POPULATION AND EDUCATION PROSPECTS IN THE ARAB WORLD: THE NEED FOR MULTI-EDUCATIONAL STATE POPULATION PROJECTIONS

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This paper pleads the case for projections that incorporate education as a dimension in the same manner as age and sex. It focuses on the study of education and population trends in the Arab region. It emphasises the significant role of education as an important source of demographic heterogeneity. Present and future education trends will not only shape the human capital component of Arab societies but will also impact the population size of those societies.

It is clear today that the widespread perspective that Arab countries will maintain unabated high rates of population growth is false. United Nations estimates show that the Western Asian region was leading in terms of the average annual rate of population growth during the 1980–85 period, with 3.0 percent per year. It has dropped now to 2.2 percent for the period 1995–2000. During the same time, the annual population growth rate declined from 2.7 percent (for the period 1980–1985) to 2.0 percent (for the period 1995–2000) in North Africa. In a similar pattern, fertility has declined in most Arab countries and is continuing to decline. The rates of population growth, both in North Africa and in the Middle East, are nevertheless higher than the average rate of less developed countries – 1.65 percent for 1995–2000 (United Nations, 1997). The contradiction between high rates of population growth and declining fertility stems from the population momentum.

There are two main questions associated with the fertility decline. The first is: to what minimum level will fertility decline reach? Possible answers are replacement fertility (slightly above two children per woman), stabilisation at higher fertility levels, or follow in the path of South European countries (Spain, Italy, and Greece) with fertility levels way below replacement levels (about 1.2 children on average per woman). The second question is: at what speed will fertility decline? The decline so far has been taking many different shapes in the Middle East and North Africa (MENA) region. For example, Egypt and Tunisia underwent early transitions, starting between 1960 and 1974. The decline started 10 to 15 years later in Algeria and Morocco, with more modest falls at first, but a sudden acceleration in the 1990s. The onset was in the 1980s in Syria but the decline was then extremely rapid. It occurred at the same time in Jordan but much less rapidly. The decline from high levels was very rapid for some Gulf States, such as Bahrain, Qatar and also in Iran. There are more recent and modest falls in Iraq, Iran, Libya, Saudi Arabia and Sudan but high fertility levels persist.

Knowledge about the education levels of the population, especially of women, in those countries will diminish the uncertainty about the fertility decline. This assumption is based on two main phenomena, as explained below.

First, no other socio-economic variable shows a similar degree of association with fertility – and also mortality – than education. This conclusion can be easily extracted from the results of the large demographic surveys conducted in developing countries in the last 25 years (World Fertility Surveys, Demographic and Health Surveys, Pan Arab Project for Child Development surveys). For instance, Moroccan women with ten years of education or more had 3.3 fewer children than women who had never attended school in 1987. The difference was 2.7 children in Syria in 1993, and 3.5 children in the United Arab Emirates in 1987. Table 1 provides other examples of such differentials in the MENA region.

Table 1. Total fertility rates by women's years of education, 1976–1995.

				Women's education					
Country	**Year**	**Source**	**Total**	**0 (A)**	**1–3**	**4–6**	**7–9**	**10+(B)**	**(B) – (A)**
Algeria	1992	Papchild	4.4	5.6	3.8	3.3	3.3	2.5	–3.1
Egypt	1976	WFS	5.3	6.5	6.4	6.2	3.8		–2.7
Egypt	1988/89	DHS	4.7	5.7	5.3	4.2	3.4	3.4	–2.3
Egypt	1995	DHS	3.6	4.6	3.7	3.1		3	–1.6
Jordan	1976	WFS	7.6	9.3	8.6	7.0	4.9		–4.4
Jordan	1990	DHS	5.6	6.9		6.0	5.4	4.1	–2.8
Kuwait	1987	Gulf	6.5	8.6	5.4		NA	NA	NA
Libya	1995	Papchild	3.8	5.2	4.2	3.7		3.4	–1.8
Morocco	1972/73	WFS	5.9	6.4	5.2	4.4	4.2		–2.2
Morocco	1987	DHS	4.9	5.5	3.9	2.9	2.4	2.2	–3.3
Morocco	1992	DHS	4.0	4.9	2.4		2.0		–2.9
Morocco	1995	DHS	3.3	4.0	2.4		1.9		–2.1
Oman	1988/89	Gulf	7.8	9.9	5.0		NA	NA	NA
Sudan	1973	WFS	5.9	6.5	5.6	5.0	3.4		–3.1
Sudan	1989/90	DHS	5.0	5.9	5.1		4.6	3.3	–2.6
Sudan	1992/93	Papchild	4.5	5.3	4.2	3.4	2.9	2.2	–3.1
Syria	1978	WFS		8.6	4.3	3.2			–5.4
Syria	1993	Papchild	4.2	5.3	4.2	3.8	3.1	2.6	–2.7
Tunisia	1978	WFS	6.5	7.3	5.9	6.0	3.9		–3.4
Tunisia	1988	DHS	4.4	5.1	4.7	3.7	2.8	2.6	–2.5
Tunisia	1996	Papchild	3.1	4.0		2.9	2.6	2.3	–1.7
UAE	1987	Gulf	5.9	8.1		4.6			–3.5
UAE	1995	Gulf	4.8						
Yemen	1979	WFS	8.5	8.6	5.4				–3.2
Yemen	1991/92	Papchild	7.6	8.1	5.7		3.5	NA	NA
West Bank & Gaza Strip	1995	PCBS	6.2	6.6			5.6	4.7	–1.5

Second, the educational composition of most Arab countries is changing rapidly. Many MENA countries have taken great strides to increase the enrolment of pupils in the education systems, especially of female students. This is very clear for instance in Libya, Tunisia,

Morocco, Bahrain, Kuwait, and Saudi Arabia. This increase in enrolment levels will have a significant compositional effect, increasing the relative weight of the more educated in the total population. This phenomenon, together with the large educational fertility differentials mentioned above, has already contributed to the notable decline of fertility observed this decade in most Arab countries and will continue to do so.

This calls for an explicit consideration of education when doing population projections in the MENA region, and that is the gap that this research will be addressing.

Population projections by education for most MENA countries are highly feasible. IIASA has developed a multi-state population projection method that allows dividing the population to be projected into any number of educational groups. Further, the required input data (population by age, sex and education, enrolment levels, fertility differentials by education) are available across most countries.

Considering the importance of education in the context of social and economic development, its impact on demographic processes, and the feasibility of prospective analysis, it is indeed surprising that educational population projections have not been produced more frequently. Most educational statistics, produced by national statistical institutes or international organisations such as UNESCO, stop at enrolment levels. Enrolment ratios can hardly be seen as an end in themselves. "What counts is the educational composition of the total population, and there is a long time lag between increasing enrolment among children and seeing the total composition change" (Lutz *et al*., 1998).

Educational population projections provide an excellent tool to show the long-term benefits of investments in education. "Especially in times of structural adjustment programs that often tend to curtail educational investments because they show no payoff in the short run, the demonstration of the longer-term benefits, or costs in the case of declining enrolment, should get high political priority" (Lutz *et al.*, 1998).

The projections could also be a useful tool for development planners as they offer a clear picture of the available human capital by age, by sex, and by education.

Literature review

Studies have been pointing to education as an important factor of heterogeneity in fertility within populations. Education has been very present in demographic research in addressing two separate sets of issues. The first one is that differentials by education attainment may indicate the considerations that underlay fertility decisions, and second that the interpretation of differentials according to education attainment over time is central to the study of fertility change (Singh *et al*., 1985). The education-fertility relationship is very relevant because the education level of a society can be directly influenced by government policy. This means the State has the potential to play a key role in the demographic transition.

The theme of fertility-education linkages has been constantly present in the demographic literature and especially after the first round of World Fertility Surveys (WFS) that shed light on the causal linkages between education and fertility in a large number of developing countries and across a wide range of societies. A new round of data from the Demographic and Health Surveys (DHS) conducted in the late 1980s and 1990s, 10–15 years after the WFS, gave us the opportunity to re-examine and deepen our knowledge on the education-fertility relationship from a cross-national perspective and with the possibility to analyze time series in

countries that experienced both WFS and several rounds of DHS. The availability of data in Arab countries was enlarged by the implementation of several other surveys: the Pan Arab Project for Child Development (PAPCHILD), the Gulf Child Health Survey (GCHS), and the Gulf Family Health Survey (GFHS).

These studies gave evidence that countries where women are better educated have in general lower fertility levels than countries where women are poorly educated. The most striking proof of female education acting as a major source of fertility differentials is a comparison of fertility levels among education groups of women. For example, when comparing, in Table 1, the fertility of women located at the upper end of the education continuum (women with at least 10 years of schooling), with that of women at the lower end of the continuum (women with no education at all or 1–3 years of education), the fertility of women in the former group is always lower.

Jejeebhoy (1995) shows that fertility differentials between the upper and lower education groups tend to cluster regionally, with linkages to the level of socioeconomic development, the stage of the demographic transition, the stage in the level of mass education in the country and the cultural setting. The narrowest fertility gaps are mostly observed in countries quite advanced in the process of development and in the demographic transition towards low mortality and fertility levels. The largest differentials are found in settings of medium development that are positioned halfway through the process of demographic transition, such as most Latin American countries. The difference between the fertility of women with the highest and lowest levels of education considered is more than four children in Brazil, Guatemala, and Mexico. The countries which are at the earliest stage of the demographic transition exhibit lower fertility differentials; such is the case of most sub-Saharan African and Arab countries with on average a difference of 2-3 children between the levels of education.

The strength of the relationship was called into question in a number of cases – for instance, see Jain (1981). If the relationship is clear between the fertility of women with the highest and lowest levels of education, it is not always the case at the lower spectrum of education levels. Sometimes the fertility differentials between women with no education at all, 1–3 years, and 4–6 years are very small: they are less than one year in most sub-Saharan African countries. And sometimes, the relationship appears to be negative, meaning that women with some education have more children in fact than women with no education at all. Cochrane reported in 1979, before most results of the WFS were published, that in countries with the lowest level of female literacy, education initially increases the ability to have live births, probably through improved health, better nutrition and the abandoning of traditional patterns of lactation and postpartum abstinence. Initially, this effect seems to be strong enough to counteract the effect of education on the postponement of marriage (Cochrane, 1979; see also Kenny, 1991).

Of the 59 studies reported in Jejeebhoy (1995), “fewer than half (26) find a straight inverse relationship between education and fertility; 13 studies find that women with a small amount of education bear more children than do either uneducated or more educated women; 13 studies find that uneducated women and those with a small amount of education have the same number of children, and women with more education have fewer; 7 studies find a positive or no-relationship between women’s education and fertility.” The countries in which there is either no or a positive relationship were almost exclusively in sub-Saharan Africa. A number of the sub-Saharan African studies used by Jejeebhoy were quite outdated. Newer

evidence from 14 Demographic and Health Surveys (Muhuri *et al*., 1994) finds only four cases of a positive association between fertility and a small amount of education.

Although there are many questions about the causality of the link between women's education and fertility or the cost effectiveness of education to reduce fertility (Cochrane, 1988), the strong negative relationship between women's schooling and education has been shown convincingly through many scientific studies (Cochrane, 1983; Cleland and Rodriguez, 1988; Schultz, 1994; United Nations, 1995). For instance, a multivariate analysis to assess the net effect of education on fertility shows that the relationship between women's education and cumulative fertility remains statistically significant in Egypt, Morocco, and Tunisia after controlling for demographic (marital duration, age at marriage, and parity) and socioeconomic (husband's education, rural/urban residence) factors (United Nations, 1995).

Knodel and Jones (1996) summarize what is important about the relationship between educational progress and fertility decline: "the effect on parental fertility of mass schooling, the expectations it creates about children's costs and benefits, and the impact it has on quality/quantity tradeoffs in the course of parents' reproductive decisions (see also Caldwell, 1980; Axinn, 1993; Amin, Diamond, and Steele 1996).

There are three main models that may be used to explain the special relationship between education and fertility. These are discussed below. Although they differ on the analysis of the factors through which education will affect the population in their choice of a certain pattern of fertility behavior, all theories agree on the point that education has a major role to play in fertility decline.

(1) Davis and Blake (1956) analyzed the biological and behavioral dimensions of human fertility. They linked the two dimensions through a set of proximate determinants or intermediate fertility variables. These proximate determinants have a direct influence on fertility. Socioeconomic factors and health and nutrition influence the proximate determinants. Education was found to influence fertility and its proximate determinants: marriage, contraception, and induced abortion. The framework was further used and modified by Bongaarts (1978) and Bongaarts and Potter (1983).

(2) The approach by Easterlin (1983) and Easterlin and Crimmins (1985) is a further evolution of the work done by Bongaarts and Davis and Blake on proximate determinants analysis. In the Easterlin and Crimmins framework, the number of children is the balance between the demand for children – family size desires if fertility regulation were costless – and supply of children – the number of children surviving to adulthood a couple could have if they make no deliberate attempt to limit their family size. In a pre-modern or early modern situation there is no motivation to limit fertility because the number of surviving children is below the demand for children. With the progress of modernization, the supply increases due to increased natural fertility and improved child survival, and results in the spread of deliberate fertility control whose cost declines as knowledge of contraceptive methods expands. Education is recognized by the two authors to be the most pervasive factor influencing fertility control behavior. In contrast to other factors (innovations in public health and medical care, urbanization, and the introduction of new goods), education operates on all three of the intervening variables, in the following way:

(a) On the supply of children: education delays age at marriage; breaks down traditional beliefs (e.g., post-partum abstinence during lactation) and customs (e.g., long duration of breast-feeding) that had the effect of limiting fertility or increasing spacing

between births; it improves health conditions by diffusing improved knowledge which lowers child and maternal mortality. Education leads to higher standards of child care, with more emphasis on quality than quantity.

(b) On the demand for children: education shifts tastes in a way unfavorable to many children and decreases the price of goods relative to children; it improves the income earning possibilities of women and thus increases the opportunity cost of the mother's childrearing time; it increases the relative cost of children by reducing the possible contribution of child labor to family income; it decreases the intensity of the desire for children (associated with "old good") relative to goods (new life styles put forward by education); it decreases the preference for sons over daughters.

(c) On the costs and obstacles to contraceptive use: education lowers time costs with information on various means of fertility control; it alters cultural norms opposed to the use of fertility control; it increases spousal communication.

(3) The work of Caldwell on "wealth flows" stresses factors affecting the demand for children (1980, 1982). He argues that fertility decline began when there was a reversal of the net flow of resources between parents and children, such that the net flow was from parents toward children rather than from children to parents. Caldwell distinguishes between the primitive, traditional society, and the transitional society. In the primitive society, the largest organizational institution is the tribe, the clan, or the village. The minimization of risks is more important than the search for profit. In such a system, high fertility is very rational so as to increase the size of the security system. Extra children do not have an immediate impoverishing effect: under-use of resources is common in primitive societies and moreover, children work and the patriarch of the family benefits economically and socially from a large number of children. Adult children assist their parents through their old age. In a transitional society, the attitudes toward children change mainly through the import of Western culture through two main vehicles: mass education and the mass media. The presence of mass education in a country will increase the impact of education on lowering fertility rates. In those countries, a small amount of education will be associated with a decline in fertility. The introduction of mass education is just a sign of a changing society moving towards modernity in the Western sense of the word (industrial, urban, monetarized economy with lower community childbearing norms).

The literature that was reviewed in this section emphasizes the particular relation education has with fertility. However, education is more than a fertility deflator. It plays a crucial role in individuals' well-being and social progress (United Nations, 1995b). Moreover, measures of the educational attainment of populations have been important explanations of growth success. Recent studies indicate that education matters over and above its effect as an additional input to production; at the country and firm level, it is associated with higher total factor productivity, that is, with higher product with given inputs (Birdsall, 1994).

Considering the overall importance of education, it seems amazing that it was not taken more into consideration in population projection work. When relating the education topic to that of population projections, there are two ways to proceed: implicitly or explicitly consider education in the definition of fertility and mortality assumptions. Both ways are certainly "correct". Most projection work includes education implicitly. The United Nations, for instance, defines its target fertility period – the period at which the assumed fertility decline will pause – "... by taking into account a range of socioeconomic factors, such as population policies and programmes, adult literacy, school enrolment levels..." (United Nations, 1995c).

Goujon and Wils (1996) showed that the momentum and non-linearity of education diffusion have significant implications for the way that we think about the future of population growth, status of women, and labor force skills. In particular, the practically linear declines of fertility such as those assumed in most of the United Nations and World Bank population projections are shown to be unlikely because of the non-linear changes in the level of education. This is particularly important in the Arab world as the region is in a period of transition to lower fertility and higher levels of education, especially for the female population, after a long period of high population growth (see also Lutz *et al.*, 1998).

Illustrative Examples[1]

The potential impact of education on population growth and composition in Arab countries will be shown through educational population projections of two countries: Egypt and Lebanon. The two countries are very different. Before the 15-year civil war Lebanon was enjoying a privileged status in the region in terms of economic development, demographic transition, women's status and education. Most indicators today are still below their 1970 levels – for instance, total proportion enrolled in school -- but the catching up is almost complete. Nevertheless, Lebanon is again better off than its neighbours in the region. Egypt is in a period of rapid demographic transition. Fertility has declined steadily from over 5.0 births per woman in the early 1980s to 3.6 births in 1995. In comparison with Lebanon, women have often limited control over important aspects of their lives such as family planning, access to education, financial autonomy, etc. The hypothesis according to which education would modify/accelerate the demographic transition will be tested with a scenario approach. The scenarios are made primarily to assess the effects, lags, and momentum of past and hypothetical future educational policies on the educational levels of adults, on fertility, and population size. Projections based on multiple educational states are compared to those based only on age and sex structure.

The populations of Egypt and Lebanon are projected from 1995 to 2050 following two groups of scenarios. In the first group, all rates are kept constant at 1995 levels. The projections are calculated separately as a single-state (all educational groups together) and a multi-state model. The second group of scenarios follows the 1998 United Nations medium variant assumptions for fertility and mortality for both countries and assumes some improvements in the enrollment ratios. Again the calculations are performed alternatively as single-state and multi-state projections. In the multi-state projections, the education-specific fertility rates were assumed to decline at the same rate as the aggregate total fertility rate (TFR) according to the UN medium variant. The assumption that fertility would decline in the same proportion in all education categories is very unlikely, but this hypothesis was made to show the effect of the fertility declines by education categories on the overall fertility level for the country. The 1998 UN medium variant assumes that fertility would reach the replacement level (TFR = 2.1) early in the 21st century and remain constant after that until the end of the projection period. It declines from 3.4 in 1995-2000 to 2.1 in 2010-15 in Egypt, and from 2.6 to 2.1 in 2005-10 in Lebanon. Life expectancies at birth are assumed to increase to 76 years for males and 80 years for females in 2050 in Egypt, and 76 and 81 years respectively in Lebanon.

Results for Egypt are given in Table 2 and for Lebanon in Table 3[2]. The figures show that the transition from single-state to multi-state makes more difference for Egypt than for Lebanon

[1] This section partly reproduces the work of Lutz *et al.* (1998) which also included Sudan and Tunisia.

[2] The data in Table 2 and 3 do not fully correspond to the UN projections because of different interpolation procedures applied for fertility and mortality.

in terms of total population. For Egypt, there is a drop of 3.4 percent under constant rates and 6.9 percent under UN assumptions whereas for Lebanon the difference is less marked (higher by 1.8 percent under constant rates, and lower by 4.4 percent under UN assumptions). The case of Lebanon shows that within the constant scenario groups, the total population is higher under the multi-state model than under the single-state model. This is an unusual case as progressing educational improvements change the composition of the population in a way that the higher educational groups that have lower fertility make up increasing proportions of the total population. This is clearly seen in terms of the aggregate total fertility rates for 2050 given in the lower parts of the tables which are consistently lower for the multi-state models, even in the case of Lebanon (see also Lutz *et al*., 1998).

In more detail, the results for Egypt (Table 2 and Figure 1) show that its population, estimated at 62 million in 1995, is likely to be multiplied by a factor of 1.7 or 1.8 by the middle of the next century. Under the purely hypothetical assumption of constant fertility and mortality rates it would be 2.4-2.5 times higher. But the point here is not the projection of population size but the difference between the single-state model that disregards educational heterogeneity and the multi-state model that accounts for it. As noted above the difference between the two models is smaller in the case of constant rates. Even under the assumption of constant enrollment rates the proportion with low schooling will decrease from 50 percent to only 27 percent. Simultaneously the proportion with medium, high, and advanced education will increase from 50 percent to 73 percent. These significant compositional effects together with strong educational fertility differentials are expected to result in sizable differences between the results of the single-state and the multi-state models. And indeed, the constant-rates scenario results in 151 million if this compositional effect is accounted for in the multi-state model, and 156 million (3.5 percent higher) if it is not accounted for. In the case of UN fertility and mortality assumptions together with increasing enrollment, the proportion with low schooling would decline to below 10 percent; that with medium and high education would increase to 51 percent. Under this scenario the difference between the two models (single- and multi-state) is higher (7.4 percent). Under conditions of recent educational efforts that are reflected in strong age differentials in educational attainment and strong educational fertility differentials, the explicit consideration of education in population projections does have a significant impact even on purely demographic output parameters such as total population size.

In the case of Lebanon (Table 3 and Figure 2), the picture is quite different. The proportion illiterate in Lebanon will decrease from 14 percent to 2 percent by 2050 in the constant-rate scenario. At the same time, the weights of the other three educational categories in the population will remain very close to their 1995 levels because there is very little improvement embedded in the current educational composition by age due to an already very long history of educational improvements in the past. Lebanon was always at the forefront of the educational improvements in the region. Therefore the difference between the single- and multi-state projections is not so great, but the former exceeds the latter by 4.6 percent under UN assumptions for fertility and mortality.

The projections substantively indicate that one cannot expect an immediate pay-off on investments in education. The models clearly demonstrate, however, that investments will significantly impact the educational attainment of the adult population in the future. The multi-state scenarios implementing increases in the levels of educational enrollment show that by 2050 these efforts have not fully reached the entire population over 15 years of age. In addition to the social and economic benefits of better education, this is very likely to have a sizable impact on fertility trends in the future, possibly even causing non-linearities in the

decline (which are not captured by the usual interpolations of aggregate TFRs) when highly educated cohorts enter the prime childbearing ages (see Goujon and Wils, 1996).

Table 2. Egypt, 1995-2050, assumptions and results of single- and multi-state models for two scenarios: constant fertility and mortality rates, and United Nations medium fertility and mortality assumptions.

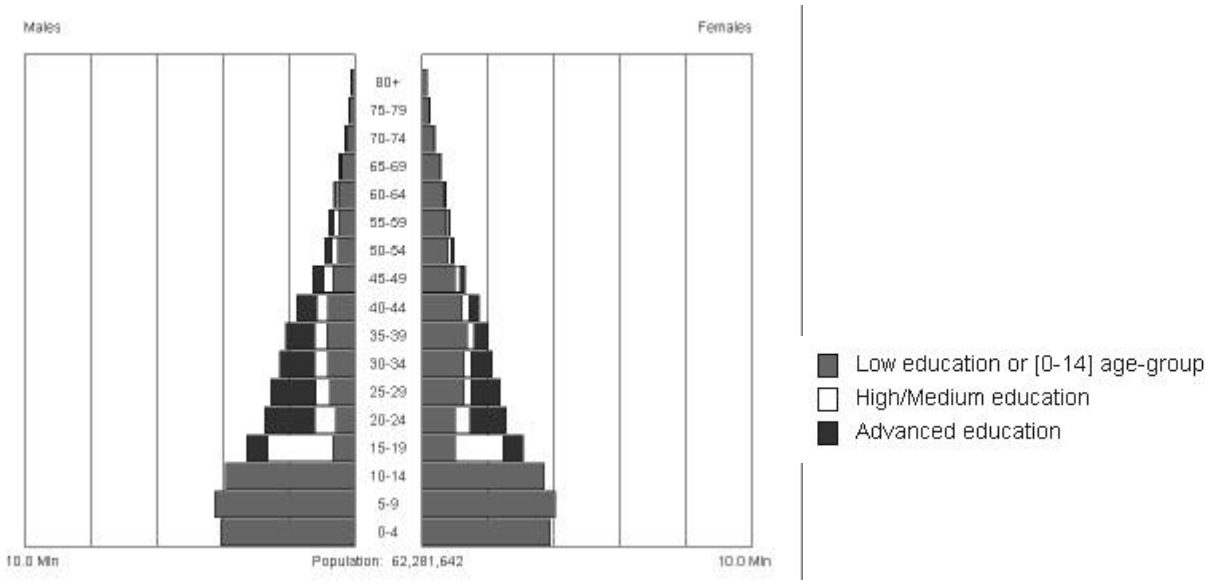
		1995	**2050**			
			Constant rates		UN fertility and mortality rates	
			Single-state	Multi-state	Single-state	Multi-state
Results						
Total Population (in millions)		**62.3**	**156.3**	**151.0**	**111.8**	**104.1**
Proportion 15+ by level of education (in %)						
Low education		49.6		27.1		9.3
Medium/High education		20.8		27.3		50.8
Advanced education		29.6		45.6		39.9
Assumptions						
Overall total fertility rate *and by level of education:*		**3.4**	**3.4**	**3.24**	**2.10**	**1.80**
Low education		4.0		4.0		2.5
Medium/High education		3.0		3.0		1.9
Advanced education		2.8		2.8		1.7
Life expectancy at birth						
(in years)	Male	62.4	62.4	62.4	75.6	75.6
	Female	65.6	65.6	65.6	80.1	80.1
School enrollment transitions (in %)						
to medium/high	Male	79		79		100
	Female	67		67		100
to advanced	Male	16		16		16
	Female	13		13		16

Table 3. Lebanon, 1995-2050, assumptions and results of single- and multi-state models for two scenarios: constant fertility and mortality rates, and United Nations Medium fertility and mortality assumptions.

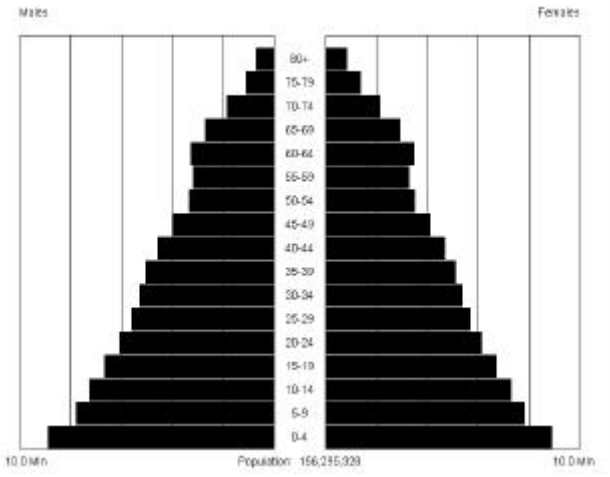
	1995	**2050**			
		Constant rates		UN fertility and mortality rates	
		Single-state	Multi-state	Single-state	Multi-state
Results					
Total Population (in thousands)	**3,009**	**5,981**	**6,088**	**5,134**	**4,907**
Proportion 15+ by level of education (in %)					
Illiterate	13.8		2.4		1.1
Read & Write, Elementary	36.5		38.0		20.1
Middle and High School	40.8		47.6		65.8
Undergraduate and Graduate	8.9		12.0		12.9
Assumptions					
Overall total fertility rate	**2.69**	**2.69**	**2.67**	**2.1**	**1.85**
and by level of education:					
Illiterate	3.94		3.94		3.08
Read & Write, Elementary	3.60		3.60		2.81
Middle and High School	2.33		2.33		1.82
Undergraduate and Graduate	1.20		1.20		0.94
Life expectancy at birth					
(in years) Male	66.6	66.6	66.6	76.1	76.1
Female	70.5	70.5	70.5	80.6	80.6
School enrollment transitions (in %)					
to read & write, elementary					
Male	96		96		100
Female	96		96		100
to middle and high school					
Male	40		40		77
Female	47		47		79
to under- & graduate studies					
Male	6		6		12
Female	7		7		13

Figure 1. Egypt, 1995-2050, results of single- and multi-state models for two scenarios: constant fertility and mortality rates, and United Nations Medium fertility and mortality assumptions.

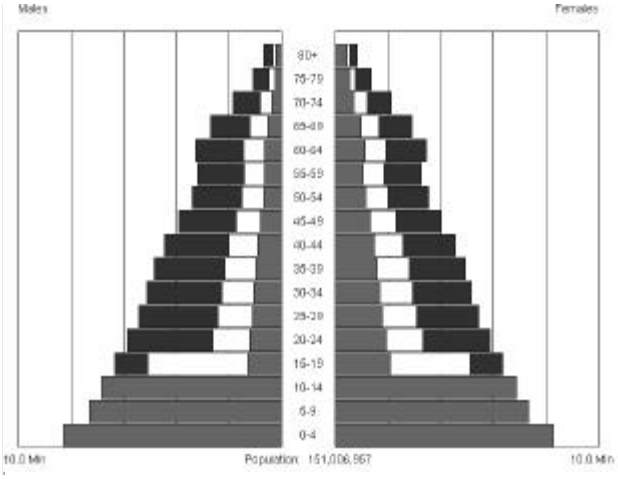
Base year population: 1995



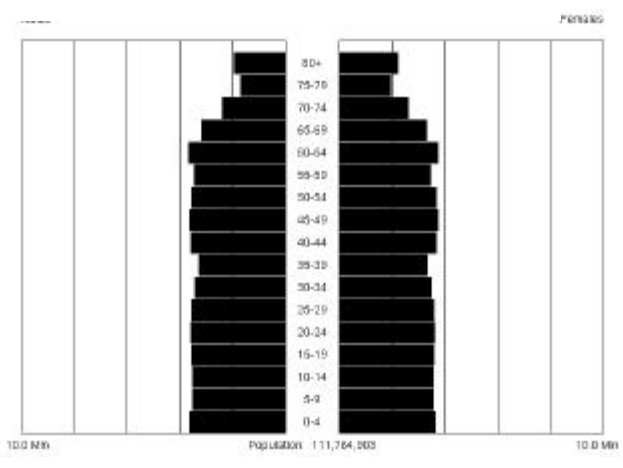
2050: Constant, single state



2050: Constant, multi-state



2050:UN,single state



2050: UN, multi-state

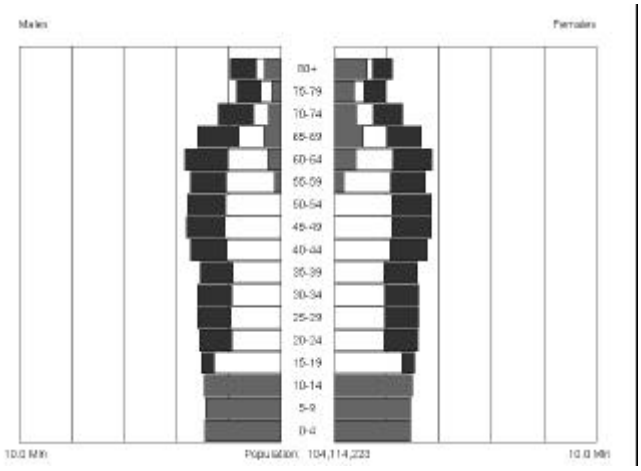
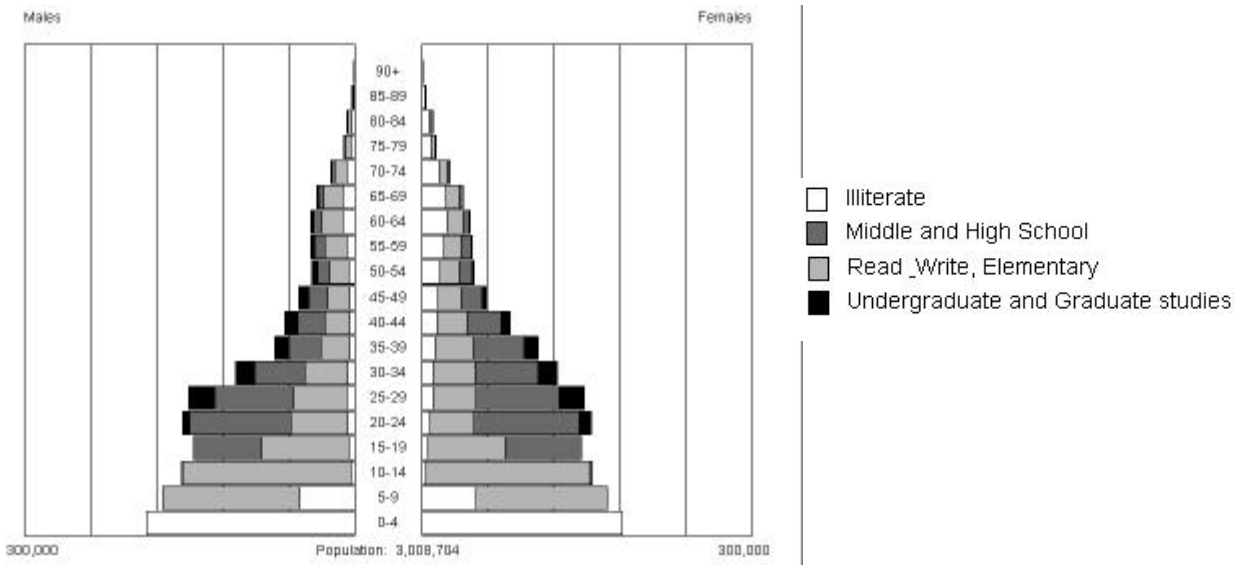
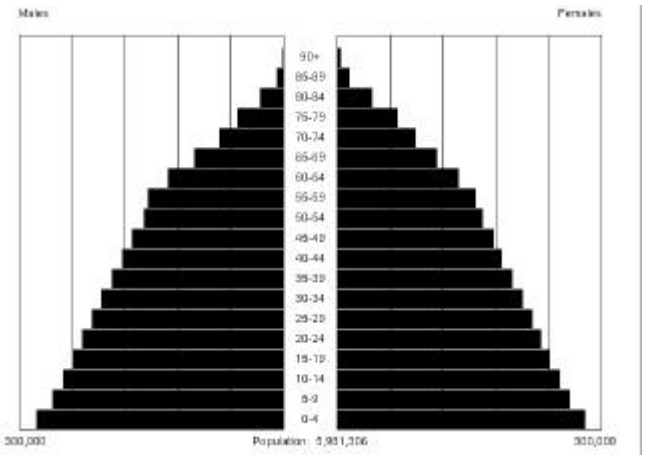


Figure 2. Lebanon, 1995-2050, results of single- and multi-state models for two scenarios: constant fertility and mortality rates, and United Nations Medium fertility and mortality assumptions.

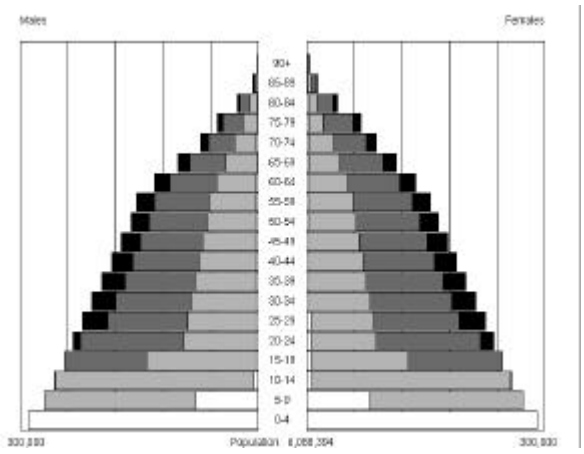
Base year population: 1995



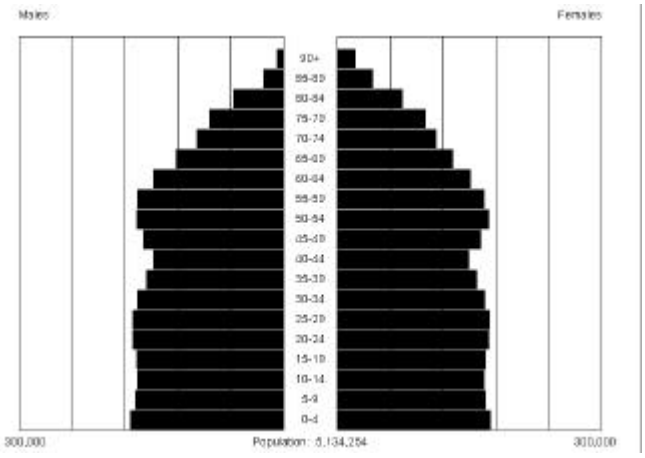
2050: constant, single state



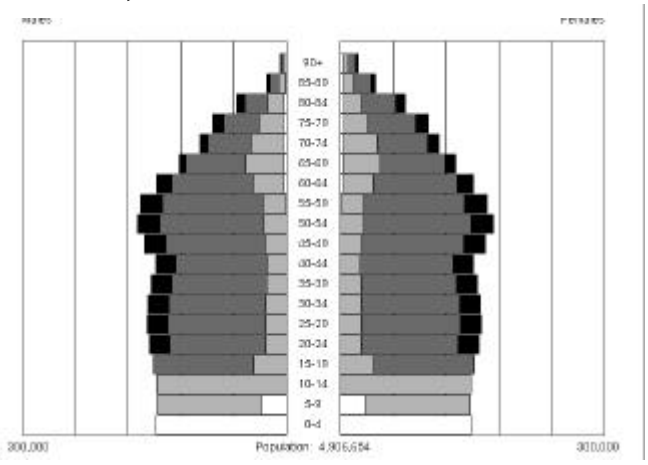
2050: constant, multi-state



2050: UN, single state



2050: UN, multi-state



Conclusion

Education policies and future levels of school enrolment will be decisive in shaping future population composition and growth. This is especially true in the Middle East and North African region where the educational fertility differentials are very strong and substantial changes are presently occurring or can be expected to occur in the educational composition of the populations. Increased efforts towards achieving higher levels of school enrolment in the Arab region may induce fertility rates to decline faster than expected.

Moreover, the analysis of the output of multi-educational state population projections could provide insights into the combined effect of population and education momentum implications in terms of population growth, aging, and levels of educational attainment of the population in the future in the case of several realistic scenarios.

Appendix: Methodology

The projections are generated using the PDE Population Projections software. This software has been developed by IIASA's Population Project to be used as a cohort component population projection module in multi-sector Population–Development–Environment (PDE) analysis. This tool can also be used independently of PDE analysis for simple and multi-state population projections in cases of several states that interact with each other. The multi-state population projection method allows the division of the population to be projected into any number of "states", which have traditionally been geographic regions (Rogers, 1975) but could as well be educational categories. Actually, as pointed out by Lutz *et al.* (1998), "the demographic method of cohort-component projection is most appropriate to educational projections because education is typically acquired in childhood and youth and then changes the educational composition of the population along cohort lines". The software has proven reliable; it was used during the study of population in Mauritius (Lutz, 1994), in Cape Verde (Wils, 1996), and of population and education trends of North Africa countries (Yousif et al., 1996) and in Jordan, Lebanon, Syria, the West Bank and the Gaza Strip (Goujon, 1997).

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