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THE EXPERIENCE WITH ECONOMIC-DEMOGRAPHIC MODELS FOR BRAZIL DESCRIPTION AND RESULTS

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* Este artigo foi preparado e apresentado em Verona (Italia) em fevereiro/88, no Seminário de Modelização Demográfica, organizado pela Associação de Economia Aplicada. Vale ressaltar que os resultados numéricos apresentados são de caráter preliminar.

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1. INTRODUTION

The activity concerned with economic-demographic modelling, started in Brazil in 1975 when a project was launched at the official statistical office (IBGE), in order to construct a BACHUE type of model for Brazil. As is well known, this family of models aimed at allowing better understanding of economic-demographic dynamic inter-relationships and providing support to evaluations of responses to different medium and long term policy variables.

Since the beginning it was clear to the participants that modelling should be regarded as a permanent activity which should not only be meeting user's needs but also incorporating most recent statistical informations and theoretical and factual developments.

During the second half of the sevnties, and with the technical and financial support from the ILO, a first model, referred here as the "National" model was elaborated, being published in 1979. This "tentative" model provided interesting results and found applications within the statistical office and also outside it, namely in the state energy sector's planning departments. Since then this activity progressed slowly along two main lines. One which was an updating of this National model, and another which was directed towards a spatial desagregation of it. Given the large brazilian regional disparities, this option has been felt as the most reasonable one to concentrate efforts on, as by incorporating to the models this dimension one would enlarge the number of potential users as well as give more credibility to it as an analytical tool. The effort of desagregation referred above, has resulted in the so called "Regional" model. This model, is presently only operational in its demographic and educational components.

Moreover since 1986, in agreement with the IBGE, this activity was transferred to the Fedeal University of Rio de Janeiro (UFRJ). New applicatons of an academic nature where made

possible and the models serve as a teaching instrument in the graduate economic courses. In parallel, they have been improved in theoretical terms as a result of being closer to academic research.

The present paper aims both at reporting this modelling activity in Brazil, presenting some information on the structure of the existing models and selected numerical results from each of them. As the paper is destinated to professionals of this area of specialization, no reference will be made to the well known advantages and general limitations, information and statistical constraints, etc. which are normally involved in the process of construction and use of social models.

In the first part of the paper (2.),a brief description and a set of results based on the National model are shown, having in mind putting forward demo-economic relationships and consistent economic and demographic projections for Brazil. Similarly, in its second part (3.),it presents the most relevant informatin concerning the structure of the "Regional" model as well as selected results, to be regarded as reference or baseline poulation forecasts. As a matter of conclusion, the paper shortly refers to the ongoing and future developments of this activity in the brazilian context.

2. THE NATIONAL MODEL

2.1 - Structural Description

On top of being long term oriented and of a global (economic-demographic) and simulation nature, the National model has the following general mathematical definition:

$$Y(t) - f[Y(t-i), X(t), X(t-i), E(t), E(t-i)] = 0$$

where Y stands for a vector of explained variables in time (t), Y(t-i) the same vector of explanatory variables for a previous

calculation period,f or the log of f, generally being a linear function, X a vector of explanatory (also endogenous) variables and E a vector of exogenous variables. It should also be said that this model is (a) physical, i.e. calculated at constant prices, although allowing for the inclusion of trends of exogeneously determined structure of relative prices, (b) dynamic, having in some parts equations solved simultaneously and in others a sequential resolution, and (c) highly endogenised, which means that its frontiers are wide and treat as explained fenomena all which are not external to the brazilian economic-demographic system.

Going a little further in this description, it is firstly necessary to dedicate some attention to the theoretical references and the variables categorization used in each of the modules of the model. Taking as guideline the computation sequence, one can summarize the model's structure in the following way:

- Income distribution: Family income is supposed to be distributed according to a lognormal distribution, whose parameters are calculated based on results from the labour market block, namely employment and labor income estimates. Additionally, an exogeneous expected (historical) value for average family income growth is used.

- Demand and Production: The choice here has been to use Leontief's demand based production function, whereby it is necessary, given a technological frame (input/output table), to estimate the various vectors of demand in order to derive production. Some of the demand components, like exports and government expenditures have been treated exogeneously. The others are represented by behavioral equations. The most important one, the household consumption function, assumes there is a linear relation of expenditure with family income and composition.

Indirect taxes and wage bills are derived from

economic-demographic "feedbacks". On the one hand, it depends for its evolution on two economic variables: per capita government (education) expenditures and household income. On the other hand, as mentioned above, it influences population reproduction pattern through illiteracy rates. In the frame of the labour market, education is used as a categorical variable that influences the decision to enter the labour force and also determines the structure of relative wages and labour productivity.

An important example of demographic-economic feedbacks is the household consumption function. It considers family composition indicators, which makes it possible to take into consideration the effects of changes of the demographic structure of the family on its expenditure pattern. It is worth recalling the importance of such a relation in the context of a country with fast changing reproduction standards.

Finally, in a more conventional and mechanic way, the demographic-educational block provides the economic one with some basic inputs. These are related to the supply side of the labour market which when confronted with labour demand makes it possible to identify eventual imbalances of an economic nature, i.e. for example, building up of a structural unemployment situation.

In the next section with the help of results of a simulation reference run, a brief illustration of how economic and demographic projections flow together is presented.

2.2 - Some Results of a Reference Run

This section is divided in two parts. The first, outlines the working hypothesis (exogeneous variables) involved in the reference run. The second, will pick up the most relevant simulation results which have to do with the interdependency of economic and demographic development over time(2). (see tables 2.1 to 2.5)

(2) The simulation period corresponds to the years 1985 to 2000.

Table 2.1

P O P U L A C A O (POPULATION)

	PESSOAS (MILHARES)			TAXAS											
	URBANA	RURAL	TOTAL	TX.MIG. ANUAL %	TX.BR. NATAL. 0/00	TX.BR. MORT. 0/00	TX. CR. VEGET. %	TX. AN. URBANA %	TX. AN. RURAL %	TX. DEP URBANA %	TX. DEP RURAL %
1980	80759	40865	121628	2.66	30.413	8.547	2.19	27.30	55.71	68.57	90.13
1985	94630	39953	134782	2.72	28.392	7.974	2.04	24.70	49.70	64.34	82.06
1990	105192	39191	148383	2.68	25.761	7.397	1.84	20.95	43.86	59.79	76.59
1995	123073	38324	161396	3.00	23.526	7.219	1.63	17.16	38.60	55.06	73.51
2000	137015	36728	173746	3.37	21.741	7.054	1.47	14.47	33.74	50.88	71.25

	PERSONS (TH.)			RATES							
	URBAN	RURAL	TOTAL	MIGRATION RATE	NATALITY RATE	DEATH RATE	NATURAL GROWTH	ILLIT. URBAN	ILLIT. RURAL	DEPEND. URBAN	DEPEND. RURAL

Table 2.2

C O N T A S N A C I O N A I S (NATIONAL ACCOUNTS)

(BIO DE CRS DE 1970)

	P.I.B.	CONS. FAMIL.	CONS. GOV.	FBCF PRIV.	FBCF GOV.	SALDO BAL.COM 8 SER	SALA- RIOS	LUCROS	IMP. INDIR.	RENDA FAMIL.	RECEITA GOV.	POUP. FAMIL.	POUP. GOV.	POUP. EMPR.
1980	495	344	46	100	13	-7.1	156	281	57	357	73	13	28	64
1985	522	370	47	80	10	15.2	162	299	61	384	78	14	31	60
1990	719	493	64	131	12	20.1	221	413	85	511	106	18	42	102
1995	992	665	89	204	16	18.1	301	570	120	689	149	25	60	154
2000	1372	903	125	307	22	15.7	413	791	168	937	208	33	83	227

	G.D.P.	HOUSEHOLD CONS.	GOV. CONS.	PRIV. INV.	PUBL. INV.	TRADE BAL.	WAGE MILL	PROFITS	IND. TAXES	HOUSEHOLD INC.	GOV. RECEIPT	HOUSEH. SAV.	GOV. SAV.	COMP. SAV.

Table 2.3

R E N D I M E N T O (INCOME)

	REN MED FAM URB CR/MES	REN MED FAM RUR CR/MES	GINI URB %	GINI RUR %	% FAM URB C/ REN<100 CR/MES	% FAM RUR C/ REN<100 CR/MES	PARTIC SALAR NA AGRC %	SAL MED NA AGRC CR/MES	REN MED AUTON NA AGRC CR/MES	PART SAL SET TRADIC %	SAL MED SETOR TRADIC CR/MES	REN MED AUT SET TRADIC CR/MES	PART SAL SET MODERNO %	SAL MED SETOR MODERNO CR/MES
1980	1253	546	55.01	53.58	4.00	14.20	18.98	166	154	30.62	317	506	32.39	640
1985	1126	575	59.52	56.12	7.94	16.60	19.18	185	168	32.01	338	555	30.91	670
1990	1226	642	58.54	56.83	6.15	14.85	19.87	215	190	31.82	349	568	30.11	706
1995	1358	785	58.61	57.01	5.30	11.33	20.75	251	223	32.26	367	594	29.18	769
2000	1536	981	58.37	57.15	4.16	8.19	21.04	286	307	33.59	393	627	28.08	847

	AVERAGE HOUSEHOLD INCOME URBAN Cr/Mth	AVERAGE HOUSEHOLD INCOME RURAL Cr/Mth	GINI URBAN	GINI RURAL	% HOUSEH. WITH INC < 100 URBAN Cr/Mth	% HOUSEH. WITH INC < 100 RURAL Cr/Mth	WAGE SHARE IN AGRIC. %	AVERAGE WAGE AGRIC. Cr/Mth	AVERAGE N-WAGE INCOME AGRIC. Cr/Mth	WAGE SHARE TRAD. SECT. %	WAGE TRAD. SECT. Cr/Mth	AVERAGE N-WAGE TRAD. SECT. Cr/Mth	WAGE SHARE MOD. SECT. %	AVERAGE WAGE MOD. SECT. Cr/Mth

Table 2.4

Q U A D R O S E T O R I A L E M A O D E O B R A (SECTORIAL AND LABOR STRUCTURE)

	CONSUMO FAMILIAR (%) ALI-MEN-TACAO	VEST. BENS DOM. E MORAD.	TRANSP SAUDE E CACAO	DIVER-SOS	ESTRUTURA DO V.A. (%) AGRI-CUL-TURA	IND. MOD.	IND. TRAD.	SERV. MOD.	SERV. TRAD.	MAO DE OBRA PEA URB (MIO)	PEA RUR (MIO)	EMPRE-GO AGRIC. (MIO)	AUT. & N-REM. AGRIC. (MIO)	EMPRE-GO SET TRAD. (MIO)	AUTON. SET. TRAD. (MIO)	EMPRE-GO SET MOD. (MIO)
1980	26.96	45.05	14.52	13.47	11.55	28.72	18.78	23.16	14.97	33	17	5	10	13	7	12
1985	27.98	44.14	14.54	13.44	12.53	30.08	17.32	22.59	14.75	38	17	6	9	13	9	12
1990	25.63	45.47	15.05	13.85	12.27	30.85	17.63	22.52	14.06	47	18	7	8	17	11	15
1995	23.50	46.50	15.75	14.25	11.94	32.05	17.59	22.58	13.24	54	18	8	5	22	12	19
2000	21.46	47.48	16.45	14.61	11.66	32.72	17.42	22.84	12.81	62	17	10	3	30	12	24

	HOUSEHOLD CONS. (%) FOOD	HOUSEH. GOODS	HOUSEH SERV.	OTHER	VALUE ADDED STRUCTURE (%) AGRIC.	MOD. IND.	TRAD. IND.	MOD. SERV.	TRAD. SERV.	LABOR FORCE EAP URBAN	EAP RURAL	AGRIC. EMPL.	AGRIC. N-EMPL.	TRAD. SECT. EMPL.	TRAD. SECT. N-EMPL.	MOD. SECT. EMPL.

Table 2.5

I N D I C A D O R E S D I V E R S O S (OTHER INDICATORS)

	DESEMPREGADOS TAXA %	PESSOAS(MILHARES) AGRIC.	N-AGRIC.	TX.UTIL. CAP.PROD % SET	MOD	SALARIO MEDIO/EDUCACAO (CR$ DE 1970) E1	E2	E3	E4	RELACAO EX ANTE CAP.FIN./FBC	RELACAO CAPITAL /PRODUTO	PIB P/CAPITA US$ 1970
1980	2.24	93	1018	88.61		220	368	549	1132	1.06	2.09	885
1985	11.86	378	6204	84.17		223	381	575	1129	1.04	2.55	842
1990	9.83	282	6026	100.76		231	386	570	1133	1.03	2.37	1054
1995	6.84	144	4775	106.41		245	393	573	1206	1.01	2.39	1336
2000	1.77	67	1339	106.96		264	406	599	1277	1.00	2.50	1717

	UNEMPLOYMENT RATE %	PERSONS (TH.) AGRIC.	N-AGRIC.	PROD. CAPAC. UTILIZ. % MOD.SECT.	AVERAGE WAGE BY EDUCATION LEVEL E1	E2	E3	E4	EXANTE FIN. CAP. / INV. RATE	COR. CAP./PROD.	GNP PER CAPITA US$ 1970

- Working Hypothesis: As the demographic block (fertility, mortality and migration) is essentially endogeneous, the idea was to test how economic trends would influence population parameters and how on their turn these would constrain or support economic development.

In broad terms, the hypothesis made for exogeneous variables in the reference run projections were an extrapolation of historical trends of the brazilian economy. Rural and urban annual potential income growths were fixed at respectively, 5% and 7%. Total Government expenditure would follow the average growth rate of the economy, except on basic education where the per head expenses would double between 1985 and 2000. No changes in fiscal policy would occur. Exports would grow at 5% per year and imports have an elasticity around one from 1985 onwards. In the private (production) sector, technology would be constant, investments treated endogeneously and, on average, the technical progress would be 1,5 per year. The policy regarding wage or income distribution would be neutral in the sense that it would not interfere in the market for altering the relative wage structure and make productivity gains be equally partitionned between labor and capital.

- Simulation Results: the main effects in terms of demographic variables are the following. Marginal population growth should fall 33% between 1985 and the year 2000: the difference between natality and mortality rates becomes 1,5%, versus 2.0% in 1985. This slowdown is due mostly to the fertility decline, explained by the fall in illiteracy and the progress of industrialisation: in the year 2000, 17% are agricultural workers as opposed to 27% in 1985. Migration probability has also tended to accelerate, mainly as a result of the decline in the rural fertility rates and higher average level of education in this area. As a result of this performance, by the end of the century, more than 3/4 of the brazilian population would be urban, as opposed to less than half in 1960. Moreover, 100% of the growth in the labour force would be concentrated in the urban areas, with around 1,6 millions new workers every year.

But the most interesting evolution seems to be that expressed by the dependency ratio which falls significantly especially in urban zones, as a result of the combination of the fertility decline and, to a lesser extent, life expectancy increase. This decline has evident economic consequences as it will change government receipts and expenditures (investment and current) in the sense that on the one hand, education costs could be reduced or directed towards quality improvement, and on the other, social security economic "balances" (retirement funds) would come under pressure.

It is also worth noting that given the economic performance of about 6,7% per year for the period 1985-2000, the modernisation process and the productivity gains of the economy as a whole, allow for a sustained absortion of the labour supply. As expressed by the unemployment rates, which were very high as a result of economic recession in the early 80's, one sees that only very gradually unemployment is reduced. However it should be pointed out that this is possible only if a substantial and sustained investment effort is made (participation of investment in GDP goes from 17% in 1985 to 24% in 2000), allowing the production capacity to be continually expanded to attend domestic demand but also exports, which are essential to avoid the external financial constraint. Actually, given the growth in the labour force and the historical economic performance, the prductivity should grow no more than 3,8% per year in order to be able to absorb labour supply.

As a result of the combination of the improvement in the general level of education and the neutral income distribution policy "adopted" in this reference run, one notes that the GINI coeficient remains rather constant. However, the relative and absolute gains of the lower wage group, resulted in a decrease in the proportion of families in the lowest income group.

As a concluding remark, one could say that in spite of being extremely simplified and using rather simple hypothesis,

this exercise points out to some interesting "boundary type" results showing that it is not an easy task to match population and economic evolutions in a country like Brazil, where imbalanced or potentially conflicting situations can easily arise.

3. THE REGIONAL MODEL

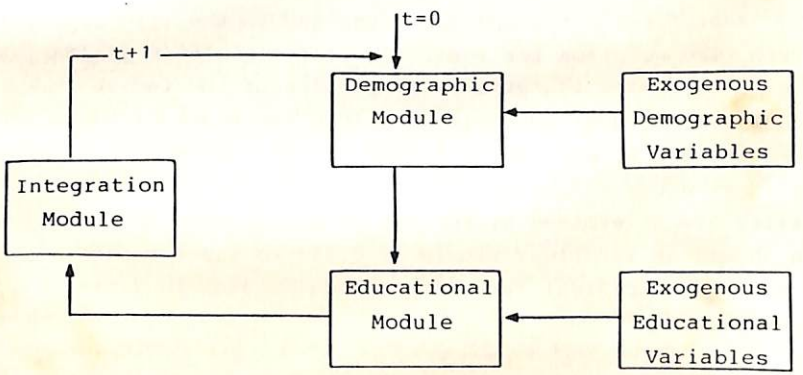
One of the marked features of population trends in Brazil is its spatial heterogeneity. For instance, as to fertility trends in the period 1930-1980, it can be shown to have already taken a downward turn since the late 1960's in the relatively more developed areas - the southern region, São Paulo, Rio de Janeiro and Minas Gerais states - while it was actually increasing in the less developed areas like the Amazon and the Northeast. Although all regions have experienced large declines in fertility, more recently differentials in fertility levels and in the pace of decline are still remarkable. Estimates of the Total Fertility Rate (TFR) for the 1975/80 period can vary from as high as 6.8 for the rural areas in the Northern and Center West regions to a low of about 2.6 fore the urban areas in São Paulo and Rio de Janeiro regions. Similar differentials in life expectancy can also be observed during this whole period.

Because a more accurate picture of economic-demographic interrelationships has to take into account the spatial heterogeneity, an effort to regionalize the simulation model described above is currently underway. In particular, a model for the demographic and educational sectors was built in which the population by age bracket and educational level is projected as a function of some basic parameters and policy variables.

3.1 - Model Description

The regionalized model was decomposed into three behavioral modules. First, a demographic Module to project the

population by sex and age brackets. This module is used to define the demand for educational services and to establish population totals to be followed in the projections made in other modules. Second, an Educational Module to represent the dynamics within the school system and the resulting educational profile of the population. This module gives us measures for the production of educational services as a function of demographic projection on one hand, and of other parameters (exogeneous variables) of school system performance on the other hand. Finally, an Integration Module, receiving at each time period the projections by both Demographic and Educational modules, making them compatible in the form of a matrix representing the population by age bracket and educational level. We can represent the model by the following flowchart:



The model was built to simulate the period 1970 to 2000 for rural and urban areas in the following regions:

Region 1 - North and Center West
Region 2 - Northeast
Region 3 - Minas Gerais and Espírito Santo States
Region 4 - Rio de Janeiro and São Paulo States
Region 5 - South

The Demographic Projection Module uses the well-known "components" method, which will not be described here.

Fertility and mortality levels are endogenously determined for rural and urban populations. In both cases linear regression equation models were estimated relating the dependent variables (1970 estimates based on Brass method) to a set of independent variables (1970 estimates based on Brass method) to a set of independent variables referring to the same time period. A stepwise selection procedure was used to obtain the most economical model in each case.

In the case of fertility levels the TFR for each Brazilian state was estimated and these, in turn, were related to a minimal set of conceptually significant variables to be eventually incorporated into the model. This set of variables makes up a system of theoretically interrelated variables to be formally exploited in the completed simulation model. Thus, urban TFR's are functionally related to per capita income levels, to female labor force participation rates and to the life expectancy at birth. The equation for rural fertility levels is similar, an indicator of female education - proportion of the female population aged 10 or more with complete lower school education - is used instead of per capita income (which varies very little among rural areas in the Brazilian states). Age patterns of fertility are determined by the use of a lognormal distribution, which showed an excellent fit ($R^2 \geq 0,98$) to the national and international empirical fertility schedules used to estimate its parameters.

Mortality level functions were estimated in a similar way. Estimates of male life expectancy at birth are linearly related to an indicator of educational levels prevailing in the area, to an indicator of food consumption (average kilocalories consumption by adult per day) and to an indicator of income level (the proportion of population with monthly family income greater than 25 dollars per capita). Female life expectancies at birth are estimated from male expectancies and death probabilities are obtained using these life expectancies to select appropriate life tables from a set of Model Brazilian Life Tables.

As to migration paterns, inter-regional migration rates are fed exogenously, the same being true as to urban to rural intra-regional migration. However rural to urban intra-regional migration is endogenously determined by the proportion of the economically active population employed in the secondary sector and by the proportion of agricultural enterprises using mechanical power in production activities.

The Educational Module is composed by two main elements:

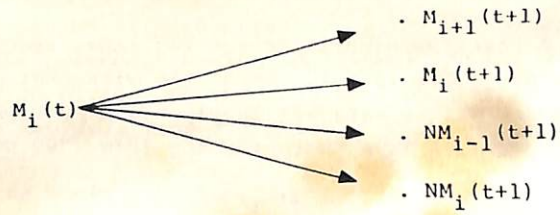
a) Accounting vectors for each school grade
   M(t): vector of students enrolled ad time t, being
   Mi(t): total of students enrolled at the ith grade at time t;
   NM(t): vector of population not in the school system at time t, being
   NMj(t): total population with j grades completed.

b) A probability matrix P representing the performance rates and defining the school system dynamics.

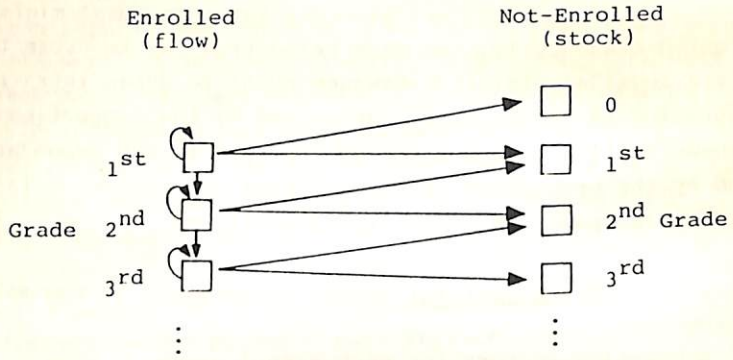
In matrix terms, this system can be defined by the following equation:

$$NM(t+1) + M(t+1) = NM(t) + P(t)*M(t)$$

where P is constituted by grade completion rates, grade repetition rates and school termination (at grade i) rates. The product P(t)*M(t) transforms the population from time t to t+1 and, for the ith grade, it can be graphically described as:



Ignoring the time factor, we can represent the educational flows and stock formation as:



The elements in the P matrix (completion, repetition and termination rates) are fed exogenously; the model requires additionally the proportional period change in school supply at entry point.

The Integration Module uses Deming and Stephan's proportional iterative fitting algorithm to obtain the Enrolled and Not-Enrolled in school population by age and grade attained, making it compatible with totals produced by the Demographic and Educational modules, for each time period.

3.2 - Some results from the Regional Model

A baseline simulation run was made, resulting in a population projection largely compatible with that for the National model. At an agregate level, the demographic indicators obtained for Brazil as a whole for the 1970-2000 period are the following ones:

DEMOGRAPHIC INDICATOR	PERIOD						
	1970-1975	1975-1980	1980-1985	1985-1990	1990-1995	1995-2000	2000-2005
Life Expectancy at birth (both sexes)	59.9	61.8	63.4	64.8	66.2	67.4	68.5
Total Fertility Rate	4.8	4.1	3.8	3.4	3.1	2.9	2.7

Migration and educational patterns prevailing in the 1970-1980 period were kept constant.

The estimates for the year 2000 are a population of about 174 million people, growing at 1.5% per year, with a Total Fertility Rate around 2.7 for the population as a whole. Still, very marked differences are expected to persist. While the TFR for the urban population (TFR = 2.2) is expected to reach almost replacement level, fertility in rural areas will be almost twice as that, being expected to be around 4.0 children per woman. Stimilarly, wide rural/urban diferentials in mortality are also expected to persist, the differences in life expectancy at birth possibly being as large as 6.4 years (about 70.0 for urban areas vs. 63.6 for rural areas). Adding a regional dimension, these differentials widens even further, reaching a 15.0 year difference in life expectancy between the urban area in the Southern region and Minas Gerais/Espírito Santo states (e_o = 73.4 and 73.7, respectively) on the one hand, and the rural areas in the Northeast Region (e_o = 58.5) on the other hand. A more detailed picture of the results from the regional model can be seen in tables 3.1 to 3.3 below.

We would like to point out two important results from the regionalized baseline simulation run. First, mainly as a consequence of the differences in levels and pace in fertility decline, and in spite of heavy interregional migration, the proportion of population living in the less developed North and

Northeast regions are expected to increase from 41% in 1980 to about 45% in the year 2000. Also, because wide fertility differences are expected to persist (for instance, TFR for the Northeast region in the year 2000 is expected to be as high as 3.4, while in the South region as well as in the S.Paulo and Rio de Janeiro states it will be around replacement level), the age structure in these less developed regions will be significantly younger than those in the more developed South and Southeastern regions. As a consequence of this fact, dependency ratios will still be much higher in the poorer areas.

Second, educational trends will probably reinforce this dual spatial structure of Brazilian society. Let us consider, for instance, the case of illiteracy among the young people (those aged 15 to 19). By the year 2000 illiteracy in this group will have virtually disappeared in the Southern region and declined very substantially in the Southeastern region (states of Minas Gerais, Espirito Santo, Rio de Janeiro and São Paulo), to a low of about 4% (see table 3.4 below). However, in the North, and specially in Northeastern region, after a period of decline up to 1985, the proportion illiterate among young people stabilizes around 39% in the Northeast, or increases slightly to around 25% in the case of the Northern region. Consequently, for Brazil as a whole, unless we succeed in improving substantially the performance of the school system in those poorer areas, we have to expect a very significant proportion of illiterate adults (around 20%) to persist in the early decades of the next century.

4. CONCLUDING REMARKS

Beyond academic type of applications, the experience has shown an increasing demand by public and state planning agencies for the kind of information models such as the ones described above can provide, especially in their more desagregated versions. Thus, the Regional Model has already been applied to different fields. Recently the Brazilian Urban Development Ministry has requested for their planning activities projections

of population size and distribution over the next decade. Likewise, the Ministry of Education asked an evaluation of future demand to the school system at the lowest level of spatial detail feasible. We have clear indications that similar requests coming from the productive (non-social) sectors, like energy state companies, are likely to be reinforced in the near future.

Probable extensions of the models will concentrate along two main lines. One, to extend the regionalization to the economic-productive area; second, to introduce new social sectors blocks, such as health, dwellings, social security, etc. This should meet the needs for academic teaching and research activities on the one hand, and on the other, enable these models to be used as sophisticated tools in non-academic sectoral planning activities.

Table 3.1

		1970	1975	1980	1985	1990	1995	2000
	B R A S I L							
1	POPULAÇÃO TOTAL	92953276	106555232	120022896	133490032	147084656	160586016	173565008
2	TX. GLOB. FECUNDIDADE	4.81	4.14	3.76	3.37	3.09	2.85	2.66
3	ESPERANÇA DE VIDA	55.85	61.80	63.37	64.82	66.19	67.43	68.45
4	NASCIMENTOS	0	3EC0832	3621454	3744374	3797949	3830186	3813895
5	MORTES	0	992455	1015908	1050939	1079011	1129857	1217285
6	TX. BRUTA MORTALIDADE	0.00	9.28	8.46	7.87	7.34	7.04	7.01
7	TX. BRUTA NATALIDADE	0.00	35.52	30.17	28.05	25.82	23.85	21.97
8	TX. CRESC. VEGETATIVO	0.00	2.62	2.17	2.02	1.85	1.68	1.50
9	% DE POP. URBANA	55.91	61.56	67.03	70.46	72.88	74.26	75.28
	R E G I Õ E S (REGIONS)							
NORTE	1. POP. TOTAL	6656456	10754528	12870367	14548406	17045744	19159424	21287024
	2. TX. GLOBAL FECUND.	6.38	5.62	5.04	4.08	3.68	3.35	3.05
E	3. ESPERANÇA VIDA	61.39	64.39	66.81	68.16	69.48	70.36	71.32
	4. TX.CRESC. GEOM (%)	0.00	4.34	3.59	2.99	2.63	2.34	2.11
CENTRO	5. TX.CRESC.VEGET (%)	-0.00	3.94	3.38	2.88	2.52	2.29	2.06
OESTE	6. % POP. URBANA	46.85	53.81	60.83	65.50	68.86	70.84	72.31
	1. POP. TOTAL	2EC5E176	32157072	36251504	41101792	46164752	51666512	57161200
NOR-	2. TX. GLOBAL FECUND.	6.50	5.67	5.32	4.76	4.24	3.81	3.43
	3. ESPERANÇA VIDA	51.00	52.07	53.42	56.09	58.16	60.28	61.82
DESTE	4. TX.CRESC. GEOM (%)	0.00	2.73	2.40	2.51	2.32	2.25	2.03
	5. TX.CRESC.VEGET (%)	-0.00	3.16	2.77	2.73	2.53	2.35	2.12
	6. % POP. URBANA	41.80	46.03	50.39	55.11	58.82	61.49	63.59
	1. POP. TOTAL	13066C48	14722739	16261951	17524456	19629792	21445656	23151776
MINAS	2. TX. GLOBAL FECUND.	4.78	4.02	3.50	3.05	2.92	2.68	2.46
	3. ESPERANÇA VIDA	61.16	64.30	67.89	69.29	70.69	71.66	72.72
E	4. TX.CRESC. GEOM (%)	0.00	2.39	1.99	1.95	1.82	1.77	1.53
	5. TX.CRESC.VEGET (%)	-0.00	2.88	2.31	2.13	1.98	1.84	1.59
ESPIR.	6. % POP. URBANA	51.63	55.52	66.89	70.83	74.11	75.58	77.47
	1. POP. TOTAL	2670C688	31C7E000	34926912	38207264	41384432	43922608	46248256
SÃO	2. TX. GLOBAL FECUND.	3.24	2.81	2.54	2.32	2.17	2.02	2.01
PAULO	3. ESPERANÇA VIDA	64.44	66.29	67.06	67.99	69.10	70.13	71.18
	4. TX.CRESC. GEOM (%)	0.00	3.04	2.34	1.80	1.60	1.19	1.03
E	5. TX.CRESC.VEGET (%)	-0.00	2.21	1.67	1.39	1.22	1.00	0.85
	6. % POP. URBANA	82.87	86.55	90.00	91.66	92.55	93.02	93.24
RIO	1. POP. TOTAL	1647C028	18281904	19712144	21380880	22859936	24391776	25700752
	2. TX. GLOBAL FECUND.	3.97	3.29	2.86	2.70	2.40	2.24	2.01
PARANA	3. ESPERANÇA VIDA	65.62	67.72	69.14	69.88	70.84	71.68	72.06
	4. TX.CRESC. GEOM (%)	0.00	2.09	1.51	1.56	1.41	1.30	1.05
S.CAT.	5. TX.CRESC.VEGET (%)	-0.00	2.50	1.86	1.77	1.61	1.40	1.15
	6. % POP. URBANA	44.27	52.63	61.08	65.22	67.63	66.70	69.45
R.G.S.								

1 TOTAL POPULATION
2 TOTAL FERTILITY RATE
3 LIFE EXPECTANCY
4 BIRTHS
5 DEATHS
6 CRUDE MORTALITY RATE
7 CRUDE NATALITY RATE
8 NATURAL GROWTH RATE
9 % URBAN POPULATION

NORTH AND CENT. WEST	1. TOTAL POPULATION 2. TOTAL FERT. RATE 3. LIFE EXPECTANCY 4. COMPOUND GROWTH RATE 5. NATURAL GROWTH RATE 6. % URBAN POPULATION

Table 3.2

		NORTE E CENTRO-OESTE	NORDESTE	MINAS GERAIS E ESP.SANTO	RIO DE JANEIRO E S. PAULO	PARANA', S.CAT. E R.G.SUL	BRASIL
	- 2 C 0 0 -						
1	POPULAÇÃO TOTAL	21287024	57181200	23151776	46248256	25700752	173569008
2	NASCIMENTOS	526317	1628192	485430	720750	453207	3813895
3	MORTES	109987	473549	130058	337718	165974	1217285
4	TX. BRUTA MORTALIDADE (C/00)	5.44	8.70	5.83	7.49	6.63	7.01
5	TX. BRUTA NATALIDADE (C/00)	26.03	29.92	21.77	15.99	18.09	21.97
6	TX. CRESC. VEGETATIVO (%)	2.06	2.12	1.59	0.85	1.15	1.50
7	TX. GLOBAL FECUNDIDADE - URB.	2.47	2.62	2.39	1.92	1.70	2.22
8	TX. GLOBAL FECUNDIDADE - RUR.	4.54	4.85	2.73	3.24	2.71	3.55
9	ESPERANÇA DE VIDA - URBANA	72.55	63.73	73.71	71.55	73.37	70.03
0	ESPERANÇA DE VIDA - RURAL	68.13	58.49	69.33	66.12	69.08	63.63
1	MIGRAÇÃO INTRA-REGIONAL						
2	RUR - URB: MIGRANTES	144340	379892	102434	102538	113777	
3	RUR - URB: TAXA	2.45	1.82	1.96	3.28	1.45	
4	URB - RUR: MIGRANTES	78783	127257	45176	79202	66598	
5	URB - RUR: TAXA	0.51	0.35	0.25	0.18	0.37	
6	MIGRAÇÃO INTER-REGIONAL						
7	IMIGRANTES - URB	14564	0	5728	111745	0	132036
8	EMIGRANTES - URB	-2929	-6901	-3455	-8425	-6969	-28679
9	IMIGRANTES - RUR	5738	3398	864	1544	0	11544
0	EMIGRANTES - RUR	-5768	-61496	-20839	-1862	-24936	-114901

	NORTH AND C.-WEST	NORTH EAST	M.GERAIS & ESP.S.	RIO DE J. & S.PAULO	SOUTH	BRAZIL

1. TOTAL POPULATION
2. BIRTHS
3. DEATHS
4. CRUDE MORTALITY RATE (0/00)
5. CRUDE BIRTH RATE (0/00)
6. NATURAL GROWTH RATE (%)
7. TOTAL FERTILITY RATE-URBAN
8. TOTAL FERTILITY RATE-RURAL
9. LIFE EXPECTANCY - URBAN
10. LIFE EXPECTANCY - RURAL
11. INTRA-REGIONAL MIGRATION
12. RUR-URB: TOTAL
13. RUR-URB: RATE
14. URB-RUR: TOTAL
15. URB-RUR: RATE
16. INTER-REGIONAL MIGRATION
17. IMIGRANTS - URBAN
18. EMIGRANTS - URBAN
19. IMIGRANTS - RURAL
20. EMIGRANTS - RURAL

Table 3.3

- 2000 - TOTAL						
CLASSES DE IDADE	URBANO		RURAL		TOTAL	
	HOM	MUL	HOM	MUL	HOM	MUL
0 - 4	6180041	5911001	2969849	2831996	9149890	8742997
	9.68	8.85	13.14	13.95	10.58	10.04
5 - 9	6042307	5791948	2865752	2708454	8908059	8500402
	9.46	8.67	12.68	13.34	10.30	9.76
10 - 14	5991608	5775947	2711957	2537282	8703565	8313229
	9.38	8.65	12.00	12.49	10.07	9.54
15 - 19	5935357	5828382	2469037	2222740	8404394	8051122
	9.29	8.72	10.93	10.95	9.72	9.24
20 - 24	5728977	5746736	2273859	1962997	8002836	7709733
	8.97	8.60	10.06	9.67	9.26	8.85
25 - 29	5440352	5552267	2019691	1732450	7460043	7284717
	8.52	8.31	8.94	8.53	8.63	8.36
30 - 34	5076201	5285110	1743796	1485530	6819997	6770640
	7.95	7.91	7.72	7.31	7.89	7.77
35 - 39	4652606	4939411	1427842	1228685	6080448	6168096
	7.29	7.39	6.32	6.05	7.03	7.08
40 - 44	4152502	4484796	1133886	1001521	5286388	5486317
	6.50	6.71	5.02	4.93	6.11	6.30
45 - 49	3610540	3990216	877771	767760	4488311	4757975
	5.65	5.97	3.88	3.78	5.19	5.46
50 - 54	3057655	3458324	667075	570443	3724729	4028766
	4.79	5.18	2.95	2.81	4.31	4.62
55 - 59	2514650	2914234	496479	416581	3011169	3330815
	3.94	4.36	2.20	2.05	3.48	3.82
60 - 64	1999262	2383161	359416	303387	2358677	2686548
	3.13	3.57	1.59	1.49	2.73	3.08
65 - 69	1508306	1877289	253535	218547	1761841	2095835
	2.36	2.81	1.12	1.08	2.04	2.41
> 70	1965895	2868352	328751	319866	2294646	3188218
	3.08	4.29	1.45	1.58	2.65	3.66
TOTAIS	63856208	66807088	22598608	20308176	86454816	87115264
	130663296		42906784		173570080	
%	48.87	51.13	52.67	47.33	49.81	50.19

AGE BRACKET	URBAN		RURAL		TOTAL	
	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
0 - 4						

Table 3.4

EDUCAÇÃO		1975	1980	1985	1990	1995	2000
B	% POP. 15-19 ANALFABETOS	28.70	22.02	18.93	18.17	18.70	19.71
R	% POP. 15-19 MATRIC. NO 1 GRAU	14.74	11.00	8.86	7.64	6.93	6.52
A	% POP. 15-19 COM 1 SERIE	71.33	78.01	81.08	81.84	81.31	80.29
S	% POP. 15-19 COM 4 SERIE	42.32	45.08	45.99	45.92	45.24	44.45
I	% POP. 20-54 ANALFABETOS	22.92	15.33	11.79	10.41	10.28	10.74
L	% POP. 20-54 COM 1 SERIE	77.11	84.69	88.22	89.60	89.72	89.27
	% POP. 20-54 COM 4 SERIE	44.28	48.98	50.98	51.58	51.19	50.48
	% POP. 20-54 COM 8 SERIE	18.01	20.58	21.56	21.76	21.42	20.94
N	% POP. 15-19 ANALFABETOS	29.51	21.95	20.00	20.85	22.69	24.84
O	% POP. 15-19 MATRIC. NO 1 GRAU	18.18	12.53	9.17	7.52	6.63	6.10
R	% POP. 15-19 COM 1 SERIE	70.49	78.05	80.01	79.16	77.31	75.17
T	% POP. 15-19 COM 4 SERIE	32.51	35.55	35.99	35.15	33.89	32.66
E	% POP. 20-54 ANALFABETOS	25.13	16.83	13.72	13.13	13.70	14.76
	% POP. 20-54 COM 1 SERIE	74.87	83.18	86.28	86.87	86.31	85.25
E	% POP. 20-54 COM 4 SERIE	33.37	39.34	42.18	42.90	42.40	41.57
C.O.	% POP. 20-54 COM 8 SERIE	13.94	16.83	18.17	18.35	17.87	17.23
N	% POP. 15-19 ANALFABETOS	51.49	43.98	39.68	38.11	38.24	39.16
O	% POP. 15-19 MATRIC. NO 1 GRAU	12.28	9.47	7.67	6.72	5.94	5.42
R	% POP. 15-19 COM 1 SERIE	48.53	56.04	60.34	61.90	61.77	60.85
D	% POP. 15-19 COM 4 SERIE	19.75	21.23	22.30	22.40	21.95	21.32
E	% POP. 20-54 ANALFABETOS	43.45	33.40	27.92	25.48	24.96	25.37
S	% POP. 20-54 COM 1 SERIE	56.57	66.62	72.09	74.54	75.05	74.64
T	% POP. 20-54 COM 4 SERIE	24.84	29.15	31.92	33.21	33.31	32.52
E	% POP. 20-54 COM 8 SERIE	10.49	12.58	13.95	14.58	14.57	14.32
M	% POP. 15-19 ANALFABETOS	21.41	11.25	5.71	3.22	2.66	3.16
I	% POP. 15-19 MATRIC. NO 1 GRAU	18.67	13.69	10.45	8.66	7.68	7.10
N	% POP. 15-19 COM 1 SERIE	78.63	88.80	94.29	96.78	97.34	96.84
A	% POP. 15-19 COM 4 SERIE	45.01	50.17	52.46	54.27	55.18	55.56
S	% POP. 20-54 ANALFABETOS	20.40	9.82	4.75	2.49	1.78	1.84
	% POP. 20-54 COM 1 SERIE	79.65	90.23	95.25	97.51	98.22	98.16
E	% POP. 20-54 COM 4 SERIE	40.30	46.06	48.46	49.71	49.90	49.82
E.S.	% POP. 20-54 COM 8 SERIE	16.36	19.77	21.15	21.78	21.76	21.61
R	% POP. 15-19 ANALFABETOS	15.33	10.92	8.69	7.51	6.76	6.08
I	% POP. 15-19 MATRIC. NO 1 GRAU	15.89	11.87	10.02	9.14	8.72	8.60
O	% POP. 15-19 COM 1 SERIE	84.68	89.08	91.31	92.49	93.24	93.52
	% POP. 15-19 COM 4 SERIE	62.88	65.79	67.43	68.43	69.16	69.81
E	% POP. 20-54 ANALFABETOS	10.84	6.76	4.96	4.09	3.58	3.15
	% POP. 20-54 COM 1 SERIE	89.19	93.24	95.04	95.92	96.42	96.81
S.P.	% POP. 20-54 COM 4 SERIE	61.54	64.72	65.99	66.47	66.64	66.71
	% POP. 20-54 COM 8 SERIE	26.50	28.78	29.60	29.79	29.74	29.58
PAR.	% POP. 15-19 ANALFABETOS	15.93	8.20	3.79	1.67	0.86	0.45
	% POP. 15-19 MATRIC. NO 1 GRAU	12.02	5.30	7.50	6.53	6.09	5.94
S.C.	% POP. 15-19 COM 1 SERIE	84.12	91.85	96.21	98.33	99.15	99.55
	% POP. 15-19 COM 4 SERIE	52.50	58.08	61.63	63.94	65.30	66.23
E	% POP. 20-54 ANALFABETOS	14.91	7.25	3.24	1.37	0.66	0.37
	% POP. 20-54 COM 1 SERIE	85.15	92.80	96.76	98.63	99.35	99.64
R.S.	% POP. 20-54 COM 4 SERIE	50.39	57.08	60.32	61.90	62.49	62.82
	% POP. 20-54 COM 8 SERIE	16.82	19.81	20.80	20.99	20.77	20.53

B	% POP. 15-19 ILLITERATE
R	% POP. ENROLLED IN ELEMENT.
A	% POP. 15-19 WITH 1st GRADE
Z	% POP. 15-19 WITH 4th GRADE
I	% POP. 20-54 ILLITERATE
L	% POP. 20-54 WITH 1st GRADE
	% POP. 20-54 WITH 4th GRADE
	% POP. 20-54 WITH 8th GRADE

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