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FERTILITY DECLINE IN INDIA: MAPS, MODELS AND HYPOTHESES

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This final chapter will view the questions considered in the course of this work in the wider perspective of a reflection on the dynamics of fertility in India. An examination of regional studies reveals, in fact, the inadequacy of the theoretical frameworks regularly employed to account for fertility decline. This situation requires at the same time, a reconsideration of a number of theories, which have often been presented as contradictory, whereas it appears that each contributes to the explanation of the dimensions of the observed variations in fertility and the rates of contemporary decline.

The first part of this chapter, therefore, will consider the different theoretical options applied in the case of India. In the following part, we shall give details of a preliminary study of the results of 2001, using new sources which seem to cast a fresh light on the determinants involved in the decline of fertility. In the third part of this chapter, we shall compare the results of the analyses of fertility carried out by various authors on the basis of data from the last three censuses (1981, 1991, 2001). The last part, availing of the geographical approach that was involved in various studies presented in this volume, will consider the hypothesis of diffusion factors and provide an additional framework for the interpretation of demographic change in India.

Micro-economy of Fertility

The understanding of changes in reproductive patterns constitutes a rich area for reflection, both for sociologists and economists who have fostered discussions for the last 40 years. One of the pioneering contributions was undoubtedly the micro-economic analysis of fertility behaviour introduced in the 1960s by Becker (1991), who also examined a large number of social behaviours (such as discrimination, criminality and education) from the perspective of economic rationality.[1]

The basic principle of micro-economic analyses is to consider the household as a relatively autonomous economic unit, endowed with objectives, constraints and strategies. Children belong to goods produced by a specific household economy, which rests in particular, on the time availability of its members. The family is therefore, subject to a budgetary constraint in terms of income and time. Each family attempts to maximize its well-being, which will be a function of its consumption and of the number and 'quality' of children, upon which depend the investments made for the child in matters of health or education. The historical evolution of fertility will be conditioned notably by the rise in productivity affecting the individuals of the household and the declining cost of investments (rise in life expectancy, development of health and education infrastructures, etc.). Thus, fertility would be, in the last instance, an adjustment of households to the changing living conditions, reflected above all by the price system. It suggests that in India, the fall in fertility will be primarily stimulated by economic progress, which will bring about an increase in the relative cost of children.

The synthesis model proposed by Easterlin et al. (1980; 1985) goes farther, combining demand for children to supply factors, which tally more with demographic mechanisms properly speaking.[2] The supply of children represents, in effect, the result of the infant or childbirth and death levels. In a traditional demographic regime, the supply of children can be lower than the demand because of the effects of mortality and can encourage maximal fertility so as to raise the number of surviving children. This has been frequently evoked in the case of India as regards the

[1] Various aspects of Becker's theories, notably on fertility and nuptiality, are collected in Becker (1991).

[2] See also Pollack and Watkins (1993). For a recent critical appraisal of the economic theory of fertility, see Robinson (1997).

minimum number of children to be born to ensure the survival of a son.[3] In a 'traditional' regime, these attitudes define a very high demand of children, often not fully satisfied, on the basis of which a vigorously pro-birth normative system will be formed. This supply function makes it possible to account for the initial increase in fertility, which precedes the beginning of a fall and is related to behavioural changes in breastfeeding, post-partum taboo, effect of nutrition, etc. During this period, the supply of children is growing and even reaches a point at which it exceeds the formerly unsatisfied demand. This phase of prior increase in fertility was, in fact, observed in India (Srinivasan and Jejeebhoy, 1981). Increasing fertility during the pre-transitional period can, moreover, give rise to an initial demand for the reduction of offspring, facilitating the early introduction of family planning on a larger scale.

Easterlin's (1980; 1985) theory incorporates more directly the effect of family planning, which constitutes a third dimension (after supply and demand of children) in the model: the costs of fertility regulation. A birth-control programme thus results in the reduction of market costs of contraception through diffusion of information and contraceptive products. However, it also reduces 'psychic' costs by gradually legitimating an innovative practice which traditional society could previously condemn.

The progressive reduction of the fertility norm, registered by the number of children desired by women according to generation, expresses this continual change in India, as much as it manifests the fall in demand. In any case, it will be noted that the norm remains systematically higher or equal to two children, whereas the fertility observed in numerous regions of south India seems to be actually less than two.

Table 13.1 contains data according to age of the ideal number of children in 1998–99 and makes it possible to examine in detail certain discrepancies in the south. In Tamil Nadu, the fertility norm is totally adjusted to two children per woman among women less than 40 years, whereas the actual fertility attained in parts of Tamil Nadu approaches 1.5 children per woman. In Kerala, the ideal number of children is significantly higher than in the rest of south India, and definitely higher than the actual level of fertility observed during the last 10 years. Among the oldest women in the sample (45–49 years), the ideal number of children is on average of 2.6 in the southern states (to which Goa is added). The last figure is however, significantly lower than the actual number of children born of women of these generations—around three to four children according to the state. The oldest women in the survey have thus adjusted *ex post* the ideal number of children to the contemporary norm.

Table 13.1: Ideal Number of Children per Woman Classified by Age Groups

	Age Group						
State	15–19	20–24	25–29	30–34	35–39	40–44	45–49
Goa	NA	2.3	2.1	2.1	2.3	2.6	2.6
Andhra Pradesh	2.2	2.1	2.3	2.4	2.6	2.8	3
Karnataka	2.2	2.2	2.1	2.2	2.2	2.3	2.3
Kerala	2.9	2.4	2.4	2.4	2.6	2.7	2.7
Tamil Nadu	2.0	2.0	2.0	2.0	2.0	2.1	2.2
South India	2.2	2.1	2.2	2.2	2.3	2.5	2.6
India	2.5	2.5	2.6	2.7	2.7	2.8	2.9

Source: IIPS (2000).

It therefore appears to be clear that the norm as collected in such a survey remains a very fluid notion, which can be slightly higher than future fertility among the youngest and significantly lower than the completed fertility among the oldest women. It only imperfectly encompasses reproductive behaviour; one finds there both the theoretical intentions of couples among the youngest age groups, and the *ex post facto* rationalization for the oldest, as well as the effect of official discourse on the social behaviours considered to be adequate.[4]

The Role of Family Planning and Social Institutions

The model proposed by Easterlin (1980; 1985) stimulated discussion on the effects of supply of family planning, because for some, the availability of contraceptive means was a crucial factor in the fall of fertility in southern Asia, whereas for more orthodox analyses, the demand for contraceptives governed the supply. This question is of considerable importance in India, for among the developing countries it has the longest history of family planning policies. The system put in place in the 1950s was, in effect, progressively expanded, enhanced and improved, avoiding—except during the state of emergency in 1975—recourse to overtly authoritarian policies.

[3] For example, May and Heer (1968) estimated in the 1960s that an Indian couple needed six children to be absolutely certain to have one surviving adult son.

[4] For a more general discussion of the use of information on the desired fertility, see Pritchett (1994).

Family planning in India adopted the contours of the health policy, placing the accent on the greater availability of contraceptive means to the populations and benefited, since the 1970s, from the genuine support of a succession of different governments.[5] However, the role attributed to public policies in the demographic changes in the developing world is very diversely evaluated according to observers, and it also remains extremely difficult to demonstrate the autonomous role of contraceptive supply in the individual choices recorded in surveys.

In India, and particularly in certain parts of south India, such as Tamil Nadu (Srinivasan, 1995: 248–62; Antony, 1996), it has often been suggested that the success of family planning depended more on the efficiency of the regional administration than on social or economic changes in the population. This thesis in part conforms to considerations relating to the unexpected drop in fertility in Bangladesh, interpreted by some as resulting of a particularly efficient government intervention.[6]

The effort involved in family planning remains very difficult to evaluate and is often measured in terms of the rate of contraceptive prevalence, an indicator which reflects both supply and demand. Analyses tend sometimes to interpret the fertility decline, or the rise in contraceptive prevalence, as an illustration *ex post* of the success of family planning policies. On the state level, the performances as regards fertility decline of Kerala and Tamil Nadu, on the one side, and the Bimaru states, on the other, are sometimes cited as evidence of the action of the respective governments and of the quality of the health system. The quality of the family planning infrastructure is often assessed in a qualitative manner, through monographic surveys at the ground level. The picture that emerged from these studies is often 'gloomy' with respect to access and availability, quality and implementation (Foo and Koenig, 2000). For Tamil Nadu, a state whose fertility decline is supposedly due to the effectiveness of its family welfare programme, in-depth surveys such as those by Sundari Ravindran (1999) tell a different story, stressing the severe limitations of the mother and child health and family planning system. It is, however, only when comparable data are made available, that the situation in south India

[5] The history of family planning in India has, of course, fluctuated, having known ups and downs as well as several changes in orientation. See, for example, Narayana and Kantner (1992) and Gupta (2000: 198–227).

[6] There are, however, conflicting views on the actual role of the family planning programme and on the impact of other societal changes in Bangladesh. See Cleland et al. (1994) and Caldwell et al. (1999).

may appear significantly better than that obtained in other states (see for instance, Roy and Verma, 1999).

The cartographic analyses of fertility, however, indicate that the boundaries of demographic change have rarely coincided with the administrative borders of the states in which family planning policies are implemented. To come back to Tamil Nadu's case, the exceptional decline identified in the Kongu Nadu region, of which we shall speak below, is opposed to a slower movement in other parts of the state, such as the Palar valley (Vellore region) which is not distant from Kongu Nadu. It would be difficult to interpret this spatial patterning within Tamil Nadu as a reflection of variations in the functioning of the health administration. Conversely, strong demographic similarities are observed on either side of the state boundaries, as between Tamil Nadu, on the one side, and Kerala or Andhra Pradesh, on the other. The presumed specificity of regional administration in Tamil Nadu has apparently no discernible role in the differences between the states. The analysis of data from the Reproductive and Child Health (RCH) survey will make it possible to approach this question again below.

From a theoretical point of view, the hypothesis of an endogenous change in the system of preferences as made by Easterlin (1980; 1985) is not without hazard. This system of preferences, purportedly exogenous in classical economy, in fact defines the manner in which the actors choose to distribute their choices and in particular to determine their demographic behaviour in a given context. If the system of preferences can evolve according to societal changes, as Easterlin suggests (ibid.), economists could find themselves facing a Pandora's box: social transformations governing the system of preferences respond to very different dynamics of a more sociological than economic character. The changes in the preference of couples or women, a matter of inclination or of choice, consequently elude the analysis and are more directly a matter of social mechanisms. As the measure of the familial norm in India shows, these notions can be difficult to study. For his part, in a study concerning India (Easterlin and Crimmins, 1985: 148–76), Easterlin confines himself to a quite simplistic formulation, basing himself on the all-purpose concept of 'modernization', or the mere evocation of a change of 'inclinations' to the detriment of preferences for large families. His model is thus very imperfectly tested in the Indian situation.

The weakness of the direct application of micro-economic theories in the case of India stems from the partly ahistoric and asocial character of

the modelling used.[7] The particularism of local institutions, the family first and foremost, must absolutely be taken into account, and India provides on this point an extremely diversified cultural and historical framework. The traditional pro-birth ideology which has been able to take precedence in India can be considered as the product of an ancient patriarchal system which endorses male domination in the traditional systems of production. The new familial models, encouraging the diminution of fertility, as well as the nuclearization of households, would thus have been imposed owing to a restoration of the balance in the power structures between men and women, between town and country dwellers, between wage earners and big landowners, etc.

The cogency of traditional models would explain to a large extent the variable rate of fertility decline according to region in India. Where traditional models have best resisted, the place of the woman remains marginal in the economy and the levels of human development have scarcely progressed. For the women, their role in the reproductive sphere is essential and encourages high fertility. In addition, the preference for male descendants constitutes an important dimension of the Indian patriarchal system and can tend to increase the pressure on fertility.

The pioneering chapter by Dyson and Moore (1983), underscoring the division between the north-west and south-east poles which structure Indian cultural space, sets the states in the north against those in the south on several points: linguistic situation (Indo–European as opposed to Dravidian languages), historical influence (Muslim invasion in the north, Christianization in the south), agricultural tradition (cultivation of dry cereals in the north as opposed to rice-growing in the south), kinship system (exogamous in the north, endogamous in the south), etc. This analysis brings up 'female autonomy' as the key concept of these differences, and consequently the unequal influence of patriarchy in India. The interregional differences in fertility are thus interpreted as consequences of different social systems, the foundations of which rest upon specific cultural traditions.

The emphazis on social structures accounts for interregional differences, but responds less well to the question of social change, affecting both traditional structures and the reproductive behaviours linked to them. This is become institutional evolution is not necessarily linear in India, proceeding in the sole direction of western-type 'modernization'.

[7] Folbre (1996) offers several valuable theoretical insights on the way to expand the economic approach to the functioning of local institutions.

The growth of female discrimination or the fall in rates of female participation among educated women, are examples of changes which sometimes do not follow the expected path and could, in theory, increase rather than lower the number of children.

Modelling Fertility from the 2001 Census Data

Given here are the results of a preliminary analysis based on provisional results of 2001. The analysis pertains to the districts in the census of 2001, from which have been removed 17 districts.[8] The data are shown in Table 13.2. Several variables, such as urbanization or literacy, come directly from the census of 2001. The data on fertility, corresponding to the period 1994–2001, have been estimated on the basis of the proportion of children of at least seven years of age, and on child mortality in the regions considered in a separate study. The child mortality level by district was also estimated in that work (Guilmoto and Irudaya Rajan 2002).

Several important control variables, however, such as the religious composition of the district, rely on data that are only available for 1991. It will be several years before those for 2001 are published. We have chosen to estimate them by employing the data from 1991 and using the following method: in the 351 districts which did not change between 1991 and 2001, the value for 1991 is retained. In the 226 districts in 2001 which came from a single district in 1991 (the 1991 district most often being divided in two or three districts in 2001), the value of 1991 is attributed to the new districts. As to the 16 new districts in 2001 that were formed on the basis of several districts in 1991, we have simply calculated the average value for the different district components in 1991 and have applied it to the new districts. This calculation was made for variables of a very high demographic stability, such as religious composition. It goes without saying that such estimation, relying on figures from 1991, would be inadvisable for phenomena that evolve very rapidly, like fertility or literacy.

An additional source of data proceeds from results, also provisional, of the RCH survey. This survey, financed by the World Bank, was carried

[8] There were 14 districts in Jammu and Kashmir that were not available in 1991, while another three districts were not covered in the census of 2001, or by the RCH survey in 1998–99 (viz. Kinnaur, Kachchh and Kokrajhar).

Table 13.2: Description of Variables Used in the Regression Analysis

Variable	Description	Source	Mean	Standard Deviation	Maximum	Minimum
Population	district population (000s)	Census 2001	2,776	1,779	31.3	9,638
Density	population density	Census 2001	1,262.0	3,683.3	2.0	29,395.0
Urban	proportion urban	Census 2001	0.278	0.221	0.000	1.0
Child sex ratio	girls below 6/boys* 1,000	Census 2001	0.928	0.045	0.754	1.036
Literacy	literacy rate	Census 2001	65.1	12.7	30.0	96.6
Male literacy	male literacy rate	Census 2001	75.8	10.8	39.6	97.6
Fem literacy	female literacy rate	Census 2001	53.8	15.5	18.5	96.1
Literacy sex ratio	female/male literacy rate* 1,000	Census 2001	0.697	0.124	0.395	1.099
Dalit	% of total population	Estimated from 1991 census	16.1	7.4	0.0	51.8
Tribal	% of total population	Estimated from 1991 census	8.7	15.2	0.0	98.1
Hindus	% of total population	Estimated from 1991 census	81.9	15.4	1.8	99.5
Muslims	% of total population	Estimated from 1991 census	12.2	11.2	0.0	94.3
Christians	% of total population	Estimated from 1991 census	2.3	7.9	0.0	97.5
Female workers	female participation rate	Estimated from 1991 census	21.8	12.6	1.8	60.1
Marriage age	female age at marriage	Estimated from 1991 census	17.7	1.1	14.9	20.9
Survival	proportion surviving below 7	Estimated from 1991 census and SRS	0.925	0.033	0.827	0.998

(Table 13.2 contd)

(Table 13.2 contd)

Variable	Description	Source	Mean	Standard Deviation	Maximum	Minimum
TFR 01	total fertility rate	Estimated from 2001 census	3.23	1.06	1.33	5.79
Tetanus	% pregnant women inoculate three antenatal check-ups	RCH survey 1998–99	66.6	18.5	7.2	98.4
Antenatal	% pregnant women who had against tetanus	RCH survey 1998–99	46.9	30.4	1.9	100.0
Inst. Deliveries	% institutional deliveries	RCH survey 1998–99	37.3	25.3	4.0	100.0
Immunization	% of children fully immunized	RCH survey 1998–99	57.9	23.9	1.6	99.5
Current users	% couples protected	RCH survey 1998–99	45.2	16.9	1.6	81.5
Sterilization	% couples protected by sterilization	RCH survey 1998–99	34.4	16.1	0.2	72.7
IUD	% couples protected by IUD	RCH survey 1998–99	2.0	2.2	0.0	12.4
Other methods	% couples protected by other methods	RCH survey 1998–99	8.6	9.5	0.0	52.3
Health workers	% rural women visited by health worker during the last 3 months	RCH survey 1998–99	18.4	16.4	0.0	87.0
MCH index	principal component (see text)	Estimated from RCH data	0.000	1.811	–3.901	3.741
SRS index	principal component (see text)	Estimated from RCH data	0.0	1.9	-4.0	4.1
Bimaru	Bihar, Madhya Pradesh, Rajasthan, Uttar Pradesh	1991 boundaries	0.416	0.493	0.000	1.000
South	Andhra Pradesh, Kerala, Karnataka, Pondicherry, Tamil Nadu		0.220	0.415	0.000	1.000

out in two phases in 1998 and 1999, each round covering approximately 250 districts spread throughout all states.[9] The provisional results suffer from two defects. In the first place, the choice of available variables is limited and the available variables can differ between the two rounds. We have, therefore, retained only the variables that are identical in both rounds.[10] In the second place, the districts encompassed in the RCH survey number 504; from which two districts (Kargil, Kokrajhar) are excluded where the survey was not carried out. This division straddles the administrative divisions of 1991 (466 districts) and of 2001 (593 districts). We have consequently used the same technique as earlier to calculate the values of the districts in 2001: in the new districts, the value is deduced from the value of the district(s) from which they issued. Despite the difficulties connected with the specific format of the provisional data from the RCH survey, the originality of certain data by district justifies this effort.

We have, in particular, calculated the mother and child health (MCH) index on the basis of a factor analysis (principle components method). We avail of several indicators of good quality of maternal and infant care, corresponding also to the prenatal period, as well as to delivery and follow-up. The individual quality of these data is variable (sometimes shaky), but factorization had the natural effect of eliminating aberrant values. The variables employed for the factor analysis are strongly inter-correlated as shown by results of the factor analysis summarized in Table 13.3.

Table 13.3: Results from Principal Components Analysis Applied to Reproductive Health Variables form the RCH Survey

Eigen value of the first component	3.28141
Proportion of variance explained	82.04%
Correlation with original variables	
Tetanus	0.48244
Antenatal	0.51401
Institutional Deliveries	0.50036
Immunization	0.50268

Source: computed from RCH survey data.

[9] At time of preparing this analysis, the results were on the following web site: http://mohfw.nic.in/fsnfhs. I thank Dr K.N.M. Raju for detailed information on the functioning of the survey.

[10] A simple analysis of the variation (ANOVA) between the two rounds made it possible to eliminate several variables, the results of which varied very significantly from one round to the next.

Analysis and Results

The method employed here is initially a classical regression. However, in distinction to numerous analyses, we have systematically weighted the analyses of the demographic weight of the districts. This decision made it possible to compensate for the inadequacy of certain statistics in the less populated districts, notably in north-east India and Kashmir. Table 13.4 presents the first results. The first model used a large set of socioeconomic variables. As is seen, the results of the regression are quite encouraging and are oriented in the direction intuitively expected. The most significant variable is the literacy SR, which represents equality of access to education. On the other hand, the literacy level among men, used as a control variable to represent the level of global or district economic development, has no measurable effect on fertility.

Table 13.4: Results from Regression Analysis of Fertility Rates. Socioeconomic Variables and Regional Dummies

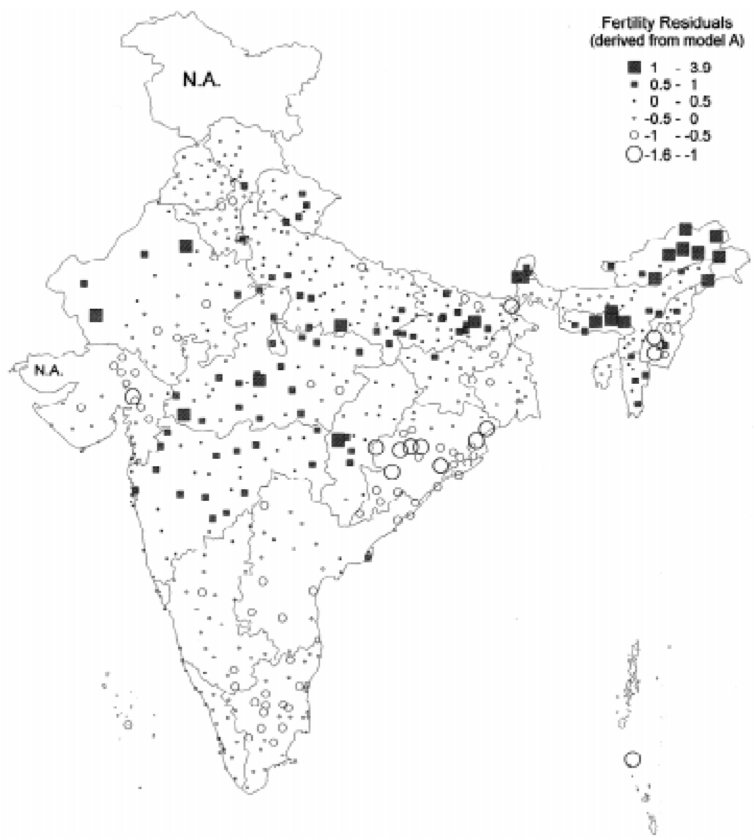
	Model A TFR 01			Model B TFR 01		
Variable	Co-efficient	*t*	P(*t*=0)	Co-efficient	*t*	P(*t*=0)
Male Literacy	0.001	0.200	0.840	–0.014***	–6.250	0.000
Urban	–0.175	–1.220	0.223	–0.307***	–2.880	0.004
Muslims	0.017***	7.570	0.000	0.015***	8.910	0.000
Christians	0.016***	5.420	0.000	0.014***	6.330	0.000
Dalit	–0.003	–0.930	0.352	–0.001	–0.350	0.729
Tribal	0.004	2.240	0.026	–0.001	–0.970	0.335
Child sex ratio	–2.725***	–5.290	0.000	–1.731***	–4.330	0.000
Female workers	–0.017***	–8.280	0.000	–0.002	–1.040	0.298
Literacy sex ratio	–5.868***	–19.900	0.000	–2.751***	–10.790	0.000
Density	0.000	–0.070	0.945	0.000	0.080	0.937
Survival	–8.129***	–9.230	0.000	–4.095***	–6.080	0.000
Bimaru				0.787***	16.910	0.000
South				–0.505***	–10.470	0.000
Constant	17.532***		0.000	11.301***	16.360	0.000
N	576			576		
r^2	0.811			0.902		

Significance levels: *** = 1%; **= 5%; *=10%.

The religious variables seem to play a very important part in regional variations. Although this has long been established as regards Muslims, the high fertility among Christians should be noted here. This makes itself felt particularly in the few districts where Christians represent more than 10 per cent of the population in north-east India, in Kerala and in Goa, as well as in other districts in Tamil Nadu, Jharkhand and Orissa. The proportion of Dalits or tribals has the effect of only a minimal increase in fertility, which can in part be attributed to the introduction of the Christian variable. The participation of women apparently plays an important role in the lowering of fertility, as well as the level of child survival, a variable which will be analyzed in greater detail below.

Despite the number of socioeconomic variables employed, substantial differences remain which can be examined more precisely in Map 13.1. This map shows the residuals of fertility for each district, calculated after

Map 13.1: Fertility Residuals after Controlling for Socioeconomic Factors (Model A)



application of Model A. These residuals are expressed in children per woman, as fertility: the positive values correspond to fertilities higher than those expected from the statistical model. This is notably the case in certain states such as Arunachal Pradesh, Meghalaya or Sikkim. Bimaru states, from Rajasthan to the former Bihar (comprising present day Jharkhand) are characterized by a higher fertility than predicted by the model. The negative deviations are observable throughout south India, as well as in states such as Gujarat or Manipur. The situation is particularly notable in Orissa, as the estimated fertility in 2001 is often lower by more than one child per woman compared with predicted fertility. Even though the geographic picture of these deviations is complex (see the analysis of spatial autocorrelation below), it is obvious that the geographic particularism of fertility accounts for some of the model's distortions.

These observations justify the enhancement of this first model so as to account for this phenomenon by introducing two regional dummies: one for the south and another for the Bimaru states (see Table 13.2).[11] The two geographic variables tend to considerably clarify the links between socioeconomic variables and fertility. More than 90 per cent of the variance between districts is now accounted for by Model B, which constitutes a very high value for only seven significant socioeconomic indicators. In fact, urbanization and the level of male education have henceforth a negative effect on fertility, as was expected. This corresponds to the only variables with an economic dimension that we have been able to include in the model, and which would no doubt merit being complemented from this point of view by other development indicators.[12]

The effect of the proportion of tribals completely disappears subsequent to the introduction of the two regional variables. It is seen that the coefficient of adjustment also decreases for numerous variables, indicating that regional patterning was responsible for part of the statistically measured effect in the first regional model. This is the case for the gender variables, such as the preference for boys (child SR) or female education. The impact of female activity on fertility, for its part, becomes entirely imperceptible. These are variables for which the opposition between the patriarchal forms in the north and the south is very pronounced. Also to be noted is the significant diminution of the effect of mortality on fertility, suggesting that the regional North-South differences determine a significant part of the co-efficient estimated in the first model.

[11] We have nonetheless, refrained from multiplying ad hoc geographic dummies, avoiding in particular the individualization of states like Orissa.

[12] The comparison with other models suggests the potential role of other variables such as the prevalence of the joint family, the role of agriculture, the level of development, etc. Unfortunately, we could not estimate such values for 2001.

In conclusion, in Model B, the specificity of the regional demographic regimes, here summarized in three types (South; Bimaru states; remainder of India), becomes evident in a striking manner and redefines the relations initially brought to light.

A Closer Examination of Fertility and Reproductive Health

A closer examination of the variables used in our analysis suggests that some of them may play an ambiguous role in determining fertility variations. It may be that some of these factors are at the same time a cause as well as a consequence of fertility decline. Child mortality is a case in point, as parents with less children tend to spend more time and other resources on their well-being, improving their survival further. This is the trade-off between quality and quantity of children derived from Becker's (1991) theories: a choice of high fertility implies a lesser amount of resources devoted to the children's well-being. In case of this equivocal relationship between fertility and child mortality, the latter may end up being an endogenous variable in our model. The usual way to solve this problem is by replacing the endogenous variable (here child survival) by an instrument, i.e., a variable that is strongly correlated with it but not associated with the dependent variable (here fertility). Using the RCH data, we identify the percentage of institutional deliveries (in hospital, dispensaries, etc.) as an adequate instrument for child survival. We now have a simultaneous system with two equations in reduced form, one for child survival and the other for fertility.

Table 13.5 presents the result of the two-stage least squares regression performed. The first Model C shows the result of the first regression, used to instrument child survival using the proportion of institutional deliveries. However, we also have to use the other explanatory variables from our model as instruments in this first equation. As is shown, the proportion of institutional deliveries provides an adequate instrument ($t = 4.8$). When introduced in the fertility equation, this instrument performs reasonably well and turns out to be highly significant (Model D). This confirms that the impact of child mortality levels on fertility is no artefact of an endogenous variable.

Table 13.5: Results from Two-stage Regression Analysis of Fertility Rates. Test of Endogeneity of the Survival Variable

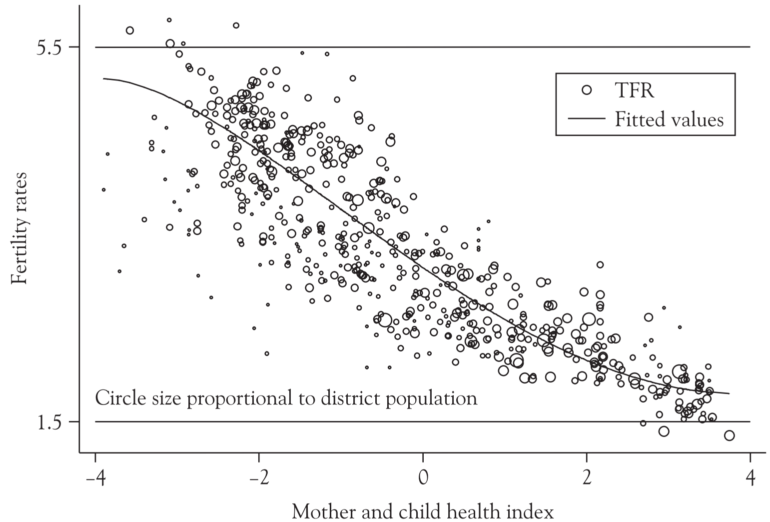
	Model C Survival			Model D TFR 01		
Dependant Variable	Co-efficient	t	P(t=0)	Co-efficient	t	P(t=0)
Male Literacy	0.000	0.860	0.389	−0.009***	−3.020	0.003
Urban	0.006	0.860	0.392	−0.125	−0.840	0.400
Muslims	0.000	−1.110	0.269	0.013***	5.900	0.000
Christians	0.001***	4.430	0.000	0.022***	5.620	0.000
Dalit	−0.001***	−3.540	0.000	−0.009**	−2.170	0.030
Tribal	−0.001***	−6.470	0.000	−0.010***	−2.900	0.004
Child sex ratio	0.013	0.520	0.604	−1.450***	−2.800	0.005
Female workers	0.000	1.010	0.312	−0.001	−0.260	0.794
Literacy sex ratio	0.053***	3.400	0.001	−1.941***	−4.590	0.000
Density	0.000	1.070	0.285	0.000	0.900	0.369
Bimaru	−0.019***	−6.650	0.000	0.505***	4.520	0.000
South	−0.009***	−2.920	0.004	−0.552***	−8.710	0.000
Inst. Deliveries	0.000***	4.820	0.000			
Survival/instrument				−16.635***	−3.870	0.000
Constant	0.873***	36.580	0.000	22.010***	5.950	0.000
N	576			576		
r^2	0.619			0.841		

Significance levels: *** = 1%; **= 5%; *=10%.

A similar analysis is now conducted using some additional data from the RCH survey. This should help us assess the independent impact of the health services on fertility, an issue that has been seldom statistically explored for want of adequate data at the national level. As the RCH survey offers the most comprehensive database on health services in districts, it is very tempting to confront it with socio-demographic data from other sources, such as the census. We started with the observation that our MCH index was strongly correlated with our census-based fertility estimates.

In Figure 13.1, district values have been plotted, with circles of size proportional to the district population. There is indeed a close agreement between the quality of MCH services and low fertility. The fitted curve shows a logistic relationship existing between the two variables, with TFRs declining roughly from 5.5 to 1.5 children per woman as the quality of

Figure 13.1: Fertility (TFR) and Reproductive Health (MCH) Index, Indian Districts, 1998–99



reproductive health services improves. This is reflected in a strong correlation co-efficient (r= −0.898).

As shown in Table 13.6 (Model E), MCH does appear to have a powerful impact on fertility (t<−8) when added to our previous models. However, it remains to be seen whether the quality of MCH services plays a really independent role in fertility. The question is whether it is feasible to distinguish fertility from our index of reproductive health.

The MCH index was constructed using indicators of ante- and postnatal care: tetanus injection, antenatal check-ups, deliveries in hospital and other institutions, child immunization (see Table 13.3). It cannot therefore be construed as a proximate variable of fertility in the manner that age at marriage, contraceptive use or child mortality could be. However, there is again a real possibility of simultaneity: fertility and reproductive health may be linked to the same phenomenon of changing reproductive practices and therefore, strongly correlated. In such a case, MCH would not be an exogenous variable and would simply display the same variations as fertility.

This simultaneity hypothesis was examined with the same technique of two-stage regression as was done previously. To do that, we identified another variable from the RCH survey as a potential instrument for MCH, viz. the proportion of women in rural areas who reported a recent visit by

Table 13.6: Results from Two-stage Regression Analysis of Fertility Rates. Test of Endogeneity of the Reproductive Health Index

Dependant Variable	Model E TFR 01			Model F MCH index			Model F TFR 01		
	Co-efficient	*t*	P(*t*=0)	Co-efficient	*t*	P(*t*=0)	Co-efficient	*t*	P(*t*=0)
Male literacy	−0.009***	-4.440	0.000	0.026***	5.910	0.000	−0.017***	−3.630	0.000
Urban	-0.151	-1.470	0.141	0.896***	4.100	0.000	−0.429**	−2.280	0.023
Muslims	0.012***	7.810	0.000	−0.014***	-4.130	0.000	0.016***	5.630	0.000
Christians	0.011***	5.360	0.000	−0.013***	-2.980	0.003	0.016***	4.480	0.000
Dalit	-0.002	-0.940	0.346	-0.005	-0.990	0.323	0.000	-0.090	0.930
Tribal	-0.004**	-2.570	0.010	−0.012***	-4.170	0.000	-0.001	-0.260	0.797
Child sex ratio	-1.326***	-3.470	0.001	2.476***	3.040	0.002	-1.951***	-3.400	0.001
Female workers	0.000	-0.190	0.851	0.004	1.250	0.213	-0.002	-0.780	0.437
Literacy sex ratio	-2.219***	-8.880	0.000	3.270***	6.260	0.000	-3.009***	-5.160	0.000
Density	0.000	1.040	0.298	0.000	1.390	0.166	0.000*	1.880	0.060
Survival	-3.001***	-4.610	0.000	6.844***	5.000	0.000	-4.907***	-3.810	0.000
MCH index/instrument	-0.159***	-8.170	0.000	0.104	0.680	0.497			
Bimaru	0.652***	13.870	0.000	−0.787***	-8.200	0.000	0.874***	6.350	0.000
South	-0.278***	-5.200	0.000	1.392***	13.620	0.000	-0.686***	-2.980	0.003
Health Workers				0.008***	3.470	0.001			
Constant	9.224***	13.150	0.000	-13.031***	-9.280	0.000	12.674***	5.950	0.000
N	576			573			573		
r^2	0.912			0.855			0.883		

Significance levels: *** = 1%; ** = 5%; * = 10%.

health workers.[13] The way the information is canvassed in this question suggests that visits by health workers do not depend on women's needs or requests, but on the frequency of actual visits and ultimately on the quality of health coverage in the area. It may therefore be assumed that this variable is strictly exogenous.

This variable is significantly correlated with MCH as shown in Model F in Table 13.6. As done previously, all other (exogenous) regressors of fertility are used in the computation of the instrument. But the final result (Model G) is different, as it shows the effect of the MCH index to vanish entirely when an instrument is used, instead of the original variable. As with other cases of two-stage regressions, this result depends heavily on the quality of the instrument selected, but the result of the regression of the reduced form seems straightforward, as the co-efficient of the MCH index is not more significant. It is, therefore, safe to assume at this point that the quality of health services as measured by the MCH index has no independent impact on fertility.

There is, on the contrary, a strong possibility of simultaneity which remains to be fully explained. As much more RCH data will be available in the near future, a brief interpretation of our results may suffice at this junction. We believe that the results indicate that the MCH index does not act as a pure supply variable linked to the quality of services to mothers and children provided by the health system (be it public or private). The use of these services may be less related to their availability and quality than to the actual demand for them expressed by fertility-regulating women. Women using health services during the ante- and postnatal period are precisely the women who have reduced their fertility.

This suggests that the supply of health services per se has little or no independent impact on reproductive behaviour. We have also tested another health variable, namely, the frequency of visits by health workers used in the previous two-stage regression. We find once again, no significant effect (results not shown here). These observations confirm that women who make use of reproductive health services are women who have already opted for fertility regulation and that no additional impact related to health supply factors emerges from the RCH district data.[14]

[13] The exact wording of the question is: 'did the auxiliary nurse-midwife or any health worker visit your household during the last three months?'

[14] Thanks to Virginie Chasles for her personal comments based on her ongoing fieldwork in rural Andhra Pradesh.

A Comparative Analysis for 1981–2001

The discussions concerning the model based on the data from 2001 can be enhanced through the comparison with other models derived from the censuses of 1981 and 1991, insofar as these models integrate certain data that are not available for 2001. We start here with five models of district-level fertility, pertaining to the period preceding the corresponding censuses. To this, we have added by way of comparison an analysis of fertility differentials in south India for 1991, employing an indirect indicator of fertility (CWR) on the scale of rural clusters, because they make use of new variables (see Chakrabarty and Guilmoto in this volume).

Studies by Malhotra et al. (1995) and by Murthi et al. (1995) make use of data from 1981, the latter having been enhanced by Dréze and Murthi (2001), who incorporate the estimates of 1991. Bhat's work (1996) is based on an original estimate of fertility on the basis of distribution by age in 1991, which may be the most precise, and the methodology of which was adapted for our own estimates of 2001 (Guilmoto and Irudaya Rajan, 2002).

What makes the comparison of the works interesting is the fact that the authors made use of highly varied indicators (more than 20 are tested). Of course, a few limitations of comparability should be noted. In the first place, the districts varied and the coverage of India is neither complete nor identical from analysis to analysis. In the second place, some variables designating the same phenomenon are defined in different ways. We have, however, chosen to assimilate indicators of the same nature in Table 13.7, rather than to distinguish them individually, so as to enable an easier comparison of the analyses. For the same reason, some variables of little importance appearing in the models are not included in our comparative table. To simplify the comparison, we have furthermore indicated the degree of significance on the basis of the value of the statistical relation (asymptotic *t*) by representing them in the form of arrows, reclassifying them in three simple categories. We shall, of course, refer to the original chapters for a precise definition of the variables and for a complete description of the modelling procedure followed by the authors.

These models account for 72 to 90 per cent of the variance, which is quite considerable. They project a very composite picture of the fertility determinants in India, comprising layers of very different factors which seem to have superimposing effects. It would, therefore, be difficult to interpret fertility decline as the consequence of a single factor.

Table 13.7: Models of District-level Fertility in India, 1981 and 1991

	Authors					
Explanatory Variables	Malhotra et al. (1995)	Murthi et al. (1995)	Drèze and Murthi (2001)	Chakrabarty et al.	Bhat (1996)	Guilmoto (2000)
Economic development						
Agriculture	◆	◆	◆	↑↑	◆	◆
Poverty level	◆	○	○	◆	◆	◆
Agricultural labourers	↓↓↓	◆	◆	↑↑↑	○	◆
Child labour	◆	◆	◆	◆	↑↑	◆
Agricultural productivity/irrigation	↓↓	◆	◆	↓↓↓	◆	◆
Development index	◆	◆	◆	◆	↓	◆
Banks	◆	◆	◆	◆	↓↓	◆
Male literacy (or total literacy)	↓↓↓	○	○	↓↓	◆	↓↓↓
Urbanization/proximity to nearest town	◆	○	○	↓	◆	↓↓
Average settlement size	◆	◆	◆	↓↓↓	◆	◆
Social structure						
Joint family	◆	◆	◆	◆	↑↑↑	◆
Muslims	○	◆	↑↑↑	◆	↑↑↑	↑↑↑
Christians	◆	◆	◆	◆	◆	↑↑↑
Dalits	○	○	○	○	◆	○
Tribal population	○	↓↓↓	○	↑↑↑	↑	○
Women's status						
Female mortality index (son preference)	↑↑	◆	↑↑↑	◆	◆	↑↑↑
Female participation rate	↓↓↓	↓↓↓	◆	↓↓	◆	○

(Table 11.7 contd)

(Table 13.7 contd)

Explanatory Variables	Authors Malhotra et al. (1995)	Murthi et al. (1995)	Drèze and Murthi (2001)	Chakrabarty et al.	Bhat (1996)	Guilmoto (2000)
Female exogamy	○	◆	◆	◆	◆	◆
Female literacy	○	↓↓↓	↓↓↓	↓↓↓	↓↓↓	↓↓↓
Female age at marriage	○	◆	◆	◆	○	◆
Sex ratio (F/M)	◆	◆	◆	◆	↓↓↓	◆
Ideational variables						
Educational facilities	◆	◆	◆	↓↓↓	◆	◆
Media exposure	◆	◆	◆	◆	↓↓↓	◆
Cinema	◆	◆	◆	◆	○	◆
Communication and transport	◆	◆	◆	○	◆	◆
Density	◆	◆	◆	○	↓	○
Health infrastructure						
Male child mortality (infant, below 5)	↑↑↑	◆	↑	◆	↑↑↑	↑↑↑
Reproductive health services	◆	◆	◆	◆	◆	○
Medical personnel/ health infrastructure	↓	○	◆	○	◆	◆
Spatial autocorrelation						
Index of spatial autocorrelation	↑↑↑	↑↑↑	◆	◆	◆	◆
Regional dummy variables						
Bimaru/North	◆	◆	↑↑↑	◆	○	↑↑↑
West	◆	↓↓	○	◆	◆	◆
East	↓↓	○	○	◆	◆	◆
South	↓↓	↓↓↓	↓↓↓	◆	◆	↓↓↓
Kerala	◆	◆	◆	○	○	◆
Tamil Nadu	◆	◆	◆	↓↓↓	↓↓↓	◆
Time dummy						
1991 (vs 1981)	◆	◆	↓↓↓	◆	◆	◆
Model characteristics						
Units used	districts	districts	districts	rural clusters	districts	districts
Number of units in the analysis (*n*)	358	296	652	618	326	573
Census year	1981	1981	1981 and 1991	1991	1991	2001
Adjusted R^2	0.74	0.89	0.78	0.72	0.90	0.88
Method used (LS = least squares, ML = maximum likelihood)	ML	ML	2-stage LS	LS	LS	2-stage LS
Sources	Model 6, p. 297	Table 3, p. 762	Model 3, p. 53	Table 6	Model 3, p. 141	Table **, Model 7

Notes: The significance of measured correlation co-efficients and is based on *t* values when available. (↑ and ↓ for are respectively for positive and negative correlations); ↑↑↑ significant at 1 per cent; ↑↑ significant at 5 per cent, ↑ significant at 10 per cent; ○ not significant; ◆ variable not included in the model. The definition of explanatory variables varies across models. Some variables have been omitted. For a complete definition of the variables in each model, see Malhotra et al. (1995), Murthi et al. (1995), Chakrabarty et al. (this volume), Guilmoto (this chapter), Drèze et al. (2001) and Bhat (1996).

First to be noted is the relatively modest role played by economic variables, notwithstanding their number and their variety. For example, the models of Murthi et al. (1995) and Drèze and Murthi (2001) do not identify any variable of the economic type whose effect would indicate 10 per cent. Other models identify effects linking low fertility to economic development as a whole, expressed particularly by urbanization and human capital, and more precisely agricultural development. These connections are however weaker than other statistical links brought to light, and are sometimes not significant. Strangely, poverty and unequal land-owning do not seem to be clearly associated with a higher fertility and the measurements are nil or ambiguous. The positive link between fertility and activity among children which Bhat (1996) brings to light seem, however, to indicate that on the level of households, where the advantages of child labour make themselves felt, the trade-off between pro-birth strategy and Malthusian strategy can be influenced by the possibilities of employment for children.[15]

The variables relating to the social structure of the districts, for their part, play a particularly large role in the case of Christian and Muslim religious minorities, having a higher fertility than the average. A more detailed analysis which we carried out on the basis of data from the RCH survey shows, moreover, that these communities have very different contraceptive choices than the Hindus. Thus, the Christians, the majority of whom are Catholic, practice contraception less often and, in particular, avoid sterilization. Sterilization is also less frequent among Muslims, who prefer other contraceptive measures, such as the use of condoms.

Notwithstanding their strong social identity, the Dalit populations have no specific fertility, and this result is a constant in the surveys; the high fertility of the Dalits observed in the surveys thus stems above all from their other social and economic characteristics. The picture is more ambiguous, or indeed contradictory, as concerns the tribals, for one of the analyses of 1981 attributes them a *lower* fertility. As in the case of the Dalits, it is reasonable to think that tribal fertility is not necessarily different from the average, once other characteristics are taken into consideration. This category also covers a very heterogeneous population, including a number of geographically very isolated groups which stand apart from the development in the plains, but also populations which have blended more into the social or locally majority 'mainstream', as in the north-east

[15] The variable, however, risks being endogenous, for fertility can also be interpreted as a cause of child labour.

of the country. According to the analysis by Bhat (1996), the frequency of joint families also favours high fertility (data from 1981 were used), but this variable could not be used for 1991 and 2001, nor tested in other models.

The variables of women's status undeniably occupy a considerable place in the analysis and we have chosen to present them separately, but they are for the most part ultimately a matter of social and familial institutions. They present a very coherent picture, systematically linking autonomy and the place of women in a society with low fertility. This is foremostly true of female literacy, measured after controlling for the rate for men. The connection is sufficiently established as to make long commentaries unnecessary. The local surveys illustrated by the different chapters of this work systematically confirm this link, even if in states with a high literacy level, such as Kerala, the role of this variable is gradually decreasing. In future, a more precise educational variable—such as the number of school years, as in the NFHS surveys—would be preferable to the literacy indicator. By the same token, the participation of women is an indicator which is almost systematically linked with low fertility, as was already observed in the past.

The age at marriage, which formerly represented the first of the proximate variables of fertility, is observed to play no role at all in the observed fertility levels. An illustration of this anomaly no doubt comes from Andhra Pradesh, henceforth at the forefront of fertility decline, and which is furthermore characterized by a strikingly low age at marriage for women.

The effect of female discrimination on fertility is often more open to dispute, as fertility decline may also exacerbate excess mortality among girls and selective abortion (Das Gupta and Bhat, 1997). However, the frequency of female foeticides and infanticides, which is a dramatic reflection of the preference for boys, is reflected in our child SR, which is systematically associated with a higher fertility. This clearly appears in our analyses based on data from 1981, 1991 and 2001, despite the strong decline in fertility in the Punjab, where the districts registered the most striking female deficits.

The geography of discrimination by far exceeds the borders of the Punjab to reach the states of Rajasthan, Haryana and Uttar Pradesh, where fertility decline remains on the whole quite meagre. More precise analyses, employing more homogeneous regional data, reveal a similar de-linking of high fertility and sexual discrimination. Salem, in Tamil Nadu, studied by Stéphanie Vella in this volume, is an example of a subregion which has a rather moderate fertility, but which is marked by an extremely low proportion of young girls. This explains in part why the analysis of data from south India reveals no statistical link between these two variables, as the model by Chakrabarty and Guilmoto in this volume shows (see Table 13.7). We also carried out an analysis of fertility using Model A (see Table 13.4) and only states in the north-west, including Uttar Pradesh. No link has been established between fertility and the child SR. From this one concludes that the relationship between fertility and child SR remains ambiguous. The result obtained on the all-India level thus shows a more general association between patriarchal institutions and resistance to fertility decline than a causal link between the contemporary practice of sexual discrimination and high fertility.

A disparate category of variables is grouped under the term 'ideational variables', adopting here the terminology borrowed from Cleland and Wilson (1987). These are factors related to communication, to which one has also added demographic density. None of them appears to play a real role in the decline of fertility, even if some indicators are at times associated with low fertility. This is the case for the educational infrastructures in south India, or again, the exposure to media (state-wise data from the NFHS). However, the results are limited and have not been verified in the other analyses for want of adequate data. In the case of density, the effect on fertility is weak or nil, and it is probably a question of an indicator being too crude to measure the intensity of social contacts thought to favour the diffusion of new reproductive practices. Similarly, the indicator of local transportation facilities plays no role in the south Indian sample.[16] The education of women is certainly the single most important 'ideational' variable in fertility, but it is *a priori* connected with questions of social structure and gender ratios.

The health situation is described by three variables in Table 13.7, the main one of which is of course the infant or child mortality rate which has a close and strong link to fertility. This link, moreover, is confirmed by the analyses of Drèze and Murthi (2001) and those conducted on the basis of data of 2001 (see above), which use instruments to avoid the risk of endogeneity. Fertility undeniably responds to the fall in infant mortality which gives rise to an increase in the number of surviving children. In infrastructural terms, no major effect in the presence or quality of health services emerges from the different analyses. The preceding discussion on the data of reproductive health shows that the link observed with

[16] The association between lower fertility and the transportation network (*pucca* road, bus stops) is reported both for a sample of Indian villages (Shariff, 1999: 193) and Tamil Nadu (Savitri, 1994).

fertility can be in reality, completely spurious. These observations contradict the impact ascribed to the health systems and, more broadly, to reproductive health policies, on the dynamics of fertility decline.

The geographic variables, on the other hand, play a considerable role in the determination of the fertility differences between districts. This observation is sometimes directly tested by integrating spatial autocorrelation (measured by simple matrices of contiguity between districts) in the analyses, as has been done in two analyses presented here. The use of regional dummies has been generalized in the analyses and the specificity of the two regional groups (north and south) is brought to light. The more precise de-linking can cause other regional particularisms to appear, notably as regards the low fertility in Tamil Nadu. Notwithstanding the increase in number and the diversification of variables tested, the analyses come up against strong regional patterning.

Belonging to a given regional unit, such as the south, encompasses a set of unobserved variables that appear closely related to fertility levels. The regional demographic regimes, therefore, seem to differ profoundly and account for persistent gaps, despite the role played by structural variables, such as education across all districts. Between the Bimaru states and south India, the residual difference reaches nearly 1.4 children per woman according to our modelling for 2001 (Model B). This figure represents not less than 43 per cent of the average district fertility in 2001, or again nearly 130 per cent of its standard. An extreme illustration of these regional gaps would consist in modelling 2001 fertility variations using only the two regional dummies, without introducing any socioeconomic variables. Such an admittedly simplistic regression nevertheless explains 71 per cent of the variance of differences in fertility, just as well as would the regression reduced to literacy and child survival. One cannot, therefore, speak of residual local variations when they are as significant as those ascribed to the main socioeconomic factors of fertility.

Limitations of the Adjustment of Model and Diffusion Processes

The strong and systematic statistical significance of regional formations, in fact, marks a relative failure in the understanding of the phenomenon, for we encounter major characteristics which are unobserved, except in a purely descriptive manner by geographical identification. In addition, the comparison of regional co-efficients from 1981 to 2001, when this is possible, indicates no relative diminution of these regional dummies and the highest figures in the calculation of the latter are, in effect, attained for our analysis of 2001. One would rather expect the decline in fertility, the rate of which is accelerating for the whole of India and is slowing for the states of Tamil Nadu and Kerala, to homogenize the regional levels of fertility.

In terms of time, we note furthermore that the relations between fertility and its explanatory factors are also variable. Thus, the study made by Drèze and Murthi (2001), which is the only one to have gathered data from two successive censuses, causes, according to model, a time dummy to appear for 1991 between –0.33 and –0.52, representing the fertility decline ascribed to temporal change alone. According to the authors, this temporal change represents not less than 50 per cent of the decline in fertility recorded between 1981 and 1991, the remainder of the decrease stemming from improvements in the level of education and mortality in childhood. Between 1991 and 2001, the spectacular progress in the elimination of illiteracy in India (an decadal improvement of 12.5 per cent) explains probably a more important part of the accelerated decrease in fertility, but the temporal factor remains. The application of the literacy and survival rates of 1991 to the models for 2001 presented above does not, in fact, account for the entire decrease in fertility observed between 1991 and 2001.

We are thus confronted with the limitations of the idea of modelling fertility as an adjustment to exogenous phenomena. The very diverse social and demographic indicators employed in the models do not succeed in major regional variations. These variations can to an extent follow from historical differences, inscribed in the social institutions of the concerned cultural areas. But they can also proceed from the specific schedule of the inception of the decline in fertility before 1970, which favoured certain pioneering regions in the south. This initial advantage seems to be integrally maintained over the years and the boundaries of fertility regions have remained fairly stable (Guilmoto and Irudaya Rajan, 2001).

The inter-temporal comparison shows moreover, that additional factors, also unobserved, explain a considerable part of the recorded decline, as is shown for the period 1981–91. An illustration of these changes no doubt reverts to the link between fertility and the education of women, which dominated all explanatory frameworks: the intercensal comparison of these links shows, for example, that this relation is far from being fixed. In the case of 1981 and 1991, the co-efficient linking female literacy decreased.[17] In other words, for a given level of education, the predicted fertility would be lower in 1991 than in 1981. A similar observation was made on the basis of geographical difference in south India. In Kerala and in Tamil Nadu, the same level of education corresponds to a lower level of fertility than in Karnataka and Andhra Pradesh (see Chakrabarty and Guilmoto in this volume).

International comparisons indicate that the usually negative relationship obtained between women's education and fertility is not of identical level or shape (Jejeebhoy, 1995).[18] Within India, this suggests that not only the 'exogenous' factors have changed, but that the responses to these factors have also evolved in a direction which generally favoured fertility decline in the 'advanced' regions or during the most recent periods. In economic terms, this relates to a change in the system of preferences mentioned earlier. These considerations lead us to a more direct reflection of the diffusion mechanisms, which could explain part of these evolutions (Cleland and Wilson, 1987).

The diffusionist approach hinges on the view that the diffusion of birth-control practices plays a crucial role in the decline of fertility, whereas it is not explicitly taken into account in economic models. Diffusion is a process through which one's demographic behaviour and attitudes are affected by those of people with whom one comes in contact and postulates that interaction networks are shaped by proximity, both social and spatial. This hypothesis is not, strictly speaking, a theory, but rather of the observation that the diffusion of demographic innovation remains socially and geographically circumscribed. In most of the known historical situations, a considerable part of the differences in schedule and in intensity of contraceptive behaviours is not explained by economical characteristics, but by social or cultural factors that shape the inception and acceleration of fertility decline. The European experience is of course well known, and can be considered on a large scale (Coale and Watkins, 1986), as well as in the case of more reduced spaces, as Bocquet-Appel and Jakobi (1996) do for the diffusion of contraception in nineteenth century's Britain.

New reproductive behaviours have gradually spread from forerunner groups, and social, cultural or geographical proximity have at times played

[17] See the results in Table 4 in Drèze and Murthi (2001: 47).

[18] About the relationship between women's education and fertility, see Bledsoe et al. (1999) and Jeffery and Basu (1996).

a more important role than economic circumstances in facilitating the diffusion. Fertility transition can thus be seen as the effect of the diffusion of new contraceptive methods and ideas, notably of information concerning contraceptive means (techniques, social legitimacy). The diffusionist model does not necessarily contradict economic theses and, on the contrary, makes it possible to describe the progressive lowering of fertility as a mechanism of information and technology dissemination (Pollack and Watkins, 1993). However, the interest in the diffusionist model is less evident for economists, for the causes of 'ideational' evolutions are difficult to bring to light. In the western world, according to the analyses of Lesthaeghe and Surkyn (1988), the two cardinal values of secularization and individuation contribute to these evolutions.

The mechanisms of diffusion, properly speaking, seem to indicate a distinct type of logic (social, spatial, etc.), eluding the classic modelling of fertility which we have examined so far. The effect of diffusion tends to be self-sustaining, according to observable social or economic conditions.[19] The recent change of dominant political ideas in India provides an example of the evolution of a secular model toward a Hindu nationalist model, which would be difficult to assign to economic or social evolutions alone. Further, the resistance to the diffusion in certain regions, such as Tamil Nadu or West Bengal, furthermore illustrates the importance of cultural and historical boundaries in the dissemination of new ideas. A more demographic example is provided by migratory clustering (migrants coming most often from very clearly circumscribed regions). The existence of strong migratory pockets, as around Thrissur, Kerala, are thus observed. The existence and location of such concentrations are only marginally explained by prevailing economic conditions which would locally favour migration. These migration pockets follow, rather, from the former existence of well-constituted migratory networks, which have spread only to a limited number of micro regions. The migratory idea therefore spread in a very uneven manner in Kerala, without a direct relation to the economic conditions which are usually thought to induce migrations.

Expressed more concretely, the diffusionist theories suggest that fertility decline is conditioned both by the date of its onset and by the capacity of the social fabric to facilitate the dissemination of social change across social groups. Fertility is most often compared to the evolution of literacy, and these two phenomena seem to be involved in a somewhat irreversible

[19] This mechanism can be related to the self-sustaining dimension of migration exemplified by the network effects (Guilmoto and Sandron, 2001).

movement, as reversions (rise in fertility or illiteracy) seem to be very rare. Evolution appears to be one-way and ought not to slow down until approaching a level of saturation, such as replacement-level fertility or universal literacy. Ultimately, the new behaviour assumes a predominant position, determining the new system of behavioural norms which condemn practices of the past. High fertility or illiteracy, once widespread, are today perceived in Tamil Nadu or Kerala as nearly deviant behaviours, attributed to or defining marginal social groups. The last generations of high fertility, born before the 1930s, have not yet passed away, but their voices are no more heard. The rapidity with which the new Malthusian norm has spread, including among women who have not applied it, demonstrates the strength of the new normative system, as we previously observed regarding the declared ideal number of children.

An expected effect of diffusion mechanisms is the dissemination within and across social groups, notably according to a top-down model. In zones where the dominant classes have seen their fertility decline most rapidly, the reduction in fertility is likely to spread to other social groups. Elsewhere, low fertility will on the contrary be limited to pioneering groups and the effects on the rest of society will be less discernible.

The figures of the NFHS-2 point in this direction, showing how the fertility of disadvantaged groups is aligned with that of the élites in the states with low fertility, whereas the differences between groups are much more pronounced elsewhere in India. This can be illustrated by comparing the case of Andhra Pradesh with the Indian average. Andhra Pradesh provides an interesting example, because fertility underwent a spectacular reduction while other indicators of social development—such as age at marriage and the elimination of women's illiteracy—lag behind the rest of India.

The data in Table 13.8 express the fertility levels in percentage of the regional average in Andhra Pradesh and in India. The rural–urban difference in Andhra Pradesh has thus gradually been brought down to approximately 10 per cent of the average fertility, while it is more than 25 per cent in the country as a whole. Illiterates also have a fertility which is only 4 per cent higher than the Andhra Pradesh average, as opposed to 22 per cent for India. Similarly, the difference between the poorest and the wealthiest groups is 13 per cent in Andhra Pradesh, as against 45 per cent in India. However, inequalities are still pronounced among Dalits and are even much more marked in the tribal populations than elsewhere in India. This latter category, as we have already noted, covers extremely diverse situations from state to state. However in Andhra

Table 13.8: Fertility Differentials in Andhra Pradesh and in India, 1998–99

	% of Regional Average	
	Andhra Pradesh	India
Urban	92.0	79.6
Rural	103.1	107.7
Education		
Illiterate	104.4	121.8
Literate, < middle school complete	98.7	92.6
Middle school complete	86.2	79.3
High school complete and above	97.8	69.8
SC	111.6	110.5
ST	122.2	107.4
Standard of living index		
Low	101.8	118.2
Medium	103.1	100.0
High	88.4	73.7
TFRs (children/woman)	100.0	100.0
	2.25	2.85

Note: TFRs expressed as percentage of the regional average.
Source: NFHS-2.

Pradesh, the tribal population as a whole suffers from major social and economic discrimination.

The latter observations show how much the decline in fertility above all rests on the dissemination of Malthusian behaviour among groups which would supposedly be economically or socially less likely to adopt them. The fertility decline has thus socially broadened. However, by the same token, diffusion has a high likelihood of being favoured by the proximity of social groups and the frequency of interaction, and we shall therefore now return to the spatial dimensions of fertility in India.

Geographical Patterning of Fertility in India

A recurrent dimension in this work is the strong geographical patterning of fertility in each of the southern states. This does not mean that the fertility levels would be homogeneous within the states, as on the contrary, major intra-regional variations can be sizeable, as for example in Karnataka (see Sekher et al. in this volume). But this means that fertility is distributed in a very organized manner over the regional territory, causing wide regions

of low or high fertility to appear, which can most often extend beyond administrative boundaries. Very few completely isolated zones, i.e., specific areas greatly differentiated from the surrounding areas, appear on the maps. The same observation, made on the national scale for the period 1951–91 (Guilmoto and Irudaya Rajan, 2001), is confirmed here by regional studies in the south and thus suggests that fertility is very homogeneous at the micro level.

Our examination first turns to the level of India as a whole, using data from 2001. More systematic analyses of spatial autocorrelation make it possible to relate the observed statistical correlation between the units of observation to the distance which separates them. If there exists a spatial autocorrelation, the nearest localities are characterized by similar levels of fertility, and the correlation between these values will thus be an inverse function of the distance.

For a more precise comparison, we computed the semivariance of district fertility, i.e., average variability for all sample pairs at a given distance.[20] The semivariance $\gamma(h)$ is equal to half the statistical variance of the sample difference for distance h. The formula used to calculate the semivariance for fertility values (fi at district i) is given below:

$$\gamma(h) = \frac{\sum_{i,j} (f_i - f_j)^2}{2.n}$$

for n pairs of locations i and j such as distance$(i, j) = h$

In the absence of spatial autocorrelation, this indicator is very similar to the overall sample variance. However, if districts are close by and fertility levels similar, $\gamma(h)$ tends to be very low. Semivariance analysis is conducted with the help of the variogram (more precisely, the semivariogram), which is a plot of semivariance vs distance for the sample districts. Intuitively, we expect the variogram to show that semivariance increases as distance between districts increases. In order to be able to compare variograms for different variables (with different sample variances), we divided the semivariance values by the overall sample variance for each variable used. Therefore, semivariance is now equal to one when there is no longer any spatial autocorrelation.

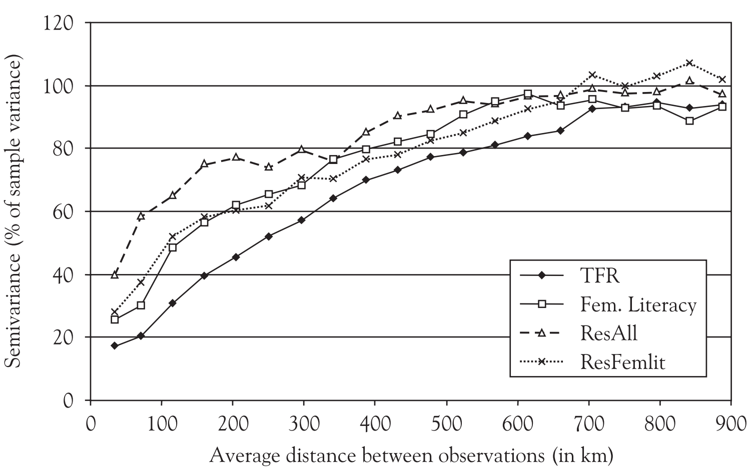
[20] On semivariograms, see for example Isaaks and Srivastava (1989).

The variogram analysis is first performed for the unweighted fertility levels for the 576 districts used in our regression analysis. This fertility indicator was then decomposed into its female literacy component and the residuals (*ResFemLit*). Female literacy is the variable most correlated to fertility levels trends ($r^2 = 0.64$) and the literacy residuals encompass other socioeconomic variables found in Model A as well as the error term. In addition, we have tested a fourth variable (*ResAll*), viz., the residuals derived from Model A that includes female literacy as well as many other socioeconomic indicators. This overall residual was already given in Map 13.1.

District localization is assumed to coincide with that of its headquarters. Distance intervals used are of 50 km, but results in Figure 13.2 are not given beyond 1,000 km (for which spatial autocorrelation has little sense). There are only 343 pairs of districts for the first distance interval, but this number increases very fast for other distance intervals. As expected, the semivariance increases regularly with distance, which demonstrates the existence of spatial autocorrelation. It also comes very close to the overall variance for the largest distance intervals.

Fertility is characterized by the greatest spatial autocorrelation because the semivariance values are the lowest irrespective of the distances. For the shortest distances, the variance between observations represents less than 20 per cent of the total variance and in part corresponds to the 'statistical noise'. By modelling these values with the help of an exponential function,

Figure 13.2: Semi-variogram of Various District Variables, 2001



this semivariance would even be only 7 per cent at nil distance (this value is termed 'nugget').

The other variables examined register higher semivariances, indicating that their degree of spatial autocorrelation is lower than for fertility. One distinguishes in the first place education and the residual term (*ResFemLit*) which is derived from it. There is no large difference between the two variables, especially for the first distance interval. For the distances of less than 200 km, literacy appears to be marginally less autocorrelated than its residual term, while beyond 200 km and up to the level of the sample variance, the reverse is true. These differences remain however nearly negligible.

The last variable (*ResAll*) is derived from Model A. The degree of spatial autocorrelation is lower, without however, being by any means negligible. As indicated in Map 13.1, this variable which corresponds to the remaining 10 per cent of the fertility variations defines particular zones which are generally well circumscribed in space.

This examination shows, first, that fertility manifests an extremely high patterning. This spatial autocorrelation cannot be solely associated with that of female education, as the latter appear less pronounced than that of fertility. This is all the more significant as indirect fertility estimates used here are probably of poorer quality than literacy proportions derived from the census. In addition, the decomposition of fertility in education effect and other effect (*resliteracy*), indicates that the two components have almost the same spatial characteristics. The non-literacy component of fertility variations display as strong spatial autocorrelation as literacy itself. This responds negatively to the underlying question: is the spatial autocorrelation of fertility only a by-product of the autocorrelation of its main determinant, that is, the education of women? This goes against a view sometimes held by geographers that fertility patterns are independent of place *per se*, but are rather produced indirectly as consequences of factors other factors that related to fertility (Compton, 1991). According to Compton's approach, spatial variability in fertility is simply an incidental outcome of the geographical patterning of social, economic and cultural attributes.

Although this may be valid for fertility in western societies, we have seen, however, that its high degree of spatial patterning in India is irreducible to its determinants, such as female literacy. A complementary analysis, which is not presented here, has also shown that the spatial autocorrelation of fertility was stronger than that of its most important proximate variables, such as child survival, contraceptive prevalence or the female age at marriage.[21] We therefore, encounter a phenomenon which is not only anchored in the historical and social geography of India, but seems more strongly organized around the principle of spatial proximity than any other variable studied. This confirms the possibility of an effect of spatial diffusion specific to fertility.

Some Hypotheses on the Inception of Fertility Decline in the South[22]

The strong association between fertility and socioeconomic variables is embedded in a specific geography of Indian society which has given the fertility decline its contours. Moreover, the process of rapid change, which has completely reshaped India's demographic scene, proceeds also along spatial lines and has probably reinforced the geographical patterning of fertility. Supported by this result, we shall shift the analysis to south India and propose a few exploratory hypotheses for the situation as observed in 1991.

The same analysis can be conducted on the scale of south India, for which we avail of data in 1991, which are spatially disaggregated. It is therefore possible to once again examine the map of fertility as a whole and that of the 'residual' after controlling for literacy.[23] The scale of analysis here will be that of rural clusters. The spatial autocorrelation is slightly weaker than for the indicators of districts and this stems notably from the quality of the data, in particular for the fertility estimated on the basis of the CWR. By omitting the urban zones from this map, for reasons of statistical comparability, we moreover block out the effect of large towns on the peripheral rural zones.

[21] Using the same procedure as for the analysis reported on Figure 13.2, the semi-variogram of all variables has been computed. The data employed come from our estimates (child survival), from the RCH survey (contraceptive prevalence) and from the 1991 census (female age at marriage).

[22] I thank Corinne Pruvost Giron for her insightful comments on this section.

[23] Fertility (CWR) was modelled here with a polynomial function of female literacy. This provides a much better adjustment than the simple linear adjustment because of the lower limit of fertility in Kerala.

The first map in Plate 8 takes up the regional data on fertility, which have already been examined for each state in the preceding chapters.[24] The lowest fertility in 1991 was concentrated in two pockets lying quite near each other, Kongu Nadu (the western part of Tamil Nadu from Coimbatore to Erode) and southern Kerala (between Kochi, Kollam and Kottayam). The highest fertility was observed, in 1991, in the Deccan Plateau, between Karnataka and Andhra Pradesh, in the regions that were for a long time under the domination of the Muslim sultanates, from Bijapur to Hyderabad. The scale chosen makes it possible to show the isolated sub-regional units, which the mapping by district entirely conceals. One thus distinguishes regions with specific populations, particularly zones with high Muslim or tribal populations, having a fertility level that is locally higher than the average.

The second map is that of female literacy. It follows a more regular geographical orientation along a downward gradient starting on the Kerala coast. Literacy thus gradually decreases as one moves farther from Kerala towards the rest of the west coast, Tamil Nadu, and the Deccan Plateau. The lowest levels (less than 20 per cent of women who can read and write) in the south are reached in the central Deccan, as well as in the tribal belt of Andhra Pradesh which borders Madhya Pradesh, Chhatisgarh and Orissa. The correspondence with fertility is not perfect, as shows the third map in Figure 13.2 which uses the residual fertility after controlling for the variable of female education.

This map refers to naturally smaller values because a significant part of the deviations has already been explained by literacy. But the specificity of certain pockets shows through. This is notably the case in the region of Tamil Nadu extending from Coimbatore towards Salem and Tiruchchirapalli, or again from another, smaller 'trough' of fertility which is located north of Andhra Pradesh (Karimnagar and Nizamabad districts). Conversely, the high residual fertility in northern Karnataka is discernible, as are other pockets such as the district of Malappuram in Kerala. The residuals of the complete regression of fertility were also mapped, using all the variables identified in the model by Guilmoto and Chakrabarty (this volume). The result is geographically the same, with Kongu Nadu and northern Karnataka standing out, even if the residual values become smaller.

[24] Fertility (here CWR) has been modelled as a polynomial function of female literacy. The fitted values are of better quality than those derived from a usual linear adjustment as fertility tends to level off in many clusters in Kerala or Tamil Nadu.

These findings highlight the particularity of the Kongu Nadu plateau in the fertility decline in south India, as well as the better-known case of southern Kerala. It is, however, difficult to ascertain if this precise geography of fertility differentials in 2001 simply corresponds to the early inception of fertility decline in these areas. In fact, the data from 1991 are the first to enable of a geographical decomposition on the village scale, and it will never be possible to estimate fertility before 1991 below the district level. We are therefore obliged to return to the district data to examine the period 1951–81 and use fertility estimates derived from a previous work. These estimates are based on the child-woman index that offers a mortality-corrected fertility indicator for five-year periods from 1951 to 1991 (see Guilmoto and Rajan, 2001).

The fertility estimates for all the districts of Tamil Nadu and Kerala have been arranged somewhat arbitrarily in three groups (see Figure 13.3), according to the level of estimated fertility for 1986–90. The first group of districts, as shown in Figure 13.3, is the core of pioneers of fertility decline. All the districts of Kerala are included in the triangle Thrissur–Kottayam–Kollam, extending to Thiruvananthapuram. In Tamil Nadu, the district of Coimbatore is identified, as well as the Nilgiris district adjacent to Coimbatore, and the metropolitan district of Chennai.[25] The Coimbatore zone was thus affected by a very early decline in its fertility, which dates, as is the case of all the districts in this first group, from the 1950s or earlier. For all the other districts, the inception of the decline is later than 1960, or indeed 1970, for the predominantly Muslim district of Malappuram that was carved out of Palakkad district in 1969.

It is not out of question that the decline in certain pioneering zones in the first group preceded independence, for the tendencies observed during the 1950s seem to already have been confirmed in several districts of Kerala, such as Alappuzha or Thiruvananthapuram, as also in Coimbatore. Such an early decline at the end of the colonial period would upset a number of ideas as to the development of demographic changes, but there is no doubt that the data from 1931 and 1941 must be carefully examined to establish the date when the decline began.[26] However, it is worth remembering that works routinely dates the onset of fertility

[25] The latter two districts are particularly affected by immigration movements and this can upset the calculation of fertility on the basis of distribution according to age.

[26] It will be noted that the data for 1931 are not available as raw data because they were smoothed by the census. The data for 1941 were only partially published because of the war. Finally, it should be mentioned that Kerala and Tamil Nadu were seriously affected by the crisis of 1942–43, which can disturb the analysis of the period 1941–51.

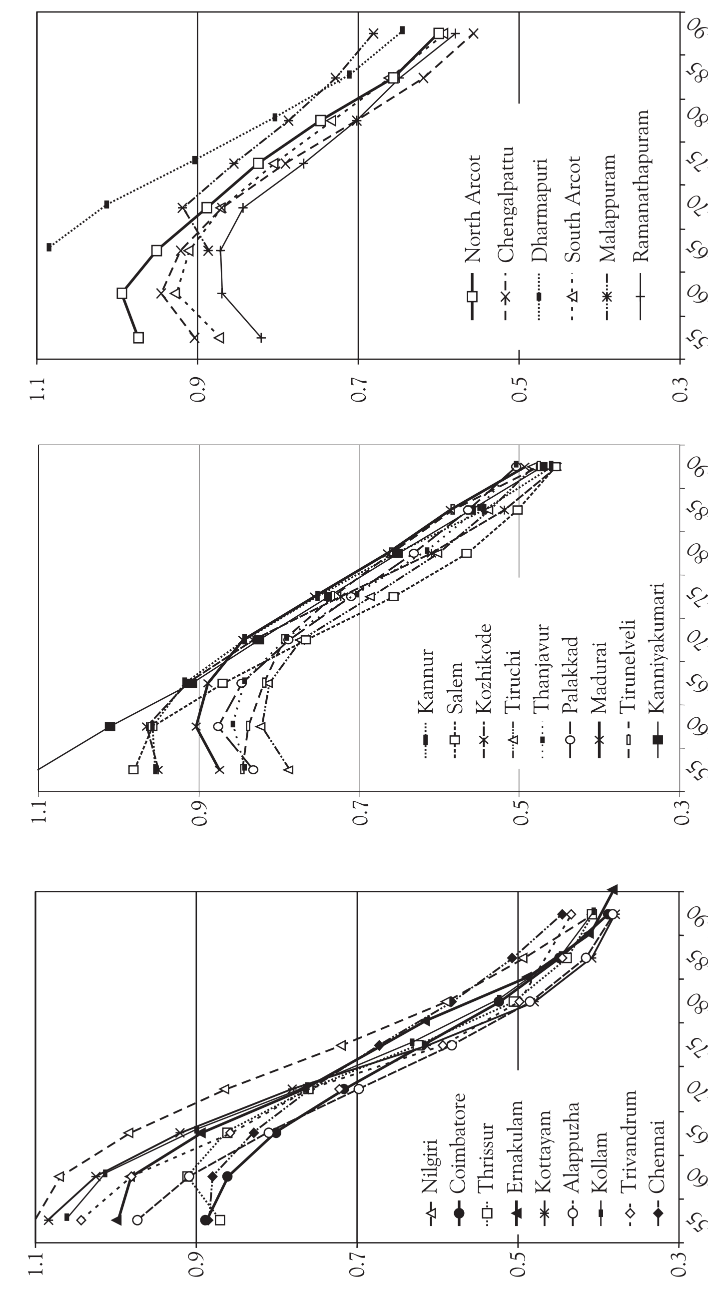


Figure 13.3: Quinequennial Fertility Indices, South Indian Districts, 1951–90

decline in Tamil Nadu to the late 1960s or the early 1970s (see for instance Kishor, 1994).

The case of Palakkad (Palghat) district, which forms the frontier zone between the pioneering regions of Kongu Nadu and Travancore-Cochin, is of interest. It appears among the districts of the second group and the fertility decline there was both later (1961–65) and less pronounced than in the neighbouring regions of Kerala and Tamil Nadu. In 1991 and in 2001, the estimated fertility level there was still higher than that of the pioneering zones. This district is the inevitable passage from Kerala to Coimbatore across the Ghats. It was for a long time under Tamil influence and, in 1991, more than 7 per cent of its population still had Tamil as their mother language, among whom the large Brahman community, and a yet larger percentage understood Tamil.[27] It may therefore be assumed, that the fertility there must have been much closer to the levels attained in Coimbatore or in the districts of southern Kerala.

However, the level of education in Palakkad is lower than in southern Kerala. Among older women (60 years and above), the level of literacy was, in 1991, one of the poorest in Kerala and these are precisely the women who gave birth to children in the period 1951–81. The women there still get married at a distinctly younger age than in the districts of southern Kerala. Examining its social composition, one also notes that this district contains nearly 25 per cent Muslims, and even higher percentages in the *taluks* bordering the district of Malappuram. In addition, the tribal population is in the majority in the north on the slopes of the Ghats. A more precise analysis of fertility in 1991 shows, moreover, that the number of children per woman in these zones is much higher, whereas it is much lower on the Palakkad route from Kerala to Tamil Nadu.[28]

Palakkad has thus constituted more a buffer or a march than a passageway between the regions of Kongu Nadu and Travancore-Cochin, thereby representing a check on the spread of fertility decline. This also suggests that the cases of Coimbatore and of southern Kerala are distinct, even if they are separated by less than a 100 km, and merit separate analyses. As we shall see, the conditions of fertility decline have effectively high chances of being very different from one zone to another.

[27] Statistics by district are gathered in the *District Profile 1991* volumes of the census of 1991.

[28] For comparative data on Palakkad and neighbouring Ernakulam and Malappuram districts, see Zachariah et al. (1994). On the socio-historical link between Palakkad and Kongu Nadu, see Pruvost Giron (2002).

The absence of more precise data, however, marks a limit of our knowledge. We would have to avail of retrospective information to reconstruct the history of fertility decline in these forerunning regions, in a necessarily more qualitative manner privileging the collection of information among the actors of that time, in particular among the older women who experienced the change of periods. In the absence of this type of information, we can however advance a few hypotheses as to the nature of the processes which took place in these regions. They remain tentative and aim at orienting future research, rather than at closing the dossier.

Where a high level of education existed for more than 50 years, as is the case in southern Kerala, the decline was without doubt favoured by the action of local pioneering groups. Among these, the Syrian Christians may have constituted the avant-garde and have been the first to identify the advantages of investing in the education of their families, and particularly of their daughters. According to a recent demographic study (Zachariah, 2001), the higher acceptance of family planning rate of family planning methods among Syrian Christians is one of the reasons why their growth rate declined faster than in the rest of the state's population. The rapid increase of the age at marriage among women during the twentieth century is another factor that may account for their early fertility transition. Their fertility level is probably today the lowest in Kerala along with that of the Nayar community.

The geography of the fertility decline in Kerala is seen to correspond with the implantation of Syrian Christians, who are concentrated between Kollam in the south and Kochi in the north, with a heavy implantation in the Kottayam hills. In several *taluks* of the districts of Kottayam and Kollam, Christianity constitutes the majority religion, among which the Syrian Christians are the most numerous. The community constitutes locally a dominant caste, equal to the Nayars, the largest dominant caste in Kerala. The community include a large number of merchants who have a historical importance in the pepper trade. Syrian Christians rose to prominence in late nineteenth century's Travancore, as they became wealthy landowners, thanks to the rise in prices of plantation crops and to important changes in the land ownership system. Whereas the Nayars followed a matrilineal system characterized by large families and impartible properties, Syrian Christians benefited from living in much smaller families and were the main beneficiaries when land became available.[29] Syrian

[29] See Visvanathan (1993) and Ramachandran (1998). I also benefited from discussions with Irudaya Rajan on these issues.

Christians migrated both within Travancore and to the Malabar districts, and later on established migration networks to the US.

The historical advantage of this region in the development of mass education is clearly attested. At the beginning of the twentieth century, Syrian Christian schools still outnumbered Protestant schools that are usually held responsible for Travancore's literacy success.[30] It is very likely that the Syrian Christian maintained a significant educational advantage over other local communities during the last century. Education and nuclear family arrangements constitute two possible factors for an early fertility decline in a community, whose recent demographic history resembles that of Parsis, except for the strongly urban concentration of the latter. It is, however, difficult to know whether the progress in literacy and birth control was inter-related or simply simultaneous. Social change, led by distinct pioneer groups may have begun earlier than we suggested above. One should be able to trace this change to some pioneer groups in the 1930s, even though the phenomenon is not clearly discernible before 1951 on the basis of the aggregated data available. If the Syrian Christians, and to a lesser extent the Nayars, played the role of innovators, the rapid decline beginning in the 1950s suggests that their behaviour was gradually imitated by several other lower strata of the population such as the *Izhavas* or the *Pulayas*. The questions as to how and why this model of behaviour spread to other groups remain open, but the extremely rapid progress of literacy among the masses throughout the districts of southern Kerala shows that the example of pioneer groups and the effects of public policies spread very rapidly. The very high population density in this area and the intense level of social interaction that goes with it were probably facilitating factors for the diffusion of instruction. Should one envisage a similar phenomenon as regards fertility, or should one abide by the model of fertility behaviour as an adjustment to exogenous change in levels of education? A socially and geographically more precise analysis would be necessary in order to respond to such a question, which we must leave open.

While the cases of Kochi and Kottayam are closely linked to the impressive progress in literacy, the profile of the Coimbatore region is different. Social development there was more modest and the district is, moreover, bordered by particularly backward regions, such as the forest regions that separate them from Karnataka (Sattyamangalam) or the districts of Salem

[30] It is also worth mentioning that the *Malayala Manorama*, among the oldest daily vernacular newspaper, was started at Kottayam in 1890 and is still today the biggest non-English daily in India.

and Dharmapuri. On the other hand, this region has features in common with the Kerala littoral: a high density and a large non-agricultural workforce, notably in the rural zones. Since the beginning of the twentieth century, Coimbatore has been an important industrial centre and has witnessed a formidable growth ever since the 1920s. The town's population numbered 75,000 inhabitants in 1921, as against almost 300,000 in 1951 and 1,400,000 in 2001, adding about 45 per cent more population every 10 years. Interestingly enough, other secondary urban centres (Erode, Tiruppur, Bhavani, Mettupalayam, etc.) did not suffer from Coimbatore's development and recorded on the contrary a sustained demographic growth from the 1920s.[31] Despite a real agricultural potential because of well irrigation and the proximity to the Kaveri, industry, in particular the textile industry, plays a large role in the rural economy as it has attracted a large workforce chiefly from local villages (Ramaswamy, 1983). It should be added that Kongu Nadu is one of the historical *Nadus* of Tamil Nadu and that its mode of social organization is particular to it. The dominant castes, within which the Kongu Vellalars appear, and the Telugu-speaking Naidus, lend the region a recognized historical specificity (Beck, 1972).

However, the initial factors are less evidently discernible because the most pronounced local characteristics, such as a long-standing industrialization, are also found in other Indian regions. Other towns underwent early industrial development or particularly strong development during the period 1950–80; Bangalore, Surat, Bhopal, Ranchi and Mumbai and its suburbs, etc., can be mentioned in this regard.[32] These cities, which for the most part have recorded substantial declines in their fertility, do not have the pioneer character which can be ascribed to Coimbatore, for the demographic change there is more recent and clearly less pronounced. Moreover, it is a matter above all of urban mechanisms, whereas the fertility decline in Kongu Nadu is as rural as it is urban. Fertility in the three large agglomerations (Coimbatore, Tiruppur and Erode) was, moreover, in 1991, paradoxically 'lagging behind' the rural zones of the districts surrounding Coimbatore and Erode (formerly Periyar) districts which register lower values (see Oliveau, this volume).

The social characteristics in the Coimbatore zone are not seen to be favourable. The situation in terms of education was for a long time particularly poor. Less than 8 per cent of the women over 60 years in rural areas

[31] See Guilmoto (1992: 93). On Coimbatore industrial and agricultural development, see Baker (1984).

[32] Concerning urbanization during the period 1950–80, see particularly Bose (1982) and *The Population of India* (1974).

were able to read and write in 1991, while this percentage exceeded 75 per cent in the districts in Kerala, such as Kottayam or Pathanamthitta, dominated by Syrian Christians. In relation to the rest of Tamil Nadu, the average age at marriage among women is high and child mortality lower, but these differences are very modest and cannot explain the deviations in fertility observed for several decades. The populating of this area by the Vellalars, who constitute the dominant case of the region *par excellence*, suggests once more that one consider the possibility of particular historical mechanisms.

Older documents pertaining to the mechanisms of fertility decline in Kongu Nadu are rare. Historical references from the colonial period, however, frequently mentioned the possibility of fertility control practised among the *Gounders* (*Vellalars*) of the region.[33] Some have linked this desire to reduce fertility to the practice of the dominant castes in the rural zones, attempting to avoid the division of the inheritance among male descendants. It is therefore possible that the same communities of wealthy landowners, who have since then massively contributed to the urban economy and to the industrial development of the Coimbatore region, had for decades practised certain forms of birth control in order to preclude the dilution of family capital over the generations.

Unfortunately, studies conducted today such as the survey by Ravichandran (in this volume) do not shed light on the role of the birth control precursors which as been probably long forgotten. The perceived costs of children and the demand for family planning may be widespread today across social groups and subregions in Kongu Nadu, but only ethnographical evidence would help describe the diffusion mechanisms that shaped fertility decline.

It would thus be less a matter of a Beckerian goal of improvement of human capital, as in the case of Travancore-Cochin, than of an evolution dictated in a Malthusian manner by the control of resources among cultivators in Kongu Nadu. However, if these attitudes toward birth control were the doing of the landowners, one must also assume that they were transmitted both to the poor peasants as well as to the large rural and urban population working in the industrial sector. This would suggest other forms of explanation of Malthusian behaviour among the households which are more dependent on the family workforce than other forms of capital, landed or human.

[33] See references from the Census of India and the colonial gazetteers in Guilmoto (1992: 84–85).

The 'social-group forerunners' identified here do not exactly follow the urban profile of the early fertility-controlling groups in Europe. In his study, Livi-Bacci (1986) identified groups that were socially and culturally quite diverse, but tended overall to belong the urban privileged classes just as the aristocracy, the Jews and other urban communities. It remains to be seen if fertility decline among the *Kongu Vellalars* or Syrian Christians started in towns or cities, but available data do not suggest any obvious urban bias as fertility decline seems to have rapidly spread to rural areas. Nor do these groups resemble the Bengali élites invoked in the diffusion of birth control in Bengal (Basu and Amin, 2000).

Of additional interest is the fact that fertility decline does not seem to mechanically tally with the structural effect of decreasing land availability or of lower mortality of children. If these two south Indian regions knew apparently distinct conditions of the inception of fertility decline, they, however, share a nearly identical schedule ever since the 1950s and happen to be geographically very close to each other. These parallel trajectories and the diffusion impact they had on neighbouring areas seem to have shaped the peculiar demographic profile of the entire region. But to some extent, this demographic revolution may have simply originated from the presence of successful demographic innovators, i.e., social groups that first experimented with fertility control and then managed to spread their new attitudes among the rest of local society. Needless to say that these hypotheses remain speculative, and needs more documentary evidence about the exact involvement of the various caste groups and about their strategies to reduce their fertility. However, this offers a preliminary framework to interpret the onset of fertility decline in south India.

Conclusion

The comparative examination of these fertility models finally leads to the superimposition of diverse interpretative frameworks in the explanation of the geographic and temporal variations of fertility during the last 30 years. We shall recapitulate these changes in three orders of phenomena: pre-existing socio-historical factors, changes of a structural type, and the endogenous dynamics of social change.

The advantage particular to economic analyses resides notably in the scientific efficiency of the models which use the variables of the first two orders. They can be tested every time a direct or indirect indicator is proposed, and the models can be refined if necessary, without completely rejecting the preceding model. It is difficult today to forego them, all the more so as the regional district-wise data have undergone a remarkable development over the last 10 years. But, from one model to the next, the newness of factors associated with fertility has been gradually exhausted. Researchers have henceforth been led to improve the measurements by introducing geographical effects, tests of endogeneity or panel analysis to enrich the discussion. The main factors associated with fertility are henceforth well identified and were already often invoked in the first studies on the experience in Kerala.

It clearly appears that the economic change *per se* has no general effect on fertility, and that the social factors offer more promising paths toward the understanding of fertility differentials. Some of them really act as exogenous structural variables and the response of fertility and its changes may seem to be nearly mechanical. Other factors mark the old cultural differences, such as the forms of patriarchy encountered in India, and have unquestionably evolved less rapidly.

In the old demographic regime, this dimension was dominant.[34] Fertility was still restricted by the action of traditional constraints, such as the age of women at marriage (early but post-pubertal) the long duration of breast-feeding, the frequency of sexual relations, the frequency of remarriage after widowhood or divorce, abortion or infanticide. The regional variations were very high because cultural areas had acquired and retained their distinctive over long periods characterized by relative isolation. In the 'modern' Malthusian model, which is still transitional, it is probable that some forms of differentiation between social groups and cultural areas will tend to decrease—but not to disappear completely—as the study of post-transitional fertility in Europe shows (Watkins, 1991).

The economic framework of these analyses may perhaps appear deceptive because it presupposes a fixed referential system. This is because, it would be very difficult to conceive of a really endogenous system of preferences, without having to rely upon analyses of a sociological nature, which still elude econometric modelling. The institutions of Easterlin concerning western fertility rest upon demonstrations, which many view as at least precarious (Chesnais, 1986), and which have scarcely been confirmed.

[34] We speak of the old model in the singular out of concern for simplification. For the indicators of historical differences and of former variations in natural fertility levels, see Visaria and Visaria (1982) and Srinivasan (1995: 76–79) respectively. See also the estimates made by Gopinath in this volume.

The examination of the case of India therefore, illustrates the contributions just as well as the limitations of the economic model. The rapidity of the decline in fertility beginning in 1970, as in Kerala where fertility fell abruptly by 56 per cent in 20 years, seems to correspond to too radical a process to alone result from re-allocations of resources in the households effected, for example, by economic or social development, or the diffusion of contraceptive methods. By the same token, the spread of Malthusian behaviours could be explained (by education in particular) in southern Kerala, but this schema does not readily apply to the very near Coimbatore region.

This is the reason for which part of the evolution of fertility seems to follow from endogenous changes which cannot necessarily be captured by the battery of socioeconomic indicators used. The progressive diffusion of the fertility decline depends on focal or core regions where the decline was initiated independently of the neighbouring regions, among which we have clearly identified Coimbatore and southern Kerala. But there are other secondary focal regions in south India, around Chennai or in northern Telengana, for example. On the level of India, these focal regions are increasing and are to be found in the Punjab, in Gujarat, Orissa and West Bengal.

This endogenous evolution rests on the social dynamics within the local societies, and particularly on the demographic innovation initiated by groups in a dominant position. These groups may share certain features on the pan-Indian scale: education, women's autonomy, reduction of infant mortality, etc. However, these characteristics do not necessarily act mechanically on demographic behaviour and the cases of inception of fertility decline are rarely associated with a unique socioeconomic profile. The case of Kerala, the population of which closely corresponds to the intuitive profile of the 'early fertility decliner', unintentionally precipitated a standard schema of fertility decline which was for a long time applied to the entire country. The regional variations to this model have been subsequently introduced to correct this effect and are known as the Tamil Nadu or the Andhra Pradesh model. But the search for a unifying theory has not necessarily advanced. This study of south India suggests that the plurality of local experiences could be for a long time to come an obstacle to a decontextualized analysis. On the other hand, the map of progress and setbacks in fertility decline serves as a marker for an original reading of the dynamic of family institutions in India by delineating more precisely than other statistical indicators the regional contours of the penetration of social change.

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