DETERMINANTS OF CONTRACEPTIVE USE IN EGYPT: A MULTILEVEL APPROACH

Abstract. The increasing use of family planning methods seems to be the intermediate determinant which mostly influences the fertility decline in developing countries, and in particular in those countries which are in an advanced phase of demographic transition such as Egypt. Moreover large countries, like Egypt, are characterized by very different geographical realities and even by strong regional heterogeneities. The aim of this study is the analysis of the determinants of contraceptive use in Egypt, with particular reference to the differentials due to the socio-economic context and to the area of residence. To estimate each individual and regional factors' effect on contraceptive use, a logistic two-level random intercept model is fitted to EDHS 2000 data; the use of a multilevel analysis is suggested by the two-level data structure: the first level units are the women, the second level units are their regions of residence.

Key-words: Multilevel models; Contextual effect; Egypt; Contraceptive use; Fertility transition.

1. Introduction

This study aims at analysing the determinants of contraceptive use in Egypt, with particular reference to the differentials due to the context and to the area of residence. It also aims at studying the relations between the process of cultural, social and economic transformation in the two Mediterranean Shores and the process of demographic transition.

Whereas the countries of Mediterranean Europe are in a phase of demographic contraction, in the South-Eastern shore a slow and postponed decline in fertility level, together with an increase in survival level, caused an evident acceleration of population growth rate.

At the moment, however, we are facing a decline in fertility levels in all the Southern Shore, so that present fertility level is about half of that of the Seventies; this decrease appears to be the result of an always growing number of families living in urbanized areas, with high educational levels and with a reduced number of children (Mencarini, Salvini 2003; Mencarini, Salvini, Vignoli 2005; Mencarini, Salvini, Vignoli (2006).

If the first phase of fertility transition is characterized by an increase of the age at marriage, the increase in contraceptive use appears to be the intermediate determinant (Bongaarts 1978) with the greater impact on the fertility decline in less developed countries (Salvini 1997), and it plays an even greater role for countries in an advanced transitional phase (as those of the Southern Shore). Specifically, in the comparative evaluation carried out by Boongarts (1993) on the impact of family planning programmes on fertility, the incidence of this factor on the reduction of fertility in Egypt was estimated at 59% of the total.

Nevertheless, if on the whole the country shows a massive diffusion of birth control (the percentage of women which used a contraceptive method throughout their life course

being equal to 75%[1]), there are still very remarkable differences among social groups. Parallel to the heterogeneity of contraceptive behaviours, there exists a difference in the health facilities use, with particular consequences on maternal and infant health. Higher risks characterise women with lower educational level, living in rural areas and not working outside home, as they more frequently live in conditions of marginality and they are also more unlikely to assume a decisional role independently from their roles of wives and mothers. Women's conditions thus discriminate reproductive and contraceptive behaviours causing differentiated risks for maternal and infant health (Angeli, Rampichini, Salvini 1996).

The desire of children, however, cannot be interpreted exclusively at the individual level, since many collective aspects contribute to its determination, interacting with individual desires (Farina, 2001). As a matter of fact, economic development and modernization imply a lower demand for children (Entwisle, Mason, Hermalin 1986) and, as a consequence, a greater contraceptive use. In countries such as Egypt, then, characterized by a wide territorial extent and by very differentiated regional situations, besides the differentials related to the urban/rural area of residence, there exists marked regional heterogeneities, mainly due to the geographic isolation of some areas and to the uneven income distribution.

Therefore, an analysis carried out at a disaggregated territorial level, both on the basis of the typology of area of residence (urban/rural) and of the region of residence, emphasizes the differences related to the contraceptive behaviours and to the socio-economic and cultural stratification (Angeli, Rampichini, Salvini 1996).

Women's individual characteristics, on the other side, explain only partially the variability of contraceptive use. Thus, taking into account contextual factors, related to the cultural norms of the community and to the distinct opportunities that the area of residence has to offer, allows a better understanding of the choices' determinants[2].

This theoretical approach implies the need for an explanatory model of differentials in contraceptive choices in which, beside the mechanisms governing women's individual choices (*micro* dimension), the socio-cultural contextual factors (*macro* dimension) may represent the interpretative keystone. As a consequence, the exigency of not separating the two levels of analysis but of utilizing instead a methodology which allows the simultaneous inclusion in a single statistical model of both the micro and macro components, leads to the choice of a *multilevel* approach.

2. Fertility and contraception in Egypt: trend and differentials

2.1 Fertility

[1] El-Zanaty e Way (2001), Egypt Demographic and Health Survey (EDHS) 2000.

[2] We may think, for example, about the different length of exposure time to messages of family planning and the diversified access to health facilities, or about policies promoting reproductive health or female emancipation in some contexts rather than others.

We shall start our analysis by reconstructing the fertility trend in Egypt[3] from 1953 to 2000.
In fig.1 we can observe the spread of the fertility transition over the whole country since the post war period. Particularly, in the most recent decades, the fertility level has decreased continuatively, passing from a TFR equal to 5.3 in 1980 to 3.5 in 2000.

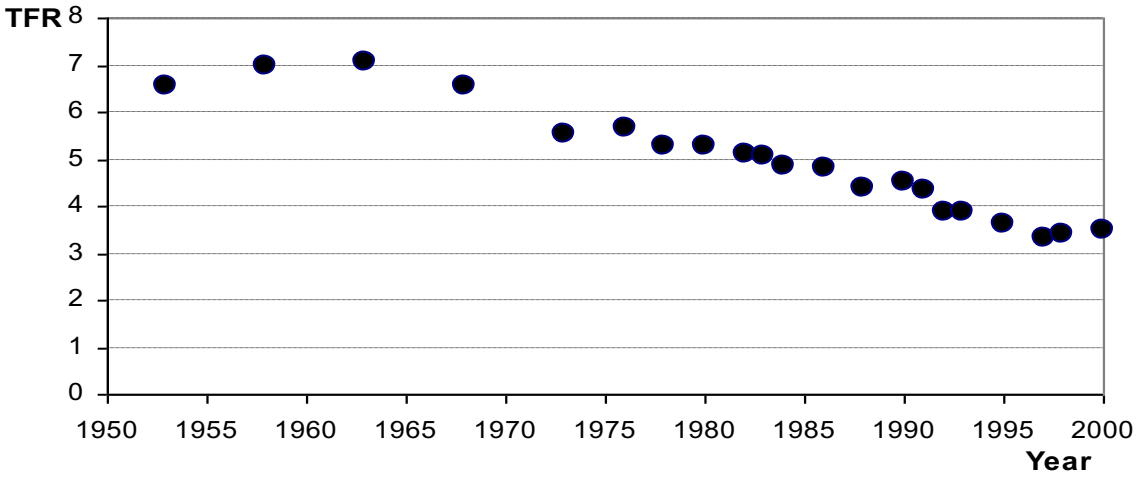

Fig.1. Fertility trend in Egypt (1953-2000). Source: our elaboration from Locoh (1988) and from EFS and EDHS data (various years) [4].

Nevertheless, if the fertility decline was particularly rapid in the decade 1980-1990, it showed a discontinuous trend throughout the decade 1990-2000. Moreover, fertility decline did not affect all the cohorts of fertile women to the same extent: while specific fertility rates decreased of more than 40% from 1980 to 2000 for women aged 30 and more, the decline was of only 25% for women aged less than 30. The consequence of these two distinct trends for the two age groups has been a concentration of births mainly among women aged less than 30. In 2000, a woman with an average of 2.3 children at the age of 30, has lived the two third of her fertile life (El-Zanaty, Way 2001).
If, on the one hand the marked decline of fertility in the Eighties is undoubted (from 6 to 4 children per woman), on the other side attention should be paid to the "stasis" of TFR in the Nineties. Recently there have been many discussions regarding the stasis phases of Egyptian fertility. Whereas studies based on interpolation techniques, apart from the intrinsic limits deriving from using these techniques with forecasting aims, have highlighted a continuation of fertility decline in Egypt (Fargues 1997; UN 2003; US

[3] Egypt population amounts to 77,505,756 inhabitants (CIA, The World Factbook2005, Egypt). The country still be characterised by the presence of very numerous family, by a proportion of population with no or low educational level higher than 50 % of the total population (greater than 60% among women) and by a annual income per capita equal to 1,200$ (ICE, 2005).
[4] TFR estimations are computed on ever-married women with different methodologies according to the utilised survey. *Egypt Fertility Survey* (EFS - 1980), *Egypt Contraceptive Prevalence Survey* (ECPS - 1984) and *Egypt Maternal and Child Health Survey* (EMCHS - 1991) surveys are based on a single year preceding the survey, whereas *Egypt Demographic and Health Survey* (EDHS - 1988, 1992, 1995, 1997, 1998, 2000) are based on the three years preceding the survey. Also the different sample size on which the TFR were estimated influences the final result; therefore the computed rates on the basis of the DHS (1997 e 1998) *interim* surveys have wider error margins than the ones obtained from standard DHS surveys.

Census Bureau 2004), a study carried out by El-Zanathy and Way (2004), on more recent *Egypt Demographic and Health Survey* (EDHS) data, reveals an increase of Egyptian fertility levels[5] during the Nineties (Engelhardt 2004).

2.2 Contraception

Recent fertility trends have been worrying the Country Government, which recently started to promote explicit policies of family planning with the aim of reaching replacement level within 2017. Particularly, the trend in the current use of methods for family planning between 1984 and 2000 according to the area of residence (tab.1) has been constantly increasing both in urban and rural areas. However, the area of residence influences the change: the higher relative increase is observed in the rural areas of Southern Egypt (from 7.9% in 1984 to 40.2%), whereas the more urbanised areas are characterised by a more moderate increase.

Tab.1. Trend in current use of contraceptive methods in Egypt according to area of residence (1984-2000). Source: El-Zanaty, Way 2001.

	1984 (ECPS)	**1988 (EDHS)**	**1992 (EDHS)**	**1995 (EDHS)**	**2000 (EDHS)**
Urban residence	45.1	51.8	57.0	56.4	61.2
Rural residence	19.2	24.5	38.4	40.5	52.0
Urban governorates	49.6	56.0	59.1	58.1	62.7
Northern Egypt (Lower Egypt)	34.1	41.2	53.5	55.4	62.4
Urban areas	47.6	54.5	60.5	59.1	64.9
Rural areas	28.5	35.6	50.5	53.8	61.4
Southern Egypt (Upper Egypt)	17.3	22.1	31.4	32.1	45.1
Urban areas	36.8	41.5	48.1	49.9	55.4
Rural areas	7.9	11.5	24.3	24.0	40.2
Frontier governorates	-	-	-	44.0	56.1
Total	30.3	37.8	47.1	47.9	56.1

The demand for methods of fertility control never rises for a unique purpose: it may be determined by the desire of limiting the number of births, or of spacing out births keeping constant the number of desired children, or, finally, it may be a sum of the two exigencies. Contraceptive need, thus, may be divided into the desire of limiting family size and the desire of spacing out births. In Egypt, the unmet contraceptive need derives mainly from the first aspect: from EDHS 2000 survey we know that, among women currently using a contraceptive method, 40.0% of them aim at limiting the number of births, whereas only 10.0% desire to space them out.
The analysis of the existing relationship between fertility levels and contraceptive behaviours highlights a decreasing trend of total fertility rate as the percentage of women

[5] It is necessary to underline that period measures of the Total Fertility Rate, such as the ones used in the text, are inevitably influenced by cohort effects (i.e. changes in the average age at childbearing). However, a recent study on the role of cohort effects on the Egyptian fertility trend shows how the "quantum" of fertility – represented through adjusted measures for cohort effect - confirms the stasis of fertility in Egypt during the decade 1980-1990 (Engelhardt 2004).

using contraceptive methods increases (fig.2). However, in the last years we observe a less marked association.

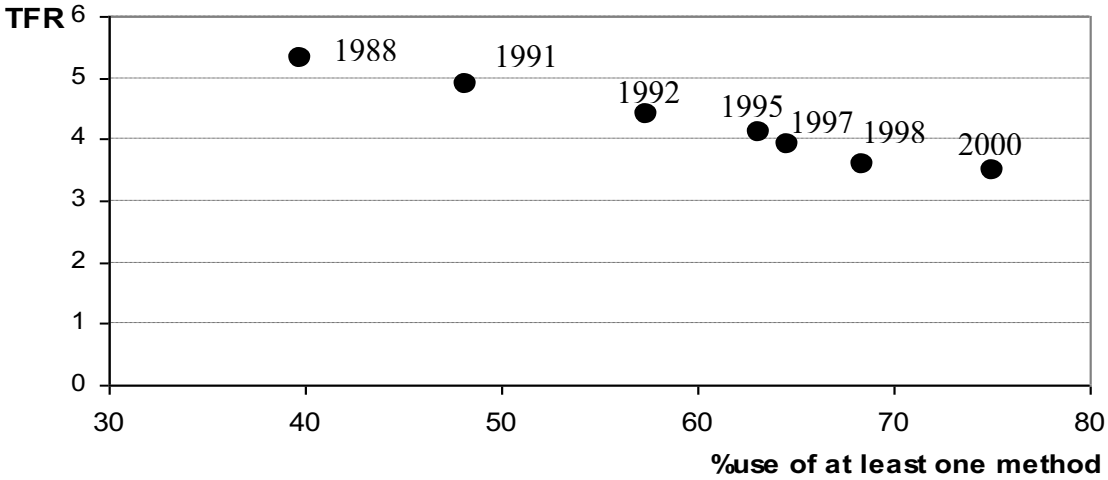

Fig.2. Total fertility rate and contraceptive prevalence. Years 1980-2000. Source: our elaborations on EFS e EDHS data; various years.

We shall therefore study in depth the trend in contraceptive use. As a whole, the growth in the percentage of women declaring to have used at least a contraceptive method throughout their life is remarkable: from 39.8% in 1980 to 75.1% in 2000. The increase, however, is particularly significant during the eighties, when the percentage rises from 39.8% in 1980 to 63.2% in 1991. As to the various age groups, higher levels are found for women aged between 35 and 39, whereas lower levels for the youngest women aged between 15 and 19 (El-Zanaty, Way 2001).
We turn then our attention to fertility trend according to the place of residence (tab.2), since urban areas are reckoned as contexts fostering and accelerating socio-demographic transition and, more specifically, fertility transition (Mencarini, Salvini, Vignoli 2005).

Tab.2. Contraceptive use in Egypt (percentage of women declaring to have used throughout their life at least a contraceptive method), according to the residence. Source: El-Zanaty, Way 2001.

	% use of at least one method
Urban residence	80.8
Rural residence	70.7
Urban governorates	81.7
Northern Egypt (Lower Egypt)	80.6
Urban areas	84.1
Rural areas	79.2
Southern Egypt (Upper Egypt)	65.4
Urban areas	76.6
Rural areas	60.0
Frontier governorates	63.3

It is widely proved that socio-economic structural changes, the mortality decline, the changes within domestic economy, the costs associated to birth control, the models of ideas diffusion and the relevance of social networks, they are all factors which have a stronger impact in urban areas (White *et al.* 2002).
Administratively, Egypt is divided into 26 Governorates plus the Luxor City. The 4 Urban Governorates (Cairo, Alexandria, Port Said and Suez) do not count rural population. The others 22 governorates are divided between rural and urban areas; 9 of them are situated in the Nile Delta (Northern or Lower Egypt), 8 of them in the Nile Valley (Southern or Higher Egypt) and the remaining 5 Frontier Governorates are located close to eastern and western borders.
Women living in Urban Governorates and in urban areas of Northern Egypt show the highest percentages, whereas women in rural areas of Southern Egypt show absolutely the lowest percentages (60.0%); similar values are particularly low even when compared to those of women who do not work (74.0%) or of women without education (71.7%) (see tab.3).
In order to gain a more detailed view, we further disaggregate the data examining contraceptive use for each single region of residence. The specificities related to regional heterogeneity turn out to be particularly significant in discriminating contraceptive use. The highest percentage values are found in all the Urban Governorates (in Cairo, for instance, around 83.0% of women declare to have used, throughout their life, at least a contraceptive method among the known ones), in the Nile Valley and in other regions of Northern Egypt. The lowest values characterise some of the regions of Southern Egypt and of the Frontier Governorates (still rather underdeveloped as to contraceptive use), which diverge from the country average and from the average of their region (class of Governorates): Assuit (56.9%), Souhag (50.1%), Qena (54.3%), North Sinai (53.7%), South Sinai (55.9%).
As a consequence, analyses disaggregated only at the level of the great regions (Northern Egypt, Southern Egypt, Urban Governorates, Frontier Governorates), even though distinguishing between urban and rural areas, tend to disregard many significant differences existing among regions (see tab. 2). It must thus be underlined how the region and the area of residence (particularly if considered jointly) "absorb" the greatest part of variability in contraceptive behaviour, as they synthesize many contextual factors related to inequalities in the access to the structures of family planning (Salvini 1997).
As to the differentials related to the more strictly demographic and socio-economic variables (tab.3), we observe different contraceptive behaviours according to the cohort of birth, to the educational level, to the employment status[6] and to the opinions towards family planning.
Observing cohorts effects, it may be noticed that the youngest cohort show the lowest percentage in contraceptive use; it is very likely, indeed, that older cohorts already had reproductive experiences and thus make greater use of methods for birth control.
Moreover, there is also a strong selection effect due to the availability of information concerning only married women. In fact, even though the samples are statistically significant, the results regarding the younger cohorts lose to some extent their significance in comparison with those over the whole female population (Mencarini,

[6] Many of the conventional measures of labour force participation, obtained from survey questions, hide consistent proportion of women carrying out productive activities (Danahoe 1999).

Salvini 2003; Mencarini, Salvini, Vignoli 2005; Mencarini, Salvini, Vignoli (2006): it is very likely that women who marry at a young age introduce some sort of distortion towards a high fertility level and a smaller contraceptive use.

Tab.3. Contraceptive use in Egypt (percentage of women declaring to have used at least one contraceptive method throughout their life), according to some demographic and socio-economic characteristics. Source: our elaborations on EDHS 2000.

	% use of at least one method
Cohort	
1950-1959	77.6
1960-1969	83.9
>=1970	65.4
Education	
No education	71.7
Incomplete primary education	79.1
Complete primary or incomplete secondary	76.8
Complete secondary or higher	78.5
Employment status	
Not working	74.0
Unpaid work	79.0
Paid work	81.0
Opinions towards family planning	
Agree	77.3
Disagree	32.7

We shall then highlight a particularly interesting aspect: if generally it is education, among all the social and economic factors, to show the stronger effect on fertility (Courbage 2002), in Egypt we observe a much more relevant impact on contraceptive use of contextual factors related to the residence (see tab.2 and 3).
Finally, 77.3% of women approving family planning declare to have used, throughout their life, at least one contraceptive method among the known ones, against the 32.7% declaring that they do not approve family planning. Reproductive behaviours, indeed, represent a social phenomenon on which an intervention is legitimated only if such intervention becomes an integral part of reproductive norms handed on within the family: the legitimacy of innovative behaviours regarding reproduction depends on the degree of interiorization of traditional beliefs and of behaving rules (Lesthaeghe, Vanderhoeft 1998).
The measures of contraceptive use seen so far are based on women's assertions, and therefore they do not take into account the male point of view. However, we wonder whether the man intervenes in the decision concerning contraception and, if yes, which is his role. We shall analyse, therefore, the pattern in contraceptive use according to some of the husband's features (tab.4). It may be noticed that the strongest effects are played by the partner approving family planning and by the possibility for the woman of discussing it with the partner. It comes out how the patriarchal organization typical of Arabian societies leave little margin of action to women (Fargues 2003): in the public sphere as well as in the private one, the man holds the large part of decisional power.

Tab.4. Contraceptive use in Egypt, according to some features related to the husband. Source: our elaborations on EDHS 2000.

	% use of at least one method
Age difference between partners	
<15 years	77.4
>=15 years	63.1
Husband's education	
No education	68.4
Incomplete primary education	79.0
Complete primary or incomplete secondary	79.2
Complete secondary or higher	81.5
Husband's employment status	
Not working	72.7
Working	77.4
Discussion with partner about family planning issues	
Not discussing	69.0
Discussing	86.6
Husband's opinion on family planning	
Not approving	45.3
Approving	82.7

To conclude, the simple descriptive outcomes exposed so far highlight the complexity of the examined situation. Notwithstanding the policies of family planning implemented by Egyptian governments with the aim of reaching replacement level within 2017, fertility levels remain stagnant over 3.5 children per woman throughout the Nineties. A picture clearly emerges in which contraceptive use appears markedly different among population sub-groups (think for instance about the observed differentials related to education, to urbanization, to labour market participation, to the partner role) and in which the combination of regional context and typology of area of residence "absorbs" a great amount of the variability observed in contraceptive behaviours.

3. Specification of the model

3.1 Research hypotheses and proposed model

The descriptive analyses carried out so far do not allow an evaluation of the "net" role played by each explanatory factor (individual or context-related) on the phenomenon of interest. Then it is necessary to define a model which allows investigating over the factors truly influencing contraceptive use in Egypt.
Specifically, we want verify the hypothesis that women's education, urbanization, labour market participation and a more egalitarian relationship with their partners significantly influence the probability of using contraceptive methods. Besides, we aim at verifying the impact of contextual variables on contraceptive use before and after the inclusion of individual variables in the model. In other words, we wonder to what extent the individual variability in contraceptive use is due to the variability observed in the socio-economic and cultural context, given the observable individual characteristics.

In this work we propose a two-level hierarchical model of logistic regression fitted to Egypt Demographic and Health Survey (2000 EDHS)[7] data. This model allows taking into account the effect on contraceptive use related to the grouping of observations into homogeneous geographical areas; therefore, the grouping effect is not seen as a disturbance but as an integral part of the population structure: it is included in the model so that it may contribute to a better understanding of the relations among analysed variables (Angeli, Rampichini, Salvini 1996).
Our dependent variable is the use of at least a contraceptive method (among the known ones) by the interviewed women: each woman may have used a contraceptive method at least once or never. The choice of this dependent variable in opposition to "current contraceptive use" allows to consider the whole woman's life-course, besides making our analysis similar to previous studies carried out on the same issues (Entwisle, Mason, Hermalin 1986).
In our model the first level units are 15573 ever-married women aged 15-49 who were interviewed using the individual EDHS questionnaire. The second level units are the 26 Egyptian regions, further disaggregated according to the typology of residence, urban or rural; consequently, we have a total of 48 units at the second level[8]. From now on we will refer to these units as the "regions of residence" of interviewed women.
Coherently with the theory, the estimation was carried out in three steps: **(1)** estimation of the *null model*, to test the reasonableness of a multilevel analysis through the estimated variance of second level residuals; **(2)** estimation of the *model with first level variables*, to make explicit the effect of the context given the observed individual characteristics; **(3)** estimation of the *final model*, including first and second level variables, to interpret the variability associated with the context.
In this paper, we will relate and comment in depth only the results of the *final model*.
The estimation procedure we used is PROC NLMIXED of the software SAS-STAT[9] (SAS Institute Inc., 1999, *SAS/STAT® User's Guide, Version 8*, SAS Institute Inc., Cary NC.).

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[7] The Egypt Demographic and Health Survey (2000 EDHS) is the latest in a series of a nationally representative population and health surveys conducted in Egypt. The 2000 EDHS was conducted under the auspices of the Ministry of Health and Population and National Population Council. Technical support for the 2000 EDHS was provided by ORC Macro through MEASURE *DHS*+, a project sponsored by the U.S. Agency for International Development to assist countries worldwide in conducting surveys to obtain information on key population and health indicators. USAID/Cairo, under the Population/Family Planning IV Project, provided funding for the survey. The primary objective of the sample design for the 2000 EDHS was to provide estimates of key population and health indicators including fertility and child mortality rates for the country as a whole and for six major administrative regions (the Urban Governorates, urban Lower Egypt, rural Lower Egypt, urban Upper Egypt, rural Upper Egypt, and the Frontier Governorates). The 2000 EDHS involved two questionnaires: a household questionnaire and an individual questionnaire. The individual questionnaire was administered to all ever-married women age 15-49 who were usual residents or who were present in the household during the night before the interviewer's visit (El-Zanaty, Way 2001).
[8] We must keep in mind that the 4 Urban Governorates do not have rural areas; thus the units of second level turn out to be 48 instead of 52.
[9] This procedure requires the specification of the linear predictor, as a function of the explanatory variables, and of the utilised *link* function. When convergence is reached, the output of this procedure provides the parameters estimates, the estimate of their standard errors and it also includes, for each single parameter, the verification of their significance through the Wald t-statistic test. As to the estimate procedure, the PROC NLMIXED maximizes a numeric approximation of the exact marginal likelihood of not linear

3.2 – The contextual effect (model 1)

The first step was the estimation of a two level regression model without any explicative variable, that is the *null model*.
In this model the response variable y_{ij}, measured at the first or individual level, is dichotomous: it assumes value 1 if woman i from region j have used at least a contraceptive method throughout her life, 0 otherwise.
Similarly, P_j is the probability that any woman from region j have used at least a contraceptive method; thus the *null model* is:

$$y_{ij} = P_j + e_{ij} \tag{1}$$

The response value for woman i from region j is therefore given by the medium probability of region j plus a first level residual component e_{ij} having mean 0 and variance strictly dependent on P_j[10].
Considering now a logit transformation[11] returning normal distributed P_j probabilities, we obtain the model:

$$\text{logit}\left(P_j\right) = \beta_j \tag{2}$$

and

$$\beta_j = \gamma + U_j \tag{3}$$

Thus the *null model* is

$$\text{logit}\left(P_j\right) = \gamma + U_j \tag{4}$$

where the intercept γ gives the mean value of the (transformed) probability for the entire population, whilst U_j is the deviation from this value for region j. The residuals U_j, peculiar to multilevel models, represent the second level random effects; for them we suppose a normal distribution with mean 0 and constant variance τ^2: $U_j \sim \text{N}(0, \tau^2)$.
Through the *null model* we can test the significance of the second level variance τ^2: we compare the model *Deviance* (which is two times the natural logarithm of the Likelihood) with the one resulting from the same model fitted without the U_j residuals, thus computing a Likelihood Ratio test. In our model this test results highly significant, suggesting that the woman's region of residence truly influences her contraceptive behaviour.

3.3 – The contextual and individual effect (model 2)

Having verified the existence of a two-level structure in the data, the second step was the estimation of a random intercept hierarchical model including individual variables. This

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model, through the *method of adaptive quadrature of Gauss-Hermite*. This make it possible to utilise the measure of Deviance provided by the output to compare different models through the Likelihood Ratio test.

[10] In particular, we have Var (e_{ij})= P_j (1-P_j). Moreover we can notice that, since y_{ij} can assume only the values 0 and 1, the first level residuals will assume respectively the values -P_j and 1-P_j.
[11] The logit transformation is: logit (P_j)=log [P_j/(1-P_j)].

new model is $y_{ij} = P_{ij} + e_{ij}$, where P_{ij} is the probability that woman *i* from region *j* have used at least a contraceptive method throughout her life. Then we have:

$$\text{logit}(P_{ij}) = \gamma + \sum_{h=1}^{r} a_h X_{hij} + U_j \tag{5}$$

$$U_j \sim \text{N}(0, \tau^2) \tag{6}$$

As before, the regression response y_{ij} is an individual dichotomous variable, whilst the explicative variables X_h are the individual covariates (continuous or categorical).
The second level random components U_j, which were already in the *null model*, represent now the residual effect of every region on the response variable having controlled the effect of the covariates X_h.
With regard to the categorical variables introduced in the model, we had to specified a reference modality to interpret their effect, as in any canonical logistic regression. For each of them we decided to choose the modality having the "worst" effect on contraceptive use as resulting from the descriptive analysis. From now on we will refer to the woman having all these reference modalities as the *baseline* woman.
As regards instead the continuous covariates, we decided to compute each individual value as the deviation from the corresponding regional mean value[12].
The choice of the covariates included in the *model with the first level variables* was based on the descriptive analysis and on the existing demographic literature. In particular, we created these variables: **(a)** two dummy variables referring to the *woman's generation*, to distinguish if the woman belongs to generations 1950-1959 and 1960-1969, having chosen the generation of women born after the year 1970 as a reference; **(b)** four dichotomous variables referring to the *woman's educational level*, the *woman's employment status*, the *partner's educational level*, the *partner's employment status*; these variables assume value 1 respectively if the woman has a secondary or higher level of education, if the woman worked at the moment of the interview, if the partner has a secondary or higher level of education, if the partner worked at the moment of the interview, 0 otherwise; **(c)** one continuous variable measuring *age difference between the woman and her partner*, with each woman's value centered to the corresponding regional mean; **(d)** one dichotomous variable assuming value 1 if *the woman or her partner approves family planning*, 0 otherwise; **(e)** two dichotomous variables referring to the *woman's disposition and/or will to speak about family planning* (with anyone) and to *speak about family planning with her partner*, which both assume value 1 in the affirmative case, 0 otherwise; **(f)** one continuous variable representing the *number of household members*, with each value centered to the regional mean; **(g)** finally, since we were also interested in measuring the *woman's decisional autonomy*, we created a dichotomous variable assuming value 1 if the woman declares to have a say in the matter of the most important family decisions, 0 otherwise.

[12] We chose the *group mean centering* approach, which enable to consider the so-called "frog-pond effect" (Hox 2002). Considering an example in the educational context, this effect refers to the fact that a student with a mean intelligence can be considered highly intelligence in a class where all other students are lacking in wit, or little intelligence if his mates are all excellent students. This approach therefore enables to estimate variables' "within" effect.

3.4 – Interpreting the contextual variability (model 3)

A very interesting characteristic of multilevel models is that they offer the possibility to consider, besides the individual variables (model 2), covariates referring to the higher level of analysis, enabling "to control" at least a part of the U_j variability.
In particular, we estimated this model:

$$\text{logit}(P_{ij}) = \gamma + \sum_{h=1}^{r} a_h X_{hij} + \sum_{k=1}^{s} b_k \overline{X}_{kj} + \sum_{m=1}^{t} c_m Z_{mj} + dW_j + U_j \qquad (7)$$

$$U_j \sim \text{N}(0, \tau^2)$$

Following the suggestions of multilevel literature (Snjiders, Bosker 1999; Hox 2002) we first considered as macro variables the regional mean values of the individual ones (variables $\overline{X}_{kj}$).
Then we selected a group of regional indicators playing an important role in contraception behaviour according to the literature (Bulatao, Lee 1983): the number of resident women, the percentage of women using contraceptive methods, the average number of children per woman, the average number of desired children, the percentage of women declaring to know their fertile period (variables Z_{mj}).
Besides, we could use a variable directly measured at the regional level: the EDHS *Wealth Index* (variable W_j), an indicator computed with the aim to determine the economical status of each family interviewed during the EDHS surveys[13]. We introduced the *Wealth Index* in the model centering each regional value with respect to the overall mean; besides, we standardized the centered index values to better interpret the final results.

4. Results

The evolution of the contextual variability through the three different estimated models is in tab.5.

Tab.5. Second level variance and corresponding intragroup correlation for the *null model* (1), for the *first level variables model* (2) and for the *final model* (3).

	Model 1	**Model 2**	**Model 3**
Second level variance			
τ^2	0.3109***	0.2565***	0.1737***
Intragroup correlation			
ρ	8.63%	7.08%	5.02%

*** significance <=0,0001

[13] To compute this indicator, the items referring to the economical status are first categorized and then summed up using weights obtained through a principal component analysis. Between the family measures used to compute the *Wealth Index* there are, for example, the electricity and current water, modern toilet availability and the television, radio and car possession. For more details we refer to Rutstein, Johnson (2004).

For the *null model* we obtained τ^2=0.3109, with a resulting intragroup correlation[14] of the 8.63%: this is the share of the total variability in the use of contraceptive methods explained by the regions (administrative regions disaggregated in rural and urban areas).
In general, the inclusion of first level covariates can increase or reduce, besides the individual not observed heterogeneity, also the grouping variability[15]; in this case we observe a reduction from 8.63% to 7.08% in the intragroup correlation: that is, in our model a share of the regional variability is due to contextual factors.
As regards the third model, the final one, though many of the variables $\overline{X}_{kj}$ and Z_{mj} were initially significant, with the inclusion of the Wealth Index W_j they all became not significant: this fact confirms us that it is possible to interpret the W_j as a socio-economic development index able to catch the multidimensional nature of regional differentials.
More in detail, we observed a further reduction in the residual variance, with a consequent reduction in the intragroup correlation from the value of 7.08% to 5.02%: then we can say that the *Wealth Index* "absorbs" almost the 30.0% of the regional heterogeneity.
We now consider the results obtained for the *final model* (tab.6). To better interpret these results the estimates have been transformed in probabilities of using a contraceptive method (through the logistic function); for example, the intercept estimate implies a probability of contraceptive use of 5.12% for the baseline woman living in a hypothetical baseline region (that is a region with Wealth Index equal to the overall mean and U_j=0). Starting from this assumption we can then interpret all the other estimates in terms of the changes in the probability of contraceptive use they imply (in respect to the baseline woman).

Tab.6. Final model estimates and interpretations.

Parameters	Estimate	Probability of contraceptive use	Variation with respect to the *baseline woman*
Fixed effects			
First level			
Intercept γ	-2.919***	5.12%	-
Generation 1950-59	1.1372***	14.41%	+9.29%
Generation 1960-69	1.2892***	16.39%	+11.26%
Partner's education secondary/higher	0.1920**	6.14%	+1.02%
Age difference	-0.00845**	5.08%	-0.04%
Discussion with the partner about f.p.	1.3288***	16.94%	+11.81%
Discussion about family planning	0.3740***	7.28%	+2.15%
Family planning approvation	2.3025***	35.06%	+29.94%
Number of household members	0.0662***	5.45%	+0.33%
Decisional role	0.5926***	8.90%	+3.77%

[14] We computed the intragroup correlation coefficient as $\rho = \frac{\tau^2}{\tau^2 + \pi^2/3}$ (Giusti 2004).

[15] We also tested the interactions between the first level variables, but none of them turned out to be significant.

Second level			
Wealth Index	0.3011***	6.80%	+1.68%
Random effects			
Second level variance τ^2	0.1737***		

*** significance <=0,0001; ** significance<=0,001

We immediately note that the two variables related to the woman's generation are both significant[16], though we do not observed a specific trend (see section 2.2). As we already noticed, in fact, we can suppose a higher contraceptive use prevalence for the older cohorts, since generally these women are already mothers; this fact, together with the nuptial selective effect (the women already married in a young age are more tied to traditional values), implies a strong increase in the individual probability of contraceptive use going from the younger to the older women.

The woman's socio-economic variables (educational level and employment status) are both significant if considered in a model excluding partner's variables; they instead loose in significance when we introduce into the model the partner's educational level, the age difference between the two and the discussion within the couple about family planning. Then we understand how Egyptian women live in a familiar context which leaves them a very little autonomy: only considering the partner's role we can obtain a comprehensive overview.

As regards the effect of the partner's covariates, discussing within the couple about family planning seems to be the most significant. In particular, when the woman knows her husband's opinion on these issues, and maybe also his desired number of children, the probability to use a contraceptive method increases of the 11.81%. Besides, the results relative to the husband's education and to the age difference confirm that a distant and asymmetric relationship between the two partners, together with not taking into account the husband's opinion, represent an obstacle to family planning.

As well as with the husband, discussing about family planning outside the couple also plays an important role. More specifically, discussing about these issues with at least one person between the mother, the father, the sister, the brother, the children, the mother-in-law, the friends or other relatives implies an increase of the 2.15% in the probability of contraceptive use.

Considering together the two "discussion" variables, trying to catch the effect of discussing about family planning as a whole, the probability to use a contraceptive method increase of the 17.74%, becoming about the double in respect to that of the baseline woman.

The estimate obtained for the variable concerning the approval of family planning is the highest in absolute value: compared with the opposition or the lack of opinion on this issue, we observe an increase in contraceptive use of the 29.74%. In this sense we can say that reproductive behaviours represent a social phenomenon highly influenced by one person's inner values and behaving rules: contraception is often considered illegitimate, and the deriving "cost" for the community is usually perceived as too elevate.

[16] We clarify that the generations has to be interpreted exclusively as controlling variables for the estimated statistical model. Anyway, the obtained results seems to suggest that in the future it would be possible to estimate separate models for each generation.

Beside, each additional household component increases the baseline woman's contraception probability of the 0.33%. Hence the dimension of the family, which takes into account also the number of children, has a positive effect on contraceptive use.
Among the socio-economic variables related to the woman's status, the decisional autonomy resulted the best discriminant of the woman's role in the Egyptian society: indeed, while with the introduction of the partner's variables the woman's educational level and working activity became not significant, the variable measuring her decisional autonomy preserved a highly significant effect in the *final model*. This variable, which summarizes the independence from the partner with respect to the main family expenditures, implies an increase of the 3.77% in the contraception probability. This result highlights that the division of the woman's and the man's life spaces has a primary role on Egyptian fertility transition, since it permits to catch the woman's emancipation extent from her traditional roles of wife and mother.
Considering now the results relative to the second level, we observe that when the *Wealth Index* increases of one unit, this implies an increase of the 1.68% in the probability of contraceptive use for the baseline woman.
After having considered all the individual and regional variables, we must now remember that also the second level random residuals play a significant effect on our results. For example, we can compute the effect on the baseline woman's probability due to their some possible realizations: if we denote with τ the square root of the second level variance, we obtain the results shown in tab. 7.

Tab.7. Random effects.

Hypothetical value of the random effect	Baseline woman probability	Variation with respect to the *baseline woman*
$-2\tau = -0.830$	2.60%	-3.17%
$-\tau = -0.415$	3.89%	-1.89%
$\tau = 0$	5.12%	0.00%
$\tau = 0.415$	8.50%	+2.72%
$+2\tau = 0.830$	12.33%	+6.56%

We see that the U_j can noticeably modify the baseline woman's probability (corresponding to the value $\tau = 0$); particularly important, for example, is the increase we observe when the random effect is twice the standard deviation τ. This means that, *ceteris paribus*, living in a given region can sensible modifying the individual probability of contraceptive use.
Finally, a last interesting analysis we can carry out is the estimation of each U_j second level residual, the so-called *Bayes estimates* (Chiandotto, Giusti 2005). More specifically, we computed these values both for the *null* and the *final model*[17]. It was possible, in this way, to compare the different regions, since each U_j estimate represents the effect of region j on the probability of contraceptive use "controlling" for all the explanatory variables.
Generally, the regions having the more positive effects (that is greatest *Bayes estimates*' values) on the contraception probability are those of the Northern Egypt; but if we

[17] See Giusti and Vignoli (2005) for detailed results.

compare the *null* and the *final model*'s estimates, we can notice very interesting results. For example, while in the *null model* the four Urban Governorates (Cairo, Alessandria, Port Said and Suez) took benefit from the fact that the socio-economic modernization contributes to increment the probability of contraceptive use, controlling instead for regional heterogeneity through the *Wealth Index* (*final model*), the corresponding U_j are "penalized" and their values decrease.
In this sense, we can also observe that all the other important modifications comporting a decrease in the contraception probabilities are those of the urban areas of Northern Egypt. On the contrary, the higher increases, controlling for the first and second level variables, are in general those resulting for the rural areas of the country.

5. Conclusions

Egypt, notwithstanding its advanced stage of socio-demographic transition, showed in the last decade a nearly stagnant trend in the reduction of fertility levels.
The differences among social groups in the country still persist very markedly: Islamic religion (which strongly influences various social spheres and women's condition in particular), education, the entry into a labour market of difficult definition and interpretation, the role of partner, are all aspects significantly differentiating women's reproductive choices. Moreover, in a country like Egypt, characterised by a wide territorial extension and by very different geographic realities, besides the differentials associated to the typology of area of residence urban/rural, there exist also regional differences emphasizing the socio-economic and cultural stratification.
In this study we aimed at analysing the influence of contextual characteristics on the intermediate determinant of fertility which mostly conditions reproductive behaviour, that is contraception. In order to do so we proposed a hierarchical model of logistic regression on two levels (*micro* level, represented by women and *macro* level by region of residence), to evaluate the "net" effect played both by individual and contextual explanatory variables on the propensity towards contraceptive use. As to individual variables, those related to the partner turned out to be particularly significant. The often distant and asymmetrical relationship between partners and the supremacy of male opinion over family planning represent undoubtedly an obstacle to the diffusion of contraception all over the country.
As to characteristics more strictly related to women, the decisional autonomy within the family certainly play a major role. This dimension came out to be more significant than female education or participation to the labour market, probably because it allows to catch more directly the process of emancipation from the traditional roles of wife and mother. Finally, we verified that the effect of modernization on contraceptive use in each specific area is not merely the weighted sum of the effect of the more modernized women within the same area: women's choices are also significantly influenced by the specific context of residence. This "absorbs" a great part of the variability in contraceptive behaviour, given the observable individual characteristics. Using the *Wealth Index* as indicator of the regions' degree of modernization, then, we noticed how a more frequent contraceptive use is observable in the northern regions of the country, which are the most

advanced in the process of socio-economic development. If, in our opinion, the *Wealth Index* allowed to take into account in a rather satisfactory way the context dimension, future developments of this research may point towards a reduction of the residual variability related to regional heterogeneity: having at our disposal additional macro indicators we would be able to test their effect on individual probability of contraceptive use, evaluating at the same time their possible interaction with the *Wealth Index*.

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