The Effect of Modernization on Desired Fertility in Egypt

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ABSTRACT

Using a conceptual framework that borrow notions both from the economic theory of fertility and social interaction theory, this paper assesses the relative importance of social and economic modernization at individual and community level in explaining the geographical differential in desired fertility in Egypt. Using 2000 Egyptian Demographic Health Survey and an up-to-date map of land cover in Egypt, this paper provides an application of an advanced methodology which uses a combination of the multilevel modeling and Geographical Information System techniques and shows how the GIS techniques facilitate the construction of several variables representing level of economic modernization as land use, road density and urbanization. This study also analyses the effect of current family composition on desired fertility in Egypt and shows the desire of Egyptian society to have at least two children and at least one boy.

1 Introduction and background of the study

After the 1980 Egyptian World Fertility Survey (EWFS 1980) a series of studies designed to look at the salient features of diversity in patterns of demographic preferences and fertility behaviour in Egypt was conducted through collaboration between the Central Agency for Public Mobilization and Statistics (CAPMAS[1]), the World Fertility Survey (WFS) and the World Bank (WB). These studies found strong regional differences between Upper and Lower Egypt in fertility levels, contraceptive use and patterns of desired fertility (Hallouda *et al.* 1988). Easterlin *et al*. (1988) looked at the effects of modernization on the demand and supply side of fertility considering a range of individual-level modernization variables, mainly education level, husband's occupation, and wife's work experience. They found that modernization variables played a more important role in explaining differences in demographic behaviour than cultural variables, and among the modernization variables, education was by far the most important. Using data from a parallel community survey to the WFS, Casterline and Eid (1988) looked at the effect of community characteristics on desired fertility and found that substantial variation between communities still existed after controlling for individual-level characteristics. They found that village setting influenced the motivation for a small family size and non-agricultural economic opportunity and modernization of agricultural practice were hypothesized to transform the role of children, and as a consequence the value placed on them.

In subsequent decades other studies have confirmed the persistence of marked geographical differentials in desired fertility between urban and rural areas of Lower and Upper Egypt (El-Zanaty and Way 2001; Osheba and Cochrane 1988; Zaky 1995). According to the 2000 Egyptian Demographic and Health Survey (EDHS), urban women express a desire to limit family size at lower parities than rural women. For example, 69 per cent of urban women with two children want to stop childbearing, compared with 48 per cent of rural women with two children (Table 1). Women living in the frontier governorates and rural Upper Egypt are generally the least likely to want to limit childbearing. More than half of married women with two children in the Urban Governorates, in urban areas in Upper and Lower Egypt, and in rural Lower Egypt want no more children, but only one in three women with two children in rural Upper Egypt (El-Zanaty and Way 2001).

[1] The Egyptian statistical agency.

Table 1: Desire to limit childbearing. Percentages of currently married women who want no more children, by number of living children and selected background characteristics, Egypt 2000.

	Number of living children [1]							
	0	1	2	3	4	5	6+	Total
Urban-Rural Residence								
Urban	0.9	8.2	68.8	87.9	91.6	91.0	93.1	66.9
Rural	1.2	7.0	48.3	76.8	88.3	91.3	92.4	64.2
Place of Residence								
Urban Governorates	1.5	10.0	76.6	91.6	90.1	94.8	93.9	69.2
Lower Egypt	1.5	8.3	61.7	88.1	95.6	94.8	96.5	69.4
Urban	0.0	7.6	70.6	90.0	95.4	96.8	97.7	69.9
Rural	2.0	8.6	57.4	87.2	95.6	94.3	96.3	69.2
Upper Egypt	0.4	5.1	40.5	67.1	80.9	86.9	90.2	58.8
Egypt Urban	0.4	5.6	51.9	79.1	89.4	82.7	90.6	60.6
Egypt Rural	0.4	4.8	31.9	59.1	77.2	88.6	90.1	58.0
Frontier Governorates	1.4	5.5	32.0	57.7	78.8	77.5	83.1	52.3

Sources: Table 9.3 (El-Zanaty and Way 2001), page 113,

[1] Includes current pregnancy.

Recent years have witnessed a growing recognition of the importance of contextual influence on demographic behaviour (Clements *et al.* 2004; DeGraff, Bilsborrow and Guilkey 1997; Entwisle, Casterline and Sayed 1989; Hirschman and Guest 1990; Madise and Diamond 1995). However, few studies have looked at contextual effects and more specifically the effects of modernization on desired fertility (Casterline and Eid 1988). Several studies have found that fertility intentions are a good predictor of subsequent fertility behaviour (Bankole 1995; Tan and Tey 1994) and that studies of the determinants of desired fertility can help in predicting not only future fertility but also contraceptive use. This study intends to look at both the contextual and the individual-level effects of modernization on fertility intentions.

Various authors have provided definitions of modernization, but a review of the literature reveals there is no standard definition. Modernization is rather a multivariate phenomenon, incorporating economic, social and political characteristics. In common with much of the literature, this paper will consider the term modernization, to be interchangeable with the term 'development', and will consider two major aspects of modernization: economic modernization and social modernization.

Easterlin (1983:645) defines economic modernization as `a transformation in economic, social, and political organization. On the economic side, this transformation involves a sustained rise in real output per capita. It encompasses wide-ranging changes in techniques of producing, transporting, and distributing goods; in the scale and organization of productive activities; and in types of output and inputs. It embraces major shifts in the industrial, occupation, and spatial

distribution of productive resources and in the degree of exchange and monetization of the economy'. In this paper economic modernization will considered as referring to all economic aspects that characterise modernization, for this reasons the present definition of economic modernization is narrower than the one proposed by Easterlin (1983) as aspect of modernization as political and social modernization will be not included in the economic modernization definition. Economic modernization is characterised by a rise in real income per person, as an improvement in the economic subsystem of the society which includes the consumption, production, and distribution of goods and services, and improvement in transportation. It refers to 'industrial well being', and the growth and efficiency of the economy. Economic modernization will also be considered as referring to increases in employment opportunity through getting new business relocated in a community or the expansion of existing businesses. In less industrialized regions, economic modernization is also believed to be achieved by an increase in industrial production and relative decline in the importance of agricultural production.

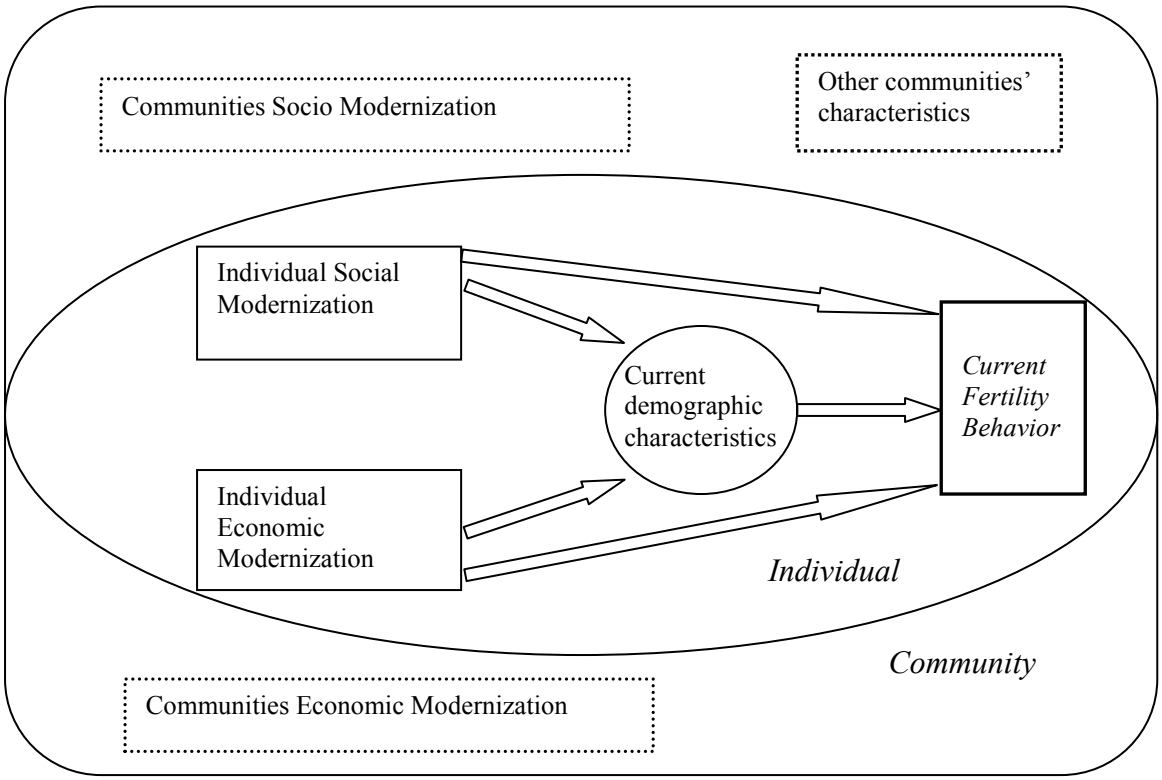
By social modernization I mean a major improvement in social structure, the enhancement of women's status, and an increased level of education. Social modernization encompasses a commitment to individual well being and volunteerism, and the opportunity for citizens to determine their own needs and to influence decisions which affect them. It also refers to an increased openness to new experience, increased independence from parental authority, and reductions in the functions of the family and kinship groups. In other words social modernization is 'a phenomenon of transforming a society with traditional values to a society of modern values and associated behavioural changes'(Inkeles and Smith 1974).

Both social and economic modernizations potentially have effects at the individual and contextual-community level. Social modernization refers to the enhancement of social structure in terms of a higher educational level, women's status, and social development. At the individual level this has an effect on individual autonomy, specifically reductions in the functions of the family and kinship groups; it can translate into work opportunity and can help to increase the reception of new ideas. At the community level it increases the community's social capital, which can in turn have the effect of increasing community wealth. Economic modernization results in enhancement of the economic wealth and per capita income both at individual and contextual levels. At the contextual level it can change the economic system both in terms of the mode of production and exchange, and through the development of a non-agricultural market

sector. At the individual level economic modernization instigates a restructuring of employment sectors, which will enhance work opportunities, resulting in an effect on per capita income.

Individual fertility behaviour is influenced directly by individual demographic characteristics, and both individual social and economic modernization (see Figure 4.1). The community in which the individual lives influences the effect of individual characteristics and individual social and economic development on fertility behaviour. It might be hypothesized that the strength of the effect of social and economic modernization changes according to the community where an individual lives. For example, in communities where an industrial type of production prevails the individual level of social modernization (measured for example, by a woman's status), and the individual level of economic modernization (represented, for example, by individual/household wealth) might influence individual fertility behaviour in a manner, and to an extent different from that in a community which is less 'modern' and where, for example, agriculture is the major mode of production.

Figure 1: Community and individual influences on of fertility behaviour.



In the literature there have been few studies who have conceptually separated this two aspect of modernization (Easterlin *et al.* 1988) and their effect on fertility behaviour and no study has looked at their individual and community role. The two aspects of modernization are likely to be interlinked and highly correlated with each other, hence the lack of attempt in the

literature to disentangle their separate effect, even though in terms of policy implication they do not necessary imply similar action. If economic modernization appears to have a stronger effect on fertility in a certain area than social modernization, then policies that tend to promote economic investment or improvement in infrastructure will probably result in a stronger reducing effect on fertility than policies that promote education. If aspects of social modernization appear to be more important for fertility behaviour, then policies that promote the education and status of women and enhance women's work opportunities will have more impact on fertility.

To summaries this paper assesses the relative importance of social and economic modernization, at individual and community level in explaining geographical differentials in desired fertility in Egypt. It analyses how important are community effects on geographical differentials on the decision to have another child. The paper conceptually separate the effects of social modernization and economic modernization on desired fertility, and analyse which aspect plays the major role in explaining geographical differences in desired fertility in Egypt.

The paper is organized as follows: Section 2 introduces the conceptual framework, Section 3 presents the data, Section 5 illustrates the sample selection and methodology, Section 6 presents the major results, Section 7 discusses the major results and Section 8 concludes the paper.

2 Conceptual framework

This paper looks at the role of modernization on the demand side of fertility which is defined as 'the number of living children parents would want if fertility regulation were costless' (Easterlin 1975:55).We do not consider the actual number of children parents want at the time of the survey, as this measure varies with changing tastes and economic circumstances over time (Bongaarts 1992; Bulatao and Lee 1983). Therefore, as we do not have detailed information on incomes and fertility preferences over time we limit the analysis to a more static measure of demand as the desire or not for additional children at the survey date.

Several authors have recognized that modernization and development have an effect on the demand for children (Bongaarts and Watkins 1996; Bulatao and Lee 1983; Easterlin 1983), reducing fertility from high to low levels. Modernization has been often associated with countries in their fertility transition (Bongaarts and Watkins 1996; Easterlin 1983). However, a number of studies have shown that the economic theory of fertility alone is not enough to explain

the process of fertility transition across countries and within countries. Bongaarts and Watkins (1996) suggest that the differences between countries and within countries in their fertility level might be due to differences in the distribution of channels of social interaction. In other words, despite similar levels of modernization or development, one region might proceed faster in its fertility reduction because of its multiplicity of channels of social interaction that connect communities within a country. Furthermore, the social interaction within a community will affect the perceptions of the costs and value of children, and these influence both the individual and the community's relative price of children compared to other goods and strength of tastes for goods relative to children. The social interaction theory would therefore help in explain the formation of tastes (Easterlin 1975).

The conceptual framework I use to study the role of modernization on the demand side of fertility borrows notions both from the economic theory of fertility as defined by Easterlin (1975) and from social interaction theory or diffusion theories (Bongaarts and Watkins 1996; Cleland 2001). As been previously suggested by Easterlin (1975) those theories are likely to be both relevant in explaining the fertility transition, as 'the real world process would inevitably be characterized by timing differences between various groups in the population'(Easterlin 1975:62). As he proposed a 'needed extension of fertility theory is to take explicitly account of the diffusion processes'(Easterlin 1975:62). This paper will uses both of those theories as we believe that they are not mutually exclusive and both can be applied in order to gather more understanding of the role of modernization in changing fertility behaviour.

According to the economic theory of fertility (Becker 1960, 1991; Easterlin 1975) the demand for children is determined by the interplay between tastes for children and constraints on couples. According to Easterlin (1975:55) there are three immediate determinants of fertility: the demand for children, or 'the number of surviving children parents would want if fertility regulation were costless'; the potential output of children, or the 'number of surviving children parents would have if they did not deliberately limit fertility'; and the cost of fertility regulation. In this paper we will concentrate on the demand for children. Easterlin defines as the immediate determinants of the demand for children: incomes, prices of other goods relative to children and tastes by which norms regarding family size and 'quality' of children (standard of child care and rearing) operate. A couple is assumed to have some preference between children and other goods, including consumer durables and leisure. 'Preference for children is constrained by the resources available to the couples as income and time, combined with the relative prices and

time-intensities of children and other goods'(Bulatao and Lee 1983:6). Evaluating these constraints requires attention to the direct economic benefits and costs of children (Caldwell 1983), and the value placed on them by every couple becomes a salient determinant of future desired fertility. According to Easterlin (1975) the process of modernization influences fertility behaviour by altering the 'nature of the problem, from one to having too few to one having too many'(Easterlin 1975:62), in other words from a situation where childbearing is 'taken for granted'(Easterlin 1975:62) to one where couples take decisions on fertility limitation.

The way in which modernization affects demand depends on the stage of development. In the early stages of development, an increase in fertility has been observed in some societies which Easterlin (1975)relates to an 'income effect' due to relaxing of the budget constraint, so that couples are able to 'afford' both more children and more other goods. In the later stages of development, however, the other two determinants also change as the price of children rises relative to other goods and tastes alter (especially the quality-quantity trade off).

Bongaarts and Watkins (1996:657) argue that social interactions 'includes the active evaluation and transformation of new information and idea by peers' and suggest three salient aspect which characterize it. First, social interaction involves exchanges of new ideas; second, it involves a sharing of information and its joint evaluation within a local context; and third it refers to social influence, where perceptions of the views of others affect a person's own behaviour. The diffusion of ideas is then a implication of the process of social interaction which Bongaarts and Watkins (1996:656) defines as 'the process by which innovation spreads among regions, social groups, or individuals, often apparently independently of social and economic circumstances'.

I believe that both the economic theory of fertility and social interaction theory might help to explain geographical differences in desired fertility in Egypt. Where the level of modernization does not completely explain the differences, the social interaction theory helps to fill in the gap. Despite an increase level of modernization, certain changes in fertility behaviour will not occur if channel of social interaction are not efficient.

In Figure 1 are displayed the pathway by which individual and community modernization affect individual fertility behaviour. The effect of individual modernization operates both through the individual demographic characteristics and directly on fertility behaviour. In other words, part of the effect of individual modernization is conditional on the individual

demographic characteristics and part of this effect operates directly on fertility behaviour. Community modernization is hypothesised to affect the effect of the individual characteristics (both demographic and socio-economic). In the context of the economic theory of fertility, individuals living in a community with a higher level of modernization (in both its economic and social aspects) will see an increase in the opportunity costs of having a child as the relative price of children compared to other goods increases. According to social interaction theory, community interactions affect the perception of those perceived changes. Thus, social interaction theory affects the community variation in fertility behaviour which is not explained by socio-economic individual and community characteristics.

To consider a few aspects of both social and economic modernization, the next section outlines possible effects that modernization indicators could have on the demand for another child using both the economic theory of fertility and social interaction theory.

Increase of the level of education

According to the economic theory of fertility, an increase in the level of education tends to reduce the demand for children by shifting tastes in a manner unfavourable to children and decreasing the price of goods relative to children (Lindert 1983). Moreover, better education and modernization improve the income-earning possibilities of women, and the opportunity cost of the mother's time required for child-rearing is increased. Furthermore, education may lead to higher standards with regard to child care and rearing, creating more emphasis on the quality of children at the expense of the quantity.

According to social interaction theory a higher level of education might increase the level and the range of channels of interaction. It might increase the frequency with which individuals interact together both directly or though its effect on work opportunity. For women, a higher level of education might mean a higher freedom of movement and increased autonomy, resulting in greater opportunities to exchange ideas.

Urbanization

According to the economic theory of fertility, urbanization reduces the demand for children by reducing tastes and lowering the price of goods relative to children. The relative price of children of a given 'quality' is usually higher in urban areas than rural areas (Cochrane 1983; Lindert 1983). Urbanization, therefore, increasingly places the population in an environment

where goods become relatively less expensive than children, and (other things being equal) more attractive (Easterlin *et al.* 1988). For the social interaction theory, urbanization augments the channels of social interaction by facilitating physical interaction though an improved transport network, enhancing work opportunities and thus promoting social interaction.

In this study I will account for both individual demographic and socio-economic characteristics at the individual level, and community social and economic modernization using a range of contextual data sources. I will analyse, after controlling for demographic characteristics, how individual socio-economic modernization influences desired fertility in Egypt according to the economic theory of fertility. The unexplained community and governorate-level variation that remains after controlling for individual level characteristics will be then estimated. I will test if the effect of both social and economic modernization variables changes by community. I will then select a range of contextual variables available at different levels, which represent socio-economic modernization and see how those variables help in explaining the variation at contextual level and assess how much social rather than economic modernization help in explaining the regional differences. The results will be interpreted using both economic theory of fertility and social interaction theory. We will not directly measured social interaction with each community as data available do not provide enough information to allow capturing the complex phenomena of social interaction. However, we will interpret the results considering the level of social interaction as our unobserved component.

3 Data

The data used in this study are: 1)the individual and household questionnaires of the 2000 Egyptian Demographic and Health Surveys (EDHS); 2) information about Global Positioning System (GPS) locators for primary sampling unit (PSUs) in the survey obtained by DHS Measure Macro International ORC Macro, 3) governorate-level indicators available in the 2003 Egypt Human Development Report (Saad 2003) based on estimated values for 2001, 4) a map of landcover for Egypt obtained from the Africover project from FAO which is called Spatially Aggregated Multipurpose Landcover databases, 5)a road map for Egypt also available from the Africover projet.

The 2000 EDHS is a nationally representative sample of 15,573 ever-married women aged 15-49 years, is a three stage probability sample. In recent years Demographic and Health Survey (DHS) data have included information about Global Positioning System (GPS) locators for

primary sampling unit (PSUs) in the survey. This new information allows the linking of other contextual data sources to the DHS data.

The locations of PSUs were obtained by DHS Measure Macro International ORC Macro. They were collected using the Global Positioning System locators (Montana and Spencer 2001). The information of PSUs locations together with map of land use and road infrastructure for Egypt allow the construction and the linking to contextual data sources to DHS survey.

The map of land cover , the so called Spatially Aggregated Multipurpose Landcover databases (which are a spatially reaggregated version of the original national Africover Land cover multipurpose database) obtained from the Africover project from FAO (Di Gregorio 2003) in an ArcView 8.2(© ESRI International) shapefile (which is a format for storing geometric location and associated attribute information). The road map also obtained from Africover project was available in an ArcView 8.2 layer (a logical set of thematic data described and stored in a map library). Both the land use shapefiles and road layers have been produced from the FAO project from visual interpretation of the digitally enhanced LandSat TM images (Band 4, 3, 2) acquired mainly in the year 1997. The land cover classes have been developed using the Food and Agricultural Organisation and United Nations Environmental Project (FAO/UNEP) international standard Land Cover Classification System (LCCS) [2].

4 Methods

In this paper multilevel modelling techniques and Geographical Information Systems (GIS) are used to examine the role of contextual variables representing social and economic modernization in explaining geographical differentials in the desire for another child in Egypt. The GIS techniques allowed the construction of several variables representing levels of economic modernization in terms of land use, representing the extent of the agricultural and non-agricultural market sectors in a community, the road density and the degree of urbanization (see section on contextual data). The multilevel modelling technique not only allows us to accommodate the hierarchical nature of the data, but it corrects the standard errors to allow for the clustering within each area unit (Goldstein *et al.* 1998) and facilitate the identification of area-level random effects that often remain even after controlling for a range of individual, household and community factors. The area-level variation (random effect) will allow us to

[2] See the following web site for technical Insight of procedure used to construct Africover maps http://www.africover.org/tech_insight.htm

assess how the contextual effects of social and economic modernization affect the desired fertility in Egypt.

A three-level of hierarchy in the data has been considered: individual/household, PSU, and governorate. At the first level I only consider the individual level responses as there were too few women per household to allow for separate household level estimates. Two level of aggregation have been used, the PSU which represent villages; governorates, which are provinces which are often affected by the same state policies.

The choice unit of geographical analysis has been dictated by data availability and the structure of the data. Notwithstanding this, we believe that the spatial aggregation used are not affected by the Modifiable Areal Unit Problem (MAUP), which is a potential source of error that can affect spatial studies, which utilize aggregate data sources (Unwin 1996).

In order to analyze which aspect of modernization helps more in explaining the geographical variation in desired fertility in Egypt a three-level logistic model has been applied which is written as:

$$\log_e(\pi_{ijk}/(1-\pi_{ijk})) = \alpha + \beta_k X_{ijk}^T + U_{jk} + V_k + \varepsilon_{ijk}\,.$$

Where π_{ijk} denotes the probability of wanting another child and $(1-\pi_{ijk})$ the probability of not wanting another child for individual *i* in PSU *j* in governorate *k.* The variance of the individual residual term ε_{ijk} is constrained to be one and the term is normally distributed. The outcome variable $\log_e(\pi_{ijk}/(1-\pi_{ijk}))$ fitted in the model is the log-odds of wanting versus not wanting another child. This constrains the predicted values for π_{ijk} from the model to be between zero and one. The parameter α is a constant, whilst β_k is the vector of parameters corresponding to the vector of potential explanatory factors defined as X_{ijk}. β_k will be firstly assumed not to varies by governorates (a random intercept model) and subsequently, to allow for the fact that some of the women's characteristics might have a different effect on desired fertility accordingly to the governorates where they lived β_k will be allowed to vary by governorate (giving a random slope model). The PSU (level 2) residual term is defined as $U_{jk} \sim N(0,\sigma_u^2)$, and the governorate (level 3) residual term is defined as $V_k \sim N(0,\sigma_v^2)$. A final assumption is

that the there is no covariance between U_{jk}, V_k or between either of these and the individual-level error term ε_{ijk}.

The models are estimated using MLWin software which allows the calculation of the residual variance remaining after the model fitting. The design of each survey is accounted for by including the factors used in stratifying the sample either as covariates or as levels in the model. However, the analysis is not weighted as this can potentially bias random effects in multilevel models (Brown, Madise and Steel 2002). Thus the design of each survey was accounted by the levels of the multilevel model and by either urban-rural residence.

The dependent variable is a categorical binary variable for denoting whether or not a woman want another child at the time of the survey, which takes the value of 1 for women who want another child and 0 otherwise. Despite studies which have looked at the demand for children stressing the importance of considering both husband's and wife's responses on desired fertility, the 2000 EDHS did not collect information about husband's desired fertility, so we cannot compare the two responses. Previous studies of Egypt, however, have found that husband preferences do not have a significant effect on their wives preferences (Cochrane, Ali Khan and Osheba 1990).

Currently married women aged 15-49 with at least one child who were fecund, not sterilized and not pregnant were selected for the analysis, comprising a total of 10,116 women, which resides in 499 PSUs and 26 governorates.

Individual level variables In order to capture the effect of modernization variables on the desire for another child we control for a set of individual demographic variables as age, and family composition and we control also for place of residence. Previous studies have found an effect of gender preference on contraceptive use and fertility in Egypt (Yount, Langsten and Hill 2000), though no one study has look at the effect of family composition on desired fertility. In this study we will look at the desired fertility conditional on current family composition. Furthermore we control for a set of variables which potentially allows to capture the value placed on children or the potential opportunity cost of having an extra child has been considered: ownership of land, whether the husband is self-employed in agriculture, the woman's current work status and the respondent's educational level.

The ownership of land has been previously found in other countries to be positively associated with fertility, and could capture the household's need for child labor which is a practice recorded in Egypt cotton fields and other agricultural areas(Human Right Watch 2001). The same could be said about the husband's employment in agriculture, which might also be a proxy for the value placed on children by the household. Another variable which could capture aspect of the cost for children (in terms of opportunity cost of an extra child) is the respondent's current work status. If a woman is employed, her opportunity cost of having another child might be higher due to her loss of future earnings because of childbearing and child rearing. The same could be said about respondent's educational level, but this time instead of capturing the loss in earning we could capture her future earning potential. The model also accounts for previous experience of child death because according to the economic theory of fertility the demand for another child could be directly affected by the survival prospect of children, and previous experience of child death affects the individual perception of survival probability. Easterlin (1975:55) notes that 'even though tastes, prices and income remain unchanged, birth behavior might vary because of changes in the survival prospect of children'. The model also includes level of wealth and husband's educational level. Other studies have considered husband educational level as a proxy of income. Both wealth and income according to the economic theory of fertility should directly affect the demand for another child as they represent the budget constraint.

Descriptive statistics, and cross tabulations with desire for another child are shown in Table 4.2 for the selected women from the 2000 EDHS. In column 1 are shown the percentage distributions of each covariate included in the model by category, whereas in column 3 are shown their frequency distribution. In column 2 are shown the proportion of women wanting another child respectively for each category.

Younger women are more likely to want another child: 69 per cent of women below age 25 in this selected sample want another child compare to 27 per cent and 4 per cent of women between age 25 and 35 and women aged above 35 respectively (Table 4.2). There appear to be no differences in the desire for another child for women with one child according to the sex their child. However, amongst women with two children, 46 per cent of women with two daughters desired another child compared to around 30 per cent for those women who have two sons or a son and a daughter. A similar pattern appears also among women with three children: 20 per cent of women with three daughters want another child compare to fewer than ten per cent for other

currently family compositions. One in five of the women living in the capital or in large cities desired another child compared to one in four for women living in small cities, towns or in the countryside. More than 27 per cent of women who had no experience of child death expressed a desire for another child compared to only 10 per cent of women who had a least one previous experience of child dead.

At individual level I also include in the model both individual social and economic modernization variables. As economic modernization variables I consider husband's education, as it is often consider as a proxies for income, whether the husband is employed in agriculture and if household owns land. This last variable could also be a proxy for income, and the last two of these variables could measure the valued placed on children in a society where child labor is employed in agriculture, as in the case of Egypt (Human Right Watch 2001). Amongst the economic modernization variables I also consider a measure of living standard, in term of the asset index (see Appendix A for a details description). According to previous analyses using DHS data, the household index is a good proxy of long-run household wealth (Filmer and Pritchett 1994), and it has been proved to be a good measure of living standards. As variables measuring individual social modernization I consider respondent's education and respondent's work status as both of these have been extensively considered in the literature as characteristic of modern society. Both increases in female education and women's participation in the labor market have been associated with an increased level of female autonomy. As we can see from Table 2, 32 per cent of women with secondary or higher education desired another child compare to 18 per cent for women with a primary or no education. Furthermore, 25 per cent of women who are currently working want another child compared with 19 per cent for women who are not currently working.

Table 2: Descriptive statistics and cross-tabulations with desire for another child for the selected women from the EDHS 2000.

	Percentage	Proportion wanting another	Number of
	%	child (%)	women
Age			
Below 25	16.4	0.69	1667
25-35	41.9	0.27	4234
Above 35	41.7	0.04	4215
Family Composition			
A boy	7.3	0.89	733
A girl	6.7	0.91	678
A boy and a girl	11.7	0.27	1185
Two boys	6.3	0.31	641
Two girls	5.0	0.46	508

Two boys and a girls	8.2	0.13	833
Two girls and a boy	9.1	0.07	919
Three boys	3.3	0.09	332
Three girls	2.2	0.21	220
Three boys and a girl	4.3	0.04	434
Two boys and two girls	6.4	0.04	648
A boy and three girls	3.8	0.08	380
Four girls	0.7	0.27	74
Four boys	1.1	0.08	113
5 or more children	23.9	0.04	2418
Previous experience of child death	22.0	0.12	2228
No previous experience	78.0	0.28	7888
Respondent's education			
No education	39.7	0.18	4016
Primary	17.5	0.18	1766
Secondary	34.0	0.33	3436
Higher	8.8	0.29	898
Husband's education			
No education	25.9	0.16	2621
Primary	22.0	0.19	2225
Secondary	37.6	0.32	3802
Higher	14.5	0.25	1467
Don't know	0.0	0.0	1
Respondent currently work	17.7	0.25	8330
Respondent do not work	82.3	0.19	1786
Husband self-employed in agriculture	10.2	0.24	1034
Husband employed in agriculture	8.1	0.22	826
Husband do not work in agriculture	81.7	0.25	8256
Ownership of land	21.1	0.25	2439
Do not own a land	75.9	0.24	7677
Place of residence			
Capital, large city	16.9	0.20	1709
Small city	22.1	0.24	2237
Town	7.9	0.26	805
Countryside	53.1	0.25	5365
Quintile of asset score			
Poorest	18.7	0.23	1895
Middle-poor	19.8	0.25	2003
Middle	19.6	0.25	1985
Middle-upper	20.6	0.25	2085
Upper	21.2	0.20	2148

Source: Author's calculation using 2000 EDHS.

Contextual variables The list of contextual variables and their descriptive statistics, together with their classification into social or economic modernization variables is shown in Appendix Table A.1, some contextual variables were collected using different sources (see Appendix Table A.1, column 4), whereas other contextual variables have been constructed throughout the application of GIS techniques using the ArcView 3.2 and 8.2 software.

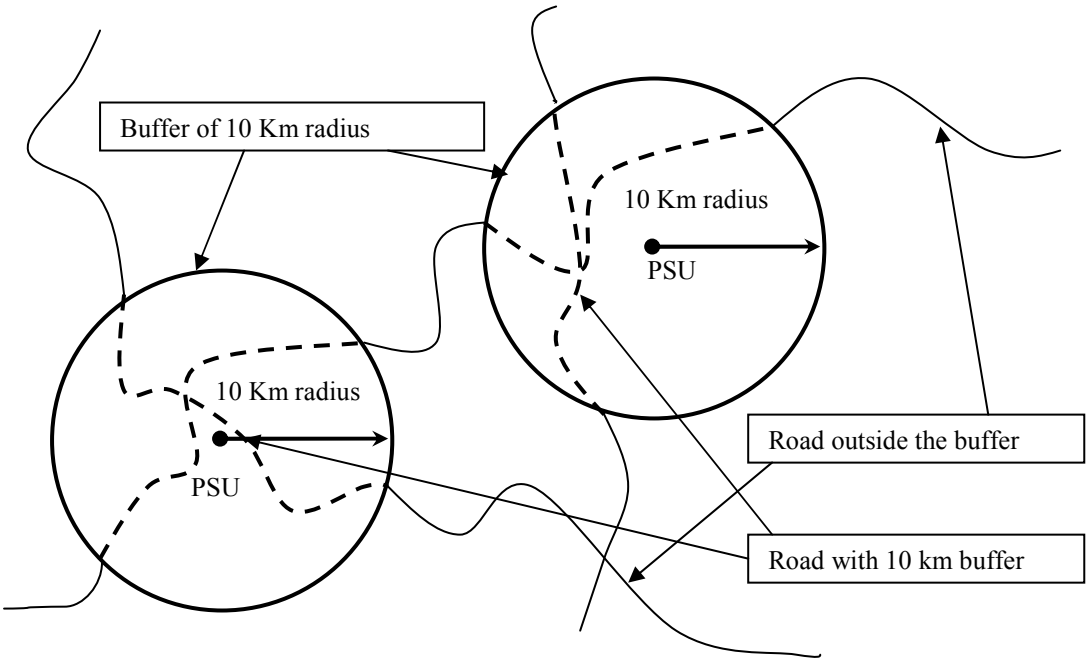
As has been previously mention two level of aggregation has been used PSU and governorates level. At PSU level some variables has been constructed both through the GIS techniques using the Africover maps and for selected variables calculating their mean values at PSU level using the 2000 EDHS. At governorates level indicators available in the 2003 Egypt Human Development Report (Saad 2003) based on estimated values for 2001 has been also used.

At the PSU level I use location data for collected by ORC Macro using the Global Positioning System concomitant with the DHS data collection (Montana and Spencer 2001). This additional information allows the linking of individual-level data to the area where information was collected and consequently the linking of contextual data at the PSU level. Using the GPS (Global Positioning System) locator for the PSUs, a series of GIS variables was constructed using the Spatially Aggregated Multipurpose Landcover database[3] and road layer. I construct variables as the proportion of land area dedicated to each specific category of land use area (which includes cotton plantations, rice, water, bare areas, urbanized road density) within a 10 kilometre (km) buffer(which is A zone of a specific distance around a feature or point and in this case the PSUs location). A 10 km buffer has been constructed around the sampling point and then intersected with the land cover reclassified layers. Using a Avenue script[4] in ArcView 3.2, the area dedicated to each land cover type within each buffer was calculated, obtaining the proportion of specific types within the area of the 10 km buffer. A similar procedure was applied to calculate the road density within each buffer, by intersecting the road layer with the 10 km buffer thus obtaining the total road length within each 10 km buffer (see Figure 2). The road density was then calculated as the ratio between road length within the buffer and the surface area of the buffer.

[3] Using ArcView 2.1 and 8.2 we classified the shapefile of the Spatially Aggregated Multipurpose Landcover database to eight major classes of land use:
1) cultivated terrestrial areas and managed lands (composed of rain fed tree crops and irrigated tree crops such as olive, peach, date palm, citrus, mango, apple, etc.),
2) cultivated terrestrial areas and managed lands (composed rain fed herbaceous crop, irrigated herbaceous crop such as wheat, cotton, sugar cane, maize, etc.),
3) natural and semi-natural terrestrial vegetation (mainly shrubs land),
4) cultivated aquatic or regularly flooded areas,
5) natural and semi-natural aquatic vegetation,
6) artificial surfaces and associated areas (mainly urban areas and industrial areas
7) bare area
8) artificial water bodies and inland water bodies(lakes, river, reservoirs, etc.).

[4] Developed by Andy Murdock from the Geodata Institute at Southampton University.

Figure 2: Illustration of GIS analysis to calculate road density.



The contextual variables selected represent different aspect of modernization (social and economic). Those contextual variables will be tested in the model and those that will reduce the area variance at governorates and PSU levels will be selected. To measure social modernization, I consider variables representing educational level (the mean number of years of education for women within a community, the female enrolment ratio for basic and secondary level and the female literacy rate), female-male gaps in education (the women-husband secondary ratio or literacy rate of female as percentage of males), and the female role in the labour market (as the percentage of women in the labour force or the female unemployment rate). To measure economic modernization, I consider variables representing land use (the proportion of the 10 km buffer dedicated to cotton plantation, rice or the total agricultural area), variables representing the level of urbanization (the proportion of urbanized area within 10 km buffer, road density within 10 km buffer and population density), and variable representing the level of wealth (as gross domestic product per head per governorate or the mean asset index per PSU).

Those variables selected do show a high variability within their area of analysis, which suggest that differences in fertility behaviour might be explained in differences in those contextual modernization variables.

5 Results

The results of the modelling will be presented in three sections. In the first section I will begin with the results for a model including only individual-level variables in order to show the effect of these variables on desired fertility, and to assess which of them have significant effects. In the second section contextual variables measuring social and economic modernization will be added to the model with the aim of reduce the area variances, and to highlight which contextual factors help in explaining the geographical variation. In the third section the effect on the area random effect of the inclusion of the selected contextual variables will be described as well as the role of social rather than economic modernization in explaining governorate variation.

5.1 Individual variables model

In this section four set of models will be presented. First, the estimate of the three- level random intercept model for all women for the selected sample will be presented to show the effect of current family composition on desired fertility, and the effect of individual social and economic modernization variables conditional on current family composition and a set of demographic variables. Second, the same model is applied to a subset of the sample of women having at least two children, and the results presented in order to verify if the effect of the covariates changes with current parity. Third, the model will be re-estimated without controlling for current family composition to see if the effect of social and economic modernization at individual level changes and thereby to see to what extent the individual-level effect of those variables is captured by the effect of family composition. Fourth, I shall test if the effect of the covariates changes according to the governorate where a woman lives and estimate a random slope model for the covariates that appear to have a significantly different effect according to the governorates where a women lives. The results are presented in Table 3.

Table 3: Results of three- level logistic modelling.

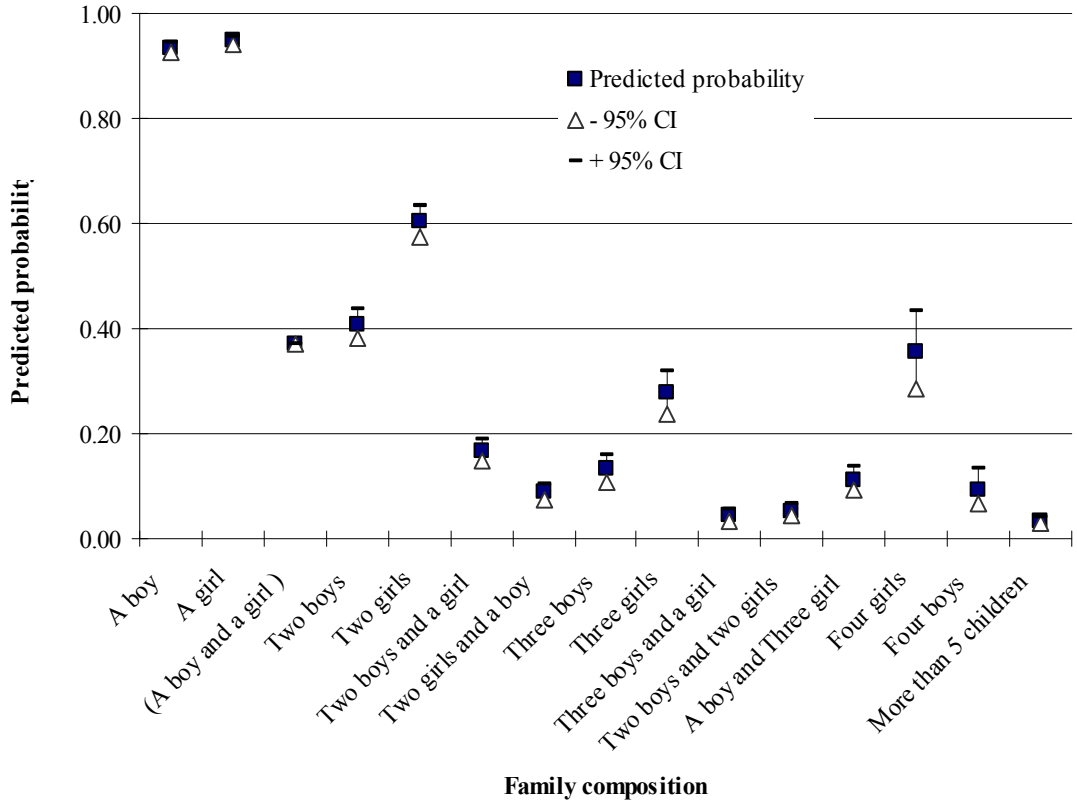
	Individual variable model			Individual variable model for women with at least two children			Individual variable model excluding family composition variables			Individual variable model with random slope for the individual wealth		
	(a)	SE		(b)	SE		(c)	SE		(d)	SE	
Small city	0.573	0.297		0.582	0.339		0.279	0.209		0.611	0.243	**
Town	0.753	0.321	*	0.837	0.362	*	0.361	0.228		0.828	0.269	**
Countryside	0.803	0.291	**	0.908	0.332	**	0.186	0.204		0.904	0.245	***
(Capital city)												
25-35	-0.437	0.092	***	-0.395	0.103	***	-1.918	0.069	***	-0.451	0.092	***
Above 35	-1.876	0.136	***	-1.657	0.148	***	-4.070	0.106	***	-1.894	0.137	***
(Below 25)												
A boy	3.189	0.153	***	n.a						3.126	0.161	***
A girl	3.46	0.167	***	n.a						3.381	0.176	***
Two boys	0.164	0.121		0.157	0.122					0.157	0.120	
Two girls	0.955	0.126	***	0.984	0.128	***				0.922	0.126	***
Two boys and a girl	-1.069	0.142	***	-1.128	0.143	***				-1.068	0.142	***
Two girls and a boy	-1.803	0.165	***	-1.873	0.167	***				-1.830	0.166	***
Three boys	-1.346	0.223	***	-1.426	0.226	***				-1.362	0.224	***
Three girls	-0.430	0.209	*	-0.483	0.211	*				-0.447	0.208	*
Three boys and a girl	-2.561	0.286	***	-2.680	0.287	***				-2.641	0.291	***
Two boys and two girls	-2.344	0.234	***	-2.462	0.236	***				-2.385	0.237	***
A boy and three girls	-1.535	0.227	***	-1.639	0.229	***				-1.580	0.229	***
Four girls	-0.063	0.328		-0.121	0.331					-0.067	0.326	
Four boys	-1.727	0.403	***	-1.854	0.405	***				-1.796	0.407	***
More than 5 children	-2.786	0.176	***	-2.986	0.181	***				-2.882	0.182	***
(A boy and a girl)												
Previous Experience of child dead	0.171	0.105		0.206	0.109		-0.168	0.087		0.162	0.106	
Individual Social Modernization												
Respondent education												
Primary	-0.032	0.119		0.042	0.126		0.069	0.096		-0.025	0.119	
Secondary	0.002	0.112		-0.013	0.12		0.505	0.089	***	-0.026	0.111	

Higher	0.036	0.183		-0.041	0.201		1.064	0.146	***	-0.032	0.182	
(No education)												
Women currently working	0.007	0.105		-0.059	0.114		0.046	0.084		0.026	0.104	
Individual Economic Modernization												
Husband Education												
Primary	0.177	0.118		0.191	0.124		0.170	0.095		0.189	0.118	
Secondary	0.269	0.118	*	0.218	0.126		0.411	0.094	***	0.274	0.118	*
Higher	0.281	0.164		0.281	0.177		0.276	0.131	*	0.269	0.164	
(No education)												
Asset index	-0.343	0.126	**	-0.378	0.132	**	-0.298	0.102	**	-0.174	0.144	
Household own a land	0.136	0.097		0.103	0.103		-0.115	0.078		0.139	0.097	
Husband is self-employ in agriculture	0.346	0.141	*	0.365	0.147	**	0.237	0.114	*	0.381	0.142	**
Husband is employ in agriculture	0.083	0.15		0.072	0.159		0.053	0.12		0.089	0.152	
(husband not employ in agriculture)												
Constant	-0.534	0.409		-0.522	0.447		0.683	0.291	*	-0.890	0.454	*
Governorates Variance	0.654	0.196	***	0.736	0.220	***	0.194	0.063	**	2.213	0.839	*
Random slope for asset										0.125	0.094	
Covariance										-0.550	0.273	*
PSU variance	0.131	0.047	**	0.148	0.054	**	0.073	0.029	**	0.112	0.045	*
Number of Cluster	499			499			499					
Number of Governorates	26			26			26					
Number of Observation	10116			8705			10116					

Note: *** Significant at 1 per cent level, ** Significant at 5 per cent level, * Significant at 10 per cent level

A significant effect of **family composition** (Figure 3) was found. Women with one child show a strong desire for another child, with a predicted probability of above 0.90 that they will want another child, though there is not a significant difference according to the sex of their one child. There seams to be the strong desire in Egyptian society to have at least two children. On the other hand, women who have two children both of whom are girls have a 20 per cent point higher probability of wanting another child compare with those who have a mixed pair, and those who have two boys. A similar pattern appears for women at higher parities having only girls, which seems to suggest the strong desire to have at least one boy. The desire for another child is, in general lower after 3 children than after 2.

Figure 3: Predicted probability of wanting another child by currently family composition.



Source: 2000 EDHS, author's calculation

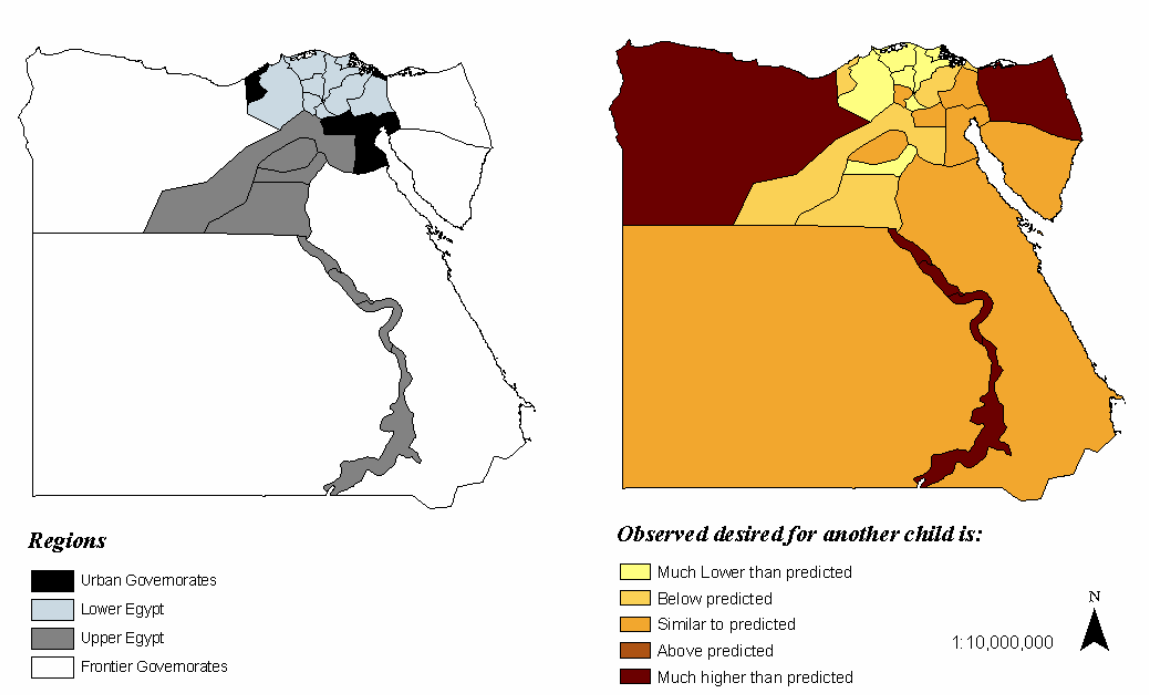
Note: Reference category women of the individual level model.

As far as the **individual social modernization** variables are concerned, unlike previous studies we do not find a significant difference in the desire for another child by respondent's educational level or respondent's current work status after having accounted for demographic variables like age of woman and parity. At the individual level, social modernization variables do not appear to play a major role in influencing the desire for another child.

As far as the **individual economic modernization** variables are concerned, there is a weakly significant effect for husband's education. Husband with secondary education are associated a 7 percentages point higher probability of wanting another child compared with husbands with no education, though the effect is significant only at 10 per cent level. Women married to husbands who are self-employed in agriculture have a 10 per cent higher probability of wanting another child compared with those who do not work in agriculture, but again the this effect is only significant at the 10 per cent level. Women belonging to a household with a higher living standard (top quintile) appear to have a lower probability of expressing a desire for an extra child compared with household with lower living standard. There appear to be a significant effect of place of residence, women living in countryside having a 20 percent point higher probability of wanting another child than women living in the capital or a large city.

The governorate residuals from the multilevel logistic model (Figure 4.4) show that governorates in Upper Egypt tend to have an observed value much higher than predicted. This area is characterized by an unusually high desire for another child. On the other hand, the governorates in Lower Egypt show a much lower observed value than predicted, revealing that this is an area with 'unusually' low desire for another child. Urban governorates show values similar to those predicted by the model.

Figure 4: Adjusted governorates variation in observed desire for another child.



Note: Much lower than predicted: the desire for another child is 1.64 standard deviations (SD) below the desire for another child predicted by the model; Below predicted : the desire for another child is between 1.64 SD to 1 SD below the predicted desire for another child; Similar to predicted: the desire for another child is within 1 SD of the predicted desire for another child; Above predicted: the desire for another child is between 1 SD and 1.64 SD above the predicted desire for another child; Much higher than predicted: the desire for another child is greater than 1.64 SD above the predicted desire for another child.

In order to verify that our results on the modernization variables did not change with parity, I estimated the same model for a women 15-49 with at least two children who were fecund, not sterilized and not pregnant (comprising of a total of 8705 women). The results of this model are displayed in Table 3 model b. The results show that there is no major differences in the significance of the modernization variables for women with at least two children (model b) compare to women with at least one child (model a).

I then estimated the individual variables model without controlling for current family composition and found a significant effect for both husband's and wife's education (Table 3 model c). This seems to imply that the effect of education at the individual level (both for husband and wife) in desired fertility is completely captured by the effect of family composition.

I then tested whether the individual level variables had a different effect on the desire for another child according to governorate, and estimated a random slopes model for each set of individual level variables. The only individual-level variable which turned out to have an effect on the desire for another child which varied significantly with governorate was the household asset index. The results seem to suggest that in governorates where women have an higher desired for another child are also those governorates where individual wealth have a lower impact. The results for model including a random slope for the asset index are shown as model d in the Table 3.

5.2 Contextual variables model

A forward selection procedure to select contextual variables that best fit the model and reduce the area-level variance has been used. After having fitted the three-level logistic model using individual-level variables with random effects at levels 2 and 3(i.e. variance components) I noticed a significant random effect at governorate and PSU level. Using the chi-square test I selected the contextual variable that best fit the data and most reduced the area variance. I then re-estimated the individual-level model adding this selected contextual variable, and tested again using the remaining contextual variables to see which had the highest chi square value. I repeated this selection procedure until no other contextual variables significantly improved the model. Some contextual variables were correlated to each other, as some of them were capturing the same aspect of modernization. In such cases I choose those which were more significant, avoiding having highly correlated variables together in the model. Moreover, the random slope for the asset index appeared no longer to be significant once we included the contextual variables, so I removed the random slope for the asset for the estimation of the contextual variable model. The results are displayed in model b in Table 4.

Table 4: Results of multilevel modelling with and without contextual variables, 2000 EDHS.

	Individual variable model (a)			Contextual variables model (b)		
		SE			SE	
Small city	0.573	0.297		0.825	0.248	***
Town	0.753	0.321	*	0.919	0.274	***
Countryside	0.803	0.291	**	1.039	0.246	***
(Capital or large city)						
25-35	-0.437	0.092	***	-0.430	0.092	***
Above 35	-1.876	0.136	***	-1.863	0.136	***
(Below 25)						

A boy	3.189	0.153	***	3.192	0.152	***
A girl	3.460	0.167	***	3.459	0.166	***
Two boys	0.164	0.121		0.165	0.121	
Two girls	0.955	0.126	***	0.954	0.126	***
Two boys and a girl	-1.069	0.142	***	-1.066	0.142	***
Two girls and a boy	-1.803	0.165	***	-1.807	0.166	***
Three boys	-1.346	0.223	***	-1.347	0.224	***
Three girls	-0.430	0.209	*	-0.421	0.209	*
Three boys and a girl	-2.561	0.286	***	-2.569	0.286	***
Two boys and two girls	-2.344	0.234	***	-2.353	0.234	***
A boy and three girls	-1.535	0.227	***	-1.525	0.228	***
Four girls	-0.063	0.328		-0.079	0.328	
Four boys	-1.727	0.403	***	-1.736	0.404	***
More than 5 children	-2.786	0.176	***	-2.807	0.177	***
(A boy and a girl)						
Previous experience of child death	0.171	0.105		0.171	0.105	
Individual Social Modernization						
Respondent's education						
Primary	-0.032	0.119		-0.035	0.120	
Secondary	0.002	0.112		0.010	0.112	
Higher	0.036	0.183		0.028	0.183	
(No education)						
Woman currently working	0.007	0.105		0.028	0.105	
Individual Economic Modernization						
Husband's education						
Primary	0.177	0.118		0.177	0.118	
Secondary	0.269	0.118	*	0.282	0.118	*
Higher	0.281	0.164		0.299	0.164	
(No education)						
Asset index	-0.343	0.126	**	-0.358	0.127	**
Household owns land	0.136	0.097		0.141	0.097	
Husband is self-employed in agriculture	0.346	0.141	*	0.336	0.141	*
Husband is employed in agriculture	0.083	0.150		0.082	0.150	
(Husband not employed in agriculture)						
Contextual Social Modernization						
Women in the labor force(as % of the total)				-0.105	0.028	***
Infant Mortality Rate				0.037	0.010	***
Female enrolment ratio				0.031	0.014	*
Contextual Economic Modernization						
Proportion of cotton area in 10km buffer including cotton area with majority rice				-0.738	0.194	***
Constant	-0.534	0.409		-2.533	1.255	*

Governorate variance	0.654	0.196	***	0.166	0.059	**
PSU variance	0.131	0.047	**	0.137	0.047	**
Number of cluster	499			499		
Number of governorates	26			26		
Number of observations	10116			10116		

Note: *** Significant at 1 per cent level, ** Significant at 5 per cent level, * Significant at 10 per cent level.

Amongst the social modernization variables I found a significant effect for women's participation in the labor market, the female school enrolment rate, and the Infant Mortality Rate (IMR), whereas amongst the economic modernization variables we found a significant effect for the proportion of area dedicated to cotton crops within a 10 km buffer.

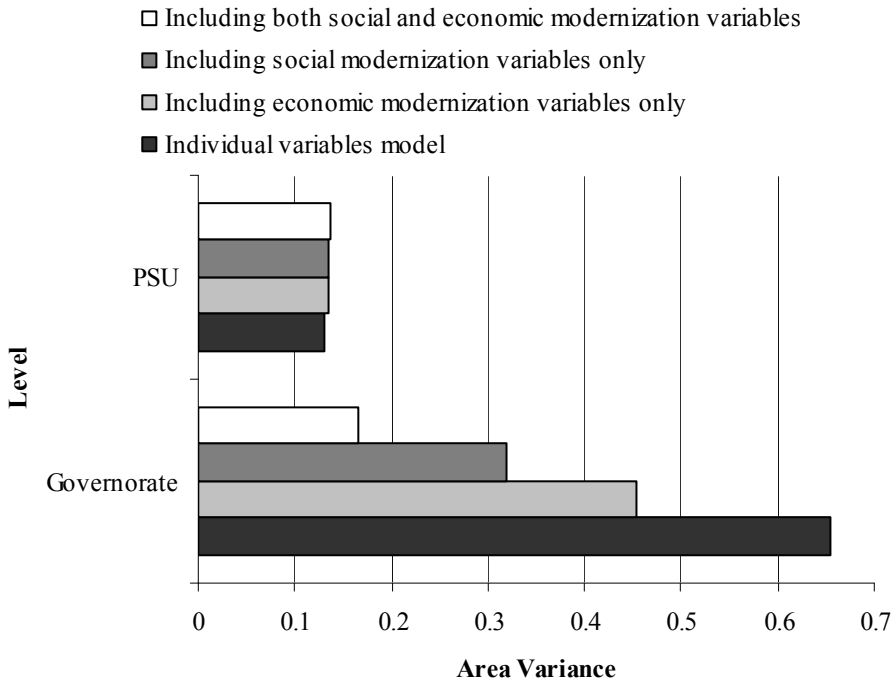
Women living in an area with a high participation of women in the labor force are less likely to desire another child, though the size of the effect is rather small. Women living in governorates with a IMR one standard deviation higher than the mean have a 13 percentage point higher probability of wanting another child compared with women living in governorates with an IMR one standard deviation below the mean. This could be due to a 'compensation' effect. Women living in an area with high infant mortality, compensate with their fertility for the possibility of future child death. Contrary to expectations, women living in area with high female enrolment in secondary or higher education are more likely to express a desire for another child. Women living in governorates with a female enrolment ratio one standard deviation higher than the mean have a **14 per cent higher probability** of wanting another child compared with women living in governorates with a female enrolment ratio one standard deviation above the mean.

Women living in the proximity of agricultural area are less likely to want another child. Though, moving from an area with higher proportion of land area dedicated to cotton crop such as rural Lower Egypt to an area with a low proportion, such as the Frontier Governorates does not have a big effect on the probability to want another child.

5.3 Area random effect

Figure 5 shows the changes in the governorate-level and PSU-level variances after the inclusion of only social modernization variables, after the inclusion of only economic modernization variables and after the inclusion of both in the model.

Figure 5: Area variance



Source: 2000 EDHS, author's calculation.

Contextual modernization variables appear to help greatly in explaining the governorate-level variation, which decreases by almost 73 per cent points after the inclusion of contextual modernization variables. Including only economic modernization variables among the contextual variables appears reduce the governorate-level variance by 30 per cent, whereas after the inclusion only of social modernization variables the governorate-level variance decreases by almost 50 per cent.

Thus, social modernization variables appear to be relatively more important in explaining regional variation in desired fertility than economic modernization variables.

The PSU variance does not change with the inclusion of contextual variables in the model. Both the PSU and governorate variances are significant after the inclusion of modernization variables. This result seems strongly to suggest that the community where women live influences her fertility behaviour. Social and economic modernization variables do not reduce the community-level variation, suggesting that there are other unobserved community characteristics that influence desire

for another child in each community. In our model we could not account for community social interaction as DHS data do not provide enough information about community interaction and for this reason, it is considered as an unobserved component. We did, however, account for a range of community characteristics representing socio-economic modernization, therefore our unobserved component refers to such aspects as tradition and community attitudes.

As far as the governorates-level variances are concerned, despite the reduction of the area variances after the inclusion of modernization variables, there is still a significant unexplained governorate-level variation. This also seems to suggest that the governorate where a woman lives and not only local communities are affected by unobserved characteristics which are not related to the level of development of the area, and as has been argued before, this could be related to the channel or types of social interaction, which varies from place to place.

6 Discussion

The results for the effect of individual modernization variables on fertility preferences differ from those of previous studies conducted by Easterlin *et al.*(1988). We do not found a significant effect of respondent's and husband's education on desired fertility. One main reason for this is that Easterlin's model (1988a) looks at the desired family size and does not account for current family composition, whereas this study look at the desired fertility and does account for current family composition. Our results show that the effect of education is acting through the current fertility and not on the desired fertility at individual level.

We found a strong effect of current family composition on desired fertility, showing complex family preferences. There appears to be a strong desire in Egyptian society to have at least two children and at least one boy. These results partially confirm literature on gender preferences in Egypt (Yount *et al.* 2000)though they add an extra layer of information where the gender preferences act on the desired of at least one boy and at least two children.

Excluding family composition from the model we found a significant positive effect of respondent's education on desired fertility. According to the economic theory of fertility these results could suggest that increased women's earning potential does not translate in to an increase cost of children. This could be due to the fact that the cost of children are completely inelastic to the

woman's potential earnings and that increases in their potential earning acts as an 'income effect' increasing budget constraint. The same could be said about husband's educational level, which is considered as a proxy for income. Increased income appears to increase the budget constraint and prices of children relative to other good seem not to be affected by this.

At the individual level there appear to be a significant negative effect of wealth on desired fertility. One interpretation of this is that wealthier families are those which have accumulated more wealth and have been wealthier than others for more than one generation. In this case the increased income does not just increases the budget constraint but also increases the price of children relative to other goods, resulting in a reduction in the demand for children.

There appears also to be a significant positive effect of the husband being self-employed in agriculture. This could show that in an agricultural society, especially where the family economics is related to agriculture, the returns to having an extra child are higher than for a family which is not self-employed in agriculture. In other words children are valued more probably because of their possible involvement in agricultural work.

In the estimation of contextual variables model I keep family composition variables in the model to control for individual family composition and enable the contextual variables model to capture the direct effect of modernization variables on desired fertility

At community level the most important effects I found were of the IMR and female enrolment ratio. The level of infant mortality in a community influences the individual desired fertility. Women living in a community with a high level of infant mortality have higher desired fertility. This appears to confirm Easterlin's (1975) hypothesis of a direct effect on fertility, and possible 'compensation effect'. The perceived survival probability in a community with an higher incidence of infant mortality is lower, hence families within that community have an higher desired fertility in order to compensate for their possible future loss. Communities with a high female enrolment ratio have an higher probability of wanting another child and this could be due to fact that the costs of children are completely inelastic to wife's earning potential, acting as an 'income effect' for the family which are not rely on women's earning for supporting or covering children. The opportunity costs of potential woman's earning do not play a role in families' fertility decisions.

Overall we do find that there is a substantial variation across governorates, which is partly explained by the contextual effect of modernization and differentials among governorates in the level modernization level do not play a role in reducing the community-level variation. However, we did not account for community differentials in tradition, or in attitudes, which characterize the channel of social interaction and define the process of diffusion of new idea. These results suggest that the economic theory of fertility does help in explain regional variation, though this theory appears not to be completely sufficient as there is remaining unexplained difference between communities. These results also suggest that the channels or types of social interaction vary between communities and to some extent also between governorates and social interaction theory does help in explain variation in desired fertility between communities in Egypt.

Overall, social modernization plays a more important role in explaining community-level variation than economic modernization and the results also suggest that the increase in women's role in society and more importantly the promotion women's gender role within families should translate in to a reduction of fertility. The traditional women's role in Egyptian society has not changed despite the modernization of Egyptian society in the past twenty years. Women are still appreciably accepting their traditional gender role. Policy directed to reduce fertility should aim to promote gender equality and enhance women's role in society, which will in turn be translated in a fertility reduction.

7 Conclusion

Using a conceptual framework that borrows notions from both the economic theory of fertility and social interaction theory, this paper looks at the role of different aspects of modernization both at the individual and community level on desired fertility in Egypt.

Previous studies have found that place of residence is one of the most important determinants of desired fertility and that different levels of modernization play an important role in explaining the regional differences in demographic behaviour(Easterlin *et al.* 1988; Hallouda *et al.* 1988). This study also confirmed the finding that village setting is an important determinant of desire for another child (Casterline and Eid 1988). This study shows that modernization helps in explaining governorate differences but not the community differences and a significant unexplained variation still exists at governorate level.

Considering modernization in terms of economic and social modernization, we found that at individual level modernization variables do not play a major role in determining the desired fertility in Egypt once family composition is accounted for, and at the community level the social development of an area is more important that economic modernization in explaining the governorate differences and in reducing the desire for another child.

The results show a strong effect of family composition on desired fertility in Egypt. There appears to a strong desire in Egyptian family for at least two children and at least one boy. The effect of education disappear once one account for family composition, a finding which seems to explain the differences in results between our analysis and the analysis of Easterlin *et al.* (1988), where using the 1980 WFS, they found that education, women work's experience and husband's occupation play a major role in explaining a differences in demographic behaviour.

This paper also provides an application of a method that uses both multilevel modelling and Geographical Information System (GIS) techniques based on an up-to-date map of land cover in Egypt made available from the Africover project(Di Gregorio 2003) of Food Agricultural Organization(FAO).

These results suggest that the economic theory of fertility do help in explain regional variation though this theory appears not to be sufficient in explaining the left unexplained difference between communities. These results also suggest that the channel or types of social interaction varies between communities and between governorates. Social interaction theory does help in explain variation in desired fertility between communities in Egypt.

Appendix

Table A.1: Descriptive statistics of contextual variables.

	Mean	SD	Level	Sources
Social Modernization				
Mean years of education (respondent) per PSU	4.56	0.81	PSU	M
Mean years of education (husband) per PSU	4.80	0.49	PSU	M
Proportion of women with secondary or higher education per PSU	0.40	0.24	PSU	M
Proportion of husbands with secondary or higher education per PSU	0.50	0.21	PSU	M
Woman-husband secondary education ratio [a] per PSU	0.77	0.30	PSU	M
Proportion of husbands employed in a professional an managerial job per	0.22	0.17	PSU	M
Proportion of husbands employed or self-employed in agriculture per PSU	0.18	0.20	PSU	M
Mean parity per PSU	3.12	0.59	PSU	M
Human Development Index (HDI) 2001	0.68	0.05	G	HDR
Infant Mortality Rate (IMR) 2001	29.4	10.9	G	HDR
Female literacy rate 2001	53.6	14.8	G	HDR
Female enrolment ratio (basic and secondary) 2001	84.0	9.5	G	HDR
Percentage of population 15 + with secondary education or higher	23.1	8.7	G	HDR
Percentage of women in the labour force	15.3	4.5	G	HDR
Literacy rate of females as percentage of males	59.1	14.8	G	HDR
Under 5 mortality rate	38.6	11.8	G	HDR
Percentage of labour force 15 + in agriculture	30.1	17.2	G	HDR
Female unemployment rate	19.0	8.3	G	HDR
Economic Modernization				
Mean asset index per PSU	1.8	0.36	PSU	M
Proportion of bare land in 10 km buffer	0.17	0.22	PSU	GIS
Proportion of herbaceous (cultivated area) in 10 km buffer	0.11	0.14	PSU	GIS
Proportion of urbanized are a in 10 km buffer	0.12	0.18	PSU	GIS
Proportion of cultivated tree area	0.09	0.13	PSU	GIS
Proportion of inland water in 10 km buffer	0.04	0.06	PSU	GIS
Proportion of natural and semi natural terrestrial vegetation	0.02	0.02	PSU	GIS
Proportion of cotton area in 10 km buffer excluding cotton in majority rice	0.20	0.26	PSU	GIS
Proportion of cotton area in 10 km buffer including cotton in majority rice	0.36	0.36	PSU	GIS
Proportion of rice area in 10 km buffer, include majority of rice	0.16	0.31	PSU	GIS
Proportion of agricultural area in 10km buffer	0.57	0.33	PSU	GIS
Proportion of cotton area within agricultural area in 10km buffer	0.28	0.33	PSU	GIS
Road density km /1000km2	0.22	0.08	PSU	GIS
Gross domestic product per capita in Egyptian Lira	5737	2498	G	HDR
Urban population as percentage of the total	45.6	27.6	G	HDR
Population of largest city (as % of the total urban)	52.1	26.5	G	HDR
Population density (per km^2)	630	817	G	HDR
Person per feddan	88.2	376	G	HDR

Sources: Egypt Human Development Report 2003 (Saad 2003), Egyptian Demographic and Health Survey 2000 (El-Zanaty and Way 2001), Africover map of Egypt(Di Gregorio 2003),

Notes: M variable constructed as means of PSU value, Governorates variables: G, Primary Sampling Units variables PSU.

[a] number of women with secondary education as percentage of husband, contextual variable have been calculated using the all dataset.

References

Bankole, A. 1995. "Desired Fertility and Fertility Behaviour among the Yoruba of Nigeria: A Study of Couple Preferences and Subsequent Fertility." *Population Studies* 49(2):317-328.

Becker, G. 1960. "An economic analysis of fertility." Presented at Conference of the Universities-NBER Committee for Economic Research, Princeton.

—. 1991. *A Treatise on the Family*: Enlarged Edition. Cambridge: Havard University Press.

Bongaarts, J. 1992. "Do Reproductive Intentions Matter?" *International Family Planning Perspectives* 18(3):102-108.

Bongaarts, J.and S.C. Watkins. 1996. "Social Interactions and Contemporary Fertility Transitions." *Population and Development Review* 22(4):639-682.

Brown, J., N.J. Madise, and D. Steel. 2002. "Accounting for sample design in multilevel models." Presented at Paper presented at the Population Association of America Annual Conference, Atlanta 9-11 May 2002.

Bulatao, A.R.and D.R. Lee. 1983. "The Demand for Children: A Critical Essay." Pp. 233-287 in *Determinants of Fertility in Developing Countries: Volume 1 Supply and Demand for Children*, edited by A.R. Bulatao and D.R. Lee. New York: Academic Press.

Caldwell, J. 1983. "Direct Economic Costs and Benefits of Children." in *Determinants of Fertility in Developing Countries: Volume 1 Supply and Demand for Children*, edited by A.R. Bulatao and D.R. Lee. New York: Academic Press.

Casterline, J.B.and I. Eid. 1988. "Village Characteristics and Reproductive Behaviour." in *Egypt Demographic Responses to Modernization*, edited by A.M. Hallouda, S. Farid, and H.S. Cochrane. Cairo: CAPMAS.

Cleland, J. 2001. "Potatoes and Pills: An Overview of Innovation-Diffusion Contributions to Explanations of Fertility Decline." in *Diffusion Process and Fertiliy Transition: Selected Perspectives*, edited by J. Casterline. Washington, D.C.: National Academy Press.

Clements, S., A. Baschieri, M. Hennink, N. Madise, and R. Stephenson. 2004. "Explaining Areal Variations in Contraceptive Use in East Africa." *Applications and Policy working papers, S3RI, Southampton* A04/01.

Cochrane, H.S. 1983. "Effects of Education and Urbanization on Fertility." in *Determinants of Fertility in Developing Countries*, edited by A.R. Bulatao and D.R. Lee. New York: Academic Press.

Cochrane, H.S., M. Ali Khan, and I.K.T. Osheba. 1990. "Education, Income and Desired Fertility in Egypt: A Revised Perspective." *Economic Development and Cultural Change* 38(2):313-339.

DeGraff, D., R.E. Bilsborrow, and D.K. Guilkey. 1997. "Community-level determinants of contraceptive use in the Philippines: a structural analysis." *Demography* 34(3):385-398.

Di Gregorio, A. 2003. "Africover Project Overview on Methodological Approach." Rome, Italy: Food and Agriculture Organization of the United Nations (FAO).

Easterlin, A.R. 1975. "An Economic Framework for Fertility Analysis." *Studies in Family Planning* 6(3):54-63.

—. 1983. "Modernization and Fertility: Critical Essay." in *Determinants of fertility in Developing Countries: Vol 2 Fertility Regulation and Institutional Influences*, edited by A.R. Bulatao and D.R. Lee. New York: Academic Press.

Easterlin, A.R., M.E. Crimmins, A.M. Ahmed, and M.S. Soliman. 1988. "The Impact of Modernization on the Motivation for Fertility Control." in *Egypt Demographic Responses to Modernization*, edited by M.A. Hallouda, S. Farid, and H.S. Cochrane. Cairo 1988: CAPMAS.

El-Zanaty, F.and A.A. Way. 2001. "Egypt Demographic and Health Survey 2000." edited by N.P.C.a.O.M. Ministry of Health and Population [Egypt]. Calverton, Maryland [USA].

Entwisle, B., J. Casterline, and A.A. Sayed. 1989. "Villages as contexts for contraceptive behaviour in rural Egypt." *American Sociological Review* 54(6):1019-1034.

Filmer, D.and L. Pritchett. 1994. "Estimating Wealth Effects without Expenditure Data or Tears." *Policy Research Working Paper*(WPS1994).

Goldstein, H., I. Rasbash, D. Plewis, D. Draper, W. Browne, M. Yang, G. Woodhouse, and M. Hearly. 1998. "A user's guide to MlWin." London: Multilevel Model Project, Institute of Education, University of London.

Hallouda, A.M., S. Farid, and H.S. Cochrane. 1988. *Egypt Demographic Responses to Modernization*. Cairo: CAPMAS.

Hirschman, C.and P. Guest. 1990. "Multilevel models of fertility determination on four south-east Asian countries: 1970-1980." *Demography* 27(3):369-396.

Human Right Watch. 2001. "Underage and Unprotected: Child Labor in Egypt's Cotton Fields." *Human Rights Watch* Vol. 13 No. 1 (E).

Inkeles, A.and D.H. Smith. 1974. *Becoming Modern: Individual Change in Six Developing Countries*. Cambridge: Oxford University Press.

Lindert, P. 1983. "The Changing Economic Costs and Benefits of Having Children." in *Determinants of Fertility on Developing Countries 1*, edited by A.R. Bulatao and D.R. Lee. New York: Academic Press.

Madise, N.J.and I. Diamond. 1995. "Determinants of Infant Mortality in Malawi: An Analysis to Control for Death Clustering Within a Families." *Journal of Biosocial Science* 27(1).

Montana, L.and J. Spencer. 2001. "Incorporating Geographical Information into MEASURE Surveys: A field Guide to GPS Data Collection." Calverton, Maryland: Macro International.

Osheba, I.T.and S.H. Cochrane. 1988. "The Determinants of Desired Family Size: A Causal Analysis for Policy." in *Egypt Demographic Responses to Modernization*, edited by M.A. Hallouda, S. Farid, and H.S. Cochrane. Cairo 1988: CAPMAS.

Saad, T., Allam. 2003. "Egypt Human Development Report 2003." United Nation Development Programme and Institute of National Planning.

Tan, P.C.and N.P. Tey. 1994. "Do Fertility Intentions Predict Subsequent Behaviour? Evidence from Peninsular Malaysia." *Studies in Family Planning* 25(4):222-231.

Unwin, D.J. 1996. "GIS, spatial analysis and spatial statistics." *Progress in Human Geography* 20(4):540.

Yount, K.M., R. Langsten, and K. Hill. 2000. "The Effect of Gender Preference on Contraceptive Use and Fertility in Rural Egypt." *Studies in Family Planning* 31(4):290.

Zaky, H.H.M. 1995. "Profile of Men's and Women's Fertility Preferences in Egypt." in *Perspectives on Fertility and family Planning in Egypt: Results of Further Analysis of the 1992 Egyptian Demographic and Health Survey*, edited by M. Mahran, El-Zanaty, and A.A. Way. Calverton, Maryland: National Population Council [Egypt] and Macro International Inc.