

Selection Effects in an Analysis of Contraceptive Discontinuation in Morocco: An application of a Multiprocess Multilevel Model

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1. Introduction

An important area of demographic research in developing countries has been the contribution of family planning programmes to increasing contraceptive prevalence and fertility decline. More recently, as contraceptive prevalence increases, attention has extended to other measures of programme success such as contraceptive continuation. Studies of programme impact on fertility and contraceptive prevalence typically involve examining the effects of community-level indicators of programme availability and accessibility. However, to examine the impact of a family planning programme on contraceptive discontinuation it is necessary to compare discontinuation rates across different types of facility. To do so, individual-level data on where couples obtain their contraceptive supplies is required. Such data were collected for the first time in Morocco in 1995 under the Demographic and Health Surveys (DHS) programme. The aim of this paper is to estimate the effect of source of contraceptive supply on pill discontinuation in Morocco using these DHS data.

Since women living in the same community have access to similar family planning services it is natural to use a multilevel model to study the factors influencing contraceptive discontinuation. A further hierarchical level may be identified from the Morocco DHS data since women may contribute more than one episode of pill use over the six-year observation period. Using a multilevel approach unobserved factors operating at the individual and community level are represented in the model by random effects. These random effects are usually assumed to be uncorrelated with the covariates in the model. In evaluating the effect of source of supply on contraceptive behaviour, however, this assumption is likely to be questionable for two reasons: non-random programme placement and self-selection.

Family planning programmes are unlikely to be placed at random, and there may be differences in the placement strategies for government and private facilities. Further, the factors influencing programme placement may also affect discontinuation rates. Targeted programme placement is a form of selectivity that operates at the community level since family planning services are implemented at this level. In addition, there is potentially selectivity at the individual level since a couple's decision about which service to use depends not only on the availability and quality of facilities, but also on their personal preferences. There may be factors that affect a couple's choice of supplier, such as economic status, that also affect their probability of discontinuing contraceptive use. Unless these two sources of selectivity are controlled, it is unclear whether a low or high discontinuation rate observed among users of a particular type of facility reflects the characteristics of that facility, the characteristics of the community in which it is located, or the characteristics of its clients.

Selection bias in programme evaluation due to non-random placement or self-selection into programmes has been extensively discussed in the econometrics literature (e.g. Angeles, Guilkey and Mroz (1998) and Moffitt (1991)). One way to correct for non-random placement is to use a simultaneous equations model in which the outcome of interest is modelled jointly with the endogenous programme indicators (Angeles et al., 1998). Simultaneous equations models have also been used to allow for self-selection (see, e.g., Pitt et al., 1999). In this paper, a multilevel simultaneous equations model, also called

a multiprocess multilevel model, is used to account for both non-random placement and self-selection.

2. The multiprocess multilevel model

A multiprocess multilevel model is used to allow for the effects of omitted covariates at the individual and community level that influence both continuation of contraceptive use and choice of source. This approach involves modelling simultaneously the processes of contraceptive continuation and choice of source of supply, allowing for correlation between individual and community-level random effects across processes. The hazard of a method-related discontinuation is modelled using a three-level event history model as follows:

$$\ln h_{ijk}(t) = f(t) + \hat{\mathbf{a}}^D \mathbf{X}_{ijk}^D + \mathbf{g}_{ijk} + v_k^D + u_{jk}^D \quad (1)$$

where $h_{ijk}(t)$ is the hazard of discontinuation in month t for pill episode i of woman j in community k . The log-hazard rate is assumed to depend on the month of use through a function $f(t)$, the baseline log-hazard rate, which is specified as a piecewise-linear spline. The explanatory variable of major interest is Z_{ijk} , a binary indicator for source of supply (classified as private or government). Other covariates, defined at any level in the hierarchical structure, are represented by the vector \mathbf{X}_{ijk}^D . Z_{ijk} and \mathbf{X}_{ijk}^D have coefficients \mathbf{g} and $\hat{\mathbf{a}}^D$ respectively. Normally distributed random effects u_{jk}^D and v_k^D are included to allow for unobserved heterogeneity at the individual and community level respectively.

A three-level probit model is used to model choice of source of supply. We assume that underlying the binary indicator of choice of source is a continuous latent variable Z_{ijk}^* that represents the propensity to choose a private facility rather than a government facility. We observe $Z_{ijk} = 1$ if $Z_{ijk}^* > 0$, and $Z_{ijk} = 0$ if $Z_{ijk}^* \leq 0$. The probit model takes the following form:

$$Z_{ijk}^* = \hat{\mathbf{a}}^S \mathbf{X}_{ijk}^S + v_k^S + u_{jk}^S + \mathbf{e}_{ijk}^S \quad (2)$$

where \mathbf{X}_{ijk}^S is a vector of covariates and u_{jk}^S and v_k^S are, respectively, individual and community level random effects assumed to follow normal distributions. Error at the episode level is captured by \mathbf{e}_{ijk}^S which is assumed to follow a standard normal distribution.

Equations (1) and (2) together form a three-level multiprocess model. The two equations are linked by allowing random effects at the same hierarchical level to be correlated across equations. These correlations are denoted by $\text{Corr}(u_{jk}^D, u_{jk}^S) = \mathbf{r}_u^{DS}$ and $\text{Corr}(v_k^D, v_k^S) = \mathbf{r}_v^{DS}$. Non-zero correlations allow for unmeasured individual and community level factors that influence both discontinuation and the choice of source. For example, if $\mathbf{r}_u^{DS} > 0$ women with above-average risk of discontinuing ($u_{jk}^S > 0$) will tend also to have above-average propensities to use a private facility ($u_{jk}^D > 0$).

3. The effect of source of contraceptive supply on pill discontinuation in Morocco

The analysis sample consists of all pill episodes started after January 1990. A total of 2013 episodes were analysed, contributed by 1309 women in 105 clusters ('communities'). We focus on discontinuation due to method-related reasons, the most frequent of these being failure, side-effects and health concerns. The explanatory variable of major interest is the source of contraceptive supply, classified here as government or private (mainly pharmacies). Other explanatory variables that are included as predictors of both discontinuation and choice of supplier are the woman's age at the start of the episode, her level of education, region of residence and the year that she started use.

The results from a standard multilevel event history model are compared to those from the

multiprocess model. From the multiprocess model, we obtain estimates of the correlation between the random effects at the same hierarchical level across the equations for discontinuation and choice of provider. The estimates of the correlations between the individual-level and community-level random effects are respectively $\hat{\mathbf{r}}_u^{DS} = 0.103$ (SE = 0.192) and $\hat{\mathbf{r}}_v^{DS} = 0.324$ (SE = 0.213). Although \mathbf{r}_v^{DS} is not significantly different from zero, the moderate positive estimate suggests that communities where use of private facilities is relatively high also tend to have high discontinuation rates.

An interactive effect between source of supply and year of starting use is found in both models (see Table 1). For pill episodes that began during 1990 or 1991, the difference in discontinuation rates is underestimated using the standard event history model; for episodes beginning in 1992, the standard model slightly overestimates the effect of source. However, before 1993 the effect of source is not found to be significant in either model. From 1993, discontinuation rates were significantly higher among users of a private facility. This effect remains, though reduced, once endogeneity of source is controlled for using the multiprocess model.

Table 1. Estimated coefficients from multilevel event history models for pill discontinuation (adjusted for age, education and region of residence)

	Standard model		Multiprocess model	
	Coefficient	(SE)	Coefficient	(SE)
<i>Source of supply</i>				
Public	0.00	-	0.00	-
Private	-0.15	(0.16)	-0.34	(0.31)
<i>Year of start of episode</i>				
1990	0.00	-	0.00	-
1991	0.07	(0.19)	0.07	(0.19)
1992	0.08	(0.20)	0.08	(0.20)
1993-95	-0.17	(0.18)	-0.17	(0.18)
<i>Source x Year interaction</i>				
Private and 1991	-0.03	(0.29)	-0.04	(0.29)
Private and 1992	0.27	(0.28)	0.28	(0.28)
Private and 1993-95	0.73	(0.24)	0.75	(0.24)

From the probit model of choice of source of supply (results not shown) we find evidence of substantial differences in the characteristics of private and public sector clients. The more education a woman has completed, the greater her likelihood of using a private facility. Also, the probability of choosing a private source is highest among women in the major cities of Rabat and Casablanca and lowest among rural women. This effect most likely reflects differences in the availability of private services across different regions and between urban and rural areas. There is also evidence of a large amount of unexplained variation in choice of source between women and between communities. One might expect that the availability and quality of private facilities would be major determinants of their use, and that such factors might also influence the chance of contraceptive discontinuation. However, from the multiprocess model, we find that the community factors affecting choice of a private source and the community factors affecting the likelihood of a method-related discontinuation are not significantly correlated.

4. Conclusions

The arguments for using multilevel models to analyse data from a hierarchical population are well known (see, for example, Goldstein 1995). However, many variables that we consider as explanatory are potentially endogenous with respect to our outcome of interest. In a multilevel situation, endogeneity may operate at any level in a hierarchical structure. For example, in the context of family planning programme evaluation, the possibility of targeted programme placement is well known. Angeles et al. (1998) use a multiprocess model to adjust for selectivity at the community level in an analysis of the impact of community-level measures of service accessibility on individual-level behaviour. In the present case, there is the additional possibility of a selection effect operating at the individual level since source of supply

is an individual-level programme measure. This paper provides an illustration of how multiprocess multilevel modelling may be used to allow for selectivity at each level in a hierarchical structure in assessing the impact of choice of source of supply on contraceptive discontinuation.

Little evidence of a selection effect of source of supply on discontinuation is found. The estimates obtained from both models imply that discontinuation rates were higher among users of private facilities for pill episodes starting after 1992. Although the effect of provider is reduced when endogeneity of source of supply is controlled, the effect remains in the same direction and statistically significant. This suggests that there is a real difference in the discontinuation rates between these two types of service provider which cannot be explained by differences in the characteristics of their clients or in the characteristics of the communities in which they are located.

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RESUME

Les modèles hiérarchiques présupposent qu'il n'existe pas de corrélation entre les variables explicatives et les effets aléatoires. Dans certaines situations une telle supposition n'est pas valable. Tel est le cas de l'évaluation d'un programme sanitaire ou social construit de manière non-aléatoire dans lequel la participation de sujets est volontaire. Il peut alors y avoir les facteurs qui influencent l'élaboration du programme et la décision de participer qui influencent les résultats obtenus. Cet article présente une application d'un modèle hiérarchique utilisé pour mesurer les différences dans la fréquence d'utilisation de méthodes contraceptives selon qu'elles sont distribués soit par le secteur privé soit le secteur publique. Ce modèle tient aussi compte de la possibilité qu'il puisse y avoir des facteurs, tant au niveau des individus que des communautés, qui passent imperçus mais qui n'en influencent pas moins les couples dans leur choix de "distributeur" ainsi que dans la probabilité qu'ils cessent d'utiliser un mode de contraception.