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**ATTRITION IN LONGITUDINAL HOUSEHOLD
SURVEY DATA: SOME TESTS FOR THREE
DEVELOPING-COUNTRY SAMPLES**

**Harold Alderman, Jere R. Behrman, Hans-Peter Kohler, John A. Maluccio,
Susan Cotts Watkins**

Food Consumption and Nutrition Division

International Food Policy Research Institute

2033 K Street, N.W.

Washington, D.C. 20006 U.S.A.

(202) 862-5600

Fax: (202) 467-4439

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ABSTRACT

Longitudinal household data can have considerable advantages over much more widely used cross-sectional data. The collection of longitudinal data, however, may be difficult and expensive. One problem that has concerned many analysts is that sample attrition may make the interpretation of estimates problematic. Such attrition may be particularly severe in areas where there is considerable mobility because of migration between rural and urban areas. Many analysts share the intuition that attrition is likely to be selective on characteristics such as schooling and that high attrition is likely to bias estimates made from longitudinal data. This paper considers the extent of and implications of attrition for three longitudinal household surveys from Bolivia, Kenya, and South Africa that report very high per-year attrition rates between survey rounds. Our estimates indicate that (1) the means for a number of critical outcome and family background variables differ significantly between attritors and nonattritors; (2) a number of family background variables are significant predictors of attrition; but (3) nevertheless, the coefficient estimates for “standard” family background variables in regressions and probit equations for the majority of the outcome variables considered in all three data sets are not affected significantly by attrition. Therefore, attrition apparently is not a general problem for obtaining consistent estimates of the coefficients of interest for most of these outcomes. These results, which are very similar to results for developed economies, suggest that for these outcome variables—despite suggestions of systematic attrition from

univariate comparisons between attritors and nonattritors, multivariate estimates of behavioral relations of interest may not be biased due to attrition.

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Harold Alderman
The World Bank

Jere R. Behrman
University of Pennsylvania

Hans-Peter Kohler
Max-Planck Institute for Demographic Research

John A. Maluccio
International Food Policy Research Institute

Susan Cotts Watkins
University of Pennsylvania

1. INTRODUCTION

Longitudinal household data can have considerable advantages over more widely used cross-sectional data for social science analysis. Longitudinal data permit (1) tracing the dynamics of behaviors, (2) identifying the influence of past behaviors on current behaviors, and (3) controlling for unobserved fixed characteristics in the investigation of the effect of time-varying exogenous variables on endogenous behaviors. Unfortunately, the collection of longitudinal data may be difficult and expensive, and some, such as Ashenfelter, Deaton, and Solon (1986), question whether the gains are worth the costs.

One problem in particular that has concerned analysts is that sample attrition may lead to selective samples and make the interpretation of estimates problematic. Such attrition may be particularly severe in areas in the developing world in which there is considerable mobility because of migration between rural and urban areas. Many analysts share the intuition that attrition is likely to be selective on characteristics such as schooling and that high attrition is likely to bias estimates made from longitudinal data. Table 1 summarizes the attrition rates in a number of longitudinal data sets from developing countries. While these vary considerably (ranging from 6 to 50 percent between two survey rounds and 1.5 to 20.5 percent per year between survey rounds), often there is considerable attrition.

In this paper, we consider the implications of attrition for three of the four longitudinal household surveys from developing countries in Table 1 that report the highest per-year attrition rates between survey rounds: (1) a Bolivian household survey

designed to evaluate an early childhood development intervention in poor urban areas, with survey rounds in 1995/1996 and 1998; (2) a Kenyan rural household survey designed to investigate the nature of social networks in the dissemination of contraceptive use and behaviors related to HIV/AIDS, with survey rounds in 1994/1995 and 1996/1997; and (3) a South African (KwaZulu-Natal Province) rural and urban household survey designed for more general purposes with survey rounds in 1993 and 1998. All three survey areas were relatively poor and experienced considerable mobility.

The next section summarizes recent studies on attrition in longitudinal surveys for developed countries. Section 3 describes the three data sets used in this study while Section 4 presents some tests for the implications of attrition between the first and the second rounds of the three surveys. Section 5 summarized our conclusions.

2. SOME THEORETICAL ASPECTS OF THE EFFECTS OF ATTRITION ON ESTIMATES

Most studies of attrition we know of are for major longitudinal samples in developed economies including those summarized in a special issue of *The Journal of Human Resources* (Spring 1998) on “Attrition in Longitudinal Surveys.” The striking result of these studies is that the biases in estimated socioeconomic relations due to attrition are small—despite attrition rates as high as 50 percent and with significant differences between attritors and nonattritors for the means of a number of outcome and

standard control variables. For example, Fitzgerald, Gottschalk, and Moffitt (1998) observe:

By 1989 the Michigan Panel Study on Income Dynamics (PSID) had experienced approximately 50 percent sample loss from cumulative attrition from its initial 1968 membership.... (p. 251).

We find that while the PSID has been highly selective on many important variables of interest, including those ordinarily regarded as outcome variables, attrition bias nevertheless remains quite small in magnitude. The major reasons for this lack of effect are that the magnitudes of the attrition effect, once properly understood, are quite small (most attrition is random).... (p. 252).

Although a sample loss as high as [experienced] must necessarily reduce precision of estimation, there is no necessary relationship between the size of the sample loss from attrition and the existence or magnitude of attrition bias. Even a large amount of attrition causes no bias if it is 'random'.... (p. 256).

The other studies in this volume reach similar conclusions. For example, Lillard and Panis (1998, p. 456 on PSID) indicate that, "While we found significant evidence of selective attrition, it appears that this...introduces only very mild biases in substantive results." Van den Berg and Lindeboom (1998, p. 477 on data from the Netherlands)

observe that "...the estimates of the covariate effects in the labor market transition rates do not change a lot when allowing for...relations between labor market durations and attrition. In any standard empirical analyses these covariate effects are the parameters of interest." Zabel (1998, p. 502 on SIPP and PSID) concludes that "It appears that accounting for attrition has little impact on the parameter estimates." Ziliak and Kniesner (1998, p. 507 on PSID) also agree that "...nonrandom attrition is of little concern when estimating [labor relations] because the effect of attrition is absorbed into the fixed effects...." And finally, Falaris and Peters (1998, p. 531 on NLS and PSID) note that "In general...we find that attrition either has no effect on the regression estimates or only affects the estimates of the intercept...."

Fitzgerald, Gottschalk, and Moffitt (1998) provide a statistical framework for the analysis of attrition bias in which the common distinction between selections on unobservables and observables is used to develop tests for attrition bias and correction factors to eliminate it. While neither type of attrition (on unobservables or on observables) necessarily imposes a bias on estimates of interest, when one does, the latter may be more amenable to statistical solutions. This leads to a sequence of tests that we will follow in this study. First, given that there is sample attrition, one determines whether or not there is selection on observables. For this purpose, selection on observables includes that which is based on endogenous observables such as lagged dependent variables that are observed prior to the point of attrition. Even if there is selection on observables, this does not necessarily bias the estimates of interest. Thus, one needs to test for the potential bias as well.

More formally, assume what is of interest is a conditional population density $f(y|x)$ where y is a scalar dependent variable and x is a scalar independent variable (for illustration, but in practice the extension to making x a vector is straightforward).

$$y = \mathbf{b}_0 + \mathbf{b}_1 x + \mathbf{e}, y \text{ observed if } A = 0 \quad (1)$$

where A is an attrition indicator equal to 1 if an observation is missing its value of y because of attrition, and equal to zero if an observation is not missing its value of y . Since (1) can be estimated only if $A=0$, that is, one can only determine $g(y|x, A=0)$, one needs additional information or restrictions to infer $f(\cdot)$ from $g(\cdot)$. These can come from the probability of attrition, $\text{PR}(A=0|y, x, z)$, where z is an auxiliary variable (or vector) that is assumed to be observable for all units but not included in x , implying estimates of the form:

$$A^* = \mathbf{d}_0 + \mathbf{d}_1 x + \mathbf{d}_2 z + \mathbf{u} \quad (2)$$

$$\begin{aligned} A &= 1 \text{ if } A^* \geq 0 \\ &= 0 \text{ if } A^* < 0. \end{aligned} \quad (3)$$

Selection on unobservables occurs if z is independent of $\mathbf{e}|x$ but \mathbf{u} is not independent of $\mathbf{e}|x$. Selection on observables occurs if z is not independent of $\mathbf{e}|x$ but \mathbf{u} is independent of $\mathbf{e}|x$. Stated alternatively, selection on observables occurs if

$$\text{Pr}(A=0|y, x, z) = \text{Pr}(A=0|x, z) \quad (4)$$

Selection on unobservables occurs if (4) fails to hold so that the attrition function cannot be reduced from $\text{Pr}(A=0|y, x, z)$.

Selection on unobservables is often presented as dependent on the estimation of the attrition index equation. Identification, however, usually relies on nonlinearities in the index equation or an exclusion restriction, i.e., some z that is not in x . It is difficult to rationalize most such exclusion restrictions because, for example, personal characteristics that affect attrition might also directly affect the outcome variable, i.e., they should be in x . There may be some such identifying variables, however, in the form of variables that are external to individuals and not under their control, such as characteristics of the interviewer in the various rounds (Zabel 1998). However, in general, selection on unobservables presents an obstacle to accurate parameter estimation.¹

If there is selection on observables, the critical variable is z , a variable that affects attrition propensities and that is also related to the density of y conditional on x . In this sense, z is “endogenous to y .” Indeed, a lagged value of y can play the role of z if it is not in the structural relation being estimated and if it is related to attrition. Two sufficient conditions for the absence of attrition bias due to attrition on observables are either (1) z does not affect A or (2) z is independent of y conditional on x .

Specification tests can be based on either of these two conditions. One test simply is to determine whether candidate variables for i (for example, lagged values of y) significantly affect A . Another test is based on Beckett, Gould, Lillard, and Welch (1988). In the BGLW test, the value of y at the initial wave of the survey (y_0) is regressed

¹Fitzgerald, Gottschalk, and Moffitt (1998) suggest that indirect tests for selection on unobservables can be made by comparisons with datasets without (or with much less) attrition (e.g., the CPS for the United States), but only very limited possibilities are present for most panels.

on x and on future A . The test for attrition is based on the significance of A in that equation. This test is closely related to the test based on regressing A on x and y_0 (which is z in this case); in fact, the two equations are simply inverses of one another (Fitzgerald, Gottschalk, and Moffitt 1998).

Clearly, if there is no evidence of attrition bias from these specification tests, then one has the desired information on $f(y|x)$. However, Fitzgerald, Gottschalk, and Moffitt (1998) also note that if attrition bias is generated by this type of selection it can be eliminated by the use of weighted least squares (WLS), using weights obtained from estimated equations for the probability of attrition,

$$w(z, x) = [\text{Pr}(A = 0|z, x)] / [\text{Pr}(A = 0|x)]^{-1}. \quad (5)$$

The numerator in relation (5) inside the brackets is the probability of retention in the sample. Because both the weights and the conditional density g are identifiable and estimable functions, the complete population density $f(y|x)$ is estimable, as are its moments such as its expected value. Indeed, Fitzgerald, Gottschalk, and Moffitt (1998) show that a comparison between the WLS and the ordinary least squares (OLS) results provides an additional test for attrition bias.

3. DATA AND EXTENT OF ATTRITION

BOLIVIAN PRESCHOOL PROGRAM EVALUATION HOUSEHOLD SURVEY DATA

El Proyecto Integral de Desarrollo Infantil (PIDI) in Bolivia is a targeted urban early child development project expected to improve the nutritional status and cognitive development of children who participate and to facilitate the labor force participation of their caregivers. PIDI delivers child services through childcare centers located in the homes of women living in the target areas who have been trained in childcare. The program provides food accounting for 70 percent of the children's nutritional needs. In addition, the centers provide health and nutrition monitoring as well as programs to stimulate the children's social and intellectual development. The PIDI program was designed to facilitate ongoing impact evaluation through the collection of panel data.

Eligibility for PIDI at the time of the collection of the first and second rounds of data was based on an assessment of social risk. The selection criteria results in children who attend a PIDI center are, on average, from poorer family backgrounds than children who live in the same communities but who do not attend a PIDI center (see Todd, Behrman, and Cheng 2000). The first PIDI evaluation data set (Bolivia 1) was collected

between November 1995 and May 1996 and consisted of 2,047 households.² The second PIDI evaluation data set (Bolivia 2) was collected in the first half of 1998 and consisted of interviews in the 65 percent of the original 2,047 households that could be located (plus an additional 3,453 households that were not visited in Bolivia 1). The attrition rate of 35 percent for Bolivia 1 is relatively high, which raised concern about whether reliable inferences could be drawn from analysis of Bolivia 2.

THE KENYAN IDEATIONAL CHANGE SURVEY (KICS)

KICS is a longitudinal survey designed to collect information for the analysis of the roles of informal networks in understanding change in knowledge and behavior related to contraceptive use and AIDS. Four rural sites (sublocations) were chosen in Nyanza Province, near Lake Victoria in the southwestern part of Kenya. The sites were chosen to be similar in most respects but to maximize variation on two dimensions: (1) the extent to which social networks were confined to the sublocation versus being geographically extended and (2) the presence or absence of a community-based distribution, family-planning program. Villages were selected randomly within each site

²These households were stratified into three subsamples: (P) (40 percent of the total), which is a stratified random sample of households with children attending PIDs in which first the PIDI sites were selected randomly and then children within the sites were selected randomly. (A) (40 percent of the total), which is a stratified random sample (based on the 1992 census) of households with children in the age range served by PIDI living in poor urban communities comparable to those in which PIDI had been established, but in which PIDI programs had not been established as of that time. (B) (20 percent of the total), which is a stratified random sample (based on the 1992 census) of households with at least one child in each household in the age range served by PIDI and living in poor urban communities in which PIDI had been established and within a three block radius of a PIDI but without children attending PIDI.

and interviews were attempted with all ever-married women of childbearing age (15–49) and their husbands. The study consisted of ethnographic interviews, focus groups, and a household survey of approximately 900 women of reproductive age and their husbands that was conducted December 1994–January 1995 (Kenya 1). A second round was conducted in 1996/1997 (Kenya 2). The attrition rates between the two surveys were 33 percent for men, 28 percent for women, and 41 percent for couples (Table 1).³ These rates are comparable to the 35 percent reported for the Bolivian data.

Table 2 summarizes data on the reported causes of attrition for men and women as obtained generally from other household members for most individuals who were interviewed in Kenya 1 but not in Kenya 2.⁴ Mortality between the surveys accounted for 18.4 percent of the reasons given for men's attrition, but only half as much (9.9 percent) for women. For both men and women the leading explanation was migration, accounting for 58.6 percent of the reasons given for women and 47.8 percent of the reasons given for men. Because this is a patrilocal society, a significant share of this migration (over one-third) for women was associated with divorce or separation, but this was not a major factor for men. Not being found at home after at least three visits by interviewers was the next most common explanation for attrition in Kenya 2 among respondents in Kenya 1 who were still living at the time of Kenya 2, accounting for about one-sixth of the reasons given for both men (17.9 percent) and women (15.8 percent). Explicitly refusing or

³There also is "reverse attrition" in the sense of respondents who were present in Kenya 2 but not in Kenya 1: 12 percent (of the Kenya 2 total) for men, 11 percent for women, and 19 percent for couples.

⁴These data are not available for 22.4 percent of the men and 21.8 percent of the women interviewed in Kenya 1 but not in Kenya 2.

claiming to be too busy or sick to participate accounted for slightly smaller percentages—15.9 percent for men and 11.4 percent for women (with most of this gender difference accounted by “other,” which is 4.4 percent for women but 0.0 percent for men).

KWAZULU-NATAL INCOME DYNAMICS STUDY (KIDS)

The first South African national household survey, the 1993 Project for Statistics on Living Standards and Development (PSLSD), was undertaken in the last half of 1993 under the leadership of the South African Labour and Development Research Unit (SALDRU) at the University of Cape Town.⁵ Unlike the special purpose household surveys for Bolivia and Kenya described above, the South African survey was a comprehensive household survey similar to a Living Standards Measurement Survey or “LSMS” (Grosh and Muñoz 1996; Deaton 1997) and collected a broad array of socioeconomic information from individuals and households. Among other things, it included sections on household demographics, household environment, education, food and nonfood expenditures, remittances, employment and income, agricultural activities, health, and anthropometry (weights and heights of children aged six and under).

The 1993 sample was selected using a two-stage, self-weighting design. In the first stage, clusters were chosen proportional to population size from census enumerator districts or approximate equivalents when these were unavailable. In the second stage, all

⁵PSLSD is alternatively referred to as the SALDRU survey, the South African Integrated Household Survey (SAIHS), and the South African Living Standards Measurement Survey (LSMS).

households in each chosen cluster were enumerated and then a random sample selected (see PSLSD 1994 for further details).

Since the 1993 survey, South Africa has undergone dramatic political, social, and economic change, beginning with the change of government after the first national democratic elections in 1994. With the aim of addressing a variety of policy research questions concerning how individuals and households were coping during this transition, households surveyed by the PSLSD in South Africa's most populous province, KwaZulu-Natal, were resurveyed from March to June, 1998, for the KIDS (see May et al. 2000). In this paper, the sample of 1993 PSLSD households in KwaZulu-Natal is referred to as South Africa 1 and those reinterviewed in 1998 for KIDS, South Africa 2.

An important aspect of the South Africa resurvey—differentiating it further from the Bolivian and Kenyan longitudinal surveys—is that, when possible, the interviewer teams tracked, followed, and reinterviewed households that had moved.⁶ Hence, unlike in Bolivia and Kenyan surveys, migration does not imply automatic attrition from the sample. In addition to reducing the level of attrition and allowing analysis of migration behavior, tracking and following plausibly reduced biases introduced by attrition, a claim that is evaluated below.

In 1993, the KwaZulu-Natal sample contained 1,393 households (215 Indian and 1,178 African). Of the target sample, 1,171 households (84 percent) with at least one

⁶In practice certain key individuals in the household were predesignated for tracking if they had moved; in some cases this led to split households in 1998, but that does not affect this analysis, which, except for the attrition indicator, uses only 1993 data (May et al. 2000).

1993 member were successfully reinterviewed in 1998 (Maluccio 2000). As in most surveys of this type in developing countries, refusal rates are low; only nine recontacted households refused an interview. There were four one- and two-person households whose members had all died over the period. The remaining households not interviewed were either verified as having moved but could not be tracked (81 or 5.8 percent) or left no trace (128 or 9.2 percent). Had 63 movers not been followed, only 79 percent of the target households would have been reinterviewed. Put another way, the tracking procedures yielded a 25 percent reduction in the number of households that attrited.

Reinterview rates were slightly higher in urban areas, reflecting the 89 percent success rate in recontacting urban Africans (294 households). Offsetting that success was a reinterview rate of 78 percent (215 households) for Indian households, all of which were urban. The reinterview rate for rural Africans was 84 percent (884 households), reflecting the rate for the overall sample. There were no major differences between the rural and urban samples, and we therefore pooled them in the analysis below.

The discussion of attrition between South Africa 1 and South Africa 2 to this point has focused on attrition at the household level. For an analysis of individual-level outcomes, however, measuring attrition at the individual level is more appropriate.

Because a household was considered to be a nonattritor if at least one 1993 member was reinterviewed, individual level attrition for the entire sample is necessarily higher than household attrition, although this need not be the case for subsamples of individuals. Focusing on the sample of children aged 6–72 months for whom there is complete information on height, weight, and age in 1993 (N=916), for example, 78 percent were

reinterviewed as resident or nonresident household members in 1998, indicating one-third more attrition than at the overall household level.⁷

4. SOME ATTRITION TESTS FOR THE BOLIVIAN, KENYAN, AND SOUTH AFRICAN SAMPLES

As noted, the attrition rates for the three samples considered here are considerable—35 percent for the Bolivian sample, from 28 percent for women to 41 percent for couples in the Kenyan sample, and from 16 percent for households to 22 percent for preschool children in the South African sample. However, studies for developed economies suggest that while attrition of this magnitude may be selective, it may not significantly affect estimated multivariate relations of interest. To test this, we conducted three sets of tests of attrition as it relates to observed variables in the data along the lines of some of the tests presented by Fitzgerald, Gottschalk, and Moffitt (1998).

COMPARISON OF MEANS FOR MAJOR OUTCOME AND CONTROL VARIABLES

First, we compared means for major outcome and control variables measured in the first rounds of the respective data sets for (eventual) attritors versus nonattritors

⁷There are 1,029 African and Indian children in KwaZulu-Natal in 1993 with complete height, weight, and age information but the following are dropped from the analysis: 26 because the absolute value of at least one of the three height-for-weight z -scores, weight-for-age z -scores, or weight-for-height z -scores exceeded 9.9; 47 who were less than 6 months old; and 30 who were more than 72 months old. If only those reinterviewed as residents (living in the household more than 15 out of the past 30 days) are considered, attrition rises to 31 percent, but the results reported on here are qualitatively the same.

(Tables 3, 4, and 5). Major variables are defined with respect to the interests of the project in which these data have been collected.

Bolivia

A number of means for attritors differ statistically from those for nonattritors. For example, rates of severe stunting, moderate wasting, and the fraction reporting Quechua mainly spoken at home are all greater for attritors. Conversely, weight-for-age, gross motor ability test scores, fine motor ability test scores, language-audition test scores, personal-social test scores, mother's age, father's age, home ownership, fraction with both parents present, number of rooms in the home, number of siblings, ownership of durables, mother having job, and household income are significantly *smaller* for attritors. Other variables do not differ significantly.

Thus, 7 of the 11 early childhood development outcome variables included in Table 3 differ significantly, at least at the 10 percent significance level between attritors and nonattritors. All of these indicate that in the first round of the data (Bolivia 1), children who were worse off in terms of these measures were more likely to attrite from the sample before the second round. Among the 14 predetermined parental and household level variables in Table 3, 11 differ significantly for the two groups at least at the 10 percent significance level. Attritors are more likely to be children with younger parents (one of whom is more likely to be absent) who have fewer children, speak Quechua mainly at home, live in a smaller house with fewer durables that are less likely to be owned by them, with the mother less likely to have a permanent job and with relatively smaller household income. Thus, both in terms of child development outcome variables

and family background variables, attrition seems to be systematically more likely for children who are worse off. Such systematic differences, together with the high attrition rates, may cause concern about what can be inferred with confidence from these longitudinal data.

Kenya

For the Kenyan data (Table 4), both male and female attritors have higher schooling, more languages, and are more likely to have heard radio messages and lived in households with males who received salaries. They are also younger and have fewer children than nonattritors. For a few variables the means differ significantly between attritors and nonattritors for men but not for women (ever-use of contraceptives, residence in Gwasssi) or for women but not for men (want no more children, visited by community-based distribution agent, speaks Luo only, belongs to credit group or to clan welfare society, residence in Ugina). On the other hand, the means do not differ between attritors and nonattritors for either men or women for a number of characteristics (currently using contraceptives, heard about family planning at clinic, discussed family planning with others, heard lecture at clinic, number of partners in networks, primary schooling, lived outside of province, polygamous household).

Therefore, it appears that attrition is selective in terms of some “modern” characteristics (including some of the outcome variables that these data were designed to analyze) with selectivity related more to women’s characteristics. On the other hand, the means for many characteristics—including those for most of the indicators of social

interaction, the impact of which is central to the project for which these data were gathered—do not differ significantly between attritors and nonattritors.

South Africa

Because the South African survey is a comprehensive household survey, a large number of variables could be considered in the attrition analysis. For comparability, this study examined a set of variables similar to those considered for Bolivia, i.e., child nutritional status as measured by anthropometrics and a health indicator, whether the child was sick in the last two weeks, as well as a set of predetermined family background characteristics. As such, this analysis cannot be extended to different outcome variables—each case should be evaluated individually.

There are no significant differences in child nutritional status and health outcome variables between the two groups (Table 5). This is not the case for the predetermined family background variables, however, where there are a number of significant differences in means. Nonattritors are significantly more likely to be African rather than Indian, have lower income, lower expenditures, less educated household heads, and fewer durable assets. Of course, since these background variables themselves tend to be highly correlated, in particular, race with education, income, and assets, it is not surprising that they show similar patterns for these mean comparisons. In sum, while there are no apparent differences in the child outcome variables, children from better-off or Indian households were more likely to attrite.

PROBITS FOR PROBABILITY OF ATTRITION

We start with a parsimonious specification of probits for the probability of attrition in which only one outcome variable at a time is included; then we include all outcome variables plus predetermined family background variables (Table 6). The dependent variables in these probits are whether attrition occurs between the survey rounds (1=yes; 0=no). Chi-square tests presented at the bottom of the Table 6 test the significance of the overall relations.

Bolivia

The Chi-square tests indicate that if only one of the outcome variables at a time is included in these probits, the probit is significant at the 5 percent level only for severe stunting—that is, attrition is more likely when there is also severe stunting. For moderate and severe low weight-for-age and the four test scores, the probits are significant at the 10 percent level, suggesting that low childhood development increases the probability of attrition. If the family background variables and all childhood development indicators are included, however, among the childhood development indicators only moderate stunting is significantly nonzero, even at the 10 percent level, with a negative sign indicating that children with moderate stunting in Bolivia 1 are less likely to attrite. That 1 in 11 of the childhood development indicators has a significant coefficient estimate at the 10 percent level, when all variables are included, is what one would expect to occur by chance only if none of the childhood development indicator coefficients, in fact, are truly significant predictors of attrition, once there are family background controls. Moreover, the one

childhood development outcome variable that has a significantly nonzero coefficient estimate in Table 6, once there are multivariate controls for family background, does *not* have significant differences in the univariate comparison of means between attritors and nonattritors in Table 3.

The bivariate comparisons of means between attritors and nonattritors for the childhood development outcomes, therefore, may be quite misleading regarding the extent of significant associations of these childhood development indicators with sample attrition, once there are multivariate controls for family background characteristics. The bivariate comparisons in Table 3 indicate that there is selective attrition with regard to childhood development indicators, with those children who are worse off in round 1 significantly more likely to attrite. But the multivariate estimates indicate that the extent of significant associations for the child development outcomes in probits for predicting attrition with multivariate controls for family background is about what would be expected by chance. Thus, conditional on control for observed family background characteristics, attrition is *not* predicted by child development indicators for round 1. (Of course, there may be multicollinearity among the child development indicators that disguises their significance.)

If the predetermined family background variables in Bolivia 1 are included alone or with all of the early childhood development indicators, the probits are significantly nonzero at very high levels. Some family background variables are significantly (at least at the 10 percent level) associated with higher probability of attrition: older and less-schooled fathers, speaking Quechua mainly in the household, not owning the home,

having more rooms in the house, having fewer siblings, having fewer durables, father having permanent or no (rather than a temporary) job, and mother having no or a temporary (rather than a permanent) job, with some significant differences also among the urban areas included in the program. The majority of these significant coefficient estimates are consistent with what might be predicted from the significant differences in the means in Table 3, reinforcing the observation that attrition tends to be selectively greater among children from worse-off family backgrounds.

But some of these significant coefficient estimates are opposite in sign from what might be expected from the univariate comparisons of the means in Table 3, suggesting the opposite relation to attrition if there are multivariate controls for other standard background variables than what appears in the univariate comparisons. Specifically, the univariate comparisons in Table 3 suggest that attrition is significantly more likely when fathers are younger, the house has fewer rooms, and there are fewer siblings—but all three of these signs are reversed with significant coefficient estimates in Table 6. Moreover, two variables that are not significantly different for attritors versus nonattritors in Table 3 have significant coefficient estimates in Table 6, i.e., father's schooling and father having a temporary job, both of which are estimated to significantly reduce attrition probabilities in Table 6. Finally, both mother's age and household income have means that are significantly different between attritors and nonattritors in the univariate comparisons in Table 3, but do not have coefficient estimates that are significantly nonzero, even at the 10 percent level, once there is control for other family background characteristics in Table 6.

Thus, exactly which family background characteristics predict attrition with multivariate controls and what the directions of those effects are cannot be inferred simply by examining the significance of means in univariate comparisons between attritors and nonattritors. While the patterns in Tables 3 and 6 suggest that worse-off family background is associated with greater attrition, the multivariate estimates may be somewhat less strongly supportive of this conclusion due, for example, to the negative significant association with number of rooms in the household and household income.

Kenya

For men, we find that when the outcomes of interest are included singly, only one of the five fertility-related outcomes (number of surviving children) is significantly related to attrition at the 5 percent level and one other (ever-used contraceptives) is significantly related to attrition at the 10 percent level (Table 6). If other variables are included among the right-side variables, among the five fertility-related outcomes none is significantly nonzero at the 5 percent level, and only not wanting more children is significantly related to attrition at the 10 percent level. A Chi-square test for the joint significance of these five variables rejects such significance ($p=0.52$). Among the control variables only age is significant, but not schooling, language, household characteristics, past residence in Nairobi or Mombasa, or current sublocation of residence. A Chi-square test for the joint significance of all the right-side variables rejects such significance at the 5 percent level ($p=0.068$).

For women, we find that two of the five lagged outcome variables, wanting no more children and the number of surviving children, are individually significant (and negative). When all the lagged outcome variables and the predetermined variables are included, only the latter (number of surviving children) remains significant. However, in contrast to the results for men, Chi-square tests for the joint significance of the five fertility-related outcome variables and for the entire set of right-side variables indicate significance ($p=0.0000$ in both cases).

Thus, for the Kenyan data, there is no significant association between attrition, most of the outcome variables of interest, and most of the major control variables. However, there is a significant negative association between attrition and number of surviving children, even with such controls for women though not for men.

South Africa

Probit estimates for the probability of attrition reveal little evidence that the outcome variables are associated with attrition, reflecting the results of the mean comparisons above (Table 6). When only one outcome variable at a time is included, none is significant at conventional levels. When all are included at once, the outcome variables are both individually and jointly insignificant.

The conditional influence of the predetermined variables differs from the mean comparisons but confirm that some of them are significant predictors of attrition, although the overall relation is insignificant. Children in households with older heads and more assets (number of rooms and durables are jointly significant) are more likely to

have attrited. Conditional on these assets, however, household ownership made it less likely that there was attrition, probably due to homeowners having deeper roots or higher moving costs. After controlling for these factors, race is no longer associated with attrition.

DO ATTRITORS HAVE DIFFERENT COEFFICIENT ESTIMATES THAN NONATTRITORS?

The BGLW tests, in which the value of an outcome variable at the initial wave of the survey is regressed on predetermined variables for the initial survey wave and on subsequent attrition, are presented in Tables 7, 8, and 9 for Bolivia, Kenya, and South Africa, respectively. In short, the test is whether the coefficients of the predetermined variables and the constant differ for those observations that are going to attrite versus those that are not going to attrite. The aim is to determine whether those who subsequently leave the sample differ in their initial behavioral relationships. Tables 7, 8, and 9 present these multivariate regression and probit estimates for the same outcome variables considered above, with the same family background variables among the right-side variables. The first part of the table gives the coefficient estimates for the family background variables for the nonattriting sample. At the bottom of the table are the F or Chi-square tests for whether there are significant differences between the nonattriting sample and tests for (1) all of the slope coefficients and constant and (2) all of the slope coefficients (but not the constant).

Bolivia

F tests indicate that all of the 11 estimated equations for childhood development indicators are statistically significant at the 0.01 percent level (Tables 7a and 7b). These estimates indicate a number of associations that are consistent with widely held perceptions about child development. For example, household income is significantly positively associated with height-for-age and significantly negatively associated with severe stunting; mother's schooling is significantly positively associated with height-for-age and weight-for-age, though significantly negatively associated with gross motor ability; and ownership of consumer durables is significantly positively associated with height-for-age, gross motor ability, fine motor ability, language-audition, and personal-social test scores, but significantly negatively associated with severe wasting.

There are, however, no significant differences at the 5 percent level⁸ between the set of coefficients for attritors versus nonattritors for over half of the indicators of child development: height-for-age, moderate stunting, gross motor ability tests, fine motor ability tests, language-audition tests, and personal-social tests. The second set of tests, further, indicates that there are no significant differences at the 10 percent level for severe stunting. These estimates for the anthropometric indicators related to stunting and for the four cognitive development test scores, therefore, suggest that the coefficient estimates of standard family background variables are *not* significantly affected by sample attrition.

⁸This is true at the 10 percent level as well for all of these except for the fine motor ability test score.

The results differ sharply, however, for the anthropometric indicators related to wasting. Both tests for these four child outcome variables indicate that the coefficient estimates for observed family background variables do differ significantly at the 5 percent level (and for all but weight-for-age at the 1 percent level) between the nonattriting and attriting subsamples. For these outcomes, therefore, it is important to control for the attrition in the analysis, e.g., as with the matching methods used in Todd, Behrman, and Cheng 2000.

Kenya

We conduct BGLW tests with Kenya 1 contraceptive use (ever or currently), want no more children, number of surviving children, and family planning network size as the respective dependent variables for the Kenya 1 sample. The right-side variables again include a fairly standard set of control variables, i.e., age, schooling, wealth indicators, language indicators, and location of residence. Tests for the significance of the differences in the slope coefficients in all cases for both men and women fail to reject equality of all the coefficients between attritors and nonattritors (Table 8). Tests for the joint significance of the differences in the slope coefficients and intercepts in all cases fail to reject equality of all the coefficients and of an additive variable for attrition (with the exception at the 5 percent level of number of surviving children and at the 10 percent level for currently using contraceptives, both only for women and in both of which cases the constant differs between attritors and nonattritors, but not the slope coefficient estimates).

Thus there is no significant effect on the slope coefficients of attrition for either men or women, but limited evidence of a significant effect on the constants for women.

South Africa

The evidence for South Africa in previous sections suggests that there is not a significant amount of attrition bias resulting from selection on observables. The BGLW tests largely confirm this, although there are some exceptions (Table 9).

For the first three anthropometric outcomes, the attrition interactions are not jointly significant, although in the case of height-for-age, the joint test on all interacted coefficients approaches significance at the 10 percent level ($p=0.104$) when the constant is not considered. The overall fit for the stunting and wasting probits is much better than for the regressions in the first three columns: all four relationships are significant at the 5 percent level. The attrition interaction terms are significant only in the case of moderate stunting, indicating the possibility of attrition bias in this relationship. On the other hand, attrition does not appear to have any association with severe stunting or moderate and severe wasting. In the last column presenting the results for an indicator of whether the child was sick in the last two weeks, the results for the full set of interactions suggest attrition bias is present.

As described in Section 3, one important difference in the South African sample relative to the others is that, when possible, households that had moved were followed. These households are included in the analysis presented above. What would happen if they were excluded? Reestimating the equations in Table 9, categorizing those that had

moved as having attrited, leads to a stronger rejection of the null hypothesis that there are no differences in coefficients across the two groups (results not shown). In every case the p value for both F-tests declines and for height-for-age and severe stunting this decline is enough for the tests to now become significant at the 10 percent level. It appears that the investment made in following movers had a substantial payoff in terms of reduced attrition bias for this set of relationships.

5. CONCLUSIONS

Our conclusions are similar in some respects to those of Fitzgerald, Gottschalk, and Moffitt (1998) for the Panel Study of Income Dynamics in the United States that is summarized in Section 2, but differ in other respects.

The means for a number of critical child development outcome and family background variables do differ significantly between attritors and nonattritors. For the Bolivian PIDI data, there is a definite tendency for attritors to have worse child development outcomes and family background than do nonattritors. In the poor urban communities on which PIDI concentrates, it appears that worst-off households are most mobile and thus most difficult to follow over time. This is similar to the U.S. results, but contrasts with the Kenyan rural data and the South African rural and urban data, where households and individuals with better backgrounds, e.g., more schooling, more likely to speak English, are most mobile and thus hardest to follow over time. For the Kenyan data, this is also the case, because such individuals tend to migrate from the poor rural

sample areas to urban areas. For the South African data, however, this result is for both rural and urban areas, so it does not reflect selective migration from rural to urban areas by those who are better off.

Some of the Bolivia 1 family background variables, but not the Bolivia 1 child outcome variables, are significant predictors of attrition in multivariate probits. The result for the child outcome variables is similar to that for the outcome variables in the Kenyan case. But the significance of a number of background variables in predicting attrition in the Bolivian data, while similar to the U.S. results, again contrasts with the limited significance of such background variables in predicting attrition in the Kenyan and South African data. There are some gender differences in the Kenyan data, with attrition for women being more associated with their observed characteristics than is attrition for men. For South Africa, the overall probit relation does not significantly predict attrition, even though some individual variables appear to predict greater attrition of children—older household heads, more nonhousing assets, and lack of home ownership.

The coefficients estimates for “standard” family background variables in regressions and probit equations for the majority of the Bolivian child development outcome variables—including all of those related to stunting and to the test scores for gross and fine motor ability, language/auditory and personal/social interactions—are not affected significantly by attrition. The coefficients on “standard” variables in equations with the major outcome and family planning social network variables in the Kenyan data also are unaffected by attrition and—in contrast to the Fitzgerald, Gottschalk, and Moffitt (1998) study—the constants also do not differ in most cases, with the possible exceptions

of number of surviving children and of currently using contraceptives (the constant differs at the 10 percent level) for women. For six of the seven child anthropometric measures in the South African data, moreover, there are no significant effects of attrition on the coefficient estimates of the “standard” variables nor, again, of the constants. Therefore, attrition apparently is *not* a general problem for obtaining consistent estimates of the coefficients of interest for most of the child development outcomes in the Bolivian data, for the fertility/social network outcomes in the Kenyan data, and for some of the anthropometric indicators in the South African data. These results are very similar to the results for the outcome measures of interest for the United States and suggest that for these outcome variables, despite suggestions of systematic attrition from univariate comparisons between attritors and nonattritors, multivariate estimates of behavioral relations of interest may not be biased due to attrition.

But for the Bolivian child development outcomes related to child weight and for South African child moderate stunting and morbidity, the results differ strikingly and suggest that attrition bias is likely to be a problem in multivariate estimates of related behavioral relations that do not control for attrition. Among the particular outcomes that we consider in all three samples, there are significant interactions of attrition with the sets of “standard” variables that we consider in 6 out of 29, or 21 percent, of the cases, higher than the 5 percent that would be expected by chance at the 5 percent significance level. Attrition selection bias appears to be model specific: changing outcome variables may change the diagnosis even within the same data set. Thus, as a general observation,

analysts should assess the problem for the particular model and the particular data they are using.

Nevertheless, the basic point remains that in contrast to concerns often expressed about attrition, for most of the outcomes of primary interest for the purposes of these three developing country samples, the coefficients on “standard” variables in equations are unaffected by attrition. Therefore, though attrition bias may occur in more cases than would be expected to be estimated by chance, for our exploration, significant effects of coefficient estimates of standard variables are found in only about a fifth of the cases. Thus, attrition apparently is *not* a general and pervasive problem for obtaining consistent estimates of the coefficients of interest in these developing country samples, despite their fairly high attrition rates.

TABLES

Table 1—Attrition rates for longitudinal household survey data in developing countries listed in order of attrition rates per year

| Country, time period/interval between rounds (in rough order of attrition rates per year) | Attrition rate between rounds (percentage) | Attrition rate per year (percentage) | Source |
|---|---|--|--|
| Bolivia (urban), 1995/6 to 1998 (two-year interval) | 35 | 17.5 | Present study (also see Alderman and Behrman 1999) |
| Kenya (rural, South Nyanza Province), 1994/5 to 1996/7 (two- year interval) | 41 | 20.5 | Present study (also see Behrman, Kohler, and Watkins 1999) |
| couples | 33 | 16.5 | |
| men | 28 | 14.0 | |
| women | | | |
| Nigeria (five-year interval) | 50 | 10.0 | Renne (1997) |
| South Africa (KwaZulu-Natal) 1993 to 1998. (five year interval) | | | Present study (also see Maluccio 2000) |
| households | 16 | 3.2 | |
| preschool children | 22 | 4.4 | |
| India (rural) 1970/71 to 1981/2 (11- year interval) | 33 | 3.0 | Foster and Rosenzweig 1995 |
| Malaysia (12-year interval) | 25 | 2.1 | Smith and Thomas 1997 |
| Indonesia 1993 to 1997 (four-year interval) | 6 | 1.5 | Thomas, Frankenberg, and Smith 1999 |

Table 2—Reported reasons for men’s and women’s attrition in Kenyan (KICS) survey

| Reason for attrition: | Men | | Women | |
|---|--------|------------|--------|------------|
| | Number | Percentage | Number | Percentage |
| Working, moved to, or visiting outside Nyanza Province | 45 | 22.4 | 21 | 10.3 |
| Working, moved to, or visiting elsewhere in Nyanza Province | 51 | 25.4 | 56 | 27.6 |
| Not home | 36 | 17.9 | 32 | 15.8 |
| Refused | 26 | 12.9 | 20 | 9.9 |
| Sick or busy | 6 | 3.0 | 3 | 1.5 |
| Deceased | 37 | 18.4 | 20 | 9.9 |
| Separated, divorced, then moved away | n/a | n/a | 42 | 20.7 |
| Other | 0 | 0.0 | 11 | 4.4 |
| Total | 201 | | 205 | |

Note: n/a = not available

Table 3—Bolivia. T-tests for differences in means in Bolivia 1 data for attritors versus nonattritors ^a

| Variables | Nonattritors | | Attritors | | Difference | |
|---|--------------|--------------------|-----------|--------------------|------------|-----------|
| | Mean | Standard Deviation | Mean | Standard Deviation | Mean | t-test |
| Early child development outcome variables | | | | | | |
| Height-for-age ^b | 18.0 | (22.5) | 17.4 | (22.1) | 0.65 | (0.72) |
| Weight-for-age ^b | 32.2 | (26.5) | 30.3 | (25.8) | 1.91** | (1.81) |
| Weight-for-height ^b | 58.1 | (26.5) | 56.9 | (27.2) | 1.21 | (1.10) |
| Moderate stunting ^c | 0.639 | (0.48) | 0.631 | (0.48) | 0.008 | (0.43) |
| Severe stunting ^c | 0.279 | (0.45) | 0.323 | (0.47) | -0.0437* | (-2.37) |
| Moderate wasting ^c | 0.365 | (0.48) | 0.400 | (0.49) | -0.035** | (-1.79) |
| Severe wasting ^c | 0.0796 | (0.27) | 0.0946 | (0.29) | -0.0150 | (-1.30) |
| Gross motor ability | 20.8 | (7.81) | 20.3 | (7.67) | 0.5136** | (1.65) |
| Fine motor ability | 19.4 | (7.28) | 19.0 | (7.19) | 0.480** | (1.65) |
| Language-audition | 19.2 | (7.62) | 18.6 | (7.44) | 0.569** | (1.88) |
| Personal-social | 19.9 | (8.02) | 19.4 | (8.06) | 0.534** | (1.65) |
| Predetermined family background variables | | | | | | |
| Mother's age | 29.8 | (6.45) | 28.7 | (6.44) | 1.07* | (4.10) |
| Father's age | 33.0 | (7.70) | 32.2 | (8.03) | 0.85* | (2.66) |
| Mother's schooling | 3.0 | (1.5) | 3.0 | (1.5) | -0.06 | (-0.9113) |
| Father's schooling | 3.6 | (1.4) | 3.6 | (1.4) | -0.02 | (-0.42) |
| Quechua mainly | .00099 | (0.0315) | 0.0114 | (0.106) | -0.00414* | (-2.85) |
| Amarya mainly | .00396 | (0.0628) | 0.00456 | (0.07) | -0.000605) | (-0.23 |
| Home ownership | 0.428 | (0.495) | 0.215 | (0.411) | 0.213* | (12.02) |
| Number of rooms in the house | 1.50 | (1.05) | 1.40 | (1.00) | 0.100* | (4.17) |
| Both parents present | 0.841 | (0.366) | 0.775 | (0.42) | 0.0656* | (4.54) |
| Number of siblings | 2.37 | (1.80) | 2.05 | (1.59) | 0.322* | (4.80) |
| Ownership of durables ^d | 6.30 | (2.11) | 5.92 | (1.92) | 0.375* | (4.69) |
| Job of mother ^e | 2.26 | (0.91) | 2.08 | (0.91) | 0.174* | (4.73) |
| Job of father ^d | 2.70 | (0.54) | 2.70 | (0.55) | -0.006 | (-0.28) |
| Household income | 922 | (755) | 868 | (638) | 55* | (2.68) |

Notes: * indicates significance at 5 percent level and ** at 10 percent level.

^a Values of two-sample t-test with unequal variances are given in parentheses in last column.

^b Height-for-age in centimeter/years. Weight-for-age in kilogram/years. Weight-for-height in kilograms/meters.

^c Stunting and wasting are based on height-for-age and weight-for-age. Z-scores calculated are based on CHS/CDC/WHO standards. "Moderate" refers to being more than one standard deviation below the means and "severe" more than two standard deviations below mean.

^d Ownership of durables measures number of durables owned out of 15 asked.

^e Job of mother/job of father: 1=no job; 2=temporary job; 3=permanent job.

Table 4—Kenya. T-tests for differences in means in Kenya 1 data for attritors versus nonattritors ^a

| Variables | Men | | | | | | Women | | | | | |
|---|--------------|--------------------|-----------|--------------------|------------|---------|--------------|--------------------|-----------|--------------------|------------|---------|
| | Nonattritors | | Attritors | | Difference | | Nonattritors | | Attritors | | Difference | |
| | Mean | Standard Deviation | Mean | Standard Deviation | Mean | t-test | Mean | Standard Deviation | Mean | Standard Deviation | Mean | t-test |
| Fertility-related outcome variables | | | | | | | | | | | | |
| Currently using contraceptives | 0.196 | (0.017) | | (0.031) | -0.033 | (-0.95) | 0.126 | (0.012) | 0.103 | (0.021) | 0.024 | (0.91) |
| Ever used contraceptives | 0.233 | (0.018) | 0.311 | (0.052) | -0.077** | (-1.79) | 0.238 | (0.016) | 0.196 | (0.027) | 0.042 | (1.25) |
| Want no more children | 0.208 | (0.017) | 0.237 | (0.031) | -0.029 | (-0.83) | 0.351 | (0.018) | 0.220 | (0.037) | 0.132* | (3.59) |
| Number of surviving children | 4.76 | (0.171) | 3.94 | (0.277) | 0.817* | (2.46) | 3.88 | (0.089) | 2.78 | (0.138) | 1.10 | (5.90*) |
| Family planning program variables | | | | | | | | | | | | |
| Visited by community-based distribution agent | 0.156 | (0.015) | 0.132 | (0.025) | 0.024 | (0.78) | 0.163 | (0.014) | 0.113 | (0.022) | 0.050** | (1.75) |
| Heard family planning message on radio | 0.931 | (0.011) | 0.968 | (0.013) | -0.037** | (-1.86) | 0.870 | (0.916) | 0.916 | (0.019) | -0.046** | (-1.79) |
| Heard about family planning at clinic | 0.495 | (0.021) | 0.513 | (0.036) | -0.018 | (-0.42) | 0.851 | (0.013) | 0.828 | (0.027) | 0.023 | (0.80) |
| Discussed with others family planning lecture heard at clinic | 0.679 | (0.029) | 0.691 | (0.047) | -0.012 | (-0.21) | 0.629 | (0.070) | 0.661 | (0.037) | -0.032 | (-0.76) |
| Number of network partners in network for | | | | | | | | | | | | |
| Family planning | 3.7 | (0.20) | 4.0 | (0.35) | -0.3 | (-0.86) | 2.9 | (0.11) | 3.1 | (0.20) | -.18 | (-0.78) |
| Wealth flows | 5.0 | (0.21) | 5.0 | (0.36) | -0.04 | | 2.8 | (0.12) | 2.4 | (0.21) | 0.38 | (1.45) |
| Reproductive health | — | | — | | — | (-0.10) | 3.2 | (0.16) | 2.8 | (0.23) | 0.38 | (1.19) |
| Knows secret contraceptive user | 0.637 | (0.069) | 0.558 | (0.095) | 0.079 | (0.60) | 0.408 | (0.02) | 0.377 | (0.03) | 0.030 | (0.77) |
| Control variables | | | | | | | | | | | | |
| Age (years) | 40.1 | (0.52) | 36.8 | (0.78) | 3.3* | (3.24) | 29.7 | (0.332) | 26.3 | (0.488) | 3.4* | (5.04) |
| Education | | | | | | | | | | | | |
| No schooling | 0.112 | (0.013) | 0.063 | (0.018) | 0.049** | (1.94) | 0.214 | (0.015) | 0.141 | (0.024) | 0.072** | (2.30) |
| Some primary schooling | 0.577 | (0.021) | 0.537 | (0.036) | 0.040 | (0.96) | 0.669 | (0.018) | 0.668 | (0.033) | 0.001 | (0.03) |
| Secondary schooling | 0.298 | (0.019) | 0.379 | (0.035) | -0.081* | (-2.06) | 0.117 | (0.012) | 0.190 | (0.027) | -0.074* | (-2.75) |

(continued)

Table 4 (continued)

| Variables | Men | | | | | | Women | | | | | |
|--------------------------------------|--------------|--------------------|-----------|--------------------|------------|---------|--------------|--------------------|-----------|--------------------|------------|---------|
| | Nonattritors | | Attritors | | Difference | | Nonattritors | | Attritors | | Difference | |
| | Mean | Standard Deviation | Mean | Standard Deviation | Mean | t-test | Mean | Standard Deviation | Mean | Standard Deviation | Mean | t-test |
| Language | | | | | | | | | | | | |
| Luo only | 0.796 | (0.017) | 0.805 | (0.029) | -0.010 | (-0.28) | 0.422 | (0.018) | 0.327 | (0.033) | 0.095** | (2.46) |
| English | 0.443 | (0.021) | 0.532 | (0.036) | -0.089* | (-2.11) | 0.178 | (0.014) | 0.263 | (0.031) | -0.086* | (-2.73) |
| Swahili | 0.655 | (0.020) | 0.726 | (0.032) | -0.072** | (-1.82) | 0.396 | (0.018) | 0.517 | (0.035) | -0.121* | (-3.11) |
| Lived | | | | | | | | | | | | |
| outside of province | 0.591 | (0.021) | 0.653 | (0.035) | 0.061 | (1.49) | 0.370 | (0.018) | 0.371 | (0.034) | -0.001 | (-0.02) |
| in Nairobi or Mombasa | 0.336 | (0.020) | 0.400 | (0.036) | -0.064 | (-1.58) | 0.214 | (0.015) | 0.205 | (0.028) | 0.009 | (0.29) |
| Belongs to credit group | 0.257 | (0.019) | 0.242 | (0.031) | 0.015 | (0.40) | 0.351 | (0.018) | 0.288 | (0.032) | 0.064** | (1.70) |
| Belong to clan welfare society | 0.868 | (0.014) | 0.905 | (0.021) | -0.037 | (-1.35) | 0.747 | (0.016) | 0.644 | (0.034) | 0.103* | (2.93) |
| Women sell on market | – | | – | | – | | 0.464 | (0.019) | 0.444 | (0.035) | 0.020 | (0.51) |
| Household characteristics | | | | | | | | | | | | |
| Polygamous household | 0.293 | (0.019) | 0.238 | (0.031) | 0.055 | (1.45) | 0.350 | (0.018) | 0.371 | (0.034) | -0.021 | (-0.56) |
| Self/Husband receives monthly salary | 0.170 | (0.016) | 0.255 | (0.032) | -0.085* | (-2.56) | 0.334 | (0.019) | 0.402 | (0.037) | -0.068** | (-1.66) |
| Husband interviewed | – | | – | | – | | 0.765 | (0.016) | 0.752 | (0.029) | 0.013 | (0.41) |
| Household has radio | – | | – | | – | | 0.492 | (0.019) | 0.546 | (0.035) | -0.055 | (-1.38) |
| House has metal roof | 0.173 | (0.016) | 0.189 | (0.029) | -0.016 | (-0.51) | 0.201 | (0.015) | 0.187 | (0.027) | 0.014 | (0.45) |
| Sublocation of residence | | | | | | | | | | | | |
| Gwassi | 0.278 | (0.019) | 0.216 | (0.030) | 0.063** | (1.69) | 0.213 | (0.015) | 0.210 | (0.029) | 0.003 | (0.08) |
| Kawadhgone | 0.230 | (0.018) | 0.237 | (0.031) | -0.007 | (-0.20) | 0.240 | (0.015) | 0.205 | (0.028) | 0.035 | (1.06) |
| Oyugis | 0.259 | (0.019) | 0.300 | (0.033) | -0.041 | (-1.11) | 0.286 | (0.017) | 0.263 | (0.031) | 0.023 | (0.63) |
| Ugina | 0.233 | (0.018) | 0.247 | (0.032) | -0.014 | (-0.39) | 0.261 | (0.016) | 0.322 | (0.033) | -0.061** | (-1.72) |

Note: * indicates significance at 5 percent level, and ** at 10 percent level.

^a Values of two-sample t-test with unequal variances are given in parentheses in third and sixth columns.

Table 5—South Africa. T-tests for differences in means in South Africa 1 data for attritors versus nonattritors^a

| | Nonattritors | | Attritors | | Difference | |
|---|--------------|--------------------|-----------|--------------------|------------|---------|
| | Mean | Standard Deviation | Mean | Standard Deviation | Means | t-test |
| Early child nutritional status and health outcome variables | | | | | | |
| Height-for-age ^b | 0.377 | (0.008) | 0.377 | (0.016) | 0.000 | (1.00) |
| Weight-for-age ^b | 5.369 | (0.107) | 5.281 | (0.195) | 0.088 | (0.69) |
| Weight-for-height ^b | 14.83 | (0.099) | 14.74 | (0.198) | 0.090 | (0.68) |
| Height-for-age z-score | -1.171 | (0.073) | -1.338 | (0.143) | 0.167 | (1.04) |
| Weight-for-age z-score | -0.621 | (0.058) | -0.742 | (0.106) | 0.122 | (1.00) |
| Weight-for-height z-score | 0.179 | (0.070) | 0.113 | (0.136) | 0.066 | (0.43) |
| Moderate stunting ^c | 0.539 | (0.019) | 0.534 | (0.035) | 0.005 | (0.13) |
| Severe stunting ^c | 0.275 | (0.017) | 0.284 | (0.032) | -0.009 | (-0.25) |
| Moderate wasting ^c | 0.389 | (0.018) | 0.441 | (0.035) | -0.052 | (-1.32) |
| Severe wasting ^c | 0.185 | (0.015) | 0.172 | (0.026) | 0.014 | (0.46) |
| Sick in last two weeks | 0.104 | (0.011) | 0.098 | (0.021) | 0.006 | (0.25) |
| Predetermined family background variables | | | | | | |
| Age in months | 37.36 | (0.671) | 37.51 | (1.260) | -0.146 | (-0.10) |
| Fraction male | 0.501 | (0.019) | 0.490 | (0.035) | 0.011 | (0.28) |
| Fraction African | 0.912 | (0.011) | 0.863 | (0.024) | 0.049** | (1.85) |
| Household size | 8.817 | (0.144) | 8.500 | (0.289) | 0.317 | (0.98) |
| Total monthly expenditures | 1473.3 | (30.19) | 1545.4 | (65.47) | -72.1 | (-1.00) |
| Per capita monthly expenditures. | 194.2 | (5.53) | 219.3 | (12.91) | -25.1** | (-1.79) |
| Total monthly income | 1160.6 | (45.02) | 1396.3 | (97.41) | -235.7* | (-2.20) |
| Per capita monthly income | 156.8 | (7.88) | 215.8 | (20.86) | -59.1* | (-2.65) |
| Household head age | 51.75 | (0.515) | 52.98 | (1.076) | -1.235 | (-1.03) |
| Household head education | 2.978 | (0.123) | 3.453 | (0.250) | -0.476** | (-1.70) |
| Household head male | 0.698 | (0.017) | 0.711 | (0.032) | -0.013 | (-0.35) |
| Own house | 0.886 | (0.012) | 0.843 | (0.026) | 0.043 | (1.53) |
| Number of rooms | 4.949 | (0.099) | 5.377 | (0.211) | -0.428** | (-1.84) |
| Number of durables | 3.132 | (0.081) | 3.608 | (0.146) | -0.476* | (-2.85) |
| Urban | 0.278 | (0.017) | 0.294 | (0.032) | -0.016 | (-0.44) |
| In former Natal | 0.160 | (0.014) | 0.225 | (0.029) | -0.065* | (-2.02) |

Notes: * indicates significance at 5 percent level and ** at 10 percent level.

^a Values of two-sample t-test with unequal variances are given in parentheses in last column.

^b Height-for-age in meter/years. Weight-for-age in kilogram/years. Weight-for-height in kilograms/meters.

^c Stunting and wasting are based on height-for-age and weight-for-age. Z-scores calculated are based on NCHS/CDC/WHO standards. "Moderate" refers to being more than one standard deviation below the means and "severe" more than two standard deviations below mean.

Table 6—Probits for predicting attrition between rounds 1 and 2 for Bolivian, Kenyan, and South African data ^a

| Bolivia | | | Kenyan Men | | | Kenyan Women | | South Africa | | |
|--------------------|----------------------------------|---|---|----------------------------------|---|----------------------------------|---|---------------------------|----------------------------------|---|
| Outcome variables | Outcome variables, one at a time | All outcome variables + pre-determined variables ^b | Outcome variables | Outcome variables, one at a time | All outcome variables + pre-determined variables ^c | Outcome variables, one at a time | All outcome variables + pre-determined variables ^d | Outcome variables | Outcome variables, one at a time | All outcome variables + pre-determined variables ^e |
| Height-for-age | -.0015 (-0.83) | -.0002 (-0.04) | Currently contracepting | 0.118 (0.95) | -0.065 (0.34) | -0.134 (0.92) | 0.004 (0.02) | Height-for-age | -0.001 (-0.01) | 1.376 (1.44) |
| Weight-for-height | -.0015 (-0.99) | .0032 (0.80) | Ever used contraceptives | 0.162** (1.67) | -0.103 (-0.70) | -0.142 (1.26) | -0.036 (0.28) | Weight-for-height | -0.007 (-0.37) | 0.042 (1.08) |
| Weight-for-age | -.003** (-1.74) | -.0037 (-0.78) | Want no more children | 0.099 (0.83) | 0.245** (1.69) | -0.374* (3.60) | -0.010 (0.07) | Weight-for-age | -0.006 (-0.42) | -1.355 (-0.04) |
| Moderate wasting | .148** (1.78) | .1003 (0.70) | Number of surviving children | -0.033* (-2.46) | -0.017 (-0.78) | -0.139* (5.82) | -0.136* (3.73) | Moderate wasting | 0.125 (1.19) | 0.279 (-1.62) |
| Severe wasting | .191 (1.35) | .1353 (0.70) | Number of family planning network partners | -0.009 (-0.85) | 0.003 (0.22) | 0.012 (0.78) | -0.010 (0.56) | Severe wasting | -0.055 (-0.47) | -0.119 (-0.81) |
| Moderate stunting | -.0315 (-0.38) | -.291** (-1.93) | | | | | | Moderate stunting | -0.012 (-0.13) | -0.040 (-0.38) |
| Severe stunting | .2110* (2.41) | .2066 (1.51) | | | | | | Severe stunting | 0.026 (0.22) | 0.056 (1.62) |
| Bulk motor ability | -.009 (-1.64) | .0123 (0.59) | | | | | | Sick in last two weeks | -0.038 (-0.23) | -0.055 (-0.32) |
| Fine motor ability | -.009 (-1.63) | -.0073 (-0.35) | | | | | | | | |

(continued)

Table 6 (continued)

| Bolivia | | | Kenyan Men | | | Kenyan Women | | South Africa | | |
|---|----------------------------------|---|-------------------|----------------------------------|---|----------------------------------|---|-------------------|----------------------------------|---|
| Outcome variables | Outcome variables, one at a time | All outcome variables + pre-determined variables ^b | Outcome variables | Outcome variables, one at a time | All outcome variables + pre-determined variables ^c | Outcome variables, one at a time | All outcome variables + pre-determined variables ^d | Outcome variables | Outcome variables, one at a time | All outcome variables + pre-determined variables ^e |
| Language-audition | -.010** (-1.84) | -.0059 (-0.27) | | | | | | | | |
| Personal-social | -.008 (-1.64) | -.0014 (-0.07) | | | | | | | | |
| Constant | | .75** (1.72) | | | -0.239 (-0.70) | | -0.097 (0.29) | | | -1.271 (-0.93) |
| Chi-square test [prob > Chi ²] | f | 300.22 [0.00] | | g | 25.13 [0.068] | h | 54.49 [0.000] | | i | 24.63 [0.22] |

Note: * indicates significance at 5 percent level; ** indicates significance at 10 percent level

^a Values of z-tests are in parentheses beneath point estimates. P-values of Chi-square tests are in brackets.

^b Predetermined variables for Bolivian households that are: (a) significant at 5 percent level (with sign in parentheses)—father's age(+); Quechua only (+); ownership of house (-); number of durables owned (-); Oruro (-), Postosi (-), Santa Cruz (-) relative to La Paz; mother's job permanent relative to no job (-); (b) significant at the 10 percent level – father's schooling (-), number of rooms in the house (+), number of siblings of child (-); father's job temporary relative to no job (-); (c) not significant even at the 10 percent level – mother's age, mother's schooling, Amarya only, El Alto, Cochabamba, Tarija relative to La Paz; father's job permanent relative to no job; mother's job temporary relative to no job; household income.

^c Predetermined variables for Kenyan men that are (a) significant at the 5 percent level (with sign in parentheses)—men's age; (b) not significant even at the 10 percent level – primary schooling; secondary schooling; Luo only; English; lived in Nairobi or Mombasa; polygamous household; earns a monthly salary; sublocation of residence.

^d Predetermined variables for Kenyan women that are: (a) significant at the 5 percent level (with sign in parentheses)—husband interviewed (-); (b) significant at the 10 percent level—resided in Oyugnis relative to Ugina (-) (c) not significant even at the 10 percent level—primary schooling; secondary schooling; Luo only; English; lived in Nairobi or Mombasa; polygamous household; household has radio; household has metal roof; other sublocation of residence.

^e Predetermined variables for South African households that are (a) significant at the 5 percent level (with sign in parentheses)—age of household head(+); (b) significant at the 10 percent level—own on home (-); (c) not significant even at the 10 percent level—male respondent; African respondent; household size; ln total monthly expenditures; household head schooling; household head sex; number of rooms; number of durables; urban; former Natal.

^f For Bolivian data, Probability > Chi-square (a) at the 5 percent level—severe stunting; (b) at the 10 percent level—weight-for-age, moderate wasting, language-auditory.

^g For Kenyan men, Probability > Chi-square (a) at the 5 percent level—number of surviving children; (b) at the 10 percent level—ever-used contraceptives.

^h For Kenyan women, Probability > Chi-square (a) at the 5 percent level—want no more children, number of surviving children.

ⁱ For South African data, Probability > Chi-square (a) at the 5 percent level—none; (b) at the 10 percent level—none.

Table 7a—Bolivia. Testing impact of attrition between Bolivia 1 and Bolivia 2 on coefficient estimates of family background variables in early childhood development anthropometric outcomes^a

| Right-side variables | Ordinary Least Squares Regressions for | | | Probits for | | | |
|---|--|-------------------|--------------------|---------------------|--------------------|---------------------|--------------------|
| | Height for age | Weight for age | Weight for height | Moderate Stunting | Severe Stunting | Moderate Wasting | Severe Wasting |
| Predetermined Family Background Variables | | | | | | | |
| Mother's age | -0.0369 (-0.31) | 0.162 (1.13) | 0.214 (1.46) | -0.00933 (-0.79) | -.00363 (-0.27) | -0.00352 (-0.29) | 0.0142 (0.67) |
| Father's age | 0.222* (2.29) | 0.130 (1.13) | -0.072 (-0.61) | -0.00558 (-0.58) | -0.0165 (-1.50) | -.0209* (-2.08) | -0.0186 (-1.06) |
| Mother's schooling | 0.998* (2.40) | 1.51* (3.05) | 0.611 (1.20) | — | — | — | — |
| Father's schooling | -0.143 (-0.34) | -0.407 (-0.82) | -0.534 (-1.05) | — | — | — | -0.106 (-1.37) |
| Quechua mainly | -3.58 (-0.23) | -7.23 (-0.40) | -1.05 (-0.06) | 16.4* (21.42) | -0.667 (-0.46) | 17.3* (25.26) | — |
| Amaraya mainly | -0.010 (-0.00) | -3.19 (-0.35) | -7.47 (-0.79) | -0.755 (-1.00) | 0.476 (0.65) | 0.313 (0.43) | — |
| Ownership of house | -1.37 (-1.20) | -1.07 (-0.79) | 0.075 (0.05) | 0.0537 (0.46) | 0.0183 (0.15) | -0.0225 (-0.20) | — |
| Number of rooms in the house | 1.48* (2.44) | 1.15 (1.59) | 0.108 (0.15) | -0.0523 (-0.86) | -0.0591 (-0.83) | -0.0127 (-0.21) | -0.0269 (-0.23) |
| Number of siblings | -1.76* (-5.08) | -1.50* (-3.63) | 0.133 (0.31) | 0.182* (4.99) | 0.242* (6.42) | 0.104* (3.00) | — |
| Ownership of durables | 0.946* (3.28) | 0.535 (1.56) | -0.246 (-0.70) | — | — | — | -0.172* (-3.13) |
| El Alto | 0.036 (0.03) | -0.135 (-0.08) | 2.149 (1.182) | .262** (1.70) | 0.343* (2.22) | -0.0610 (-0.42) | -0.150 (-0.54) |
| Cochabamba | 4.63* (2.94) | -2.17 (-1.16) | -6.01* (-3.12) | — | — | 0.130 (0.84) | — |
| Oruro | -4.43* (-2.10) | -6.89* (-2.75) | 1.12 (0.44) | 0.526* (2.29) | 0.551* (2.56) | 0.509* (2.53) | 0.676* (2.10) |
| Potosi | -0.869 (-0.43) | -10.0* (-4.16) | -11.93* (-4.83) | 0.229 (1.08) | 0.481* (2.34) | 0.936* (4.78) | — |
| Tarija | 6.65* (3.18) | 14.35* (5.76) | 12.4* (4.83) | -0.189 (-0.91) | -0.0944 (-0.41) | -0.723* (-3.10) | — |
| Santa Cruz | 9.65* (6.28) | 5.02* (2.74) | -2.27 (-1.21) | -0.748* (-4.92) | -0.673* (-3.67) | -0.346* (-2.21) | -0.372 (-1.26) |
| Job of father is temporary | -4.77** (-1.79) | -7.29* (-2.30) | -3.85 (-1.18) | 0.411 (1.57) | 0.6766** (2.06) | 0.372 (1.35) | — |
| Job of father is permanent | -4.38** (-1.73) | -6.38* (-2.12) | -2.88 (-0.93) | 0.393 (1.59) | 0.679* (2.14) | 0.282 (1.07) | 0.0729 (0.16) |

(continued)

Table 7a (continued)

| Right-side variables | Ordinary Least Squares Regressions for | | | Probits for | | | |
|---|--|--------------------|---------------------|----------------------|------------------------|-----------------------|-----------------------|
| | Height for age | Weight for age | Weight for height | Moderate Stunting | Severe Stunting | Moderate Wasting | Severe Wasting |
| Job of mother is temporary | -4.80* (-2.84) | -3.53** (-1.75) | 2.63 (1.27) | 0.544* (3.04) | 0.692* (3.90) | 0.268** (1.61) | 0.0967 (0.33) |
| Job of mother is permanent | -3.23* (-2.91) | -1.92 (-1.46) | 2.37** (1.75) | 0.250* (2.26) | 0.390* (3.07) | 0.226* (2.01) | 0.0356 (0.18) |
| Household income | .00121** (1.62) | .000558 (0.63) | -.000538 (-0.59) | -0.000065 (-0.86) | -0.000164** (-1.64) | -0.0000262 (-0.33) | -0.0000376 (-0.25) |
| Constant | 10.28* (2.51) | 27.19 *(5.58) | 57.91* (11.58) | 0.845* (2.07) | -0.901** (-1.87) | -0.00232 (-0.01) | -1.39** (-1.91) |
| F test for overall relation [probability > F test] | 7.11* [0.0000] | 5.58 * [0.0000] | 4.02* [0.0000] | 257.80* [0.0000] | 278.38* [0.0000] | 179.06* [0.0000] | 98.91* [0.0000] |
| F Tests for attrition [probability > F] | | | | | | | |
| 1. Joint effect of attrition on constant and all estimates | 1.32 [0.1428] | 1.88* [0.0070] | 1.58* [0.0385] | 22.68 [0.3614] | 35.34** [0.0357] | 44.86* [0.0018] | 261.66* [0.0000] |
| 2. Joint effect of attrition on all coefficient estimates but not on constant | 1.37 [0.1169] | 1.90* [0.0068] | 1.63* [0.0315] | 22.49 [0.3147] | 29.18 [0.1097] | 42.17* [0.0026] | 253.89* [0.0000] |

Note: * indicates significance at the 5 percent level, and ** indicates significance at the 10 percent level. P-values of tests are in brackets.

^a Values of t-tests (for regressions) and z-tests (for probits) are in parentheses beneath point estimates.

Table 7b—Bolivia. Multivariate ordinary least squares regressions for testing impact of attrition between Bolivia 1 and Bolivia 2 on coefficient estimates of family background variables in child test scores^a

| Right-side variables | Gross motor ability | Fine motor ability | Language-auditory | Personal-social |
|---|---------------------|--------------------|---------------------|--------------------|
| Predetermined Family Background Variables | | | | |
| Mother's age | 0.204* (4.84) | 0.189* (4.80) | 0.203* (4.96) | 0.199* (4.57) |
| Father's age | -0.00767 (-0.23) | 0.00268 (0.08) | 0.0118 (0.36) | 0.00547 (0.16) |
| Mother's schooling | -0.257** (-1.75) | -0.127 (-0.93) | -0.0290 (-0.20) | -0.167 (-1.10) |
| Father's schooling | 0.236** (1.61) | 0.219 (1.60) | 0.159 (1.12) | 0.209 (1.38) |
| Quechua mainly | 2.85 (0.53) | 2.88 (0.57) | 3.32 (0.63) | 4.28 (0.77) |
| Amarya mainly | -4.01 (-1.47) | -3.05 (-1.19) | -3.091 (-1.17) | -2.91 (-1.03) |
| Ownership of house | -0.167 (-0.41) | 0.137 (0.36) | -0.123 (-0.31) | — |
| Number of rooms in the house | -0.0260 (-0.12) | 0.0373 (0.19) | -0.0751 (-0.36) | 0.0433 (0.20) |
| Number of siblings | -0.0370 (-0.30) | -0.139 (-1.21) | -0.00220 (-0.02) | -0.103 (-0.81) |
| Ownership of durables | 0.335* (3.30) | 0.278* (2.92) | 0.395* (4.00) | 0.403* (3.84) |
| El Alto | 1.70* (3.26) | 1.49* (3.07) | 1.87* (3.71) | 1.84* (3.43) |
| Cochabamba | 0.569 (1.03) | -0.254 (-0.49) | 0.156 (0.29) | 0.675 (1.18) |
| Oruro | .537 (0.72) | -0.337 (-0.49) | 0.761 (1.06) | 0.401 (0.52) |
| Potosi | -1.08 (-1.51) | -1.23** (-1.85) | -0.720 (-1.04) | -1.07 (-1.45) |
| Tarija | 4.01* (5.43) | 2.64* (3.83) | 3.31* (4.63) | 3.68* (4.83) |
| Santa Cruz | 2.05* (3.79) | 1.09* (2.16) | 1.63* (3.10) | — |
| Job of father is temporary | --- | -1.79** (-2.05) | -1.77** (-1.95) | -1.69** (-1.75) |
| Job of father is permanent | -2.35* (-2.64) | -2.03* (-2.44) | -2.09* (-2.42) | -2.02* (-2.20) |

(continued)

Table 7b (continued)

| Right-side variables | Gross motor ability | Fine motor ability | Language-auditory | Personal-social |
|--|---------------------|--------------------|-----------------------|-----------------------|
| Predetermined Family Background Variables | | | | |
| Job of mother is temporary | 2.20* (3.69) | 1.92* (3.45) | --- | 2.17* (3.53) |
| Job of mother is permanent | 0.948* (2.43) | 0.900* (2.45) | 0.844* (2.22) | 1.06* (2.63) |
| Household income | .000068 (0.26) | .0000878 (0.36) | -0.0000282 (-0.11) | -0.0000404 (-0.15) |
| Constant | 13.4* (9.28) | 12.47 * (9.25) | 10.28* (7.35) | 11.4* (7.62) |
| F-test for overall relation [probability > F-test] | 5.38* [0.0000] | 5.21* [0.0000] | 5.80* [0.0000] | 5.39* [0.0000] |
| F-Tests for Attrition [probability > F] | | | | |
| 1. joint effect of attrition on all estimates, including constant | 1.31 [0.1461] | 1.45** [0.0772] | 1.34 [0.1277] | 1.38 [0.1055] |
| 2. joint effect of attrition on all coefficients but not on constant | 1.37 [0.1160] | 1.51** [0.0594] | 1.40 [0.1013] | 1.44** [0.0824] |

Note: * indicates significance at the 5 percent level. ** indicates significance at the 10 percent level. P-values of tests are in brackets.

^a Values of t-tests are in parentheses beneath point estimates.

Table 8. Kenya. Multivariate probits/regressions for testing impact of attrition for men and women between Kenya 1 and Kenya 2 on key fertility-related outcome variables^a

| Right-side variables | Men | | | | | Women | | | | |
|--------------------------------------|---------------------------------|---------------------------|-----------------------|------------------------------|-------------------------------------|---------------------------------|---------------------------|-----------------------|------------------------------|-------------------------------------|
| | Probits | | | OLS Regressions | | Probits | | | OLS Regressions | |
| | Currently using contra-ceptives | Ever used contra-ceptives | Want no more children | Number of surviving children | Family planning social network size | Currently using contra-ceptives | Ever used contra-ceptives | Want no more children | Number of surviving children | Family planning social network size |
| Control variables | | | | | | | | | | |
| Age (years) | 0.004 (0.74) | 0.009 (1.62) | 0.013* (8.58) | 0.200* (20.26) | 0.015 (0.86) | 0.014* (2.03) | 0.023* (3.68) | 0.079* (11.80) | 0.161* (20.82) | 0.025* (1.97) |
| Education (relative to no schooling) | | | | | | | | | | |
| Primary schooling | 0.075 (0.36) | -0.048 (0.26) | 0.133 (0.69) | 0.955* (2.85) | 1.202* (2.08) | 0.122 (0.72) | 0.094 (0.66) | -0.004 (0.03) | -0.440* (2.66) | 0.957* (3.41) |
| Secondary schooling | 0.310 (1.22) | 0.122 (0.55) | 0.197 (0.81) | 0.736** (1.77) | 2.247* (3.12) | 0.125 (0.47) | 0.279 (1.23) | -0.107 (0.46) | -0.447 (1.60) | 1.786* (3.83) |
| Language | | | | | | | | | | |
| Luo only | 0.372** (1.87) | 0.368* (2.37) | 0.142 (0.89) | -0.180 (0.66) | 0.815** (1.74) | -0.268** (1.86) | -0.236* (1.95) | -0.228** (1.88) | -0.142 (1.00) | -0.395** (1.68) |
| English | -0.037 (0.24) | -0.048 (0.33) | 0.074 (0.46) | 0.325 (1.20) | 0.243 (0.52) | 0.264 (1.41) | 0.265 (1.59) | -0.002 (0.01) | -0.334 (1.59) | 0.125 (0.36) |
| Lived in Nairobi or Mombasa | 0.130 (1.12) | 0.221* (2.02) | 0.324* (2.74) | 0.086 (0.41) | 0.258 (0.71) | 0.311* (2.33) | 0.356* (3.05) | 0.240* (2.01) | 0.144 (0.97) | -0.066 (0.26) |
| Women sell in market | — | — | — | — | — | 0.254* (2.02) | 0.147 (1.34) | -0.119 (1.07) | 0.032 (0.24) | 0.180 (0.83) |
| Household characteristics | | | | | | | | | | |
| Polygamous household | 0.091 (0.65) | -0.025 (0.19) | -0.296* (2.10) | 2.386* (9.69) | 0.017 (0.04) | -0.161 (1.28) | -0.104 (0.97) | 0.187** (1.79) | -0.201 (1.57) | -0.089 (0.42) |
| Earns a monthly salary | 0.058 (0.38) | 0.302* (2.16) | 0.251 (1.63) | 0.312 (1.13) | 0.953* (2.00) | — | — | — | | |

(continued)

Table 8. (Continued)

| Right-side variables | Men | | | | | Women | | | | |
|--|---------------------------------|---------------------------|-----------------------|------------------------------|-------------------------------------|---------------------------------|---------------------------|-----------------------|------------------------------|-------------------------------------|
| | Probits | | | OLS Regressions | | Probits | | | OLS Regressions | |
| | Currently using contra-ceptives | Ever used contra-ceptives | Want no more children | Number of surviving children | Family planning social network size | Currently using contra-ceptives | Ever used contra-ceptives | Want no more children | Number of surviving children | Family planning social network size |
| Husband interviewed | – | – | – | – | -- | 0.211 (1.51) | -0.108 (0.94) | -0.113 (0.99) | -0.147 (1.05) | 0.101 (0.44) |
| Household has radio | – | – | – | – | -- | -0.019 (0.16) | -0.005 (0.05) | 0.046 (0.44) | -0.106 (0.85) | 0.270 (1.31) |
| Household has metal roof | – | – | – | – | -- | 0.003 (0.019) | 0.253* (2.00) | 0.173 (1.39) | 0.810* (5.15) | 0.142 (0.53) |
| Sublocation of residence (relative to Ugina) | | | | | | | | | | |
| Gwasssi | -0.639* (3.42) | -0.571* (3.50) | -0.630* (3.42) | -0.032 (0.11) | -0.323 (0.66) | -0.441* (2.37) | -0.645* (4.10) | 0.169 (1.13) | 0.357* (2.03) | -0.668* (2.29) |
| Kawadhgone | 0.145 (0.88) | 0.015 (0.09) | 0.153 (0.93) | 0.165 (0.57) | -0.182 (0.36) | -0.170 (0.99) | -0.260** (1.79) | 0.130 (0.85) | 0.240 (1.34) | 0.496** (1.68) |
| Oyugis | 0.256 (1.62) | 0.239** (1.67) | 0.328* (2.10) | 0.229 (0.82) | -0.392 (0.81) | 0.013 (0.08) | -0.179 (1.26) | 0.437* (2.93) | 0.218 (1.23) | 1.537* (5.22) |
| Constant | -1.53* (4.38) | -1.43* (4.67) | -3.34* (9.31) | -4.96* (8.94) | 0.970 (1.02) | -1.85* (5.50) | -1.34* (4.71) | -3.03* (10.01) | -0.90* (2.57) | 1.87* (3.23) |
| Chi-squared test for overall relation [probability > Chi-squared] | 48.87* [0.0000] | 58.21* [0.0000] | 134.25* [0.0000] | | | 44.22* [0.0001] | 86.05* [0.0000] | 234.12* [0.0000] | | |
| R-squared | | | | 0.560 | 0.057 | | | | 0.469 | 0.082 |
| F-test | | | | 82.81* | 3.98* | | | | 50.36* | 5.48* |
| [probability > F] | | | | [0.0000] | [0.0005] | | | | [0.0000] | [0.0000] |

(continued)

Table 8. (Continued)

| Right-side variables | Men | | | | | Women | | | | |
|---|--|----------------------------------|-----------------------------|---------------------------------------|---|--|----------------------------------|-----------------------------|---------------------------------------|---|
| | Probits | | | OLS Regressions | | Probits | | | OLS Regressions | |
| | Currently using contra- ceptives | Ever used contra- ceptives | Want no more children | Number of surviving children | Family planning social network size | Currently using contra- ceptives | Ever used contra- ceptives | Want no more children | Number of surviving children | Family planning social network size |
| Tests for Attrition | | | | | | | | | | |
| Effect of attrition on constant | 0.027 (0.21) | 0.046 (0.38) | 0.150 (1.13) | -0.065 (0.29) | 0.166 (0.42) | 0.126** (1.90) | -0.162 (1.31) | -0.189 (1.50) | -0.549* (3.77) | 0.057 (0.24) |
| Chi-squared test for joint effect of attrition on constant and all coefficient estimates [probability > Chi-squared] (F tests for regressions) | 12.11 [0.437] | 11.27 [0.506] | 16.79 [0.158] | 1.11 [0.352] | 0.71 [0.725] | 10.85 [0.763] | 12.60 [0.633] | 10.68 [0.775] | 2.08* [0.009] | 0.82 [0.657] |
| Chi-squared test for joint effect of attrition on all coefficient estimates but not on constant [probability > Chi-squared] (F-tests for regressions) | 11.90 [0.371] | 11.04 [0.440] | 15.27 [0.171] | 1.20 [0.284] | 0.67 [0.781] | 10.74 [0.706] | 11.58 [0.640] | 9.20 [0.818] | 1.05 [0.397] | 0.87 [0.588] |

Notes: * indicates significance at the 5 percent level, and ** at the ten percent level.

^a Absolute values of t-tests (for regressions) and z-tests (for probits) are in parentheses beneath point estimates:

Table 9—South Africa. Multivariate regressions/probits for testing impact of attrition between South Africa 1 and South Africa 2 on child nutritional status and health^a

| | Height-for-age | Weight-for-age | Weight-for-height | Moderate stunting | Severe stunting | Moderate wasting | Severe wasting | Sick in past two weeks |
|---|--------------------------|---------------------------|---------------------------|-----------------------------|----------------------------|----------------------------|---------------------------|------------------------|
| Control variables | | | | | | | | |
| Respondent male | 0.019 (1.08) | 0.243 (1.05) | -0.028 (0.14) | 0.116 (1.21) | 0.132 (1.28) | 0.160 (1.50) | 0.114 (1.00) | 0.032 (0.21) |
| Respondent African | 0.007 (0.17) | 0.451 (0.80) | 1.001* (2.47) | 0.044 (0.15) | 0.069 (0.18) | -0.888* (2.75) | 0.288 (0.89) | -0.125 (0.33) |
| Household size | 0.002 (0.55) | -0.013 (0.24) | -0.083* (2.24) | 0.007 (0.40) | -0.020 (0.80) | 0.020 (0.98) | 0.013 (0.56) | -0.042 (1.48) |
| Log total monthly expenditures | 0.000 (0.01) | 0.092 (0.34) | 0.228 (0.95) | -0.159 (1.31) | -0.215 (1.40) | -0.200 (1.28) | 0.044 (0.30) | -0.023 (0.13) |
| Household head age | 0.000 (0.09) | 0.005 (0.40) | 0.005 (0.46) | -0.003 (0.79) | 0.005 (1.01) | 0.002 (0.34) | 0.002 (0.43) | -0.012 (1.68) |
| Household head schooling | -0.002 (0.68) | -0.050 (1.03) | -0.032 (0.76) | -0.017 (0.84) | 0.014 (0.55) | 0.011 (0.53) | 0.002 (0.08) | 0.016 (0.54) |
| Household head male | -0.015 (0.87) | -0.317 (1.42) | -0.202 (0.82) | -0.029 (0.26) | 0.004 (0.03) | 0.154 (1.28) | 0.221 (1.76) | -0.062 (0.40) |
| Own house | 0.024 (0.78) | -0.130 (0.33) | -0.813* (2.93) | 0.090 (0.55) | 0.431 (1.88) | 0.560* (3.13) | 0.554* (2.60) | 0.025 (0.09) |
| Number of rooms | 0.001 (0.30) | 0.054 (1.25) | 0.083 (1.62) | -0.012 (0.61) | 0.018 (0.75) | -0.044 (1.69) | -0.057* (2.40) | -0.056 (1.49) |
| Number of durables | -0.001 (0.26) | 0.020 (0.27) | 0.093 (1.29) | -0.040 (1.04) | -0.050 (1.06) | -0.063 (1.61) | -0.048 (1.04) | -0.011 (0.21) |
| Urban | 0.008 (0.38) | -0.126 (0.47) | -0.536 (1.37) | -0.185 (1.02) | -0.115 (0.50) | 0.161 (0.88) | 0.317 (1.56) | 0.347 (1.42) |
| Former Natal | 0.027 (0.72) | 0.424 (0.86) | 0.277 (0.97) | -0.250 (1.41) | -0.296 (0.93) | -0.420 (1.42) | -0.184 (0.69) | -0.306 (1.19) |
| Constant | 0.327* (2.30) | 4.160* (2.18) | 13.150* (8.47) | 1.517 (1.68) | 0.404 (0.35) | 1.406 (1.32) | -2.082* (1.92) | 0.116 (0.09) |
| F-test overall (Cols 1-3) | 1.80* | 2.00* | 1.43 | 113.27* | 86.29* | 51.43* | 49.34* | 6842.91* |
| Chi-square test overall (Columns 4-7) [p-value] | [0.03] | [0.01] | [0.12] | [0.00] | [0.00] | [0.00] | [0.00] | [0.00] |
| Tests for Attrition | | | | | | | | |
| Effect of attrition on constant | 0.462 (1.61) [011] | 5.504 (1.61) [0.11] | 1.818 (0.32) [0.75] | -5.314* (2.38) [0.02] | -3.746 (1.38) [0.17] | -2.970 (1.40) [0.16] | 0.103 (0.04) [0.97] | n/a |
| Joint effect of attrition on constant and all estimates - p-value [p-value] | 1.52 [0.13] | 1.32 [0.22] | 0.88 [0.58] | 30.26* [0.00] | 16.81 [0.21] | 10.31 [0.67] | 5.82 [0.95] | n/a |
| Joint effect of attrition on all estimates but constant [p-value] | 1.64 [0.10] | 1.43 [0.18] | 0.91 [0.54] | 30.20* [0.00] | 16.56 [0.17] | 6.49 [0.89] | 5.82 [0.92] | 4187.32* [0.00] |

Notes: * indicates significance at the 5 percent level, and ** at the 10 percent level. P-values of tests are in brackets.

Columns 1–3 are ordinary least squares and columns 4–7 are probit estimation. All are estimated allowing for clustering at community level and with robust standard errors to account for multiple observations on the same households within communities.

^a Absolute values of t-tests (for regressions) and z-tests (for probits) are in parentheses below point estimates.

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