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# Fertility, Contraceptive Choice, and Public Policy in Zimbabwe

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*Zimbabwe has invested massively in public infrastructure since independence in 1980. The impact of these investments on demographic outcomes is examined using household survey data matched with two community level surveys. A woman's education is a powerful predictor of both fertility and contraceptive use. These relationships are far from linear and have changed shape in recent years. After controlling for household resources, both the availability and quality of health and family planning services have an important impact on the adoption of modern contraceptives. In particular, outreach programs such as mobile family planning clinics and community-based distributors (CBDs) have been especially successful. However, not all women are equally served by this infrastructure. For example, CBDs have a bigger impact on younger, better educated women, while mobile family planning clinics appear to have more success with older, less educated women.*

Since independence in 1980 the government of Zimbabwe has invested massively in infrastructure and a large share of the public budget has been allocated to the provision of social services, particularly health and education. For example, between 1980 and 1986, enrollment ratios rose by 40 percent among primary school age children and almost sixfold (from 8 to 46 percent) among those of secondary school age. Today the vast majority of the population has access to primary education. The family planning program, which has been integrated into the public health system since the mid-1980s, has expanded dramatically since independence (Boohene and Dow 1987), and there has been considerable effort to provide services to the poorest Zimbabweans.

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What have these investments bought in terms of demographic outcomes? Among Sub-Saharan African countries, Zimbabwe, along with Botswana and South Africa, leads the pack in terms of adoption of modern contraceptive methods. According to the 1988 Zimbabwe Demographic and Health Survey (ZDHS), 27 percent of women age 15 to 49 were using a modern method at that time, almost 50 percent had used a method, and knowledge of modern methods was virtually universal (CSO and IRD/Macro International 1989). Prevalence rates are roughly similar in Botswana (where per capita gross national product (GNP) is about 50 percent higher than in Zimbabwe) and these rates are about twice those reported in Kenya. Prevalence rates in the rest of continental Africa (apart from South Africa) are typically below 10 percent (National Research Council 1993a). Yet, in spite of the apparent success of family planning in Zimbabwe, fertility remains high: the total fertility rate (TFR) was estimated to be about 5.5 in 1988 (CSO and IRD/Macro International 1989).

Critics have charged that the family planning program is not effective. Mauldin and Ross (1991), for example, rank the strength of the program as "moderate" and well behind that of Botswana. Some studies have suggested that a majority of women use contraceptives for birth spacing rather than stopping (Way, Cross, and Kumar 1987); others have suggested that contraceptives are used inefficiently (Adamchak and Mbizvo 1990); and the family planning program has been criticized for relying too heavily on only one modern method, the pill.

There has not, however, been any systematic evaluation of the impact of the public investments in health and education infrastructure in Zimbabwe over the last decade. Because the effects of these investments are likely to be greatest on the most recent age cohorts, it will be decades before it is possible to provide a complete and definitive answer to the question of what the investments have bought. But policy decisions cannot wait decades and some aspects of the question can be addressed. This article attempts to do just that.

Using microlevel data, we begin with an examination of the determinants of fertility outcomes in Zimbabwe, focusing on the role of the household and its resources, in particular education and measures of income. To assess the impact on fertility of public investments in health and family planning services, historical data on those services are needed because fertility reflects the cumulation of choices, attitudes, and service availability over a woman's entire childbearing life. This is true even of current fertility (such as births in the last five years). Although the surveys we use are rich, they do not contain historical information that would allow us to directly examine the link between infrastructure and fertility. We turn, therefore, to a choice related to fertility outcomes, the decision to use modern contraceptives. In addition to examining the influence of household resources, we place the spotlight on the role of the availability and quality of community health and family planning services. We pay special attention to the distributional impact of investments in health programs by examining differences in the effects of the programs across educational groups and different cohorts of women.

Consistent with much of the rest of the literature, we find that education is a powerful predictor of both fertility and contraceptive usage. Moreover, these relationships are far from linear and have changed shape in recent years in Zimbabwe. For example, among women age thirty-five and above, there is no significant relationship between education and the number of children ever born; among younger women, however, the relationship is negative and significant, and even women with relatively little education have fewer children than their less educated peers. Turning to community characteristics, the results indicate that health and family planning services do have a positive impact on adoption of modern methods, after controlling for household resources. In particular, outreach programs such as mobile family planning clinics and community-based distributors (CBDs) have been especially successful. Not all women are equally served by this infrastructure. For example, CBDs have a bigger impact on younger, better educated women and mobile family planning clinics appear to have more success with older, less educated women.

The next section outlines the conceptual model guiding the empirical analysis. Section II describes the data. The results are presented in section III, and a conclusion follows.

## I. Model

Following the economic model of household production (Becker 1981) applied to fertility and contraception (Rosenzweig and Schultz 1985), we assume that households choose to allocate resources in order to maximize utility, which depends on consumption of market and nonmarket goods. Consumption includes the leisure of all household members as well as, among others, the quantity and quality of children. Household choices are made based on a budget constraint and the technology underlying home production, including the production of child quantity and quality.

On the one hand children are valued in and of themselves, and may also be viewed as productive assets, providing labor while young and yielding returns in terms of income support to parents later in life. On the other hand children impose a time and money cost on the household. A desire to lower fertility below its natural (or unregulated) level will depend on the pecuniary costs of raising children as well as on the imputed value of time costs and thus the value of parents' time. Hence, desired fertility will be lower among couples who earn higher wages and who are better educated (conditional on income). If women bear the brunt of childrearing, then the impact of maternal education is likely to be larger than that of husbands. But even if husbands spend no time raising children, as long as male and female leisure times are complementary, the husband's education, like the wife's, will be negatively associated with fertility.

Income effects are ambiguous. If children are normal goods, higher income will be associated with more children. But if demand for child quality rises with

income, this relation will operate in the opposite direction and confound the income effect. Moreover, if our income measures do not adequately measure long-run household resources, then they may be proxied by husband's education, which muddies the interpretation of that covariate.

Focusing on these indicators of household resources, we first estimate the reduced form demand for children, $N$:

$$N = N(\mu_h, \omega_h) \tag{1}$$

which depends on household characteristics, $\mu_h$, and unobserved household-level heterogeneity $\omega_h$, representing, for example, differences in fecundity and tastes for children, which are assumed to be random and uncorrelated with household characteristics.

If the costs of children outweigh their benefits, couples may choose to limit the number of pregnancies and thereby control the quantity of children. One method of limitation is the adoption of contraceptives. Since there is evidence that short birth intervals are associated with poorer maternal and child health outcomes, contraception may also be used for birth spacing. Of course, wider birth intervals for any woman will also be associated with completed fertility (of women forty-five and older) being below its natural level.

The decision to use contraceptives will depend on their perceived costs and benefits. Costs will depend on the efficacy of the contraceptive, its price, and the difficulty of obtaining and using it. Thus contraceptive usage is likely to be affected by supply-side factors. For many women, a large element of the full price will be captured by the availability of contraceptives. A key aim of this article is to examine the influence of a broad array of community level indicators of the availability of services on contraceptive use. We pay special attention to service quality and are particularly interested in the impact of the community-based distribution mechanism that has been in operation in Zimbabwe since independence in 1980.

The benefits of contraceptive usage will be associated with the fecundability of the couple and also their desire to reduce fertility below its natural level. The benefits will vary with age, and this relationship is likely to be nonmonotonic. Very young women may adopt contraceptive methods to delay childbearing. As they move into a childbearing period, usage will decline only to rise again when they decide it is time to stop bearing children. Things are a bit more complicated if contraceptives are used for birth spacing, because women in their twenties and thirties are also likely to be contraceptive adopters. Finally, since fecundability tends to be lower among older women, the benefits of contraception will not be as great and so usage is likely to be lower among these women.

If, as argued earlier, fertility is lower among higher wage and thus better educated women, contraceptive usage will tend to rise with maternal education. Of course, education is likely to play many roles, over and above its influence on the value of time, including improved information processing and possibly efficiency in usage of contraceptives. In addition to its impact through fertility,

income may affect adoption of contraceptives if they involve resources, in which case the poorest may be less willing (or able) to buy contraceptives than the better off.

Our second empirical model is a contraceptive usage, $\pi$, function:

$$\pi = \pi(\mu_h, \mu_c, \varepsilon_h) \tag{2}$$

where $\mu_c$ are community level characteristics. Unobserved household-specific heterogeneity, such as fecundity and efficacy of use, is captured in $\varepsilon_h$ which is assumed to be random and uncorrelated with either $\mu_h$ or $\mu_c$.

We thus rule out migration of women or couples to places where services are better in order to obtain access to contraceptives; endogenous program placement is also ruled out (Rosenzweig and Wolpin 1982, 1986). In the case of Zimbabwe, these assumptions do not seem to be obviously foolish. There are no taboos associated with using contraceptives, which are relatively readily available. Migration, it seems, is likely to be motivated by more than a desire for contraceptives. Since 1980 many clinics and several hospitals have been opened as public health policy has been seeking to bring basic services to the majority of the population. Because increasing contraceptive usage has not been the highest priority in public health policy, the placement of these programs is likely to have more to do with health problems and inadequate health services in the vicinity than contraception per se. Some evidence is presented that *suggests* that endogeneity of program placement may not be critical in this context, at least for large-scale investments. Nevertheless, it is not possible to definitively test these assumptions with the data at hand, and thus the conclusions regarding the impact of community characteristics need to be interpreted with this caveat in mind. Some authors have suggested using first-difference estimates to control for the endogeneity of program placement (Pitt, Rosenzweig, and Gibbons 1993; Gertler and Molyneaux 1993; Frankenberg 1995). We explore a related strategy later in the article.

Another potentially serious issue is that community services tend not to be located in the poorest regions of the country. Failure to control for household, or at least community, income levels could thus lead to substantially incorrect inferences. For example, suppose that contraceptives are more likely to be used by higher-income women who tend to live in areas that have better health services. Without good controls for resources, an empirical correlation between service quality and contraceptive usage does not have an unambiguous interpretation: it may simply reflect the impact of the omitted covariate (income) or it may in fact be that service quality does affect usage.

The survey data, discussed more fully later, contain limited information on household resources. All regressions, but one, include controls for the household's possession of a range of assets. Income of men is not reported, and so the regressions include a good predictor of it, the husband's education. As discussed above, his education will thus capture both a value-of-time effect and an income effect. Because not all women are married, controls for marital status are also included

in the model. It could be argued that marital status should be treated as endogenous in a model of contraceptive choice. But, given that a key contribution of this article lies in the examination of how contraceptive choice is influenced by community services, we choose to ignore that potential problem in an effort to control for income to the fullest extent possible. Estimates that exclude marital status and husband's education are discussed in the text; these and other estimates not presented here are reported in Thomas and Maluccio (1995).

## II. Data and Methods

Data are drawn from three sources: a household survey and two specially conducted community level surveys, which we describe in that order.

The ZDHS, conducted in 1988 by the Central Statistical Office (CSO) in collaboration with the Institute for Resource Development (IRD)/Macro International, Inc., is a nationwide survey that interviewed over 4,200 women and their families in 166 clusters. The survey provides detailed information about the fertility history of these women, their contraceptive use and knowledge, their health, and that of their children. The survey respondents also provided limited information about the socioeconomic status of their households, including their own education, that of their husband, and household's ownership of any of a series of assets. The data are fully described in CSO and IRD/Macro International (1989); key summary statistics are presented in appendix tables A-1 and A-2.

The ZDHS is part of a worldwide program that has been operating since the mid-1980s and has successfully fielded surveys in a wide array of countries. These surveys have provided an extremely rich data source, which has led to substantial contributions to the understanding of demographic change in many countries around the world. For an excellent discussion focusing on Africa, see the series of volumes published as part of a National Academy of Sciences study (National Research Council 1993a, 1993b, and 1993c).

According to the ZDHS, the average Zimbabwean woman has given birth to nearly three children, and the number increases with age. Among women age thirty-five and older, the average is 6.2, and completed fertility (of women forty-five and older) is 6.8 children; it remains to be seen whether completed fertility among the current cohort of women in their twenties and thirties will be as high as the cohort of women in their late forties. Contraceptive knowledge is virtually universal, and 27 percent of the sample women report they are currently using a modern method. For over 87 percent of these women, that method is the pill; 6 percent are sterilized, 3 percent use condoms, and 3 percent (or twenty-nine women) use intrauterine devices (IUDs). Traditional methods are very uncommon, especially among younger and urban women: less than 5 percent of the sample women report they are currently using a traditional method. The overwhelming dominance of the pill reflects policies during both the pre-independence government (which tended to emphasize birth spacing) and the first post-independence government (which banned the injectable Depo Provera

in the early 1980s). In more recent years there has been a concerted attempt to expand the choices available to women. Because very few women in the survey use a modern method other than the pill, most of the analyses reported later do not try to distinguish among the methods.

About 14 percent of women in the survey report having no education and about half have completed primary school or more, although nearly half of those women exited at the end of primary school (seven years of schooling).[1] These averages mask substantial differences across cohorts, because the youngest have benefited from heavy investments in education since independence. For example, among women thirty-five and above, only 11 percent had gone beyond primary school, but among those who are less than thirty-five years old this proportion is almost 40 percent.

Although about two-thirds of the sample women are currently married, less than three-quarters of married women are living with their husbands; split households are common in Zimbabwe, and in the majority (but not all) of the cases the woman lives in the rural area while her husband works in a town.

These household level data have been matched with two community level data sources. First, in 1989–90 the CSO and IRD/Macro International resurveyed the same 166 clusters covered in the ZDHS and obtained extremely detailed information about general infrastructure, along with the availability and quality of health and family planning services in the community. Those data, recorded in the Zimbabwe Services Availability Survey (CSO and IRD/Macro International 1991; see also Wilkinson 1992) can be directly matched, at the cluster level, with the ZDHS.

Information about local services was gathered from "knowledgeable" community informants who were typically identified by the village head; the number of informants in each community ranged from two or three to twenty or more. In addition to describing services in the vicinity, the informants were asked about six types of facilities—general or district hospitals, rural hospitals, clinics or health centers, Zimbabwe National Family Planning Council (ZNFPC) clinics, pharmacies, and private doctors. They were asked to identify the nearest facility of each type and the distance to it. If the facility was within 30 kilometers of the community center, it was visited by an enumerator who collected information on the nature, quality, and prices of services offered.

The collection of community level data is far from trivial, and it is not obvious how best to identify local providers or, put another way, the appropriate catchment area for a particular provider. Unfortunately, it appears that informants in several communities were not very well informed. For example, infor-

1. Years of schooling is constructed from responses to questions about completed level and the grade within that level. For primary school, women were able to list up to five grades, so completion of Standard 5 (seven years of schooling) is treated as completion of primary school. For secondary school, completion of Form 2 is treated as equivalent to nine years of completed schooling, and Form 4, eleven years. The small fraction of women who have twelve or more years of schooling are grouped together (see appendix table A-1). Also, we note that twelve percent of the women in the survey have not yet completed schooling.

mants in 8 percent of the clusters failed to identify a general or district hospital.[2] Exactly why a hospital was not identified is unclear, and one may argue that if the informant could not identify it, this may reflect the general perception of people in the community that they do not have access to a hospital.

Along the same lines, but perhaps a bit more problematic, is that ZNFPC clinics were identified by informants in only 16 percent of the clusters. In part this reflects the fact that these clinics do not cover the entire country and are concentrated in towns and cities, so that rural informants may not even be aware of the clinics. But in Harare, for example, where there are seventeen clusters, the ZNFPC clinic was identified by informants in only one of those clusters. Since the ZNFPC clinic shares the same grounds as the Harare Hospital (but is a completely independent entity and located apart from the hospital), we can deduce the distance to the ZNFPC clinic using reported distances to Harare Hospital: in every case, it is less than 30 kilometers. This calls for caution in relying on information about only facilities identified as being within a 30 km radius of the community (and thus visited by the enumerators). For the purposes of family planning services, therefore, we will define the community as the district (there are fifty-two districts).

Because over the last decade public policy in Zimbabwe has shifted dramatically toward the provision of family planning services through CBDs, it is of considerable interest to look closely at CBDs' role in affecting women's choice to use modern methods. Information on CBDs being rather limited in the Services Availability Survey, we turn to a second special community survey, the Zimbabwe Situation Analysis Study.

The Situation Analysis Study was conducted in 1992 by the ZNFPC, the Population Council's Africa Operations Research and Technical Assistance project, and the Family Planning Service Expansion and Technical Support project (ZNFPC 1992). The objective of the Situation Analysis Study was to provide comprehensive information about the availability, functioning, and quality of family planning services in Zimbabwe. In addition to detailed information on individuals who are CBDs, the survey provides data on family planning services available from (public and private) clinics. Information was collected in structured interviews with providers and clients (including exit polls), as well as direct observation of clinic conditions and provider-client interactions. The sample design, which is described in detail in ZNFPC (1992), is essentially facility based. We have, therefore, matched the facilities with the household data at the district level. It should be noted that not all districts in Zimbabwe were included in the ZDHS and that for those which were included but do not have data in the Situation Analysis Study, we have matched data from a neighboring district. The Situation Analysis Study gathered information from 181 clinics and 140 CBDs.

2. One of these clusters is in the Jambesi area of the Hwange District, and the informants failed to identify Hwange Hospital; in the neighboring district to the south, Gwaai, Hwange was identified by the informants, but it was too far away (87 kilometers) to be selected for a visit.

Information about CBDs and clinics contained in the Services Availability Survey and Situation Analysis Study overlaps. It is thus possible to cross-check the two sources. Because the surveys were conducted two to three years apart, the data contained in them are unlikely to be identical. Good correspondence between them, however, would suggest that district level matching of the two community surveys is reasonable in the Zimbabwe context. Similarity may arise either because there is only one provider of a particular type in each district or because the intradistrict heterogeneity is considerably smaller than the interdistrict variation.

It turns out that the information contained in both surveys is remarkably close. In only 8 percent of districts in which the Situation Analysis Study recorded an interview with a CBD, the Services Availability Survey reported no CBDs in that district. In part, this discrepancy may reflect expansion of the CBD program during the three years between the fielding of the Services Availability Survey and Situation Analysis Study.[3] There is also broad agreement about services available in clinics. For example, in only 6 percent of the districts was there disagreement about the presence of state-certified nurses, and in less than 5 percent of districts there were discrepancies in the availability of condoms and oral contraceptives. In general, we find that the intradistrict (and intersurvey) heterogeneity is tiny relative to the interdistrict variation in the data.

The results are quite reassuring. They suggest there have not been large changes in the provision of these services during the period between the two surveys. This is not too surprising in view of the fact that real public health expenditures grew little during the late 1980s and early 1990s. This is important because we are implicitly assuming that no shifts occurred in the relative distribution of availability and quality of services provided in Zimbabwe between 1988 (when the ZDHS was fielded) and 1992 (when the Situation Analysis Study was completed).

Appendix table A-2 summarizes some of the community level information. The first column is measured at the cluster level; the second to fourth columns reflect the proportion of women living in communities with the services. Of interest is the fact that about half the sample women live within the vicinity of a general hospital (and virtually all urban woman are close to a facility of this sort). There is a clinic in every community, and almost half of them have been built since 1980. About two-thirds of the communities are visited by a health worker but only half of those are also served by a mobile family planning clinic. CBDs are operating in about two-thirds of the communities.

## III. Regression Results

Using the microdata in the ZDHS, the analysis begins with an examination of the impact of household characteristics, and especially a woman's education, on

3. In 20 percent of the districts there was a discrepancy in the gender of the CBD; the Situation Analysis Study reported interviews with considerably more male CBDs. This is unlikely to reflect changes in the CBD program and suggests, perhaps, that local informants in the Services Availability Survey may have been misinformed.

fertility. We proceed to assess how the same characteristics affect the probability that she uses modern contraceptives. To discern the influence of a series of community service characteristics on this probability, we incorporate data collected in the Zimbabwe Services Availability Survey and the Zimbabwe Situation Analysis Study and estimate the reduced form, equation 2.

### *Fertility*

Fertility in Zimbabwe is high. Table 1 presents evidence on the household factors that affect one measure of fertility, the number of children ever born. Age at first birth and birth spacing are also discussed briefly. The model is estimated by the method of least squares, which ignores the fact that the outcome is discrete. The results do not rely on this assumption: a Poisson model of children ever born provides essentially identical results. Each woman's own education is included in the regression with no parametric restrictions placed on the shape of the relation between it and fertility: each year of completed schooling is represented by a dummy variable (except for education of twelve years and above, which is equivalent to continuing beyond "O" levels and accounts for less than 2 percent of women in the sample; see footnote 1). The coefficients represent the difference in the number of children born to a woman with a given education level and to a woman with no education, holding other background characteristics constant.

In the first column of table 1, education of the woman is included along with her age (represented by dummies for each five-year age group), marital status, ethnicity, and sector of residence.[4] Some authors, including Cochrane (1983) and Cochrane and Farid (1990), have noted that in many countries the impact of maternal education on fertility is not monotonic. For women with very little education, the number of children ever born tends to rise with education until some threshold level (typically somewhere between five and seven years of schooling) is reached; thereafter, fertility and education are negatively correlated. A similar pattern is observed in Zimbabwe. The first few years of primary schooling are unrelated to fertility and it is only when women are close to completing primary school (specifically, six years of education) that there is a significant negative association between education and fertility. This correlation is not constant but tends to increase with education, particularly at the top of the distribution.

To what extent can the effect of education be explained by income? We attempt to address this question in the second column of table 1, in which husband's education and a set of dummies for ownership of a range of household assets are added to the regression to control for permanent income and wealth. Income effects are small, and husband's education only matters among the better edu-

4. Dropping controls for marital status results in slightly lower education effects but only one of these differences is significant (eleven years of schooling). The $\chi^2$ statistic for significance of all differences in education effects is 5.4 with a $p$-value of 0.94. Endogeneity of marital status seems to be of second-order importance in its effect on estimated education coefficients in these regressions. The same conclusion applies to the contraceptive use regressions discussed later.

Table 1. *Number of Children Ever Born: Role of Education and Income*

| *Variable* | *Woman's education only* | *Woman's education and household income* | *By woman's age* | | *By woman's residence* | |
|---|---|---|---|---|---|---|
| | | | *Less than 35* | *35 or older* | *Urban* | *Rural* |
| *Woman's education (completed years)*[a,b] | | | | | | |
| 1 | −0.193 | −0.191 | −0.545 | 0.410 | 0.676 | −0.369 |
| | (0.88) | (0.88) | (2.85) | (0.78) | (1.41) | (1.48) |
| 2 (complete preschool) | 0.005 | 0.028 | −0.117 | 0.250 | 0.104 | 0.024 |
| | (0.04) | (0.18) | (0.85) | (0.73) | (0.33) | (0.14) |
| 3 | 0.089 | 0.105 | 0.087 | 0.287 | 0.391 | 0.046 |
| | (0.63) | (0.74) | (0.66) | (0.89) | (1.37) | (0.28) |
| 4 | −0.191 | −0.155 | −0.395 | 0.253 | 0.067 | −0.135 |
| | (1.37) | (1.11) | (3.24) | (0.73) | (0.27) | (0.80) |
| 5 | −0.157 | −0.096 | −0.333 | 0.349 | −0.129 | −0.062 |
| | (1.39) | (0.83) | (3.35) | (1.22) | (0.56) | (0.47) |
| 6 | −0.405 | −0.307 | −0.465 | 0.144 | −0.314 | −0.209 |
| | (3.50) | (2.54) | (4.72) | (0.42) | (1.40) | (1.46) |
| 7 (complete primary) | −0.516 | −0.365 | −0.461 | −0.061 | −0.306 | −0.266 |
| | (5.32) | (3.49) | (5.38) | (0.20) | (1.66) | (2.08) |
| 8 | −0.640 | −0.417 | −0.500 | 0.152 | −0.459 | −0.291 |
| | (4.26) | (2.67) | (4.30) | (0.20) | (1.86) | (1.47) |
| 9 (complete Form 2) | −0.731 | −0.456 | −0.572 | −0.346 | −0.442 | −0.383 |
| | (5.91) | (3.40) | (5.49) | (0.72) | (2.15) | (2.12) |
| 10 | −0.793 | −0.528 | −0.744 | −0.308 | −0.611 | −0.477 |
| | (4.51) | (2.90) | (5.60) | (0.29) | (2.40) | (1.88) |
| 11 (complete Form 4) | −1.051 | −0.697 | −0.959 | −0.491 | −0.736 | −0.777 |
| | (8.81) | (5.18) | (9.33) | (0.75) | (3.64) | (4.04) |
| 12 or more | −1.418 | −0.974 | −1.364 | −0.611 | −1.211 | 0.056 |
| | (6.39) | (4.17) | (7.78) | (0.72) | (4.55) | (0.10) |
| *Husband's education (completed years)*[a] | | | | | | |
| Complete preschool | | 0.112 | 0.268 | −0.042 | −0.814 | 0.203 |
| | | (0.54) | (1.49) | (0.08) | (1.63) | (0.86) |
| Some primary school | | 0.168 | 0.384 | −0.111 | 0.228 | 0.136 |
| | | (1.70) | (4.28) | (0.49) | (1.19) | (1.18) |
| Complete primary school | | −0.013 | 0.110 | −0.051 | −0.245 | 0.110 |
| | | (0.15) | (1.32) | (0.20) | (1.40) | (0.92) |
| Complete Form 2 | | −0.199 | −0.141 | 0.131 | −0.147 | −0.194 |
| | | (1.64) | (1.45) | (0.37) | (0.78) | (1.23) |
| More than Form 2 | | −0.522 | −0.246 | −0.316 | −0.467 | −0.466 |
| | | (4.33) | (2.62) | (0.74) | (2.58) | (2.78) |

*(Table continues on the following page.)*

Table 1. *(continued)*

| Variable | Woman's education only | Woman's education and household income | By woman's age: Less than 35 | By woman's age: 35 or older | By woman's residence: Urban | By woman's residence: Rural |
|---|---|---|---|---|---|---|
| *Household assets*[a] | | | | | | |
| Motorcycle or bicycle | | 0.061 | −0.011 | 0.240 | 0.096 | 0.047 |
| | | (0.98) | (0.24) | (1.27) | (1.07) | (0.59) |
| Car | | −0.288 | −0.062 | −1.320 | −0.304 | −0.240 |
| | | (2.92) | (0.85) | (3.92) | (2.95) | (1.35) |
| Radio | | −0.066 | −0.032 | −0.036 | −0.068 | −0.025 |
| | | (1.06) | (0.70) | (0.18) | (0.69) | (0.33) |
| Television | | 0.076 | 0.028 | 0.058 | 0.201 | −0.263 |
| | | (0.75) | (0.37) | (0.16) | (2.03) | (1.04) |
| Cattle | | −0.053 | −0.039 | −0.174 | 0.188 | −0.086 |
| | | (0.74) | (0.68) | (0.80) | (0.68) | (1.06) |
| Goats or sheep | | 0.077 | 0.064 | 0.081 | −0.253 | 0.087 |
| | | (1.06) | (1.11) | (0.38) | (0.85) | (1.08) |
| *Rural residence*[a] | 0.393 | 0.286 | 0.122 | 0.920 | | |
| | (6.24) | (3.53) | (2.00) | (3.40) | | |
| *Goodness of fit* | | | | | | |
| $\chi^2$ (own education) | 10.65 | 3.78 | 10.97 | 0.44 | 3.91 | 1.92 |
| | [0.00] | [0.00] | [0.00] | [0.95] | [0.00] | [0.03] |
| $\chi^2$ (husband's education) | 38.98 | 7.57 | 11.12 | 0.26 | 3.90 | 3.63 |
| | [0.00] | [0.00] | [0.00] | [0.93] | [0.00] | [0.00] |
| $F$ (all covariates) | 362.14 | 249.20 | 218.17 | 8.61 | 78.00 | 177.81 |
| | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] |
| $R^2$ | 0.67 | 0.67 | 0.69 | 0.20 | 0.65 | 0.68 |
| Number of observations | 4,201 | 4,201 | 3,129 | 1,072 | 1,407 | 2,794 |

*Note*: The values are ordinary least squares (OLS) estimates. The regressions also include controls for age (represented by dummies for each five-year age group), marital status, and presence of husband in household. *t*-statistics are in parentheses, and *p*-values are in square brackets.

a. Dummy variable: value is 1 if condition is true; 0 otherwise.

b. The coefficients represent the difference in the number of children born to a woman with a given education level and a woman with no education, holding other background characteristics constant.

*Source*: Authors' calculations based on CSO and IRD/Macro International (1989).

cated. Nevertheless, a good part of the effect of female education does appear to operate through income and the estimated effects decline from between one-quarter and one-half; this decline is greatest among the better educated. In order to take account of all unobserved community level heterogeneity, including income differences, we have also estimated the models with community fixed effects. The education effects are very similar to those reported in the second column. For example, the fixed-effects estimates indicate that women with twelve or more years of schooling have 0.972 fewer children than those with no schooling; the estimate without fixed effects is 0.974.

Although these regressions control for the age of the woman, it is possible that the effects of education vary with age because the number of children ever born rises with age and there have been dramatic increases in educational attainment among recent cohorts in Zimbabwe.[5] The third and fourth columns of table 1 present separate regressions for younger women (under thirty-five years old) and older women (thirty-five years old and above).

Among older women, there is no significant relationship between education and fertility. Among younger women, however, even fairly low levels of primary schooling are associated with lower fertility. This suggests that investments in education over the last decade are likely to have a substantial payoff in terms of reduced fertility in coming decades. The powerful negative association between education and fertility is largely an urban phenomenon (fifth column). Since younger, urban women are more likely to be participating in the formal labor market than their older or rural counterparts, this suggests that growth in employment opportunities may have a substantial impact on fertility rates in Zimbabwe. This is a hypothesis that warrants careful scrutiny: if true, then it may be that recent declines in labor demand will be associated with a flattening of the fertility-education profile.

A very similar pattern emerges for the impact of education on age at first birth (not shown). Women who complete primary school have their first child about seven months later than those who do not (and this difference is significant); women who complete eleven years of schooling wait another two years before having a child. The biggest effect, however, is among women with at least twelve years of schooling: they delay childbirth for five years relative to those without any schooling. Among older women, there is little evidence of a significant relationship between education and age at first birth except for the tiny fraction with more than ten years of schooling; in fact, relative to women with no schooling, those with less than six years of education tend to give birth at earlier ages. For more recent cohorts, in contrast, the impact of education is positive at all levels of education and significant for women with at least four years of schooling. Apparently part of the negative correlation between education and fertility among recent cohorts can be attributed to delay of the first birth.

Like age at first birth, birth space tends to rise with education and the effect is significant only among better educated, younger, and urban women. Counterbalancing this trend is a decline in birth space across cohorts: women age forty-five to forty-nine space their children about two months further apart than twenty-five to twenty-nine year olds. Although significant, this difference in birth space is small; so assuming that the more recent cohorts do not continue childbearing longer than their mothers, it seems reasonable to expect the relationship between education and completed fertility to become more powerful in years to come.

5. In addition to the fact that the impact of public investments will differ across cohorts, it is possible that the end of the civil war in 1980 brought with it greater stability in Zimbabwean households which may have resulted in a baby boom in the early 1980s.

Returning to the second column in table 1, the husband's education follows the same inverse U shape reported for women.[6] Male education has a significantly depressing impact on fertility only at the top of the education distribution (nine or more years of schooling) and only among younger women. In fact, conditional on wife's education and income, men who have some primary schooling tend to have more children than those with no education at all; this effect is large and significant among young women.

As discussed earlier, male education effects do not have an unambiguous interpretation and are likely to be capturing both the role of income and the value of time. About 30 percent of married women are not living with their husbands; in those households, husband's education should have no value-of-time effect: we find that husband's education is positively, but not significantly, associated with fertility. Among couples living together, however, the husband's education effect is negative and significant if he has completed primary school. (The coefficient on completed primary school is –0.29 with a *t*-statistic of 2.0 and on completed Form 2 it is –0.61 with a *t*-statistic of 3.6.) Recognizing that husband's presence is not exogenous, these results suggest that the effect of his education on demographic outcomes does combine the role of income and the value of time, with the latter being especially important among the better educated.

The dummies for ownership of assets also capture income effects. They are small and, apart from cars, insignificant. The effect of car ownership is substantially smaller among younger women, and it is only among older women that these income measures are jointly significant.

In sum, there is a negative association between education and fertility, albeit among the better educated. The shape of the relationship appears to have changed among recent cohorts, with education becoming a powerful force behind fertility decline in Zimbabwe. Understanding the mechanisms underlying the change in this relationship is key for policy design and will be taken up again later. Even after controlling for education and income, rural women tend to have significantly more children, although this gap may be declining over time. Among older women (thirty-five and above), rural women report about one more birth than those in urban areas, but among women less than thirty-five years old the difference is only about one-seventh of a child. This is a large decline in the urban-rural gap, although it is obviously impossible to determine at this time whether it will be completely offset by rural women having more children later in life. A natural hypothesis would be that the urban-rural gap reflects differences

6. The models have also been estimated using dummies for each year of husband's education (paralleling the female specification). To save space, we report results for the more parsimonious specification because the restrictions it imposes are not rejected and effects of other covariates are essentially unaffected by the choice. Although the main results are captured in the more parsimonious specification, the semiparametric estimates are useful to draw direct comparisons between male and female education effects. At the top of the distribution, the negative effect of husbands' education is about two-thirds the magnitude of women's education: the coefficients on eleven years and twelve or more years of schooling are –0.49 and –0.72, respectively, with *t*-statistics of 3.7 in both cases. In addition, the inverse U shape of husband's education is more striking (and significant).

in infrastructure in the two sectors. Without data on the services available to each woman over her childbearing life, it is impossible to test this empirically. However, contraceptives are used to control fertility, and it is possible to assess whether current infrastructure has any impact on current contraceptive use. We turn now to that question.

### *Contraceptive Usage*

In the following two subsections, tables 2 and 3 present the estimated effects of household and community characteristics on the probability that a woman is currently using a modern method. Since the dependent variable is dichotomous, we assume errors are distributed as a Gaussian, and estimate a probit model by maximum likelihood. Estimated coefficients have been translated into slopes and are multiplied by 100 in the tables.[7]

In view of the tiny fraction of women who are using traditional methods, we do not distinguish them in the tables. Estimates based on a trivariate multinomial logit indicate that few of the characteristics in these data explain the choice to use traditional methods.[8] Recall that of 27 percent of women who are using modern methods, 24 percent use the pill. We have also estimated quadrivariate multinomial logits (distinguishing women who use the pill, other modern methods, traditional methods, and no method). In our view, the data do not have enough information for us to reliably estimate the determinants of other modern methods, so we discuss only robust results here. Paralleling table 1, we begin with household characteristics in table 2 and then examine the impact of community characteristics on contraceptive use in table 3.

### *Household Characteristics*

Many studies have demonstrated that better educated women are more likely to adopt contraceptives. Although this is also true in Zimbabwe, the effect is significant only after women have completed several years of primary school, and the relationship is not monotonic (table 2). Among women who did not complete primary school, the function is fairly flat, and these women are about 4 percent more likely to adopt contraceptives than those without any schooling. There is, however, a dramatic step in the function at completion of primary school (seven years of education), when the impact doubles to 8 percent. It is hard to imagine that women learn about the value of contraceptives only in their final year of primary school; instead, this suggests that there is something intrinsically different between women who do and do not complete primary school. This interpretation is bolstered by the fact that the estimated effect for women who complete eight years of school-

7. The coefficient estimates, $\beta$, are multiplied by the mean probability, which is the value of the cumulative density function of the normal distribution evaluated at the sample mean, $\Phi(\bar{x}\beta)$. The tables report $100\ \beta\ \Phi(\bar{x}\beta)$.

8. Older women and women in households with cattle are more likely to use traditional contraceptives over no method and modern methods.

Table 2. *Probability of a Woman's Currently Using a Modern Contraceptive Method: Role of Education and Income*

| Variable | Woman's education only | Women's education and household income | By woman's age: Less than 35 | By woman's age: 35 or older | By woman's residence: Urban | By woman's residence: Rural | Including community characteristics[a] |
|---|---|---|---|---|---|---|---|
| *Woman's education (completed years)*[b] | | | | | | | |
| 1 | 4.432 | 3.455 | 5.888 | −0.568 | 12.033 | 1.981 | 3.461 |
| | (1.13) | (0.88) | (1.21) | (0.08) | (1.00) | (0.52) | (0.89) |
| 2 (complete preschool) | 2.201 | 1.313 | 1.586 | 1.152 | 5.950 | 0.581 | 1.615 |
| | (0.81) | (0.48) | (0.45) | (0.26) | (0.74) | (0.22) | (0.59) |
| 3 | 3.038 | 3.176 | 5.147 | 0.217 | 1.911 | 3.211 | 3.546 |
| | (1.19) | (1.23) | (1.54) | (0.05) | (0.25) | (1.27) | (1.38) |
| 4 | 4.666 | 4.584 | 4.111 | 5.616 | 7.885 | 3.112 | 5.355 |
| | (1.85) | (1.80) | (1.30) | (1.30) | (1.18) | (1.21) | (2.11) |
| 5 | 4.060 | 3.928 | 4.546 | 2.298 | 0.578 | 4.071 | 4.667 |
| | (1.97) | (1.86) | (1.75) | (0.63) | (0.09) | (2.00) | (2.21) |
| 6 | 4.314 | 3.764 | 3.344 | 3.814 | 2.838 | 3.611 | 4.045 |
| | (2.00) | (1.68) | (1.26) | (0.89) | (0.47) | (1.61) | (1.80) |
| 7 (complete primary) | 8.153 | 7.320 | 6.557 | 9.116 | 12.743 | 4.535 | 7.620 |
| | (4.61) | (3.85) | (2.90) | (2.48) | (2.58) | (2.31) | (3.96) |
| 8 | 7.272 | 5.843 | 4.466 | 15.511 | 6.633 | 5.056 | 6.487 |
| | (2.33) | (1.82) | (1.27) | (1.75) | (0.93) | (1.45) | (2.03) |
| 9 (complete Form 2) | 10.863 | 7.848 | 8.374 | 2.301 | 8.970 | 7.502 | 8.152 |
| | (4.66) | (3.08) | (2.88) | (0.41) | (1.58) | (2.55) | (3.20) |
| 10 | 11.768 | 9.102 | 9.274 | 5.238 | 9.068 | 9.784 | 8.840 |
| | (3.23) | (2.41) | (2.30) | (0.43) | (1.20) | (2.17) | (2.34) |
| 11 (complete Form 4) | 13.454 | 8.902 | 8.811 | 14.928 | 10.776 | 8.584 | 8.776 |
| | (6.08) | (3.50) | (3.12) | (1.96) | (1.93) | (2.76) | (3.45) |
| 12 or more | 21.366 | 15.895 | 14.213 | 29.167 | 16.010 | 31.290 | 16.733 |
| | (5.39) | (3.79) | (2.99) | (2.89) | (2.21) | (3.64) | (4.01) |
| *Husband's education (completed years)*[b] | | | | | | | |
| Complete preschool | | 1.137 | 0.516 | 4.144 | −2.313 | 2.150 | 0.689 |
| | | (0.31) | (0.11) | (0.64) | (0.18) | (0.61) | (0.19) |
| Some primary school | | 1.935 | 2.633 | 0.190 | 3.377 | 1.549 | 1.658 |
| | | (1.10) | (1.17) | (0.07) | (0.68) | (0.90) | (0.95) |
| Complete primary school | | 1.729 | 2.093 | −0.805 | 1.872 | 1.434 | 1.451 |
| | | (0.99) | (1.00) | (0.24) | (0.42) | (0.81) | (0.84) |
| Complete Form 2 | | 3.314 | 2.395 | 4.865 | 6.580 | 0.634 | 2.741 |
| | | (1.57) | (0.97) | (1.16) | (1.36) | (0.27) | (1.31) |
| More than Form 2 | | 5.892 | 6.629 | −2.616 | 8.099 | 4.293 | 5.602 |
| | | (2.76) | (2.75) | (0.50) | (1.71) | (1.75) | (2.64) |

ing is actually smaller (albeit not significantly) than for those with one less year of education: surely, they are not learning not to value contraceptives in their first year at secondary school.[9] Additional years of secondary school are

9. Many estimates of the relationship between education and wages also indicate steps associated with the completion of particular levels of education; these steps have often been attributed to credentialism (although selection seems like a plausible alternative hypothesis). For contraceptive usage, however, it is far from clear how or why credentialism should play any role.

Table 2. *(continued)*

| Variable | Woman's education only | Woman's education and household income | By woman's age: Less than 35 | By woman's age: 35 or older | By woman's residence: Urban | By woman's residence: Rural | Including community characteristics[a] |
|---|---|---|---|---|---|---|---|
| *Household assets*[b] | | | | | | | |
| Motorcycle or bicycle | | 3.486 | 3.072 | 3.328 | 6.005 | 2.428 | 2.870 |
| | | (2.98) | (2.23) | (1.46) | (2.39) | (1.89) | (2.45) |
| Car | | −0.779 | −2.412 | 4.236 | −3.280 | 3.325 | −0.741 |
| | | (0.42) | (1.10) | (1.09) | (1.10) | (1.18) | (0.40) |
| Radio | | 0.796 | 0.716 | 0.583 | 0.256 | 0.792 | 0.605 |
| | | (0.67) | (0.53) | (0.23) | (0.09) | (0.63) | (0.51) |
| Television | | 4.519 | 1.927 | 13.585 | 5.633 | 5.042 | 5.189 |
| | | (2.40) | (0.90) | (3.32) | (2.02) | (1.29) | (2.78) |
| Cattle | | −2.131 | −3.016 | 1.173 | −2.336 | −1.514 | −1.568 |
| | | (1.50) | (1.82) | (0.42) | (0.27) | (1.16) | (1.08) |
| Goats or sheep | | −3.793 | −3.926 | −2.834 | −13.650 | −2.550 | −1.684 |
| | | (2.71) | (2.38) | (1.06) | (1.45) | (2.01) | (1.16) |
| *Rural residence*[b] | −5.305 | −0.565 | 0.222 | −3.711 | | | 0.868 |
| | (4.48) | (0.38) | (0.13) | (1.13) | | | (0.40) |
| *Goodness of fit* | | | | | | | |
| $\chi^2$ (own education) | 61.41 | 25.25 | 17.15 | 17.69 | 14.35 | 22.42 | 26.43 |
| | [0.00] | [0.01] | [0.14] | [0.13] | [0.28] | [0.03] | [0.01] |
| $\chi^2$ (all covariates) | 562.53 | 596.93 | 490.50 | 123.45 | 261.35 | 321.35 | 551.08 |
| | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] |
| Likelihood | −2,087 | −2,064 | −1,511 | −534 | −721 | −1,323 | −2,031 |
| Pseudo $R^2$ | 0.15 | 0.16 | 0.18 | 0.11 | 0.20 | 0.14 | 0.17 |
| Number of observations | 4,201 | 4,201 | 3,129 | 1,072 | 1,407 | 2,794 | 4,201 |

*Note*: The values are maximum likelihood probit estimates transformed into derivatives. Asymptotic *t*-statistics are reported in parentheses, and *p*-values are in brackets. Regressions also include controls for age (represented by dummies for each five-year age group), ethnicity, marital status, and presence of husband in household.

a. See table 3 for a list of community characteristics.

b. Dummy variable: value is 1 if condition is true; 0 otherwise.

*Source*: Authors' calculations based on CSO and IRD/Macro International (1989, 1991) and ZNFPC (1992).

associated with slightly higher probabilities of adopting modern methods, although the next dramatic step is among women who go beyond "O" levels (twelve years or more): they are 20 percent more likely to be using a modern method relative to women without any schooling. This pattern is remarkably similar to the relationship between education and fertility, apart from the spike at completion of primary school.

Ever-married women are significantly more likely than women who have never been married to be using a modern method. Their probability of adopting contraception tends to rise with age until around thirty and then declines. Women in rural areas are significantly less likely to be using a modern method.

In the second column of table 2, husband's education and dummies for ownership of assets are added to the regression in an attempt to control for income. Apparently the entire rural-urban gap in contraceptive usage can be attributed to income differences (as measured here): the rural effect becomes very small and is not significant. Recall that in the case of fertility the rural-urban gap persists after controlling for income, although it is much smaller for younger women. Both of these results probably reflect the higher investment in infrastructure in rural areas in recent years (since independence). Husband's education is positively and significantly associated with the probability that a woman is a contraceptive adopter, but the effect is far from smooth and is significant only at the top of the education distribution.

Income, as measured by the dummies for asset ownership, should not be contaminated by current labor supply and leisure choices (although they may reflect previous labor supply). Women in households with a bicycle or motorcycle or a television are significantly more likely to be using a modern method. In contrast, however, women in households with goats and sheep are less likely to use contraceptives. The exact reason is far from clear: it may be that this is a poor measure of income (because, for example, no information is provided about the number, type, or value of the animals); it may reflect more traditional attitudes among these women; or, it may reflect greater demand for child labor in households with livestock.[10] It is most unfortunate that until DHS data on income or household resources are collected, it is not going to be possible to address these issues with these otherwise extremely rich surveys.

Income (as measured here) does account for part, but certainly not all, of the impact of female education on contraceptive usage. The role of income tends to be greater at the top of the education distribution where the estimated education effects are reduced by about a third; at the bottom of the education distribution, the effect is reduced by about 10 percent. While the general shape of the relationship remains intact, the steps at seven and twelve or more years of schooling are, if anything, even more pronounced.

Women are stratified into two age groups in the third and fourth columns of table 2. The effect of education on contraceptive usage is substantially flatter for younger (fifteen to thirty-five years old) relative to older (thirty-five to forty-nine years old) women. For example, older women who have completed eleven years of schooling are more than twice as likely to use contraceptives as those who had one less year of schooling, and only half as likely to be adopters than women with more schooling. In comparison, among younger women the differences among those who attend secondary school are small except for those

10. Since ownership of goats and sheep is unrelated to fertility (table 1), endogeneity is probably not the dominant explanation. Moreover, dropping the covariate has little effect on any other covariates other than cattle ownership (which becomes absolutely larger and significant). This is because the two covariates are highly correlated (0.62). Ownership of cattle, goats, and sheep is not exclusively a rural phenomenon; over 5 percent of urban households own cattle, and another 5 percent own sheep or goats; these proportions increase to about 50 percent among rural households.

with twelve or more years of schooling whose usage rate is about 50 percent higher than the rest. The impact of these older, better educated women on aggregate usage rates is small because those with eleven years or more of education account for only 4 percent of the sample; in contrast, over 15 percent of younger women have achieved this level of schooling.

There is far more noise in the education-usage function among older women, and thus it is only among younger women that secondary schooling is associated with significantly higher probabilities of using modern methods relative to those without any schooling. For both younger and older women, however, the step at completion of primary school remains large and significant and it is twice as large for older women. This suggests that the role of selection may be declining over time, which seems consistent with the substantial changes in the government's education policy since independence in 1980.[11]

The fifth and sixth columns of table 2 stratify the sample on sector of residence. The income effects in the two sectors are qualitatively similar (at least when they are significant) and the negative impact of goats and sheep persists even within the rural sector. For women in rural areas, the effect of education tends to be smaller (at the secondary level), and there is little evidence of a step at completion of primary school. In contrast, among urban women, there is a large and significant step at seven years of schooling, and the impact on usage is almost as large as the impact of having twelve years or more education. In the final column of the table, all measures of infrastructure, discussed later, are included in the regression. The results are remarkably similar to those in the second column (except that goats and sheep no longer significantly affect use); the same is true for a model that includes community fixed effects and so we conclude that our main results are not contaminated by unmeasured community characteristics.

In sum, education is positively associated with contraceptive usage, even after controlling for income, although the relationship is neither smooth nor monotonic, let alone linear. In fact, a regression that is linear in education would yield quite misleading inferences: the estimated impact is about 1 percent for each year of schooling. However, it is clear from the second column in table 2, for example, that the education-usage function is essentially flat at the bottom of the education distribution. If all women with four or five years of education were to spend another year at school, then contraceptive usage would not be likely to rise. Furthermore, the semiparametric estimates suggest that the estimated education effect does not solely reflect the productivity gains of additional schooling (in home production or in the market) but is intertwined with other factors such as selection of women to complete particular levels of schooling. It would, therefore, be inappropriate to infer that contraceptive usage would

11. For older women, there is an even bigger step at eight years of schooling, but this is an anomaly; less than 0.5 percent of sample women completed just one year of secondary school among this cohort. In view of the pre-independence government's education policy, which funneled very few people into secondary school, this is not surprising.

increase dramatically if all women were to complete primary school; rather, we need to understand the mechanisms whereby better educated women are choosing to use contraceptives.

The results for ever use of contraceptives are broadly the same as for current use although the slopes of the function are steeper as, taken cumulatively, better-educated women are much more likely to have ever used a modern method than women without any schooling. For example, relative to women without any education, those who have completed primary school are about 20 percent more likely to have used modern methods and this probability is closer to 50 percent among those who have completed twelve or more years of schooling.

Two additional results emerge from the multinomial logit models, which distinguish the pill from other modern methods. First, older women are more likely to have adopted other methods (mostly sterilization), and second, income plays a bigger role with ownership of a car, radio, and television all having a significant, positive impact on the use of other modern methods, relative to the pill.

### *Community Characteristics*

Since independence, public health policy in Zimbabwe has sought to bring basic health services to the majority of the population and there have been substantial investments in new infrastructure. Family planning has traditionally been under the aegis of government and quasi government clinics, although since independence there has been a substantial shift toward the use of CBDs. Has the provision of these services had any impact on contraceptive usage?

Table 3 reports estimated probabilities based on probit models that include all the household characteristics discussed earlier along with a series of measures of the availability of community services. The first four columns in the table examine their impacts on the probability a woman has ever used modern contraceptive methods. The first column includes measures of general health infrastructure, the second focuses on the role of CBDs, and the third examines the impact of detailed indicators of clinic services.[12] All measures of services are included in the fourth column. The remaining columns of the table examine the impact of community services on current usage of modern methods. The same format is repeated in the fifth through eighth columns. Results of regressions estimated separately for women less than thirty-five and for those older are reported in the ninth and tenth columns; in the eleventh and twelfth columns, women are stratified on the basis of their completing primary school. The final

12. Measures of general infrastructure are drawn from CSO and IRD/Macro International (1989); all other measures are drawn from ZNFPC (1992). Reported standard errors do not take into account the multilevel nature of the regressors. Allowing within-district correlation in the unobservables and estimating the variance-covariance matrix as a grouped infinitesimal jackknife (Huber 1967; Efron 1982) has no impact on inference. In some cases, estimated standard errors are smaller; in others they are bigger. This suggests that intradistrict correlations are not key in this application and, in view of the very complex design matrix (which also includes covariates measured at the cluster level), we prefer to report conventional estimates of standard errors. In order to allow complete flexibility and control for income to the fullest extent possible, husband's education is specified as dummies for each year of schooling in table 3.

Table 3. *The Effects of Community Services on Ever-Use and Current Use of Modern Contraceptives*

| Variable | Ever use | | | | Current use | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | By woman's age | | By woman's education | |
| | General health infrastructure | Community-based distributors | Clinic services | All variables | General health infrastructure | Community-based distributors | Clinic services | All variables | Less than 35 | 35 or older | Less than primary | Primary completed or more |
| *General infrastructure*[a] | | | | | | | | | | | | |
| General hospital | 6.617 | | | 7.048 | 3.112 | | | 3.355 | 4.804 | −1.104 | 4.447 | 2.007 |
| within 30 kilometers | (2.27) | | | (2.24) | (2.11) | | | (2.14) | (2.66) | (0.35) | (2.01) | (0.85) |
| Rural hospital | −5.129 | | | −2.414 | −1.682 | | | −0.079 | −1.262 | 3.906 | −0.159 | −0.154 |
| within 30 kilometers | (1.25) | | | (0.56) | (0.77) | | | (0.04) | (0.47) | (0.92) | (0.05) | (0.04) |
| Clinic (built after 1980) | −0.285 | | | 1.007 | −0.705 | | | −0.254 | −1.234 | 1.680 | −0.456 | −0.219 |
| within 30 kilometers | (0.13) | | | (0.43) | (0.63) | | | (0.21) | (0.90) | (0.70) | (0.26) | (0.13) |
| Rural hospital with | 6.264 | | | 0.607 | 2.578 | | | −1.276 | 0.700 | −7.153 | −2.855 | 1.314 |
| electricity | (1.42) | | | (0.13) | (1.11) | | | (0.52) | (0.24) | (1.54) | (0.83) | (0.35) |
| Clinic with electricity | 9.250 | | | 7.486 | 3.243 | | | 2.197 | −0.269 | 7.677 | 2.264 | 1.901 |
| | (2.90) | | | (2.20) | (2.04) | | | (1.31) | (0.14) | (2.35) | (0.96) | (0.73) |
| Mobile family planning | 4.137 | | | 7.304 | 1.748 | | | 3.499 | 2.060 | 8.158 | 4.848 | 2.153 |
| clinic visits | (1.73) | | | (2.80) | (1.45) | | | (2.67) | (1.36) | (3.14) | (2.64) | (1.08) |
| Mobile immunization | 5.580 | | | 2.462 | 1.659 | | | −0.359 | 0.916 | −4.779 | −2.407 | 2.045 |
| unit visits | (2.09) | | | (0.83) | (1.19) | | | (0.24) | (0.52) | (1.61) | (1.17) | (0.82) |
| Health worker visits | 0.497 | | | −0.560 | −0.243 | | | −0.882 | −1.572 | 0.202 | −2.487 | 1.284 |
| | (0.22) | | | (0.23) | (0.21) | | | (0.74) | (1.15) | (0.08) | (1.43) | (0.74) |
| Community-based | | 5.319 | | 4.317 | | 3.463 | | 2.964 | 3.272 | 1.952 | 2.315 | 3.435 |
| distributor visits | | (2.32) | | (1.81) | | (2.98) | | (2.47) | (2.38) | (0.82) | (1.3) | (1.99) |
| *Community-based distributor characteristics*[a] | | | | | | | | | | | | |
| Sample kit | | −0.434 | | 0.570 | | 0.137 | | 1.614 | 2.270 | 1.142 | 0.500 | 2.814 |
| | | (0.15) | | (0.15) | | (0.09) | | (0.86) | (1.05) | (0.30) | (0.18) | (1.03) |
| Bike | | 5.353 | | 2.754 | | 3.721 | | 4.376 | 4.392 | 4.417 | 6.157 | 3.046 |
| | | (1.73) | | (0.73) | | (2.39) | | (2.35) | (2.06) | (1.16) | (2.36) | (1.07) |
| Blood pressure | | 11.804 | | 25.095 | | 10.073 | | 12.936 | 15.959 | 20.701 | 6.524 | 18.494 |
| | | (0.70) | | (1.10) | | (1.22) | | (1.17) | (1.25) | (0.93) | (0.41) | (1.11) |
| Stethoscope | | −8.468 | | −21.012 | | −8.350 | | −11.612 | −14.832 | −19.186 | −5.198 | −16.604 |
| | | (0.53) | | (0.97) | | (1.06) | | (1.10) | (1.23) | (0.90) | (0.34) | (1.05) |
| Taken ZNFPC course | | 29.420 | | 18.353 | | 11.424 | | 9.728 | 2.462 | 32.896 | 16.389 | −2.346 |
| | | (2.62) | | (1.37) | | (1.94) | | (1.42) | (0.31) | (2.47) | (1.76) | (0.22) |

*(Table continues on the following page.)*

Table 3. *(continued)*

| Variable | Ever use | | | | Current use | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | By woman's age | | By woman's education | |
| | General health infrastructure | Community-based distributors | Clinic services | All variables | General health infrastructure | Community-based distributors | Clinic services | All variables | Less than 35 | 35 or older | Less than primary | Primary completed or more |
| *Clinic characteristics* | | | | | | | | | | | | |
| Number of needles | | 2.400 | 3.692 | | | 1.866 | 2.698 | 1.476 | 5.932 | 3.286 | 1.323 | |
| | | (2.01) | (2.82) | | | (3.27) | (4.35) | (2.00) | (5.00) | (3.98) | (1.29) | |
| Lap-kits in stock[a] | | 119.404 | 117.703 | | | 41.281 | 10.411 | −22.421 | 63.813 | 2.036 | 11.952 | |
| | | (1.99) | (1.72) | | | (1.42) | (0.32) | (0.56) | (1.09) | (0.04) | (0.26) | |
| Distributes condoms[a] | | 11.110 | 6.593 | | | 5.628 | 4.290 | 2.780 | 10.903 | 8.747 | −0.669 | |
| | | (2.13) | (1.13) | | | (2.01) | (1.40) | (0.80) | (1.63) | (1.92) | (0.15) | |
| Distributes Depo Provera[a] | | 2.902 | 0.952 | | | 2.725 | 0.028 | −3.638 | 7.008 | 1.202 | −4.224 | |
| | | (0.58) | (0.16) | | | (1.08) | (0.01) | (1.05) | (1.22) | (0.29) | (0.92) | |
| Distributes other methods[a] | | −2.966 | 0.599 | | | −1.794 | 1.138 | 3.031 | −4.008 | 0.904 | 3.152 | |
| | | (0.98) | (0.17) | | | (1.20) | (0.65) | (1.52) | (1.10) | (0.35) | (1.23) | |
| Suggests natural methods[a] | | −19.458 | −17.568 | | | −7.943 | −7.762 | −8.718 | −5.551 | −13.291 | −1.436 | |
| | | (2.40) | (1.98) | | | (1.86) | (1.68) | (1.58) | (0.66) | (1.96) | (0.21) | |
| Has at least one doctor[a] | | 6.886 | −16.165 | | | 1.949 | −12.292 | −9.884 | −12.546 | −33.784 | 7.329 | |
| | | (0.33) | (0.74) | | | (0.19) | (1.15) | (0.80) | (0.58) | (2.08) | (0.48) | |
| Number of nurses | | 16.093 | 18.308 | | | 4.655 | 7.081 | 9.181 | 1.472 | 6.547 | 6.018 | |
| | | (2.27) | (2.27) | | | (1.33) | (1.80) | (2.00) | (0.19) | (1.06) | (1.12) | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Test statistics* | | | | | | | | | | | | |
| $\chi^2$ tests | | | | | | | | | | | | |
| Infrastructure | 30.77 | | | 25.92 | 18.95 | | | 18.48 | 15.33 | 21.35 | 18.42 | 4.91 |
| | [0.00] | | | [0.00] | [0.02] | | | [0.02] | [0.05] | [0.01] | [0.02] | [0.77] |
| CBD characteristics | | 15.43 | | 7.37 | | 22.41 | | 19.23 | 18.53 | 7.90 | 11.33 | 11.31 |
| | | [0.02] | | [0.29] | | [0.00] | | [0.00] | [0.01] | [0.25] | [0.08] | [0.08] |
| Clinic | | | 24.18 | 25.18 | | | 23.11 | 30.20 | 13.58 | 31.74 | 29.21 | 8.49 |
| | | | [0.00] | [0.00] | | | [0.00] | [0.00] | [0.09] | [0.00] | [0.00] | [0.39] |
| All services | | | | 62.69 | | | | 64.29 | 46.72 | 52.56 | 54.74 | 23.66 |
| | | | | [0.00] | | | | [0.00] | [0.00] | [0.00] | [0.00] | [0.37] |
| All covariates | 1,541 | 1,526 | 1,535 | 1,574 | 804 | 808 | 808 | 850 | 730 | 187 | 228 | 628 |
| | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] |
| Likelihood | −2,139 | −2,147 | −2,142 | −2,123 | −2,057 | −2,055 | −2,055 | −2,034 | −1,489 | −509 | −1,036 | −994 |
| Pseudo $R^2$ | 0.26 | 0.26 | 0.26 | 0.27 | 0.16 | 0.16 | 0.16 | 0.17 | 0.20 | 0.16 | 0.10 | 0.24 |

*Note*: The values are maximum likelihood probit estimates transformed into derivatives. Asymptotic *t*-statistics are in parentheses, and *p*-values are in square brackets. All regressions include controls for woman's education, husband's education, marital status, presence of husband, age (represented by dummies for each five-year age group), ethnicity, and residence in rural area. The number of observations is 4,201.

a. Dummy variable: value is 1 if condition is true; 0 otherwise.

*Source*: Authors' calculations based on CSO and IRD/Macro International (1989). Measures of general health infrastructure are drawn from CSO and IRD/Macro International (1991); all other measures are drawn from ZNFPC (1992).

four columns allow us to determine the extent to which service availability and quality have differential effects on younger and older cohorts as well as to evaluate the likely distributional impact of public health investments.

*General health infrastructure.* Women who live within 30 kilometers of a general hospital are significantly more likely to use modern methods than women who live farther from a general hospital. This is a robust result, observed in all specifications and also reported in Guilkey and Cochrane (1992). It is, however, true only in rural areas because there is a hospital in virtually every urban area. Within the rural sector about 25 percent of sample women live within 30 kilometers of a general hospital, and these women are 10 percent more likely to use contraceptives than are other rural women. This does not simply reflect income differences across rural areas because the estimated effects in table 3 are conditional on the effect of income (to the extent that it is captured by the woman's marital status, her husband's education, and household asset ownership).

If the income-related measures are not included in the regression, the inference is unchanged but the magnitude of the effect is about 25 percent bigger. The increased magnitude reflects the fact that service availability is positively correlated with income and underscores the discussion above about the importance of controlling for income in order to interpret the regression results.[13] It turns out (ninth through twelfth columns in table 3) that the benefits of general hospitals are greatest among younger women and also among the least educated; the latter result suggests these investments may be reaching the poorest women. Rural hospitals, in contrast, are not associated with a greater probability that a woman has adopted contraceptives.

Although every community in the ZDHS is within 30 kilometers of a clinic, half of these clinics have been open only since independence. We thus determine whether the impact of newer clinics is different from that of clinics that were established before 1980. The answer, from table 3, is clearly no. However, if the clinics have been located in areas where fertility was high with the intent of raising contraceptive usage, it may be argued that their placement should be treated as endogenous and inferences about their impact would be incorrect. This implies that new clinics should be located in areas where fertility is relatively high among women who would have completed their fertility by the early 1980s. We can evaluate the empirical importance of the argument by estimating a reduced form model in which all household and community characteristics are regressed on the number of children ever born to women over the age of forty in 1988. The effect of a new clinic is not only tiny in magnitude (0.05 with a $t$-statistic of 0.1) but it is also negative. This suggests that placement of health facilities was not primarily motivated by a concern over fertility. In fact, the

13. In general, estimated magnitudes tend to be greater in absolute value when income is excluded from the regressions, and for some community characteristics the effects become significant. Policy analysis based on models that do not control for income will therefore not only lead to overestimates of the effects of a program in these data but also to misleading inferences.

best predictors for the opening of a facility since independence are rural location and absence of modern water and sewerage infrastructure.

About three-quarters of rural hospitals and half the clinics are serviced by electricity: we use this as a measure of the quality of the infrastructure. From table 3, the availability of electricity does seem to matter at clinics, especially with respect to ever use, which suggests that this dimension of quality has a bigger effect on older women. This inference turns out to be correct: according to the results in the tenth column, older women who live within the vicinity of a clinic that has electricity are about 8 percent more likely to be using contraceptives.

Around half the sample women live in areas that receive regular visits from mobile immunization units and health workers. These units have no direct impact on women's contraceptive usage. Those mobile units that provide family planning services operate in remote and sparsely populated areas: although they operate in about 60 percent of the clusters, only a third of the women in the sample live in those clusters. The units do appear to have a powerful effect on use of contraceptives: it is approximately the same in magnitude as the effect of a general hospital in the area, after controlling for all other infrastructure. This is true for both current use and ever use. Mobile family planning units have their greatest impact among the poor as they seem to be successfully serving women with little education, for whom the impact is about the same as a general hospital. The units also tend to serve older women. These results suggest that equipping all mobile health units with family planning services may prove to be a good investment.

Taken together, the availability and quality of infrastructure do affect the probability that a woman uses modern methods: this is true for all women, young and old, and for those with less education but not for the better educated. Apparently, investments in infrastructure have been of greatest benefit to the poorest, at least in terms of increased contraceptive usage.

*CBD characteristics.* CBDs are an integral part of the delivery of family planning service in Zimbabwe today. Started in 1967 as a field educator program with a primary focus on urban and periurban areas, the CBD program grew dramatically during the 1980s and shifted its focus to rural women. Whereas in 1970 there were 50 CBDs, by 1982 about 300 were working, and by 1987 there were some 668 CBDs associated with ZNFPC (ZNFPC 1992). CBDs are selected by the communities they work in and are typically (but not universally) female. In theory, after a six-week course conducted by ZNFPC, the CBD is equipped with a bicycle, some elementary medical equipment, and supplies of oral contraceptives and condoms. The CBD is supposed to visit each woman in the local community in an attempt to educate, motivate, and screen her suitability for oral contraceptives and, if appropriate, issue her with a four-week supply of contraceptives. At the end of this cycle the woman is directed to visit the local clinic (with which the CBD is associated) for a complete checkup. All being well, the CBD resupplies her for another four weeks. If, after four visits, the woman is

not having any method-related problems, she is supplied with three cycles of pills and the CBD visits her once every three months.

Women in areas with CBDs are significantly more likely to be using modern contraceptives and to have ever used modern methods. This effect is larger for younger women and insignificant for older women. Although one goal of the CBD program is outreach to those who do not otherwise have access to family planning services, these data indicate that the impact of CBDs is actually larger on the *better educated* and is significant for that group but not for the less educated (although the gap is not significant).

Drawing on data from the Zimbabwe Situation Analysis Study we have attributed information on the quality of representative CBDs to each district. Two factors matter: whether the CBD has a bicycle and whether the CBD has taken a course from the ZNFPC. Both these quality indicators are more important (and significant) for women with little education. Stratifying on sector of residence, the presence of a CBD in the area has a significant effect only in the urban sector, and these quality indicators are only significant in the rural sector. This may suggest that all CBDs in the urban sector are effective in motivating women to use contraceptives or that they are simply filling a demand that would be satisfied through another outlet (such as the ZNFPC clinic). In the rural sector, however, investments in simple equipment (bicycles) and training may have a payoff both in terms of improved motivation and also better access to women in more remote areas.[14]

Although CBD characteristics do have a significant impact on current contraceptive usage, they are not associated with the probability that a woman has ever used a modern method; this suggests that the CBD program has been more effective in recent years. This is consistent with the fact that CBD characteristics have no impact on usage by older women but do affect the probability among younger women.

CBDs tend to be located in lower income areas in Zimbabwe, and it turns out that inference regarding their impact on usage relies on simultaneously controlling for household resources (education and asset ownership). When household characteristics are excluded from the model, the CBD visits are not associated with higher contraceptive usage. This is another example that demonstrates the importance of controlling for local resources in these sorts of analyses.

*Clinic characteristics.* Finally, we turn to characteristics of clinics (again drawing on data for the district from the Zimbabwe Situation Analysis Study). Two measures of "quality" stand out as being significant. The first is the number of needles in stock, which has a positive impact on current and ever usage; the effect is significant for both young and older women (and very large for the latter) and is significant only for women with less education. This result is

14. These and the results for a general hospital in the area are the only ones that depend on stratification of the sample by sector of residence. These estimates are, therefore, not reported in the tables.

consistent with the effect of a general hospital and indicates that poorer women are using facilities that are better equipped.[15]

The second significant characteristic of clinic quality is the number of nurses, which also has a positive effect on usage, especially among younger women. Facilities with at least one doctor, however, tend to be associated with a lower probability of using modern methods among the less well educated. Negative effects of doctors have been reported in other studies of contraceptive usage (Feyisetan and Ainsworth 1996) and child health (Thomas, Strauss, and Henriques 1990).

The majority of women in Zimbabwe use oral contraceptives and so the model includes information about whether other methods are available in the clinic. It appears that providing a range of family planning options does not have a significant effect on usage except, perhaps, condoms among the less well educated. If the clinic has a policy of suggesting natural methods, then modern method usage tends to be lower in the area, again among the less educated. Taken together, clinic services and quality affect the probability of using modern methods, but only among older women and the less well educated.

*Other dimensions of quality and availability of services.* The two community surveys are very rich, and a number of other dimensions of quality and availability of services have been included in other specifications. These include whether particular methods were in stock at the time of the survey and whether personnel were available for consultation: neither turns out to have a significant effect. Prices of services comprise two components: the financial cost of the service and the time cost associated with getting to the facility. Price data are hard to collect particularly when there is heterogeneity in quality of services; we have experimented with including the price of a package of pills and find that it has no effect on usage. In part, this is because there is very little heterogeneity in the price (for example, *all* ZNFPC clinics in the survey charge Z$0.20). Similarly, experiments with a variety of specification of distance to facilities (which captures part of the time costs) indicate that distance does not have an impact on usage. The one exception is distance to ZNFPC facilities; the closer the facility, the more likely a woman uses modern methods. In view of the earlier discussion regarding the failure of local informants to identify ZNFPC facilities, it is not obvious how to interpret this result. We have also chosen to exclude pharmacies from the analysis—for the same reason. On the basis of our knowledge of the country, several informants identified pharmacies that were not the closest, and many informants failed to identify a pharmacy at all.

15. Lap-kits, which are used to perform sterilization, have a significant positive effect on ever use (when only clinic characteristics are included in the regression). The effect is negative for young women but positive for older women (although neither is significant); this suggests that older women who have used contraceptives are more likely to have had a laparatomy. However, the results should be treated with caution because less than 5 percent of clinics have lap-kits.

In sum, it would seem that, at least with the measures of availability and quality used in this analysis, investments in infrastructure have a positive impact on the adoption of modern methods (from table 3, the $\chi^2$ for all community service characteristics for current use is 64.3). These effects are significant for both young and old women and for the less educated but not the better educated. It is quite likely that the better educated acquire their contraceptives from private sources and so public investments are not only productive but they also serve a distributional role by bringing family planning to the poorer women of Zimbabwe. As an additional check on the robustness of these results, models have been estimated which control for all observable and unobservable community characteristics by including a community fixed effect in a linear regression. While the fixed effect sweeps out the direct impact of all the community services, it is still possible to examine differences in the impact of these services on women across the education distribution. The contrasts drawn out in this article are also apparent in the fixed-effects estimates with several of the interactive effects being significant. For example, the interaction between education and visits by a CBD is positive and significant, indicating that even after controlling for all community heterogeneity (and also potential problems associated with selective program placement), CBDs tend to have a bigger impact on the contraceptive usage of better educated women relative to women with little education.

## IV. Conclusions

There can be little doubt that the availability and quality of family planning and health services in the community are associated with higher rates of adoption of modern contraceptives in Zimbabwe and these effects tend to be larger for less educated women. Public health policy has sought to bring CBDs to all communities in Zimbabwe: according to our results, this is likely to be associated with increased adoption of modern methods. Mobile family planning clinics seem to have an even more powerful impact on adoption of contraceptives as does the presence of a general hospital in the area. It is especially important that the impact of these two investments in infrastructure is larger among women with little education.

Not only do these services have a significant impact on usage but the magnitude is substantial. For example, if a hospital, mobile family planning unit, and CBD were all introduced to a community where they did not previously exist, then our estimates suggest that contraceptive usage would be raised from 30 percent to 40 percent, on average. This is a very large effect. For example, in terms of the impact on contraceptive adoption rates, it is equivalent to giving a woman who has only completed preschool an additional seven years of schooling (so she completes Form 2).

Education also has a direct, powerful impact on contraceptive usage and fertility, especially among younger and urban women for the case of fertility. Part of

the impact of education may be attributed to the role of income and part to unobservable differences among women who complete particular grades (at least for contraceptive usage). It behooves us to better understand the mechanisms that underlie these correlations: one possibility is that education's impact on contraception use and fertility reflects increased labor market opportunities for educated women in post-independence Zimbabwe.

Table A-1. *Sample Means: Individual and Household Characteristics*

| Variable | All women | By woman's age: Less than 35 | By woman's age: 35 or older | By woman's residence: Urban | By woman's residence: Rural |
|---|---|---|---|---|---|
| *Women's contraceptive use and knowledge (percent)* | | | | | |
| Know modern method | 95.38 | 94.95 | 96.64 | 97.23 | 94.45 |
| Currently use modern method | 27.21 | 27.96 | 25.00 | 33.62 | 23.98 |
| Currently use pill | 23.54 | 25.95 | 16.51 | 27.65 | 21.47 |
| Currently use traditional method | 4.98 | 3.80 | 8.40 | 2.63 | 6.16 |
| Ever used modern method | 48.42 | 46.47 | 54.10 | 55.86 | 44.67 |
| *Fertility* | | | | | |
| Number of children ever born | 2.95 | 1.86 | 6.15 | 2.28 | 3.29 |
| Number born in last 5 years | 0.79 | 0.83 | 0.71 | 0.64 | 0.88 |
| Completed fertility (women age 45 and older) | 6.83 | n.a. | n.a. | 4.99 | 7.51 |
| Number of births in last year | 0.17 | 0.19 | 0.11 | 0.13 | 0.19 |
| Age at first birth (years) | 18.84 | 18.49 | 19.49 | 19.14 | 18.70 |
| Child survival rate (percent) | 91.96 | 93.30 | 89.42 | 94.77 | 90.65 |
| *Household characteristics* | | | | | |
| Women with completed years of education (percent) | | | | | |
| 0 | 13.64 | 10.07 | 24.07 | 6.47 | 17.25 |
| 1 | 1.64 | 1.28 | 2.71 | 0.71 | 2.11 |
| 2 (complete preschool) | 4.05 | 2.81 | 7.65 | 1.99 | 5.08 |
| 3 | 4.86 | 3.29 | 9.42 | 2.63 | 5.98 |
| 4 | 4.95 | 4.06 | 7.56 | 3.84 | 5.51 |
| 5 | 9.47 | 7.96 | 13.90 | 5.05 | 11.70 |
| 6 | 9.19 | 9.46 | 8.40 | 6.18 | 10.70 |
| 7 (complete primary) | 21.59 | 23.62 | 15.67 | 22.17 | 21.30 |
| 8 | 4.71 | 5.91 | 1.21 | 4.90 | 4.62 |
| 9 (complete Form 2) | 8.76 | 10.13 | 4.76 | 13.43 | 6.41 |
| 10 | 3.14 | 3.99 | 0.65 | 4.62 | 2.40 |
| 11 (complete Form 4) | 12.26 | 15.47 | 2.89 | 23.67 | 6.51 |
| 12 or more | 1.74 | 1.95 | 1.12 | 4.34 | 0.43 |
| More than primary school | 30.61 | 37.46 | 10.63 | 50.96 | 20.37 |
| Husbands present (percent) | 44.58 | 39.02 | 60.82 | 49.18 | 42.27 |
| Husbands with completed level of education (percent) | | | | | |
| Preschool | 1.81 | 1.47 | 2.80 | 0.64 | 2.40 |
| Some primary school | 16.14 | 10.87 | 31.53 | 8.60 | 19.94 |
| Complete primary school | 18.76 | 17.90 | 21.27 | 15.42 | 20.44 |
| Complete Form 2 | 9.16 | 9.24 | 8.96 | 12.01 | 7.73 |
| More than Form 2 | 13.07 | 14.51 | 8.86 | 23.10 | 8.02 |
| Age of respondent (years) | 27.82 | 23.28 | 41.08 | 27.22 | 28.12 |

Table A-1. *(continued)*

| Variable | All women | By woman's age: Less than 35 | By woman's age: 35 or older | By woman's residence: Urban | By woman's residence: Rural |
|---|---|---|---|---|---|
| Households that own assets (percent) | | | | | |
| Bicycle or motorcycle | 26.66 | 25.95 | 28.73 | 26.72 | 26.63 |
| Car | 11.69 | 12.08 | 10.54 | 25.66 | 4.65 |
| Radio | 45.82 | 48.19 | 38.90 | 74.91 | 31.17 |
| Television | 14.76 | 15.50 | 12.59 | 39.30 | 2.40 |
| Cattle | 40.66 | 38.99 | 45.52 | 5.12 | 58.55 |
| Goats or sheep | 41.61 | 40.17 | 45.80 | 4.34 | 60.38 |
| Percentage of women who are: | | | | | |
| Shona[a] | 78.15 | 77.82 | 79.10 | 69.72 | 82.39 |
| Married | 62.91 | 56.09 | 82.84 | 55.37 | 66.71 |
| Divorced | 10.12 | 8.15 | 15.86 | 12.22 | 9.06 |
| Resident in rural sector | 66.51 | 64.88 | 71.27 | 0.00 | 100.00 |

n.a. Not applicable.

a. Ethnic group in Zimbabwe.

*Source:* Authors' calculations based on CSO and IRD/Macro International (1989).

Table A-2. *Sample Means: Community Characteristics*

| Variable | Cluster level | Sample women | | |
|---|---|---|---|---|
| | | All | Urban | Rural |
| *General infrastructure (percent)* | | | | |
| General hospital | 50.1 | 51.1 | 98.2 | 27.4 |
| Rural hospital | 25.7 | 26.3 | 7.7 | 35.7 |
| With electricity | 18.6 | 19.1 | 7.7 | 24.8 |
| Clinic built since 1980 | 45.5 | 47.4 | 24.4 | 59.1 |
| Clinic with electricity | 47.3 | 45.5 | 98.1 | 19.1 |
| Visited by health worker | 28.7 | 62.9 | 38.8 | 75.1 |
| Visited by mobile immunization unit | 42.5 | 43.6 | 0.0 | 65.6 |
| Visited by mobile family planning unit | 61.7 | 30.7 | 9.9 | 41.2 |
| *Community-based distributor (percent)* | | | | |
| Visited by CBD | 60.5 | 62.8 | 34.5 | 77.1 |
| CBD has sample kit | 50.1 | 51.3 | 31.4 | 61.3 |
| CBD has bike | 39.5 | 39.1 | 20.3 | 48.5 |
| CBD has blood pressure gauge | 20.8 | 21.6 | 15.5 | 24.7 |
| CBD has stethoscope | 19.7 | 20.5 | 13.9 | 23.8 |
| CBD has taken ZNFPC course | 50.8 | 51.4 | 34.5 | 60.0 |
| *Clinic characteristics* | | | | |
| Number of needles in stock (thousands) | 3.0 | 2.7 | 2.2 | 2.9 |
| Lap-kits (percent) | 3.6 | 2.7 | 1.6 | 3.2 |
| Distribute condoms (percent) | 92.2 | 91.1 | 98.4 | 87.4 |
| Distribute Depo Provera (percent) | 15.0 | 15.9 | 21.7 | 13.0 |
| Distribute other methods (percent) | 41.3 | 40.3 | 67.8 | 26.5 |
| Suggest natural methods (percent) | 6.6 | 6.1 | 5.4 | 6.5 |
| Have at least one doctor (percent) | 13.2 | 10.1 | 25.9 | 2.1 |
| Number of nurses | 8.0 | 7.2 | 14.9 | 3.3 |
| Sample size | 166 | 4,201 | 1,407 | 2,794 |

*Source*: Authors' calculations based on CSO and IRD/Macro International (1989). Measures of general health infrastructure are drawn from CSO and IRD/Macro International (1991); all other measures are drawn from ZNFPC (1992).

## REFERENCES

The word "processed" describes informally reproduced works that may not be commonly available through library systems.

Adamchak, Donald J., and Michael T. Mbizvo. 1990. "The Relationship between Fertility and Contraceptive Prevalence in Zimbabwe." *International Family Planning Perspectives* 16(3):103–06.

Becker, Gary S. 1981. *A Treatise on the Family*. Cambridge, Mass.: Harvard University Press.

Boohene, Esther, and Thomas Dow. 1987. "Contraceptive Prevalence and Family Planning Program Effort in Zimbabwe." *International Family Planning Perspectives* 13(1):1–7.

Cochrane, Susan 1983. "Effects of Education and Urbanization on Fertility." In Rodolfo A. Bulatao and Ronald D. Lee, eds., *Determinants of Fertility in Developing Countries*. New York: Academic Press.

Cochrane, Susan, and Samir Farid. 1990. "Socioeconomic Differentials in Fertility and Their Explanation." In George T. F. Acsadi, Gwendolyn Johnson-Acsadi, and Rodolfo Bulatao, eds., *Population Growth and Reproduction in Sub-Saharan Africa: Technical Analyses of Fertility and Its Consequences*. Washington, D.C.: World Bank.

CSO (Central Statistical Office) and IRD (Institute for Resource Development)/Macro International. 1989. *Zimbabwe Demographic and Health Survey, 1988*. Harare, Zimbabwe, and Columbia, Md.

———. 1991. *Zimbabwe Service Availability Survey, 1989/90*. Harare, Zimbabwe, and Columbia, Md.

Efron, Bradley. 1982. "The Jackknife, the Bootstrap and Other Resampling Plans." SIAM CBMS-NSF Monograph 38. Philadelphia: Society for Industrial and Applied Mathematics.

Feyisetan, Bamikale J., and Martha Ainsworth. 1996. "Contraceptive Use and the Quality, Price, and Availability of Family Planning in Nigeria." *The World Bank Economic Review* 10(1):159–87.

Frankenberg, Elizabeth. 1995. "The Effects of Access to Health Care on Infant Mortality in Indonesia." *Health Transition Review* 5(2):143–63.

Gertler, Paul J., and John Molyneaux. 1993. "How Economic Development and Family Planning Combined to Reduce Indonesian Fertility." *Demography* 31(1):33–64.

Guilkey, David, and Susan Cochrane. 1992. "Zimbabwe: Determinants of Contraceptive Use at the Leading Edge of Fertility Transition in Sub-Saharan Africa." University of North Carolina, Chapel Hill, Dept. of Economics. Processed.

Huber, Peter J. 1967. "The Behavior of Maximum Likelihood Estimates under Non-Standard Conditions." In *Proceedings of the Fifth Berkeley Symposium on Mathematical Statistics and Probability*. Berkeley, Calif.: University of California Press.

Mauldin, W. Parker, and John A. Ross. 1991. "Family Planning Programs: Efforts and Results, 1982–89." *Studies in Family Planning* 22(6):350–67.

National Research Council. 1993a. *Factors Affecting Contraceptive Use in Sub-Saharan Africa*. Washington, D.C.: National Academy Press.

———. 1993b. *Demographic Change in Sub-Saharan Africa*. Washington, D.C.: National Academy Press.

———. 1993c. *Demographic Effects of Economic Reversals in Sub-Saharan Africa.* Washington, D.C.: National Academy Press.

Pitt, Mark M., Mark R. Rosenzweig, and Donna M. Gibbons. 1993. "The Determinants and Consequences of the Placement of Government Programs in Indonesia." *The World Bank Economic Review* 7(3):319–48.

Rosenzweig, Mark, and T. Paul Schultz. 1985. "The Supply of and Demand for Births: Fertility and Its Life Cycle Consequences." *American Economic Review* 75(5):992–1015.

Rosenzweig, Mark, and Kenneth Wolpin. 1982. "Government Interventions and Household Behavior in a Developing Country: Anticipating the Unanticipated Consequences of Social Programs." *Journal of Development Economics* 10:209–25.

———. 1986. "Evaluating the Effects of Optimally Distributed Public Programs." *American Economic Review* 76:470–82.

Thomas, Duncan, and John Maluccio. 1995. *Contraceptive Choice, Fertility, and Public Policy in Zimbabwe.* LSMS Working Paper 109. Washington, D.C.: World Bank.

Thomas, Duncan, John Strauss, and Maria-Helena Henriques. 1990. "Child Survival, Height for Age and Household Characteristics in Brazil." *Journal of Development Economics* 33:197–234.

Way, Ann, Anne R. Cross, and Sushil Kumar. 1987. "Family Planning in Botswana, Kenya and Zimbabwe." *International Family Planning Perspectives* 13(1):7–11.

Wilkinson, Marilyn. 1992. "Dimensions of Service Delivery and Their Impact on Pill Use in Zimbabwe." Johns Hopkins University, School of Public Health, Baltimore. Processed.

ZNFPC (Zimbabwe National Family Planning Council). 1992. "Zimbabwe: A Situation Analysis of the Family Planning Programme." Harare. Processed.