

/b Includes construction.

/c The previous four categories are sector specific; these ones are function specific.

/d This figure, taken directly from the source table, is suspect--either the absolute numbers underlying it are too small and the value shown therefore spurious, or there is an error involved.

/e Definitions of these two indeces (the same for Tables 15 to 18) appear in footnotes to Tables 15 and 16, respectively.

Source: IBGE (1977b), p. 45, Table 19.

Table 18: FERTILITY INDICES BY WOMAN'S LABOR EARNINGS AND URBAN-RURAL RESIDENCE: BRAZIL, 1970

Earnings Class	Fertility Index A			Fertility Index B		
	Total	Urban	Rural	Total	Urban	Rural
Cr$ 1 - 250	4.6	4.3	5.5	1.8	1.5	2.9
250 - 1,000	3.0	2.9	5.4	1.4	1.3	3.4
Over 1,000	2.9	2.9	5.3	1.4	1.4	3.9

Source: IBGE (1977b), p. 45, Table 26.

70. Having shown that both mortality and fertility are higher among the poor, the intriguing question remains of whether the rate of natural growth of this population group differs from that of the more affluent families. Unfortunately, no direct demographic estimate that would answer this question is available. Nevertheless, analysis of census data by Carvalho (1976) and Carvalho and Wood (1976) suggest that the differential in fertility across income groups is greater than in mortality. Though caution is required in mapping these measures (total fertility and life expectancy) into rates of natural increase, these results suggest that the natural increase of the low-income population has been greater. If this is the case, the rate of natural increase would be highest among the rural poor, who are estimated to have higher fertility and lower mortality than their urban counterparts.

IV. POPULATION POLICIES

71. Official Brazilian policy on population was, until 1974, implicitly pronatalist. The historical roots of Brazilian concern for having sufficient population to control her vast territory can be traced to colonial times (Merrick, 1976b). Since World War II, these sentiments have blended with the feeling that large size (in population, total output, and territory) would enhance Brazil's position as an emerging world power. Nationalistic suspicions of foreign interference in population control were heightened after 1967 amidst allegations that foreign missionaries were sterilizing poor people in Brazil (Rodrigues, 1968). While the hearings called in the Brazilian congress to investigate the matter were inconclusive, the entire topic of population remained one on which Brazilian authorities wanted outsiders to mind their own business.

72. While people in upper and middle income classes have been able to obtain contraceptives through the private sector, comparatively little has been done to make family planning available to all who might want it in Brazil. Starting in 1965, the Brazilian Family Planning Association (Sociedad Civil de Bem-Estar Familiar do Brasil -- BEMFAM), which was started by a group of Brazilian gynecologists and which got financial support from the International Planned Parenthood Federation (IPPF) and private foundations, opened clinics in several medical schools. By 1973, it had 86 clinics in operation and 130,000 new acceptors. Starting in 1973, BEMFAM began to replace its clinic network with community-based distribution programs that were organized under agreements with five state governments: Rio Grande do Norte, Paraiba, Pernambuco, Alogoas, and Parana. The number of new acceptors increased to 217,000 by 1976. Data to determine the total number of women covered by BEMFAM programs are not available. Under the most optimistic assumptions concerning continuation rates, however, it would not amount to more than a small share of the estimated 20,000,000 or so Brazilian women who are currently in the child-bearing ages and married.

73. The need to broaden access to family planning, at least insofar as cost may be a limitation, was recognized in statements by the Brazilian delegation to the 1974 World Population Conference at Bucharest and in the II Plano Nacional de Desenvolvimento (see Merrick, 1976b). These documents asserted that access to the means of family planning should not depend upon people's ability to pay for them. The first step toward implementation of this policy came in with the announcement that the 1978-1981 plan for maternal and child health would include family planning in instances where pregnancy would involve a high health risk (e.g., due to a woman's age, previous complications of pregnancy, particular health problems, etc.). The amount earmarked for this (US$3.3 million) represents more an opening of the door than a major new program effort. In all likelihood the major breakthrough, when it occurs, will be the extension of family planning services through the network of health service facilities operated by the social security systems (INPS, etc.). Mexico followed this route, and for Brazil the start-up costs would be minimal since a considerable infrastructure is

already in place. Though this would be a much larger step than the currently proposed high risk pregnancy program described below, it still would not guarantee full access to family planning. As Annex IV indicates the Brazilian health delivery system is still of difficult access to a large proportion of families, particularly in the rural Northeast.

74. In terms of broader population policy questions, especially with regard to the effects of overall population increase on economic growth, most Brazilian economists have been skeptical of macroeconomic arguments stressing the adverse effects of population increase and the broad-based age distribution resulting from high fertility on per capita income growth. They have discounted conventional arguments about the effects of age structure and dependency on investment and emphasized the role of the balance of payments, inflation, and domestic institutional crises on postwar swings in the Brazilian economy.

75. Preparations for Brazilian participation in the 1974 World Population Conference in Bucharest, which coincided with the drafting of the Second National Development Plan (II PND), provided an occasion for broader discussion of the population issue. Though there was never anything approaching public debate, discussions at the technical and interministerial level reflected a broadening range of opinion. Publication of the 1970 population census and the growing number of trained demographers and economists working on population-related topics within the government helped to wear down sentiment that mention of the subject of population automatically implied advocacy of birth control.

76. The policy articulated by Brazilians at Bucharest and in the II PND did not represent a change from the basic Brazilian position which denies that population growth is a serious threat to economic development. It did bring a change in stance, in that it moved from an implicitly pronatalist position to laissez faire on population growth. Moreover, the government recognized its responsibility in providing family planning services to individuals who wanted, of their own free choice, to plan their families but were too poor to buy contraceptives from private sources. While federal authorities have given tacit approval to a number of state-level family planning programs organized by BEMFAM, it took nearly three years to reach agreement on the program to prevent high risk pregnancies described above. This is a token effort in terms of providing family planning services; it is expected that the program will reach an additional 54,000 women, but is significant as a first step. Further steps will depend upon the views of the government which took office in March 1979. Given the delays that are likely to occur before further changes in Brazilian policy and implementation of such changes, it would appear to be a safe assumption that the path of the Brazilian birth rate in the coming decade is much more likely to reflect changing socio-economic conditions than any sort of direct public action. More will be said in the next section regarding the implications of this assumption for our population projections.

V. THE FUTURE OF BRAZILIAN POPULATION GROWTH

77. National level population projections prepared by the Brazilian Census Bureau (IBGE, 1974) soon after the publication of the 1970 census are the ones used most consistently by Brazilian authorities in planning matters that relate to population as well as for annual national and state level population estimates. The IBGE made two sets of projections using the component method, 1/ one with relatively slow fertility decline, which yielded a total population of 222 million in the year 2000, and another with faster decline that gave 201 million in 2000. Mortality assumptions did not differ in the two projections. With slight modifications, the IBGE settled on the lower fertility projection (referred to hereafter, simply, as the IBGE projections) as a base for making annual and state level population estimates. The latter follow a method which pro-rates future growth on the basis of each state's share in total growth in the recent past. While this technique yields a state by state distribution of future population increase, it does not incorporate in the projections interstate and interregional differentials in fertility, mortality, and migration patterns.

78. In presenting alternative population projections in this report, it is important to emphasize from the outset that such projections are not forecasts. Projections are regarded here as demographic simulation exercises that indicate what the size and structure of population would be at the end of a specified period if a particular set of assumptions regarding birth, death, and migration rates were to hold for that period. Various approaches can be taken to the determination of these assumptions, depending on the purpose of the projections being made. In this case, there are three major objectives:

- The first is to derive certain additional implications from the demographic assumptions underlying the IBGE projections; the "Baseline" projections serve this purpose.

- The second is to explore the likely demographic impact of alternative trajectories in the coverage of certain social services -- such as basic education and water supply -- which are important determinants of fertility and mortality. These alternative coverage trajectories correspond to the mission's best guesses of plausible boundaries to the corresponding rates of progress that will take place. They have been arrived at after careful consideration of past and current trends, alternative assumptions on future economic growth, the priority accorded by future governments to progress in these areas and likely logistical and managerial bottlenecks. 2/ Projections "A" and "B" address this objective.

1/ This methodology is explained briefly in Appendix A.

2/ Rationale for the schedules utilized is contained in Annexes III (for literacy) and V (for water supply).

- A third objective arises from analysis of results derived in pursuit of the first objective. The assumptions underlying the IBGE projections were found to produce a rate of population growth in the Northeast that seem to be at or beyond the upper bounds of reasonable likelihod. Thus alternative projections were prepared assuming faster migration out of the Northeast and hence, slower population growth in this region. This set of projections is labeled "A-Mig". This projection also differs from the others in that it is based in neither historical trends nor statistically derived relationships.

The procedure underlying the projections is described in Appendix A. Briefly, it involves making separate projections for each of the three regions (Northeast, Southeast and Frontier) by the component method: that is, using different age- and sex-specific fertility, mortality and migration assumptions for each of the regional projections. Four projections were done for each of the three regions. These projections are labeled: Baseline A, B and A-Mig. For any given region, the first three projections differ only with respect to fertility and mortality assumptions. Total migration is set at a specified level in each projection period, and then distributed by age and sex according to a predetermined schedule. Since the migration routine measures net flows, it does not capture migration patterns such as flows from the Southeast to the Frontier which are partially offset by flows from the Northeast to the Southeast.

79. The Baseline projections incorporate assumptions that approximate the IBGE projections, but with separate regional projections rather than a single national projection that is then pro-rated by region. Projections A and B present alternative fertility and mortality assumptions incorporating the changes outlined in the second objective stated above. Projection A-Mig uses the same fertility and mortality assumptions of Projection A, together with a migration schedule that results in substantially higher flows of people out of the Northeast. The Baseline projections also provide a basis for more explicit comparison between alternatives A and B, on one hand, and the IBGE assumptions. The next section compares the IBGE and Baseline assumptions and results.

A. Assumptions Underlying Baseline and IBGE Projections

1. Migration and Rural-Urban Population Distribution

80. In the Baseline projections, the volume of interregional migration is set at the level required to equate the baseline and IBGE population totals for each region in 1980, 1990, and 2000. (These levels are also maintained in alternative projections A and B.) Migrants are then distributed among age and sex categories using the proportions shown in Table 19. These profiles reflect both the patterns which emerge from the 1950-70 estimates reported in the first chapter of this annex and more general patterns of age and sex selectivity of migration flows. For example, the proportion of males is higher in all of the flows, but highest in migration

Table 19: DISTRIBUTION OF MIGRANTS BY AGE AND SEX IN PROJECTIONS, 1970-2000

Ages	Northeast		Southeast		Frontier	
	Male	Female	Male	Female	Male	Female
0 - 9	3.0	3.3	5.7	8.9	8.6	10.0
10 - 14	1.0	1.1	5.9	6.6	4.3	5.0
15 - 19	22.8	21.1	23.5	33.3	21.7	20.0
20 - 24	46.6	45.1	35.3	29.8	30.4	30.0
25 - 29	22.8	25.2	20.0	16.7	17.4	15.0
30 - 34	2.6	3.0	9.4	3.7	8.7	10.0
35 and over	1.2	1.2	1.2	1.0	8.6	10.0
Total a)	100.0	100.0	100.0	100.0	100.0	100.0
b) *	52.5	47.5	52.2	47.8	53.5	46.5

Note: * Total (b) indicates percentage distribution of males and females.

to the Frontier, where selectivity of males has been greater. Similarly, the age pattern of migration to the Frontier incorporates a slightly higher average age of migration to reflect the greater proportion of migration of family units, whereas the lower average age for Southeastern females indicates a higher proportion of individual (single) migrants. This procedure is a compromise between the unacceptable alternative of completely ignoring interregional migration and extensive research which is beyond the scope of this project. Clearly, more detailed treatment of migration would be a desirable follow-up on this initial step. The Baseline projections also adopt the rural-urban population distribution found in the IBGE projections; alternative projections A, A-Mig, and B assume faster rates of urbanization.

2. Fertility and Mortality

81. Fertility and mortality assumptions in the Baseline and IBGE projections are summarized in Table 20. Total fertility rates and sex-specific expectation of life at birth for each of the regions in the six quinquennial periods between 1970 and 2000 are shown in columns (1) to (3); averages of these regional assumptions for Brazil, and the corresponding levels of fertility and mortality in the IBGE projections appear in columns (4) and (5).

82. Concerning fertility, the starting point for each region is the total fertility schedule derived by Carvalho from census data, reported in the previous section. In selecting paths for regional fertility rates between 1970 and 2000, simple continuation of national trends is not a plausible assumption. Disaggregation of the incipient national level fertility decline showed that almost all of the decline between 1950 and 1970 occurred in the Southeast, while total fertility remained virtually constant (or perhaps increased slightly) in the Northeast and Frontier. If the Baseline projections are to approximate the IBGE results it is necessary to assume that the fertility decline will spread to other regions in coming decades. It is assumed that fertility decline in the Northeast and Frontier will lag behind that of the Southeast by about 30 years, and will come close in the period 1995-2000 to the level of total fertility (4.8) that was experienced by the Southeast in 1965-70. For the Southeast, it was assumed that the fertility decline will proceed at about 10 percent per decade. These assumptions lead to an approximation of the rate of decline for the country as a whole implied in this projection.

83. While these regional assumptions imply a decline in fertility at the national level between 1970-75 and 1995-2000 which is almost the same, roughly 30 percent, as in the IBGE projections, the level of the two trends differ because our initial total fertility estimates, based on Carvalho's work, are higher than those adopted by IBGE.

Table 20: FERTILITY AND MORTALITY ASSUMPTIONS UNDERLYING BASELINE REGIONAL POPULATION PROJECTIONS

	Northeast	Southeast	Frontier	Brazil Baseline	Brazil IBGE /a
	(1)	(2)	(3)	(4)	(5)
1. Total Fertility (in births per woman)					
1970-75	7.13	4.38	6.90	5.44	5.07
1975-80	6.66	4.17	6.48	5.14	4.78
1980-85	6.20	3.95	4.82	4.82	4.49
1985-90	5.73	3.73	5.64	4.51	4.20
1990-95	5.26	3.52	5.22	4.20	3.91
1995-2000	4.80	3.30	4.80	3.89	3.62
2. Expectation of Life at Birth (in years)					
a) Males					
1970-75	49.4	60.7	54.7	56.7	58.8
1975-80	51.2	62.5	55.9	58.4	61.3
1980-85	53.0	64.4	57.1	60.3	63.7
1985-90	55.0	66.3	58.4	62.2	66.2
1990-95	57.1	68.4	59.7	64.2	68.6
1995-2000	59.3	70.6	61.1	66.5	71.0
a) Females					
1970-75	52.8	67.9	58.8	62.5	63.1
1975-80	54.7	69.3	60.0	64.0	65.5
1980-85	56.8	70.6	61.3	65.7	67.8
1985-90	58.7	72.1	62.6	67.2	70.1
1990-95	61.2	73.6	64.0	69.0	72.5
1995-2000	63.6	75.2	65.3	70.8	74.9

/a Source: Fundacao IBGE, 1974.

84. For mortality, Carvalho's regional 1960-1970 estimates of life expectancy are the starting point for 1970-75 estimates and assumptions thereafter. Again, his estimate implies higher mortality (and lower life expectancy) than in the IBGE projections. In the latter average life expectancy (for both sexes) increases from 61 years in 1970-75 to 73 years in 1995-2000, roughly a 20 percent improvement over the three decades.

85. While this rule of thumb was probably warranted during past periods when consistent gains in life expectancy were being achieved through relatively easy and effective public health measures controlling infectious, respiratory and parasitic diseases, there are good reasons for doubting the life expectancy will continue growing at the same pace in future years when additional gains are more likely to be determined by improvements in living conditions. Thus, improvements may occur more slowly. There is good evidence that the pace of mortality decline has already slowed in Brazil. Even if a very cautious attitude is taken towards reported increases in infant mortality in larger cities during the early 1970s, it is hardly likely that the kind of improvements in life expectancy implied in the United Nations procedure described in the previous paragraphs have been occurring in Brazil at the same time.

86. It is telling to examine the infant mortality rates implied in the life expectancy improvements of the IBGE projections. The United Nations model life table corresponding to a life expectancy of 73 has an infant mortality rate of 24 per thousand live births. While it is conceivable that such a level might be obtainable in the Southeast by the year 2000, the likelihood of such an improvement taking place in the Northeast is much less.

87. Because of this, the mortality decline assumed in the regional projections is more conservative. Instead of having the entire Brazilian population reach an average life expectancy of 73 years in 1995-2000, this level is assumed only for the Southeast. Again, it is assumed that the Northeast and Frontier will lag behind by about three decades. Their schedules start at a lower level in 1970 than the IBGE projections reflecting the differences reported in the previous section, and are made to approximate the 1970 Southeastern pattern by 1995-2000. This results in somewhat smaller improvements in the Frontier than the Northeast, which seems reasonable since future migration from the latter to the former is likely to have a dampening effect on increases in life expectancy in the Frontier. Combining the regional assumptions in an average for Brazil yields about a five-year difference between the Baseline's life expectancy and that of the IBGE by the end of the projection period.

88. Table 13 translates these total fertility and life expectancy measures into crude birth and death rates and combines them with the migration assumptions outlined earlier. After initial experimentation we found that the IBGE projections of population growth gave a total population for the Frontier region that was too low to be consistent with its high rate of natural increase and migration at all commensurate with that experienced in recent decades. The population of the Northeast appeared to be too high (and

migration too low) for the same reason, so we increased the net flow of migrants from the Northeast to the Frontier until we achieved the rates shown in Table 21, which are lower than what we reported for 1960-70 in Table 6, but larger than what is implied in the IBGE state-level estimates.

B. Summary of Results

89. Tables 22-24 summarize the baseline projection results for Brazil and each of the regions. The IBGE results for total population are shown for comparison.

90. Table 22 shows total population in 1980, 1990, and 2000. Comparing the totals for 2000, the Baseline projections are shown to replicate the IBGE results quite closely. Both arrive at a total population of just over 200 million at the end of this century. The small differences in regional totals result from assuming somewhat larger immigration to the Frontier region in the Baseline than implicitly assumed in the IBGE projection. The difference in assumptions about fertility and mortality described above tend to cancel each other out, so that our projection with higher rates of fertility and mortality than IBGE's produce about the same rate of natural increase as in the latter projections.

91. The urban population projections shown in Table 23, take the urban population shares found in the IBGE projections. The overall urban share in 2000 is 70.5 percent, with values ranging from 56 percent in the Northeast to 79 percent in the Southeast. To the extent that total regional populations differ between the two projections, urban population totals vary accordingly.

92. Age profiles by sex and region for 1980 and 2000 are given in Table 24, Part A. The IBGE projections do not provide regionalized age-sex profiles. Part B of Table 24 compares the age-sex profile of the total population in 2000 in the baseline projections to those of the IBGE. The assumptions of falling fertility (and mortality) lead to a decline in the proportion of the population in ages 0-14 and corresponding increases in the proportions in other categories, especially the younger working age group in ages 15-39. Since the Northeast and Frontier start out with relatively high proportions in ages 0-14 in 1970 (45-46 percent) they still show comparatively high proportions (above 40 percent) in the year 2000. The 0-14 share increases slightly in both between 1970 and 1980 (compare Tables 8 and 23) because of the adjustment for underenumeration of ages 0-14 in the 1970-75 step in the projections.

93. In comparing the profile of total population in the Baseline projection to the IBGE results we observe a higher proportion in ages 0-14 in the former. The IBGE profile comes closest to the regional profile for the Southeast in the Baseline projections, which is to be expected since the IBGE projections incorporate assumptions about fertility and mortality which have been assumed to apply only to the Southeast in the Baseline projections. Higher levels of both components are assumed for the Northeast and Frontier in the regionalized projections.

Table 21: BIRTH, DEATH, MIGRATION, NATURAL AND TOTAL INCREASE RATES IMPLIED IN ASSUMPTIONS FOR BASELINE PROJECTION
(per 1000 of average population for decade)

	Northeast	Southeast	Frontier	Brazil
1970-1980				
Birth Rate	44.4	32.6	46.7	37.6
Death Rate	14.8	7.6	11.1	10.1
Natural Increase	29.6	25.0	35.6	27.5
Net Migration	-6.2	3.7	5.1	-
Total Increase	23.4	28.7	40.7	27.5
1980-1990				
Birth Rate	39.2	30.7	41.9	34.3
Death Rate	11.8	6.6	9.4	8.4
Natural Increase	27.4	24.0	32.5	25.9
Net Migration	-5.0	1.7	2.8	-
Total Increase	22.4	25.7	35.0	25.9
1990-2000				
Birth Rate	36.1	26.6	36.5	30.4
Death Rate	9.5	5.7	7.9	7.0
Natural Increase	26.6	20.8	28.6	23.4
Net Migration	-4.0	1.4	1.7	-
Total Increase	22.6	22.2	30.3	23.4

Table 22: IBGE AND BASELINE PROJECTIONS OF TOTAL POPULATION BY REGION, 1970-2000 (in millions)

	1980		1990		2000	
	IBGE	Baseline	IBGE	Baseline	IBGE	Baseline
Northeast	36.5	36.0	46.1	45.1	57.3	56.5
Southeast	74.7	75.2	96.2	97.3	121.4	121.5
Frontier	12.9	13.1	17.8	18.6	23.5	25.1
Brazil	124.1	124.3	160.0	160.9	202.3	203.2

Table 23: IBGE AND BASELINE PROJECTIONS OF URBAN POPULATION AND URBAN SHARES BY REGION, 1970-2000
(population in millions)

	1970		1980			1990			2000		
	Census	% a/	IBGE	Baseline	% a/	IBGE	Baseline	% a/	IBGE	Baseline	% a/
Northeast	11.8	41.8	17.4	17.0	47.6	24.0	23.2	52.2	32.1	31.2	56.0
Southeast	36.3	64.4	54.9	55.0	73.5	73.3	74.8	76.3	96.3	95.8	79.3
Frontier	4.1	46.8	6.8	6.9	52.8	10.1	10.5	56.8	14.1	14.5	60.0
Brazil	52.1	55.9	77.1	78.8	62.1	108.5	109.3	67.8	142.6	141.5	70.5

a/ Urban population percentage share of total population projected by IBGE (Table 21). Corresponding shares for the Baseline projection are, by design, very similar.

Table 24: AGE-SEX PROFILE OF BASELINE POPULATION PROJECTION BY REGION, 1980 AND 2000
(percentage of total population in each year)

A. Regional	1980			2000		
	Male	Female	Total	Male	Female	Total
Northeast						
0-14	24.0	22.9	46.9	21.1	20.2	41.3
15-39	17.1	18.6	35.7	21.2	20.7	41.9
40-64	6.7	7.6	14.3	6.0	7.4	13.4
65+	1.4	1.7	3.1	1.4	2.0	3.4
Total	49.2	50.8	100.0	49.7	50.3	100.0
Southeast						
0-14	19.0	18.5	37.5	17.1	16.5	33.6
15-39	20.7	20.8	41.5	20.4	20.1	40.5
40-64	8.6	8.7	17.3	10.3	10.7	21.0
65+	1.7	2.0	4.7	2.2	2.7	4.9
Total	50.0	50.0	100.0	50.0	50.0	100.0
Frontier						
0-14	23.5	22.4	45.9	20.8	19.8	40.6
15-39	19.7	19.3	39.0	21.0	20.1	41.1
40-64	6.7	6.3	13.0	7.8	8.0	15.8
65+	1.0	1.1	2.1	1.2	1.3	2.5
Total	50.9	49.1	100.0	50.8	49.2	100.0

B. Comparison of Total in 2000	Baseline			IBGE		
	Male	Female	Total	Male	Female	Total
0-14	18.7	17.9	36.6	18.0	17.4	35.4
15-39	20.7	20.2	40.9	20.6	20.3	40.9
40-64	8.8	9.4	18.2	9.3	9.8	19.1
65+	2.0	2.3	4.3	2.1	2.5	4.6
Total	50.2	49.8	100.0	50.0	50.0	100.0

C. Alternative Projections "A" and "B"

94. The purpose of alternative projections "A" and "B" is to derive the effects on population growth and composition of a broader range of assumptions regarding fertility, mortality, and migration than those reflected in both the IBGE and Baseline projections. Two specific issues are addressed:

(i) In the 1970s, the Brazilian government has undertaken major programs to extend the coverage of certain basic services among the population at an accelerated rate. Literacy instruction and water supply are notable among such services. These programs, and the plausible boundaries of the resulting evolution in corresponding coverage indices, are described in Annexes III and IV of this report. It is still too early to judge the full effects of such accelerated coverage rates on mortality and fertility, but the interrelations between these variables is known to be strong. Because of this, the underlying Baseline assumptions of continuation of past trends may be overly pessimistic. Alternatives "A" and "B" carry assumptions based on statistically derived estimates of the potential impact of possible changes in variables which influence fertility and mortality.1/ The alternatives differ in the extent to which they assume that program goals are achieved, with "A" representing a more pessimistic view and "B" reflecting what seems a plausible, albeit optimistic, upper boundary of what could be achieved in terms of such indicators under very favorable circumstances.

(ii) Baseline projections adopted the IBGE projections' distributions of rural and urban population. Implicit in the IBGE assumption is an increase in the rate of rural population growth toward the end of the projection period. In view of the fact that rural population increase slowed substantially in the 1960s (and hardly grew at all in the Southeast) such an increase is not very likely. Alternatives "A" and "B" incorporate assumption which result in slower rates of rural population increase.

1/ Another part of this report (Annex II: 'Employment, Earnings and the Distribution of Income') also deals with statistical relations involving fertility and mortality. In the case of Annex II, the main purpose of the exercise is to explore empirical associations between the demographic variables and the mean income of the population of Brazilian states, together with the income share of the poorer members of the labor force. The two sets of regressions (the one in Annex II and the set reported in this Annex) serve different purposes, and neither of these purposes is to describe or otherwise investigate the nature of causal relations that may underlie such empirical associations.

1. Migration Assumptions

95. The Baseline assumptions concerning interregional migration are maintained in projections A and B. Consequently, the resulting regional population shares in these projections are very close to those of the Baseline and those of the IBGE projections.

96. Within each region, rural-urban shares in projections A and B were derived using a logistic-curve model. If urban shares at two points in time are known, this procedure requires only one assumption 1/ to generate urban shares at any other date. This assumption is the maximum urban share that will ultimately be reached. For these projections, urban shares for each region in the years 1950 and 1970, were taken from census data (these are reported, together with the projections in Table 22). The ultimate maximum urban share was set at 95% for all regions.

2. Mortality

97. Although life expectancy reflects survival experience at all ages, infant and child mortality are its decisive components in populations at Brazil's stage of demographic development. Thus, in exploring what the range of trajectories of Brazil's future population growth might be, it is of interest to examine the factors that may affect the future course of infant mortality to be incorporated in these alternative projections.

98. A recent study based on special survey data in 12 Latin American cities documents the close relationship between child mortality, certain socio-economic variables and demographic characteristics of the household in those locations (Puffer and Serrano, 1975). Nutrition, water supply, the practice of breast feeding, and educational attainment of mothers were shown to have a strong influence on mortality. Among more specifically demographic characteristics, maternal age, birth order, and birth weight (itself closely related to nutrition) were also important correlates.

99. The analysis of the relation between a number of these variables and infant mortality for 21 state-level observations around 1970 in Brazil, also reveal strong statistical associations.

100. In spite of limitations imposed by data availability 2/ and the expectedly high inter-correlation among those independent variables for which data was available, some simple yet seemingly robust regression estimates for infant mortality were obtained.

1/ In addition, of course to the basic assumption that urbanization proceeds according to a logistic or S-shaped pattern. In other words, in early stages of urbanization, the urban share grows at an accelerating pace; as the process matures, an inflexion point is reached and thereafter the urban share rises asymptotically to an upper bound.

2/ e.g., no congruent observations could be had for such presumably important factors as nutrition, breast feeding, birth weight and birth order.

101. Table 25 presents simple correlations between fertility, infant mortality, life expectancy and certain social and economic indicators. The latter include income per capita, female literacy, urban share, residences with piped water, with sanitation 1/ and the proportion of all births accounted for by women over 40 years of age. Two of these variables deserve brief comment. The standard operational definition of literacy used in national statistical sources (including the Brazilian census) has long been subject to serious reservations by educational experts. Essentially, their main problem with this definition (an affirmative answer to the question of whether the person knows how to read and write) is that it fails to distinguish between those who are "functionally literate" and those who are not. This is doubtlessly true. Yet, it also may be true that women whose educational experience leads them to claim that they know how to read and write will, on the average, care better for their babies than the rest -- whether they are "functionally literate" or otherwise. Also, they may well desire fewer children, control their fertility better, or both.

102. Infant mortality is generally higher for births to very young (15-19) and older (over 40) women. Variation in the proportion of births occurring in the 15-19 age category across Brazilian states is rather small. The range is wider in the case of births to women over 40, with 5.7 percent of births occurring at these ages in Sao Paulo versus 9.6 percent in Paraiba. Even Sao Paulo is high by European standards, where this proportion averages 3.5 to 4 percent.

103. Results of various regression experiments of infant mortality (INFMRT) on female literacy (FMLIT), safe water (SFWTR) and births to women over age 40 (OVRAGE) are reported in Appendix B. Because of the high correlation between FMLIT and SFWTR, their separate effect on INFMRT are statistically blurred. The following equation showing their combined effect, through a variable defined as a composite of the two (LITWTR), will be used for hypothetical projections A and B. 2/

(1) $INFMRT^* = 2.75 - .255\ LITWTR^* + .66\ OVRAGE^*$

$R^2 = .71$ (.05) (.32)

1/ For more detailed discussion of the last two variables, see Annex V.

2/ $LITWTR_t = (FMLIT_{t-10} \cdot SFWTR)_t$. The choice of variables and specifications for this, and the fertility regression equations ultimately used for the demographic simulations was guided by multiple criteria. In rough order of importance, preference was given to: (i) policy relevant independent variables (income per head was disqualified on these grounds), (ii) variables dealt with elsewhere in the report, (iii) high $\bar{R}^2$ s and high t-ratios. Conformity of the specification to rigorously described a priori notions on how mortality and fertility may be causally determined was not one of these criteria.

Table 25: CORRELATIONS AMONG VARIABLES USED IN REGRESSIONS OF STATE-LEVEL FERTILITY AND MORTALITY

			X1	X2	X3	X4	X5	X6	X7	X8	X9
INFMRT	X1:	Infant Mortality	1.0								
LFX	X2:	Life Expectancy	-.99	1.0							
TFRT	X3:	Total Fertility	.69	-.71	1.0						
INCAP	X4:	Income per capita	-.57	.58	-.90	1.0					
FMLIT	X5:	Female Literacy	-.77	.79	-.85	.85	1.0				
PCTURB	X6:	Percent Urban	-.32	.33	-.79	.88	.73	1.0			
SFWTR	X7:	Percentage of Residences with Safe Water a/	-.75	.77	-.92	.90	.96	.78	1.0		
SEWR	X8:	Percentage of Residence with Sewers a/	-.54	.55	-.90	.96	.94	.94	.91	1.0	
OVRAGE	X9:	Births to Women over 40	.61	-.60	.58	-.46	-.37	-.23	-.47	-.37	1.0
	Means (Unweighted)		107.5	53.0	6.68	120	52.7	49.0	33.5	19.9	7.5

a/ These variables are defined and discussed in greater detail in Annex V.

Source: IBGE (1971).

104. The asterisks indicate that logarithms of the variables are used. Standard errors of the regression coefficients are shown in parentheses. This equation will serve to estimate infant mortality rates under different assumptions relating to the three independent variables.

105. Typical values for the Northeast in the 1960s:

($FMLIT_{-10}$ = .33, SFWTR = .15, OVRAGE = 8.5) yield an estimated infant mortality rate of 138 for that period, which is approximately what is reported in Table 3.

106. Table 26 presents a range of values for the infant mortality rate derived from using various combinations of female literacy, safe water and births to women over 40 in this regression equation. Because of the high correlation between literacy and safe water, their effect on the infant mortality levels as derived from this equation should be interpreted more as the outcome of a "package" containing roughly "comensurate" 1/ magnitudes of each. For this reason, Table 26 does not report infant mortality rates resulting widely disparate levels of literacy and safe water (e.g. 100 percent on one scale and 15 percent on the other). The "limit" value implied by the regression (FMLIT = SFWTR = 1; OVRAGE = 3.5) is an infant mortality rate of 36 per thousand live births, which is somewhat higher than the 10-20 per thousand current range of infant mortality in industrialized countries, and hence an optimistic but not implausible end point for Brazilian trends in the next two or three decades under favorable conditions for rapid socio-economic progress.

107. Clearly, caution is required in projecting infant mortality rates on the basis of values of these three independent variables which fall outside the range of values on which the regression coefficients were estimated.

108. Since important changes in policies affecting all three (right-hand side) variables have taken place in the 1970s, projections based on initial conditions in the late 1960s and prospects for future progress (such as in the case of the Baseline projections) may be in error regarding the magnitude as well as the path of declines in mortality. To the extent that these improvements have been effective, the baseline mortality assumptions may be too pessimistic. Other sections of the report describe gains made in the areas of education, water, and sanitation, and we have already noted the initiation of Brazil's program to reduce high risk pregnancies.

109. One way to account for these recent developments is to introduce an additional set of mortality assumptions in the projections at the

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1/ Where the standard of "commensurability" may be taken as their linear statistical relationship.

Table 26: INFANT MORTALITY RATES ASSOCIATED WITH VARYING LEVELS OF FEMALE LITERACY, HOUSES WITH SAFE WATER, AND BIRTHS TO WOMEN OVER AGE 40

Percent with Piped Water	Percent Literate				
	40	55	70	85	100
	A. Nine Percent of Births over 40:				
15	137	123	115	--	--
35	110	99	92	87	--
55	--	88	82	78	83
75	--	--	76	--	74
	B. Four Percent of Births over 40:				
55	--	52	48	45	43
75	--	--	44	42	40
95	--	--	42	40	38
100	--	--	--	39	37

Source: Regression equation (1), as explained in text.

1975-80 step. This serves a double purpose. A 1975-80 benchmark makes the projections more sensitive to improvements in conditions affecting mortality in the 1970s. At the same time it reduces their sensititivity to 2000, which run much beyond the ranges of values used to estimate the regression coefficients. Moreover, the 1970-2000 trend is on surer footing because the 1975-1980 values exercise a stronger influence on the magnitude and timing of mortality patterns in the projection interval than would be the case if only 1995-2000 targets were used.

110. Table 27 presents alternative regression estimates of infant mortality using projects of female literacy and households with safe water derived in other sections of the report. The panel for 1975-80 presents ranges of estimates of the effects of policies in the 1970s, while the panel for 1995-2000 projects the outcome of alternative plausible boundaries on likely future projections of conditions affecting mortality. Two variants are provided: the first (A) represents the more pessimistic boundaries, while the second (B) represents the more optimistic boundaries for the evolution of these two indices corresponding to a combination of brisk economic growth and the successful pursuit of a strategy emphasizing rapid human resource development and basic needs satisfaction. 1/ More detailed discussion of the policies underlying these assumptions can be found in other volumes of the report. The selection of levels for variable OVERAGE (births to women over 40) is somewhat more arbitrary since no historical series on this variable can be obtained on which to base expectation of future changes. The optimistic case (B) is assumed to produce a value of 4% in all regions by 1995-2000. This level is comparable to current European levels. The pessimistic case (A) assumes an improvement of 2 percentage points in the Northeast (where the potential for gain is greatest) and 1 point each for the other two regions.

111. Also shown in Table 26 are levels of life expectancy associated these statistically derived infant mortality schedules. A set of Brazilian model life tables prepared by the IBGE (Frias and Leite, 1975) were issued to

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1/ Notions of plausibility boundaries concerning the future evolution of these variables are subjective to a considerable extent. Consequently, difference of opinion on whether the regressor values used here may be too extreme are to be expected. In the specific cases of the optimistic schedule (B) for female literacy and households with safe water (in Table 27), the mission itself considers them overly optimistic. Yet, such extreme values serve a purpose. This table shows that even if these overly optimistic values were to be achieved, according to the derived relationship: (i) life expectancy would still be below the IBGE assumptions for the corresponding period and (ii) infant mortality, at 39, would still be way above current levels in OECD countries (around 16 per thousand).

Table 27: COMPUTED LEVELS OF INFANT MORTALITY AND LIFE EXPECTANCY FROM CURRENT ESTIMATES AND PROJECTED REGRESSOR VALUES, 1975-1980 AND 1995-2000

Period/ Region	Female Literacy a/		Safe Water		Births Over 40		Infant Mortality			Life Expectancy a/		
	A	B	A	B	A	B	A	B	Baseline	A	B	Baseline
	(in percent)				(per 1000 births)					(in years)		
1975-1980												
Northeast	40	40	30	53	9	7	115	84	125	54.6	62.2	52.9
Southeast	69	69	61	71	6	5	64	54	63	66.8	69.6	65.8
Frontier	54	54	36	68	7	7	86	76	99	61.9	64.1	58.7
1995-2000												
Northeast	60	100	44	100	7	4	79	39	93	63.4	72.7	61.4
Southeast	93	100	72	100	5	4	50	39	43	71.5	72.7	72.8
Frontier	80	100	48	100	6	4	65	39	85	66.6	72.7	62.3

a/ Lagged by 10 years.

b/ Average of male and female.

determine life expectancy and survival ratios corresponding to the various levels of derived infant mortality rates. 1/

112. Comparing the statistically derived infant mortality schedules and associated life expectancies with the corresponding values in the Baseline projection, Table 26 shows that:

- for the Northeast and Frontier, the Baseline turns out to be the most pessimistic projection by a wide margin -- and widest in the case of the Northeast, that is, even more pessimistic than the "pessimistic" case A.

- for the Southeast, on the other hand, the Baseline is by far the most optimistic of the three concerning infant mortality and very close to the other two with respect to life expectancy.

113. This seemingly odd result is due partly to the effect of introducing in projections A and B the mission's boundary assessments of the ostensibly rapid progress that is currently being made in improving conditions affecting mortality. The Baseline projections, on the other hand, reflect a more pessimistic view of mortality conditions, especially for the Northeast, and thus, implicitly assume that conditions in 1995-2000 will continue to lag severely behind those in the Southeast. The question boils down to how effective current efforts will be in bridging the existing gap between these regions, and it is useful to have both the Baseline and these additional alternative mortality assumptions at hand as an indication of the possible range of their outcomes.

3. Fertility

114. Regressions were also used to derive alternative fertility schedules. Aside from the new program to avoid high risk pregnancies (which is aimed primarily at mortality reduction rather than fertility control), Brazil does not currently have any programs with the direct purpose of reducing birth rates on a large scale. Given the high zero order correlation between total fertility (TFRT) and infant mortality (INFMRT) of 0.69, as well as the strong and positive correlations between literacy, safe water, and fertility, it is likely that programs leading to improved living conditions

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1/ These model life tables have the advantage of reflecting more closely the relation between patterns of mortality in early childhood and mortality throughout the remaining ages in Brazil than the standard model life tables, such as the U.N. series used in the IBGE projections discussed earlier. As Frias and Leite point out, the latter are based heavily on European experience (for which vital data were available) and tend to yield levels of adult mortality that are too low for a given level of childhood mortality, thereby biasing life expectancy upward.

would also affect fertility. 1/ To incorporate these effects, infant mortality was included in the fertility regression along with the percent of population residing in urban areas (PCTURB), another close correlate of total fertility. Analysis of the residuals of the regression of TFRT on INFMRT and PCTURB revealed a consistent underestimation of fertility in the Frontier region. Analysis of interregional fertility differences in Brazil (Merrick, 1974) has shown that earlier marriage and land availability in the Frontier lead to higher rural fertility than is found in other areas. A dummy variable (DMY) for Frontier states is included in regression equation (2):

$$(2)\quad TFRT = 6.31 + .0225\ INFMRT - .0458\ PCTURB + 1.05\ DMY$$

$$\bar{R}^2 = .89 \quad (.003) \qquad (.007) \qquad (.29)$$

A logarithmic form of equation was also tested, but performed less well than the linear form. Regression equation (2) was used to calculate the total fertility estimates shown in Table 28. The infant mortality rate was taken from Table 26 and the urban population shares are those derived on the bases of the logistic model described above. As with mortality, estimates are shown for 1975-80 and 1995-2000.

115. Inclusion of the indirect effects (via infant mortality) of improvements in female literacy and provision of safe water on fertility alters somewhat the pace and magnitude of the trend in total fertility in alternatives A and B when compared to the Baseline projections, which assumes a linear decline from 1970 to 2000. In the Northeast, total fertility under A and B assumptions bracket the baseline assumption of 4.80 in 1995-2000, but in both there is an earlier onset in the decline due to improved mortality conditions in the 1970s. A similar pattern holds in the Southeast. However, the possibility of bias resulting from derivation of the regression-based schedules beyond the range of values on which the parameters are based is most serious in the case of the Southeast. Thus, more caution is required in assessing these differences. Because of increased urbanization built into alternatives A and B, Frontier fertility rates are lower than in the Baseline. The differences between A, B and the Baseline fertility schedules are also afflicted by the Frontier dummy factor in the derivation of fertility rates for 1975-80. It has the effect of raising total fertility by one per thousand. Since Frontier migration appears to be continuing at a steady pace in the 1970s, application of the dummy appears justified for this period. Its effect is to delay Frontier fertility decline for a decade.

1/ Excellent recent reviews of the theoretical grounds and empirical results for other countries dealing with the relationship of these and similar variables with fertility, are Birdsall (1977), Cassen (1976) and Cochrane (1978).

Table 28: FERTILITY REGRESSOR LEVELS AND CORRESPONDING PROJECTIONS OF TOTAL FERTILITY FOR 1975-1980 AND 1995-2000

Region	Urban Share	Infant Mortality		Total Fertility		
		A	B	A	B	Baseline
	(per cent)	(per thousand)		(per woman)		
A. 1975-80						
Northeast	50	115	84	6.55	5.87	6.66
Southeast	73	64	54	4.37	4.15	4.17
Frontier	56	86	76	6.66*	6.44*	6.48
B. 1995-2000						
Northeast	65	79	39	5.05	4.17	4.80
Southeast	85	50	39	3.52	3.28	3.30
Frontier	73	65	39	4.40	3.82	4.80

Note: The dummy for the Frontier was set equal to 1 in 1975-1980 and 0 in 1995-2000.

116. The total fertility rates shown in Table 27 were used to derive age-specific fertility schedules for the projection program. No attempt was made to estimate changes in the age profile of fertility, so that each region's age specific fertility schedules in 1975-80 and 1995-2000 are simply fractions of the 1965-70 profile (i.e., $ASFR_i$ in 1975-80 = $(TF_{1975-80} / TF_{1965-70})$ $ASFR_i$ in 1965-70).

117. Projections A and B maintain the volume of interregional migration used in the Baseline projections, so that interregional differences in population growth and composition are attributable to differences in the statistically derived mortality and fertility schedules in the former vis-a-vis the prescribed schedules in the latter.

118. Because social programs accelerated by the government in the 1970s (i.e., water supply, literacy) have a more direct impact on mortality than on fertility, the differences between the Baseline and "A", and "B" are greatest with respect to the former. This runs somewhat counter to the usual emphasis on fertility in alternative demographic projections for developing countries. As will be seen in the projection results, this approach suggests that variations in mortality may be more important than is commonly assumed in making such projections.

119. To show, in addition, the effect that a higher rate of migration out of the Northeast would have on population growth and distribution, an additional run was made using the "A" fertility and mortality assumptions but doubling the volume of migration out of the Northeast between 1970 and 2000 from that assumed in the Baseline projections. This experiment is designated projection A-MIG.

120. The components of population increase (crude birth, death and migration rates) and the corresponding rates of natural and total increase implied in alternative "A", "A-MIG", and "B" are shown in Table 29. In the Northeast, lower mortality rates result in greater natural increase than in the Baseline projections though changes in age structure have a dampening effect on crude birth rates. Higher fertility in the Southeast and Frontier in Alternatives "A" and "B" raise their rates of natural increase even more in relation to the Baseline projections.

4. Summary of Results

121. Table 30 summarizes results for the alternative population projections A, B, and A-Mig in terms of total and regional populations in the year 2000 and compares the results to those of the IBGE and Baseline projections. Both the A, B, and A-Mig population totals are higher in 2000 than in the Baseline and IBGE projections. This results from the accelerated mortality decline reflected in the 1975-80 schedules. Declining mortality feeds into the derived fertility schedules, so that total population in

Table 29: COMPONENTS OF POPULATION GROWTH IN PROJECTIONS BY REGIONS
(per thousand of average population in decade)

	Northeast				Southeast				Frontier			
	Baseline	A	B	A-MIG	Baseline	A	B	A-MIG	Baseline	A	B	A-MIG
1970-1980												
Birth Rate	44.4	43.6	40.6	42.4	32.6	33.5	32.2	33.7	46.7	46.7	45.8	47.3
Death Rate	14.8	14.0	10.8	14.0	7.6	7.3	6.6	7.3	11.1	9.7	9.6	9.7
Natural Increase	29.6	29.6	29.8	28.4	25.0	26.2	25.6	26.4	35.6	37.0	36.2	37.6
Net Migration	-5.0	-4.8	-4.8	-11.6	3.7	3.6	3.8	5.9	5.1	5.8	6.2	12.6
Total Increase	24.6	24.8	25.0	16.8	28.7	29.8	29.4	32.3	40.7	42.8	42.0	50.2
1980-1990												
Birth Rate	39.2	39.3	35.0	35.3	30.7	31.5	29.9	32.1	41.9	40.7	38.8	42.4
Death Rate	11.8	11.0	7.3	11.0	6.6	6.5	5.9	6.5	9.4	7.7	6.3	7.7
Natural Increase	27.4	28.3	27.7	24.3	24.0	25.0	24.0	25.6	32.5	33.0	32.5	34.7
Net Migration	-5.0	-4.8	-4.8	-11.1	1.7	1.8	1.9	2.9	2.8	2.7	2.6	7.8
Total Increase	22.4	23.5	22.9	13.2	25.7	26.8	25.9	28.5	35.0	35.7	35.1	42.5
1990-2000												
Birth Rate	36.1	37.1	31.6	36.2	26.6	27.6	26.0	27.8	36.5	34.1	30.8	34.3
Death Rate	9.5	8.8	5.5	9 3	5.7	6.0	5.7	5.9	7.9	6.5	4.5	6.3
Natural Increase	26.6	28.3	26.1	26.9	20.8	21.6	20.3	21.9	28.6	27.6	26.3	28.0
Net Migration	-4.0	-3.8	3.9	-12.0	1.4	1.4	1.4	2.2	1.7	1.9	1.9	5.3
Total Increase	22.6	24.5	22.2	17.6	22.2	23.0	21.7	24.1	30.3	29.5	28.2	33.3

Table 30: SUMMARY OF HISTORICAL POPULATION ESTIMATES AND PROJECTED VALUE IN THE YEAR 2000

	Total Pop.	(%)/a	Urban	(%)/b	Rural	(%)/b
Northeast						
1950	17,973	(34.6)	4,745	(26.4)	13,228	(73.6)
1970	28,113	(30.2)	11,753	(41.8)	16,360	(58.2)
2000						
IBGE	57,298	(28.3)	32,111	(56.0)	25,187	(44.0)
Baseline	56,529	(27.8)	31,635	(56.0)	24,894	(44.0)
A	58,313	(27.9)	37,967	(65.1)	20,346	(34.9)
B	56,763	(27.9)	36,958	(65.1)	19,805	(34.9)
A-MIG	45,577	(22.0)	29,675	(65.1)	15,902	(34.9)
Southeast						
1950	30,389	(58.5)	13,034	(42.9)	17,355	(57.1)
1970	56,350	(60.5)	36,268	(64.4)	20,082	(35.6)
2000						
IBGE	121,446	(60.0)	96,337	(79.3)	25,109	(20.7)
Baseline	121,530	(59.8)	96,366	(79.3)	25,164	(20.7)
A	125,102	(59.8)	105,720	(84.5)	19,382	(14.5)
B	122,017	(59.9)	103,112	(84.5)	18,905	(14.5)
A-MIG	131,447	(63.4)	111,081	(84.5)	20,366	(14.5)
Frontier						
1950	3,582	(6.9)	1,004	(18.0)	2,578	(72.0)
1970	8,677	(9.3)	4,064	(46.8)	4,613	(53.2)
2000						
IBGE	23,526	(11.6)	14,125	(60.0)	9,401	(40.0)
Baseline	25,162	(12.4)	15,101	(60.0)	10,061	(40.0)
A	25,646	(12.3)	18,632	(72.7)	7,014	(27.3)
B	25,001	(12.3)	18,166	(72.7)	6,835	(27.3)
A-MIG	30,300	(14.6)	22,013	(72.7)	8,287	(27.3)
Brazil						
1950	51,944	(100.0)	18,783	(32.2)	33,161	(67.8)
1970	93,140	(100.0)	52,085	(55.9)	41,055	(44.1)
2000						
IBGE	202,270	(100.0)	142,573	(70.5)	59,697	(29.5)
Baseline	203,221	(100.0)	143,102	(70.5)	60,119	(29.5)
A	209,061	(100.0)	162,319	(77.6)	46,742	(22.4)
B	203,781	(100.0)	158,236	(77.6)	45,545	(22.3)
A-MIG	207,324	(100.0)	167,769	(80.9)	39,555	(19.1)

/a Percent of total population of Brazil.
/b Percent of total population of Region.

projection B is lower than in projection A, even though mortality decline is faster in B. This is an important result of the projection exercise. Still, the faster pace of mortality decline at an early stage in the projections leads to a larger total population than would result from extrapolating historical trends in mortality decline as in the IBGE and Baseline projections.

122. Despite substantial differences in the underlying assumptions, proportional differences in the total population in the four projections are not great. This happens because demographic change is an inherently slow process, and because of the interdependence between fertility, mortality, and age structure incorporated in the projections through the regression estimates.

123. Divergences in the geographic distribution of the population are greater. As indicated earlier, projections "A" and "B" maintain the interregional migration patterns of the IBGE and Baseline projections, but adopt a more rapid intra-regional rural-urban population shift. Underlying this is the assumption that a larger share of the population increase of each region between 1970 and 2000 will be absorbed by cities within that region. Table 30 shows that in the Northeast, for example, the population doubles from 28 to about 56 million in all projections except A-Mig. In the IBGE and Baseline projections, cities absorb about two-thirds of this and rural areas one-third, while in projections A and B, cities account for nearly nine-tenths of the projected growth. Similarly, in the Southeast the urban share of population increase between 1970 and 2000 is 92 percent in the IBGE-Baseline projections and 100 percent in A and B, with the corresponding proportions being 63 and 86 percent in the Frontier region.

124. These regional and rural urban distributions are consistent with objectives stated by the Brazilian government to reduce the amount of interregional migration to the Southeast from the levels of 1950-1970 (see Brazil, Secretariat of Planning, 1974). This policy does not contemplate action to reduce the natural increase of the Northeastern population. In fact, projections A and B show that policies to improve health conditions in the Northeast will probably augment its natural increase. If interregional migration is reduced, resulting increase in numbers will have to be absorbed within the region, as shown in the projections.

125. If Northeastern cities cannot absorb the large proportion of the population growth indicated in the projections (the equivalent of 125 cities of 200,000 inhabitants), then interregional flows will clearly be much larger than envisaged in official planning documents.

126. The possibility that migration out of the Northeast will in fact be much larger than official expectations is explored in projection A-Mig, which assumes a level of interregional migration which is double (in terms of absolute numbers). The amount assumed in the Baseline and A-B projections (Table 30) shows that under this assumption, 10-12 million of the Northeast's 1970-2000 increase of 28 million will move to other

regions (and principally to their cities). In this case the Northeast's share of total population would drop from 30% in 1970 to 22% in 2000, rather than only 28% as in the other projections.

127. Earlier discussion of the pressures of current urban population increase on urban infrastructure has shown that they are already severe in all regions. Doubts were likewise raised about the capacity of the Amazonian frontier to absorb migrants. The implications for policy are serious and complex, and this discussion can only raise the question.

128. Another important question relates to age composition. Though total population size does not vary greatly under the different fertility and mortality patterns used above, the differences which do occur are concentrated in the youngest age category (Table 31). Total population in projection A is 5.3 million greater than in projection B; however, the population aged 0-14 is 5.9 million greater (counterbalancing changes in other age groups make up the difference). Such differences take an added significance when they are related to such age related services as education; and later on to employment opportunities. Projection B, on the other hand, generates a population with a larger share of population over age 40 than in projection A.

129. It is important to recognize the implications of the current laissez-faire towards population growth. When considered together with officially stated objectives concerning population coverage targets for various social services and productive employment, it implies acceptance of the costs required to meet them given the population increases associated with this laissez-faire policy. These costs will obviously be higher than required to meet the same coverage targets for the smaller population increments that would presumably result from an activist policy to slow population growth. Looked at in a slightly different way, to the extent that Brazil is willing and able to allocate a certain quantum of resources to meet the stipulated coverage targets under the laissez-faire regime, an activist and effective population policy would allow it to shorten the time required to meet such targets. While the logic underlying these observations is elemental, the welfare trade-offs they highlight are eminently complex -- and of course, only the Brazilians have the prerogative to choose among these trade-offs.

130. Another important type of trade-off between demographic and other national objectives is also apparent in the Brazilian case: that between interregional population distribution and export growth. A striking illustration bears on the land-use policy for the Frontier region. Current policy for this region emphasizes expansion of export agriculture as an important part of the broader policy to foster export growth. Products (mostly soybeans and cattle) and corresponding technology suitable for this purpose, however, are land and capital intensive; labor use is scant. This militates strongly against the objective of having the Frontier region absorb the bulk of the natural population increase generated in the Northeast -- currently, of the order of one million persons per year. If a population policy which

Table 31: COMPARISON OF AGE PROFILES AMONG PROJECTIONS FOR THE YEAR 2000
(percentage distribution)

Region	Baseline	A	B	A-MIG
A. Northeast				
0-14	41.3	42.3	39.0	42.5
15-39	41.9	41.0	41.9	42.0
40-64	13.4	13.3	14.8	11.1
65+	3.4	3.4	4.3	4.4
Total	100.0	100.0	100.0	100.0
B. Southeast				
0-14	33.6	34.2	32.8	34.2
15-39	40.5	40.4	40.8	40.5
40-64	21.0	20.4	21.2	20.7
65+	4.9	5.0	5.2	4.6
Total	100.0	100.0	100.0	100.0
C. Frontier				
0-14	40.6	39.5	37.6	35.9
15-39	41.1	41.8	39.5	38.1
40-64	15.8	16.6	20.1	23.6
65+	2.5	2.1	2.8	2.4
Total	100.0	100.0	100.0	100.0
D. Total				
0-14	35.4	37.1	35.1	36.3
15-39	40.9	40.8	41.0	40.5
40-64	19.1	18.1	19.3	19.0
65+	4.6	4.0	4.6	4.2
Total	100.0	100.0	100.0	100.0

emphasizes better geographic distribution rather than control of overall growth is to be successful, it has to be coordinated with other policies which have an effect on the carrying capacity of the area in question.

131. As a final reflection on the current laissez-faire policy towards population growth, it is instructive to consider its implications for the future beyond the current century. According to the projections discussed here, Brazil's total population in the year 2000 will be between 202 and 209 million, and its annual rate of growth, between 2.2 and 2.4%. Barring an unforeseen catastrophe of major proportions indeed, it is quite unlikely that these boundaries will be seriously violated under a continuation of the standing laissez-faire policy. 1/ Taking also into account the projected ranges of age structure and total fertility for century's end, demographic theory and experience of other countries virtually guarantee that the Brazilian population will continue to grow at least until the second half of the 21st century and that it will not cease its growth until a population of no less than 400 million is reached. This is more than 3.4 times the estimated size of the current population. It is difficult to imagine how such a staggering increase in population could occur without detrimental effects to Brazil's ecological systems and hence to its environment. Current concerns for air and water pollution in the major metropolitan areas; and for soil leaching and erosion caused by overcropping and overgrazing in many agricultural regions, to name only a few, seem to be fully warranted in the light of current conditions. These, in turn, may well be very favorable compared to the quality of the environment that would accompany a population much more affluent than today's and 2.5 times its size.

1/ Note, for example, that deaths from the cyclones and floods in Bangladesh in year 1970 are estimated at between half a million and a million persons. At the projected rates of population growth for the decade 1990-2000, it would take no more than three and a half months for these deaths to be replaced.

Appendix A

PROJECTION PROCEDURE

132. As stated, the aim of the "Baseline" projections is to develop region-specific projections that incorporate regional differences in fertility, mortality, and migration flows and at the same time approximate the IBGE projections that are currently being used for planning purposes in Brazil. Instead of starting with a national-level projection incorporating a single set of fertility and mortality assumptions and then prorating regional shares of the resulting total -- as in the case of the IBGE projections, we have started with separate component method projections 1/ for each of three regions (Northeast, Southeast, Frontier) in the simplified regional scheme described in the body of this annex. Each of these regional projections use different fertility, mortality, and migration assumptions. Projections of the rural-urban population distribution within each of these regions are then obtained through a logistic function, specifying, in each case, the urban shares for that region in 1950 and 1970; and its upper assymptote.

133. To provide surer footing for the regional projections in the three decades from 1970 to 2000, the projection program was also run for the period 1950-1970 in order to track regional growth trends in the two decades prior to those for which the actual projections would be made. Besides providing a check on the internal consistency between population data in the censuses and the estimates of fertility and mortality reported in section I, this step also yielded, as a by-product, an estimate of the net migration to or from each of the regions. However, because migration is estimated as a residual, age reporting errors in the census are incorporated in each region's migration total. The main problem that this poses for projections relates to the persistent underreporting of the population in the 0-4 age group. Survival estimates of internal migration generally omit ages 0-9 because of this. To obtain an internally consistent series of regional population estimates by age, it was necessary to adjust for underenumeration at some point. The 0-4 age category for each region was adjusted so that the projections of population after 1970 will not carry the effect of underenumeration forward into future age estimates.

134. The component method of population utilizes age-specific fertility, mortality and migration schedules to project future population by sex for each cohort. It is incorporated in the Long Run Planning Model (LRPM) population projection module, which was used for the projections. The LRPM was also used for generating estimates of age and sex specific net migration between 1950 and 1970; projections of migration after 1970; rural-urban population distributions, and a series of sub-populations relevant to employment, education, health and housing projections. The migration feature permits treatment of the population of each region as a separate "country"

1/ Described, for example, in United Nations (1956).

and thereby generates interregional migration flows in the form of migration to and from each of the separate projection units. 1/ Because of underreporting in the censuses, it was not possible to "close" the interregional migration flow in accounting for the 1950-1970 period. After adjusting for underenumeration in 1970, however, the outflows from the Northeast in subsequent years does equal inflows to the Southeast and Frontier.

1/ International migration, which has accounted for less than one percent of total Brazilian population increase in recent periods, is not included in the projections.

Appendix B

REGRESSION ANALYSIS OF INFANT MORTALITY

135. The relatively high zero order correlations (.8 or more) among the variables relating to fertility and mortality included in Table 17 illustrates the interdependence among the various dimensions of social welfare that they index. It also poses the problem of multicolinearity in the estimation of regression equations for deriving the likely effects on fertility and mortality -- for projection purposes -- of plausible trajectories of such socio-economic indices in the coming years.

136. The multicolinearity problem is evident in regression equation (1) below. It relates infant mortality (INFMRT) to the proportion of birth to women over 40 (OVRAGE), safe water (SFWTR), and female literacy (FMLIT). The last variable is lagged a decade to take account for potential delays in the effect of changing literacy rates on improvement in practices affecting infant care and hence in the infant mortality rate. Data limitations prevent tests of lagged forms with safe water and overage births; this does not seem to be a serious limitation since there is more reason to agree that current rather than lagged levels of these variables affect infant mortality. The results of the regression, with standard errors shown in parentheses beneath regression coefficients are:

$$\text{(B.1)}\quad \text{INFMRT} = 73.0 - 1.38\ \text{FMLIT} - .12\ \text{SFWTR} + 13.5\ \text{OVRAGE}$$

$$\bar{R}^2 = .68 \qquad (1.19) \qquad (.88) \qquad (5.6)$$

Despite the high zero order correlation of infant mortality with safe water and with female literacy, the regression fails to yield statistically significant coefficients for either, though adjusted R^2 (=.68) indicates that a significant proportion of interstate differences in infant mortality is explained by the equation. The variations of these two variables are so closely related that it is impossible to separate them statistically. Only the overage birth coefficient yields a robust estimate of the relationship between a potentially policy-sensitive variable and infant mortality. The estimated coefficient implies that reducing overage births by 1 percentage point would be associated with a 13.5 percentage point decline in infant mortality.

137. A logarithmic form (indicated by * on the logged variables, as in equation 2) improved the $\bar{R}^2$ slightly (to .71) but leaves us with basically the same problem with regard to the coefficients for FMLIT and SFWTR:

$$\text{(B.2)}\quad \text{INFMRT*} = 2.43 - .589\ \text{FMLIT*} - .088\ \text{SFWTR*} + .79\ \text{OVRAGE*}$$

$$\bar{R}^2 = .71 \qquad (.37) \qquad (.19) \qquad (.34)$$

Experimentation with a variety of specifications did not yield a satisfactory way of estimating separate and reliable coefficients for FMLIT and SFWTR, so an index LITWTR of the combined effect of the two variables was used. The index is the logarithm of the product of the two proportions (with literacy lagged a decade). It has a value of zero when both proportions are equal to 1.0 and tends towards minus infinity with lower values (e.g., with FMLIT = .33 and SFWTR = .15, LITWTR = -3.01). This form has the desired effect of increasing exponentially the effect of very low values of either literacy or safe water on infant mortality, and of generating declining mortality at a decreasing rate as these measures approach 1.0. Regression equation (3) uses the composite index variable LITWTR in place of FMLIT* and SFWTR*.

$$\text{(B.3)}\quad \text{INFMRT*} = 2.75 - \underset{(.05)}{.255}\ \text{LITWTR} * \underset{(.317)}{.66}\ \text{OVRAGE*}$$

$$\bar{R}^2 = .71$$

In this equation, $\bar{R}^2$ is the same as in equation (2), but the standard error of the regression coefficient of LITWTR is now only 20% of the coefficient itself. This coefficient is clearly more reliable, though it does not allow us to determine the separate effects of FMLIT and SFWTR nor the relative importance of one vis-a-vis the other. Equations (1) and (2) suggest that female literacy is more important. However, omitting SFWTR from the equation entirely reduces $\bar{R}^2$ to about .55, suggesting that it is important to maintain it for purposes of projection.

Appendix C

STATISTICAL APPENDIX

Appendix Table C.1: HOUSEHOLDS BY (HOUSEHOLD) MONEY INCOME LEVEL, BY STATE GROUP, 1970
(in thousands of households)

State Group	Average Monthly Income (in Cruzeiros) 1-150 (1)	151-300 (2)	301-500 (3)	501+ (4)
1. Amazonia a/	236	193	81	79
2. Maranhao-Piaui	584	191	48	32
3. Central Northeast b/	1,692	514	188	199
4. Bahia-Sergipe	874	346	124	131
5. M. Gerais-E. Santo	1,015	660	286	339
6. Rio de Janeiro - Guanabara	206	525	394	750
7. Sao Paulo	466	956	754	1,420
8. Parana	450	449	179	183
9. S. Catarina - R.G. Sul	474	657	326	376
10. Central-West c/	366	272	121	134
Brazil	6,362	4,766	2,500	3,644

Source: Private communication from Mr. Charles Wood, gratefully acknowledged.

a/ Includes: Acre, Amazonas, Para, Amapa, Rondonia e Roraima.

b/ Includes: Ceara, Rio Grande do Norte, Paraiba, Pernambuco, Alagoas and Fernando de Noronha.

c/ Includes: Goias, Mato Grosso and Federal District.

Appendix Table C.2: HOUSEHOLDS BY (HOUSEHOLD) MONEY INCOME LEVEL, BY STATE GROUP, AND LOCATION, 1970
(in thousands of households)

State Group	Average Monthly Income (in Cruzeiros) 1-150		151-300		301-500		500+	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
1. Amazonia a/	69	167	81	112	48	336	628	171
2. Maranhao-Piaui	112	466	60	131	24	24	24	8
3. Central Northeast b/	573	1,119	316	198	145	42	182	17
4. Bahia-Sergipe	245	628	170	176	83	41	114	17
5. Minas Gerais - Espiritu Santo	300	715	406	255	212	74	295	44
6. Rio de Janeiro-Guanabara	121	85	456	70	370	24	733	159
7. Sao Paulo	215	251	720	236	667	87	1,358	62
8. Parana	66	384	164	283	167	74	148	35
9. S. Catarina-R. G. Sul	115	359	339	318	215	111	318	57
10. Central-West c/	105	261	135	137	79	42	112	22
Brazil	1,923	4,440	2,850	1,915	1,946	554	3,349	2,953

Source: Private communication by Mr. Charles Wood, gratefully acknowledged.

a/ Includes: Acre, Amazonas, Para, Amapa, Rondonia e Roraima.

b/ Includes: Ceara, Rio Grande do Norte, Paraiba, Pernambuco, Alagoas and Fernando de Noronha.

c/ Includes: Goias, Mato Grosso and Federal District.

Appendix Table C.3: LIFE EXPECTANCY BY HOUSEHOLD MONEY INCOME LEVEL, BY STATE GROUP AND LOCATION, 1970

Sub-Region	Money Income Class a/	Total	Rural	Urban	Urban Rural
1. Amazonia b/	1	53.4	53.8	52.6	0.98
	2	53,9	53.6	54.3	1.01
	3	54.8	53.2	55.8	1.05
	4	58.2	54.5	59.3	1.09
2. Maranhao-Piaui	1	50.0	50.7	47.0	0.93
	2	50.8	51.2	50.2	0.98
	3	52.7	51.9	53.3	1.03
	4	55.7	49.8	57.7	1.16
3. Central Northeast c/	1	43.8	44.3	40.0	0.90
	2	46.1	46.6	45.9	0.98
	3	50.3	48.2	50.8	1.05
	4	54.4	53.4	54.4	1.02
4. Bahia-Sergipe	1	48.9	50.4	45.1	0.89
	2	50.3	52.4	48.8	0.93
	3	51.9	52.3	51.8	0.99
	4	54.9	52.6	55.3	1.05
5. Minas Gerais-Espiritu Santo	1	53.8	55.3	49.6	0.90
	2	55.4	57.2	54.5	0.95
	3	58.6	59.2	58.4	0.99
	4	62.3	61.9	62.4	1.01
6. Rio de Janeiro-Guanabara	1	54.1	56.8	51.2	0.90
	2	54,8	55,9	54.6	0.98
	3	57.6	56.9	57.6	1.01
	4	62.1	61.1	62,1	1.02
7. Sao Paulo	1	54.7	56.4	51.9	0.92
	2	56.1	57.5	55,7	0.97
	3	58.7	58.3	58,8	1.08
	4	63,9	61.4	64,0	1.04
8. Parana	1	54.8	55.3	51.2	0.93
	2	56.5	57,1	55.5	0.97
	3	59.3	60.0	59.0	0.98
	4	63.7	62.3	64,1	1.03
9. S. Catarina-R. G. do Sul	1	60.5	62.0	54.6	0.88
	2	61.2	63.4	59.3	0.94
	3	63.4	65.2	62.6	0.96
	4	66.9	66.2	67.1	1.01
10. Central West d/	1	56.5	57.1	54.8	0.96
	2	57.1	58.7	55.6	0.95
	3	58.2	57.6	58.5	1.02
	4.	63.3	62.5	63.4	1.01
Brazil	1	49.9	51.4	46.0	0.89
	2	54.5	55.9	53.7	0.96
	3	57.6	57.6	57.6	1.00
	4	62,0	60.0	62,2	1.04

Source: Carvalho and Wood (1976:16). Notes in following page.

Appendix Table C.3 (continued)

Notes:

a/ Classes as follows: 1 = Cr$ 1.00 a 150; 3 = Cr$ 301.00 a 500;
2 = Cr$ 151.00 a 300; 4 = Cr$ 500.00 +

b/ Includes: Acre, Amazonas, Para, Amapa, Rondonia e Roraima.

c/ Includes: Ceara, Rio Grande do Norte, Paraiba, Pernambuco, Alagoas and Fernando de Noronha.

d/ Includes: Goias, Mato Grosso and Federal District.

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