The Impact of Family Planning Service Provision on Contraceptive-use Dynamics in Morocco

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This article uses linked data from the 1995 Morocco DHS calendar and the 1992 Morocco DHS service-availability module to study the effect of service environment on contraceptive discontinuation, switching, and adoption of a modern method following a birth. The 1995 Morocco DHS also collected information on the source of supply for each episode of use of a modern method recorded in the calendar, allowing study of the association between the source of supply and discontinuation and switching rates. Multilevel event-history models are used to evaluate the impact of individual-level sociodemographic characteristics and community-level indicators of family planning service provision. The findings show that the presence of a nearby public health center is associated with higher modern-method adoption after a birth and lower method-failure rates; the presence of a pharmacy is associated with lower discontinuation due to side effects or health concerns. The degree of method-choice potential has a positive impact on both the rate of switching from the pill to another modern method and on modern-method adoption after a birth.
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The role of access to and quality of family planning services in contraceptive behavior has long been of interest to program managers and policymakers. Despite this interest and despite many years of research, the relative importance of supply-versus-demand factors to contraceptive behavior remains an area of active debate (see Bongaarts 1994; Knowles et al. 1994; and Pritchett 1994a and 1994b). Although the available evidence tends to support a role for access to services as a determinant of contraceptive behavior at the individual level (see DeGraff et al. 1997; Gertler and Molyneaux 1994; Hotchkiss et al. 1995a; and Tsui and Ochoa 1992), the strength of the association is mixed, and a few studies have failed to show an association between service access and contraceptive use (for example, Akin and Rous 1997; Hotchkiss et al. 1995b).

Recently, interest in the role that quality of services plays in influencing contraceptive behavior has increased. Jain (1989) argues that the quality of family planning services is likely to be an important determinant of contraceptive use by increasing adoption of methods and, more significantly, by increasing continuity of contraceptive use. Jain emphasizes access to a range of contraceptive methods as a key component of service quality that is likely to influence continuity of use and, thereby, contraceptive prevalence. Using the availability and access component of the program effort score (see Mauldin and Lapham 1985), Jain demonstrates a strong relationship between the range of methods available in a country and contraceptive prevalence.

Since Jain's work was published, several authors have attempted to substantiate the theoretical link between quality of services and contraceptive use. For example, Mensch and her colleagues (1996) found a moderate but significant effect of service quality on current contraceptive use in Peru. In Morocco, Hotchkiss et al. (1995a) found a significant positive effect of the availability of pills in local pharmacies and of the level of family planning infrastructure and equipment in local facilities on use of modern contraceptives. Also in Morocco, Magnani et al. (1999) found a significant positive effect of the number of methods available in local facilities on subsequent contraceptive use among nonusers. The effect of the avail-

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ability of methods at the nearest government facility was particularly strong among women who, in 1992, said they did not intend to use a contraceptive method. However, Hotchkiss et al. (1995b) failed to find any effects of service quality on contraceptive use in two states in northeast Brazil.[1]

Most studies using national surveys, such as the Demographic and Health Surveys (DHS), DHS service-availability modules (SAM), and situation analyses (SA), have focused on current contraceptive use. A few specialized subnational studies have examined the effects of service quality on contraceptive adoption and continuation. The largest of these examined the impact of women's perceptions of the quality of services provided by field-workers in Matlab, Bangladesh on subsequent contraceptive adoption and continuation (Koenig et al. 1997). The study found a significant positive effect of women's perceptions of service quality on both adoption and continuation, but the effect was particularly strong for continuation, consistent with Jain's hypotheses. Other studies have shown a positive association between clients' receiving their chosen method and their contraceptive continuation in Indonesia (Pariani et al. 1991) and between adequate counseling on side effects and contraceptive continuation in the Gambia and Niger (Cotten et al. 1992). Although these studies support Jain's hypothesized link between service quality and contraceptive adoption and continuation, Bertrand et al. (1995) argue that more studies are necessary to firmly establish the link empirically and to distinguish between effects on adoption and effects on continuation.

To date, the authors are aware of no studies that have attempted to examine the relationship between service environment and the separate components of contraceptive adoption and continuation at the national level outlined in Jain's theoretical framework. In order to examine the relationship between service environment and contraceptive adoption and continuation, linking individual data on contraceptive-use dynamics (for example, from DHS calendar data) with community-level data on the service environment (for example, from DHS, SAM, or SA) is necessary. A major obstacle to linking these types of data is that the community-level data typically are collected at about the same time as are the individual data. The data on contraceptive adoption and continuation are collected retrospectively for a five-year period prior to the survey, but the data on the service environment refer to the environment at the time of the survey (that is, at the end of the analysis period). If the service environment has changed, the situation at the time of the survey may not be relevant to the earlier period covered by the calendar.

In this study, the opportunity presented by the 1995 Morocco DHS (Azelmat et al. 1996) and the 1992 Morocco SAM (see Mohamed et al. 1995 for the questionnaires) is used to study the effects of service factors on contraceptive adoption and continuation. The 1995 Morocco DHS was conducted in a subsample of the clusters selected in the 1992 DHS, which allows the facility data collected in the 1992 SAM to be linked to the individual contraceptive histories collected in the 1995 DHS. Thus, by restricting the analysis to episodes of contraceptive use that began after the 1992 SAM, indicators can be obtained of the service environment at the beginning of the analysis period (not at the end). Another feature of the 1995 Morocco DHS is the collection of information on source of supply for each episode of use of a modern method recorded in the contraceptive history, which permits examination of the association between source of supply and continuity of contraceptive use.

Three aspects of contraceptive behavior are considered here: adoption of a modern contraceptive method following a birth; discontinuation of the pill; and switching from the pill to another method. The analysis of pill discontinuation distinguishes between different reasons for discontinuation (failure, desired pregnancy, side effects and health concerns, and other method-related reasons), whereas the analysis of switching from the pill distinguishes between different types of switching behavior (pregnancy and preference for another modern method, a traditional method, and no method). Because the quality of the service environment is measured at the community level, multilevel competing risks-hazards models are used to model the effects of both individual and community-level variables on differing types of outcomes.

Methodology

The 1992 and 1995 Morocco DHS surveys were designed to be coordinated as a panel study. Of the 212 sampling clusters selected for the 1992 Morocco DHS, 107 were selected at random for the 1995 DHS. All of the dwellings selected in the 1992 sample in these clusters were revisited, and interviews were conducted with members of the households living in those dwellings in 1995. No attempts were made to locate household members who had moved in the period between the two surveys. Interviewers were also instructed to survey all women aged 12–46 in 1992 who had been listed in the 1992 DHS (that is, women who would be 15–49 in 1995). Limited attempts were made to contact women who had moved within the cluster, and any additional women aged 15–

49 in households in the sample were also interviewed.[2] Fieldwork for the 1995 Morocco DHS was conducted in April and May 1995. A total of 4,753 women aged 15–49 were interviewed, of whom 3,324 had been interviewed in 1992, and 1,429 were new respondents.

The individual questionnaire used in the 1995 survey generally follows the standard DHS questionnaire. Of particular interest for this analysis is the calendar section of the questionnaire. The calendar consists of a matrix of rows and columns and is used to record monthly contraceptive histories for the period from January 1990 until the survey. Each row of the calendar represents a particular calendar month. Column one is used to record monthly pregnancy/contraceptive-use status, column two is used to record the source of supply when an episode of contraceptive use begins, and column three is used to record the main reason for discontinuation whenever an episode of contraceptive use ends. For an overview of the DHS calendar, see Curtis (1997).

The 1992 Morocco SAM was conducted in all 212 clusters selected for the 1992 DHS. Between two and six informed respondents were identified in each cluster[3] and questioned about the characteristics of the community, including the infrastructure; the availability of family planning and health services; and identification of the closest health facility of each type (hospital, health center/dispensary, private clinic, pharmacy, private doctor, and Association Marocaine de Planification Familiale [AMPF] clinic). Interviewers visited the nearest facility of each type within 30 kilometers (18.6 miles) of the cluster and interviewed a staff member about the services provided at the facility. Specifically, the facility questionnaire covered the following topics: general characteristics (staffing, patient capacity, payment procedures, sterilization procedures, and basic equipment); services provided; availability of selected medicines; staff working in family planning; and availability of contraceptive methods. Fieldwork for the SAM was conducted in August and September 1992. For this analysis, only the SAM data from the 107 clusters selected for the 1995 DHS are used. These data are linked to the individual data from the 1995 survey by means of the cluster identification number.

The analysis of contraceptive adoption examines the time until the first use of a modern contraceptive following a live birth. The analysis sample consists of live births between August 1992 and the 1995 DHS survey. Births to women who were not interviewed in the 1992 DHS are excluded because these women may not have been living in the same cluster in 1992 and because no information is available on migration. Therefore, the 1992 service environment in these women's current (1995) cluster may not represent their service environment at the time of the index birth. The final sample consists of 862 births. Women who became pregnant again before adopting a contraceptive method or who adopted a traditional method first are treated as censored observations, as are women who had not adopted a method by the time of the 1995 survey.

Method choice is strongly related to subsequent method continuation (Curtis and Blanc 1997). However, the relationship between method choice and continuation is complicated because many of the factors that influence method choice also influence continuation. Indeed, the risk of contraceptive failure and the intended length of use are likely to be among the factors that women consider in choosing a method. Therefore, disentangling the effects of the method chosen on discontinuation from the effects of factors influencing method choice is difficult. Because of these statistical complications, the analysis of contraceptive discontinuation focuses on pill discontinuation. In Morocco, the choice of more than three-fourths of current users in 1995 was the pill (Azelmat et al. 1996), by far the dominant method. Focusing on pill users avoids potential statistical problems associated with method choice but does not eliminate selectivity problems, because women who use the pill are likely to be different from women who choose another method. Therefore, the analysis applies only to pill users, not to all women who use contraceptives in Morocco. The analysis sample consists of episodes of pill use that began after August 1992. An episode of pill use is defined as a continuous period of use recorded in the calendar. If a woman stops using the pill, even for only one month, the episode is considered to have ended, and a new episode begins when she starts to use it again. Therefore, individual women may contribute more than one episode of pill use to the sample. Episodes of pill use among women who were not interviewed in the 1992 DHS are excluded for the same reasons that the births to these women were excluded from the analysis of contraceptive adoption. A total of 775 eligible episodes of pill use were identified in the calendar. These episodes were contributed by 636 individual women.

As noted above, the analysis distinguishes four different types of discontinuation: contraceptive failure, desired pregnancy, side effects or health concerns, and other method-related reasons (husband disapproves, inconvenient to use, respondent wants a more effective method, cost, and accessibility). These four types of discontinuation are categorized according to the main reason for discontinuation reported by the woman in the calendar. Episodes of pill use that were in progress at the time of the 1995 survey are censored, as are episodes

of use that were discontinued for any reasons other than the four listed above (for example, separation or widowhood, marital dissolution, infrequent sex, and menopause).

The analysis of switching behavior also focuses on pill users for the reasons described above and employs the same sample as the analysis of contraceptive discontinuation. In this analysis, the outcome of interest is behavior after discontinuation. Four types of switching behavior are examined, based on the contraceptive or pregnancy status of the woman in the month immediately after discontinuation and on her stated reason for discontinuation. The four types of switching behavior are defined as: pregnancy (both contraceptive failures and cases of women who discontinued in order to become pregnant); switching to another modern method (the IUD, an injectable, Norplant®, the condom, vaginal methods, and male or female sterilization); switching to a traditional method (periodic abstinence, withdrawal, other traditional methods); and not using a method and at risk of pregnancy. For this last category, women are defined as nonusers and being at risk of pregnancy if they did not immediately switch to another method and they discontinued the pill for any reason other than a desire to become pregnant, or because of menopause, marital dissolution, or infrequent sex.

The explanatory variables of most interest in this analysis are those relating to the service environment in 1992. The objective in defining these variables was to include indicators of both the physical access to services and the quality of available services based on the six elements of service quality defined by Bruce (1990). However, the data available on service quality in the 1992 SAM are limited, and the appropriate indicators for five of the six elements of the Bruce quality-of-care framework could not be identified. The only element of the quality of services that can be addressed is the first one, method-choice potential.

Details of the service variables considered are given in Table 1. The first three (a public health center being within 10 kilometers, a pharmacy within 5 kilometers, and outreach services) all provide indicators of physical access to family planning services. The fourth variable, at least three methods available at the nearest facilities, measures the choice of methods available in the community. Because different methods may be provided at different types of facilities, the number of available methods is calculated across all types of facility within 30 kilometers of the cluster.[4]

The final service variable, source of supply, differs from the others in that it is measured at the level of the episode of use, whereas the others are measured at the cluster (or community) level. Different contraceptive outlets are considered to provide services of varying quality, and therefore, to the extent that the quality of services influences contraceptive discontinuation and switching, the source of supply may affect continuation rates. The data on sources of supply are obtained from the second column of the calendar. Although the source of supply may change during an episode of use, only information on the first source was collected for each episode; therefore, this variable refers to the first source used. According to the 1995 DHS, 58 percent of current pill users obtained the method from a government source, primarily health centers and dispensaries. The majority of the remaining women obtained oral contraceptives from a pharmacy (Azelmat et al. 1996). For this analysis, source of supply is classified as government and other because too few users of nongovernment sources other than pharmacies were surveyed to allow a finer classification.

In addition to the service variables, three cluster-level socioeconomic indicators were considered in the analysis to characterize a woman's environment in more detail. Key informants were asked for the source of drinking water and type of toilet facilities used by the majority of households in their community. The third variable considered was the principal economic activity in the area, as reported by the informants.

A number of individual variables were also included in the models. These variables were chosen on the basis that they have been shown to be associated consistently with contraceptive behavior in other studies (for example, Hotchkiss et al. 1995a; Steele and Choe 1997). For the analysis of contraceptive adoption, the individual variables used are: age of the woman at the birth of the child, woman's education, area of residence, whether the index birth was wanted, and whether the woman was breastfeeding. For the analysis of contraceptive discontinuation and switching, the individual variables used are: age of the woman at the start of the episode of use, her education, her area of residence, and her contraceptive intention at the time of the episode of use. Descriptions of these variables are given in the table.

Data Quality

Both the calendar and the panel design of the data raise important data-quality considerations. The calendar requires women to recall detailed information about contraceptive adoption and discontinuation for the five-year period before the survey. Such retrospective reporting relies heavily on the ability of respondents to recall these events accurately. Strickler et al. (1997) used the panel design of the 1992 and 1995 Morocco DHS surveys to

Table 1 Explanatory variables considered in the analysis of service-provision impact on contraceptive-use dynamics, Morocco

Variable	Description
Service	
Public health center within 10km	Public health center that provides family planning services within 10km (6 miles) of the cluster
Pharmacy within 5km	Private pharmacy that provides family planning services within 5km of the cluster
Outreach services	Regularly available home family planning visits, mobile teams, contact points, or itinerant agent that provides family planning services regularly
At least three methods available at nearest facilities	The number of different methods available at the set of nearest facilities of each type within 30km of the cluster (classified as <3 and ≥3)
Source of supply	First source of supply for episode of pill use (used in analyses of discontinuation and switching only; classified as government and other)
Community socioeconomic	
Source of drinking water	Most common source, as reported by key informants (classified as household tap and other)
Toilet facilities	Type of toilet used by majority of households, as reported by key informant (classified as inside toilet, shared or private, and other)
Principal economic activity	As reported by key informant (classified as business/industry/services and other)
Individual	
Age	Woman's age at birth/ start of episode of pill use (classified in single years in the analysis of adoption and as <25, 25–34, and 35+ in the analyses of discontinuation and switching)
Education	Woman's education (classified as none, primary, and secondary+)
Residence	Area of residence (classified as urban and rural in analysis of adoption and as city, town, and rural in analyses of discontinuation and switching)
Contraceptive intention	Whether the woman is using the pill to space births or to limit births (based on the wantedness status of the next birth if the episode of use is followed by a birth, or on current fertility intentions if it is not; used in the analyses of discontinuation and switching only)
Last child wanted	Whether the index birth was wanted then, wanted later, or not wanted (used in analysis of adoption only)
Currently breastfeeding	Time-dependent variable indicating whether the mother is breastfeeding (used in the analysis of adoption only)

examine the reliability of reporting of events in the calendar. The calendars in the 1992 and 1995 DHS surveys overlap for the period 1990–92. Strickler and her colleagues compared individual responses in the calendar for the overlapping period. They found that reporting of contraceptive behavior at the aggregate level was good but that considerable unreliability characterized the individual-level responses, particularly for complex histories. The monthly histories for the period 1990–92 matched exactly for only 28 percent of women who reported at least one episode of contraceptive use in the analysis period in 1992. The reported reason for discontinuation among matched episodes of use was also unreliable; slightly more than one-third of respondents gave a different reason for discontinuation (excluding censored episodes of use). Overall, a slight tendency was found for respondents to be more likely to report in the 1995 DHS than in the 1992 DHS that they had discontinued use in order to become pregnant, responses that may reflect postevent rationalization if a pregnancy followed the discontinuation.

These findings have implications for the analysis. Strickler et al. (1997: 52) show that the reporting errors in the calendar affect estimates of discontinuation and failure rates and conclude that "the unreliability of the reported reason for discontinuation should serve as a caution regarding the conduct of complex statistical analyses designed to explain variation in reasons for discontinuation." The analysis presented here uses information about the reported reason for discontinuation to study discontinuation by reason and to study switching behavior after discontinuation. The analysis by Strickler and her colleagues is based on episodes of contraceptive use during the period 1990–92, whereas this analysis is based on episodes of use during the period 1992–95. To the extent that reporting errors decrease for events that take place closer to the survey date, the analysis sample for this study should be of better quality than the sample of episodes from the 1995 DHS used by Strickler et al.[5] Although the authors agree with Strickler et al. that the calendar data should be used with caution because of the unreliability found in the reporting of past events, they feel that the reason for discontinuation is an important piece of information and that ignoring it completely compromises the analysis more than the data-quality problems do that are introduced by using it.

A second data-quality issue arises from the panel design of the 1992 and 1995 surveys. An important concern in panel studies is loss of respondents between waves of the panel (Duncan and Kalton 1987). Overall, 72 percent of women interviewed in 1992 who were eligible to be reinterviewed in 1995 were successfully reinterviewed. These women were older, more likely to be married or widowed, less educated, and were more likely to live in rural areas than were the women who

were lost to follow-up (Azelmat et al. 1996). The multivariate analysis is based only on responses from women who were interviewed in both rounds, so that the sample is more rural and less educated than the general population.[6] Although both of these characteristics are controlled in the analysis, migration, by itself, may affect some of the relationships of interest. The sample includes some women who migrated prior to 1992, but migrants are under-represented in the sample, compromising the generalizability of findings if the effect of service environment on contraceptive adoption and continuation is different among migrants and nonmigrants. This effect is unlikely to influence the overall conclusions of the study, however.

Statistical Methods

This article uses event-history analysis to evaluate the impact of family planning program indicators, net of individual characteristics, on contraceptive adoption after a birth, on discontinuation, and on switching. In each case, the duration of the occurrence of some event marking a change in contraceptive behavior is of interest—either discontinuation of pill use or initiation of contraceptive use following a postpartum interval of nonuse. Event-history analysis is appropriate for two main reasons: First, a great proportion of women have not experienced the event of interest by the time of the survey; the event-history approach allows such right-censored cases in which the full duration is unknown to be retained in the analysis. Second, some of the factors leading to a change in contraceptive use will vary over the observation period (for example, breastfeeding status). An event-history modeling approach allows time-varying covariates to be incorporated into the analysis. (For an overview of the use of event-history analysis for family planning program evaluation, see Steele and Choe 1997.)

In a study of contraceptive-use dynamics, distinguishing between different reasons for discontinuation of use and different types of behavior following a discontinuation is usually of interest. For example, in the analysis that follows, reasons for discontinuation are grouped into the four categories mentioned earlier. Similarly, behavior after discontinuation may be classified into several categories to distinguish between method switching and continued nonuse. Situations in which more than one event of interest is reported are known as "competing risks." Two approaches are employed to model competing risks. The first is analogous to the multiple-decrement life table and yields net or dependent rates in which the probability that a particular type of event will occur depends on the probabilities corresponding to each of the other competing events. An alternative approach involves using a multivariate extension of the associated single-decrement life table in which an individual who experiences any event other than the one of current interest is treated as censored. This approach yields gross or independent rates that represent an individual's underlying risk of experiencing an event if all other competing risks are absent. In the present competing-risks analysis of contraceptive discontinuation and switching, the first approach is adopted. Although gross rates are often useful for making comparisons across populations, that approach requires the assumption that all competing risks operate independently (Kost 1993). Net rates represent an individual's observed risk of experiencing each of the various types of events and allow for the fact that the competing risks usually operate simultaneously.

In this article, discrete-time event-history models are used. Because durations of contraceptive use are recorded to the nearest month, an approach that assumes measurement in discrete time rather than in continuous time is more natural. Furthermore, accommodating tied observations (in which two or more individuals experience an event for the same duration) and time-varying covariates using a discrete-time formulation is more straightforward. Another advantage of the discrete-time approach is that using it makes possible explicit testing of the assumption made in many event-history models that the hazards for different subgroups are proportional, that is, that the effects of covariates are time-constant. In a discrete-time model, nonproportional effects can be incorporated by interacting covariates with time.

In the single-event case, the discrete-time event-history model can be fitted using logistic regression or any other technique for analyzing binary response data (Allison 1982). If multiple types of events are analyzed, a discrete-time competing-risks model can be fitted using multinomial logistic regression. In order to fit a discrete-time model, each duration must be expanded so that an individual contributes a series of records, one for each discrete time point. Clearly, this procedure may generate an extremely large data set. One way to reduce the size of the data set is to group durations into wider intervals. Thus, in the analysis of discontinuation and switching shown here, durations of contraceptive use are grouped into three-month intervals.

The main focus of this study is the impact of indicators of family planning service provision on contraceptive-use dynamics. However, factors relating to the family planning program operate at a community rather than at an individual level: Women living in the same community share similar health and family planning ser-

vices. Furthermore, although a wide range of family planning indicators is considered in the analysis, some factors relating to the availability and quality of services and other community characteristics that affect contraceptive behavior are probably unobserved or may even be unobservable. Failure to control for these factors would invalidate the fundamental assumption of conventional regression models, namely that individual outcomes are independent; the unexplained component of community-level variation may induce clustering of outcomes among individuals living in a single community. The penalty for ignoring clustering within communities is underestimation of standard errors and a concomitant overstatement of the statistical significance of covariate effects. One way of allowing for community-level variation is to use a multilevel model. In this approach, random effects or error terms defined at individual and at cluster levels are incorporated in the model to represent unobserved individual- and cluster-level factors. These unobserved factors may lead some women or clusters to undergo higher-than-average risks of experiencing an event of interest, whereas other women or clusters may undergo lower-than-average risks. A multilevel model yields estimates of the variation resulting from unobserved factors at each level in the hierarchy. (For a discussion of the use of multilevel models in the study of contraceptive discontinuation, see Steele et al. 1996.) Details of the multilevel event-history models used in this article are given in Appendix A.

The Service Environment in Morocco

Before presenting the main results, some background on service provision in Morocco is provided here to indicate the context for the analysis. The Morocco family planning program was founded in 1966 through the Ministry of Public Health. It aims to provide global coverage of family planning services through a diverse service-delivery infrastructure. A program of home visits for family planning motivation (Visites à Domicile de Motivation Systématique) was launched in 1977, initially in Marrakesh, and was expanded subsequently to cover the entire country. In 1991, this program was expanded to the 12 least-developed provinces, increasing coverage to 95 percent of the population. A social marketing program has been implemented since 1988. The program initially provided the male condom but has been expanded recently to cover two brands of the contraceptive pill and private sales of the IUD (Zarouf and Oucherif 1992).

The expansion of family planning services in Morocco has not been random. Activities have typically started in urban areas and spread to rural ones. As far as is clear, the development of family planning services has been based on logistical and practical considerations rather than on demand factors (for example, placing facilities where demand is high, or conversely, where it is low to stimulate it). The coverage of services is now high in Morocco, as is shown in Table 2.[7] The large majority (84 percent) of women of reproductive age live within 10 kilometers of a health center that provides family planning, whereas 54 percent live within 5 kilometers of a pharmacy, and 63 percent live in a community with some sort of family planning outreach services. Private-sector family planning services are less widely available; fewer than 30 percent of women live within 30 kilometers of a private family planning clinic or an AMPF clinic. The distribution of communities (clusters) in the 1995 DHS sample shows a similar picture. Eighty-seven percent of communities are within 10 kilometers of a health center. Pharmacies and outreach services are also available in most communities, but private-sector facilities are less widely available. Despite this wide coverage, exploratory analysis (not shown) revealed that the socioeconomic status of a community is linked to the type of facilities available. Outreach services tend to be in socioeconomically poorer areas, whereas health centers and pharmacies tend to be located in more urban, better-off areas. The nonrandom placement of facilities

Table 2 Percentage of women and clusters, by service environment and percentage of episodes of pill use, by source of supply, Morocco, 1992

Service characteristic	Women	Clusters
Access to facilities offering family planning		
Health center within 10km	83.7	86.9
Health center within 5km	70.4	77.6
Private clinic within 30km	29.7	35.5
AMPF clinic within 30km	28.8	38.3
Pharmacy within 5km	53.6	62.6
Outreach services[a]	63.4	59.8
Method-choice potential		
Mean number of methods offered at nearest facilities[b]	3.8	4.0
Health center ran out of pills in last six months	9.7	8.4
Source of supply[c]	**Episodes of pill use**	
Government (fixed facility)	49.4	—
Government (mobile services)	5.0	—
Pharmacy	40.9	—
Other	4.6	—

AMPF = Association Marocaine de Planification Familiale.
— = Not applicable.
[a]Outreach services are defined as home visits, mobile units that visit the cluster, point of contact in the cluster, or an itinerant agent who provides family planning services. [b] The total number of methods available at the nearest set of six major types of facility (hospital, health center, private clinic, AMPF clinic, pharmacy, and doctor). The maximum possible is seven methods. [c]Source of supply is measured at the level of episode of use.

raises some statistical issues for the analysis, and these are discussed below.

As mentioned above, the majority of Moroccan women who practice contraception use the pill. A current objective of the Morocco family planning program is to diversify the range of modern contraceptives available. The program is promoting the IUD by training providers and by means of information, education, and communication activities. In addition, Norplant implants and injectable contraceptives have recently been introduced in selected facilities. Table 2 shows that the mean number of methods available to women at their nearest set of facilities in 1992 was 3.8 and that the mean number available in communities was 4.0. Pill supplies are generally available consistently; for only 10 percent of women and 8 percent of communities did the nearest health center within 30 kilometers run out of pills at some point during the last six months. Exploratory analysis revealed evidence that a wider range of methods is available in better-off communities. Another current objective of the Morocco family planning program is to increase the private sector's participation. In the lower panel of the table, the distribution of source of method supply is presented for all episodes of pill use in the 1995 DHS calendar. For 54 percent of episodes of use, pills were obtained from a government source, usually a stationary facility. In the majority of remaining episodes, the pill was obtained from a pharmacy. Relatively few women obtained supplies from any other source. Exploratory analysis (not shown) found that young, educated women living in urban areas were more likely to use a nongovernment source than were older, less-educated, rural women.

The Morocco family planning program is based on a client-centered approach that places a lot of emphasis on providing services of good quality. The DHS SAM data do not provide much information on the quality of services. Data from a 1992 situation analysis conducted in five provinces of Morocco suggest, however, that the quality of services is reasonably good in the majority of facilities, although lack of counseling materials and frequent stockouts of the Ovrette pill (a progestin-only pill) were noted (Brown et al. 1995).

Results

Table 3 presents life-table postpartum adoption rates and net discontinuation rates according to the reasons for discontinuation and behavior after discontinuation. Forty-four percent of women adopted a modern method of contraception within six months of experiencing a live birth, a proportion increasing to almost 70 percent within two years. Side effects and health concerns were the major method-related reason cited for pill discontinuation; 14 percent of women stopped using the pill for one of these reasons within two years. Failure rates for pill users are also relatively high; 7 percent reported experiencing a failure within the first 12 months of use. These failure rates are of a similar magnitude to those observed in many developing countries (Jejeebhoy 1991). The major reason reported for discontinuation at longer durations of pill use was the desire to become pregnant.

Table 3 Six-month, 12-month, and 24-month life-table postpartum modern-method adoption rates and life-table net pill discontinuation rates, by reason for discontinuation and behavior after discontinuation, Morocco, 1992–95

Rates	6 months	12 months	24 months
Postpartum modern-method adoption	44.4	56.2	68.8
Contraceptive pill discontinuation			
Method failure	4.5	7.3	10.6
Desires pregnancy	5.5	9.3	15.9
Side effects/health concerns	7.5	10.3	14.2
Other method-related reason	5.5	6.8	8.2
Other reasons	9.7	10.7	11.9
Continues to use	67.2	55.7	39.2
Pill discontinuation			
Other modern method	6.7	8.8	10.5
Traditional method	3.8	4.6	6.1
Nonuse–at risk	4.1	5.4	7.6
Pregnancy	10.1	16.6	26.5
Nonuse–not at risk	8.1	8.8	10.0

The discontinuation rates by status after contraceptive use has ceased show that the majority of women stopped using the pill either because they wanted to become pregnant or because they experienced method failure. Within the first year of pill use, approximately 13 percent of women switched to another method, in most cases to another modern method rather than a traditional method. Of major concern, however, is the proportion of women who did not switch to an alternative method although they did not state that they wished to become pregnant and were, therefore, at risk of experiencing an unintentional pregnancy. This type of behavior following a discontinuation is termed "nonuser and at risk," and almost 8 percent fell into this category within two years of starting pill use.

In the multivariate analysis of contraceptive-use dynamics, a set of individual-level control variables was introduced first. A combination of forward selection and backward elimination was employed to identify the service variables that influence adoption or any type of discontinuation or method switch. Finally, the socioeconomic community-level variables were tested for statistical significance. In the model-selection process, all

interactions between the explanatory variables and duration of use (or duration of nonuse in the analysis of adoption) were considered to test the assumption that the effects of the explanatory variables are constant across time. In addition, interactions between the service variables and region of residence were considered to test whether the impact of family planning services differed for urban and rural areas. No duration or urban–rural interactions were found to be statistically significant in any of the three analyses, however. The parameter estimates and standard errors for the three selected models are displayed in Appendix B (Tables B1 to B3). Because the focus of the present study is to evaluate the impact of family planning service provision on contraceptive behavior, the discussion of the results is restricted to the statistically significant service variables. To aid interpretation, the estimated coefficients for these variables have been converted to cumulative probabilities. Figure 1 presents the estimated proportion of women who adopt a modern method within 12 months of experiencing a live birth. Cumulative net rates of pill discontinuation by reason are presented in Figure 2. In the calculation of estimated rates for a particular variable, all other variables in the model are held constant at their sample mean.

Two service variables are significantly associated with postpartum method adoption. The estimated rate of modern contraceptive adoption within 12 months of a live birth decreases from 65 percent if a health center provides family planning services within 10 kilometers of the cluster to 43 percent if there is no nearby health center (see Figure 1). Method-choice potential also has a large impact: 12-month adoption rates are considerably higher in clusters with a choice of at least three methods than in those where a more limited range of methods is offered. None of the community socioeconomic indicators was significant. The estimate of the cluster-level variance remains significant even after controlling for these variables (see Appendix Table B1), and their addition to the model reduces the variance by only 10 percent, suggesting that although the degree of method choice and the provision of family planning services at a nearby hospital have a strong influence on method adoption, some important unobserved factors remain.

In the analyses of pill discontinuation (Appendix Table B2) and behavior after discontinuation (Appendix Table B3), no cluster-level variances were statistically significant for any reason for discontinuation or type of switch. Thus, both models were simplified to two levels; random effects at the individual level were retained to allow for unobserved factors at that level. The source from which a woman obtained her pill supplies had a significant effect on some reasons for discontinuation: Discontinuations due to method-related reasons other than failure, side effects, or health concerns were more prevalent among women who obtained their pills from a nongovernment source (see Figure 2). Furthermore, evidence shows (at the 10 percent level) that after discontinuation, women who obtained supplies from a nongovernment source were more likely to discontinue all contraceptive use while they were at risk of experiencing an unintended pregnancy (see Appendix Table B3). Overall, 12-month continuation rates are estimated to be 8 percent higher among women who received the pill from government stationary facilities or outreach services.

Figure 1 Estimated cumulative percentage of women adopting a modern contraceptive method within 12 months of giving birth, by service environment, Morocco, 1992–95

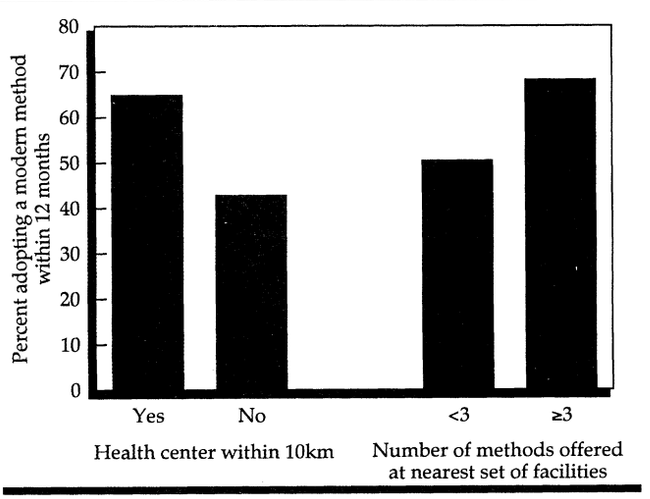
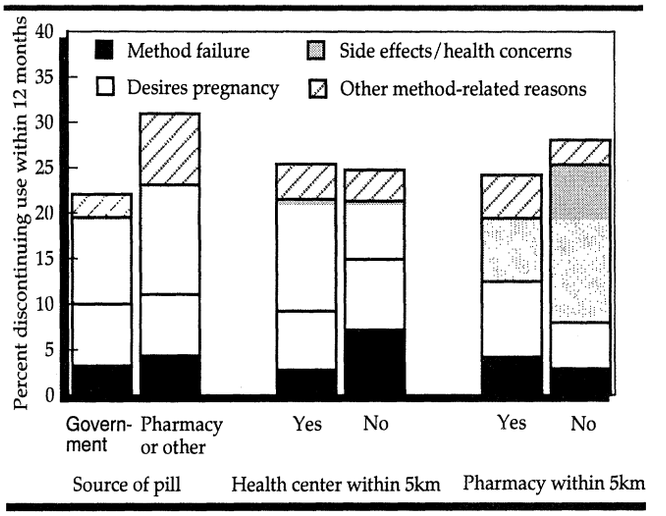


Figure 2 Estimated cumulative net percentage of women discontinuing contraceptive pill use within 12 months, by reason for discontinuation and service environment, Morocco, 1992–95



Method-choice potential did not significantly influence pill discontinuation, but some evidence exists of an effect on behavior after discontinuation. In clusters that offer at least three methods at the nearest set of facilities, women were more likely to switch to an alternative modern method than were their counterparts who had fewer methods from which to choose.

The availability of family planning services at a public health center or a pharmacy within 5 kilometers of the cluster was associated with discontinuation, but not with switching behavior. Failure rates among pill users with access to a nearby public health center were less than half of those experienced by women in areas where the distance to the nearest health center was more than 5 kilometers. The rate of discontinuation due to side effects or health concerns among users in areas without a nearby pharmacy is estimated to be 2.5 times the rate observed in clusters within 5 kilometers of a pharmacy (see Figure 2).

Community-level socioeconomic conditions were significantly associated with only one of the contraceptive outcomes considered: the rate of method-related discontinuation for reasons other than failure, side effects, or health concerns was significantly lower in clusters in which most households have their own tap for drinking water (not shown). Although exploratory analysis revealed that better-off communities are more likely to have health centers, pharmacies, and a reasonably wide choice of methods than are poorer areas, nevertheless the addition of this socioeconomic indicator had almost no influence on the estimated effects of the service variables considered.

Discussion

The findings of this study show some relatively strong service effects on postpartum modern-method adoption, discontinuation, and switching. The number of methods available in a community significantly increases postpartum contraceptive adoption, but has only a weak effect on switching from the pill to another modern method. This finding suggests that the recent emphasis on increasing the diversity of methods available in the Morocco family planning program could result in increased practice of family planning following a birth but is unlikely to lead to substantially increased switching of methods or to significantly longer durations of contraceptive use, at least in the short term.[8]

The Morocco DHS contraceptive-history calendar offers a unique opportunity to examine the link between source of method supply and contraceptive-use dynamics. The results show that women who use a nongovernment source are more likely to discontinue using the pill for method-related reasons and are more likely to stop using a method altogether when they discontinue the pill than are women who use a government source. That higher discontinuation is associated with use of the nongovernment sector is important because of recent interest in increasing the role of the private sector for providing family planning services in Morocco. Unfortunately, determining from these data what source influences behavior is not possible. An in-depth study of the role of source of supply on subsequent contraceptive behavior is needed to address this important question.

The availability of public health centers within 5 kilometers increases method adoption following a birth but has only a weak (and nonsignificant) effect on discontinuation. The availability of pharmacies in the community significantly decreases the risk of discontinuing the pill because of side effects and health concerns. Access and availability problems are rarely cited as a reason for discontinuing the pill (Azelmat et al. 1996), but they may contribute to discontinuation for other reasons. For example, women may be less willing to put up with side effects if supplies are also inconvenient to obtain. As mentioned earlier, pharmacies tend to be situated in better-off areas, and the availability of pharmacies in a community may indicate more convenient access to pill resupplies as well as a greater diversity of source options.

Many of this study's findings are consistent with those found by other authors who have considered the influence of service indicators on contraceptive behavior in Morocco. Magnani et al. (1999) also found that the number of methods available at the nearest set of public clinics increased contraceptive use between 1992 and 1995 among those who were nonusers in 1992, particularly among women who in 1992 stated that they did not intend to use a method. Their study also found that the number of sources of family planning and of pill supplies available within 30 kilometers was associated with increased use. Some differences between the results from this analysis and those from other studies are also evident, however. For example, Hotchkiss et al. (1995a) found a significant effect of home family planning visits on use of contraceptives following the last birth and weaker effects of method availability (only pill availability at pharmacies increased modern-method use). These differences may be the result of inequalities in the outcome variables studied or of differences in the definitions of service variables and in the analytical techniques employed.

Although this study has highlighted the importance of several service variables, limitations exist in the SAM data used in the analysis. As noted above, the lack of

data on service quality limited examination of quality to one element of the framework proposed by Bruce (1990). The analysis of postpartum method adoption reveals a large amount of unexplained cluster-level variation even after controlling for the available measures of service provision, and at least some of this variation is likely due to differences in service quality among clusters. Although data from situation analysis tend to provide more information on quality, these data are not available nationally for Morocco. Furthermore, synthesizing all the information collected in a situation analysis into a few overall indicators for use in a multivariate analysis is difficult.

A second limitation of the analysis arises from the nature of data on the service environment and source of supply. As discussed above, neither the location of facilities nor the choice of source is random, and unmeasured factors associated with these decisions may also influence contraceptive adoption and continuation (that is, service availability and source of supply may be endogenous). Statistically, endogeneity of these variables could bias the parameter estimates (Maddala 1983). For example, if facilities are placed in areas where demand for contraceptives is high, failure to take this factor into account could lead to overstatement of service effects. If, however, facilities are targeted toward areas with low levels of contraceptive use, the effects of service variables may be understated. Controls for several factors known to be associated with the location of services and choice of source have been included in the analysis; doing so did not significantly affect the conclusions regarding service. In addition, the variables on the environment from the SAM measure the environment before the behaviors that are examined occurred, reducing problems of reverse causality. Addressing the endogeneity problems inherent in analyses of this type requires sophisticated statistical techniques that are beyond the scope of this analysis, although further work is planned in this direction.[9] However, the authors are reasonably confident that the broad conclusions presented here are likely to be robust to these statistical problems.

Even if the relationships observed between service factors and contraceptive adoption and discontinuation are not entirely causal, one general conclusion remains the same. Efforts to increase the adoption of contraceptive methods should reach areas with relatively low physical access to services and areas with access to a limited range of methods, and efforts to increase continuity of contraceptive use should reach users of nongovernment sources.

APPENDIX A

Statistical Methods

The statistical models used in the analyses presented and procedures used in their estimation are described below.

Discrete-time Event-history Model of Postpartum Modern-method Adoption

In order to fit a discrete-time event-history model, duration data need to be expanded to give a binary response for each discrete time point indicating whether the event of interest has occurred:

y_{ti} = 1 if individual i experiences the event at time t and 0 otherwise

Thus, each individual contributes a series of responses consisting of a set of zeros for each time point at which the event has not yet occurred, followed by 1 if the event occurs or 0 if the individual is censored.

The discrete-time event-history model for single events (for example, contraceptive adoption) can be fitted as a logistic regression model (see, for example, Allison 1982) and this basic model can be extended to include random effects that capture variation due to unobserved factors operating at individual and community levels:

$$\log\left(\frac{h_{tij}}{1-h_{tij}}\right) = \alpha_t + x_{tij}'\beta + u_{ij} + v_j ,$$

where h_{tij} is the probability or hazard that individual i in cluster j experiences an event at time t, given that the event has not occurred before time t; α_t is some function of time; x_{tij} is a set of possibly time-varying covariates with associated parameters β; u_{ij} and v_j are the individual- and cluster-level random effects, respectively, that are assumed to follow normal distributions with zero means. In the analyses presented in this article, the hazard is represented by a quadratic function of time, that is, $\alpha_t = \alpha_0 + \alpha_1 t + \alpha_2 t^2$. This formulation was found to match the observed hazard the closest.

Discrete-time Event-history Model for Contraceptive Discontinuation and Switching

In the competing-risks situation, the restructured data set will consist of a series of multinomial responses:

y_{rti} = r if individual i experiences an event of type r at time t

One category is taken as the reference category that contains individuals who have not yet experienced an event of any kind at time t and remain in the same state as at the start of the exposure period.

The discrete-time competing-risks model can be formu-

lated as a multinomial logistic regression model and, as in the single-event model, random effects representing unobserved individual- and cluster-level factors may be incorporated:

$$\log\left(\frac{h_{rtij}}{h_{stij}}\right) = \alpha_{ri} + \alpha_{rtij}'\beta_r + u_{rij} + v_{rj},$$

where h_{rtij} is the hazard that an event of type r occurs at time t and h_{stij} is the hazard that no event of any type occurs (the final category s is taken as the reference). The individual- and community-level random effects associated with event type r are respectively u_{rij} and v_{rj}, which are assumed to be normally distributed with zero means. Because the shape of the hazard function and the effects of covariates may vary across different types of events, a separate set of parameters α and β is estimated for each contrast of a type of event with the reference "no event" category.

Estimation of Multilevel Discrete-time Event-history Models

Both the single-event and competing-risks multilevel models can be fitted using multilevel techniques developed for analyzing categorical response data (Goldstein 1995). In this article, the MLn software (Rasbash and Woodhouse 1995) is used to perform the analyses. Estimation of a multilevel multinomial model in MLn requires each multinomial response to be converted to a set of binary responses (see Yang et al. 1996). This procedure generates a very large data set, and, therefore, in the analyses of discontinuation and switching, durations of use were grouped into three-month intervals.

In MLn, estimation of nonlinear models, such as logistic and multinomial models, is carried out using approximate estimation procedures. Two procedures are available in MLn: marginal quasi-likelihood (MQL) and penalized quasi-likelihood (PQL). Rodríguez and Goldman (1995) found that in situations where the number of lower-level units per higher-level unit is small, the MQL procedure may lead to serious underestimation of the random-effect variances. However, Goldstein and Rasbash (1996) found that when the improved PQL estimation procedure was applied to the data sets used by Rodríguez and Goldman, these biases were virtually eliminated. Therefore, PQL estimates were obtained for the analyses presented in this article.

APPENDIX B

Results from the Multilevel Discrete-time Event-history Analyses

Table B1 Parameter estimates (with standard errors) from discrete-time event-history model of modern-method adoption after a birth, Morocco, 1992–95

Variable	Estimate	Standard error
Currently breastfeeding[a]	0.19	(0.21)
Mother's age at birth (years)	–0.04**	(0.01)
Mother's education		
None (r)	0.00	—
Primary	0.93**	(0.21)
Secondary+	0.97**	(0.23)
Last child wanted		
Yes (r)	0.00	—
No, later	0.33	(0.18)
No, not at all	0.57**	(0.18)
Region of residence		
Rural (r)	0.00	—
Urban	0.60*	(0.26)
Cluster-level		
Public health center within 10km	0.65*	(0.30)
≥3 methods available at nearest set of facilities	0.51*	(0.24)
Random-effect variances		
Cluster-level variance	0.53**	(0.14)
Individual-level variance	0.73**	(0.14)
Constant	–2.05	(0.45)
Duration of nonuse[a] (months)	–0.14**	(0.02)
Duration of nonuse squared	0.00**	(0.00)

(r) = Reference category. *Significant at $p \leq 0.05$; **$p \leq 0.01$. — = Not applicable.

[a]These variables are time dependent.

Table B2 Parameter estimates (with standard errors) from the discrete-time competing-risks model of pill discontinuation, Morocco, 1992–95

Variable	Reason for discontinuation: Method failure vs. continue		Desires pregnancy vs. continue		Side effects/ health concerns vs. continue		Other method-related[a] vs. continue	
Constant	–4.36	(0.98)	–3.94	(0.70)	–3.76	(0.74)	–4.17	(1.26)
Duration	0.12	(0.14)	0.28	(0.12)	–0.04	(0.10)	–0.23	(0.23)
Duration squared	–0.01	(0.01)	–0.02	(0.01)	0.00	(0.01)	0.01	(0.03)
Age at start								
<25	0.60	(0.33)	0.83**	(0.24)	0.10	(0.28)	–0.20	(0.60)
25–34 (r)	0.00	—	0.00	—	0.00	—	0.00	—
35+	–0.54	(0.42)	–0.05	(0.42)	0.49*	(0.28)	1.33*	(0.57)
Contraceptive intention								
Spacing (r)	0.00	—	0.00	—	0.00	—	0.00	—
Limiting	0.62	(0.32)	–1.66**	(0.32)	–0.10	(0.25)	–0.99	(0.52)
Education								
None (r)	0.00	—	0.00	—	0.00	—	0.00	—
Primary	–0.57	(0.51)	–0.08	(0.36)	0.21	(0.34)	0.45	(0.61)
Secondary+	0.24	(0.41)	0.54	(0.33)	0.93**	(0.33)	–0.55	(0.75)
Residence								
Rabat/Casablanca (r)	0.00	—	0.00	—	0.00	—	0.00	—
City	–0.38	(0.60)	–0.57	(0.54)	0.13	(0.40)	–1.15	(1.14)
Town	0.04	(0.46)	0.54	(0.40)	0.05	(0.39)	0.07	(0.76)
Rural	–0.47	(0.84)	–0.03	(0.60)	–0.25	(0.63)	–0.99	(1.07)
Source of pill								
Government (r)	0.00	—	0.00	—	0.00	—	0.00	—
Other[b]	0.37	(0.34)	0.08	(0.27)	0.31	(0.26)	1.19*	(0.51)
Cluster-level								
Public health center within 5km	–0.94	(0.54)	–0.18	(0.36)	0.66	(0.35)	0.13	(0.79)
Pharmacy within 5km	0.33	(0.58)	0.46	(0.42)	–0.95**	(0.36)	0.53	(0.84)
Household tap most common source of drinking water	0.12	(0.64)	–0.89	(0.48)	–0.03	(0.49)	–1.78*	(0.88)
Random-effect variances								
Individual-level variance	0.00	(0.00)	0.06	(0.25)	0.95**	(0.36)	0.96	(1.16)

(r) = Reference category. — = Not applicable. *Significant at $p \leq 0.05$; **$p \leq 0.01$.
[a]Reasons include husband disapproves, inconvenient, more effective method wanted, cost, and accessibility. [b]Category includes pharmacy and private sources.

Table B3 Parameter estimates (with standard errors) from the discrete-time competing-risks model of behavior after pill discontinuation, Morocco 1992–95

Variable	Type of switch: Pregnancy vs. continue		Other modern method[a] vs. continue		Traditional method vs. continue		Nonuse and at risk[b] vs. continue	
Age at start								
<25	0.79**	(0.19)	0.40	(0.45)	–0.14	(0.45)	–0.01	(0.35)
25–34 (r)	0.00	—	0.00	—	0.00	—	0.00	—
35+	–0.26	(0.30)	0.86*	(0.44)	0.66	(0.42)	0.30	(0.35)
Contraceptive intention								
Spacing (r)	0.00	—	0.00	—	0.00	—	0.00	—
Limiting	–0.67**	(0.20)	–0.16	(0.39)	–0.38	(0.38)	–0.23	(0.32)
Education								
None (r)	0.00	—	0.00	—	0.00	—	0.00	—
Primary	–0.29	(0.29)	0.75	(0.49)	1.02*	(0.52)	–0.15	(0.45)
Secondary+	0.40	(0.26)	0.85	(0.48)	1.67**	(0.50)	–1.31	(0.77)
Residence								
Rabat/Casablanca (r)	0.00	—	0.00	—	0.00	—	0.00	—
City	–0.49	(0.40)	–0.46	(0.60)	0.36	(0.49)	0.88	(0.89)
Town	0.40	(0.31)	0.25	(0.51)	–0.20	(0.56)	1.29	(0.83)
Rural	0.37	(0.29)	–0.43	(0.54)	–0.73	(0.61)	1.56*	(0.79)
Source of pill								
Government (r)	0.00	—	0.00	—	0.00	—	0.00	—
Other[c]	0.24	(0.21)	0.30	(0.41)	0.69	(0.43)	0.55	(0.32)
Cluster-level								
≥3 methods available at nearest set of facilities	0.31	(0.21)	0.95	(0.57)	–0.74	(0.46)	–0.54	(0.29)
Random-effect variances								
Individual-level variance	0.00	(0.00)	0.51	(0.73)	1.89**	(0.66)	0.83	(0.54)
Constant	–4.18	(0.41)	–5.94	(0.87)	–4.51	(0.79)	–4.80	(0.88)
Duration	0.21*	(0.09)	0.02	(0.17)	–0.07	(0.15)	–0.19	(0.13)
Duration squared	–0.01	(0.01)	–0.01	(0.02)	0.00	(0.02)	0.02	(0.01)

(r) = Reference category. — = Not applicable. *Significant at $p \leq 0.05$; **$p \leq 0.01$.
[a]Figures include unwanted pregnancies (due to contraceptive failure) and wanted pregnancies. [b]Includes those at risk of an unwanted pregnancy, that is, discontinuations for reasons other than wanted pregnancy, menopause, marital dissolution, and infrequent sex. [c]Category includes pharmacy and private sources.

Notes

1 An index of mechanisms to promote continuity of use did have a statistically significant effect on use, but the effect was negative.

2 For further details of the design of the 1995 Panel Survey, see Azelmat et al. (1996) or Curtis and Westoff (1996).

3 The survey protocol specified that about six informed respondents should be identified, including at least one woman, but in practice, fewer than six informed respondents were identified in the majority of clusters, and only two respondents were identified in more than half of the clusters (Mohamed et al. 1995).

4 Information on method availability is collected only for the nearest of each type of facility. Therefore, the variable reflects the number of methods available at the set of nearest facilities. Essentially, the same methods are assumed to be available in facilities of the same type in the same community.

5 Strickler et al. (1997) found no evidence of improvement in the quality of reporting of events in the first column of the calendar over time for the period 1990–92. In an analysis of data from the same two surveys, however, Bankole and Westoff (1998) found that women were more likely to report in the 1992 DHS than in the 1995 DHS that the last birth in the period 1990–92 was unwanted, which the authors attributed to postevent rationalization. To the extent that some of the unreliability of reporting of the reason for discontinuation reflects postevent rationalization, the data used here for the period 1992–95 should be more reliable than the data used by Strickler et al.

6 Never-married women are not included in the sample because they were not asked about contraceptive use and fertility and therefore cannot contribute reports of any births or episodes of use to the responses.

7 The figures for women are obtained by linking the 1992 SAM data to the sample of all women interviewed in the 1995 DHS. The figures for clusters are based on the 1992 SAM data for the 107 clusters included in the 1995 DHS. All figures are unweighted. Because the sample of women in the 1995 DHS is self-weighted, the figures in Table 2 are representative of all women in Morocco. Clusters were selected, however, with probability proportional to size; therefore, the sample of clusters is not self-weighting, and the figures for clusters are not representative of all clusters in Morocco.

8 Lakksir and Brown (1998) found that provider bias and negative rumors about the side effects of the IUD were a barrier to its adoption in Morocco. In the longer term, switching and continuation may increase with method diversity as new methods become better established and fears about them subside.

9 One way of allowing for the effects of unobserved variables would be to use an estimation approach by which the determinants of source of supply, program placement, and discontinuation are modeled simultaneously. Angeles et al. (1998) assessed program impact in Tanzania taking into account nonrandom placement of program services in a simultaneous equations approach. Their approach requires the collection of supplementary community-level data, however. Their study uses time-series data at the cluster level, including information on government health expenditure and child mortality rates, to construct a series of equations for modeling the determinants of facility placement.

References

Akin, John S. and Jeffrey J. Rous. 1997. "Effect of provider characteristics on choice of contraceptive behavior: A two-equation full-information maximum-likelihood estimation." *Demography* 34(4): 513–523.

Allison, Paul D. 1982. "Discrete-time methods for the analysis of event histories." In *Sociological Methodology*. Ed. S. Leindhardt. San Francisco: Jossey-Bass. Pp. 61–98.

Angeles, Gustavo, David K. Guilkey, and Thomas A. Mroz. 1998. "Targeted program placement and the estimation of the impact of family planning programs on fertility." Paper presented at the annual meeting of the Population Association of America, Chicago, 2–4 April.

Azelmat, Mustapha, Mohamed Ayad, and El Arbi Housni. 1996. *Enquête de Panel sur la Population et la Santé (EPPS) 1995*. Calverton, MD: Ministère de la Santé Publique, Direction de la Planification et des Ressources Financières, Services des Etudes et de l'Information Sanitaire de Maroc and Macro International.

Bankole, Akinrinola and Charles F. Westoff. 1998. "The consistency and validity of reproductive attitudes: Evidence from Morocco." *Journal of Biosocial Science* 30(4): 439–455.

Bertrand, Jane T., Karen Hardee, Robert J. Magnani, and Marcia A. Angle. 1995. "Access, quality of care and medical barriers in family planning programs." *International Family Planning Perspectives* 21(2): 64–69.

Bongaarts, John. 1994. "The impact of population policies: Comment." *Population and Development Review* 20(3): 616–620.

Brown, Lisanne, Mostafa Tyane, Jane Bertrand, Don Lauro, Mohamed Abou-ouakil, and Lisa deMaria. 1995. "Quality of care in family planning services in Morocco." *Studies in Family Planning* 26(3): 154–168.

Bruce, Judith. 1990. "Fundamental elements of the quality of care: A simple framework." *Studies in Family Planning* 21(2): 61–91.

Cotten, Niki, John Stanback, Halima Maidouka, Joseph T. Taylor-Thomas, and Tom Turk. 1992. "Early discontinuation of contraceptive use in Niger and The Gambia." *International Family Planning Perspectives* 18(4): 145–149.

Curtis, Siân L. 1997. "Using calendar data to study contraceptive use dynamics." Paper presented at the joint EVALUATION Project/International Union for the Scientific Study of Population seminar on Methods for Evaluating Family Planning Programs, Costa Rica, 14–16 May.

Curtis, Siân L. and Ann K. Blanc. 1997. "Determinants of Contraceptive Failure, Switching, and Discontinuation: An Analysis of DHS Contraceptive Histories." *DHS Analytical Reports* No. 6. Calverton, MD: Macro International.

Curtis, Siân L. and Charles F. Westoff. 1996. "Intention to use contraceptives and subsequent contraceptive behavior in Morocco." *Studies in Family Planning* 27(5): 239–250.

DeGraff, Deborah S., Richard E. Bilsborrow, and David K. Guilkey. 1997. "Community-level determinants of contraceptive use in the Philippines: A structural analysis." *Demography* 34(3): 385–398.

Duncan, Greg J. and Graham Kalton. 1987. "Issues of design and analysis of surveys across time." *International Statistical Review* 55(1): 97–117.

Gertler, Paul J. and John W. Molyneaux. 1994. "How economic development and family planning programs combined to reduce Indonesian fertility." *Demography* 31(1): 33–63.

Goldstein, Harvey. 1995. *Multilevel Statistical Models*. London: Arnold.

Goldstein, Harvey and Jon Rasbash. 1996. "Improved approximations for multilevel models with binary responses." *Journal of the Royal Statistical Society, Series A*. 159(3): 505–513.

Hotchkiss, David R., Robert J. Magnani, Jeffrey J. Rous, Mustapha Azelmat, Thomas A. Mroz, and Jaffar Heikel. 1995a. "The effects of MCH service utilization on subsequent contraceptive use in Morocco." School of Public Health and Tropical Medicine, Tulane University Medical Center. Unpublished.

Hotchkiss, David R., Robert J. Magnani, Naomi Rutenberg, Luciano L. Correia, Gwendolyn T. Morgan, and Martha Scutula. 1995b. "Access to family planning services, service quality, and contraceptive use in northeast Brazil." Paper presented at the annual meeting of the Population Association of America, San Francisco, 2–8 April.

Jain, Anrudh K. 1989. "Fertility reduction and the quality of family planning services." *Studies in Family Planning* 20(1): 1–16.

Jejeebhoy, Shireen. 1991. "Measuring contraceptive use—failure and continuation: An overview of new approaches." In *Measuring the Dynamics of Contraceptive Use*, proceedings of the United Nations Expert Group Meeting on Measuring the Dynamics of Contraceptive Use. New York: United Nations.

Knowles, James C., John S. Akin, and David K. Guilkey. 1994. "The impact of population policies: Comment." *Population and Development Review* 20(3): 611–615.

Koenig, Michael A., Mian Bazzle Hossain, and Maxine Whittaker. 1997. "The influence of quality of care upon contraceptive use in rural Bangladesh." *Studies in Family Planning* 28(4): 278–289.

Kost, Kathryn. 1993. "The dynamics of contraceptive use in Peru." *Studies in Family Planning* 24(2): 109–119.

Lakksir, Abdelylah and Lisanne Brown. 1998. "Intrauterine device use in Morocco: Identifying barriers and evaluating progress." Unpublished.

Maddala, G.S. 1983. *Limited Dependent and Qualitative Variables in Econometrics*. New York: Cambridge University Press.

Magnani, Robert J., Leigh Anne Shafer, David R. Hotchkiss, and Curtis S. Florence. 1999. "The impact of the family planning supply environment on contraceptive intentions and subsequent use in Morocco." Forthcoming in *Studies in Family Planning*.

Mauldin, W. Parker and Robert J. Lapham. 1985. "Measuring family planning program effort in developing countries, 1972 and 1982." In *The Effects of Family Planning on Fertility in the Developing World. World Bank Staff Working Paper* No. 677. Ed. Nancy Birdsall. Washington DC: The World Bank.

Mensch, Barbara, Mary Arends-Kuenning, and Anrudh Jain. 1996. "The impact of the quality of family planning services on contraceptive use in Peru." *Studies in Family Planning* 27(2): 59–75.

Mohamed, Zaoui, El Harim Karima, and Lisanne Brown. 1995. "Disponibilité des services de santé et de planification familiale au Maroc: Rapport preliminaire." Unpublished.

Pariani, Siti, David M. Heer, and Maurice D. Van Arsdol, Jr. 1991. "Does choice make a difference to contraceptive use? Evidence from East Java." *Studies in Family Planning* 22(6): 384–390.

Pritchett, Lant H. 1994a. "Desired fertility and the impact of population policies." *Population and Development Review* 20(1): 1–55.

———. 1994b. "The impact of population policies: Reply." *Population and Development Review* 20(3): 621–630.

Rasbash, Jon and Geoff Woodhouse. 1995. *MLn Command Reference*. London: Multilevel Models Project, Institute of Education, University of London.

Rodríguez, Germán and Noreen Goldman. 1995. "An assessment of estimation procedures for multilevel models with binary responses." *Journal of the Royal Statistical Society Series A* 158(1): 73–89.

Steele, Fiona, Ian Diamond, and Duolao Wang. 1996. "The determinants of the duration of contraceptive use in China: A multilevel multinomial discrete-hazards modeling approach." *Demography* 33(1): 12–23.

Steele, Fiona and Minja Choe. 1997. "Event history analysis for family planning programme evaluation." Paper presented at the joint EVALUATION Project/International Union for the Scientific Study of Population seminar on Methods for Evaluating Family Planning Programs, Costa Rica, 14–16 May.

Strickler, Jennifer A., Robert J. Magnani, H. Gilman McCann, Lisanne F. Brown, and Janet C. Rice. 1997. "The reliability of reporting of contraceptive behavior in DHS calendar data: Evidence from Morocco." *Studies in Family Planning* 28(1): 44–53.

Tsui, Amy Ong and Luis H. Ochoa. 1992. "Service proximity as a determinant of contraceptive behavior: Evidence from cross-national studies of survey data." In *Family Plannning Programs and Fertility*. Eds. James F. Phillips and John A. Ross. London: Clarendon Press–Oxford.

Yang, Min, Harvey Goldstein, and Jon Rasbash. 1996. *MLn Macros for Advanced Multilevel Modelling*. London: Multilevel Models Project, Institute of Education, University of London.

Zarouf, Mohamed and Brahim Oucherif. 1992. Programme National de la Planification Familiale. Ministère de la Santé Publique (de Maroc), Direction de la Prevention et de l'encadrement sanitaire, Division de la Population.

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