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Influences on fertility: assets, women's autonomy or both? An analysis of fertility in rural areas of India, Botswana and South Africa

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1. An introduction to the analysis of fertility in rural areas of India, Botswana and South Africa[1]

In 1999-2002, Michael Lipton, Research Professor at Sussex University's Poverty Research Unit, co-ordinated a EU-funded research project by the title "The impact of land and asset size and distribution on rural fertility, migration, and environment in drylands of Botswana, South Africa (Northern Province) and India (Rajasthan)". Interested readers can find all the relevant details about this research at the website:

http://www.sussex.ac.uk/Units/PRU/demography.html.

The Department of Statistics of the University of Florence, too, under the supervision of Professor Massimo Livi Bacci, took part in the research. What follows is the final report that we prepared on that occasion.

1.1 Fertility levels and trends in the countries examined

Before examining in detail the results of our research, it is perhaps worth having a look at the general context within which they can be placed. Several official sources provide information (in the form of estimates and projections) on fertility levels and trends in all the countries of the world. For instance, the latest (2000) version of the UN *World population prospect,* reports, among others, the data shown in table 1 below. What stands out clearly is a continuous and marked decline of fertility in the world as a whole, and, more specifically, in all of the countries we examined.

[1] by Gustavo De Santis .

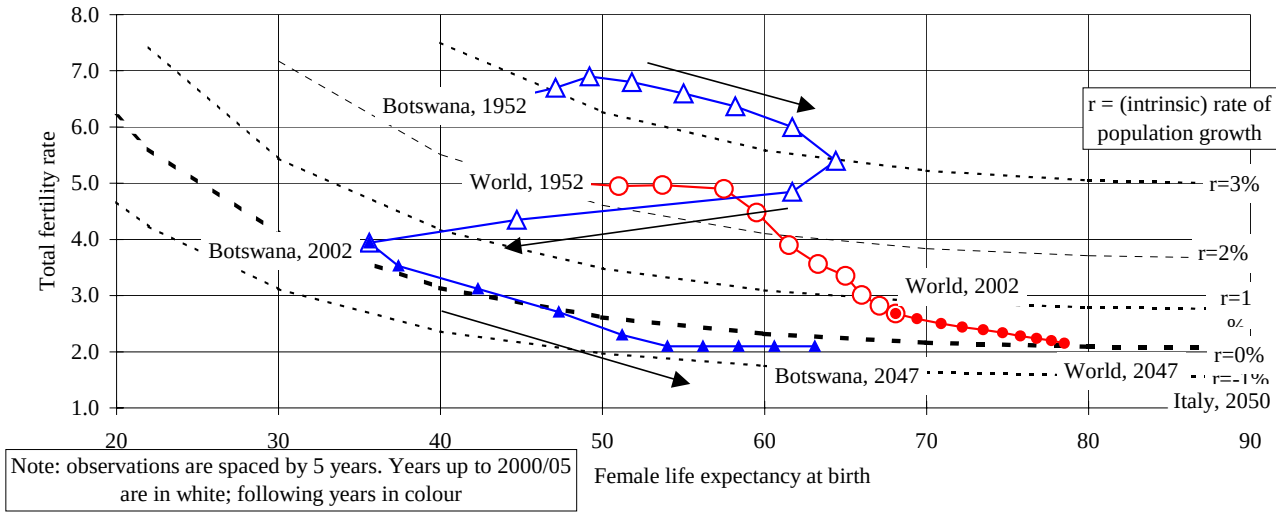
Table 1. Total period fertility rates
in India, Botswana and South Africa, 1950-2050

Year	India	Botswana	S.A.	World
1950-1955	5.97	6.50	6.50	5.01
1955-1960	5.92	6.70	6.50	4.95
1960-1965	5.81	6.90	6.50	4.97
1965-1970	5.69	6.80	5.90	4.90
1970-1975	5.43	6.60	5.44	4.48
1975-1980	4.83	6.37	5.00	3.90
1980-1985	4.48	6.00	4.56	3.56
1985-1990	4.08	5.40	3.85	3.35
1990-1995	3.70	4.85	3.25	3.01
1995-2000	3.32	4.35	3.10	2.82
2000-2005	2.97	3.94	2.85	2.68
2005-2010	2.62	3.53	2.60	2.59
2010-2015	2.27	3.12	2.35	2.50
2015-2020	2.10	2.71	2.10	2.44
2020-2025	2.10	2.30	2.10	2.39
2025-2030	2.10	2.10	2.10	2.34
2030-2035	2.10	2.10	2.10	2.28
2035-2040	2.10	2.10	2.10	2.24
2040-2045	2.10	2.10	2.10	2.20
2045-2050	2.10	2.10	2.10	2.15

Source: UN (2000)

For reasons that will become apparent shortly, it may be worthwhile to track this decline together with the evolution in survival in the so-called "growth space" of Figure 1.

Figure 1. Growth space, iso-growth curves and selected actual populations: World and Boswana (F, 1950/55-2045/50



Non-specialists may find such a representation difficult to interpret at a first sight. What it intends to highlight is the fact that every possible combination of fertility (on the *y* axis) and

survival (measured in terms of average length of life for females, on the *x* axis) translates, among other things, into an "intrinsic" rate of demographic growth *r*, i.e. into a rate of growth that is purely theoretical in each given period, but that would eventually emerge if those demographic behaviours (fertility and mortality) were to remain constant for a relatively long span of time.[2] Obviously, demographic behaviours do not remain constant in the long run, but this analysis may nonetheless prove fruitful in that is says whether a given combination of fertility and mortality can be sustainable in the long run.

Two types of sets of points are of particular interest in a space of growth. One is the theoretical combinations of fertility and mortality that produce the same intrinsic rate of population growth *r*, or iso-growth curves: these are the dotted curves in Figure 1. Among these, the iso-growth curve with $r=0$ is of particular interest, because it locates the combinations of demographic behaviours that are surely sustainable in the long run, and probably the only ones that are possibly sustainable in the very long run.

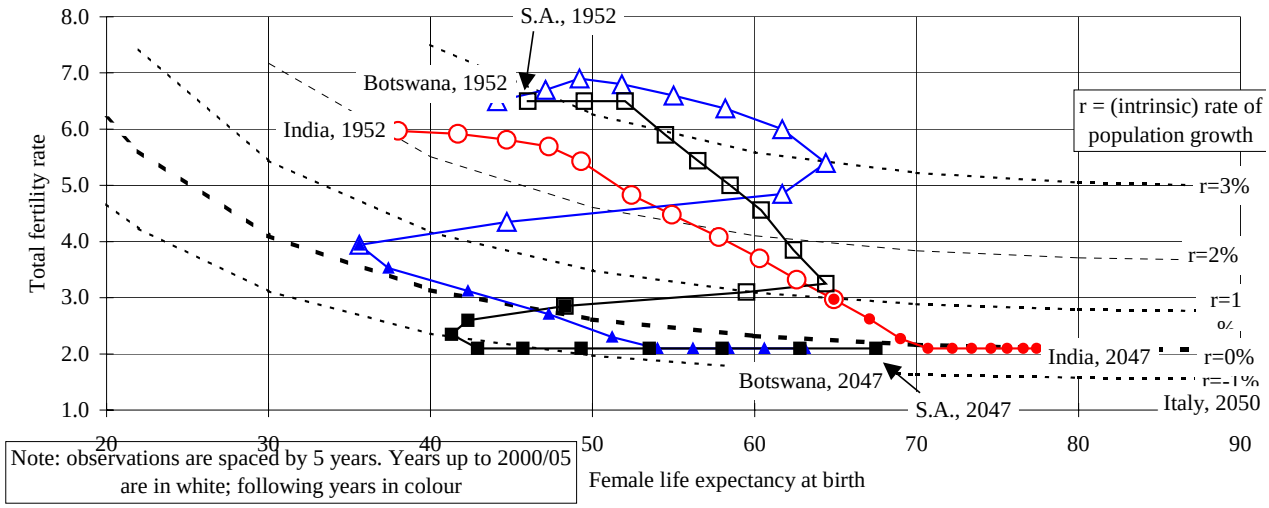
The other type is given by the combinations of fertility and mortality that characterise actual populations. In Figure 1, for instance, the observed evolution of the world as a whole from 1950-55 to our days, and its likely future (according to the UN-DIESA medium variant) can be followed with relative ease. In the early fifties, fertility was about 5 children per woman, and female life expectancy at birth reached 48 years. This translated into an intrinsic rate of population growth of slightly more than 2% - an astonishingly high value by all historical records. From then on, for about 20 years, fertility hardly changed, whereas mortality declined, and this implied ever higher intrinsic (and actual) rates of growth, up to about 2.5%. Subsequently, while life expectancy kept growing, fertility started to decline. It is currently estimated at 2.7 children per woman, and might reach replacement value - that is about 2.1 - by mid-century.

The evolution of a country like Botswana – also shown in Figure 1 – is much more complex, and therefore more interesting. With a much higher fertility (up to nearly 7 children per woman in the early sixties) and a slightly lower life expectancy at birth than the world as a whole, it reached and maintained intrinsic rates of demographic growth well over 3% for about 30 years, despite the emergence of the demographic transition – i.e. of the concomitant decline of mortality (first) and fertility (later). But since the late eighties, mortality conditions started to deteriorate rapidly because of the spread of the HIV infection, and are currently estimated to be worse than they were fifty years ago. Life expectancy at birth is as low as 36 for women (37 for men) and, with a total period fertility rate of little less then 4, the resulting intrinsic rate of growth is very close to zero, and is projected to remain so, if fertility keeps declining and survival conditions evolve as the medium variant of the UN demographic projections suggests.

Figure 2 shows the same type of representation for the estimated and projected evolution of fertility and mortality for the three countries considered in our analysis.

[2] Migration is ignored in this analysis. The omission is not as important as it may appear at first sight, because the demographic behaviours that are depicted in the picture refer to national populations, whose net migration rates tend to be relatively modest and, most importantly, do not generally persist for many years. In all cases, allowance should be made for (net) migratory movements for those cases where they are known to be important – but their influence cannot be formalised in a simple bi-dimensional space like that of Figure 1.

Figure 2. Growth space, iso-growth curves and selected actual populations: India, Boswana, and South Africa (F, 1950/55-2045/50)



Note: observations are spaced by 5 years. Years up to 2000/05 are in white; following years in colour

India, which is relatively immune from the spread of AIDS, evolves in line with the world as a whole. South Africa and Botswana, on the contrary, share the characteristic of an S-shaped path, although both fertility and mortality are lower in South Africa.

1.2 Cohort and period fertility in the areas examined

What about the areas within India, Botswana and South Africa that we investigated with our survey? We cannot measure mortality levels – a totally different questionnaire would have been necessary to do that – but we have two different indications for fertility.

One is on life-time fertility, or number of children ever born (CEB), shown in Table 2. Not surprisingly, this value tends to[3] grow with age, and reaches between 4 and 6 children per woman in the three cases.

[3] Exceptions can be observed when there is a rapid change in cohort fertility and/or when the data observed are relatively scarce, and therefore subject to fluctuations – as in our case, especially in South Africa. The data of Table 2 may not coincide exactly with those reproduced in the country reports because, for the analyses of the next sections we dropped women with missing or defective information on the variables that we identified as possible correlates of fertility (cf. below).

Table 2. Children ever born (CEB) to the surveyed women

Age class	India	Botswana	South Africa
<20	0.64	0.92	0.19
20-29	2.57	1.72	1.42
30-39	4.07	3.36	2.32
40-49	4.90	4.99	4.53
>50	5.78	6.00	4.00
All	4.50	3.27	2.19
No. of women	591	533	195

But the data in Table 2 describe cohort fertility and are therefore not comparable to those of the United Nations we examined before. A better indicator is therefore given by the number of children born in the last 5 years, shown in table 3.

Table 3. Age specific fertility and TPFR for the surveyed women

Age class	India	Botswana	South Africa
<20	0.64	0.27	0.19
20-29	1.27	0.52	0.68
30-39	0.60	0.33	0.46
40-49	0.10	0.22	0.50
			0.11
TPFR	**5.22**	**2.69**	**3.67**
No. of women	591	533	195

TPFR= Total period fertility rate

These values are markedly different from, and not strictly comparable to, those of the United Nations shown in Table 1, because of two main possible reasons. One is that in our case we have a limited number of women, overall and in each age class[4], which greatly increases the variability of our results. Another reason is that fertility among the women that we interviewed (in rural, semi-arid parts of each country) need not coincide with that of the general population. As a matter of fact, in India and South Africa (although, surprisingly, not in Botswana), our data suggest that rural fertility is higher than general fertility: this is consistent with our expectations, and encourages us to proceed in the analysis.

[4] Young women are particularly underrepresented in our sample, in part because they happen to be relatively few in the rural areas we surveyed, especially in Botswana and South Africa (because of temporary urban migration), and in part because of the selection procedure we adopted. Indeed, within each survey household, we decided to focus in particular on women (up to three per household) as close as possible to the end of their reproductive period, so as to make sure that their life-long fertility, as recorded at the time of the interview, could be as close as possible to their fertility *intensity* (number of children ever born, per woman), and therefore independent of their fertility *timing* (age of the mother at the birth of the child). Intensity, not timing, is in fact our dependent variable in the analyses of the next pages.

1.3 Analysis

Fertility interacts with virtually every other sphere of human behaviour, be it of demographic nature, or economic, social, etc. These connections have long attracted the attention of researchers and analysts, and the wealth of published studies has rapidly become such that merely listing them would require a paper of its own. Very synthetically, however, what emerges from such readings is that an extreme complexity characterises this connection: fertility is normally both a cause and an effect; the time lag between stimulus and response may vary; the responses may depend on a variety of concurring factors; etc.

Stimulating as they may sound, these considerations imply that all comprehensive studies on this topic should be included within a very broad theoretical framework, and should collect empirical evidence in a very detailed way. This is what this research tried to do, but, as a matter of fact, some parts of the questionnaire worked better than others, and after exclusion of the women for which the available information was considered qualitatively or quantitatively insufficient, the number of cases that could be analysed dropped considerably.

Therefore, after scrutinising in depth the available data, we decided to limit our interest to the analysis of just one kind of connection, the one that originates from the economic and cultural setting and influences fertility and reproduction. This is described in detail in the following chapters, that have one very important point in common: they are all based on the very strong, but at this stage unavoidable, assumption that what was recorded at the time of the interview both in economic and cultural terms reflects reasonably well what the investigated women experienced all along their life. For instance, living in a rural setting, being relatively poor, scoring low on an index of female autonomy, etc., although recorded only once, at the turn of the century, is assumed to be a relatively fair description of that particular woman even 10 or 20 years before.

Even so, the possibilities of the analysis, unfortunately, are somewhat limited, because even in relatively high fertility contexts, the birth of a child is still a relatively rare phenomenon. The parameters that one is interested in are therefore relatively difficult to estimate precisely (e.i. their standard error is relatively high), so that significant relationships tend to remain hidden, and can emerge as meaningful only with fairly large data sets. If we could have merged the three data sets of India, South Africa and Botswana, as we had originally intended to do, things would have been eased, but preliminary analysis discouraged us from doing so: formally identical questions seem to have been interpreted differently in the three contexts, the same items apparently do not carry the same substantial meaning everywhere (e.g. having or not having a car; the notion of female autonomy, etc.), some questions have been selectively omitted in certain countries, etc.

These limitations produced two main consequences: on the one hand, although we had started our analyses with complex and rich models, we eventually had to accept that only a few variables could display some significant effect. This does not mean that the variables omitted from the following tables and graphs are not important in general, or even in the countries and villages under study: merely that their impact could did not prove meaningful in our data.

On the other hand, because what we are dealing with is basically “sparse” data, traditional regression models (or, for that matter, even generalised regression models, that keep into account the discontinuous nature of the dependent variable – the number of children ever born to a woman) very frequently fail to produce meaningful, or converging parameter estimates. We therefore decided to have recourse to a different methodology, log-linear analysis (described in chapter 4): this performs better in statistical terms, but does not lend itself to an easy synthesis of the results, or, at least, not in the way readers normally expect, in terms, for

instance, of effects on the dependent variable deriving from changing x% in the independent one(s).

Despite this limitation, two main results emerge clearly from our study. The first is that, in all three contexts, the economic dimension matters: fertility is inversely related to a woman's (and her household's) standards of living and the "excess" fertility is particularly evident for the poorest. Beside, and independently of this, the cultural dimension seems to matter too: the level of education of the woman and her degree of autonomy (self and social recognition of rights, freedom, etc.) contribute in a significant way to determine the number of children she will ultimately have.

The details of these findings (methods, results, etc.) can be found in the following sections. The policy implications of this finding, however, can be grasped already at this stage: if steps need to be taken to accelerate the on-going fertility decline in these countries, and especially in their rural areas – as we think it would be advisable to do – they must be taken on both levels: economic development and cultural change, with special attention to the role (education, autonomy, recognition of rights, working possibilities, etc.) women play in these societies.

2. Economic assets and fertility among rural households in Botswana, India and South Africa[5]

2.1. Introduction

Our survey information provides us with the necessary empirical data to study some of interactions between assets and demographic behaviour at the micro level. The focus of our analysis will be not only on differential fertility by age, education and other individual characteristics of the women, but also by access to land and standard of living of the household these women belong to, with information gathered both at household and village level.

We will measure fertility in terms of number of children ever born, up to survey date, for each woman: this depends, among other things, on the woman's age, that we will therefore use as a control variable in our analysis.

The first part of the chapter considers only women who live in households with access to land. After briefly revising the link we would theoretically expect to exist between land accessibility and fertility, we will analyse the fertility impact of landholding and the size of land in a multiple regression model, which includes certain individual characteristics of the women.

Subsequently, we will broaden our scope, to consider the relationship between standard of living and fertility, and not only in an agricultural setting. Once again, we will first revise what the theory says about this connection, and later analyse it empirically. In order to do this, we will have to construct a synthetic index to try to measure the relative deprivation of each household. The relative deprivation index that we will use, described in detail in section 2.3.2, takes into account several economic variables (including income and non-rural assets), and synthesises them along the lines of the "totally fuzzy and relative approach" to the measurement of the standard of living (Cheli and Lemmi, 1995). In short, each of these variables is weighted, and the weight should in principle reflect as objectively as possible the actual impact of that specific variable on relative deprivation - and this separately for each of the three countries considered. We then use the index to analyse synthetically the relationship between fertility and standards of living[6].

The aim of this analysis is to compare the relationship between rural and non-rural economic characteristics of the women and their fertility behaviour as it emerges from the 4ERP survey data. A more detailed description of the economic situation at household and village level in India, South Africa and Botswana is provided in the general country reports.

2.2. Landholding and fertility in a comparative perspective

2.2.1 The link between land and fertility

Differential access to land and rural assets has consistently proven to be an important factor in agrarian societies, with a relevant impact on the social and demographic life of individuals and households. The relationship between land (extension, tenure, etc.) and

[5] by Letizia Mencarini and Simona Drovandi.

[6] In this work we have not developed the possibility that fertility and standard of living interact, with feedback in the cause-effect chain: this is left for future work.

demographic behaviour has long been debated in the literature: see, among others, Smith (1984), Cain (1985 and 1986), Stokes et al. (1986), Jolly et al. (1993), James (2000).

Land has at least two dimensions that are potentially relevant to fertility behaviour and that are expected to influence fertility in a contrasting way. One concerns land tenure, i.e. the legal and institutional arrangements of land ownership (Stokes et al., 1986). The "land-security" hypothesis suggests that land ownership, by increasing old-age security, exerts a negative long-term effect on fertility, reducing desired family size through a reduction in the importance attributed to future parental security obtained by having children (James, 2000).

A second dimension relates to the size of the landholding. Here, what matters is the demand for rural land-labour. The operational extension of land under one's control is thought to have a positive influence on fertility because, *ceteris paribus*, households with larger holdings require more labour, and are assumedly able to use family labour more effectively: therefore, their fertility is comparatively high. Of course, this hypothesis is particularly relevant with non-mechanised agricultural production systems, where production is labour-intensive and where large families may be an asset. The relationship is complicated by the fact that land is both a production factor (that influences the capacity of the rural population to have and maintain a given level of consumption) and the principal repository of wealth in a rural economy (influencing inheritance, marriage systems, and desired family size). Where there is a communal system of land, the picture is even more complicate, because the inheriting of land ownership may be substituted by an opportunity for access to communal land, and since this is often distributed taking into explicit consideration the size of households, the system contributes to the maintenance of a high demand for children (Doveri, 2000).

For landless farm workers, very small tenants, or those with insecure land property rights, the two hypotheses mentioned above can interact in complex ways, and lead to relatively high or low fertility, depending on which factor prevails. For instance, very poor couples, with high child mortality, may need several young workers to secure minimal income and security. If this hypothesis turned out to be supported by our data, it would imply that land reform, with a general redistribution of small land ownership or the creation of equal conditions of access to the agricultural market, would lead to a reduction of fertility in rural areas, or, more precisely, to an acceleration of the pace of fertility decline. In countries like South Africa and Botswana, characterised by a highly skewed distribution of land, and where agricultural reforms are still in a preliminary stage, this would obviously have very important policy implications.

2.2.2 Results among Botswana, Indian and South African women

In this section, we will try to measure the influence that access to land exerts on fertility. In order to do this, we will concentrate on landholding households only, and leave landless households out of the picture. The idea is that the hypothesised relationship exists, it should emerge even with censored data. The reason why we decided not to include landless households at this stage of the analysis is that not all rural households necessarily live out of rural production: for instance, those who base their living on trade, or manufacturing activity, while landless, may have fertility behaviours that respond to totally different stimuli. Unfortunately, we cannot unambiguously separate the two types of landlessness (very poor rural households, and non-rural households who happen to live in a rural context). Besides, due to data limitation problems, we decided not to distinguish between crop- and farm-land, and to ignore the value of the livestock (but to keep the value of the land). The pieces of information that we will use for this part of our analysis, supplied at the household level, are:

- quantity of land altogether, including the residential site, cultivation lands and other plots that may form part of the holding;
- tenure arrangements, i.e. whether the land is owned (by inheritance or purchase), or whether the household has commercial or usufruct rights on it, or whether the land is rented or share-cropped (in or out).

Here, since we want to investigate the link between land and fertility, we will consider all of these variables, including fertility, at the individual (woman's) level[7]. Unfortunately, restricting our sample of observations to women who live in households with access to land reduces the number of observations considerably. Although the survey was carried out in a rural setting, these women constitute only a sub-sample of the total, and while we suffer from only a marginal loss in India (551 women left, out of 593), we observe a significant reduction in the two African countries: 282 out of 541 in Botswana, and 324 out of 585 in South Africa (table 1). In the same table we show the results for women in households that have access to land, according to the type of ownership of their most important arable plot: as a result of missing information on land tenure or on the size of the plot, the final sub-samples of women become relatively small. For instance in South Africa we have a total sample of women of 585, among these only 324 belong to household with access to land, but for some women we do not know the size of land or we have no information on the landholding system, so that at the end we can run the model on 231 women only.

A further consideration is that we cannot test the "land-security" hypothesis on Indian data, because virtually every household owns at least some land.

Consistently with the theories sketched before, the dependent variable in our regression model is the number of children ever born to each women and the specific independent variables on which we focus our attention are the size of land, the land-tenure type and the total value of plots. We expect the size of land and the total value of plots to have a positive effect on fertility, whereas the tenure-effect, inserted in this model as a dichotomous variable - measuring the effect of ownership as opposed to other arrangements (rent, etc.) - is supposed to be negative.

These effects are measured net of other individual variables that may affecting fertility: the woman's age in years, child mortality[8], and woman's years of education[9]. According to the most relevant literature on developing countries demographic studies, we expect the first two variables to have a positive effect on fertility, and the last a negative effect. Unfortunately the models for South Africa and India are not exactly the same, because in India almost all women belong to land-owning households, whereas for South Africa we do not have the total estimation of land value, and therefore we were forced to exclude this variable from the relative model. As for Botswana, finally, we have information on land size for only a few women (92), and therefore the parameters are generally not statistically significant (results not shown here).

The results of the model for India and South Africa that analyses simultaneously the effects of all of the explanatory variables are shown in table 2. Although the two data sets are relatively small, which has an obvious influence on the significance of our estimates, the signs of the parameters do provide some clues as to the direction of the relationship. As for the

[7] For the descriptive analysis of households that have access to land, their type of ownership and rural assets please refer to the country reports.

[8] This is a ratio: at the denominator we put the number of children ever born to that specific woman, while at the numerator we put the number deaths under the age of 5 occurred among of these children. This ratio varies between 0 (no child died) and 1 (they all died).

[9] Of course land access could also be a determinant of demand for education and this can be modelled as well. In this analysis we do not take this effect into account.

variables capturing the value of agricultural assets, we find that owning crop-land (variable "tenure"), as opposed to just using rented or communal land, goes along with lower fertility. On the other hand, the effect of the size of land is positive, although, among Indian women, the effect of the value of the land seems to be negative (but this is not statically significant). The results obtained confirm what has previously been found elsewhere about the sense of the relationship between agricultural assets and the demographic behaviour of cultivator households. Both hypotheses on the influence of land, that is landholding as an asset and land-size as a determinant of labour demand, prove relevant in influencing fertility in this context. Finally, both in India and South Africa, fertility is lower where female education is higher, and where child mortality is low.

Table1: Women in households that have access to land

	Botswana	*India*	*South Africa*
Total sample size of women with comparable information about fertility	541	593	585
N of women in household that have access to land	282	551	324
Owned	*162*	*544*	*197*
Commercial or usufruct rights	*-*	*3*	*23*
Rented	*1*	*-*	*2*
Other	*114*		*9*
Tot. women in households that have access to land, according to type of ownership of the most important arable plot (when information is available)	282	547	231

Table 2: Results of Poisson log-linear regression[10] on fertility (CEB) among women from households with access to land in India and South Africa

Variables	Regression coefficient[§] β	e^{β}	Standard Errors
INDIA			
Age	0.0151**	1.015	0.1321
Child mortality	0.5554**	1.743	0.0138
Years of education	-0.0306*	1.031	0.0025
Size of land (in bighas[11])	0.0029	1.003	0.0000
Total value of plots (rupees)	-0.0001	1	0.0014
Intercept	0.823**		0.075
Sample	547		
SOUTH AFRICA			
Age	0.0433 **	1.044	0.0042
Child mortality	0.2535	1.289	0.4828
Years of education	- 0.0129	1.013	0.0141
Size of land (in acres)	0.0390*	1.040	0.0214
Tenure (owned land)	-0.0708	1.073	0.0892
Intercept	-0.635*		0.25
Sample	231		

**highly significant (p-value=0.001); * significant (p-value =<0.05).

2.3. Standard of living and fertility behaviour

2.3.1 Standard of living, deprivation and fertility in less developed countries

A low standard of living is often considered to be a key-factor in driving high fertility and therefore high rates of population growth. Consequently it is seen as a crucial element that can slow down or possibly stop the demographic transition currently taking place in the less developed countries.

At the micro level, this interpretation has a bearing on the expected relationship between fertility and the standard of living of the household a woman lives in. Empirical research on this topic is still partial and contradictory, but the number of studies has substantially increased during the last decade (Schoumacher and Tabutin, 1999). Results from survey studies with micro-level data show that the relationship between standard of living and fertility is not unidirectional. Some studies suggest a negative relationship between fertility

[10] A one-unit increase in an independent variable has a multiplicative impact of e^{β} on the mean of the dependent variable, that is the mean number of children ever born: for instance, among Indian women each additional year of education decreases the mean number of children per woman by 3%.

[11] The "bigha" is a traditional unit of land area in South Asia. The bigha varies in size from one region to another: in India it is generally less than an acre (0.4 hectare).

and deprivation level, others find it to be positive, and yet others find it to have an inverse J-shaped relationship. Other studies find little evidence of any relationship at all.

However, considering the specific context of these studies and the period to which the studies refer (Schoumacher and Tabutin, for instance, take into consideration studies from the 70s up to the present), a few regularities seem to emerge. Let us simplify matters by assuming that each country can be located at a certain "level" in terms of standards of living and economic development. Among the poorest countries, the relationship between standard of living and fertility is mostly positive, because of reduced reproduction capability and general higher infecundity of the poor (Schoumacher and Tabutin, 1999; Lipton 1983).

In relatively more developed countries the relationship has frequently been found to assume the shape of an inverse J. This can be interpreted in terms of the demand for children. In rural societies the demand for children is high because they provide important labour supply, and this acts as an insurance against lower standards of living. Nevertheless, in these societies there will still be landless farmers who cannot take advantage of children working, if the "land-size effect" prevails. These individuals will therefore have a lower demand for children, generating the inverse J-shape. The most common relationship between standard of living and fertility in contemporary less developed countries is, however, negative. Here the demand for children is higher among the poorest, and decreases with increased standard of living. Explanations can be provided at various possible levels: culture (ignorance and tradition keep fertility high), economic rationality (among the poor, children can soon become productive assets, and overall the benefits that parents, and especially fathers, can derive from them exceed their costs), effects of family planning services (the demand for children may be roughly the same at every socio-economic level, but in developing countries only the better-off would have knowledge of and access to contraception), etc.

As for the three countries considered here, empirical results of previous studies provide contradictory findings (see Schoumacher and Tabutin, 1999, for a comparative analysis). The relationship between standard of living and fertility had previously been found to be of little significance in rural Botswana during the 70s (in a pre-transitional stage of high fertility), highly negative in rural South Africa in the 80s and 90s (Mencarini, 2001) and in both directions in rural India (but with a prevalence of a positive relationship), in several studies on the period from 60s to 80s.

The use of cross-sectional survey data (as we have here) poses some important limitations on the analysis of the relationship between standard of living and fertility. The problem is that we are liking the *current* standard of living to *past* fertility. Thus, we are induced to consider the *current* deprivation level as a determinant of the fertility behaviour that took place in the past, and sometimes in a very remote past, because our oldest women can have had their children up to 35 years before the survey. We therefore analyse the relationship under the quite unrealistic hypothesis that there has no mobility in terms of individual standard of living[12]. If mobility between different socio-economic levels is independent of fertility, the only consequence is an underestimate of the true effect of standard of living on fertility; but if the number of children affects a woman's future in terms of economic well-being, the resulting estimate may be biased, because we can have a spurious effect and mutual feedbacks.

An essential problem in this analysis is the identification of the worst off group. To this end, absolute measures of poverty are sometimes used in the developing countries. These definitions include an "absolute poverty threshold" or "the minimum standards of living", but

[12] A more theoretically convincing approach would require the use of panel data, which permit a dynamic analysis of the evolution of both socio-economic conditions and fertility behaviour, although panels have their limitations too (high costs, attrition, etc.).

these theoretical notions are difficult to translate into empirical indicators. A possible alternative here is to use a relative measure of deprivation, where the categories of standard of living are determined on the basis of the actual distribution of the indicator or indicators used (e.g. income, consumption, wealth, etc.).

Theoretical research into what constitutes a certain level of standard of living (or, on the far left tail, poverty) has often taken a philosophical path (Sen, 1976 and 1985). From a purely economic point of view (or monetary measurement of deprivation), the standard of living is often assimilated to the satisfaction obtained through consumption of goods and services. For market or auto-consumed goods the price is utilised to convert the quantity consumed into virtual expenses. This quantification is of course more difficult for certain services supplied by the public sector such as drinkable water and electricity. And, in general the task of collecting reliable data on both private and public consumption is not always easy.

The choice of the indicators to consider in the construction of a synthetic index is the most delicate phase, with problems related to time-varying cultural and economic relevance of the indicators; the presence of subjective elements; the balance between material and non-material items; data availability; etc. And although, typically, full consistency between the theoretical concept of standard of living and the empirically available indicators is rarely possible, economic surveys often contain measures of incomes and expenses, and information on the structural characteristics of the household, so that comparable (per-equivalent-person) measures can be constructed. These are therefore particularly useful in analysing the relationship between standard of living and demographic behaviour.

There is evidence, for instance, that consumption per adult has a statistically significant effect on the demographic behaviour, although the most substantial – and negative - effect on fertility in developing countries seems to be exerted by women's education, so that it should always be kept separate from economic indicators and explicitly modelled in regressions (cf. e.g. Montgomery et al., 2000).

Direct economic variables are not always available, or sufficient. In this case, they can be supplemented by proxy variables such as access to water and electricity, nature of toilet facilities, indicators of housing quality, ownership of selected consumer durables, and the like. Although indicators of standard of living have sometimes proved to be weak predictors of consumption per adult, their link to demographic behaviour (fertility, mortality, etc.) is basically the same, and, therefore, such indicators, when available, are customarily used in demographic applications (Montgomery et al., 2000).

Understandably, the type of indicators or synthetic index used has a non-trivial effect on the size, significance and sign of the relationship one finds between standard of living and fertility (Schoumacher and Tabutin, 1999)[13].

Furthermore, a global index of well-being based on a set of deprivation indicators seems more appropriate than indexes based only on income or expenditure to assess a situation of permanent poverty and deprivation. Such an index should ideally take into account the basic needs, including food, clothing, housing and household equipment, working conditions, leisure, health, education, environment, family and social activities (Miceli, 1998).

2.3.2. A relative approach for a multidimensional analysis of deprivation level

In order to carry out a demo-economic analysis of differential fertility behaviour, we need to construct a convenient multidimensional index of relative deprivation in the reference populations, in our case, each of the three country taken separately.

[13] This, together with the relatively small samples available in this study, calls for caution in the interpretation of the results from our statistical analysis.

The statistical approach chosen to synthesise and measure the incidence of relative deprivation is the so-called "Totally Fuzzy and Relative approach", based on the theory of fuzzy sets and recently used in several similar studies (Miceli 1998; Vero 1999, Qizilbash 2001). The basic idea is well being and poverty are the extremes of a continuous dimension, and each individual (or household) can in principle occupy any position on this continuum. Apart from clear cut cases, most individuals (households) will thus show to belong in part to the set of "the rich" and in part to the set of "the poor", in various degrees. This is what makes the sets "fuzzy": most people will not be unambiguously identified as belonging to this or that set solely. Empirical applications of this idea work better with a plurality of indicators, each of them signalling "degrees of belonging (or membership)" to the extreme, clear-cut cases of being rich or poor. The problem with several indicators is that their potentially contrasting messages must be synthesised somehow. Several options are available to this end, but what it is most common to adopt in this field of study is a sort of self-weighted procedure. The basic idea is that the relative importance of a given item depends on its prevalence: if virtually everybody has that particular thing, then not having it is a strong indicator of (relative) deprivation; if only a few possess it, then missing it is but a weak indication of (relative) deprivation.

In mathematical terms the approach can be described as follows. For each variable examined one defines a function that indicates the degree of membership of each statistical unit to a certain fuzzy subset of the whole population considered (Cheli-Lemmi, 1995; Lemmi e Pannuzi, 1995 e Cerioli-Zani, 1990)

In a sample of J households, let $\mathbf{x_i}$(i=1, ..., I) be a vector of observed characteristics for each household. The fuzzy set of the poor can be defined as

$$f(x_i) = \frac{\sum_{j=1}^{J} g(x_{ij}).w_j}{\sum_{j=1}^{J} w_j} \qquad (i = 1, ..., I)$$

where $\mathbf{w_j}$ is the weight attributed to $\mathbf{x_j}$.

In the definition of $g(x_{ij})$ 2 cases can be distinguished:

- if X is a dichotomous variable then $g(x_{ij}) = 1$ indicates that for the i-th family the modality assumed by this variable denotes a symptom of poverty, whereas $g(x_{ij}) = 0$ indicates the absence of this symptom;
- if X is of the qualitative ordinal type, the modalities of the variables are arranged in increasing order with respect top the risk of deprivation connected to them

The quantitative continuous or non-dichotomous variables are transformed in ordinal ones.

To eliminate the problem of high frequencies at extreme modalities, one can consider an alternative "normalised" function $g(x_{ij})$, where H is the sampling distribution function of the variable x_i ordered by increasing levels of deprivation

$$g(x_{ij}) = g(x_j^{(k)}) = \begin{cases} 0 & if\ x_{ij} = x_j^{(1)};\ k = 1 \\ g(x_j^{(k-1)}) + \dfrac{H(x_j^{(k)}) - H(x_j^{(k-1)})}{1 - H(x_j^{(1)})} & if\ x_{ij} = x_j^{(k)};\ k > 1 \end{cases}$$

The range of the degrees of membership is by construction from 0 to 1. The household who has the least favourable position has a degree of membership (to the set of the poor) equal to 1: this signals a maximum relative deprivation, and identifies those who are the worst-off. At the other extreme of the scale, equal to 0, one finds the households that are at a (relative) minimum of deprivation, i.e. the best-off. Between these two extremes is located the group of those who reveal a partial membership to both sets, that is those whose well-beoing is somewhere between the best and the worst observed in that community[14].

The system of weights used is $w_j=\ln(1/\overline{g(x_j)})$, where $\overline{g(x_j)} = \frac{1}{n}\sum_{i=1}^{n} g(x_{ij})$ represents the fuzzy proportion of poor households with respect to Xj. This means what we anticipated before: if a variable, and therefore the indicator of a particular item, is widespread among the total sample of households, not owning that particular item can be interpreted as a clear sign of poverty, and the item (variable) will be highly weighted in the index; on the contrary if only a few households have a certain item, the absence of it, and therefore the relative indicators, will receive only a scarce weight as poverty symptoms.

In this way, the degree of membership to the fuzzy-set of the worst-off is relative to the frequencies of deprivation indicators and their weights. The weighting system[15] gives more importance to those indicators associated with less frequent symptoms of poverty. This can justified by the fact that, in a relative definition, people have stronger feeling of deprivation when they do not own a very widespread good. In this context, the less individuals or households conform to the prevailing lifestyle, the more they appear to be worse-off. Obviously, this leads to the necessity that particular attention be paid to selecting *relevant* indicators that are supposed to summarise individual living conditions: the fact of not possessing a given good does not necessarily have the same meaning for different group of population and the choice of the indicators made by an external observer is always somewhat arbitrary (Miceli, 1998).

Consistently with the relative concept of deprivation, the importance of an item for the measurement of it should directly depend on how representative it is of the community's life style (Filippone et al, 2001) and therefore the relative importance of each indicator in the analysis of total deprivation is determined by directly observed deprivation symptom frequencies.

[14] For instance, in table 4 if one looks at the first indicators, that is per capita monthly income, the membership function is in the 5th column (0.0034, 0.155, 0.516, 0.789, 1). These cumulative frequencies are translated in an alternative function in the following way. The first is put =0. The second frequency is calculated as 0 +(0.155-0.0034)/(1-0)=0.121/0.966=0.125. The third frequency is calculated as 0.125 + (0.516-0.155)/(1-0.034)=0.125+(0.361/0.966)=0.125+0.373=0.498. And so on for the following frequencies.

[15] Many other systems of weights satisfy the same properties. analyses to investigate how the results vary with different weighting systems have been performed: Filippone at al (2001), for instance, compared three different weighting functions, but came up with substantially coinciding results.

2.3.3. The results of the survey: a living standard index in Botswana, India and South Africa

The summary deprivation index we finally retained represents relative household deprivation and synthesises 16 economic non-specifically rural variables, collected at the household level. The index is calculated only for households with information on all of the relevant indicators and, because of missing values, this reduced somewhat our samples of households: to 1225 out of 1462 for Botswana, 521 out of 585 for South Africa, and 567 out of 593 for India.

All of the indicators have been selected after careful consideration, keeping into account, in particular, the quality and the proportion of answers we could collect on each item, and whether that particular item could be considered an indirect measure of well-being. We are aware that each variable (i.e., the possession of certain durables assets; characteristics of the house, etc.) can be also affected by factors not directly linked to the household economic well being, like tastes, availability of time, household composition, etc. However, this shortcoming is typical of most indicators, and should be reduced by the fact that we select several indirect indicators, that should ultimately shed light on the only element they have in common, that is the relative affluence or deprivation of each household.

The set of indicators we have is larger for South Africa than for Botswana and India, basically because missing values for some items would have reduced the sample too much, or because some items are completely absent in the area under study (for instance, cars among Indian rural households), and therefore not fitted for this (or, actually, any other) analysis.

In the case of qualitative variables, the modalities of the indicators reflect, among other things, the way the information was collected, and the necessity of avoiding too small classes. As for continuous variables (e.g. income), we first identified the situation of the best and the worst-off (to define the extremes), and subsequently created intermediate classes, so as to guarantee balanced frequencies in all of them

The IRD index synthesises the following variables:

1) Monthly adjusted income (or "per-equivalent adult income")

The total monthly household's income includes all incomes of different sources of all household members. Remittances from non-present members are included too. The total monthly income has then been deflated to keep into account the composition of the household, using the following equivalence coefficient:

Number of equivalent adults = resident adults + 0.5 (children under 16 years)

Based on this adjusted income, we assigned households into classes (see tables 3, 5, 7 for classes in each countries, according to national currency), and considered cumulative frequencies. The value 0 attributed to the is the highest income class means absence of relative deprivation risk.

2) Value of dwelling or house, including the value – if any – of the land on which the dwelling is located.

We considered 5 classes, with the most valuable houses in class 0, which indicates absence of poverty signs.

3) Access to drinkable water.

There are three indicators of water supply and they regard the quantity of water supplied, the quality (cleanness of water supply) and distance to the water source. Cases where the supply is always or almost always adequate, the water is always or almost always clean and there is a separate tap connected to the house indicate absence of deprivation risk, and are assigned value 0.

4) Access to electricity

A good connection has been considered as a symptom of absence of relative deprivation and assigned 0 in the membership function.

5) Presence of toilet facilities

The presence of a private toilet in the household plot has been considered as a symptom of absence of deprivation.

6) Characteristics of the house

The presence of either a dining or a living room suite has been interpreted as an indication of relatively favourable economic situation and assigned a value of 0.

7) Ownership of household durable assets not used for farming.

These items include telephone, hi-fi set, radio, TV, electrical or gas stove, bicycle and car for personal transport.

These are dichotomous variables where 0 indicates the presence of the asset and the absence of deprivation, whereas 1 indicates non-possession of these items and therefore a symptom of deprivation.

Tables 3 to 8 show in detail the construction of the IRD indexes, from the frequencies registered in the sub-populations and the alternative way of considering the cumulative frequencies.

For lack of information, only for South Africa could we actually include all the indicators listed above.[16] Graph 1 provides a comparison among the three mean values of indicators of deprivation symptoms considered (for a description of incomes, expenses and household infrastructure in the three countries, see the country reports).

[16] We remind readers that the three IRD indexes constructed for the three countries have a different composition, depending on data availability and on the relevance of each indicator in that particular context.

Table 3: South Africa: Indicators used to build IRD

Indicators: deprivation "symptoms"	N HH (tot 585)	Modalities	Frequencies	$g(x_{ij})=H(x_j^{(k)})$ Cum. Freq.	Alternative $g(x_{ij})$
Per capita monthly income	521	>1,000 Rand	0.034	0.034	0
		500-1000 Rand	0.121	0.155	0.125
		200-500 Rand	0.368	0.516	0.498
		100-200 Rand	0.276	0.789	0.781
		<100 Rand	0.211	1	1
Dwelling/house Value	574	> 100,000 Rand	0.036	0.036	0
		50,000-100,000 Rand	0.258	0.294	0.267
		30,000-50,000 Rand	0.269	0.563	0.546
		10,000-30,000 Rand	0.265	0.827	0.819
		<10,000 Rand	0.172	1	1
Quantity of water supply	579	Always or almost a.	0.461	0.461	0
		Usually or most the time	0.326	0.787	0.604
		Seldom or occasionally	0.145	0.932	0.873
		Almost never	0.068	1	1
Quality of water supply (cleanness)	579	Always or almost always	0.507	0.508	0
		Usually or most the time	0.278	0.786	0.565
		Seldom or occasionally	0.148	0.934	0.866
		Almost never	0.067	1	1
Distance of water supply	574	Own tap connection	0.331	0.331	0
		Outside <100m	0.294	0.625	0.439
		Outside 100-500m	0.194	0.818	0.727
		Outside >500m	0.181	1	1
Access to Electricity	579	Good connection	0.465	0.465	0
		Connected, but unreliable supply	0.162	0.627	0.303
		No connection	0.373	1	1
Telephone	579	Yes	0.043	0	0
		No	0.957	1	1
Private toilet in the plot	581	Yes	0.823	0	0
		No	0.177	1	1
Hi-fi set	575	Yes	0.396	0	0
		No	0.604	1	1
Radio	581	Yes	0.666	0	0
		No	0.334	1	1
TV	577	Yes	0.497	0	0
		No	0.503	1	1
Dining room Suite	578	Yes	0.413	0	0
		No	0.586	1	1
Living room Suite	574	Yes	0.327	0	0
		No	0.673	1	1

Electric or gas Stove	577	Yes	0.327	0	0
		No	0.673	1	1
Bicycle	576	Yes	0.274	0	0
		No	0.726	1	1
Car	561	Yes	0.135	0	0
		No	0.865	1	1

Table 4: South Africa: Mean values and weights of indicators used to build IRD

Indicators: deprivation "symptoms"	Mean	Weight
Per capita monthly income	0.618	0.481
Dwelling/house value	0.604	0.504
Quantity of water supply	0.391	0.939
Quality of water supply (cleanness)	0.351	1.047
Distance of water supply	0.451	0.796
Access to electricity	0.422	0.863
Telephone	0.957	0.439
Private toilet in the plot	0.177	1.731
Hi-fi set	0.603	0.506
Radio	0.333	1.099
TV	0.503	0.687
Dining room suite	0.586	0.534
Living room suite	0.672	0.397
Electric or gas stove	0.672	0.397
Bicycle	0.726	0.320
Car	0.865	0.145

Table 5: India: Indicators used to build IRD

Indicators: deprivation "symptoms"	N HH (tot 593)	Modalities	Frequencies	g(xij)= $H(x^{(k)}_j)$ Cum. Freq.	Alternative g(xij)
Per capita monthly Income	567	>2000 Re	0.056	0.056	0
		800-2000 Re	0.226	0.282	0.239
		500-800 Re	0.236	0.518	0.489
		300-500 Re	0.219	0.737	0.720
		<300 Re	0.263	1	1
Dwelling/ House value	574	> 100,000 Re	0.194	0.194	0
		50,000-100,000 Re	0.354	0.548	0.439
		30,000-50,000 Re	0.216	0.764	0.707
		10,000-30,000 Re	0.179	0.943	0.929
		<10,000 Re	0.057	1	1
Quantity of Water supply	593	Always or almost always	0.049	0.049	0
		Usually or most the time	0.921	0.97	0.96
		Seldom or occasionally	0.030	1	1
		Almost never	-	-	-
Quality of water supply (clearness)	593	Always or almost a.	0.066	0.066	0
		Usually or most the time	0.904	0.97	0.96
		Seldom or occasionally	0.029	0.99	0.99
		Almost never	0.002	1	1

Distance of Water supply	592	Own tap connection	0.203	0.203	0
		Outside <100m	0.493	0.696	0.618
		Outside 100-500m	0.231	0.927	0.907
		Outside >500m	0.073	1	1
Access to electricity	586	Good connection	0.121	0.121	0
		Connected, but unreliable	0.568	0.689	0.625
		No connection	0.311	1	1
Telephone	592	Yes	0.007	NOT USED	NOT USED
		No	0.993	NOT USED	NOT USED
Private toilet in the plot	384	Yes	0.081	NOT USED	NOT USED
		No	0.919	NOT USED	NOT USED
Hi-fi set	357	Yes	0.185	NOT USED	NOT USED
		No	0.815	NOT USED	NOT USED
Radio	389	Yes	0.311	NOT USED	NOT USED
		No	0.689	NOT USED	NOT USED
TV	403	Yes	0.449	NOT USED	NOT USED
		No	0.551	NOT USED	NOT USED
Dining room Suite	321	Yes	0.003	NOT USED	NOT USED
		No	0.997	NOT USED	NOT USED
Living room Suite	321	Yes	0.003	NOT USED	NOT USED
		No	0.997	NOT USED	NOT USED
Electric or Gas stove	336	Yes	0.101	NOT USED	NOT USED
		No	0.899	NOT USED	NOT USED
Bicycle	329	Yes	0.283	NOT USED	NOT USED
		No	0.713	NOT USED	NOT USED
Car	593	Yes	0.00	NOT USED	NOT USED
		No	1	NOT USED	NOT USED

Table 6: India: Mean values and weights of indicators used to build IRD

Indicators: deprivation “symptoms”	Mean	Weight
Per capita monthly income	0.589	0.530
Dwelling/house value	0.531	0.633
Quantity of water supply	0.914	0.089
Quality of water supply (cleanness)	0.898	0.107
Distance of water supply	0.587	0.503
Access to electricity	0.666	0.406

Table 7: Botswana: Indicators used to build IRD

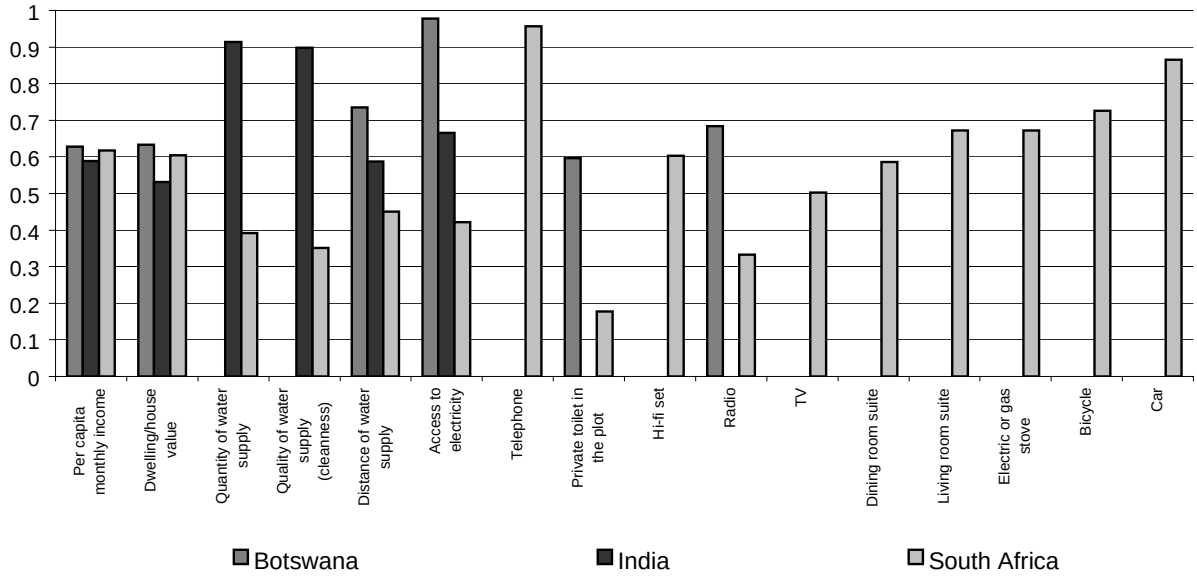
Indicators: deprivation "symptoms"	N HH (tot 593)	Modalities	Frequencies	g(xij)= $H(x_j^{(k)})$ Cum. Freq.	Alternative g(xij)
Per capita monthly Incombe	1227	>400 Pula	0.02	0.02	0.0
		100-400 Pula	0.23	0.25	0.255
		50-100 Pula	0.285	0.535	0.546
		25-50 Pula	0.232	0.767	0.783
		<25 Pula	0.232	1	1
Dwelling/ house value	715	> 100,000 Pula	0.025	0.025	NOT USED
		10,000-100,000 Pula	0.275	0.3	NOT USED
		5,000-10,000 Pula	0.201	0.502	NOT USED
		1,000-5,000 Pula	0.303	0.805	NOT USED
		<1,000 Pula	0.194	1	NOT USED
Quantity of water supply	1458	Always or almost a.	0.615	0.616	NOT USED
		Usually or most the time	0.332	0.948	NOT USED
		Seldom or occasionally	0.048	0.996	NOT USED
		Almost never	0.004	1	NOT USED
Quality of water supply (clearness)	1458	Always or almost always	0.725	0.725	NOT USED
		Usually or most the time	0.253	0.978	NOT USED
		Seldom or occasionally	0.019	0.997	NOT USED
		Almost never	0.03	1	NOT USED
Distance of Water supply	1458	Own tap connection	0.118	0.118	0
		Outside <100m	0.537	0.656	0.728
		Outside 100-500m	0.263	0.918	1
		Outside >500m	0.081	1	1
Access to electricity	1452	Good connection	0.014	0.145	0
		Connected, but unreliable supply	0.009	0.241	0.257
		No connection	0.976	1	1
Telephone	1461	Yes	0.03	0	NOT USED
		No	0.97	1	NOT USED
Private toilet in the plot	1462	Yes	0.404	0	0
		No	0.596	1	1
Hi-fi set	1461	Yes	0.046	0	NOT USED
		No	0.954	1	NOT USED
Radio	1461	Yes	0.316	0	0
		No	0.684	1	1
TV	1460	Yes	0.032	0	NOT USED
		No	0.968	1	NOT USED
Dining room Suite	1460	Yes	0.014	0	NOT USED
		No	0.986	1	NOT USED
Living room Suite	1460	Yes	0.09	0	NOT USED
		No	0.91	1	NOT USED
Electric or gas	1459	Yes	0.997	0	NOT USED

Stove		No	0.003	1	NOT USED
Bicycle	1459	Yes	0.07	0	NOT USED
		No	0.93	1	NOT USED
Car	1456	Yes	0.023	0	NOT USED
		No	0.977	1	NOT USED

Table 8: Botswana: Mean values and weights of indicators used to build IRD

Indicators: deprivation "symptoms"	Mean	Weight
Per capita monthly income	0.628	0.464
Distance of water supply	0.735	0.307
Access to electricity	0.978	0.022
Private toilet in the plot	0.596	0.518
Radio	0.684	0.380

Graph 1: Means of indicators used to build the IRD



2.4. An analysis on standard of living and fertility behaviour in rural South Africa, India and Botswana

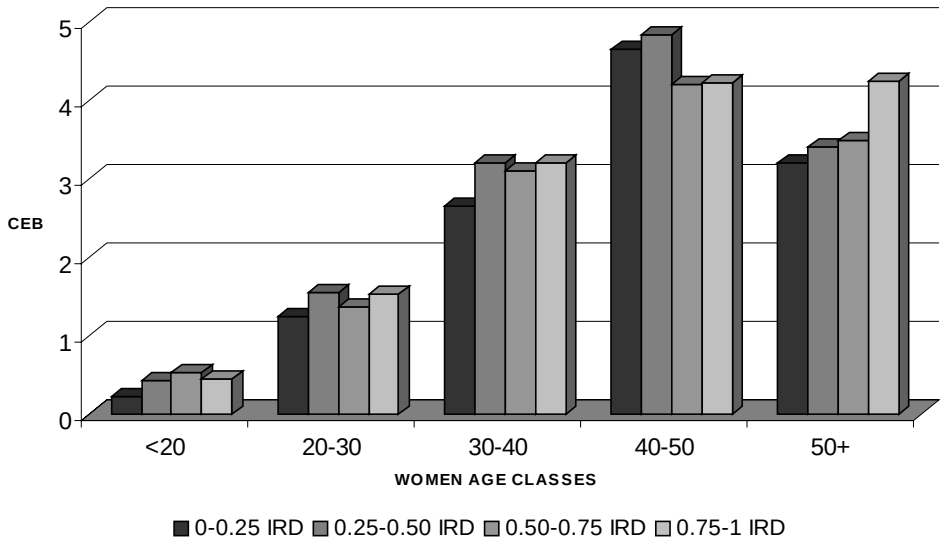
Although the interpretation of the final index is not very easy because it combines indicators of a different nature, the overall fuzzy index is particular illuminating when comparing several groups of the population.

Graphs 2, 3, and 4 show the mean number of children ever born to women in different age classes by the quartiles of the IRD value. As we can easily see, the relationship between deprivation and fertility seems to be clearly positive in Botswana, less clear but still positive in South Africa, and positive in India for younger women. Oddly enough, the relationship is instead negative for women who have already completed their fertility, i.e. older than 50. Of course, it is difficult to draw conclusions from the bi-variate analysis on the relationship between the living standards and fertility. The effect of deprivation on fertility can be mediated by omitted variables, or there can be elements (such us access to sanitary or family planning services or education) that affect both the levels of fertility and (possibly, at a different time) the standard of living.

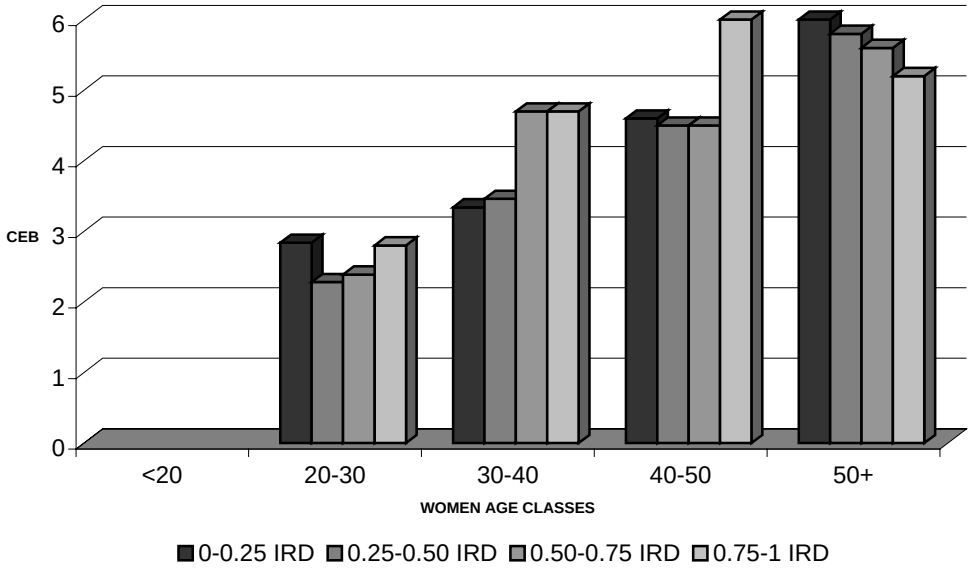
Here we propose again a simple regression model (similar to the one we used in paragraph 2.2.2) where the dependent variable is the number of children ever born and among the independent variables we include our IRD (varying from 0 to 1, and supposed to influence positively, in all contexts considered, the level of fertility). The effect of child mortality (see paragraph 2.2.2) and female education (number of years at school) should be the same as before, i.e. the positive and negative, respectivly.

When the IRD is included in the regression models (see table 9) the sign of the effect is always positive in all the three countries considered, as expected. However, the parameter is generally not significant, with the only exception of Botswana, and some unexpected results for other variables emerge: for instance, we register an apparently negative effect of child mortality on fertility in the case of Botswana. This calls for further exploration of the data: in the next paragraph we will consider a model that we consider more appropriate for our case (with sparse data), trying to better measure the effect of deprivation on fertility.

Graph 2: South Africa: Mean number of children ever born by IRD level and women' age classes



Graph 3: India: Mean number of children ever born by IRD level and women' age classes



Graph 4: Botswana: Mean number of children ever born by IRD level and women' age classes

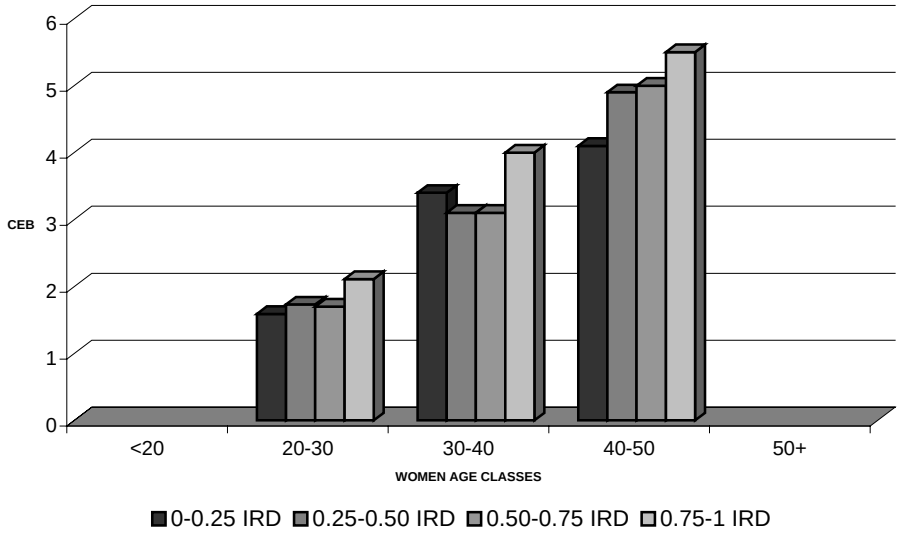


Table 9: Results of Poisson log-linear regression on fertility (CEB) among women from households in the 3 countries

Variables	Regression coefficient[§] β	e^{β}	Standard errors
BOTSWANA			
Age	0.0491**	1.050	0.0032
Child mortality	- 0.5209*	0.594	0.2909
Years of education	- 0.0006	0.999	0.0089
IRD index (0-1)	0.2439 *	1.276	0.1118
Intercept	-0.734**		0.176
Sample	432		
INDIA			
Age	0.0148**	1.015	0.0014
Child mortality	0.5683**	1.765	0.1331
Years of education	-0.0283*	0.972	0.0144
IRD index (0-1)	0.1491	1.161	0.1097
Intercept	0.743		0.110
Sample	518		
SOUTH AFRICA			
Age	0.0397**	1.040	0.0033
Child mortality	0.8487*	2.337	0.3227
Years of education	-0.0165	0.984	0.0105
IRD (0-1)	0.1113	1.118	0.2126
Intercept	-0.386		0.215
Sample	365		

**highly significant (p-value=0.001); * significant (p-value =<0.05).

2.5. A synthetic model to connect the standard of living to fertility

Here we apply a multivariate logit model (the details of which are discussed in the methodological appendix, chapter 4) to estimate how the characteristics of the women affect their probability of giving birth to a different number of children. In particular we intend to verify the relationships between fertility (by parities) and the above indicator of standard of living (IRD)[17], estimating a postulated a-priori model between dependent variable (CEB=children ever born) and our poverty IRD index[18].

First, in graphs 5 and 6 we present the results of the model for a general comparison of fertility (by parities) by women's age among in three countries considered.

By looking at graph 5 above, detailing the conditional probabilities estimated from the multivariate logit model, we see that among the youngest (aged 15-24), Botswana women show higher probabilities of not having children at all, while their South African and Indian

[17] In this paragraph we will disregard the possibility of reverse or joint causation between fertility and IRD, because our data, besides being too few, are not detailed enough to permit us to follow fertility histories.

[18] In this paragraph we have considered only the relationships between fertility and IRD index without to include in the model other indicators such as some aspects of cattle or asset ownership. The reason of this choice depend firstly on the missing values present in the above variables and secondly on the fact that also if the model estimated is useful in presence of missing values it is not possible to consider as independent variables too many indicators because a good model is a parsimonious one.

counterparts have higher probabilities to have had five or more children. The same result holds for graph 6, giving conditional probabilities for children ever born for women aged 35-44. For this group of women, almost at the end of their reproductive period, we see that Botswana women have lower probabilities to have 5 or more children than women in Africa and India.

Secondly, as in regression models (where the P-value results seems to confirm the non-robustness of estimated parameters), we introduce in the model also some other exogenous variables such as the educational level, the working condition and the age of women. Therefore, the estimates we obtain from the model are net of the influence of age, education and working condition of the considered women. We do not estimate this model for rural variables (landholding and land size, see paragraph 2) because the sub-groups of women in the households with access to land are too small to guarantee convergence in the model's estimation procedure.

We estimated the model for women in three age classes: 15-24, 25-34 and 35-44. As expected the best results in terms of significance and interpretability of results are those for relatively older women: the dependent variable, in this case, is almost completed fertility, and timing effects (i.e. having children sooner or later in one's life) do not come into play. The parameters (net of education level and working condition) that we show in graphs 7, 8 and 9 refer therefore exclusively to women aged 35-44.

Among Botswana women we can see from graph 8 that women with a relatively high standard of living (0-0.25 IRD index) have prevalently two children, while women with low standards of living have a higher probabilities to have five or more children. Our indicator of the standard of living, in other words, shows that poorer women do tend to have more children. As discussed above, this is consistent with theoretical expectations, although previous studies did not always prove capable of detecting such a relationship (Schoumacher and Tabutin, 1999). Besides, this can be explained by the fact that about 50% of Botswana people live in rural areas, where men are relatively underrepresented (because they frequently work in towns), and where children are therefore expected to help their parents with food and other basic necessities.

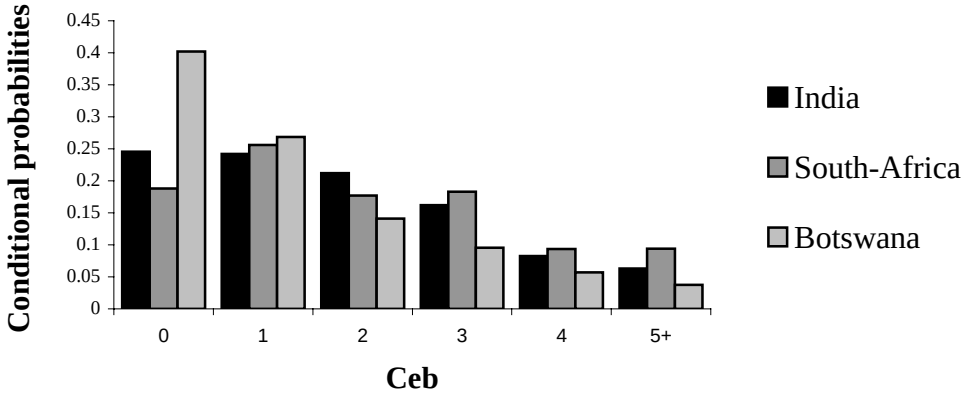
In South Africa (graph 7), the pattern is very similar to that of Botswana, and the relationship between fertility and IRD is once again positive. The only difference is that the probability of remaining childless for women with a low standard of living (0.7-1, last quartile of IRD index) is greater than for their Botswana counterparts.

About the fertility behaviour of Indian women (graph 9), at the higher parities (four or five children) we find, once again, a very clear positive relationship between deprivation levels and fertility, net of the effects of all the other variables considered here.

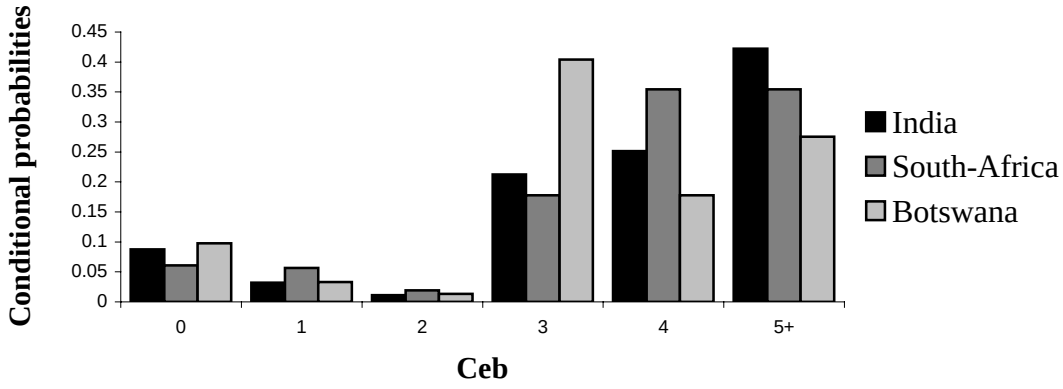
Besides, a peculiarity emerges for India: among women aged 35 to 44 years, it the worst off (0.75-1 IRD index) who have the lowest probability of remaining childless.

In conclusion, in all the three samples of women analysed we find a clear positive (statistically significant) association between high fertility and (relatively) high deprivation, even when other important factors potentially influencing fertility are kept under control (education and working activity of women). This result does not permit us to disentangle the sense of causation between the two phenomena, but it may be taken to suggest that in these rural contexts there may still be a high demand for children, possibly driven by their perceived economic value in rural activities.

Graph 5. Conditional probabilities from a multivariate logit model for Children Ever Born (Age of women: 15-24)



Graph 6. Conditional probabilities from a multivariate logit model for Children Ever Born (women aged 35-44)



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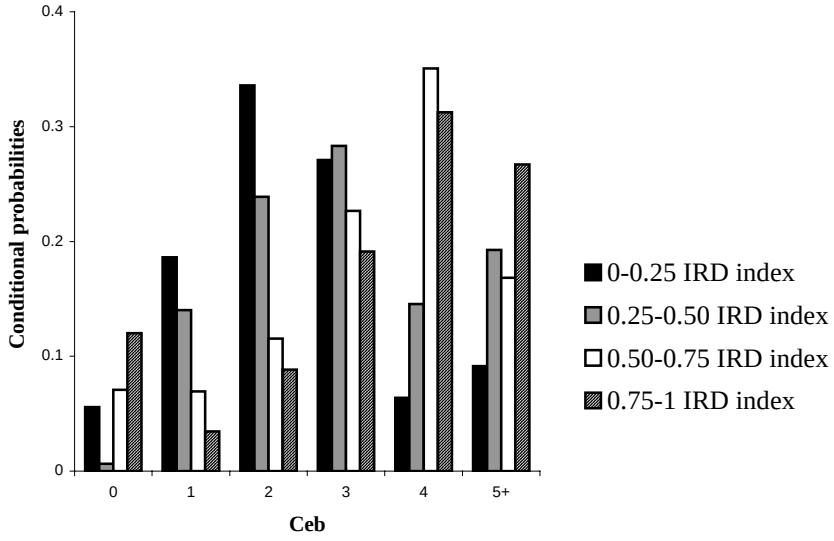
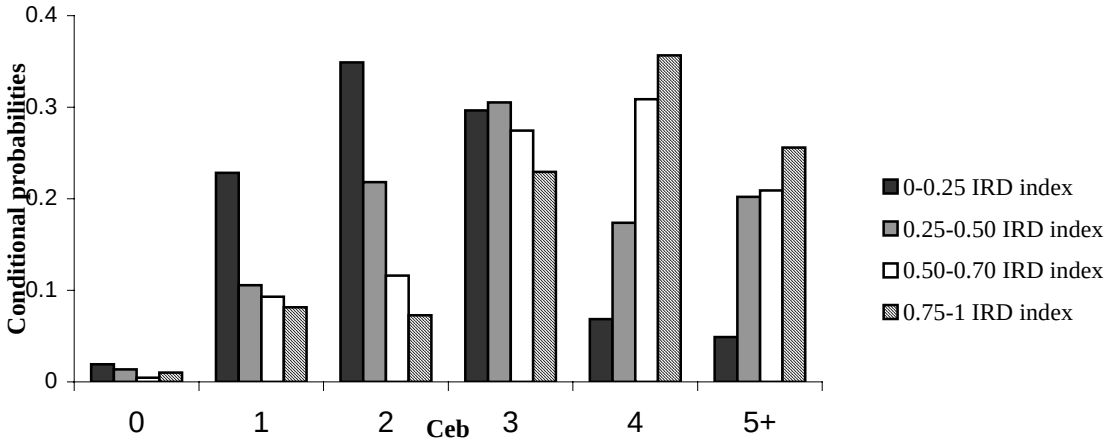
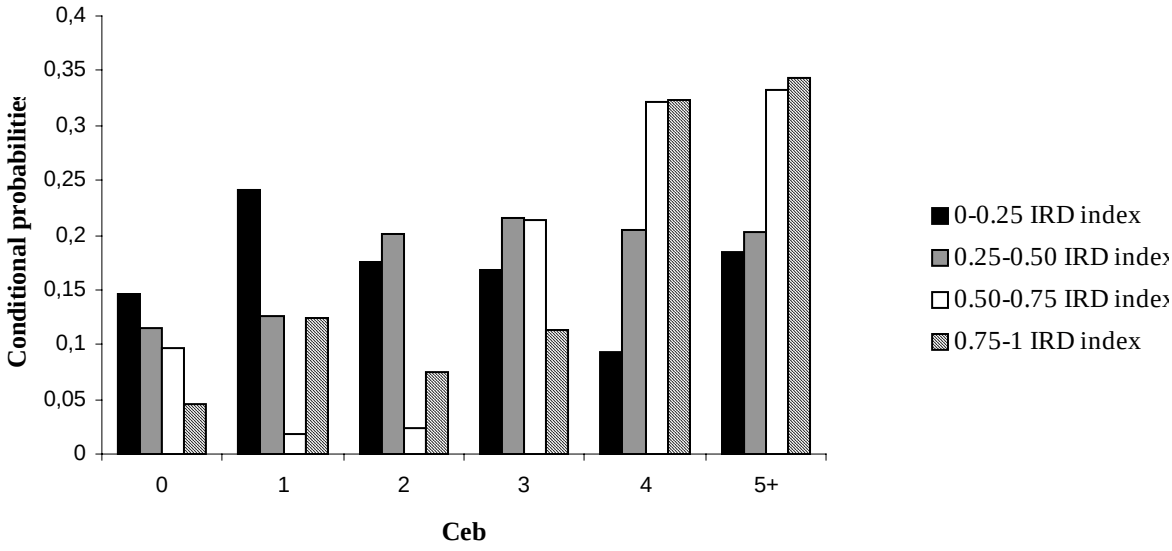
Graph 7: Conditional probabilities from a multivariate logit model for CEB by a IRD index in South-Africa (women aged 35-44)



Graph. 8: Conditional probabilities from a multivariate logit model for CEB by a IRD index in Botswana (women 35-44 years old)



Graph. 9: Conditional probabilities from a multivariate logit model for CEB by a IRD index in India (women 35-44 years old)



3.Women's autonomy and demographic behaviour[19]

3.1 Forward

Female empowerment may impact deeply on the demographic transition and on the socio-economic development of a country.

The basic aim of this paper is to compare the relation between fertility and women's autonomy in different cultural contexts, with special focus on the connections between the different components of female autonomy and some aspects of reproductive behaviour.

3.2 Women's autonomy and development: a theoretical approach

Women's status is a multidimensional concept, and, not surprisingly, different studies focus on different aspects of status. The relationship between female status and education or employment, two of the most frequently used indicators, is rather complex. Better education or engagement in paid economic activity are not necessarily indicative of, or lead to, greater autonomy or better status, because women may engage in paid labour activity as a consequence of impoverishment: indeed, this is a well-documented phenomenon. On the other side, even if education leads to better work opportunities, it does not necessarily translate into extra-domestic employment, or availability of money, or access to resources for a woman.

The various components of status may move in different directions in any given time period, so that it proves sometimes difficult to define what does or does not constitute an 'improvement'. For example, women's entry into the labour force may have very negative consequences for their health.

Also, interpretation may depend on the level of aggregation at which each variable is evaluated. Dixon-Mueller (1978) defines women's status as their overall position in society, and distinguishes this from 'power', i.e. influence and control at the interpersonal level. In other words, like children, women too can also be highly valued and, at the same time, controlled and dominated.

In a further elaboration of the concept of female power, Safilios-Rothschild (1982) identifies two types of power – one derived from men, and the other one derived independently of men. The former consists of the power that women may have depending on who their male relatives are. The latter refers to the woman's ability to take her own decisions about her productive and economic activities, including freedom of movement and control over the resulting wage or income; and her possibility of having an important say in decisions that affect her life. In these terms, the notion of power is very similar to that of female autonomy, defined as "the ability...to obtain information and use it as the basis for making decisions about one's private concerns and those of one's intimates" (Dyson and Moore, 1983).

Five separate but interdependent aspects of female autonomy can be identified as important in the education-fertility relationship (Jejeebhoy, 1995):

1. Knowledge autonomy. Educated women have a wider world view, a greater sense of alternative lifestyles, and a greater questioning of authority.

[19] by Silvana Salvini and Simona Drovandi.

2. Decision-making autonomy. Education strengthens women's say in family decisions and decisions concerning their own lives and well-being. This means that an educated woman is more confident in her ability to make a decision or voice an opinion, and more likely to insist on participating in family discussions.

3. Physical autonomy. Educated women have more contact with the outside world. Women who have been to school have more freedom of movement and more self-confidence in using available services.

4. Emotional autonomy. Educated women shift their loyalties from extended kin to the conjugal family. There is a more egalitarian relationship between spouses, greater bonding or intimacy between spouses and between parents and children, and more self-worth and less self-denial among these women.

5. Economic and social autonomy and self-reliance. Education increases a woman's self-reliance in economic matters and the self-reliance that is basic for social acceptance and status; education enhances women's economic independence, and improves access to and control over economic resources as well as women's ability to rely on themselves, rather than on their children or husbands, to attain social status or acceptance.

Moreover, Jejeebhoy (1995) considers an additional dimension: freedom from threat of violence from husbands. Literature on women's reproductive rights identifies women's security and control over their bodies as the core of female autonomy. This includes control over decisions related to sexuality and fertility, and freedom from violence (Sundari Ravindran, 1999).

What is the role of education in determining autonomy? Various explanations have been offered regarding what happens in school that affect children's behaviour. One is that schools intentionally and unintentionally teach so-called Western values and behaviour. In his review of the literature on children's experience in school, Caldwell (1982) found that school textbooks transmit Western values, as so do teachers, and even parents through the "hidden syllabus".

The essence of Caldwell's theories is that school provide students with a structured, institutional environment in which they learn to understand the world. This learning comes from the organizational characteristics of the school — in contrast to those of the family — as well as from the curriculum and textbooks. To the extent that the school exhibits values and mechanisms different from those of the child's family, the child is forced to make these values and mechanisms a part of his or her own construct of reality. Since boys have more opportunities of getting in contact with the world outside the family circle than girls do, the effect of schooling on girls may be even more profound than it is on boys (Jejeebhoy 1995).

Perhaps, the ultimate explanation of how schools affect girls' behaviour can be found in social learning theories: these postulate that a person who adopts a new behaviour must not only become *aware* of the behaviour but also gain a sense of *self-efficacy* — the belief that he or she can perform the behaviour effectively and thus achieve the desired result.

Though social learning theories help to explain the link between schooling and behavioural change, schools are not the only setting in which individuals observe new behaviours and acquire the sense of self-efficacy they need to adopt them. Social learning theories keep the door open to other experiences that offer new awareness, new knowledge, and an increased sense of self-efficacy. In the non-formal education literature, this kind of experience is often called empowerment (Jejeebhoy, 1995).

More recently, researchers have generated empirical definitions of empowerment for the purpose of measuring this phenomenon. In Nepal, researchers for the U.S. Agency for International Development (USAID) surveyed rural women to better understand what the

term 'empowerment' meant to these women and to what extent they felt empowered. Women answered that empowerment meant:

1. being literate, having knowledge, understanding issues, and sharing knowledge with others;
2. being able to stand on one's own legs, supporting oneself, having a job, making choices;
3. being able to help others, teach others, motivate others, help the village;
4. not tolerating domination, especially men's domination;
5. being able to move around freely;
6. feeling confident, being articulate, feeling able to speak in public and with government officials; and
7. being a leader, getting along with others, maintaining good relationships within the village.

Researchers on women's participation in credit bank and rural development programs in Bangladesh also developed empirical indicators of empowerment (Hashemi, Schuler, and Riley 1996). Their definition includes:

1. mobility (permission and desire to do business and socialise outside the home);
2. economic security (home ownership, possession of savings and use of cash);
3. ability to make purchases;
4. involvement with husband in major decisions;
5. relative freedom from domination by the family;
6. political and legal awareness; and
7. participation in public protests and political campaigning.

Although stated in different terms, for different purposes, and from different perspectives, these two sets of empowerment characteristics show considerable overlaps. Both USAID/Nepal and Hashemi et al. include characteristics of empowerment related to action outside the family (helping others, being a leader, participating in political activities).

This phenomenon of "empowerment" or "autonomy" is the mediating variable between:

(1) education (formal and non-formal) and (2) demographic change (see website http://www.usaid.gov/regions/afr/hhraa/formal/english/eng5.htm).

The other facet of women's autonomy is gender discrimination: among other important factors gender discrimination may induce gender inequalities, that is the gaps from which women suffer in the various contexts (education, work, access to sources of income, availability of resources, prestige), and at different levels (individual, household, village, country). As it concerns relationships between work and fertility, we must underline that work definitions may change among different contexts: this is related to evidence that women's "modern" employment tends to cut their age specific-fertility but women's more traditional employments (agricultural and most services) does not have this effect.

Many developing countries exhibit marked gender inequality in education, employment, and health outcomes. For example, girls and women in South Asia and China suffer from relatively high mortality rates, to the point that Amartya Sen and others have coined the phrase 'missing women' to describe the irregularities of the age pyramid (Sen, 1989; Klasen, 1994). In addition, there are large discrepancies in education between the sexes in South Asia and in Sub-Saharan Africa. Finally, employment opportunities and pay differ greatly by gender in most developing regions.

Gender equity may be considered a development goal in its own right (that is, apart from its beneficial impact on other development goals) as has been recognised, for example, in the Convention on the Elimination of all forms of Discrimination Against Women (CEDAW) which has been adopted (signed and ratified) by a majority of developing countries.[20]

Gender inequality may have adverse impacts on a number of valuable development goals. First, gender inequality in education and access to resources may prevent a reduction of child mortality and fertility, and an expansion of education in the next generation. Moreover, higher education permits a better performance in the labour market that, once again, may lower the number of desired children.

As relationships may be more complex that we have illustrated, the five types of autonomy above cited may be also analysed following these questions:

1) does female autonomy affect fertility? Only with female education, or even if female education is unchanged?

2) does female education affect autonomy?

3) does female education affect fertility, even with autonomy unchanged?

4) does education change the impact of economic factors, in particular of land and assets ownership on fertility?

It may help to set these 'five types of autonomy' in the context of the approach, to the topic of 'effect of female education on fertility', adopted by most economists. Are the types of autonomy due to female education, alternatives (different from the economic incentives and constraints) through which education may reduce fertility? Or are they channels through which the economic factors work, e.g. if female autonomy is higher, then the economic effects of education in reducing fertility are stronger or quicker? Will female autonomy due to education reduce fertility via more independent female attitudes, even if education does not create economic incentives for that, e.g. because even educated women are denied access to modern jobs? Will changed economic incentives due to education cut fertility on their own, if autonomy indicators are unaffected?

Economists usually model/test the mother's-education-to-fertility relationship in terms of her constrained welfare-maximising response to incentives:-

(a) Longer education usually means longer before couple formation (constraint), and makes it pay to delay couple formation - and within-couple fertility - to attain yet more education, so as to earn more later (incentive).

(b) More-educated women (because they can earn more) have higher opportunity costs of pregnancy, lactation and (especially) child-care, so cut fertility.

(c) Maybe, the children of educated women 'inherit' access to, and knowledge about good choices in education. Certainly, educated women tend to have higher income, raising household ability to defer household-earnings benefits from children. For both reasons, educated women (and their husbands?) are likely to 'substitute quality for quantity': a few educated children for many early-earning ones. This is reinforced by lower child mortality - and hence lower replacement and hoarding fertility - in households with educated mothers than in other households, even if the former households have no higher income per adult equivalent, and more so if they do.

(d) If there is "assortative mating" of educated women with educated men, the above tendencies are strengthened.

---

[1] The Convention on the Elimination of All Forms of Discrimination Against Women adopted in 1979 by the UN General Assembly, is often described as an international bill of rights for women. Consisting of a preamble and 30 articles, it defines what constitutes discrimination against women and sets up an agenda for national action to end such discrimination.

(e) All the above affects desired family size. But it is also reasonable to assume that education reduces any excess of actual over desired family size - by 'modernising' knowledge, attitudes and practice in regard to contraception (though, offsetting this, education may reduce breast-feeding).

(f) The economic factors, in particular land and assets ownership may have an important impact on fertility decisions, with a great variability in different economic and social settings.

In the future, deeper analysis will be developed to take into account all of these possible relationships, being very interesting to study the heterogeneity of the cultural context of the three countries.

In conclusion, the most important question concerning population and development in developing countries by a gender point of view can be summarised as follows: to what extent gender inequality, particularly gender inequality in education and employment, has a negative impact on demographic behaviour, conditioning and slowing down the demographic transition from an "ancient regime" to a modern setting, with low mortality and fertility, and to what extent does this relation affect growth and development? It appears that gender inequality in education does impede economic growth. Gender inequality in education has a direct impact on growth in that it lowers the average quality of human capital. In addition economic growth is indirectly affected through the impact of gender inequality on investment and population growth. Point estimates suggest that between 0.4-0.9% of the differences in growth rates between East Asia and Sub-Saharan Africa, South Asia and the Middle East can be accounted for by the larger gender gaps in education prevailing in the latter regions. Moreover, the analysis shows that gender inequality in education prevents progress in reducing child mortality and fertility rates, thereby compromising progress in well-being in developing countries (Klasen, 1999).[21]

There is a large number of studies that link gender inequality in education to fertility and child mortality (e.g. Murthi *et al.*, 1996; Summers, 1994; Hill and King, 1995). For example, Summers shows that in Africa females with more than 7 years of education have, on average, two children less than women with no education. Hill and King (1995) find a similar effect of female schooling on fertility. Over and above this direct effect, lower gender *inequality* in enrolment has an *additional depressing effect* on the fertility rate. Countries with a female-to-male enrolment ratio of less than 0.42 have, on average, 0.5 more children than countries where the enrolment ratio is larger than 0.42 (in addition to the direct impact of female enrolment on fertility). Similar linkages have been found between gender inequality in education and child mortality (Murthi *et al*., 1996; Summers, 1994). Therefore, reducing gender bias in education furthers two very important development goals, namely lower fertility and lower child mortality, quite apart from its impact on economic growth (Sen, 1999).

At the end of this section we must add some cautions, due to the difficulty that often social scholars and statisticians meet when they intend to interpret associations among processes. If these processes are measure on a longitudinal scale, causation may be established at least according to temporal sequence of events. But in this analysis this is not the case of female autonomy and fertility because there is a possible feedback among the two processes: higher level of autonomy may induce a lower demand of children and a larger diffusion of contraception (this is the approach followed in this study); on the other side, it is also possible that the higher and precocious fertility, with a larger span of life spent in child bearing and rearing, may not allow the woman the entry into the education enrolment and into

[21] Gender inequality is not the only source of lack of female autonomy, nor always a source of higher fertility. The relationships, once again, depend on the context, both in the family and in the social setting.

the labour market. In conclusion, in this second framework very high fertility reduces female autonomy, that is fertility behaviour tends to diminish the possibility of female empowerment. [22]

3.3 Women's status and fertility behaviour in three different cultural contexts

3.3.1. The measurement of women's autonomy

Since the beginning of the '80s, studies looking at the impact of women's status on demographic behaviour have increased. Empirical research – much of this carried out in India, Nepal, Pakistan and Bangladesh – was based on alternative indicators. In a study of women's status and fertility in Pakistan, Sathar *et al.* (1988) selected three measures of status: women's education, work participation and age at marriage, while Vlassoff (1992) analysed the relationship between women's status and fertility in an Indian village measuring women's position (or status) following the approach outlined by Mason (1984) and including in the analysis the control that women may have on the resources, the decision making power and the degree of isolation from external events. A similar choice is at the basis of the study carried out in two Nepali settings (Morgan and Niraula, 1995; Niraula and Morgan, 1996). The indicators of women's autonomy are women's freedom of movement and women's power in household decision-making. All these researches witness the importance of the context in determining women's autonomy and its relationships with fertility and contraception.

For example, work opportunities influence women's autonomy and contraceptive behaviour in two villages of South India analysed by Dharmalingam and Morgan (1996), who adopt the basic autonomy definition proposed by Dyson and Moore (1983): "*Autonomy indicates ability – technical, social and psychological – to obtain information and use it as the basis for making decisions about one's private concerns and those of one's intimates*". The indicators the authors use are represented by perceived economic independence, freedom to move and spousal interaction. At this proposal, the most recent studies on this argument outline the importance to collect information not only requesting to the women their perception on arguments regarding female economic independence and female freedom of movement but also requesting to the men their perceptions on the same arguments (Mason and Smith, 2000)

In the questionnaire used in the surveys carried out in Botswana, South Africa and India, following Kishor's approach (1995), we have included some questions on women's perception of decisional process regarding both family formation and more general decisions, and regarding women's freedom of movement.

The questions included were the following (which, for the sake of the exposition, can be subdivided in three groups):

[22] In this work we have not develop the possibility that fertility and female autonomy may be both endogenous variables that is the existence of feedback relationships. We hope to deep this analysis in future works.

Table 2 – Questions of the questionnaire regarding the measure of women's autonomy

Questions of type A: Customary Autonomy	
Who should have the last word on the following topics:	
1. Whether to have another child	Husband (weight 0) Wife (weight 1) Both (weight 1) Other, please specify (weight 0)
2. Whether the child should continue his/her education 3. What to arrange for a child's marriage plans 4. Whether to use a particular family planning method	Same as above
Questions of type B: Non customary Autonomy Who should have the last word on the following issues?	
1. Changing the make-up of household spending 2. Whether to visit friends or relatives 3. Taking a new loan	Husband (weight 0) Wife (weight 1) Both (weight 1) Please specify (weight 0)
4. Now I would like to talk to you about a different topic. In general if a wife disagrees with her husband should she keep quiet or speak up?	Keep quiet (weight 0) Speak up (weight 1) Not sure/don't know(weight 0)
5 Do you think a wife respects a husband more if he insists she accepts his opinion in everything or if he listens to and accepts her opinion?	Insists on his opinion (w. 0) Listens & accepts her opinion (weight. 1) Not sure/don't know (weight 0)
Questions of type C: *Realized Autonomy*	
In your home does your point of view carry the same weight as your husband's less weight than his point of view or isn't taken into account at all?	Same weight (w. 1) Less weight (w. 0) Not taken into account (w. 0) Other (w. 0)
Do you go out with your husband to purchase major household items/clothing?	Yes (w. 1) No (w. 0)
Does your husband allow you to go out alone or with your children to buy households items?	Yes alone (w. 1) Yes with children (w. 0) Not allowed (w. 0) Other (w. 0)
Who mainly decides how the money you earn will be used?	Respondent decides (w. 1) Husband decides (w.0) Jointly (w.1) Someone else decides (w.0) Jointly someone else (w.1)

For a descriptive presentation of the findings on each of these questions, please refer to the Country Reports. Then the questions were grouped according to whether they concerned the reproduction and family planning or whether they addressed other areas of family life not specifically concerned with children.

The first aggregation – questions of type A – leads us to build an index defined by Kishor (1995) of "customary autonomy" (Index measuring the extent to which women believe that they should have the last word in family planning in decision to have another child and in their children's education and marriage) while the second – questions of type B – was

defined by Kishor (1995) as the index of "non-customary autonomy" (index measuring the extent to which women believe that women should have decision-making powers in general and in areas outside their traditional role). The questions on who is perceived by the respondent to actually have decision-making power within the family and who decides on whether the respondent is allowed freedom of movement outside the home were combined to form the index of " realized autonomy". This index reflect the actual amount of autonomy women have rather than the amount they believe that women should have on decision-making powers in general, as well as in areas connected to household finances (Kishor, 1995).

As the above prospect shows, when the respondent answers "Woman" or "Both" to all four questions used to construct the customary autonomy index (type A) and to the first three questions used to construct the non customary index (type B) we assigned a weight of 1. The latter index also includes also the two other answers to B-type questions: the weight of 1 is assigned to the answer "Speak Up" to the question "if a wife disagrees with her husband should she keep quiet or speak up?" and to the answer "Listens and accepts her opinion" to the question "Do you think a wife respects a husband more if he insists she accepts his opinion in everything or if he listens to and accepts her opinion?"

For the construction of the realized autonomy index, a woman is considered to be autonomous only if she is allowed to go out alone and if her opinion carries as much weight as her husband's.

3.2 The results of the Survey: women's autonomy in Botswana, India and South Africa

The distribution of women according to the answers given to the single items that we have used for building the aggregate indexes has already been described in the country reports (see Botswana, India and South Africa Country Reports). Let us limit our study to a comparison between the situation of women in the three countries. Deep differences between the African countries on one side and India on the other emerge from Table 3: in India, on some specific dimensions in particular women appear to have a markedly low decisional power.

In India, on several questions, there seem to be very low proportions of women who have a say. The largest differences emerge when comparing India with the African countries with regard to both family and extra-domestic issues. In particular, women do not have "the last word" on financial topics, such as the money they earn and decisions on taking a loan. Also with regard to reproductive and contraceptive choices (Whether to have another child, or to use a particular family planning method) the majority of Indian women follow their partner's decision. Only in the traditional field of "arranging" a child's marriage, Indian women living in Rajastan have the last word.

Let us open a short parenthesis here, to explore the data deriving from the last survey on family and fertility carried out in India, in 1998-99 (table 4). This sample is representative at state level and permits us to compare autonomy indicators along the three dimensions discussed before: women's decision making, freedom of movement and access to resources (money). In comparison to Indian women all together, women from Rajastan appear to be at disadvantage.

Table 3 – Distribution of women according to the single items concerning autonomy

Questions type A: Who should have the last word on the following topics:		Answers *S.Africa Botswana*	*India*
	Others	32.85	81.45
1. Whether to have another child	Woman	67.15	18.55
2. Whether the child should continue its education	Not the woman	41.67	61.89
	Woman	58.33	38.11
3. What to arrange for a child's marriage plans	Not the woman	46.26	33.9
	Woman	53.74	66.1
4. Whether to use a particular family planning method	Not the woman	21.74	77.57
	Woman	78.26	22.43
Questions type B: Who should have the last word on the following issues?			
5. Changing the make-up of household spending			
	Not the woman	24.86	18.38
6. Whether to visit friends or relatives	Woman	75.14	81.62
	Not the woman	27.01	58.35
7. Taking a new loan	Woman	72.99	41.65
	Not the woman	52.3	98.15
	Woman	47.7	1.85
8. Now I would like to talk to you about a different topic. In general if a wife disagrees with her husband should she keep quiet or speak up?	Quiet	53.3	37.61
	Speak Up	46.7	62.39
6 Do you think a wife respects a husband more if he insists she accepts his opinion in everything or if he listens to and accepts her opinion?	Insists	44.02	18.72
	Accepts	55.98	81.28

Questions type C:		
In your home does your point of view carry the same weight as your husband's less weight than his point of view or isn't taken into account at all?	Not same	72.97 91.06 61.92
	Same weight	27.03 8.94 38.08
Do you go out with your husband to purchase major household items/clothing?	No	38.08 19.39 30.85
	Yes	61.92 80.61 69.15
Does your husband allow you to go out alone or with your children to buy households items?	No	57.44 64.76 52.51
	Yes	42.56 35.24 47.49

Who mainly decides how the money you earn will be used?	Not woman	39.83
		88.7
		49.5
	Woman	60.17
		11.3
		50.5

NOTE: In this tables, as in the following ones, values are not weighted.

Table 4 - Women's autonomy indicators: Rajastan and India, 1998-1999

Indicators	*Rajastan*	*India*
Percentage not involved in any decision making	13.3	9.4
Percentage involved in decision making:		
- What to cook	82.3	85.1
- Own health care	40.6	51.6
- Purchasing jewellery	42.7	52.6
- Staying with her partner	39.3	48.1
Percentage who do not need permission to:		
- Go to the market	19.0	31.6
- Visit friends/relatives	17.0	24.4
Percentage with access to money	40.5	59.6

Source: National Family Health Survey (NFSH-2), 2000

Coming back to the data deriving from our survey, it may be interesting to describe women's status in the three countries using our aggregated indexes: customary autonomy, non-customary autonomy and realized autonomy that refer to the components outlined above.

The distribution of women according to the values of the aggregated indexes and the mean value of these can be read in figure 1 and table 5[23], respectively, where the comparison between the three countries shows the deep difference existing between African and Indian women. As we have already noted, some caution is needed to interpret these data because of the cultural context in which surveys have been carried out. Although the questionnaire is the same in the three cases, translation into local dialects, and interactions with interviewers and local culture may have led to partially different interpretations in the three cases. For example, the questions regarding the freedom of movement and the decisions about money, in some cases (Indian villages) may have been interpreted as "general considerations", not referred to the woman's personal experience, due to the fact that these issues appear very far from the personal life of the rural women living in Rajastan, who often are secluded in their household. Consequently, some caution is needed also in the comparison of the following descriptive results.

[23] This table, as the following ones containing proportions and mean values, have only descriptive aims not an inferential ones. In the future, it will be possible to verify the significance of the differences through ANOVA models.

Figure 1 – Distribution of women according to the values of the indexes of autonomy

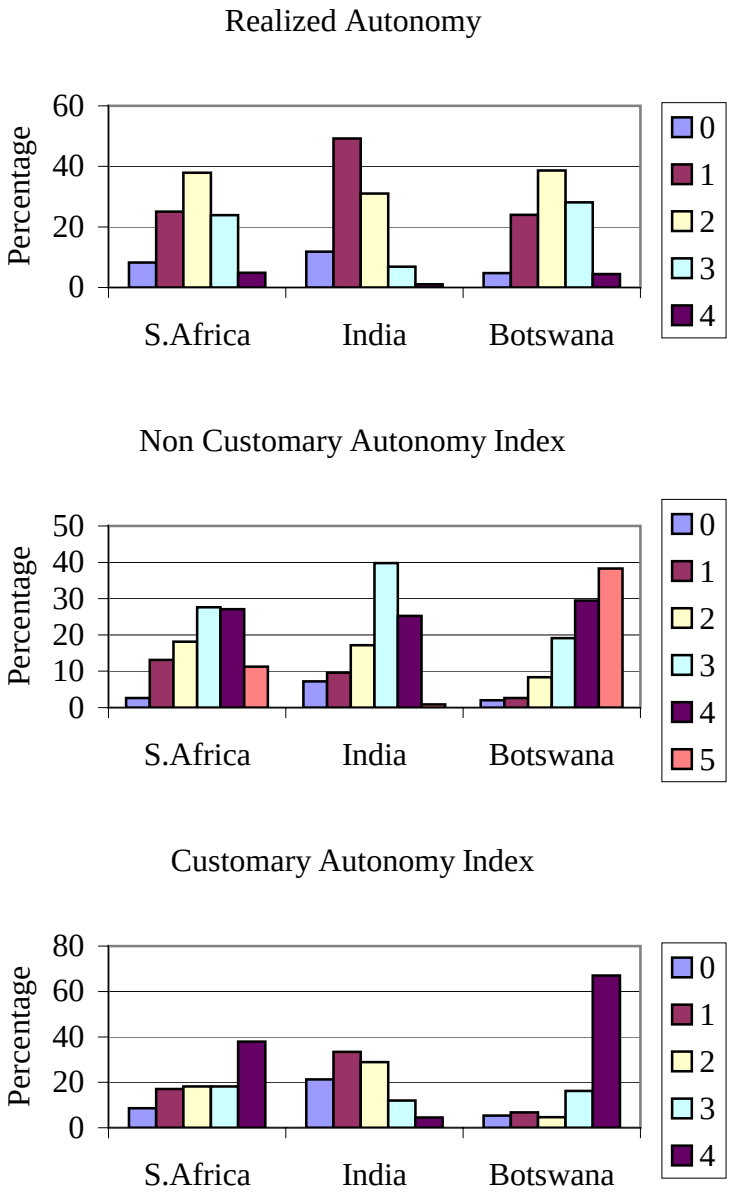


Table 5 – Mean value of autonomy indexes: Botswana, South Africa and India

	Mean values of indexes		
Countries	*Customary*	*Not customary*	*Realised*
Botswana	3.33	3.86	2.03
South Africa	2.60	2.97	1.92
India	1.45	2.69	1.36

The different aspects of the autonomy of women as measured by the three indexes are only moderately correlated in South Africa and India, while the correlation between customary and non-customary autonomy is much higher in Botswana (see table 6).

Table 6 - Correlation coefficients among the three autonomy indexes: Botswana, South Africa and India

Indexes	Customary	Noncustomary	Realized autonomy
		Botswana	
Customary autonomy	1	0.613 (<0.0001)	0.186 (0.0016)
Non customary autonomy		1	0.412 (<0.0001)
Realised autonomy			1
		South Africa	
Customary autonomy	1	0.507 (<0.0001)	0.222 (<0.0001)
Non customary autonomy		1	0.170 (0.0026)
Realised autonomy			1
		India	
Customary autonomy	1	0.491 (<0.0001)	0.056 (0.1764)
Non customary autonomy		1	0.260 (<0.0001)
Realized autonomy			1

NOTE: In the brackets we report the values of the standard errors.

For India and South Africa this moderate correlation among the three indices supports the assumption that the indicators are concentrating on distinct dimensions of the autonomy of the women interviewed in the different countries, while this may be less true in Botswana. The results of correlation indices seem to show that customary and non-customary autonomy are correlated across households while realised autonomy seems to be not correlated with other types, except with non-customary in Botswana.

When we analyse women's status by educational level and working status (table 7), we can see that education is strongly related to women's autonomy in all countries. Everywhere, educated women present higher values in all the three indexes. In all cases, differences are relatively small in India, but large in South Africa and in Botswana. [24]

[24] In the future we will add deeper analysis checking whether there are big differences within countries in the indicators of female autonomy: e.g. among main regions; between female-headed versus other households; by types of union; by age of woman. And, moreover, landed versus landless; by asset classes per person, per household.

Table 7 - Mean values of autonomy indexes according to professional status and level of education

SOUTH AFRICA				
Professional status	Level of education	C.A.	NC.A.	R.A.
Work	None	1.91	2.55	1.36
	Primary	2.87	3.13	2.31
	Secondary	3.31	3.31	2.18
	Dip. Degree	3.20	3.33	2.83
Not work	None	1.60	2.52	1.45
	Primary	2.07	2.77	1.77
	Secondary	2.70	2.95	1.96
	Dip. Degree	3.09	3.27	1.70
BOTSWANA				
Professional status	Level of education	C.A.	NC.A.	R.A.
Work	None	3.00	3.67	2.07
	Primary	3.45	4.15	2.45
	Secondary	3.34	3.76	2.35
	Dip. Degree	3.88	4.75	2.71
Not work	None	3.08	3.67	1.84
	Primary	3.19	3.92	1.81
	Secondary	3.44	3.82	2.06
	Dip. Degree	3.79	4.42	1.89
INDIA				
Professional status	Level of education	C.A.	NC.A.	R.A.
Work	None	1.43	2.73	1.48
	Primary	1.83	3.17	1.55
	Sec. +	2.33	3.10	1.86
Not work	None	1.25	2.40	1.05
	Primary	1.80	2.80	1.00
	Sec. +	1.71	2.57	1.14

As expected, work status appear to affect in particular realized autonomy: working women seem to enjoy more freedom than non-working women and this is true also in Rajastan where women present, on average, a low status with respect to their counterparts living in Botswana and South Africa.

The distribution of the components of women's autonomy measured by the three indexes by age group presents an inverse U-shaped pattern (table 8): younger women have lower values of autonomy, while women in their central ages present higher values of indexes; finally older women present lower values of autonomy indexes. This pattern may depend on two different cohort factors: first, the oldest women probably never got in contact with empowerment due to the lack of education and to the traditional family values and, second, the youngest women, even if enrolled in school, must still have time to assert their personality in their environment.

Table 8 - Mean value of the indexes by age group

	Botswana			South Africa			India		
Age	C.A.	NC.A.	R.A.	C.A.	NC.A.	R.A.	C.A.	NC.A.	R.A.
15-19	4.00	4.17	2.00	2.89	3.44	1.86	0.89	2.22	1.22
20-24	3.24	4.16	2.30	3.03	3.52	2.04	1.57	2.33	1.38
25-29	3.50	4.12	2.20	2.78	3.02	1.96	2.00	2.91	1.53
30-34	3.54	3.76	1.98	2.66	2.85	2.06	1.49	2.65	1.43
35-39	3.28	3.96	2.10	2.60	2.71	2.16	1.51	2.86	1.58
40+	3.15	3.73	1.93	2.36	2.94	1.73	1.32	2.68	1.27

3.3. Fertility, contraception and women's autonomy

Demographic behaviour - which is what particularly concerns us here - is also related with women's autonomy and the relationship is always positive: women using contraceptive methods present a higher level of autonomy with respect to non-using women. The gap is larger in South Africa than elsewhere and the differences are generally higher on the "customary" autonomy index, which takes into account family and reproductive decision process (table 9).

The relationship between fertility, autonomy and education is shown in table 10, together with the mean number of children ever born by education and autonomy indexes. Fertility too seems to depend on education: educated women typically have fewer children, although our samples are rather small, and do not provide firm evidence on this point. Also women with a higher level of autonomy generally bear fewer children, thereby confirming the negative relationship between fertility and women's empowerment during the demographic transition. This result is more evident for educated women, as we can see for instance in Botswana: women with secondary education are characterised by a higher level of autonomy (customary index), and a lower fertility (table 10 c).

Table 9 - Mean value of the indexes by contraceptive use

	Botswana			South Africa			India		
Contr. Use	C.A.	NC.A.	R.A.	C.A.	NC.A.	R.A.	C.A.	NC.A.	R.A.
Ever use	3.32	3.85	2.04	2.93	3.16	2.01	1.53	2.87	1.40
Never use	3.38	3.96	2.08	2.18	2.75	1.82	1.41	2.57	1.34

Table 10 - Mean number of children by autonomy indexes and by education

Panel a)

	Botswana				South Africa				India		
C.A.	None	Prim.	Sec.	Dip.+	None	Prim.	Sec.	Dip.+	None	Prim.	Sec.+
0	6.00	3.75	5.75		3.50	5.07	3.00		5.21	4.00	5.00
1	4.80	5.75	3.75		4.85	4.00	2.92	1.50	4.91	4.27	2.29
2	5.00	5.50	3.50	3.00	5.14	4.88	2.67	2.67	4.42	4.40	2.22
3	3.80	5.11	3.18	2.00	4.00	4.11	2.16	1.00	3.80	3.89	2.88
4	3.91	4.30	3.07	3.14	3.67	4.16	2.96	1.44	2.80	3.00	3.33

Panel b)

	Botswana				South Africa				India		
NC.A.	None	Prim.	Sec.	Dip.+	None	Prim.	Sec.	Dip.+	None	Prim.	Sec.+
0	6.00	2.50			5.00		3.00	2.00	5.23	7.50	1.00
1	5.50	3.00			5.00	5.40	2.36	3.00	5.11	4.00	3.00
2	5.17	6.00			3.67	4.38	3.50	2.50	4.50	3.13	2.75
3	4.17	5.73	3.00		4.56	4.20	2.89	1.00	4.58	4.00	2.45
4	3.59	4.35	2.89		4.27	3.81	2.27	1.63	4.48	4.39	2.90
5	4.33	4.23	3.07			4.45	2.47	0.50	3.80		

Panel c)

	Botswana				South Africa				India		
R.A.	None	Prim.	Sec.	Dip.+	None	Prim.	Sec.	Dip.+	None	Prim.	Sec.
0	5.20	7.00	5.00	1.00	5.17	5.38	3.50	3.00	5.27	3.00	4.00
1	3.93	4.43	3.53	2.80	3.57	4.46	2.46	1.33	4.63	4.55	2.75
2	4.91	4.07	3.30	3.36	4.64	4.32	2.92	2.17	4.46	3.75	2.70
3	3.31	4.84	3.09	2.88	6.50	4.19	2.41	1.00	4.36	4.33	2.00
4	5.00	6.00	1.89	3.00	5.00	3.00	3.33		4.83		

Finally we have tried to include in our analysis also age group (see table 11), but the dimension of the samples does not permit us to come to very firm conclusions. Only for some age groups can we add some considerations to our previous description. Women aged 25-29 and 30-34 and living in Botswana, present, in correspondence to the higher values of the index of realized autonomy, lower levels of fertility, but this result, for example, is not completely confirmed for Indian women and is only partially confirmed for South African women.

Table 11 - Mean number of children by age group and autonomy index

INDIA				**SOUTH-AFRICA**				**BOTSWANA**			
Age/Value of index	C.A.	NC.A.	R.A.	Age/Value of index	C.A.	NC.A.	R.A.	Age/Value of index	C.A.	NC.A.	R.A.
15-19				15-19				15-19			
0	0.25	0.50	0.00	0				0			1.00
1	0.67	0.00	0.17	1	0.00	1.00	0.67	1			2.00
2	0.00	0.00	0.00	2	1.00	0.00	3.00	2			1.00
3	0.00	0.67	2.00	3	0.67	3.00	0.50	3			0.50
4		0.00		4	3.00	1.00		4	1.00	1.50	
5				5		0.00		5		0.67	
20-24				20-24				20-24			
0	1.67	2.00	2.29	0		1.00		0			1.00
1	2.27	2.20	1.41	1	1.00		1.33	1			1.00
2	1.71	1.88	2.00	2	1.33	0.50	1.15	2	1.00	0.00	1.63
3	1.00	1.47	1.80	3	1.17	1.10	1.14	3	1.38	1.33	1.50
4	2.00	1.88		4	1.25	1.44		4	1.40	1.57	0.50
				5		1.25		5		1.38	
25-29				25-29				25-29			
0	3.57	3.67	4.50	0	2.80	3.50	2.80	0	4.00		
1	2.65	2.60	3.08	1	2.50	2.71	2.00	1	3.00	3.50	2.73
2	2.94	3.40	2.70	2	2.27	1.86	1.88	2	3.25	3.00	2.82
3	3.25	2.86	2.40	3	2.00	1.77	1.71	3	2.33	2.57	2.35
4	2.67	2.87	3.50	4	1.57	1.88	2.33	4	2.47	2.62	1.50
				5		1.57		5		2.46	
30-34				30-34				30-34			
0	5.29	4.80	4.29	0	2.50	2.00	4.00	0	4.00	4.00	5.00
1	4.24	5.00	4.36	1	2.40	2.38	3.31	1	3.33	1.00	2.81
2	3.94	3.50	3.81	2	3.50	2.94	2.91	2	5.00	3.67	3.36
3	3.43	4.62	4.50	3	2.88	3.36	2.40	3	3.56	3.00	3.00
4	3.00	4.09		4	2.78	2.56	3.33	4	3.00	3.13	3.00
5		3.00		5		4.00		5		3.27	
35-39				35-39				35-39			
0	4.80		4.33	0	5.00		4.00	0	5.25	3.00	6.00
1	3.81	4.50	3.92	1	4.67	4.56	3.25	1	3.75	3.00	4.40
2	3.80	3.00	4.00	2	3.63	6.00	4.33	2	8.00	4.33	4.12
3	3.56	4.06	3.25	3	3.25	4.00	4.75	3	3.57	5.09	3.17
4	3.50	3.92	4.00	4	4.29	3.55	4.25	4	3.74	4.00	2.50
5				5		3.50		5		3.32	
40+				40+				40+			
0	5.87	6.56	5.72	0	4.80	5.50	5.67	0	5.88	4.67	6.50
1	5.72	6.06	5.46	1	5.19	5.71	4.55	1	5.75	6.00	4.92
2	5.22	5.49	5.22	2	5.24	4.89	5.05	2	5.43	5.73	5.15
3	4.55	5.18	5.28	3	4.45	5.09	5.43	3	5.57	5.67	5.50
4	3.20	5.23	7.00	4	5.30	5.04	4.50	4	5.00	4.65	4.00
5		4.00		5		4.43		5		5.27	

To synthesise our findings, and find out which relations are more important and robust, it is necessary to use some regression models for fertility and contraception.

In this analysis we have considered as dependent variables fertility (measured by the number of children ever born) and contraceptive behaviour (ever use of methods of family planning). The explanatory variables are represented by: age of woman (in years; this is merely a control variable); contraceptive use (a dummy variable: ever use=1; never used=0); education (in years). Finally we have included in the model the three indexes of women's autonomy (considered as a quantitative variable). The results for fertility, shown in Table 12, indicate that customary autonomy is inversely related with fertility, even allowing for age, contraceptive use and education.

From these results it appears that only customary autonomy in South Africa and in India, and customary and realised autonomy in Botswana, are significantly linked to (fewer) children ever born, with significance levels of 5%, except only 10% in South Africa. We can evaluate, for example, that impacts, measured by the change (the decline, as the coefficient is negative) in children ever born - at mean of all variables – is equal to 0.72 and 1.2 respectively in South Africa and India for a rise in customary autonomy index from 0 to 4.

Education is not significant, and only when we exclude autonomy from the model, does education appear to reduce fertility in any significant way. The correlation between autonomy and education appears indirectly from the comparison of the models. [25]

Table 12 – Regression model - Dependent variable=Children ever born

Botswana					
R-Square=0.4241					
Variable	DF	Parameter Estimate	Standard Error	t value	Pr>|t|
Intercept	1	-0.99885	0.68686	-1.45	0.1476
Age of woman	1	0.14900*	0.01234	12.08	<.0001
Contraceptive use	1	0.72990*	0.23020	3.17	0.0017
Years of education	1	-0.02385	0.03322	-0.72	0.4733
Cust. Autonomy	1	-0.29551*	0.10661	-2.77	0.006
Non customary Aut.	1	0.12992	0.11113	1.17	0.2434
Realized Autonomy	1	-0.24080*	0.11472	-2.10	0.0365
South Africa					
R-Square=0.319					
Variable	DF	Parameter Estimate	Standard Error	t value	Pr>|t|
Intercept	1	-0.19436	0.62891	-0.31	0.7576
Age of woman	1	0.11553*	0.01268	9.11	<.0001
Contraceptive use	1	0.54948*	0.25728	2.14	0.0337
Years of education	1	0.00029	0.00039	0.74	0.4577
Cust. Autonomy	1	-0.18212**	0.10453	-1.74	0.0827
Non customary Aut.	1	-0.10226	0.10814	-0.95	0.3453
Realized Autonomy	1	-0.09104	0.12339	-0.74	0.4613

[25] Children ever born is a discrete variable, never assuming negative values, and the most suitable models fitting such variable is represented by Poisson models. Only for simplicity we used linear regression models to outline the "sign" of coefficients measuring links between dependent and explicative variables.

India					
R-Square=0.2768					
Variable	DF	Parameter Estimate	Standard Error	t value	Pr>|t|
Intercept	1	2.25713	0.47245	4.78	<.0001
Age of woman	1	0.07652*	0.00614	12.46	<.0001
Contraceptive use	1	-0.24803	0.17478	-1.42	0.1564
Years of education	1	-0.06410	0.04654	-1.38	0.1689
Cust. Autonomy	1	-0.31944*	0.09138	-3.50	0.0005
Non customary Aut.	1	-0.01946	0.08579	-0.23	0.8207
Realized Autonomy	1	-0.02040	0.10850	-0.19	0.8509
*= significant at 5% level					
**=significant at 10% level					

Table 13 reports the results for contraceptive behaviour, which seem to depend on the country under investigation. In Botswana, for instance, where the diffusion of contraception is very large (in our sample the use of contraceptive methods is above 65%), the autonomy does not seem to be related with family planning in any significant way. On the contrary, in South Africa and India one dimension of the status of woman is significant: for South African women, higher levels of customary autonomy seem to enhance contraception, while in India this happens for women who score particularly high on the non-customary autonomy scale.

The intercept in Botswana is significant at 5%. We can interpret this on the basis of the fact that in Botswana women are very homogeneous and more autonomous. The significance level of intercept in Botswana may depend on the fact that some latent variables explaining differences are not included in the model. Consequently, the unobserved heterogeneity “falls” entirely in the intercept result. If data would let a more sophisticated analysis, this aspect could be performed with a model including latent variables.

Once again, a note of caution is in order, because these results may be in part conditioned by non responses and in part from the possibly varying meaning respondent women gave to these questions.

Table 13 - Logistic Model - Dependent variable=Ever Use of contraception

A) Botswana

Variables	Parameter Estimate	St. Error	ChiSq	Pr> ChiSq	Point Estim.
Intercept	2.2795**	0.969	5.538	0.019	
Age of woman	-0.0217	0.018	1.452	0.228	0.979
Years of education	0.0396	0.049	0.666	0.415	1.040
Cust. Autonomy	0.0185	0.158	0.014	0.907	1.019
Non customary Aut.	-0.1470	0.167	0.776	0.378	0.863
Realized Autonomy	-0.0100	0.169	0.004	0.953	0.990

B) South Africa

Variables	Parameter Estimate	St. Error	ChiSq	Pr> ChiSq	Point Estim.
Intercept	0.8202	0.723	1.287	0.257	
Age of woman	-0.0585*	0.016	13.987	0.000	0.943
Years of education	0.0009**	0.000	3.473	0.062	1.001
Cust. Autonomy	0.3966*	0.123	10.364	0.001	1.487
Non customary Aut.	0.0634	0.130	0.237	0.626	1.065
Realized Autonomy	0.1150	0.149	0.597	0.440	1.122

C) India

Variables	Parameter Estimate	St. Error	ChiSq	Pr> ChiSq	Point Estim.
Intercept	-0.4439	0.392	1.284	0.257	0.257
Age of woman	-0.0137*	0.006	4.606	0.032	0.986
Years of education	0.0050	0.046	0.012	0.914	1.005
Cust. Autonomy	-0.0422	0.092	0.208	0.648	0.959
Non customary Aut.	0.2365*	0.089	6.999	0.008	1.267
Realized Autonomy	-0.0302	0.110	0.075	0.784	0.970

*= significant at 5% level
**=significant at 10% level

3.4. The influence of female autonomy on fertility behaviour: an analysis by parity

In this paragraph we analyse the female autonomy and the fertility behaviour from a slightly different perspective. We apply a multivariate *logit* model (the detail of which are discussed in paragraph 4- the methodological appendix) to estimate how some characteristics of women affect their probability of giving birth to a different number of children in the three countries considered. In particular now we intend to verify the relationships between fertility (by parities) and female autonomy index estimating one postulated *a-priori* model among dependent variable (CEB=children ever born) and the index considered as explanatory one. Moreover we will introduce in this model also other exogenous variables such as the educational level, the working condition and the age of women.[26] The choice of the previous indicators is justified by the following considerations.

The most important question concerning population and development in developing countries by a gender point of view is summarized in this following manner: to what extent gender inequality, particularly gender inequality in education and employment, has a negative

[26] The link education-economic opportunities-female status is very interesting to study and a deeper analysis may be performed in the future.

impact on demographic behaviour, conditioning demographic transition from an old-type regime to a modernized one characterized by a low level of fertility? It seems that gender inequality in education does impede economic growth. It does so directly through distorting incentives and indirectly through its impact on investment and population growth (Klasen, 1999). This consideration explains one of the most important reason according to which we have included education and working condition of women in the model. It is perhaps worth reminding that these estimates are net of the influence of education and working condition of the considered women.

In the following pages we consider the results regarding the conditional probabilities for CEB (children ever born) by customary, non customary and realised index respectively in the three countries. After checking in chapter 2 paragraph 4 the conditional probabilities from a multivariate logit model for children ever born according to women of different age group (15-24, 25-34 and 35-44 years old), now we comment the result only for women age 35-44 that represent the group at the end (or near to) of the reproductive period. This group, therefore, shows the more interpretable model describing the transition probabilities from one parity to the other (the next one), while the youngest groups are influenced by the truncation effect: these women belong to cohorts that must still live some events.

Figure 1.3a Conditional Probabilities of having n Ceb (children ever born) by customary index of autonomy in South-Africa

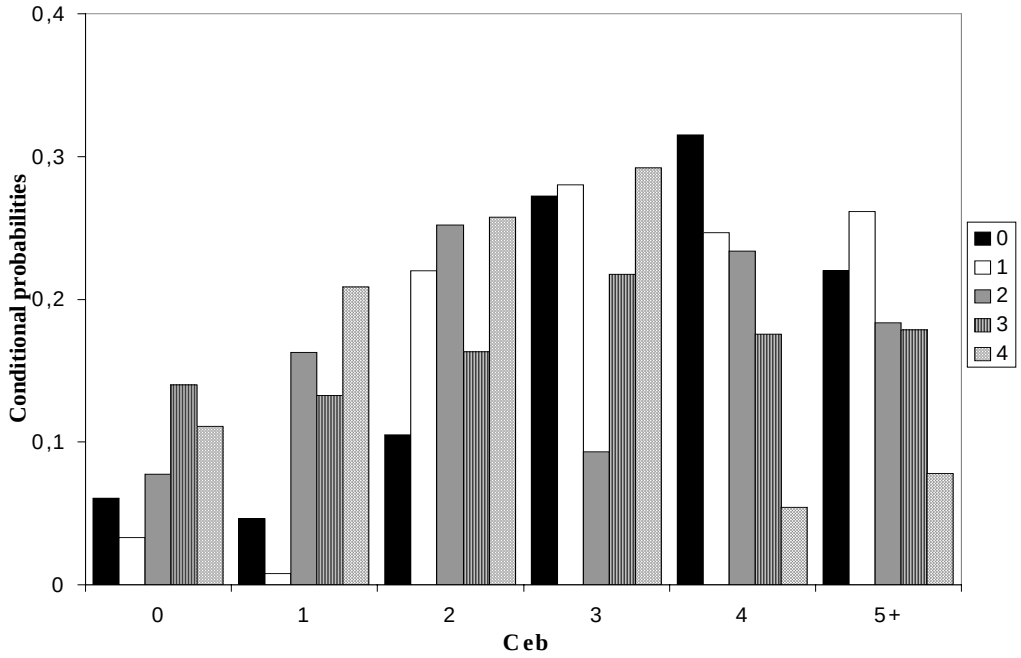


Figure 1.3b Conditional Probabilities of having n ceb (children ever born) by customary index of autonomy in Botswana

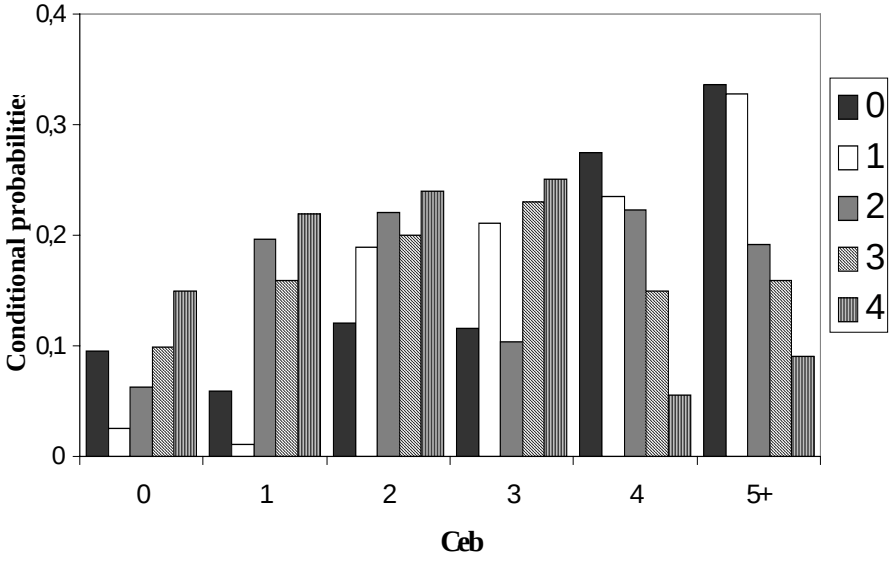
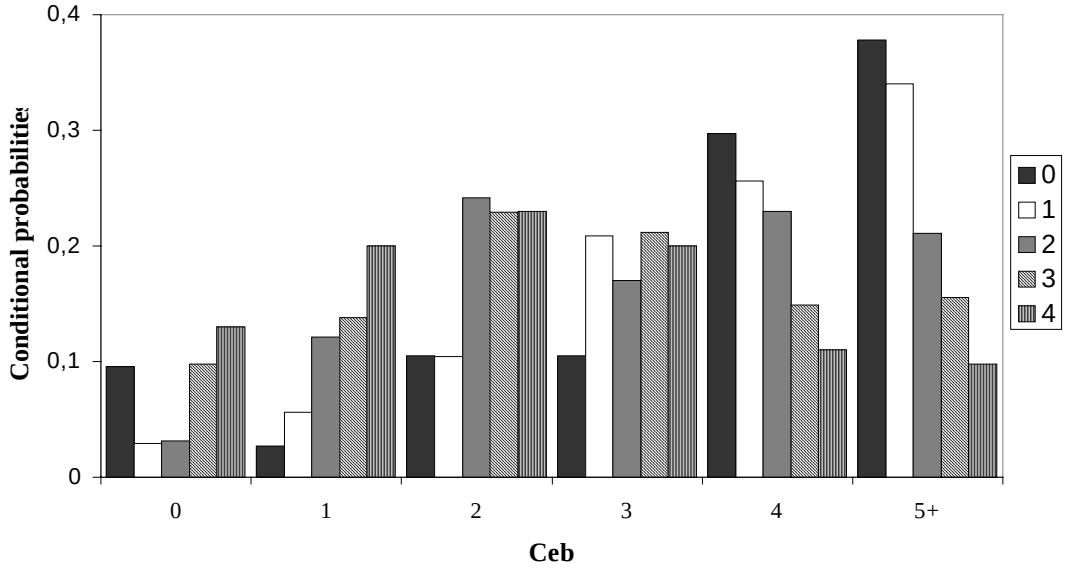


Figure 1.3c Conditional Probabilities of having n ceb (children ever born) by customary index of autonomy in India.



Let us first analyse the conditional probabilities of having *n* CEB by customary autonomy index, which takes into account family and reproductive decision processes.

In the figures 1.3a, 1.3b and 1.3c we can see that the situation is similar in Botswana and South Africa: the probabilities[27] are higher for women with high levels of autonomy. On the other hand, for high parities we can see that for more autonomous women the conditional probabilities are lower. The same is true for India.

A different result emerges if one refers to the second autonomy index considered here, non-customary, measuring the extent to which women believe that women should have decision-making powers in general and in areas outside their traditional role. From 1.4a, 1,4b and 1.4c pattern differences emerge between South Africa and Botswana. In fact in South Africa women with the two highest levels of autonomy (levels four and five) have about the same probability of having 1 or no children, while in Botswana more autonomous women (level 5) are more likely to remain childless or to have just one or two children. For higher parities the situation is more regular for South Africa than for Botswana: in the former, women show a decreasing probability of having 5 or more children as the level of autonomy increases, while for Botswana the picture is more mixed, although it remains true that it is the most autonomous women who have the lowest probability of having 5 or more children.

For India the pattern according to non customary index, figures 1.4c, is more clear both at the lower parities and the higher ones. In fact we recorded a regular increasing probabilities to remain childless or at two children, and a regular decreasing probability to have five or more children for women who declare to have decision-making powers in general and in areas "*outside*" their decisional role. The "outside" area is explained by Bennett (1991, quoted in Report commissioned by the Overseas Development Administration, 1995), which characterises gender relations in India in terms of an "*inside/outside"* dichotomy, where the former represents the domestic and reproductive sphere to which women are largely confined and the latter the public domain of fields, markets, government institutions, seen as arenas of male power and control. Whilst this is a useful distinction, it may be limiting in a number of respects. Firstly, there are in fact relatively few women in India who are exclusively associated with the '*outside*' sphere and their numbers are decreasing.

Secondly local culture may have led to partially different interpretations in the three countries. For example, the questions regarding the extent to which women believe that women should have decision-making powers in general and in areas "*outside"* their traditional role, expecially for Indian ones, may have been interpreted as "*general considerations*", not referred to the woman's personal experience, due to the fact that these issues appear very far from the personal life of the rural women living in Rajastan, who often are secluded in their household. Consequently, some caution is needed also in the comparison of the former results among the three countries considered.

Figure 1.4a Conditional Probabilities from a multivariate logit model for ceb by non customary index in South Africa

[27] The values analyzed are log-odds, that can be used to compare different probability results among different countries without the necessity to include any statistical significance level. In the future we will calculate the odds-ratios.

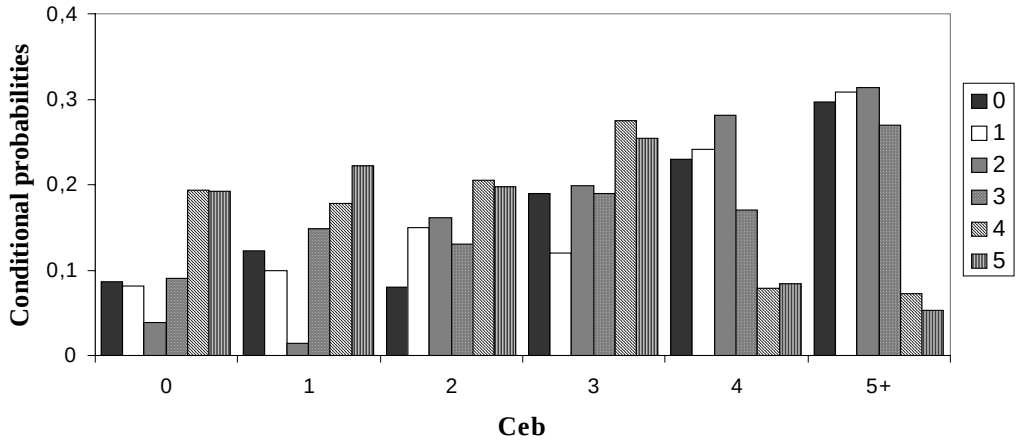


Figure 1.4b Conditional probabilities from a multivariate model for ceb by non customary index in Botswana

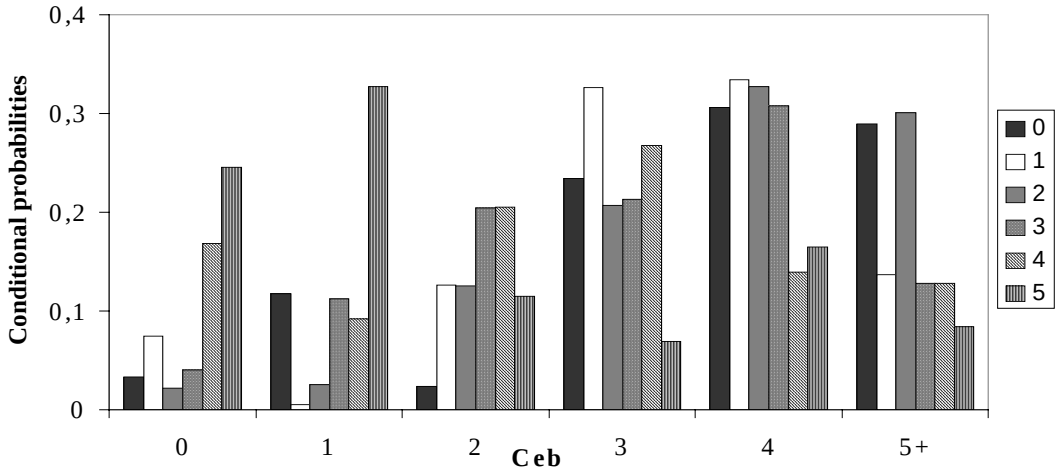
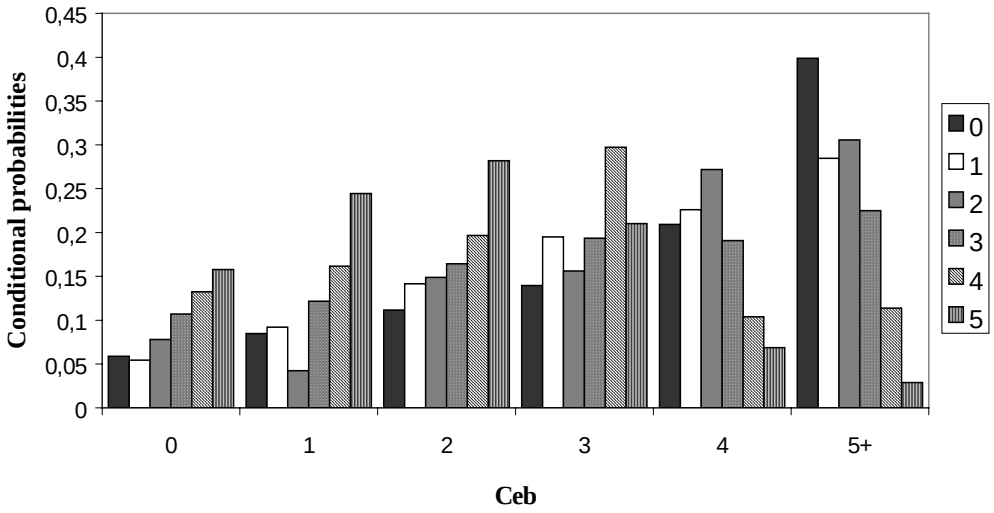


Figure 1.4c Conditional probabilities from a multivariate model for ceb by non customary index in India



The third index we considered is the realized one. This index reflect the actual amount of autonomy women have rather than the amount they believe that women should have on decision-making powers in general, as well as in areas connected to household finances (Kishor, 1995).

According to this measure, the patterns of South-Africa and Botswana are very similar (Figures 1.5a, 1.5b and 1.5c).

Women that are more autonomous are more likely to have few or no children, and less likely to have several, everything else equal. These result can, probably, partly explained by the fact that a higher percentage of households are female-headed and a higher percentage of these include women living alone. Women who lived outside of households have more freedom of movement and more decision-making power, two aspects measured by the realized index.

Figure 1.5a Conditional probabilities from a multivariate model for ceb by realized index in South Africa

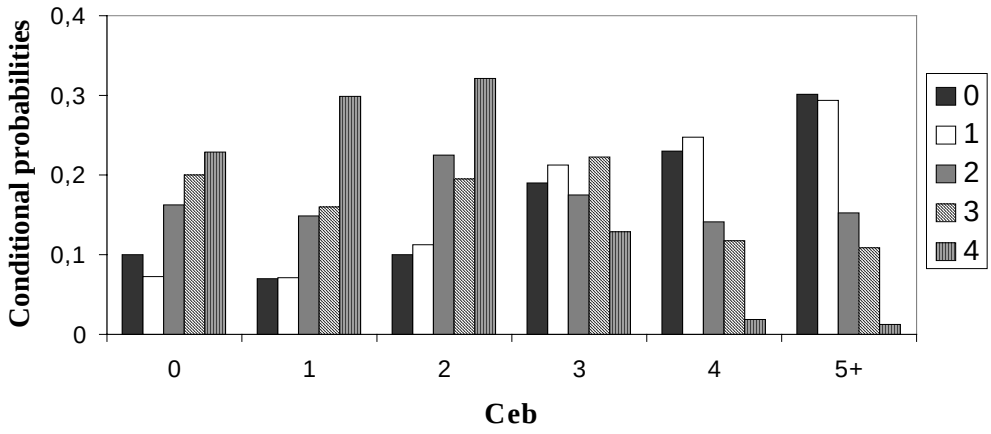


Figure 1.5b Conditional probabilities from a multivariate model for ceb by realized index in Botswana

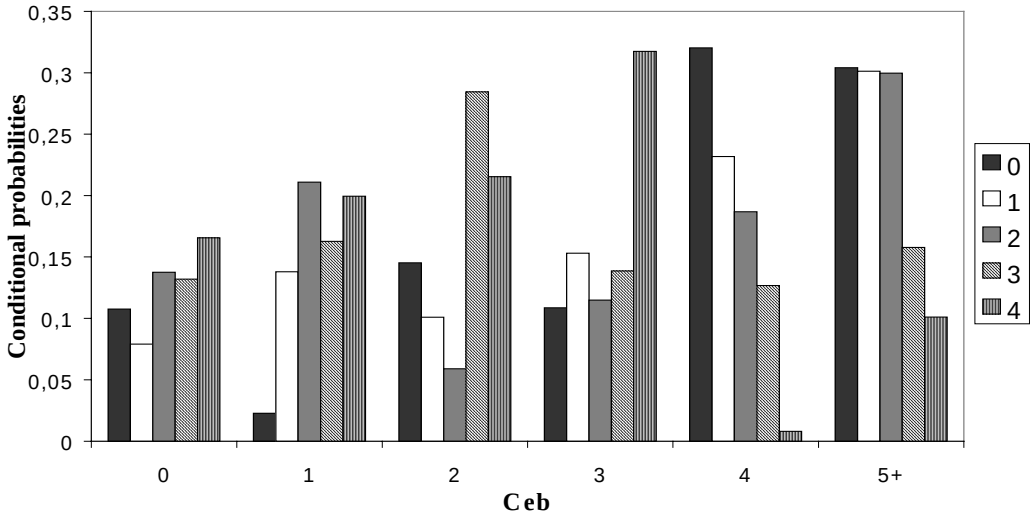
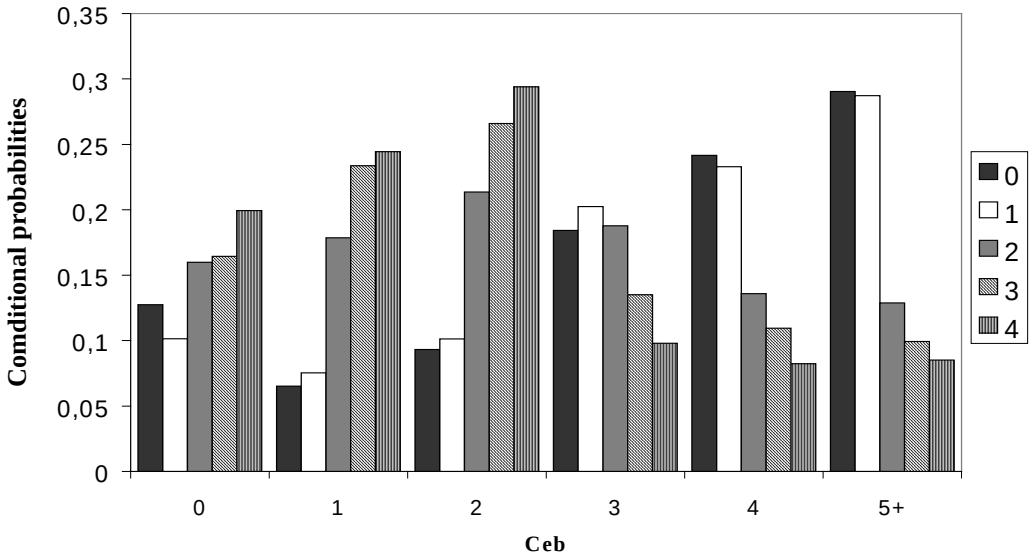


Figure 1.5c Conditional probabilities from a multivariate model for ceb by realized index in India



In India, Figure 1.5c, the situation is less clear, in fact according to our result seem that Indian women perceive to have freedom of movement or decision-making power, but this result is not in accordance with other studies according to which in India today we are far from women freedom of movement or their decision-making power.

3.5. Concluding remarks

Female empowerment may impact deeply on the demographic transition and on the socio-economic development of a country. In this paper we have tried to compare the relationship between fertility and women's autonomy in different cultural contexts, with special focus on the connections between the different components of female autonomy and some aspects of reproductive behaviour. In fact, the researches on this topic have witnessed the importance of the context in determining women's autonomy and its relationships with fertility and contraception.

The results of the analysis carried out on data collected in the rural areas of Botswana, India and South Africa have shown some similarities and also very large differences. In particular, Botswana and South Africa reveal a larger autonomy -measured following Kishor's approach (Kishor, 1995)- in the Africa context with respect to women's status in Rajastan.

According to descriptive analysis, considering the relationship between fertility, autonomy and education we see that women with a higher level of autonomy generally bear fewer children, thereby confirming the negative relationship between fertility and women's empowerment during the demographic transition. This result is more evident for educated women, as we can see for instance in Botswana: women with secondary education are

characterised by a higher level of autonomy (customary index), and a lower fertility. The same results are confirmed also by multivariate model analysis, according to which we see that the probability to increase parity is lower for more autonomous women.

The results for contraceptive behaviour seem to depend on the country under investigation. In Botswana, for instance, where the diffusion of contraception is very large, the autonomy does not seem to be related with family planning in any significant way. On the contrary, in South Africa and India one dimension of the status of woman is significant: for South African women, higher levels of customary autonomy seem to enhance contraception, while in India this happens for women who score particularly high on the non-customary autonomy scale.

In conclusion, the results obtained from the analysis performed up to now represent a preliminary description of the impact of women's roles on demographic transition. In particular the examination of the relationships between probability of the transition from one parity to the next and autonomy indices have confirmed that more autonomous women tend to reach lower parities.

Further models, taking into account the timing component of fertility by a life course point of view will be useful for interpreting the relationship with women's status and also the inclusion of the economic characteristics of households will permit interesting considerations.

4. Methodological appendix[28]

Log-linear analysis has become a widely used method for the analysis of multivariate frequency tables. What follows is a short reminder: for more complete presentations cf., e.g., Bishop, Fienberg and Holland, 1975; Goodman, 1987; Haberman, 1978, 1979; Fiemberg, 1980; Agresti, 1990; Hagenaars, 1990.

When one is interested in predicting the value of a categorical response variable by means of explanatory variables the logit model is a 'regression analytic' model for a categorical dependent variable. In the standard logit model, a binary dependent variable is related to a set of categorical regressor variables (Goodman, 1972). When the response variable has more than 2 categories, the model is called a multinomial logit model or multinomial response model (Haberman, 1979; Agresti, 1990: Chapter 9).

Imagine we have a response variable denoted by D and three categorical explanatory variables denoted by A, B and C. Moreover, assume that both A, B and C influence D, but that their effect is equal within levels of the other variable. In other words, it is assumed that there is no interaction between A, B and C with respect to their effect on D. This gives the following logistic model for the conditional probability of D given A, B and C, $\pi_{d|abc}$:

$$\pi_{d|abc} = \frac{\exp(u_d^D + u_{ad}^{AD} + u_{bd}^{BD} + u_{cd}^{CD})}{\sum_d \exp(u_d^D + u_{ad}^{AD} + u_{bd}^{BD} + u_{cd}^{CD})} \quad (1)$$

When the response variable D is dichotomous, the logit can also be written as:

$$\log\left(\frac{\pi_{1|abc}}{1-\pi_{1|abc}}\right) = \log\left(\frac{\pi_{1|abc}}{\pi_{2|abc}}\right) = (u_1^D - u_2^D) + (u_{a1}^{AD} - u_{a2}^{AD}) + (u_{b1}^{BD} - u_{b2}^{BD}) + (u_{c1}^{CD} - u_{c2}^{CD}) =$$
$$= u + u_a^A + u_b^B + u_c^C \quad (2)$$

It should be noted that the logistic form of the model guarantees that the probabilities remain in the admissible interval between 0 and 1. Alternative transformations of $\pi_{1|abc}$ which also fulfil this requisite lead to the probit model and the complementary log-log model (McCullagh and Nelder, 1983; Willekens, 1994). It has been shown that the logit model given in equation 1 is equivalent to a log-linear model (equation 2) which includes the same u terms as the logit model concerned but also an effect that fixes the marginal distribution of the independent variables (Goodman, 1972; Haberman, 1978; Fienberg, 1980, Agresti 1990). More precisely, it can be shown that the likelihood equations based on independent multinomial sampling are equivalent to the likelihood equations based on a Poisson model, given that condition

$$\sum_d m_{abcd} = \sum_d n_{abcd} \quad (3)$$

is fulfilled (Vermunt, 1996). Where n_{abcd} represents the observed count of frequency tables ABCD, while m_{abcd} denotes an expected frequency in marginal tables ABCD.

[28] by Simona Drovandi.

Including the same parameters as those in the logit model given in equation 1 and ensuring that the condition given in equation 2 is fulfilled leads to the following log-linear model

$$\log m_{abcd} = \alpha_{abc}^{ABC} + u_{d}^{D} + u_{ad}^{AD} + u_{bd}^{BD} + u_{vd}^{CD} \quad (4)$$

where

$$\alpha_{abc}^{ABC} = u + u_{a}^{A} + u_{b}^{B} + u_{c}^{C} + u_{ab}^{AB} + u_{ac}^{AC} + u_{bc}^{BC}$$

In other words, the logit model of equation 1 is equivalent to log-linear model {ABC, AB,AC,BC} for the frequency table with observed counts n_{abcd}. Note that the use of this formulation of a logit model, holds regardless of whether the response variable is dichotomous or not. If the response variables are polytomous, a log-linear or logit model of the form given in equation 3 is sometimes also called a multinomial response model (Haberman, 1979; Agresti, 1990; Chapter 7). According to Haberman (1979), in its most general form, the multinomial response model may be written as

$$\log m_{ik} = \alpha_k + \sum_j \beta_j x_{ijk} \quad (5)$$

where *k* is used as the index for the joint distribution of the independent variables and *i* as an index for the response variable.

Let us now present a 'path-analytic' extension of the logit model. Goodman (1973) proposed a log-linear model which takes a priori information on the causal ordering of the variables into account. The model, which he called a modified path model, consists of specifying a series of logit models for different marginal tables. As will be demonstrated below, this model bears some similarities with chain independence graphical models for categorical data (Wermuth and Lauritzen, 1983, 1990).

Suppose we want to investigate the causal relationships between five variables denoted by A, B, C, D, E. *Figure 1* shows the assumed causal ordering of these variables, and the assumed relationships between these variables, where a pointed arrow indicates the variables that are directly related to each other, and a 'knot' that there is a higher-order interaction:

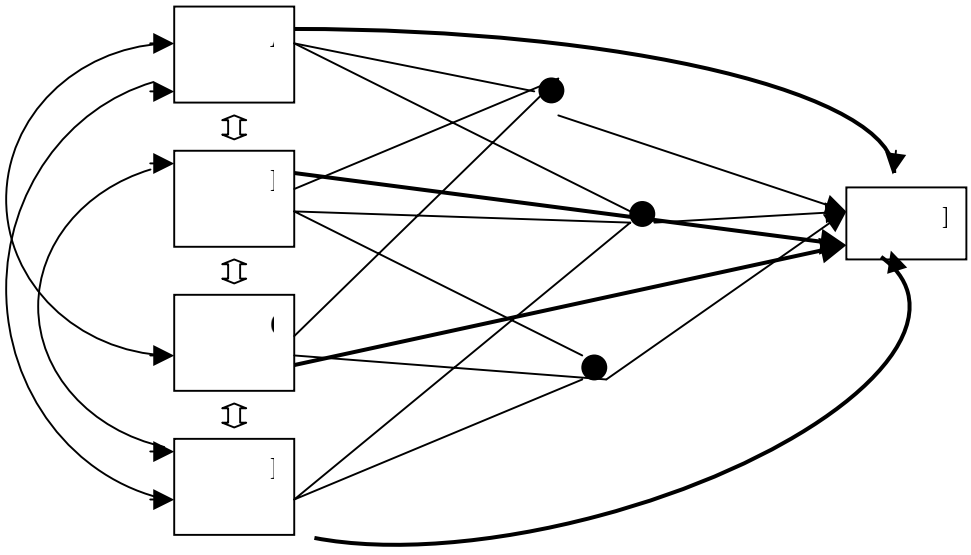


Figure 1. Path diagram between independent variable E and four indicators A, B, C and D.

Variable E (the number of children) is assumed to depend on A (cohorts of women), B (educational level of women), C (working condition of women) and D that first is considered as the status of women (paragraph 3.10) and secondly as the standard of leaving of women (chapter 2, paragraph 4). Let π_{abcde} denote the probability that A=a, B=b, C=c, D=d and E=e. The information on the causal ordering of the variables is used to decompose this joint probability into a product of marginal and conditional probabilities (Goodman, 1973). In this case, π_{abcde} can also be written as

$$\pi_{abcde} = \pi_{abcd}\pi_{e|a}\pi_{e|b}\pi_{e|c}\pi_{e|d}\pi_{e|ab}\pi_{e|ac}\pi_{e|ad}\pi_{e|bc}\pi_{e|bd}\pi_{e|cd}\pi_{e|abc}\pi_{e|abd}\pi_{e|bcd} \quad (6)$$

This is a straightforward way to indicate that the value of a particular variable can only depend on the 'preceding' variables and is not influenced by those that are assumed to 'follow'. Decomposing the joint probability π_{abcde} into a set of marginal and conditional probabilities is only the first step in describing the causal relationships between the variables under study. Generally, the aim of an analysis is to reduce the number of parameters in some way, while the right-hand size of equation 6 contains as many unknown (conditional) probabilities as the observed cell frequencies. In other words, the model in equation 6 is a saturated model in which it is assumed that a particular dependent variable depends on all its posterior variables, including all the higher-order interaction terms. Generally, one is interested in more parsimonious specifications of the conditional probabilities in which it is possible to specify what variables influence what others. The simplest way to specify more parsimonious models is to restrict directly the conditional probabilities appearing in equation 6. Suppose that, as depicted in figure 1, E depends on A, B, C and D but not on AB, AC, AD, BC, BD, ABC, ABD, BCD. In this case:

$$\begin{aligned}
\pi_{e|abc} &= \pi_{e|ab} \\
\pi_{e|abd} &= \pi_{e|ab} \\
\pi_{e|bcd} &= \pi_{e|bc} \\
\pi_{e|ab} &= \pi_{e|a} \\
\pi_{e|ac} &= \pi_{e|a} \\
\pi_{e|ad} &= \pi_{e|a} \\
\pi_{e|bc} &= \pi_{e|b} \\
\pi_{e|bd} &= \pi_{e|b} \\
\pi_{e|cd} &= \pi_{e|c}
\end{aligned} \quad (7)$$

The above-mentioned method of restricting the general model of equation 6 is similar to the formulation of so-called *chain independent graphical models or block recursive*

*graphical models (*Whittaker, 1990; Wermuth and Lauritzen, 1990). In a chain independence graph, the variables are grouped in blocks which can be completely ordered. The relationships between variables within one block are assumed to be symmetric, while the relationships between variables belonging to different blocks are assumed to be asymmetric. This is depicted graphically by undirected and direct edges, respectively. Like any other graphical model, a chain independence graphical model must be completely formulated in terms of conditional independence. In the same way Goodman's modified path analysis approach consists of using a log-linear or logit parametrization of the marginal and conditional probabilities appearing in equation 6 (Goodman, 1973). A system of logit models consistent with the path model depicted in figure 1 leads to the following parametrization of the conditional probabilities appearing in equation 6:

$$\pi_{abcd}=\frac{\exp(u_a^A+u_b^B+u_c^C+u_d^D+u_{ab}^{AB}+u_{ac}^{AC}+u_{ad}^{AD}+u_{bc}^{BC}+u_{bd}^{BD}+u_{abc}^{ABC}+u_{abd}^{ABD}+u_{bcd}^{BCD}+u_{abcd}^{ABCD})}{\sum_{abcd}\exp(u_a^A+u_b^B+u_c^C+u_d^D+u_{ab}^{AB}+u_{ac}^{AC}+u_{ad}^{AD}+u_{bc}^{BC}+u_{bd}^{BD}+u_{abc}^{ABC}+u_{abd}^{ABD}+u_{bcd}^{BCD}+u_{abcd}^{ABCD})}$$

$$\pi_{e|abcd}=\frac{\exp(u_e^E+u_{ea}^{EA}+u_{ab}^{EB}+u_{ec}^{EC}+u_{ed}^{ED})}{\sum_e\exp(u_e^E+u_{ea}^{EA}+u_{ab}^{EB}+u_{ec}^{EC}+u_{ed}^{ED})}$$

(8)

The model for the marginal distribution of the exogenous variables A, B, C and D is saturated since it contains all the interaction terms among A, B, C and D. It would also have been possible to specify a non-saturated model for the relationships between the exogenous variables. In the next equation E appears as dependent variable respectively for A, B, C and D. Moreover, there are no higher-order interactions between E and the independent variables. It is clear that this recursive system of logit equations contains far fewer parameters than the model given in equation 6.

Since specifying a logit model for conditional probabilities is equivalent to specifying a log-linear model for a frequency table in which the marginal distribution of the independent variables is treated as fixed, the logit equations given above can also be written as log-linear models. For instance the logit model for π_{abcd} (in equation 8) is equivalent to the log-linear logit model {ABCD,ABC,ABD,BCD,AB,AC,AD,BC,BD} for the (marginal) frequency table ABCD, or

$$\log m_{abcd}=\alpha_{abcd}^{ABCD}+u_a^A+u_b^B+u_c^C+u_d^D+u_{ab}^{AB}+u_{ac}^{AC}+u_{ad}^{AD}+u_{bc}^{BC}+u_{bd}^{BD}+u_{cd}^{CD}+u_{abc}^{ABC}+u_{abd}^{ABD}+u_{acd}^{ACD}$$

(9)

where m_{abcd} denotes an expected frequency in marginal table ABCD. Moreover, α_{abcd}^{ABCD} denotes the effect which fixes the marginal distribution of the dependent variable.

Thus, specifying a causal log-linear model for a set of categorical variables can be simply accomplished by specifying separate log-linear models for different marginal tables or subtables. In this case, log-linear or logit models have to be specified for tables ABCD, ABCDE.

Goodman (1973) demonstrated that the maximun likelihood estimates for the log-linear parameters and the expected frequencies in the various submodels of a modified path model can be estimated separately for each subtables. This results from the fact that when the

parameters of the various submodels are distinct, the likelihood can be factorised into submodel specific parts which may be maximized separately:

$$\log \ell = \sum_{abcde} n_{abcde} \log(\pi_{abcde}) = \sum_{abcd} n_{abcd+} \log(\pi_{abcd}) + \sum_{abcde} n_{abcde} \log(\pi_{e|abcd}) \quad (10)$$

The factorisation of the likelihood makes it possible to estimate the parameters of a modified path model by means of standard programs for log-linear or logit analysis. The *lem* program (Vermunt, 1996) has extra facilities for defining submodels without actually having to 'input' them. In *lem*, the model specification consists of defining the subtables and the subtable-specific log-linear models. As previously mentioned, the parameters of the different submodels cab be estimated separately as long as they are distinct, but, when equality restrictions are imposed on parameters coming from different submodels, the parameters of the modified path model must be estimated simultaneously. In *lem*, two types of equality restrictions can be imposed on parameters appearing in different modified path steps: log-linear or logit parameters can be assumed to be equal, and (conditional) probabilities equation can be assumed to be equal. The log-likelihood equation for a log-linear parameter appearing in different submodels is simply the sum of the contributions of the submodels concerned. The factorisation of the contribution of the submodels to the log-likelihood function can be also used for testing. Goodman (1973) proposed testing the models separately by means of the likelihood-ratio chi-square statistic. The overall test for the complete model can be obtained by adding up the L^2 values and the degrees of freedom of the separate submodels. This is an important feature if the modified path model is estimated with standard programs for log-linear analysis. This testing procedure can, however, only be applied when the model is specified in the way Goodman did, that is, when every subtable contains all the variables of the previous subtable and when no restrictions are imposed on the parameters across modified path steps. The likelihood-ratio chi-square statistic is actually a conditional test for the significance of the difference in the value of the log-likelihood function for two nested models. Two models are nested when the restricted model has to be obtained by only linearly restricting some parameters of the unrestricted model. Thus, the likelihood-ratio statistic can be used to test the significance of the additional free parameters in the unrestricted model, given that the unrestricted model is true in the population. Otherwise, when we cannot impose linear restrictions among estimated parameters, another approach to model selection is based on information theory. The aim is not to detect the true model but the model that provides the most information about the real word. The best known information criteria are the Akaike information criterion (AIC) (Akaike, 1987) and the Bayesian information criterion (BIC) (Schwarz, 1978). These two measures, which can be used to compare both nested and non-nested models, are defined as

$$AIC = -2\log \ell + 2npar$$
$$BIC = -2\log \ell + (\log N)npar \quad (11)$$

where *npar* denotes the number of unknown parameters. Lower values of AIC or BIC characterise better models, i.e. with more information, given the number of parameters. The model specified in equation (8) has been chosen between different models, with and without higher order interaction among dependent variables, because it evidenced the lowest values of the indexes AIC and BIC.

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