Fertility Transition in the Middle East and North Africa: What Coale's indices tell us?

Hani Guend, MS, MPHS, Ph.D.

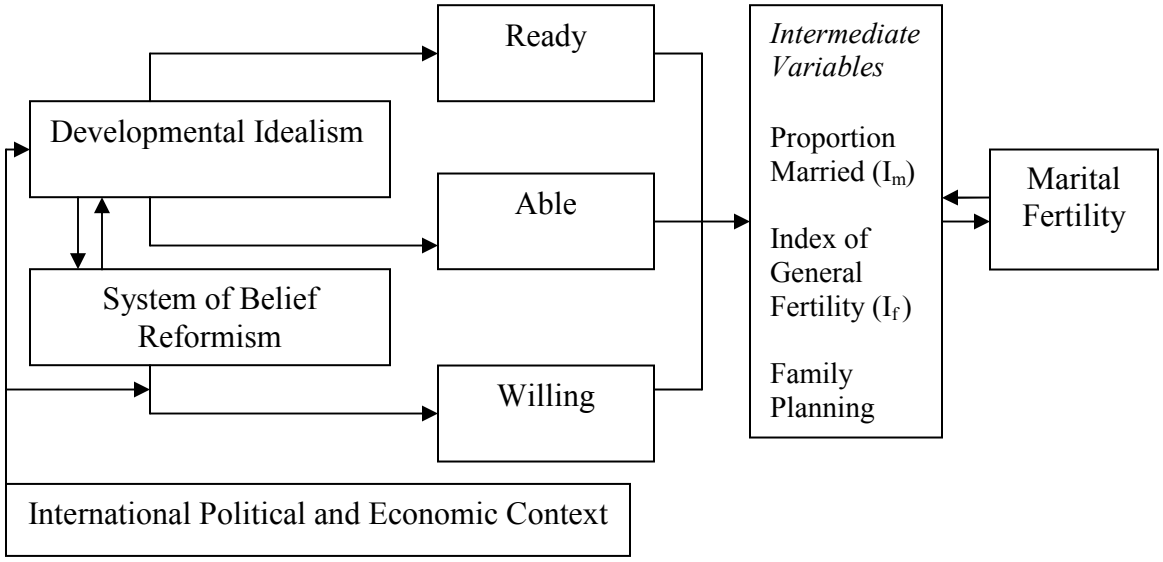
INRS – Urbanisation, Culture et Société
3465 rue Durocher
Montréal (Québec) H2X 2C6 Canada

This study examines fertility of Muslim populations to contribute a building bloc to fertility transition theory. Change in peoples' worldviews is hypothesized as a trigger of processes behind driving the fertility transition in these societies. Developmental Idealism (DI) (Thornton 2002) and System of Belief Reformism (SBR) are the components that fuel this process. Figure 1 provides a reference map for the universe of investigation and Figure 2 illustrates the hypothetical causal paths to change in reproductive behavior.

Figure 1
Muslim Population Distribution Reference Map

Source: http://www.lib.utexas.edu/maps/world_maps/muslim_distribution.jpg

Figure 2
Causal Path of the Effects of Developmental Idealism and Islamic Reformism on Marital Fertility



This paper presents cluster analyses using aggregate fertility, socioeconomic, and policy indices with countries as units of analysis. The aim is to uncover the internal structure of the data that might support pre-constructed ideal types by reference to the concepts of DI and SBR. These Ideal Types are discussed at length elsewhere (Guend 2004). First I discuss the sample's composition and present the data. Second, I define patterns of fertility decline using level of general fertility, pace of the decline, and major contributors to the decline. The first contributor is nuptiality measured by the index of proportion married and its rate of change. The second contributor is FP measured by the percent of current users of contraception. Third, I present the results of multivariate cluster analysis which links together the fertility indices and quantitative as well as qualitative explanatory variables.

1. Data and Methods

The Sample A subset of 26 countries is selected among the 57 countries members of the OIC which constitutes the initial universe of investigation on the basis of two criteria. A country is selected into the sample if at least 55 percent of its population is identified in the general literature as Muslim, and census and vital statistics data available allow the calculation of

Coale's index of general fertility (I_f) at least at two points in time. The second criterion enables us to estimate the average annual percent decline in this index, which characterizes the pace of fertility decline. The first criterion of selection actually contributes to the homogenization of the universe of analysis. It looks like some countries maintain membership in the OIC for political reasons that have little to do with the religious culture of their populations. However the availability of information on DI and even on fertility is itself a function of how deeply ingrained the process may be. Therefore it is important at the outset to examine the cases that are left out because of data availability. It is the case for 14 countries. Some of them lack data probably for reasons related to institutional instability as it is the case of Afghanistan, Iraq, Kazakhstan, Lebanon, Palestine, and Sudan. None of these countries is totally alien to DI, neither are their respective institutional instabilities totally unrelated to the way DI inspired policies were implemented. For others, namely Djibouti, The Gambia, Mauritania, Niger, Oman, Saudi Arabia, Senegal, and the United Arab Emirates, the reason might well be related to the lack of a developmental legacy. Some of these countries have characteristics that are uniquely relevant to the main thesis of this work. To highlight this fact I take more space to examine three cases: Oman, Saudi Arabia, and Senegal. The population of each country is almost 100% Muslim and the religious culture of each one represents a brand of classical Islam almost in its pure form. This quick review shall give a sense of what we are missing from the empirical analysis.

I discuss elsewhere (Guend 2004) two key concepts in this study: The Turkish paradigm which refers to the brand of developmental policies put forward by the founder of modern Turkey beginning in the second decade of the XXth century. As such, the Turkish paradigm is a variant of DI. The Sufi Ethos refers to the common cultural background shared by Muslim societies before the avent of DI and SBR. Along with the two branches of Islam, *Sunni* and *Shii*, which emerged historically after the battle of *Siffin*, a minority branch, the *Kharejites*, constituted around the rejection of the Caliphate in the form that was acceptable to the mainstream community. Their political ideology put little emphasis on government and gave much importance to the

communitarian life. This ideology evolved into a social system that is strikingly rigorous in enforcing the code of conduct of their school of thought and jurisprudence. A salient aspect that is most relevant to reproductive behavior is the strict enforcement of women's seclusion, and the strict control of the community over family life. In such a social context one expect marriage to be early and universal, divorce the exception, and fertility natural. This social system survived over the centuries in a minority status. Nowadays, communities of *Ibadites* can be found in Algeria, Tunisia, and Yemen. However the Sultanate of Oman is the only country where *Ibadism* as a religious culture is dominant (about 70 percent of total population) and naturally constitutes the governing principal of the Sultanate. The interaction with DI is likely to be very slow, Islamic reformism in its known expression in Egypt, Turkey, Tunisia, or Algeria remains alien to the Omani society as well. Since the early 1970s however, the new Sultan engaged in an extensive modernization program, has opened the country to the outside world, and has preserved a long-standing political and military relationship with the UK (The World Factbook). The demographic implications of this opening to modernization program are yet to be seen.

Libya under the *Senoussi* dynasty is an illustrative example for the Sufi Ethos as the governing principal socially and politically. Similarly, one might think of Saudi Arabia as an example, or even a unique case, that embodies the expression of the nemesis of the Sufi Ethos. Cragg (2000) describes the strong development of Sufism in classical times as a protest against the increasing formalism of Muslim theology. *Wahabism* which constitutes the official doctrine of the Saudi monarchy emerged as a reformist movement in its strictly formal meaning. That is bringing a change to an established social system through social and political activism, and occasionally military action. Wahabism shares with the Ulema modernists the common paradigm which refers to the early Muslim community as the model to be emulated. However, it does not share a characteristic more important to our purpose here. That is the reformation of the system of beliefs which questions the tenets of the classical theology. Therefore re-opening the door to innovation and ultimately facilitating the impact of DI. *Wahabism* revived the formalism of

classical Muslim theology in one of its most rigorous expressions through the writings of Ibn Taymiyya[1]. In this sense *Wahabism* differs little from *Ibadism*. The expected implications for reproductive behavior are the same. One important distinction is worth mentioning however. While *Ibadism* keeps alive a secular religious heritage and maintains its legacy mainly through the momentum of tradition, *Wahabism* took the form of an active ideology in modern times. It is in a sense a counter-offensive of the formalist classical theology against the hegemony of Sufism. It is the nemesis of the Turkish Paradigm in its practical - one might say political - dimension and the nemesis of the Sufi Ethos in its intellectual and spiritual content.

Senegal is not as a unique case as Oman or Saudi Arabia, however it is an interesting case that would have brought interesting contrasts to the analysis. Perhaps more than any country discussed in this work Senegal is where the Sufi Ethos is still alive and thrives. Neither the colonial encounter nor Islamic reformism disturbed substantially the features of the traditional cultural expression. Moreover, it might well be that the French colonial policy towards the "friendly" Sufi orders have had a protective effect which benefited the Sufi institutions as been the case in colonial Algeria. And the model still holds in independent Senegal to the benefit of a harmonious co-existence of the Sufi orders with the French educated political establishment. The case of Mali is similar to Senegal and it is included in the empirical analysis that follows. Noteworthy is the fact that Saudi Arabia is one of the few Muslim countries which have no experience with the

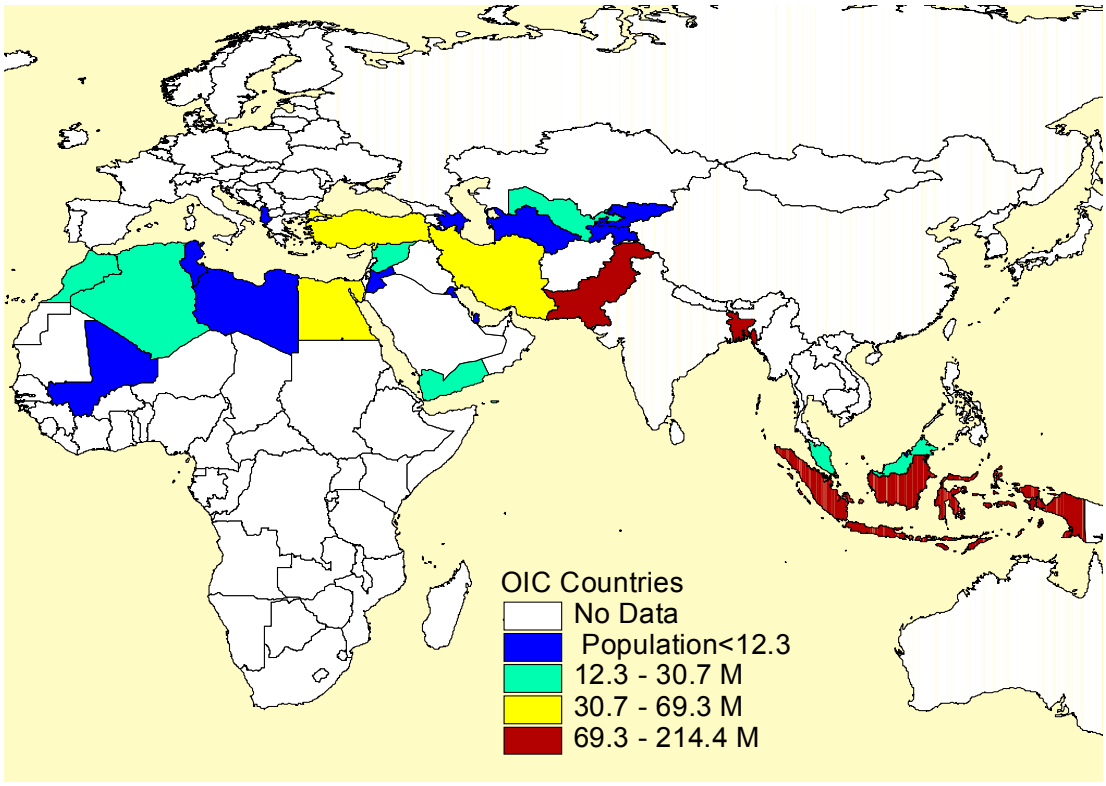
[1] Ahmad Ibn Taymiyya (1263–1328) Muslim theologian and jurist. He lived in Damascus after the collapse of the central caliphate to the Mongol invasion from the East, and during the continuous threat of Christendom from the North and West. Influenced by Ibn Hanbal, he was unyielding in his political and religious positions, and was frequently persecuted and imprisoned. A prolific writer, Ibn Taymiyya advocated a doctrine of conservative reformism, stressing the need for communal solidarity. He remains one of the lasting influences on contemporary political Islam, notably on Wahhabiya and Salafiyyah. Source: The Columbia Encyclopedia, Sixth Edition. 2001. (http://www.bartleby.com/65/ib/IbnTaymi.html)

colonial encounter, Oman once revolved in the orbit of imperial Great Britain, while Senegal experienced intense French colonization.

In the following, I characterize the major sub-regions into which the countries included in the sample can be divided. Besides the sub-Saharan African group which is not included here, Figure 3 reveals five major other human groupings. These five ethnic-linguistic groups are populations of Indian decent which constitute about 31 percent of the sample and are distributed between Pakistan and Bangladesh to which one can add Muslims of India. Populations of Asian stock constitute a second group with 26 percent of the total population sampled. Three other distinct cultural blocs are the Persian, the Arabic, and the Turkic. Among the latter three, one country dominates each ethnic-linguistic bloc with a population of a little less than 70 million and the rest distributed among national entities that are mostly the product of the post WWII international order. Each one of these five ethnic-linguistic groups includes one demographically predominant country that is characterized with a long history of statehood if not a prolonged imperial past. Egypt predominates in the Arabic speaking countries and can be thought of as a microcosm of the Arab world with regard to its experience with DI, Islamic Reformism, and the Sufi Ethos. Much the same can be said about Turkey among the Turkic languages speaking peoples, and beyond. The distinguishing feature of Turkic area is the radical ways through which DI diffused over its inhabitants. That is either through Kemalist policies or in its socialist expression in the Muslim republics of central Asia during their experience under the former Soviet Union. Iran and Pakistan are at the heart of two separate ethnic-linguistic areas of influence with each representing a different flavor of Islamic tradition, and different contemporary expressions of national identity. Although Indonesia and the surrounding Muslim countries emerged as national entities amid a mosaic of ethnic-linguistic populations, it is remarkable that they evolved into a typical sub-culture within the realm of Islam. Its salient feature is a marriage between Islamic reformism and DI against the passing Sufi Ethos long legacy. It goes without saying that these ethnic-linguistic entities intersect. When their

intersections occur within a country on the fault line of cultural and ethnic frontiers the expectation is that they develop hybrid fertility regimes which necessitate more detailed analysis to explore. Countries such as Afghanistan or Azerbaijan are lively examples of such instances. The geographic coverage is also limited by the lack of appropriate data. I exclude from the analysis African countries south of the Sahara except for Mali which represents merely 1.34 percent of the total population of the sample. Nonetheless populations of African decent constitute a substantial part of the Islamic world and their fertility regime is relevant empirically and theoretically to the questions addressed in this study. Despite this truncation, within the framework of the Islamic ethos and behind the classification into ideal-types this study aims to uncover, lay a rich racial, ethnic, cultural, and linguistic diversity.

Figure 3
26-Country Sample Classified By Population Size



Data Empirical analyses in this chapter are based on a dataset I built from several sources. First, I collected census and vital statistics data mainly from the UN demographic

yearbooks spanning the period 1950 to 2000, and other secondary sources. I use these data to estimate Coale's comparative indices of total fertility (I_f), and of proportion married (I_m). I then estimate the overall, and average annual changes in these two indices. I also collected time series of Total Fertility Rate from secondary sources (mostly PRB and UN published literature) to estimate the most recent levels and paces of decline in the number of children per women.

Table 1
Fertility and Related Demographic Indicators for all 26 states

Country	TFR Ref. Year	TFR	I_f Ref. Year	I_f[1] Index of general fertility	I_f average annual change[2]	I_m Ref. Year	I_m[1] Index of proportion married	Im average annual change[2]	FP percent using family planning	Population in Millions 2003 Estimates
Azerbaijan	2000	1.9	1999	0.139	4.59	1989	0.634	.	55	8.2
Albania	2000	2.1	1989	0.254	4.53	1989	0.674	0.28	58	3.1
Tajikistan	2000	2.4	1993	0.361	4.91	1989	0.740	.	34	6.1
Iran	2000	2.5	1996	0.210	5.74	1986	0.752	.	74	67.2
Turkey	1998	2.6	2000	0.228	1.40	1990	0.701	0.52	64	69.3
Uzbekistan	2000	2.7	1999	0.238	3.61	1989	0.730	.	67	25.3
Algeria	2000	2.8	1998	0.255	1.97	1987	0.571	1.28	64	30.7
Indonesia	1997	2.8	1997	0.214	1.05	1997	0.701	0.31	57	214
Turkmenistan	2000	2.9	1995	0.277	4.61	1989	0.669	.	62	4.7
Brunei	1992	3.1	1992	0.258	2.40	1986	0.552	0.61	.	0.3
Tunisia	1995	3.2	1997	0.187	2.17	1984	0.562	1.37	60	9.6
Bahrain	1995	3.2	2000	0.208	2.09	1991	0.591	0.63	62	0.7
Malaysia	1994	3.3	2000	0.245	1.24	2000	0.572	0.56	55	23.5
Bangladesh	2000	3.3	1991	0.376	1.31	1991	0.851	0.20	54	141.0
Kyrgyzstan	1997	3.4	2000	0.204	3.69	1989	0.708	.	60	5.0
Morocco	1997	3.5	2000	0.173	0.59	1982	0.622	.	58	29.6
Egypt	2000	3.5	1996	0.299	1.44	1996	0.670	0.15	56	69.1
Qatar	1998	3.9	1986	0.382	-1.08	1986	0.696	0.54	43	0.6
Libya	1995	4.1	1991	0.524	1.60	1984	0.563	2.75	45	5.3
Kuwait	1999	4.2	1998	0.220	1.95	1996	0.580	0.88	52	2.4
Syria	1993	4.2	1994	0.366	2.41	1994	0.611	0.69	40	17.0
Jordan	1997	4.4	2000	0.281	2.57	1994	0.573	1.07	53	5.2
Pakistan	2001	5.5	1998	0.377	0.51	1976	0.784	0.47	28	146.0
Mali	1996	6.8	1987	0.552	-1.71	1987	0.814	0.14	8	12.3
Yemen	1997	7.6	.	.	.	.	.	.	21	18.7
Maldives	.	.	1995	0.318	4.66	1990	0.728	0.56	.	0.3

1. These estimates are calculated from the most recent data available
2. See Appendix I for the period of reference

Indices which measure quantitative and qualitative population attributes of each country were collected from a variety of sources. The selected indices are listed in Table 1 and Appendix

I. I generate dummy variables to characterize countries with regard to their overall developmental policies, Family Planning, Islamic Reformism, colonial experience, and ottoman rule (Appendix II). These variables are meant to categorize countries by reference to the pathways of diffusion of DI. Note that in the absence of primary sources of information about religion, the population figures for percent Muslim are extracted form recent published travel books and other popular literature.

Table 2
Indicators of Socioeconomic Development, Political and Religious Features for 26 States Around the year 2000

Country	Pct urban	Pct Muslim	Girl/Boy School Enroll. Ratio	FPPEI	NFDI .	HDI	ODA .	Women Vote Year	Colonial Legacy	GDP Per Capita
Azerbaijan	52	93	96	.	4.0	0.74	27.5	1921	Russia	3090
Albania	43	70	94	.	0	0.74	86.1	1920	None	3680
Tajikistan	28	90	90	.	2.0	0.68	25.9	1924	Russia	1170
Iran	65	99	91	44	-0.3	0.72	1.7	1963	Britain	6000
Turkey	66	99	89	37	0.5	0.73	2.4	1930	None	5890
Uzbekistan	37	88	96	.	0.6	0.73	6.1	1938	Russia	2460
Algeria	58	99	88	31	2.2	0.70	5.9	1962	France	6090
Indonesia	42	88	95	71	1.0	0.68	7.0	1945	Dutch	2940
Turkmenistan	45	89	.	.	2.5	0.75	15.2	1927	Russia	4320
Brunei	73	67	90	.	.	0.87	1.0	None	Britain	.
Tunisia	66	98	91	63	0.6	0.74	39.2	1957	France	6390
Bahrain	93	100	96	.	.	0.84	25.8	1973	Britain	16060
Malaysia	58	52	95	58	.	0.79	1.9	1957	Britain	8750
Bangladesh	26	83	96	52	0.2	0.50	7.3	1972	Britain	1610
Kyrgyzstan	34	75	95	.	0.3	0.73	37.7	1918	Russia	2750
Morocco	56	99	84	42	0.6	0.61	17.5	1963	France	3600
Egypt	43	94	89	48	1.7	0.65	18.2	1956	Britain	3520
Qatar	93	95	95	.	.	0.83	1.7	None	Britain	28132
Libya	88	97	97	.	.	0.78	1.9	1964	Italy	6453
Kuwait	96	85	96	.	.	0.82	1.5	None	Britain	18700
Syria	52	90	89	26	0.6	0.69	9.0	1949	France	3280
Jordan	79	92	95	22	0.9	0.74	83.3	1974	Britain	3870
Pakistan	33	97	55	41	0.6	0.50	17.5	1947	Britain	1890
Mali	31	90	71	24	2.6	0.34	83.2	1956	France	810
Yemen	25	90	60	17	-2.7	0.47	22.8	1967	Britain	790
Maldives	28	99	95	.	2.6	0.75	83.2	1932	Britain	2082

Source: UNDP 2003. Human Development Report, except third and tenth columns

*Variables' Selection*Some of the quantitative variables used in the cluster analyses are self-explanatory simple indicators but others are more synthetic indices whose meanings need

specification. With the theoretical guidelines in mind, I select indices which relate to the historical experiences, the contemporary developmental policies, and the country's achievements on specific aspects of its development for all countries included in the 26-country subset. In the benefit of parsimony, I use simple linear correlation between each of the quantitative variables in order to eliminate redundant information from the analysis. Appendix III reports the correlation matrix. Following is a short discussion of the meaning of these variables. I present in Appendix IV their mathematical expressions with further specification of their content. Fertility variables include Coale's standardized[2] comparative indices of proportion married (I_m) and of general fertility (I_f). They measure respectively the impact of nuptiality and natality on period fertility (Wunsch and Termote 1978). No use is made here of the comparative indices of marital and non-marital fertility since the numbers of non-marital births is very small among Muslim population. I calculate average annual changes in these two indices on the basis of the two endpoints of the series created and use them to measure the comparative fertility and nuptiality changes. I also use Total Fertility Rate (TFR) along with the comparative index of fertility (I_f) to measure the level of period fertility, and report the average annual change in I_f to provide a comparative measure of the pace of fertility decline. Appendix I also reports the average annual change in TFR. I include other general demographic variables in the analysis in combination with select socioeconomic indices in the analytical multivariate cluster analysis. Some of these variables are total population, percent urban, and percent of women in reproductive age who use contraception around 2000. The rest of the socioeconomic variables comes from United Nations sources and reflect the developmental perspective of the institution. Note that this fits particularly well our conceptual framework since DI constitutes the underlying perspective of the UN actions and policies (Thornton 2002). From the UNDP's (2003) *Human Development Report*, I select only few but complex social, economic, and political variables which carry meanings that can be derived from

[2] Ansley Coale has chosen as standard the age-specific marital fertility "rates" of Hutterite women, for the period 1921-1930. These rates are provided in most demographic analysis textbooks.

the key concepts of DI, and SBR. In particular, the meaningfulness of gender sensitive indices with regard to DI and SBR cannot be overstated in the social and cultural contexts we are concerned with. Therefore whenever possible, I give preference to gender specific indices over equivalent but non gender weighted indices. The Ratio of Girls to Boys in primary education enrollment is one example of gender weighted indices. I use it to capture the differential schooling between girls and boys which speaks to cultural patterns that have an explanatory power for fertility transition. There is an obvious relationship between this index and the statements of developmental idealism, more education is better and gender equality is a goal of development. It is also related to Islamic reformism which champions female's education as opposed to a social environment marked by the Sufi Ethos where women's education is not taken seriously to say the least. This index is highly correlated with the ratio of literate females to males at age 15-24 (r=.758) therefore I limit the use to the former only. The year women acquired the right to vote is used to classify countries on the basis of how early the social change triggered under the effect of DI and Islamic reformism translated into actual political action. Percent of the population enumerated as Muslims are also included in the analysis. A lower percent denotes often presence of other faiths, especially Christian faith since the latter is listed among the pathways of DI (Thornton 2002). Furthermore, historians credit Arab Christian intelligentsia with a primary role in the late 19th early 20th century modernist movement in the Arab Middle East. So is the intensity of the experience with European colonialism for which a proxy is provided by the length of the period under colonial rule when the country has a colonial legacy (Appendix II).

I also include complex socioeconomic indices which reflect the position of each country on a scale of actual developmental achievements. The most comprehensive of these indices is the Human Development Index (HDI). It is a summary measure of a country's average achievements at a specific time in three dimensions of human development: 1) a long and healthy life as measured by life expectancy at birth, 2) knowledge as measured by a weighted average of adult literacy rate, and the combined primary, secondary, and tertiary gross school enrollment ratio, and

3) a decent standard of living, as measured by GDP per capita (PPP US$) (UNDP 2003). Note that UNDP published Gender Development Index (GDI), a gender weighted version of HDI. It is calculated on the basis of separate indices for females and males weighted and combined together. However GDI and HDI are highly correlated (r=.9987), therefore I use only the latter for the sake of parsimony and because there are less missing data for HDI then for GDI. To capture the effects of two other pathways of diffusion of DI, foreign aid and international economic exchange, I include a measure of per capita Official Development Assistance (ODA) received in 2001 in US dollars and the Net Foreign Direct Investment Inflows (NFDI) as percent of GDP. Finally, a major pathway of diffusion of means of and ideas about birth control is the state sponsored family planning programs. It is measured by the Family Planning Policy Evaluation Index (FPPEI) that provides a country-specific appreciation of the official efforts made to promote family planning. A statement about the time reference of these indices is in order. Most indices refer to the end of the last decade while the reference year for the outcomes of interest is earlier than that. This discrepancy shall not be a problem since the indices do not measure a static attribute at a specific point in time. The indices are proxies to a process of development that took a long time. In a sense an HDI for 2000 for example contains the history of development during the previous decades. This is precisely what is hypothesized as determinant of fertility decline.

Family Planning movement is one of the most important pathways to diffusion of DI, when support of family planning is a national policy, the expected impact on reproductive behaviors is even more important than when Family Planning is the business of private associations such as NGOs, let alone when it is considered as a personal private matter. Family Planning Policy Evaluation Index (FPPEI) is a powerful index for classification of governments with regard to their adhesion to the ideals and operational goals of FP. I averaged the estimates of this index over the years 1972, 1982, 1989, and 1994, but did not include the estimate for 1999 although it is available. The reason is to create a summary index that approximates the consistency of the governments' support to FP during a time prior to fertility decline. Only 14

governments among the 26-country sample have such an indicator reported in the UNDP publication. The front runner among Muslim countries with regard to support of FP is Indonesia with a score of 72 points. Following behind with a score of 62 point is Tunisia. Uzbekistan belongs to the group of front runners due to an artifact of the data. Indeed this county's only estimate for the period of interest in that of 1994 upon which it was classified. Mali, Yemen, Syria and Jordan provide the least governmental support to FP. Absence of governmental support does not preclude existence of other efficient ways of support such as NGOs. Most governments sampled provide a mild support to FP that corresponds to scores around 40 and many of the developmental states belong to this mainstream category.

Furthermore, I use linear regression of TFR on other characteristics of the populations to explore the relationship of fertility and population's attributes and help select meaningful variables. Several trials of regressing TFR on independent variables return non-significant relationships between population attributes and TFR. I then create a variable *Policy* which classifies the countries along the line of whether they experienced a *Turkish Paradigm* type of policy in the post-WWII era or not. Including the *Policy* as a control variable in the regression equation changes the significance of the other covariates in a positive direction. Population size, percent urban, index of proportion married, percent using family planning, proportion of women to men literacy rate, as well as the *polic*y variable all become statistically significant at least at the 90 percent confidence level. Table 1 reports a selection of demographic indices and measures for the 26-county sample. It presents Total Fertility Rate (TFR), Coale's Indices of general fertility (If) and that of marital fertility (Im), along with the year of observation and the average annual change in each one of these three indices over a period of observation that is reported in Appendix I. Percent of women in reproductive age using contraception (FP) and most recent estimates (2003) of total population in millions (Pop) are also reported in the table. More detail that complements the information of table 1 is provided in Appendix I. Table 2 provides estimates of the socioeconomic characteristics of each population as well as author generated variables to

describe specific historical, political, and cultural experiences that have potential explanatory power for fertility patterns of change. Appendix II reports more of these variables.

Method

Patterns of Fertility Decline First, A visual exploration of the data is made possible using the powerful capabilities of Arc View GIS to classify and map the units of analysis according to a single variable. I use this tool to define patterns of fertility decline prior to running a multivariate cluster analysis. For the first task, I use indices related to level of general fertility, pace of decline, and major contributors to this decline. The following indices are used to fulfill this goal: most recent figures of TFR, most recent estimates of I_f, average annual decline in I_f, most recent estimates of I_m, average annual decline in I_m, percent of women in reproductive age using contraception. These mappings amount to a uni-varied cluster analysis since using the so-called *Natural Breaks* option in Arc View GIS defines the cutoff values in the classification variable according to an algorithm that minimizes the intra-group variances and maximizes the inter-group variance. I restrict the user-defined number of classes to four and rely on the *Natural Breaks* algorithm for the choice of class magnitude, except in the case of TFR based classification. In this last case, I force the program to create one class for below reproduction fertility (cut off TFR=2.1).

Multivariate Cluster Analysis Second, I use hierarchical procedures of classification to apply a multivariate cluster analysis to the data. The goal again is testing whether the structure of the data supports the ideal-types described in chapter two and gain more insight with regard to the internal structure of the data. For this classification, quantitative summary indices are used to characterize the socioeconomic level of development with special emphasis on the human dimension of it. The following indices are included in the models, the most recent index of proportion married (I_m), the average annual change in the comparative index of general fertility (avchng2), the most recent value of the comparative index of general fertility (I_f), Total Fertility Rate (TFR), percent of women using contraception (fp), percent of the population in

urban dwellings (urb), ratio of girls to boys in school enrollment (girlboy0), and percent of the population enumerated as Muslims (pctmuslm), Human Development Index (hdi), purchase parity power of the gross domestic product (gdp_ppp), and per capita Official Development Assistance received (oda_capi).

Multivariate Qualitative Cluster Analysis A second type of classification is done on the basis of author generated binary variables that characterize the contemporary historical experience of each country as I see it. I use kmeans cluster analysis to classify countries in four groups on the basis of these qualitative binary variables. The variables describe the following aspects of the post-colonial experience for each country included in the analysis: whether a FP policy was implemented (fp_plcy), whether the country experienced a religious reformation (relrfrm), whether the country implemented a developmental policy conforming with the *Turkish Paradigm* (policy), whether the country has a legacy of Ottoman rule prior to passing under the European colonial rule (turkrule), and finally, whether the country experienced European colonial rule (colexp). Note that I choose four classes on the basis of the key concepts which underline the whole approach of this work. Expectation is to isolate a cluster of countries with the Turkish Paradigm as the most salient feature, one class with the Sufi Ethos saliency and, the rest two classes with mixture of influences to be specified. Priori specification of these ideal-types is provided elsewhere (Guend 2004).

2. Results and Discussion

The most recent estimates of TFR assess the present level of fertility for each country. Note that these are estimates collected from published literature and used only as a springboard to the indices of general fertility I_f. The latter are calculated using primary census and vital statistics data. They are used to estimate the pace of fertility decline expressed as an annual average change of I_f. Note also that the scarcity of the data which translates into only a few time points of reference for the estimated I_f. Therefore despite its importance, it is not possible to locate precisely the timing of onset of fertility decline. However, unlike the times series of TFRs, the

times series of I_f cover longers period likely to embrace the timing of onset of fertility decline. Changes in nuptiality and contraceptive use within marriage are two major contributors to fertility decline. I use Coale's index of proportion married I_m and its annual average change to characterize the level and trends of nuptiality change. And percent of women using contraception is used to characterize the variability in the prevalence of FP within marriage.

Patterns of Fertility Decline

Present Fertility Level The most recent estimates of TFR are displayed in Figure 4. The only user defined group in this map is that of countries with TFR<2.1 that aims to isolate populations with completed transition and a level of stabilization comparable to that of European countries. Note the diversity of the current level of total fertility rates with only one country, Azerbaijan from the Turkic Ethnic-Linguistic group, standing alone at below replacement level. Pakistan closes the interval at the highest end of the spectrum of changing fertility with 5.5 children per women, while the populations of Yemen and Mali have levels corresponding to natural fertility around seven children per women. The next low fertility cluster with a TFR ranging from 2.1 to 2.8 is composed of countries which experienced a post-colonial state sponsored development programs either in a centrally planned socialist economy (Albania, Tajikistan, Uzbekistan, and Algeria) or more liberal Kemalist like policies (Turkey, Iran, and Indonesian). Albania which is included in the sample of countries in the European Fertility Project and was characterized as one of two laggards within Europe with regard to the timing of onset of fertility decline (Coale and Watkins 1986) has a borderline low TFR of 2.1.

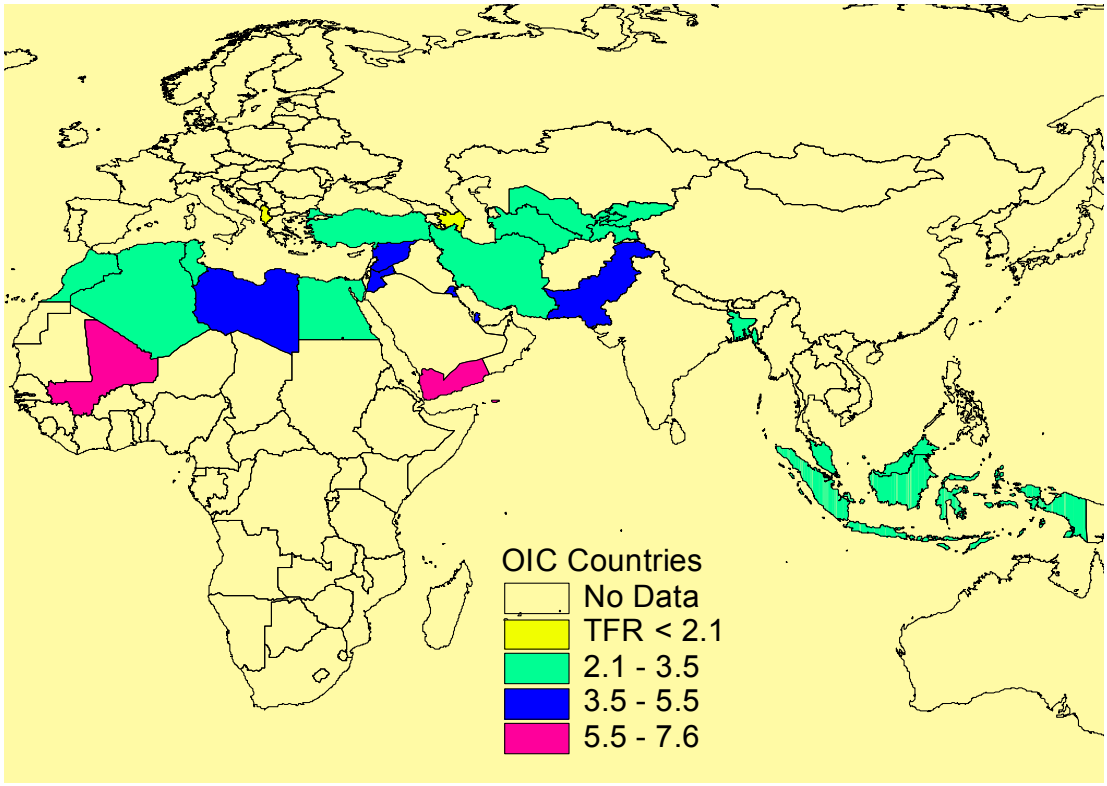
The largest cluster is composed of 9 countries out of the 26-country sample that have a TFR around 3 children per women, which denotes a well engaged transition but still a large potential for reduction. This group contains both non-induced developmental influence and state sponsored developmental policy. It looks like a group where effects of diverse causes of change converged, wealth in the case of Brunei and Bahrain, family planning in the case of Bangladesh, Egypt, and Morocco, or centrally planned policies in Turkmenistan, Tunisia, or Kyrgyzstan.

A group of laggards is composed of Qatar, Libya, Kuwait, Syria, Jordan, and Pakistan with TFR that ranges from 3.9 to 5.5 children per women, and Pakistan at the highest end of the spectrum. Libya and possibly Syria are perhaps misclassified in this case because their TFR estimates are older than that of other countries (1995 and 1993 respectively). I_m shows substantial downward change in proportion married in the case of Libya which denotes an important change in nuptiality that predicts a downward change in marital fertility. A possible alternative explanation of the Libyan case is that fertility decline lagged because the initial change came out of a background strongly marked by the Sufi Ethos, and a traditional tribal social structure, combined with the effect of a low density population. If this is true, observed change in I_m denotes a deep structural change of nuptiality which predicts a future rapid fertility decline due to a cumulative effect.

There seems to be a natural fertility group which includes Mali and Yemen and probably other countries excluded form the sample for lack of data since the latter is in and by itself an indicator of development. That is a demographic data collection system is part of the country's overall politico administrative. Its performance says something about the country's level of development from the perspective of DI. Oman, Saudi Arabia, and Senegal belong to this case. They are profiled at the beginning of this the paper.

Coale's index of general fertility (I_f) offers a comparative way to assess the level of fertility by reference to the highest level of human reproduction ever recorded, the fertility of the Hutterites in 1921-30. Figure 5 displays the countries classified according to the most recent estimates of this standardized comparative index. Mali in 1987 and Libya in 1991 constitute a group with the highest level of I_f yet it is located below 55% of the Hutterites fertility, a level close to the European pre-transition fertility regime.

Figure 4
26-Country Sample Classified by Total Fertility Rates

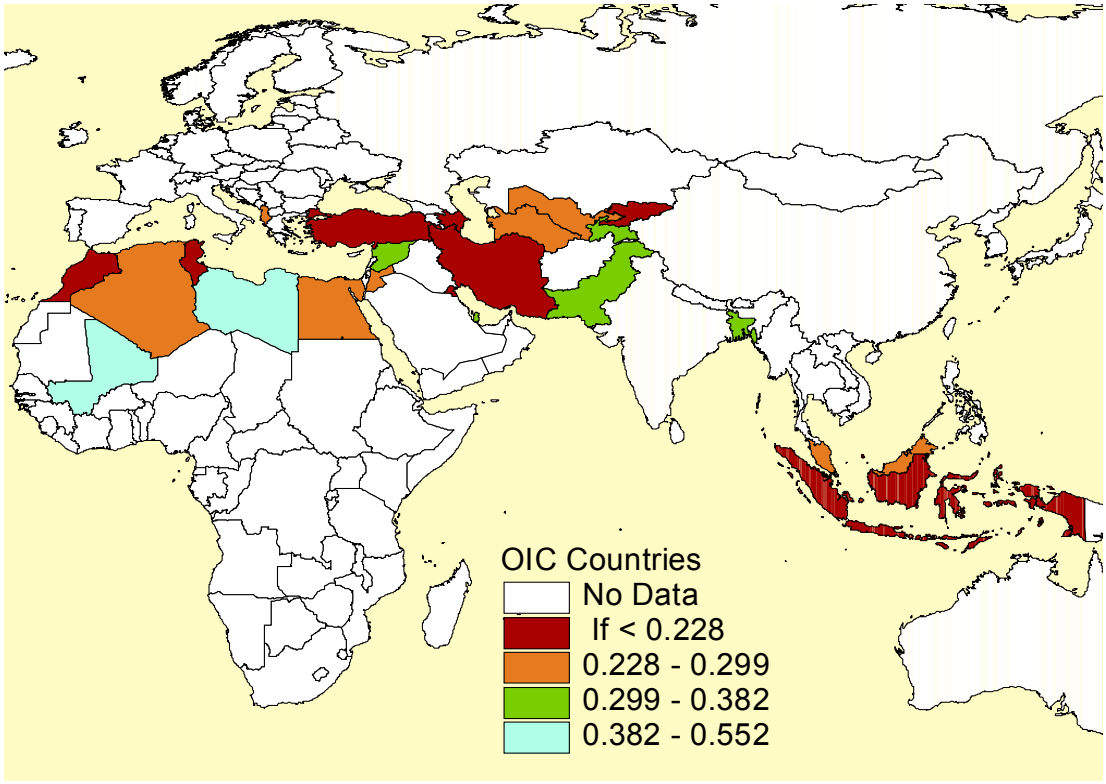


What are the Muslim's pre-transition levels of fertility? An answer to this question requires longer series of fertility indices than what is available to us. Nonetheless, one can provide an acceptable approximation by looking at estimates of I_f corresponding to the earliest dates our data provide. The populations of Libya in 1973, of Pakistan in 1976, and of Algeria in 1966 experienced the highest levels of I_f recorded with estimates around 70 percent of the Hutterites' (Libya 74, Pakistan 70, and Algeria 69 percent). The populations of Kuwait, Jordan, and Tunisia for their part, experienced levels around 60 percent of the Hutterites' fertility with 62, 61, and 57 in 1965, 1971, and 1966, respectively. An I_f evaluated at 53 percent of the Hutterites' characterizes the fertility of the populations of Malaysia in 1957 and Albania in 1955. Along with Turkey in 1960 (I_f =52). These 3 countries constitute a third group with levels close to pre-transition Europe, that is a fertility about half that of the Hutterites'.

Among the countries with suitable data, the downward change in I_f is everywhere above the 20 percent level for periods of observation ranging from 4 years in the case of Tajikistan to 43 years in the case of Malaysia. That is twice the cutoff the European Fertility Project (Coale and Watkins 1986) considered as indicator of the onset of secular decline except for five countries. Two of these exceptions, Qatar and Mali, actually experienced a rise in the index of general fertility. However this rise occurred during short periods of observation, four years and four percent rise in the first case, and 11 years and 19 percent increase in the second case. The other three exceptions, Morocco, Bangladesh, and Pakistan, experienced 11, 13, and 15 percent decline over the periods 1982-2000, 1981-91, and 1968-98, respectively (Appendix I). TFR figures provide stronger evidence of a long-lasting decline in both Morocco and Bangladesh. If one accepts this threshold as the distinctive mark of the onset of the secular decline, there is ample evidence that the onset of fertility decline is now general in the Muslim world. Well advanced on the path of fertility decline are the core-countries of the Turkic, the Iranian, and the Asian ethnic-linguistic blocs with level below 23 percent of the Hutterites. Their neighboring countries follow with less than 30 percent of the standard.

The course of fertility transition is less consistent in the three other ethnic-linguistic groups. Fertility decline is on its way to generalization among the Arab group, lagging among the populations of Indian heritage, and probably also among Muslim populations of black African decent. Furthermore, in the Arabic area, the lead in fertility decline comes from Northern Africa (Tunisia, Algeria, and Morocco) rather than form Egypt despite the latter's longer experience with FP. Note that because its index is calculated from older data (1987), Algeria is included into a higher fertility group than it should be as the TFR based map shows.

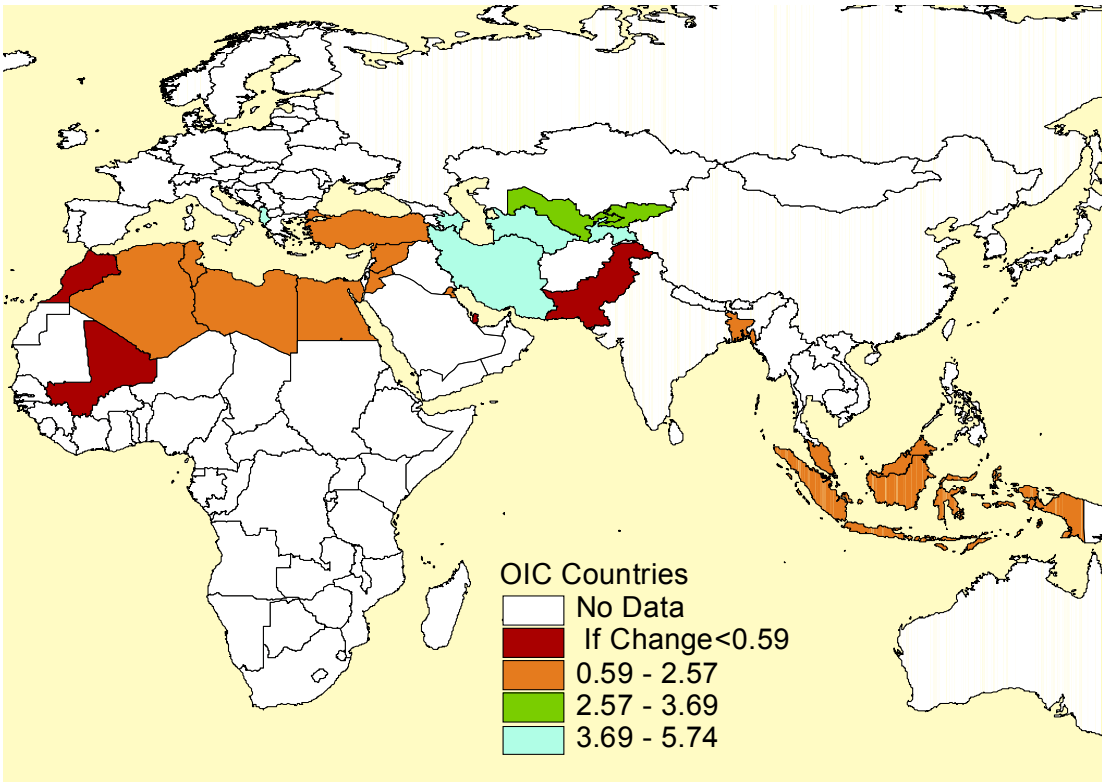
Figure 5
26-Country Sample Classified by Index of General Fertility (I_f)



Pace of Fertility Decline Mapped in Figure 6, the average annual percent change in the index of general fertility adds new insight to this exploration. Here we observe the most rapid pace of decline among the populations of Iran. So is the case among the string of Muslim republics of former Soviet Union contiguous to its Northern border, namely Azerbaijan, Turkmenistan, Uzbekistan, Tajikistan, and Kyrgyzstan. Albania also belongs to this group of rapidly changing fertility. This comes without surprise from the perspective of DI which diffused through governmental pathways in the context of highly centralized economies, and a widespread use of contraception as a result of governmental support for FP. On the other end of the spectrum of the pace of fertility decline sit the populations of Pakistan and of Morocco with declining fertility at 0.51 and 0.59 percent rate respectively. Below this level is the recorded rise in Mali and Qatar at 1.71 and 1.08 percent respectively. Most Muslim populations however are

experiencing a decline at a pace ranging from 1.05 percent annually in Indonesia to 3.69 percent in Kyrgyzstan. Note however that these rates entail a margin of error due to the differential lengths of the periods of observations.

Figure 6
26-Country Sample Classified by Average Annual Percent Change Index of General Fertility (I_f)

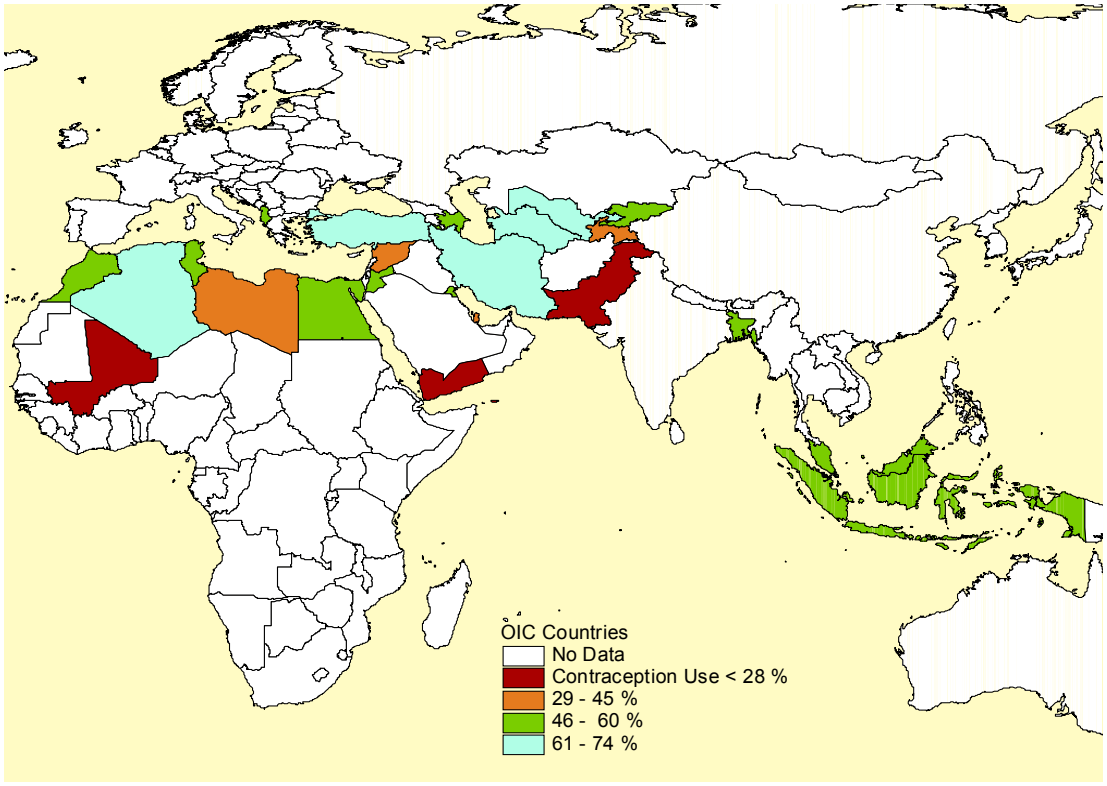


Major Contributors to Fertility Decline Contraceptive use within marriage is one of two major means of reduction of Muslim women's fertility. The second is the change that affects their nuptiality which is traditionally characterized by early and universal marriage.

Contraceptive Use DI does not equate actual socioeconomic development. It may or may not translate into concrete achievements such as industrialization, generalized education, gender equality, and other economic, cultural, and social aspect of development. The same applies to FP policy and actual contraceptive use. The highest proportions of users of contraception do not belong necessarily to populations living under governments whose efforts

are highly rated by the international organizations. Figure 7 classifies countries on the basis of the percent of women in reproductive age who use contraception. It shows that practice of FP is on its way to becoming general. Above half of women in reproductive age use contraception in 18 out of 24 countries with no missing data. Only in two countries the proportion of users is below a quarter of the total women in reproductive age. Contraception within marriage is a crucial factor for reduction of fertility given the high proportion of married women characteristic of Muslim nuptiality. Even where the proportion married is rapidly deceasing, marriage remains a compulsory passage to motherhood for a Muslim woman in most cases.

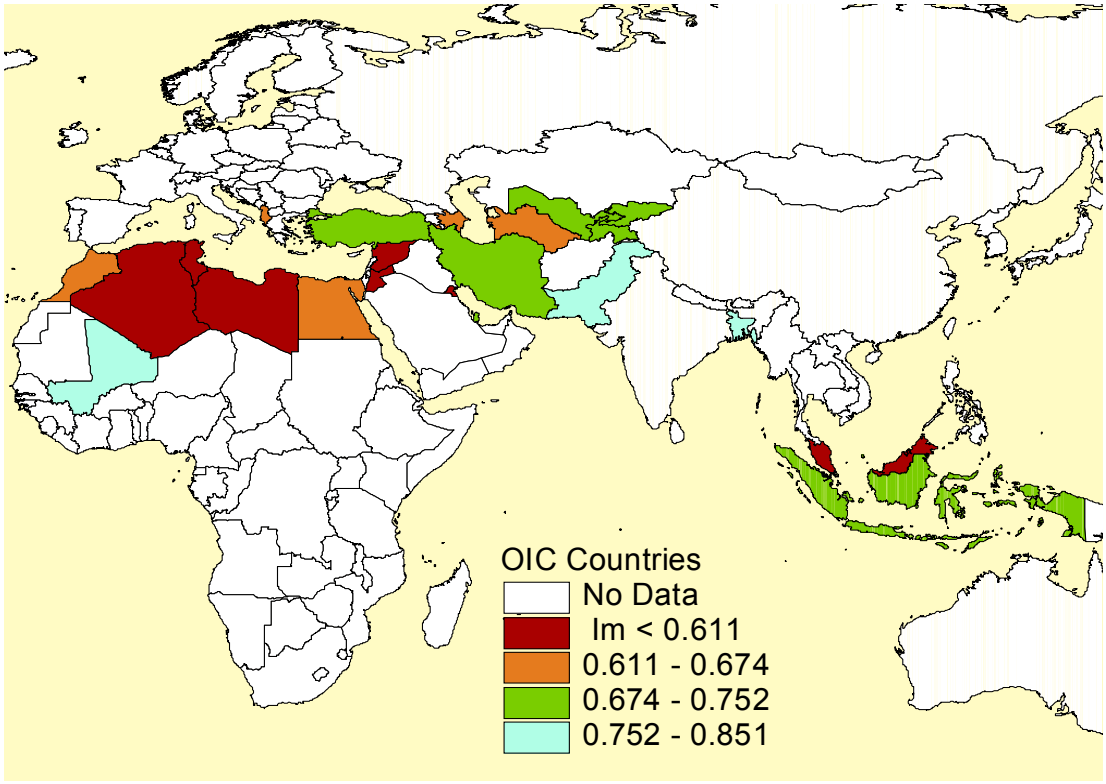
Figure 7
26-Country Sample Classified by Percent of Women Using Contraception



Proportion Married Figures 8 and 9 display the distributions of I_m and its annual rate of change respectively. Note first that both DI and Islamic Reformism lead to decline in the proportion married under two different rationales. One expects the first to result into increased

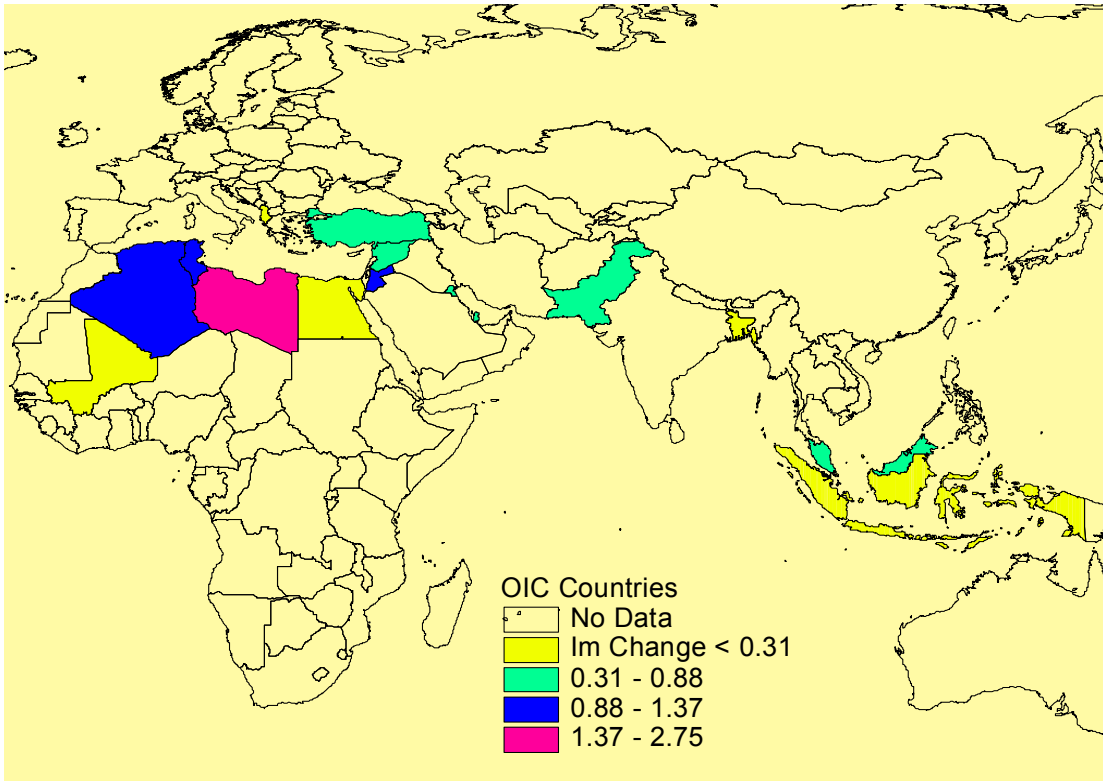
individualism due to its advocacy for gender equality, women's empowerment, and secularism among other policy goals. The second lead to the same result through promotion of women's education, and a non-intended de facto secularization. There are instances where Islamic reformism triggers processes of social change initially through the weakening of the traditional structure characterized by the Sufi Ethos. The end result with respect to nuptiality change is the same, later marriage and lower proportion married. We shall underscore the overall high proportions married among Muslim women. The upper limit of the highest cluster is only 15 percent below that of the standard. The upper limit of the lowest cluster is about 40 percent below the standard. It comes as no surprise that Mali, a natural fertility country, and Pakistan whose fertility decline lags behind have the highest proportion married. Bangladesh however is a peculiar case. Even though its index of marital fertility is more recent (1991), its level is comparable to that of Mali (1987) and Pakistan (1976). This is a further evidence of the important role contraception within marriage plays in the well documented fertility decline in Bangladesh (Cleland et al. 1993, 1994). A substantial structural change would necessarily affect the patterns of nuptiality and lower the proportion married significantly as seen in some developmental countries such as Tunisia, Libya, Algeria, or Malaysia. All have an I_m below the threshold of 60 percent. Most Muslim populations however remain within limits of fairly high levels of proportion married between 60 and 75 percent of the Hutterites'.

Figure 8
26-Country Sample Classified by Index of Proportion Married (I_m)



The annual average decline in I_m (Figure 9) again puts Libya, Algeria and Tunisia at the frontline. Jordan also has a rate of decline comparable to that of the Northern African countries but referring to more recent estimates of I_m. Given the error associated with the differential periods of reference in the calculation of the percent change, caution should accompany the reading of other clusters. However their significance shall not be completely undermined. With this limitation in mind, we observe two major regimes of nuptiality. One characterized by the slow change in the index of proportion married and includes Mali, Egypt, Bangladesh, Indonesia, and the Arab states of the Gulf. The second with a lesser slow change involves Albania, Turkey, Syria, Pakistan, and Malaysia.

Figure 9
26-Country Sample Classified by Average Annual Decline in the Index of Proportion Married, I_m



Multivariate Quantitative Cluster Analysis

"Cluster Analysis is the generic name for a wide variety of procedures that can be used to create a classification. These procedures empirically form "clusters" or groups of highly similar entities. More specifically, a clustering method is a multivariate statistical procedure that starts with a data set containing information about a sample of entities and attempts to reorganize these entities into relatively homogenous groups" (Aldenderfer and Blashfield 1984, p.7). Most cluster methods are heuristics and indeed the purpose of the cluster analysis of this chapter is also heuristic. The strategy of cluster analysis I adopt throughout this chapter is structure-seeking. Therefore it is operationalized in a way that minimizes the structure imposing operations such as pre-defined number of clusters, level of clustering, and choice of variables. However it is not a simple blind exploratory analysis of the data. It is rather a theory driven exploration of the data.

The effect of the theory is apparent in the careful selection of the variables, and the indices included in the analysis. The underlying theory is, in essence, a multi-level comparative theory. An implicit level of comparison is between two universes which reflect the historical experiences of two civilizations, the Western and the Islamic civilizations. The second level of comparison, within the second general universe, is between countries as units of analysis. The units of analysis are classified according to their diverse contemporary historical experiences in contrast to a common historical background characterized in chapter two as the *Sufi Ethos* or the *Orthopraxy* of Islam. The key to using cluster analysis is to know when the groups are "real" and not merely imposed on the data by the method. For this purpose, variables are chosen within the context of an explicitly stated theory that is used to support the classification. DI and Islamic Modernism are the key concepts of this theory. I discussed previously the variables' selection and other methodological aspects of this analysis. I turn now to summarizing and discussing the results of the multivariate cluster analysis.

I develop three models in this analysis with each model meant to uncover the inner structure of the universe investigated from a different perspective. The first model is based on the quantitative fertility variables and some of the human development variables explored. This model aims to uncover the general structure of the data on the basis of objective characteristics of the units of analysis with respect to fertility and related features of the units' populations. The second is a pure fertility transition model that aims to uncover the structure of the data on the sole basis of measures of level, and pace of fertility change. The third model is based on author's generated qualitative variables which aim to capture and summarize the mass of qualitative information processed. This model attempts to classify the units of analysis on the basis of this qualitative information. It reflects to some extent the author's perception of Muslim reality.

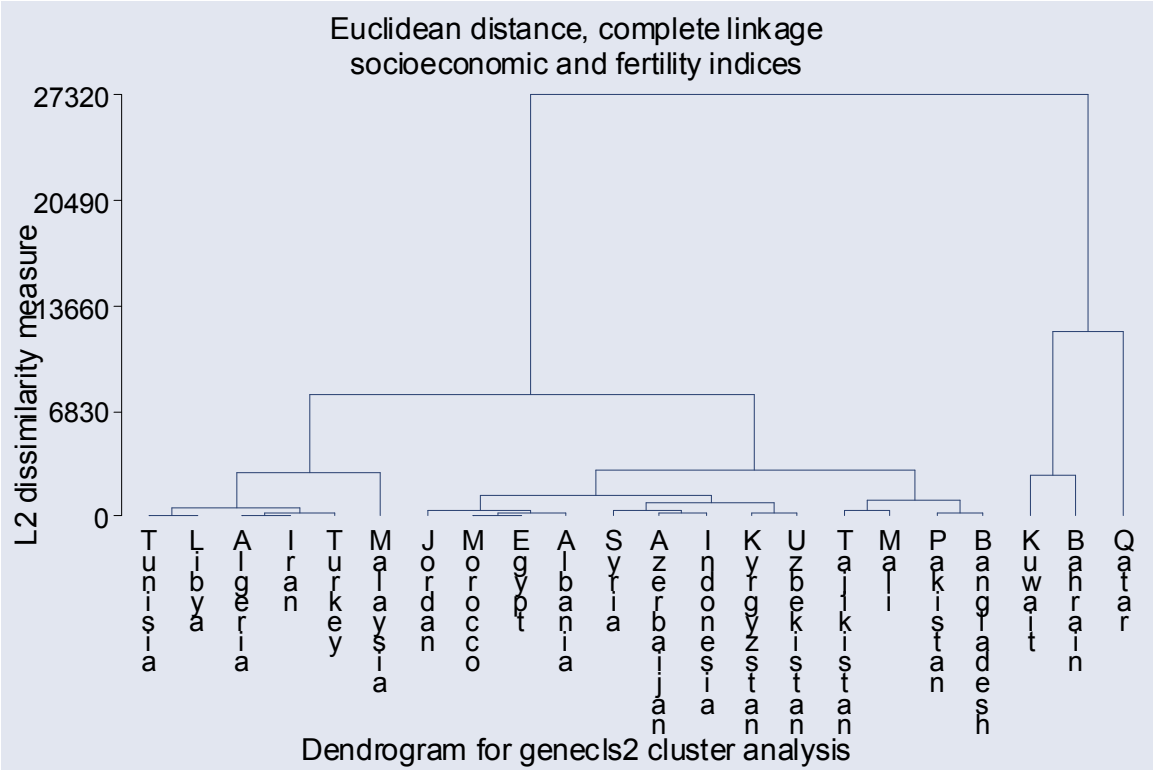
The results of the first model are illustrated by the dandrogram of Figure 10 where three clusters emerge clearly. One cluster of the atypically wealthy countries of Kuwait, Bahrain, and Qatar emerges at the first level of classification. The length of the two branches testifies to the

singularity of this group. These are countries with small populations enjoying standard of natural resources generated wealth comparable to the most economically advanced countries of Europe. However, none of these countries figure among the most advanced with regard to fertility transition. On the basis of its fertility, Qatar is even classified in the same cluster as natural fertility countries such as Pakistan and Mali. Qatar's singularity is reflected in the internal structure of the cluster which shows a substantial distance between this country and the two other units, Kuwait and Bahrain. The index of dissimilarity testifies to this distance of separation.

The second cluster that emerges at the second level of classification can be characterized as the pure developmental states. This cluster is composed of Tunisia, Libya, Algeria, Iran, Turkey and Malaysia. Note how the internal structure of this cluster differentiates even the hard core *Turkish Paradigm* countries from Malaysia which shares most but not all tenets of the Paradigm.

The rest of the countries are cluttered in a single cluster. These are the populations whose development and fertility changes occur under the effects of several forces of change. This aspect is clearly illustrated by the internal structure of this big cluster if one makes few abstractions of minor features of individual units. In one case it is what we call non-induced diffusion of DI (Egypt, Jordan, Morocco, or Albania). In another it is centrally planned development programs (Syria, Azerbaijan, Indonesia, Kyrgyzstan, and Uzbekistan). In the third it is yet targeted programs against a socioeconomic background of poor economies and traditional social structures (Tajikistan, Mali, Pakistan, and Bangladesh).

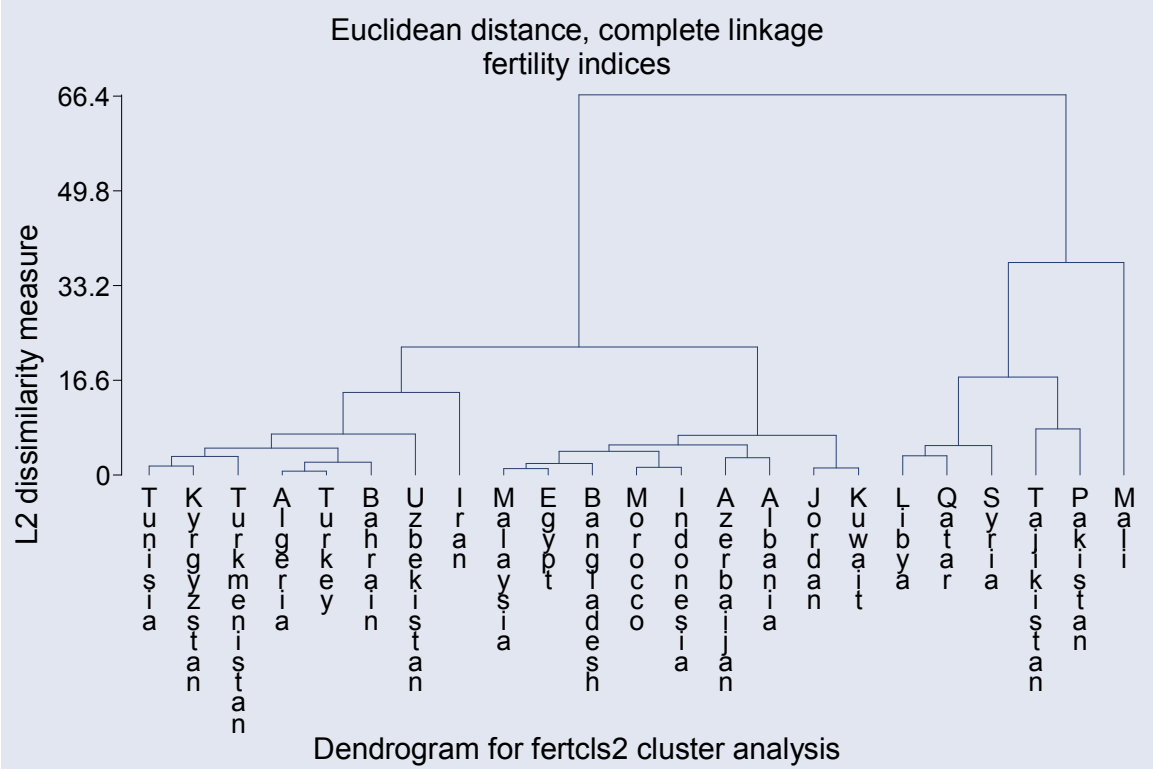
Figure 10
Dandrogram of Socioeconomic and Fertility Based Cluster Analysis



Results of the fertility based cluster analysis are illustrated by the dandrogram of Figure 11. Here three groups emerge. First, a group of laggards on the path of fertility transition is composed of countries that have been classified at different levels of development and wealth. Countries of higher level of development and wealth such as Libya and Qatar go with countries that have been classified at the lowest scale of development such as Pakistan and Mali. But even within this highly distinctive cluster an internal structure is uncovered which contrasts Mali, a natural fertility country, against the rest of the units. A more homogenous middle cluster emerges which separates the laggards from the group of more advanced transition countries. The latter is heavily influenced by countries where induced DI predominated. This is the case where the channel of DI is a centrally planned socialist type economy (Kyrgyzstan, Turkmenistan, Algeria, and Uzbekistan), or a Turkish Paradigm type national policy (Tunisia, Turkey, and Iran). The

middle cluster, in turn, is composed of countries whose salient feature is a non-induced (or targeted policy) DI such as Malaysia, Bangladesh, Morocco, Indonesia, Jordan, and Kuwait.

Figure 11
Dandrogram of Fertility Based Cluster Analysis



Multivariate Qualitative Cluster Analysis

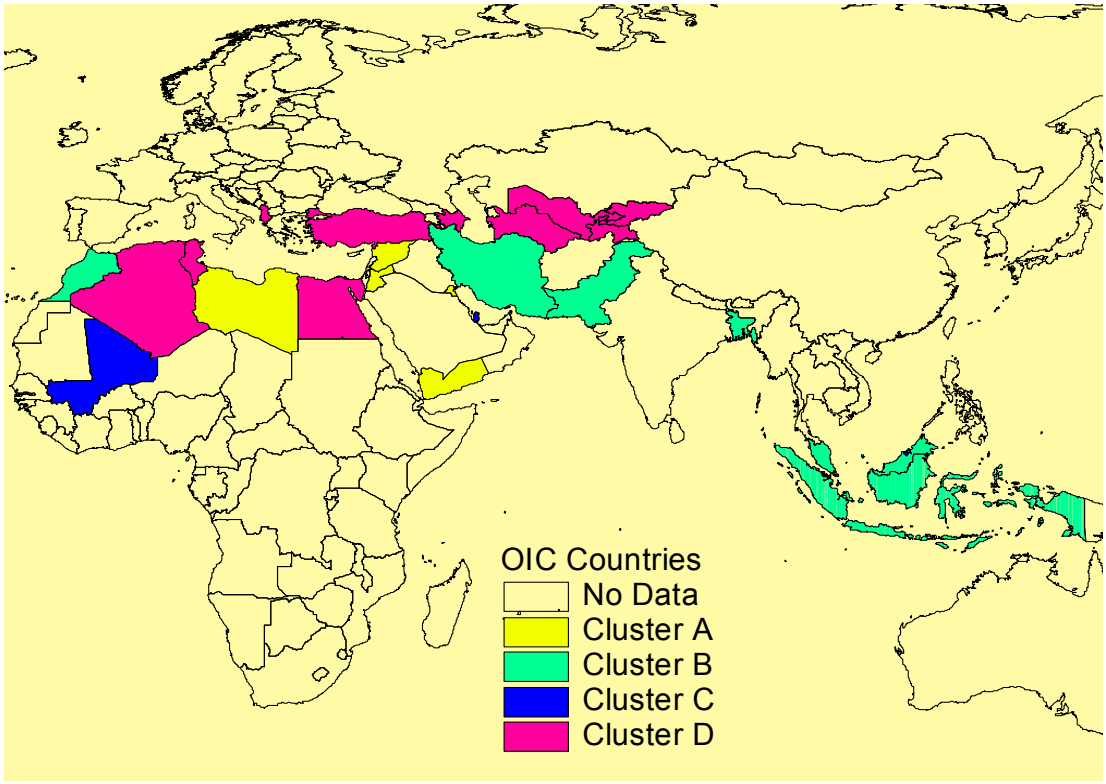
Cluster analysis based on qualitative variables does not return a neat graphical illustration of the result as is the case with quantitative cluster analysis. It creates instead a user defined number of clusters to which it assigns a number for identification purpose only. Units assigned to the same group are the most homogenous according to the binary variables included in the analysis. These variables are here proxies to *family planning policy, Islamic modernism, Turkish Paradigm like policy, experience with Ottoman rule,* and *experience with European colonialism*. The qualitative cluster analysis described in the methods part of this chapter yields four clusters as shown in Table 3.

Table 3
Qualitative Variables' Based Clusters of the 26-Country sample

Cluster A	Cluster B	Cluster C	Cluster D
Jordan	Pakistan	Bahrain Maldives	Egypt
Syria	Bangladesh		Tajikistan
Kuwait	Morocco	Qatar	Tunisia
Yemen	Iran	Brunei	Algeria
Libya	Malaysia	Mali	Azerbaijan
	Indonesia		Kyrgyzstan
			Turkmenistan
			Albania Turkey
			Uzbekistan

The five variables are chosen to reflect some of the most powerful pathways of diffusion of DI in the Muslim world, as well as historical experiences which predispose the populations for the acceptance of the tenets of DI. Cluster D confirms a previous characterization as the pure developmental states, while cluster C sits on the other end of the developmental scale. Clusters A and B are hybrid groupings with regard to these five characteristics. The geographic distribution of the four clusters (Figure 12) shows that spatial proximity plays an important role in this clustering but it is not the unique factor. For example Morocco is closer to Iran, Pakistan, or Indonesia with regard to the five features enumerated previously than it is to the cluster of developmentalist states with an Ottoman legacy of the red area. Mali, a poor African country clusters with such wealthy countries as Brunei, Bahrain, or Qatar due to a common strong traditional social structure. Libya, Yemen, Jordan and Syria share features with developmental states. They all share an Ottoman legacy but also have a strong homogenizing feature. That is a strong Arab national identity which is likely to play in favor of the strengthening of the social structures of traditional Arab societies.

Figure 12
26-Country Sample Classified According to Qualitative Binary Variables



References

Aldenderfer, Mark S., and Roger K. Blashfield. 1984. *Cluster Analysis*. Sage University Paper Series on Quantitative Applications in the Social Sciences, 07-044. Beverly Hills and London: Sage Pubns

Cleland, J.G., James F. Phillips, Sajeda Amin, G.M. Kamal. 1994. The determinants of reproductive change in Bangladesh: success in a challenging environment. *World Bank regional and sectoral studies*, Washington D.C.: World Bank

Cleland, J.G., James F. Phillips, Sajeda Amin, G.M. Kamal. 1993. Fertility decline in post-independence Bangladesh: evidence from recent demographic surveys. *Working papers*, no. 54, New York: Population Council, Research Division.

Coale, Ansley J., Susan Cotts Watkins (eds.). 1986. *The Decline of Fertility in Europe.* Princeton: Princeton University Press.

Guend, Hani 2004. *A Contextual Explanation of Fertility Transition: The Role of Modernization Policies and System of Belief Reformations*. Ph.D. Dissertation, University of Wisconsin-Madision, 223 p.

PRB 2002. *Family Planning Worldwide, 2002 Data Sheet*. Washington, D.C.: Population Reference Bureau.

Population Reference Bureau. 2003. *World Population Data Sheet*. Washington, D.C.: Population Reference Bureau.

Stata Press. 2003. *Stata Cluster Analysis Reference Manual Release 8*. Austin, Texas: Stata Corporation.

The World Factbook: http://www.cia.gov/cia/publications/factbook/geos/mu.html. In general, information available as of January, 1 2004

Thornton, A. 2002. *The Developmental Paradigm, Reading History Sideways, and Family Change.* Ann Arbor: Institute for Social Research, and Department of Sociology, The University of Michigan. [Book manuscript]

UNDP. 2003. *Human Development Report 2003*. New York, Oxford: United Nations, Oxford University Press.

United Nations. 2003. *World Fertility Report 2003*. New York: United Nations.

United Nations. 1950/2000. *Demographic Yearbooks*. New York: United Nations.

United Nations. 2002. *Demographic Yearbook, Natality Statistics CD-ROM*. New York: United Nations.

United Nations. 1997. *World Fertility Patterns 1997,* Wall Chart. New York: United Nations.

Wunsch Guillaume J. and Marc G. Termote. 1978. *Introduction to Demographic Analysis, Principles and Methods*. New York: Plenum Press.

Appendix I
Complement to Demographic Data of Table 1

Country	period of obser I_m	pct change in I_m	I_m	period of obser I_f	pct change in I_f	I_f	period of obser TFR	pct change in TFR	TFR
Azerbaijan	.	.	0.63	1989-99	46	0.14	1970-00	60	1.9
Albania	1955-89	10	0.67	1955-89	52	0.25	1970-00	60	2.1
Tajikistan	.	.	0.74	1989-93	20	0.36	1970-00	59	2.4
Iran	.	.	0.75	1986-96	57	0.20	1975-00	61	2.5
Turkey	1960-90	16	0.70	1960-00	56	0.23	1971-98	55	2.6
Uzbekistan	.	.	0.73	1989-99	36	0.24	1970-00	53	2.7
Algeria	1966-87	27	0.57	1966-98	63	0.26	1977-00	62	2.8
Indonesia	1964-97	10	0.70	1964-97	35	0.21	1973-97	46	2.8
Turkmenistan	.	.	0.67	1989-95	28	0.28	1970-00	52	2.9
Brunei	1971-86	9	0.55	1971-92	50	0.26	1973-92	44	3.1
Tunisia	1966-84	25	0.56	1966-97	67	0.19	1971-95	47	3.2
Bahrain	1981-91	6	0.59	1981-00	40	0.21	1971-95	52	3.2
Malaysia	1957-00	24	0.57	1957-00	53	0.25	1972-94	30	3.3
Bangladesh	1981-91	2	0.85	1981-91	13	0.38	1973-00	48	3.3
Kyrgyzstan	.	..	0.71	1989-00	41	0.20	1970-97	31	3.4
Morocco	.	.	0.62	1982-00	11	0.17	1975-97	54	3.5
Egypt	1975-96	3	0.67	1975-96	30	0.30	1974-00	42	3.5
Qatar	1982-86	2	0.70	1982-86	-4	0.38	1972-98	50	3.9
Libya	1973-84	30	0.56	1973-91	29	0.52	.	.	4.1
Kuwait	1965-96	27	0.58	1965-98	64	0.22	1970-99	42	4.2
Syria	1981-94	9	0.61	1981-94	31	0.37	1976-93	44	4.2
Jordan	1979-94	16	0.57	1979-00	54	0.28	1973-97	42	4.4
Pakistan	1968-76	4	0.78	1968-98	15	0.38	1973-01	13	5.5
Mali	1976-87	2	0.81	1976-87	-19	0.55	1996-01	-1	6.8
Yemen	.	.	.	.	.	.	1977-97	11	7.6
Maldives	1985-90	3	0.73	1985-95	47	0.32	.	.	.

Appendix II
Complement to Data of Table 2

Country	Women To Men Literacy Rate	Islamic Reformism Score	Turkish Paradigm Policy Score	Ottoman Rule	Colonial Time Years	GDI	NFDI Per Capita
Azerbaijan	.	1	1	1	72	.	4.0
Albania	0.97	1	1	1	0	0.73	0.0
Tajikistan	1.00	1	1	1	50	0.67	2.0
Iran	0.95	1	1	0	0	0.70	-0.3
Turkey	0.95	1	1	1	0	0.73	0.5
Uzbekistan	1.00	1	1	1	100	0.73	0.6
Algeria	0.90	1	1	1	130	0.69	2.2
Indonesia	0.99	1	1	0	129	0.68	1.0
Turkmenistan	.	1	1	1	106	.	2.5
Brunei	1.00	0	0	0	75	0.87	0.0
Tunisia	0.92	1	1	1	76	0.73	0.6
Bahrain	1.00	0	0	0	0	0.83	0.0
Malaysia	1.00	0	1	0	129	0.78	0.0
Bangladesh	0.70	0	1	0	180	0.50	0.2
Kyrgyzstan	.	1	1	0	127	.	0.3
Morocco	.	0	0	0	44	0.59	0.6
Egypt	0.83	1	1	1	63	0.63	1.7
Qatar	1.05	0	0	0	25	.	0.0
Libya	0.94	0	1	1	40	.	0.0
Kuwait	1.00	0	0	1	62	0.81	0.0
Syria	0.83	0	1	1	26	0.67	0.6
Jordan	1.00	0	0	1	27	0.73	0.8
Pakistan	0.60	0	0	0	180	0.47	0.6
Mali	0.54	0	0	0	62	0.33	2.5
Yemen	0.58	0	0	1	20	0.42	-2.7
Maldives	1.00	0	0	0	32	.	2.5

Appendix III
Correlation Matrix For Continuous Variables

Variable	avchng1	Im	avchng2	If	avchng3	TFR	popul	urb	fp	girl/boy
avchng1	1.00									
Im	**-0.83**	1.00								
avchng2	0.64	**-0.74**	1.00							
If	-0.55	0.65	**-0.73**	1.00						
vchng3	0.52	-0.66	**0.87**	**-0.72**	1.00					
TFR	-0.30	0.42	-0.68	**0.86**	**-0.85**	1.00				
opul	-0.53	0.54	-0.18	-0.14	-0.08	-0.24	1.00			
urb	0.77	-0.85	0.67	-0.64	0.53	-0.39	-0.55	1.00		
fp	0.43	-0.53	**0.77**	**-0.90**	**0.83**	**-0.97**	0.11	0.54	1.00	
girlboy	0.23	-0.43	0.62	-0.56	**0.73**	**-0.73**	-0.07	0.44	**0.74**	1.00
womale	0.52	**-0.74**	**0.76**	**-0.88**	**0.78**	**-0.78**	-0.05	**0.78**	**0.84**	**0.76**
voteyr	0.24	-0.09	0.19	0.18	0.01	0.14	-0.26	0.00	0.01	0.28
coltim	-0.17	0.47	-0.20	0.11	-0.18	0.01	0.65	-0.65	-0.07	-0.30
pctmuslm	0.56	-0.51	0.19	-0.42	0.13	-0.16	-0.36	0.54	0.25	-0.30
hdi	0.64	**-0.84**	**0.88**	**-0.90**	**0.83**	**-0.77**	-0.16	**0.83**	**0.84**	0.63
gdi	0.62	**-0.83**	**0.87**	**-0.91**	**0.84**	**-0.78**	-0.16	**0.82**	**0.85**	0.66
gdp_ppp	0.76	-0.79	0.65	**-0.81**	0.69	-0.69	-0.37	**0.79**	**0.76**	0.42
oda_capi	0.11	-0.05	-0.32	0.42	-0.56	0.67	-0.53	0.21	-0.51	-0.15
nfdi	-0.07	-0.04	-0.51	0.39	-0.33	0.37	-0.34	-0.14	-0.36	-0.22
fppei	-0.12	0.10	0.09	-0.52	0.16	-0.52	0.66	-0.23	0.42	0.27

Variable	womale	voteyr	coltim	pctmslm	hdi	gdi	gdp	oda_c	nfdi	fppei
womale	1.00									
voteyr	-0.06	1.00								
coltim	-0.40	0.27	1.00							
pctmuslm	0.23	-0.40	-0.26	1.00						
hdi	**0.94**	-0.12	-0.41	0.42	1.00					
gdi	**0.95**	-0.12	-0.42	0.39	**0.99**	1.00				
gdp_ppp	**0.73**	-0.19	-0.37	**0.72**	**0.84**	**0.83**	1.00			
oda_capi	-0.19	0.45	-0.33	-0.09	-0.30	-0.29	-0.26	1.00		
nfdi	-0.26	0.14	-0.08	0.15	-0.35	-0.34	-0.10	0.38	1.00	
fppei	0.25	-0.16	0.44	-0.14	0.18	0.19	0.11	-0.44	-0.35	1.00

Appendix IV
Definitions and Mathematical Formulae for Some Synthetic Variables

Coale's Indices[3]: At a point of time *t* the following symbols are defined, f_i as the births per women age *i*, w_i the number of women age *i*; m_i the number of married women age *i*; and F_i the standard fertility schedule.[4] The following standardized indices can be calculated:

I_f, a comparative index of general fertility = $\Sigma f_i w_i / \Sigma F_i w_i$

I_m, a comparative index of proportion married = $\Sigma F_i m_i / \Sigma F_i w_i$

TFR, Total Fertility Rate is the sum over ages 15 to 50 of the average number of births to women of reproductive age during specific calendar year.

United Nations' Human Development Indices: They are summary measures of a country's achievements in human development.

HDI, the Human Development Index measures a country's average achievement in three basic dimensions of human development: (1) a long healthy life as measured by life expectancy at birth, (2) knowledge as measured by adult literacy rate (with 2/3 weight) and the combined primary, secondary and tertiary gross enrollment ratio (with one third weight), (3) a decent standard of living, as measured by GDP per capita (PPP US$). Before HDI itself is calculated, an index needs to be created for each of the three dimensions. Performance in each dimension is expressed as a value between 0 and 1 by applying the following formula:

$$\text{Dimension index} = \frac{\text{actual value - minimum value}}{\text{maximum value – minimum value}}$$

HDI is then calculated as a simple average of the dimension indices.

GDI, The Gender-related Development Index adjusts the average achievement measured by HDI to reflect the inequalities between men and women in the three dimensions: long and healthy life, knowledge, and a decent standard of living. [5]

FPPEI, Family Planning Policy Evaluation Index is a score attributed to each country on the basis of its government's efforts in the field of family planning activities.

[3] Wunsch and Termote (1978)
[4] Age-specific marital fertility rates of Hutterite women, for the period 1921-1930
[5] For a numerical application, see: United Nations Development Program (2003), Pp.340-341