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THE DEMOGRAPHIC TRANSITION IN SOUTHERN AFRICA: ANOTHER LOOK AT THE EVIDENCE FROM BOTSWANA AND ZIMBABWE

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Abstract

Botswana and Zimbabwe have been acclaimed as being on the vanguard of the demographic transition in sub-Saharan Africa. One set of data underlying this claim are the Contraceptive Prevalence Surveys and Demographic Health Surveys which were conducted in both countries. This paper examines the comparability of these data sources and finds that at least part of the observed decline in aggregate fertility rates in both countries can be attributed to differences in sample composition. In Botswana and Zimbabwe, women of the same cohort are better educated in the second survey relative to the first. Since education and fertility are negatively correlated, this fact explains part of the observed fertility decline across the surveys. For example, it accounts for about half the decline among the cohort of women aged 25 to 34 in 1984 in Zimbabwe. The DHS included a complete birth history whereas the CPS asked only summary questions about the number of children ever born. There is evidence that differences in the structure of the instruments also raise questions about the comparability of these data.

KEY WORDS: fertility, Botswana, Zimbabwe

1. INTRODUCTION

Fertility in sub-Saharan Africa remains the highest in the world and there is little evidence that the kind of sustained declines in fertility that have been observed in all other developing areas are imminent for most countries on the sub-continent. Some recent evidence, however, has led several researchers, and policy makers, to argue that the demographic structure of a few societies in the region may be on the verge of dramatic change. In particular, Botswana and Zimbabwe, and sometimes Kenya, are frequently cited as the exceptions to an otherwise dismal picture of stable fertility rates in the region. (See, *inter alia*, Mhloyi, 1988; World Bank, 1989; Freedman and Blanc, 1990; van de Walle and Foster, 1990; Ainsworth and Nyamete, 1992).

Evidence for dramatic fertility decline in Botswana and Zimbabwe appears to be drawn from Censuses and two recent nation-wide demographic surveys conducted in each country, the first as part of the *Contraceptive Prevalence Survey* (CPS) programme and the second in the *Demographic and Health Survey* (DHS) programme. Since it is well known that Census data are potentially subject to important biases for the estimation of fertility trends, it would seem that the weight of the evidence used to draw inferences regarding fertility trends in Botswana and Zimbabwe comes from the two recent demographic surveys.[1] Indeed, these surveys which have been have been conducted in a large number of countries, have made a substantial contribution to the knowledge base regarding fertility, child survival, contraception, maternal and child health throughout the world.

In this paper, the CPS and DHS data from Botswana and Zimbabwe are re-examined. There has been some discussion of puzzles which have appeared in tabulations of these data (see van de Walle and Foster, 1990, for example) although it was only recently that all four datasets were released to the public domain so that they may be compared at the micro-level.

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[1]This is especially true in Zimbabwe where there are only two Censuses available; the 1969 Census is generally recognised as being of limited value to policy makers in post-Independence Zimbabwe. There is also some debate regarding the quality of the 1982 Census which was conducted soon after Independence.

This turns out to be a useful comparison. There is some evidence that at least part of the observed decline in aggregate fertility rates in both Botswana and Zimbabwe can be attributed to differences in the sample composition. It has been pointed out, for example, that the Zimbabwe CPS tended to under-represent women at either end of the age distribution (World Bank, 1989) and there is evidence that the DHS suffered from the same problem. There also appears to be substantial under-reporting of fertility by older women in the second Botswana survey (van de Walle and Foster, 1990).

We present evidence below for both Botswana and Zimbabwe which indicates that relative to the CPS, women in the DHS tend to be better educated. This does not simply reflect the fact that younger women have more education than older cohorts: women of the *same* cohort are better educated in the second survey, relative to the first. One of the few facts that social scientists agree on is that there is typically an inverse correlation between education and fertility. Part of the observed decline in fertility can apparently be accounted for by the shift in the distribution of education of the same cohort of women across the two surveys. The results presented below also *suggest* that differences in the design of the DHS and CPS may contaminate inferences drawn from aggregate statistics.

While there is certainly evidence for some decline in fertility in both Botswana and Zimbabwe (in these data), the evidence for dramatic decline is less clear. It may be premature to be heralding the onset of the demographic transition in Southern Africa.

2. DATA

As part of the *Contraceptive Prevalence Survey* programme, the first wave of the *Botswana Family Health Survey-I* (BFHS-I) was conducted in 1984 by the Central Statistics Office in collaboration with the Institute for Resource Development (IRD).[2] Drawing a nation-wide sample of 3 064 women aged 15 through 49, the survey collected information on fertility, contraception, child survival and some socio-demographic characteristics of the woman. (Manyeneng *et al.*, 1985).

Four years later, in 1988, the same agencies collaborated in the collection of the second wave of the *Botswana Family Health Survey-II* (BFHS-II) which formed part of the worldwide *Demographic and Health Surveys*. This survey was both more extensive (with a sample size of 4 368) and also considerably more comprehensive. In addition to the information collected in BFHS-I, the second wave collected detailed information on maternal and child health, breastfeeding and contraceptive histories. (Central Statistics Office, 1989).

Two similar surveys were conducted in Zimbabwe during the same period. The CPS, called the *Zimbabwe Reproductive Health Survey*, (ZRHS) was carried out in 1984 by the Zimbabwe National Family Planning Council in collaboration with IRD and covered 2 574 women. (Zimbabwe National Family Planning Council, 1985). In 1988, the Central Statistical Office and IRD implemented the *Zimbabwe Demographic and Health Survey* (ZDHS) which had a substantially larger sample of 4 201 women. (Central Statistical Office, 1989).

Although in most respects the 1984 and 1988 surveys in each country are broadly comparable, there is a key difference between them which may be important for a study of fertility. In the 1984 surveys, each woman was asked about children to whom she had given birth (living at home and away) and those that died. In the 1988 surveys, however, after eliciting that information, the enumerator asked each woman to provide a complete birth

[2]IRD/Macro Systems was named Westinghouse Public and Applied Systems at the time.

history covering every child. In cases where there were discrepancies between the number of birth history entries and the original tally of children born, the enumerator was instructed to reconcile the difference.[3]

This caveat notwithstanding, these data offer an unique opportunity to examine the dynamics of fertility change in Botswana and Zimbabwe. In particular, they afford the researcher the luxury of being able to cross-check estimates for consistency without having to make strong assumptions about the underlying data generating process. There can be little doubt that the availability of these surveys has already had a substantial impact on the understanding of demographic processes in Southern Africa; as additional data become available at the micro-level, further analyses along these lines will presumably add to this understanding.

The aim of this paper is quite simple: we wish to determine the extent to which the observed dramatic decline in fertility in Botswana and Zimbabwe reflects reality as opposed to differences across the surveys. We turn next to the evidence.

3. THE EVIDENCE

Table 1 presents some summary statistics regarding fertility and sample composition from the four surveys: the 1984 ZRHS, the 1988 ZDHS, the 1984 BFHS-I and 1988 BFHS-II.[4] The story they tell is fairly well-known.

The total fertility rate (tfr) in Zimbabwe was estimated to be about 6.5 in 1984 and declined by one child to 5.5 by 1988. The average woman had borne 3.4 children according to the 1984 survey and almost one half a child less, 2.95, in the 1988 survey. Completed fertility, as measured by the number of children ever born to women

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[3]Unfortunately, on the data tapes used for this study, we are unable to identify whether such discrepancies arose or how they were resolved. An examination of these data may be a valuable exercise in and of itself.

[4]The BFHS I and II as well as the ZRHS estimates are all weighted to account for different sampling proportions (of rural and urban households) included in the surveys; the ZDHS is a proportional probability sample. As a matter of fact, the essence of the results below are independent of whether or not weights are applied.

aged 45 to 49 fell from 7.5 in 1984 to 6.9 in 1988 which suggests that much of the decline in fertility has been concentrated among younger women.

These declines in fertility have occurred in the context of rising child survival rates as well as increasing knowledge and use of modern contraceptives. (Table 1). Knowledge of modern methods is virtually universal in Zimbabwe today and the usage rate among all (married and unmarried) women has risen by almost 20% from 23% in 1984 to 27.2% in 1988. These increases are probably a reflection of both successful family planning and public health programmes (Boohene and Dow, 1987) as well as broader social changes which have taken place in the country since Independence in 1980.[5] Massive spending on social services by the Government is surely partly responsible for this change[6] and Zimbabwe has registered very impressive successes in increasing access to both the health care system and public education. For example, between 1980 and 1986, primary school enrolment ratios rose by over 40%. The vast majority of the people of Zimbabwe were excluded from secondary schools at Independence; at that time, only 8% of eligible children were enrolled. These enrollments have increased by almost six fold to 46% by 1986. The number of tertiary students has tripled during the same period and, unlike many developing countries, the vast majority (over 70%) of these students are in education, science and teacher training (UNESCO, 1986). These increases are also reflected in the demographic surveys; in 1984, the average woman had 4.9 years of schooling whereas by 1988 she had over six years.

Taking a longer perspective on fertility, however, there appear to be some puzzles. According to Census data, the total fertility rate in Zimbabwe declined from 6.7 to 5.6 between 1969 and 1982; it then rose to 6.5 in 1984 and had fallen back to the 1982 level by 1988. Apart from young women, (aged 15 to 19) age specific fertility

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[5]Zimbabwe is often cited as having a very successful family planning programme. Family planning services were first introduced in Zimbabwe in 1953 and it has been, at least since 1966, an integrated component of the public health system. In 1984, family planning services were reorganized and the Zimbabwe National Family Planning Council was formed as a parastatal operating under the Ministry of Health.

[6]In 1989, Government spending as a proportion of GNP was high (40%) and almost one quarter of public spending went to education while the health sector received 7.6% of the public budget.

rates in 1982 and 1988 are very close, whereas those in 1969 are substantially higher for every age group. This would be consistent with a decline in fertility during the 1970s and a levelling off in the 1980s.

Estimated age-specific fertility rates based on the 1984 survey, however, are rather different. They are higher than the 1982 and 1988 estimates for all women under 40 and are, in fact, 40% higher for women aged 35 to 39. For older women, the reverse is true. Based on the 1984 survey, estimated fertility rates of women aged 45 to 49 were only one third of the comparable estimates in both the 1988 and 1982 datasets.

It is generally thought that Census data tend to underestimate fertility as women are inclined to forget about births several years ago and, especially, those that involved early mortality. There are, by now, many potential indirect methods which seek to adjust fertility (and mortality) data to account for recall error. World Bank (1989) has applied the Brass (1968) P/F method to evaluate the internal consistency of the four data sources and argues that there was indeed substantial under-reporting of fertility in the two Censuses and thus calculated adjusted fertility rates (reported in Appendix Table 1). According to these adjusted data, the "national total fertility rate was close to 8 in the late 1960s, ... it then fell to around 7 by 1981/82, to around 6.5 by 1983/84 and to an average of 5.7 around 1986"[7] (World Bank, 1989; see, also, Mhloyi 1988). Researchers and policy makers have, therefore, come to the conclusion that there is evidence for significant fertility decline in Zimbabwe during the eighties.

Turning next to Botswana, according to the 1981 Census, the total fertility rate was about 7.1; it had declined to 6.5 by 1984 (according to the first wave of the BFHS) and collapsed to 5.0 by 1988 (BFHS II). If these data reflect reality, then fertility has declined by over 25% in only 7 years and much of this decline is also concentrated in the latter part of the eighties. Furthermore, as in Zimbabwe, the number of children born to the average woman declined by almost half a child (from 3.1 to 2.6 children) and the completed fertility rate

[7]The authors do not discuss the rather surprising fact that among old women, even according to the adjusted numbers, fertility declined between 1982 and 1984 but then rose by 1988.

dropped by over a child from 6.9 to 5.8 suggesting that the reductions in fertility are also concentrated among younger women.

The Botswana Maternal Child Health/Family Planning Unit was formed in 1973 within the Ministry of Health but it has been during the eighties that public investment in family planning has grown fastest especially since 1984, when the first BFH survey was fielded. The evidence suggests these investments have had a high rate of return. Knowledge of contraceptives has increased by 50%: in 1984 about two thirds of women knew about modern methods and by 1988 that proportion had increased to 95%. As in Zimbabwe, knowledge of modern methods had become virtually universal by 1988. Use of these methods rose even faster, almost doubling during the four years between the two surveys from 16% to 29%. School enrolment rates also rose during this period[8] and this is reflected in the two surveys: the average woman had 4.4 years of schooling in 1984 and 5.4 in 1988, placing her slightly below the average Zimbabwean woman.

All of this evidence suggests that fertility has indeed declined dramatically in both countries during the four years between the two surveys. And several authors have heralded the onset of the (long-awaited) demographic transition in sub-Saharan (or at least Southern) Africa. Yet the final reports for both the ZDHS and BFHS II recommend caution in taking these declines at their face value (Botswana Central Statistics Office, 1989; Zimbabwe Central Statistical Office, 1989). Several reasons have been cited which suggest that following their advice would be prudent.

Recall that the 1984 surveys collected summary information on the number of children ever born whereas the 1988 surveys first asked each woman the number of children ever born and then obtained a birth history on each child. One might expect the birth history method to result in less under-reporting but it has been argued that

[8]Secondary school enrollments rose by over a quarter from 25% in 1984 to 32% in 1988. In 1989, the share of the public budget spent on education and health (20% and 5.5%) was slightly less than in Zimbabwe but Government spending accounted for a larger share of GNP (50%).

in fact, in Africa, birth histories tend to result in *lower* estimates of fertility (Government of Kenya, 1989). Exactly why this should be so is not at all clear (van de Walle and Foster, 1990); it is plausible that high parity women suffer from fatigue and so truncate their birth histories (and then reduce the total number of children born) or they may just get confused as they enumerate each child. It has also been noted that there is some slippage in the birth histories as respondents (or enumerators) appeared to mis-classify children as being older than 5 and thus not complete the child health module (Rutstein and Bicego, 1990; Arnold, 1992).

Furthermore, both the demographic surveys collected information on only woman aged 15 to 49 in each household. One might expect that young and old women would be mis-classified as being outside the admissible age range in order to reduce the interviewer's workload (Arnold, 1992). There is some sense that this is indeed a problem in the Zimbabwe surveys since the age distributions of women indicate considerable under-representation by young women[9] and also in the Botswana DHS.

The next section takes another look at the evidence to determine whether there might be other indications in the data that suggest prudence in inferring a time-series pattern from the two surveys.

4. THE EVIDENCE -- ANOTHER LOOK

Table 2 presents the age-specific number of children reported to have been ever born to women in Zimbabwe (in Panel A) and Botswana (in Panel B). Column 1 is based on the 1984 survey and column 3 on the 1988 survey. According to these numbers, there have been significant declines in fertility in Zimbabwe in *every* age group with the largest declines being in the early ages. Similarly, in Botswana, significant reductions in fertility are registered for every age group, apart from the youngest (among whom fertility has not changed significantly

[9]Whereas one quarter of women between 15 and 49 were aged 15 to 19 according to the 1982 Census and 1988 ZDHS, this age group accounted for only 20% of women in the 1984 ZRHS. The 1987 Intercensal Demographic Survey (Central Statistics Office, 1991) collected information on some 29,000 women aged 12 and above; these data should not be subject to end-point problems at 15 or 49. According to the 1987 data, 27% of the 15 to 49 year old women were aged between 15 and 19 suggesting that young women were mis-classified in the ZDHS as well.

and is slightly higher in the second survey although this may simply reflect sampling variation). Based on these data, one might also infer that women tend to complete their fertility around age 40 in both countries since the number of children ever born to women aged 35-39 in 1984 (5.36 in Botswana) is only slightly less than the average number born to women aged 40-44 in 1988 (5.43 in Botswana; the comparable numbers in Zimbabwe are 6.2 and 6.4, respectively). This inference may, however, be misleading since reported fertility for the next cohort of women (aged 40-44 in 1984) actually *declined* during the four years between the surveys from 6.3 to 5.8 in Botswana and from 7.0 to 6.9 in Zimbabwe.[10] Pointing out this fact in Botswana, van de Walle and Foster (1990) attribute it to misreporting and suggest it reflects differences in the methods used to collect fertility data in the two sets of surveys.[11] Given the fact that the anomaly arises in both countries, this seems an appealing hypothesis.

The distribution of education

But might there be some other reasons for the anomalies in the estimates of fertility based on these surveys? We pointed out above that during the eighties, Zimbabwe, and to a less extent Botswana, enjoyed spectacular growth in the educational attainment of its youth and this growth is reflected in the fact that the *average* woman in 1988 reported one more year of schooling than her counterpart in 1984. Even in the context of the rapid social change that took place in these countries, this strikes us as a large increase. The second half of each panel in Table 2 reports the number of years of education for each cohort of women in 1984 and 1988 in the two countries.[12]

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[10]This decline is significant in Botswana but not in Zimbabwe.

[11]Recall summary data were collected in the 1984 surveys and birth histories collected in the 1988 surveys.

[12]Each woman reports the specific grade she attained as well as level of schooling (primary, secondary and tertiary). A very small fraction of women reported they had attended primary school but could not recall the exact grade; we assume they have not completed primary schooling and, when calculating years of schooling, assume they completed three at the primary level. Since less than 1% of women failed to report an exact grade, the effect of varying this assumption on our estimates is trivial.

We certainly expect large increases among young women: 15 to 19 year olds report about one more year of schooling in 1988 than 1984. The biggest changes, however, occur for the next age group (20 to 24 year olds) who register, on average, more than two additional years of schooling in the 1988 survey in Zimbabwe; in Botswana, the increase is 1.3 years. For most people in both countries, schooling ends sometime during the mid to late teens and so these increases, while large, are not totally implausible.

Very few women attend school beyond their early twenties and so rapid growth in educational attainment among older women would be less plausible. At this point, it makes sense to explicitly compare cohorts of women. Using microdata from the 1988 survey, we set the age of each woman to its value in 1984 and record her education. Since education histories were not reported in the surveys, years of completed schooling must be treated as time invariant and so will not accurately reflect education levels in 1984 for younger women; for older women who had completed schooling in 1984 (say women aged 25 and over at that time) we can directly compare the educational attainment of cohorts of women in the two surveys. Clearly, in the absence of adult education programmes (as opposed to adult literacy programmes), these numbers should be the same.

These estimates of cohort-specific educational attainment are reported in the middle column of Table 2 (labelled ZDHS 1984 and BFHS-2 1984 for Zimbabwe and Botswana respectively). Reported education is about 0.7 years higher for women aged 15 to 44 in 1984 in both surveys and this difference is significant.[13] Young women, however, do not account for all the difference. In Zimbabwe, women who were aged 25 to 34 (in 1984) report almost *half a year* more schooling in 1988 than in 1984. The increase among women aged 35 to 39 is not as large and neither it nor the small difference for women aged 40 to 44 is significant.[14] In Botswana, the pattern is

[13]Part of the increase simply reflects the fact that young women were still at school in 1984 although the increase of 1.3 years for the 15-19 year old cohort seems quite large.

[14]For Zimbabwe, we can compare these estimates with the distribution of education of the same cohorts of women as recorded in the 1987 Intercensal Demographic Survey. Relative to this (large) sample, 5-year cohorts of women aged 25 through 49 as of 1984 uniformly report around a fifth of a year less schooling on average in the ZRHS and the difference for this age group is significant. Of course, women under 25 are also better educated in the 1987 survey: for example, women aged 15-19 report almost a year more schooling in 1987.

quite different. Young women (25-29) report about the same level of education in both surveys (4.6 years) but older women report substantially more schooling (about *half a year* among women aged 30-34 and 40-44 and *over a year* among women aged 35-39).

In sum, then, women in the 1988 surveys report significantly more education than those women of the same cohort in the 1984 surveys in both Botswana and Zimbabwe. Whether this is because the women in the 1988 survey were better educated than those in 1984 or whether they simply *reported* themselves as being better educated, we cannot tell. What we can say, however, is that simple comparisons of aggregates based on these data may be quite misleading. Indeed, given the fact that education and fertility tend to be negatively correlated (see below), this suggests that it would be prudent to evaluate the evidence regarding dramatic decline in fertility in both countries with this caveat in mind.

In column 2 of the upper part of each panel in Table 2, we exploit the birth history information in the 1988 surveys and calculate the number of children reported to have been born to each woman by 1984. Each woman's age is set to the level it would have been in 1984 and so columns 1 and 2 are estimates of the same thing: the average number of children born to a woman of a particular age (group) as of 1984. In an ideal world, they would be identical (apart from sampling variation).

Young women in the 1988 ZDHS report significantly more schooling than those in the 1987 survey: women aged 15-19 (in 1988) report a half year more schooling in the 1988 survey. This difference is also significant and seems like a very large number for a single year suggesting that perhaps it reflects differences in the samples and not just additional schooling. For women aged 25 through 49, in 1988, educational attainment reported in the 1987 and 1988 surveys are virtually identical (at about 4.8 years of schooling); they differ by about .04 years which is half the standard error on the difference (0.08). For these women, the 1987 ICDS and 1988 ZDHS education distributions are consistent although this does not imply that they are necessarily correct. The reason for the differences between the surveys may lie in a changing distribution of the population which is not adequately captured in the sampling frames (which are essentially common for all three surveys). Since the 1984 ZRHS was conducted closer to the 1982 Census, it may in fact be a better representation of the distribution of the population of Zimbabwe. This strikes us an important and complex issue, especially in the context of rapidly changing socio-economic environments.

On average, for women aged 15 through 44 (in 1984),[15] fertility is significantly lower in the 1988 survey relative to the 1984 survey in both Zimbabwe and Botswana. For example, in Zimbabwe, the 1984 survey estimates current fertility in 1984 to be 3.1 children per woman in 1984 but only 2.8 at that time according to the 1988 survey. This difference accounts for 80% of the observed decline in the number of children ever born over the period 1984 to 1988. In Botswana, the difference between the estimates based on cohort adjustment (in column 2) is (slightly) greater than the difference between the observed number of children ever born in the two surveys and this is due to much lower estimates (based on the 1988 data) among women aged 15 through 19 and 35 though 39 in 1984.

There are several possible explanations for these differences. The most obvious is recall error and, indeed, it is standard practice in demographic studies to treat this sort of difference as an indicator of recall error. (In essence, this is a key idea underlying the P/F method for adjusting retrospective fertility data with a single survey as suggested by Brass, 1968).[16] There are, however, other plausible explanations. Methodology differed across the two surveys and the samples appear to be different. There is some evidence that young and old women were under-represented in the 1984 surveys and the 1988 samples were relatively better educated.

To try to disentangle the potential sources of error, we next estimate fertility rates stratifying on both age and education and again exploit the fact that we can create quasi-cohort data by back-casting the 1988 survey. These estimates are reported in Tables 3A and 3B.

Since sample sizes get quite small as we stratify on both age and education, we have aggregated the women into ten year age groups: 15 to 24 year olds (left column), 25 to 34 (middle) and 35 to 44 (right column) and once

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[15]Since women over 49 were not included in the survey in 1988, ages in 1984 are truncated at 45.

[16]Little is known about the reliability of recall data which involves remembering dates (as in the birth histories recorded in 1988). As noted above, there is some evidence that children aged 5 (born in 1983) were mis-classified as born before then; this should not have affected fertility as of 1984 (reported in 1988).

again report estimates for the 1984 and 1988 survey (first and third column respectively) as well as estimates based on the 1988 survey but dated as of 1984 (middle column in each block).

Among young women (15 to 24), the increases in reported education between 1984 and 1988 for the same cohort of women are largely concentrated in upper secondary schooling (after Form 2 in Zimbabwe and after Form 3 in Botswana). This suggests that differences for these women reflect the fact that young women have not completed their education.

For older women, however, in the 1988 samples fewer report they had no education and more report they received some secondary schooling relative to the women in the 1984 surveys. For example, among women aged 25 to 34 in 1984 in Zimbabwe, 5% reported more than Form 2 schooling in the earlier survey but almost fifty *per cent* more than that (7%) claimed to have stayed at school beyond Form 2 in the later survey. Among 35 to 44 year old women, 7% had Form 2 or above in the earlier survey and 9% reported this level education in the later survey.[17] In Botswana, only 2% of all women aged 25-34 reported attending school beyond Form 3 in the earlier survey; in the later survey, among the same cohort of women three and a half times as many (7%) reported Form 3 or higher levels of education. For women in the 35-44 age group, the differences are even more dramatic: in the earlier survey, only 1% reported staying at school beyond Form 3 whereas some 6% reported more than Form 3 education in the later survey.

Impact of shift in distribution of education on fertility decline

How much of the observed decline in fertility can be attributed to these differences? The second panel of the table reports the number of children ever born to women, stratified on education. Using these fertility rates, we can calculate the average number of children born to women as reported in each survey, using the distribution

[17]Relative to the 1987 Intercensal Demographic Survey, women of the same cohorts in the 1984 ZRHS appear to have less education. Women aged 25 to 34 in the 1988 ZDHS report about the same education as the Intercensal Survey but 35 to 44 year old women are better educated in the ZDHS.

of education for each cohort implied by the 1984 and 1988 surveys. These estimates are reported in the third panel of the table. In the first row, we use the education distribution as reported in each survey; in the second row, we adopt the education distribution in the 1984 survey (adjusting for age in order to estimate the implied distribution in 1988) and in the third row, the implied distributions based on the 1988 data are used. For Zimbabwe, we also use the implied education distribution based on the 1987 Intercensal Demographic Survey.[18] Thus, reading across the rows informs us of the extent to which fertility has declined given the assumed education distribution. The first column of each group reports the predicted number of children ever born using the 1984 fertility rates and the 1988 rates are used in the second column; their difference is in the third column. For the first row, this is the decline as reported in the two surveys (not taking account of the shift in the education distribution). The proportion of this decline left unexplained when the distribution of education is consistent across the two surveys is in the fourth column; if none of the observed decline can be attributed to changing sample composition, then this proportion should be zero.

In Zimbabwe, among women aged 25-34, *over half* the observed decline in fertility across the two surveys can be attributed to differences in the distribution of education of this cohort assuming the distributions implied by the 1988 survey; 30% remains unaccounted for when the 1984 distribution is adopted and 40% given the 1987 distribution. Among women aged 35 to 44, between 10 and 15% of the observed decline is due to the shift in the distribution of schooling. In Botswana, the observed decline in fertility for 25 to 34 year old women is robust to changing the education distribution. Among older women (35-44), however, between 20 and 27% of the observed fertility decline can be attributed to the sample composition.

It appears, then, that at least part of the decline in fertility in both Zimbabwe and Botswana can be explained by the fact that relative to the 1984 survey, the 1988 survey gathered information on better educated women.

[18]These simulations are reported only for women aged 25 to 44 since the interpretation for young women is not clear.

Without knowledge of the shape of the true distribution of education at each survey date, it is very hard to determine the magnitude (and significance) of fertility change in either country.

Changes in the determinants of fertility outcomes

We have argued that comparing levels of fertility outcomes in the 1984 and 1988 surveys is not straightforward. Furthermore, indirect methods which fail to take into account the differences in the sample compositions may lead to misleading inferences regarding the dynamics of fertility change in Botswana and Zimbabwe. We are also interested in the determinants of fertility outcomes and, in particular, in determining whether there has been any change during the 1980s in the effect of education on the number of children ever born to a women. Nothing in the discussion of sample composition above would suggest there will be bias in these estimated education effects and so it may be reasonable to assume they will be comparable across the surveys at least within cohorts.

We turn next to examining this assumption. Fertility estimates for women in 1984 based on the birth histories recorded in 1988 are reported in the middle columns of each group in the second panel of Table 3. These are exactly the same estimates as presented in Table 2 except now they are stratified on both age and education.

One might expect that as women recall beyond the last five years, their memories dim and they forget some births. Estimates of fertility should, therefore, be lower in the middle column (recall for the period prior to 1984 but reported in 1988) than the first column (recalled in 1984). The patterns in Zimbabwe are quite intriguing. Consider first women aged 25 through 34. Those at the bottom of the education distribution certainly do remember fewer births.[19] But women who have at least completed primary schooling remember *more* births.[20] A remarkably similar pattern emerges for older women: those with no education remember one child less on

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[19]For women with some primary education this difference is significant.

[20]Women who have completed Form 2 remember a *significantly* larger number of births prior to 1984 in the second survey relative to the women interviewed in the first survey.

average (a significant difference) and it is only women who have more than Form 2 schooling that recall more births. Why would better educated women systematically remember more births in the 1988 survey?

On this we can only speculate. The most likely candidate, it seems, would lie in differences in the survey design: in the second survey women were asked to complete an entire birth history, whereas in the first survey they reported only the number of children born (alive and dead, by gender). It may be that the birth histories prompted better educated women to recall more events or they may have reported children born after 1984 as being born before then.[21] On the other hand, it may be that less educated women failed to recall detail on every live birth and so revised their number of children ever born downwards. Without more evidence, we cannot distinguish the hypotheses.

Table 4 presents the data slightly differently. The estimated effect on the number or children ever born to a woman of her highest level of educational attainment is reported for each age cohort (controlling for age and whether the woman lives in an urban area). The first column of each panel is based on the 1984 survey data, the third column on the 1988 data and the middle column is based on the 1988 survey back cast to reflect fertility and education as of 1984.

Generally speaking, for all age groups and both surveys, fertility and education tend to be negatively correlated but the magnitude and significance of this correlation varies dramatically between the surveys. For example, taking women aged 35 to 44, according to the 1984 survey, the fertility of women who have completed primary school or more is significantly lower than women with no schooling. By 1988, this difference is significant only for women with at least Form 2 education. Furthermore, the effect of education on fertility has apparently been

[21]There is evidence that women (or enumerators) tended to classify children aged 5 at the time of the survey as being older (presumably to avoid having to complete the child module of the survey). It is not clear why better educated women would have reported children who were aged more than four in 1988 as being younger than that.

considerably reduced during these four years.[22] Comparing these estimates with those based on the ZDHS dated as of 1984 suggests both of these inferences may be wrong. According to these data, women with less than seven years of schooling had borne significantly more children than those with no education and that women who had at least completed primary schooling did not have significantly fewer children than women without any schooling. Thus, comparing the second and third columns, we might infer that the impact of education on reducing fertility has actually increased during the four years
between the two surveys.

In Botswana, the patterns are broadly similar, although perhaps not quite as stark. Returning to Table 3, women at the bottom of the education distribution tend to forget births[23] and the better educated are inclined to remember more births (prior to 1984) in the second survey. The seven *per cent* of women at the top of the education distribution (greater than Form 3) are an anomaly as they report far fewer children born prior to 1988 than in 1984; indeed, women aged 35 to 44 in the second survey report one fewer children born by the first survey date. The same point is abundantly clear in Table 4. Consider women aged 35-44 with at least Form 3 schooling: comparing the 1984 and 1988 estimates, the impact of schooling on reducing fertility has risen dramatically; comparing the estimated based on BFHS-2 in 1988 and 1984, then all this observed change appears to be due to sample differences. All of this suggests that there is some (unobserved) heterogeneity behind this fact.

5. CONCLUSIONS

For many countries, the Contraceptive Prevalence and Demographic Health Surveys are among the first nation-wide demographic and socio-economic surveys made available for research at the primary level. There can be

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[22]For example, women with at least Form 2 education had 3.1 children fewer than women with no education in 1984 but only 1.8 children fewer in 1988.

[23]Apart from those with pre-school education in the 25 to 34 age group although this difference is certainly not significant.

little doubt that the CPS and DHS, in general, have made important contributions to the understanding of demographic processes in developing countries. In Botswana and Zimbabwe, it has only been with the collection and release of these high quality surveys that analysts have been able to examine the evidence regarding fertility decline in both countries.

It would appear that the evidence for dramatic reductions in fertility during the mid-eighties is not as strong as has been claimed. While it is clear that there have been declines in fertility in both countries, the evidence suggests that at least part of the observed differences in aggregate fertility levels in 1984 and 1988 may be attributed to differences in sample composition and survey methodology. In our view, it is not clear that we should draw inferences on the magnitude of the time series trend in aggregate fertility using only these two data points. As the final reports of both the 1988 BFHS-II and ZDHS recommend, prudence is needed in interpreting these data. What is clear, however, is that it will only be with the release of more socio-demographic data at the primary level that researchers and policy makers can hope to understand the complex process of social change taking place in Southern Africa.

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TABLE 1: *Fertility, contraceptive use and socio-demographic characteristics Means and [standard errors].*

A: ZIMBABWE Reproductive and Demographic Health Surveys

	ZRHS 1984	ZDHS 1988
Fertility		
Total # children ever born	3.40 [.06]	2.95 [.05]
Completed fertility (45-49)	7.46	6.87
Total fertility rate	6.5	5.5
Child survival rate	90.3	92.0
Contraceptives: % of all women		
Know modern method	81.1	95.4
Currently use modern	22.8	27.2
Socio-demographic characteristics		
Age	28.02 [.18]	27.82 [.15]
Years of education	4.92 [.07]	6.06 [.06]
Sample size	2574	4201
Ever had child	2014	3005

B: BOTSWANA Family Health Surveys

	BFHS-I 1984	BFHS-II 1988
Fertility		
Total children ever born	3.05 [.05]	2.58 [.04]
Completed fertility (45-49)	6.85	5.75
Total fertility rate	6.5	5.0
Child survival rate	90.8	93.9
Contraceptives: % all women		
Know modern method	65.5	95.1
Currently use modern	16.1	28.9
Socio-demographic characteristics		
Age	28.28 [.17]	27.68 [.14]
Years of education	4.40 [.07]	5.48 [.06]
Sample size	3064	4368
Ever had child	2414	3279

TABLE 2: *Age specific # children ever born and completed years of education*

	(1)	(2)	(3)
A: ZIMBABWE Reproductive and Demographic Health Surveys			
Survey:	**ZRHS 1984**	**ZDHS 1984**	**ZDHS 1988**
A1: # children ever born			
Age 15-49	3.396 [.06]	.	2.953 [.05]
15-44	3.120 [.06]	2.756 [.05]	2.662 [.04]
15-19	0.303 [.03]	0.224 [.02]	0.188 [.01]
20-24	1.649 [.05]	1.469 [.05]	1.299 [.04]
25-29	3.205 [.08]	3.088 [.07]	2.894 [.06]
30-34	4.630 [.11]	4.403 [.09]	4.346 [.09]
35-39	6.219 [.15]	5.734 [.14]	5.537 [.11]
40-44	7.037 [.21]	6.715 [.19]	6.399 [.17]
45-49	7.464 [.26]	.	6.872 [.20]
A2: Completed years of education			
Age 15-49	4.915 [.07]	.	6.056 [.06]
15-44	5.063 [.07]	5.768 [.07]	6.249 [.06]
15-19	6.747 [.12]	8.040 [.11]	7.696 [.08]
20-24	5.215 [.14]	5.640 [.14]	7.556 [.12]
25-29	4.916 [.15]	5.354 [.14]	5.370 [.14]
30-34	4.408 [.16]	4.854 [.15]	5.345 [.15]
35-39	3.894 [.18]	4.059 [.18]	4.739 [.15]
40-44	3.600 [.23]	3.627 [.20]	3.906 [.19]
45-49	2.727 [.23]	.	3.452 [.18]
Sample size	2574	3911	4201

B: BOTSWANA: Family Health Surveys			
Survey	**BFHS-1 1984**	**BFHS-2 1984**	**BFHS-2 1988**
B1: # Children ever born			
Age 15-49	3.054 [.05]	.	2.581 [.04]
15-44	2.809 [.05]	2.330 [.04]	2.387 [.04]
15-19	0.256 [.02]	0.204 [.01]	0.261 [.02]
20-24	1.444 [.04]	1.412 [.03]	1.166 [.03]
25-29	2.870 [.06]	2.679 [.06]	2.546 [.05]
30-34	4.164 [.09]	4.160 [.09]	3.698 [.07]
35-39	5.362 [.15]	4.737 [.14]	5.088 [.11]
40-44	6.259 [.21]	5.622 [.19]	5.425 [.18]
45-49	6.845 [.28]	.	5.752 [.21]
B2: Years of education			
Age 15-49	4.40 [.07]	.	5.48 [.06]
15-44	4.56 [.07]	5.22 [.07]	5.66 [.06]
15-19	6.30 [.12]	7.04 [.11]	7.03 [.08]
20-24	5.44 [.14]	5.69 [.13]	6.70 [.12]
25-29	4.55 [.16]	4.60 [.16]	5.38 [.14]
30-34	3.62 [.17]	4.04 [.18]	4.54 [.17]
35-39	2.97 [.20]	4.04 [.25]	4.06 [.19]
40-44	2.05 [.17]	2.56 [.22]	3.76 [.26]
45-49	2.00 [.24]	.	2.48 [.24]
Sample size	3064	3593	4368

Notes: [Standard errors in parentheses]. 1st & 3rd columns based on 1984 CPS and 1988 DHS resp. Middle column based on 1988 DHS evaluated at 1984; fertility calculated using birth history information.

TABLE 3A: ZIMBABWE -- *Distribution of education and # children ever born*

Age: 15-24 25-34 35-44

A1. Distribution of education by age group

Survey:	ZRHS	ZDHS	ZDHS	ZRHS	ZDHS	ZDHS	ZRHS	ZDHS	ZDHS
Date:	1984	1984	1988	1984	1984	1988	1984	1984	1988
Yrs of educn	5.94	6.96	7.63	4.70	5.14	5.36	3.78	3.88	4.40
	[0.10]	[0.09]	[0.07]	[0.01]	[0.10]	[0.10]	[0.14]	[0.13]	[0.12]
(1) if									
no educn	0.10	0.10	0.05	0.21	0.18	0.18	0.27	0.27	0.23
pre-school	0.07	0.04	0.03	0.07	0.07	0.06	0.10	0.12	0.09
some prim	0.32	0.24	0.20	0.38	0.35	0.32	0.42	0.38	0.38
comp prim	0.20	0.19	0.23	0.22	0.24	0.25	0.15	0.14	0.18
Form 2	0.17	0.14	0.21	0.08	0.08	0.08	0.03	0.04	0.07
> Form 2	0.13	0.29	0.29	0.05	0.07	0.11	0.04	0.05	0.05

A2. # children ever born by education group and cohort

Education level:									
none	1.78	1.59	1.65	4.34	4.19	4.29	7.07	6.08	6.24
	[0.15]	[0.11]	[0.15]	[0.20]	[0.15]	[0.14]	[0.27]	[0.23]	[0.21]
pre-school	1.52	1.23	1.81	4.51	3.77	3.84	7.20	6.87	6.41
	[0.17]	[0.14]	[0.20]	[0.29]	[0.22]	[0.23]	[0.46]	[0.35]	[0.32]
some primary	1.04	1.18	1.10	4.06	3.89	3.74	6.60	6.57	6.19
	[0.06]	[0.06]	[0.06]	[0.11]	[0.10]	[0.09]	[0.18]	[0.18]	[0.16]
completed primary	1.20	0.98	0.62	3.45	3.54	3.57	6.00	5.60	5.57
	[0.07]	[0.07]	[0.05]	[0.13]	[0.10]	[0.10]	[0.28]	[0.27]	[0.19]
Form 2	0.58	0.39	0.45	2.87	3.37	3.25	5.31	4.46	4.87
	[0.07]	[0.05]	[0.04]	[0.18]	[0.19]	[0.17]	[0.61]	[0.39]	[0.32]
more than Form 2	0.40	0.17	0.38	1.80	1.85	1.96	3.06	4.45	3.71
	[0.05]	[0.02]	[0.03]	[0.18]	[0.13]	[0.12]	[0.37]	[0.46]	[0.39]

A3. estimated number of children ever born

Fertility rate:	1984	1988	Diff	% unexpl	1984	1988	Diff	% unexpl
Education distribution:								
As reported	3.85	3.57	0.28	.	6.58	5.89	0.69	.
Based on 1984 survey	3.85	3.66	0.19	31	6.58	5.97	0.61	11
Based on 1988 survey	3.70	3.57	0.13	52	6.49	5.89	0.60	14
Based on 1987 ICDS	3.73	3.56	0.17	40	6.46	5.88	0.58	16

Notes: See Table 2.

TABLE 3B: BOTSWANA -- *Distribution of education and # children ever born*

Age: 15-24 25-34 35-44

B1. Distribution of education by age group

Survey:	BFHS1	BFHS2	BFHS2	BFHS1	BFHS2	BFHS2	BFHS1	BFHS2	BFHS2
Date:	1984	1984	1988	1984	1984	1988	1984	1984	1988
Yrs of educn	5.85	6.38	6.87	4.15	4.36	5.02	2.56	3.35	3.95
	[0.10]	[0.09]	[0.07]	[0.06]	[0.05]	[0.04]	[0.13]	[0.24]	[0.10]
Level of educn									
none	.20	.19	.11	.35	.36	.32	.41	.38	.34
pre-school	.02	.01	.01	.06	.06	.03	.18	.12	.10
some primary	.17	.16	.17	.23	.22	.19	.28	.32	.29
complete primary	.36	.31	.35	.22	.20	.24	.08	.07	.14
Form 3	.21	.25	.31	.12	.11	.16	.04	.05	.05
> Form 3	.04	.08	.05	.02	.07	.07	.01	.06	.07

B2. # children ever born by education group and cohort

Education level									
none	1.31	1.27	1.16	3.57	3.49	3.43	5.72	5.36	5.57
	[0.09]	[0.07]	[0.09]	[0.12]	[0.11]	[0.10]	[0.25]	[0.24]	[0.19]
pre-school	1.09	1.34	0.49	4.07	4.17	4.00	6.51	5.28	5.23
	[0.25]	[0.21]	[0.18]	[0.31]	[0.25]	[0.27]	[0.32]	[0.39]	[0.37]
some primary	0.91	0.99	0.88	3.81	3.78	3.54	5.85	5.40	5.56
	[0.07]	[0.06]	[0.06]	[0.12]	[0.11]	[0.10]	[0.20]	[0.17]	[0.16]
complete primary	0.88	0.71	0.69	3.30	3.12	2.87	4.74	4.87	4.87
	[0.05]	[0.04]	[0.03]	[0.08]	[0.11]	[0.07]	[0.32]	[0.41]	[0.24]
Form 3	0.51	0.52	0.54	2.39	2.53	2.31	4.49	4.63	4.50
	[0.04]	[0.03]	[0.03]	[0.10]	[0.11]	[0.08]	[0.34]	[0.33]	[0.25]
> Form 3	0.52	0.32	0.49	2.13	1.89	1.79	4.34	3.06	3.33
	[0.08]	[0.04]	[0.05]	[0.15]	[0.12]	[0.08]	[0.61]	[0.18]	[0.18]

B3. estimated number of children ever born

Fertility rate:	1984	1988	Diff	% unexpl	1984	1988	Diff	% unexpl
Education distribution:								
As reported	3.43	3.07	0.35	.	5.76	5.17	0.59	.
Based on 1984 survey	3.43	3.10	0.33	6	5.76	5.33	0.43	27
Based on 1988 survey	3.40	3.07	0.33	8	5.64	5.17	0.47	20

Notes: See Table 2.

Table 4: Determinants of # of children ever born

A. Zimbabwe

Age group	15-24			25-34			35-44		
Survey	ZRHS	ZDHS	ZDHS	ZRHS	ZDHS	ZDHS	ZRHS	ZDHS	ZDHS
Date	1984	1984	1988	1984	1984	1988	1984	1984	1988
(1) if maternal education is									
pre-school	0.043	-0.295	0.130	0.450	-0.451	-0.390	0.096	0.741	0.256
	[0.35]	[2.58]	[1.02]	[1.61]	[2.00]	[1.83]	[0.22]	[1.93]	[0.71]
some primary	-0.153	-0.308	-0.297	-0.249	-0.342	-0.464	-0.393	0.526	0.147
	[1.62]	[4.11]	[3.51]	[1.45]	[2.31]	[3.39]	[1.37]	[1.89]	[.595]
completed primary	-0.224	-0.418	-0.527	-0.455	-0.460	-0.646	-0.881	-0.065	-0.237
	[2.22]	[5.30]	[6.26]	[2.32]	[2.84]	[4.40]	[2.33]	[0.17]	[0.80]
Form 2	-0.306	-0.688	-0.652	-1.015	-0.573	-0.807	-0.881	-0.754	-0.517
	[2.85]	[7.97]	[7.67]	[3.66]	[2.58]	[3.99]	[1.21]	[1.28]	[1.21]
post Form2	-0.681	-0.866	-1.081	-1.851	-1.806	-1.707	-3.106	-0.818	-1.818
	[6.04]	[11.05]	[12.95]	[5.62]	[7.67]	[8.84]	[4.61]	[1.45]	[3.96]
# obs	1071	1584	1861	862	1096	1268	486	632	782
R-squared	0.49	0.47	0.51	0.26	0.23	0.29	0.15	0.10	0.11
F(educ)	11.1	31.3	71.4	9.8	12.1	16.2	5.0	2.7	4.4
F(all covs)	128.1	175.0	244.4	37.2	41.6	65.6	10.6	8.6	12.3

B. Botswana

Age group	15-24			25-34			35-44		
Survey	BFHS1	BFHS2	BFHS2	BFHS1	BFHS2	BFHS2	BFHS1	BFHS2	BFHS2
Date	1984	1984	1988	1984	1984	1988	1984	1984	1988
(1) if maternal education is									
pre-school	-0.127	0.048	-0.237	0.247	0.362	0.364	0.771	-0.005	-0.372
	[0.85]	[0.34]	[1.54]	[1.07]	[1.75]	[1.69]	[2.31]	[0.02]	[1.17]
some primary	-0.198	-0.036	0.057	0.132	0.186	0.178	0.216	0.184	0.001
	[2.80]	[0.64]	[0.92]	[0.97]	[1.47]	[1.59]	[0.74]	[0.69]	[0.01]
completed primary	-0.142	-0.211	-0.127	-0.131	-0.304	-0.308	-0.627	-0.171	-0.521
	[2.36]	[4.33]	[2.29]	[0.94]	[2.34]	[2.93]	[1.34]	[0.36]	[1.83]
Form1-3	-0.390	-0.296	-0.261	-0.899	-0.703	-0.826	-0.757	-0.576	-0.869
	[5.74]	[5.78]	[4.61]	[5.16]	[4.30]	[6.85]	[1.16]	[1.09]	[2.08]
> Form 3	-0.689	-0.682	-0.704	-1.209	-1.445	-1.438	-0.769	-1.955	-2.000
	[5.58]	[9.72]	[8.46]	[3.41]	[7.22]	[8.94]	[0.68]	[4.02]	[5.24]
# obs	1337	1881	1895	1023	1178	1524	553	534	728
R-squared	0.45	0.49	0.41	0.22	0.27	0.25	0.06	0.08	0.09
F(all educ)	10.84	24.27	24.34	9.18	17.43	28.85	2.30	4.12	6.70
F(all covs)	135.0	228.9	162.2	35.28	55.26	62.30	4.45	5.39	8.66

Notes:
See Table 2. [t statistics] in parentheses. F() is F statistic for joint significance.

Appendix Table 1

Zimbabwe: Age specific fertility rates

Age	Census 1969		Census 1982		ZRHS 1984		ZDHS 1988	
	Unadj	Adj	Unadj	Adj	Unadj	Adj	Unadj	Adj
15-19	.08	.12	.09	.13	.13	.16	.10	.13
20-24	.27	.35	.26	.33	.29	.30	.25	.26
25-29	.30	.37	.25	.32	.30	.30	.25	.26
30-34	.26	.31	.23	.38	.26	.26	.22	.22
35-39	.22	.26	.17	.21	.22	.21	.16	.16
40-44	.15	.16	.09	.11	.09	.08	.09	.09
45-49	.07	.08	.04	.04	.11	.01	.04	.03
TFR	6.7	8.2	5.6	7.1	6.5	6.5	5.7	5.5

Sources: Central Statistical Office, 1985; Johansson, 1989; Zimbabwe National Family Planning Council, 1985; Zimbabwe Central Statistical Office, 1989; World Bank, 1989. All adjusted numbers are drawn from World Bank, 1989, Table 11. 1969 and 1982 adjustments based on P/F ratios; 1984 and 1988 are adjusted for true age-group.