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ABSTRACT

Plausible arguments suggest that policies to avoid pregnancy-related dropouts can help close gender gaps in education in Africa but these payoffs require quantification. This research uses schooling life tables to simulate how the gender gaps in secondary school completion within 23 sub-Saharan African countries would narrow if these countries reduced the incidence of pregnancy-related dropouts. Results suggest that reducing pregnancy-related dropouts is neither indispensable nor sufficient to close current gender gaps in most cases, yet it could halve these gaps in one third of the countries studied.

INTRODUCTION AND BACKGROUND

Plausible arguments suggest that programs to avoid unintended pregnancies among teens can have spillover benefits in promoting gender equity in education in many countries. One of the simplest arguments invokes girls' unique vulnerability to pregnancy-related school dropouts. Since many girls and few (if any) boys drop out of school because of pregnancies, policymakers could reduce existing gender gaps by addressing pregnancy-related dropouts (Hyde 1995; Odaga and Heneveld 1995; Okojie 2001). Logical as the argument may be, the practical and unresolved question is whether these reductions are large enough to warrant policy attention. In other words, how much would poor countries reduce their current gender gaps in education through prevention of unintended teen pregnancies?

This question is timely given the current international commitment to gender equity, a commitment crystallized in the year 2000 when the United Nations adopted gender equity in education as one of only few Millennium Development priorities, with the specific goal of "*eliminating gender disparities in education at all levels by 2015* (UN 2000). Most experts regard this goal as ambitious for developing countries where gender gaps remain large and education budgets limited (Sahn and Stifel 2003; World Bank 2003; Wodon and Jayasuriya. 2003). Still, these countries can significantly narrow their gender gaps by implementing efficient policies, perhaps by integrating population and education programs (Lule 2002). One logical nexus of integration is between population programs to prevent unintended teen pregnancies and education programs to promote girls' schooling.

To warrant this integration, however, there must be evidence that reducing unintended teen fertility substantially pays off in bridging the educational gaps between boys and girls. The present research seeks to estimate these payoffs, focusing on their *total* and *relative* magnitude. In absolute terms, how much would reductions in pregnancy-related dropouts narrow the gender gaps found in many developing countries? In relative terms, would a focus on these pregnancy-related dropouts yield greater payoffs than efforts to address other dropout reasons that discriminately affect girls?

While a large body of research has inventoried the many reasons why girls in developing countries achieve lower levels of education than male peers (Hyde 1995; Odaga and Heneveld 1995; Okojie 2001), translating this knowledge into policy requires a quantitative understanding of *how much* each of those reasons matters. One persistent question is the extent to which gender inequality in schooling is rooted in deep-seated cultural preferences versus macroeconomic, demographic, or household circumstances that are amenable to policy intervention (Blumberg 1984; Mason 1986; Cubbins 1991; Sanchez 1993; Lloyd and Blanc 1996 Schultz 1995; Buchmann 2000). Within this realm, numerous reviews and descriptive studies have recognized the potential importance of teen fertility and the idea that reducing unwanted teen fertility could help narrow the educational gaps between boys and girls (eg. Odaga and Heneveld 1995; Okojie 2001). Studies have also examined the schooling consequences of teen fertility in developed settings (Keplinger, Lundberg, and Plotnick 1995; Hoffmann 1998; Ribar 1999; Levine and Painter 2000; Hoffert, Reid, and Mott 2001). However few studies have produced quantitative evidence to show how much a reduction of pregnancy-related dropouts would narrow the gender gaps in education currently found in developing countries.

Recent Demographic and Health Surveys (DHS) permit a step toward such statistical documentation. Recent DHS have asked questions about the main reasons why girls dropped out of school across 38 countries, including 23 in sub-Saharan Africa. The results, summarized in Figure 1, underscore the salience of pregnancies as a factor. For the 23 sub-Saharan countries as a whole, pregnancies account on average for nearly 18 percent of all female dropouts in secondary school and 7.3 percent overall. Percentages are generally higher in secondary school and they vary widely across countries, from less than 1 percent (Niger) to over 20 percent (Gabon and South Africa).

One problem, however, is that these percentages alone are not a good gauge of policy importance. Whether the fact that pregnancies account 18 percent of female dropouts deserves policy attention will depend on (a) the total probability of female dropout, (b) the timing of these pregnancy-related dropouts, and (c) the extent to which girls are also disadvantaged on other grounds besides pregnancy-related dropouts. With respect to (a), having 18 percent of all female dropouts associated with pregnancy has vastly different consequences depending on whether girls' overall dropout probabilities are high or very low. For instance, South Africa's high percentage of pregnancy-related dropouts (23.5 percent) may well be less problematic than the lower percentage found in Guinea (6.2 percent) if the total number of girls dropping out is far greater in Guinea than it is in South Africa. With respect to (b), the importance of these 18 percent will also depend on how early these pregnancy-related dropouts occur. The earlier they occur, the greater their cumulative effect on educational attainment. Zimbabwe for instance has a higher overall percentage of pregnancy related dropouts (5.8 percent) than Tanzania (3.8 percent). However, pregnancies could well have a more damaging influence on the cumulative educational attainment of girls in Tanzania because they occur earlier in this country --11 percent of dropouts at the primary level are pregnancy-related-- than they do in Zimbabwe, where the corresponding percentage is only 3.6 percent. Finally, with respect to (c), pregnancy-related dropouts make a greater contribution to gender inequality when educational discrimination against girls is less pervasive. In a country where girls are not disadvantaged vis-à-vis boys for all the non-pregnancy-related dropouts, a reduction in pregnancy-related dropouts will have a greater effect in closing the gender gap in educational attainment.

For all these reasons, the above DHS data must be translated into a more policy-relevant metric that summarizes how much reductions in pregnancy-related dropouts would bridge the gender gap in educational attainment. To that end, we use a life table approach that permits (a) simulation of the effects of hypothetical reductions in pregnancy-related dropouts on the magnitude of gender gaps in education and (b) partitioning the total gender gap into a pregnancy-related component and a non-pregnancy related component. In other words, this approach makes it possible to estimate how much reductions in pregnancy-related dropouts would pay off in absolute as well as relative terms. The life table approach used here also complements the regression approach used in previous studies in two ways that enhance policy relevance. First is triangulation. Regression studies generally infer the schooling effects of teen pregnancy from statistical associations between teen motherhood and educational attainment. Researchers worry however that doing so overlooks the possibility that teen pregnancies could be a symptom rather than a cause of schooling disadvantage and that these pregnancies inordinately affect the poor (e.g. Hoffman 1998; Ribar 1999). Life tables use a more direct approach that draws from respondents' own reports about whether their dropout was caused by a pregnancy. Neither approach is foolproof (see discussion in the methods section), but their triangulation enables stronger inferences about the causal influence of teen pregnancies on schooling. Second, the application of life table analysis to this area of research can serve to further bridge the gap between research and policy, i.e., it enables researchers to move from detailed research findings to concise policy interpretations. Regression studies have become increasingly detailed to the point where researchers can estimate the schooling effects of pregnancies for each grade level. While such detail is valuable, policy decision-makers also need bottom-line assessments of the cumulative effects on educational attainment, which life tables can provide (Teachman and Hayward 1993).

Our analyses focus on sub-Saharan Africa for both practical and substantive reasons. The practical reason is data availability, as 23 of the 38 countries where the DHS have collected data on dropout reasons are located within sub-Saharan Africa. Substantively, sub-Saharan Africa, along with South Asia, is one of the remaining bastions of gender inequality in education. Despite important different within each of these regions, the female-to-male ratio in secondary education in both regions still hovered around 0.80 in 2000 while other world regions had achieved parity at that level (UN 2004). By focusing on teen fertility in sub-Saharan Africa, we also expand the geographical and thematic focus of the existing literature on fertility and schooling. Previous studies of the schooling consequences of teen fertility have focused on developed countries (Keplinger, Lundberg, and Plotnick 1995; Hoffmann 1998; Ribar 1999; Levine and Painter 2000; Hoffert, Reid, and Mott 2001), while studies of the schooling consequences of fertility in Africa have focused on *parental*, rather than *teen*, fertility (Lloyd 1994; Montgomery and Lloyd 1999). A focus on African teens is timely in view of this region's current demographic trends. The age at marriage and the educational aspirations are rising, thereby creating a larger window of time when pregnancies can interfere with the schooling of adolescents. Fertility levels and aspirations are declining and many teens are increasingly willing to delay first births. Finally, current cohorts of youth are historically large and, therefore, what happens to today's teens will have lasting consequences for gender inequality in sub-Saharan Africa.

METHODS

Schooling life table methods are used to achieve the two objectives in this study, which are respectively to estimate the *total* and *relative* payoffs from reducing pregnancy-related dropouts. To meet the first objective, we use life table simulations. To meet the second objective, we use schooling life table data to partition the total gender gap into "pregnancy-related" and "non-pregnancy-related" components.

Simulation

Schooling life-tables can serve to simulate how reductions in the incidence of one cause of dropout (here pregnancy-related dropouts) affect schooling outcomes (here the female-to-male ratio in educational attainment). They are built as is shown in Table 1. One begins with detailed information on sex-grade-and-cause-specific probabilities of school dropout (columns 2a through 2f). From these probabilities, one computes the number of pupils dropping out at each grade (data not shown) and, by subtraction, the number of pupils remaining in school after each grade level (columns 3a and 3b). The survivorship of females is compared to males' to indicate how the female-to-male ratio changes over the school cycle (column 3c). While we are ultimately interested in the value of this ratio at the end of the school cycle, for practical purposes, we stop the analysis at the end of secondary school because the small number of pupils who enter university would generate unstable and unreliable estimates. One can then simulate the gender-equity payoff of reducing unintended teen pregnancy by reducing the probability of pregnancy-related dropouts (column 2b, boxed) and monitoring the changes in the gender inequality in secondary school completion (boxed cell in column 3c).

Figure 2 summarizes the results of these simulations for an illustrative case, based on schooling history data from Cameroon (Eloundou-Enyegue 2004). The curves on the chart show the female-to-male ratio in school survivorship under different policy scenarios, from the baseline (bottom curve) to the final scenario when all pregnancy-related dropouts are averted (top curve). The difference between these curves measures the payoff of reducing pregnancy-related dropouts. If one focuses on secondary school completion (here grade13), the payoff of reducing pregnancy-related dropouts can be summarized succinctly by the vertical bar above that grade. The bottom, middle, and top of this bar indicate the female-to-male ratio in secondary school completion when the incidence of pregnancy-related dropouts is reduced by 0 percent, 50 percent, and 100 percent, respectively. The longer the bar, the greater the total payoff from reducing pregnancy-related dropouts. As long as one has detailed input information on the etiology of school dropout for a country, these schooling life tables and payoff curves are easily generated.

Partitioning gender gaps into pregnancy versus non-pregnancy factors

Gender inequality in educational attainment emerges neither instantly nor from a single source. Rather, it stems from multiple sources and builds up gradually throughout the school cycle. For the purpose of this analysis, we classify dropout reasons into "pregnancy-related" and "non pregnancy-related" reasons. We likewise divide the school cycle into primary school (roughly a pre-puberty period) and post-primary school. Combining these two dimensions yields four components of gender inequality, including "pregnancy/ primary school" (G_{1p}); "pregnancy/ post-primary school" (G_{1s}); "non-pregnancy/ primary school" (G_{0p}); and "non-pregnancy/ post-primary school" (G_{0s}).

For conceptual clarity, the labels and measurement units for these four components are described below. The total gender inequality in educational attainment (G) is measured by the ratio of females to males among pupils who complete the highest level of schooling (set here at secondary school). This ratio, which we label "F/M ratio," ranges in theory from zero to infinity, but its maximum value is generally 1 or slightly above 1. Within the zero-to-one range, higher F/M values indicate lower levels of inequality, i.e., a stronger representation of females among graduating students. The complement of G is the gender gap (1-G). It indicates how far a given country stands from reaching parity in educational attainment, the target set in the United

Nations' Millennium Development Goals. Most calculations are based on the F/M ratio, but the discussion of findings uses both the F/M ratio and the gender gap.

The $G_{(0)}$ measure the contribution of "non-pregnancy" factors to gender inequality. They indicate how much girls out-drop boys for reasons other than pregnancy, whether lack of money, poor grades, lack of interest, health, death, marriage, job opportunities, household help, etc… Since there is no intrinsic reason why female pupils should have poorer families, lower grades, or inferior health than boys, the "non-pregnancy" component is also called "discrimination" and it is assumed to reflect differential treatment of boys and girls at the hands of families, schools, and society. As such, the $G_{(0)}$ represents the upper limit or "ceiling" for G if one eliminated all pregnancy-related dropouts. The $G_{(0)}$ can of course be computed for a single grade, in which case it indicates how much the ceiling is lowered by passage through the grade. A value of 0.90 for 5th grade for instance implies that the maximum F/M value is multiplied by 0.90 as a result of discrimination when pupils pass through the 5th grade; in other words, this ceiling value is lowered by 10 percent.

The $G_{(1)}$ measures the contribution of pregnancies to gender inequality. As with discrimination, the value of $G_{(1)}$ can be estimated for an entire school cycle or for a single grade level. When calculated for a single grade level, it measures how gender inequality is increased as a result of pregnancies when pupils pass through the corresponding grade level. A value of 0.06 for instance indicates a 6 percent decrease in the representation of female pupils in the student body (a decrease in F/M ratio) because of pregnancies as pupils pass through the corresponding grade. One can thus compare the contribution of pregnancies to that of non-pregnancy factors and gauge the relative importance of one versus the other. Again, as long as one has detailed input data, a partitioning of the total gender gap into "pregnancy" and "non-pregnancy" components is possible.

Computationally, the total gender gap is a relatively simple function of the four components identified above (see Eloundou-Enyegue 2004).

$$G = \prod_{k=1}^{p-1} G_{k(0)} - G_{k(1)} \times \prod_{k=p}^{t-1} G_{k(0)} - G_{k(1)}$$

where k indexes individual grade-levels,

p marks the transition between primary and secondary school,

$G_{k(0)}$ and $G_{k(1)}$ represent the "non-pregnancy" and "pregnancy" components of the gender gap,

with $G_{k(0)}$ equals $\left[\frac{1-\lambda_{k(f0)}}{1-\lambda_{k(m0)}}\right]$

$$\text{and} \quad G_{k(1)} \text{ equals } \left[\frac{\lambda_{k(f1)}}{1-\lambda_{k(m0)}} \right],$$

where λ represent the conditional probabilities of school dropout,

m and *f* index male and female pupils respectively,

1 and *0* indicate pregnancy-related and non pregnancy-related dropouts, respectively.

Provided that one has detailed input data on the dropout probabilities by sex, grade, and reason (the λs), these four components can be calculated as shown in Table 1. From the input data in columns 2a through 2f, the effect of pregnancy on gender inequality in school continuation (col. 4a) is computed as [(col. 2b)/ (1-(col. 2c))]. The effect of other reasons on gender inequality in school continuation (col. 4b) is computed as [(1-(col.2d))/ (1-(col.2c))]. Values are then cumulated within each school cycle.[1] These values, shown in the boxed cells in columns 4a and 4b, correspond to the four components (G_{op}, G_{1p}, G_{0s}, G_{1s}) listed above. Finally, the values in 5a and 5b show how inequality builds up gradually throughout the school system. The numbers under 5a represent the multiplicative effects of "pregnancy" and "non pregnancy" factors on female-to-male enrollment ratios as pupils advance through each grade level. For instance, the value of 0.956 in grade 6 implies that the female-to-male enrollment ratio gets multiplied by 0.956 as students pass through 6th grade. The numbers under 5b represent the cumulative effects on the ratio of female to male survivorship. Thus the value of 0.957 in grade 6 indicates that by the time pupils reach 6th grade, the female-to-male ratio at school entry would have been multiplied by 0.957. Even though they are calculated with different methods, the values in columns 5b and 3c are identical.

DATA AND ASSUMPTIONS

While the methods are straightforward, the required input data are often lacking. One ideally needs detailed data on dropout probabilities by sex, grade, and dropout reason but such information is rarely available at a national level. A preliminary step in our analysis is therefore to estimate these detailed dropout probabilities based on the information collected by DHS on school enrollment and dropout reasons but also based on other national statistics on the structure of the school system (i.e., the official age of school entry and the number of grades in primary and secondary school, respectively) and the efficiency in grade progression, a measure that reflects rates of grade repetition and student loss (Table 2).

[1] The cumulative effect of "non pregnancy" factors is the product of all grade-specific effects within the school cycle. In primary school, this cumulative effect is 1.002x1.001x …x1.008, which equals 0.973. The cumulative effect of "pregnancy is obtained slightly differently. Rather than a direct product, it is obtained by taking the complement of a product of complements of the grade-specific effects; in primary for instance, this is 1 – [(1-0)x(1-0)x…x(1-0.052)] which equals 0.060.

These probabilities are estimated in four steps, as follows (an Excel spreadsheet is attached as additional documentation for the interested reviewer). The first step is to transform the age-grouped enrollment data from DHS into enrollments for single years of age. The DHS compilations provide enrollment data for several age groups, including 6 to 10, 11 to 15, 16 to 20, and 21 to 24. The data for intermediary years is estimated by interpolation. A second step is to convert the age-enrollment data into grade-enrollment data, using the data on the country's age-grade progression schedules. One begins by envisioning an ideal scenario where all the pupils who would enter school do so at the official age of school entry, then progress smoothly without grade repetition. One then moves from this ideal to the real scenario by applying the age/grade efficiency coefficient to estimate the actual age of students at consecutive grades. The grade-specific enrollment is then estimated to correspond to the enrollment for students of the actual age found for this grade.[2] The third step is to convert grade-specific enrollments into grade-specific probabilities of dropout. This involves estimating the number of dropouts at each grade (as the difference in enrollment ratios between consecutive grades) and dividing the result by the initial number of pupils at risk of dropping out. The fourth and final step is to divide the total probabilities of school dropout into "pregnancy-related" and "non-pregnancy-related" probabilities, using DHS information on dropout reasons.

Ultimately, the resulting probabilities are used as input to create schooling life tables for individual countries and to perform the simulations described in the methods section. Before presenting the findings, the strengths and weaknesses of these life table simulations must be outlined. The strengths come from with the method's flexibility and suitability to policy analysis. Yet there are potential weaknesses associated with the reliability of the initial data, the accuracy of the conversion method, and the validity of causal interpretations.

One fundamental issue is the reliability of reports about dropout reasons, i.e., whether reports are affected by the framing of questions, the choice of respondents, or other interviewing processes. Survey questions about dropout reasons typically assume that pupils drop out of school for a single rather than multiple reasons. Dropouts that had several contributing causes could conceivably be attributed to pregnancy alone. Yet this also implies that the contribution of pregnancies to other dropouts may go unreported as well. For that reason, it is difficult to say whether structured questions that offer a single answer bias respondents' reports. The identity of respondents is another consideration. When parents are used as informants, they may to blame children for the school failures and emphasize such dropout reasons as laziness, poor grades, or pregnancies. The reverse is likely when children themselves are used as informants, in which case, they may exonerate themselves and emphasize reasons such as lack of parental support or resources. Because DHS data are based on reports from individuals themselves rather than parents, they may well underestimate the number pregnancy-related dropouts. On the other hand, respondents may focus on proximate (rather more fundamental) reasons, in which case pregnancies would be overstated. Where a stigma is attached to premarital pregnancy, respondents may attribute some pregnancy-related dropouts to marriage if these are followed by marriage or some cohabitation. On the other hand, because pregnancy is often a dramatic event,

[2] In most cases, the actual age is not a rounded figure and the grade-specific enrollment is obtained as a weighted average of the enrollments reported for the adjacent ages. Suppose for instance that the students average 9.45 years of age in grade 4. Then the enrollment for grade 4 will be a weighted average of the enrollments at ages 9 and 10, with weights of 0.55 and 0.45 for ages 10 and 9, respectively.

it can be overemphasized at the expense of more fundamental but less discernible precursor events. On balance, it is unclear whether under-reporting or over-reporting is more likely. The central point, however, is that the simulation results presented here depend on the accuracy of DHS reports of dropout reasons.

A second issue is the accuracy of our conversion method. In converting the DHS data into grade-and-reason-specific dropout probabilities, we assumed that (a) enrollments change linearly within the age intervals used in the DHS groupings, (b) grade repetition is relatively constant through the school cycle, and (c) the incidence of pregnancy-related dropouts is constant within the grade intervals defined by DHS. There are reasons to doubt all three assumptions. Dropout rates often spike around key educational milestones and grade repetition can become less frequent as pupils advance in school, through increased selection of the student population. Our procedure smoothes out grade-to-grade variation and erases the spikes expected around some school transitions such as from primary to secondary. Yet the cumulative findings in terms of secondary school completion are expected to be fairly accurate. A sensitivity analysis using different assumptions about (a), (b), and (c) showed little change in the substantive conclusions.[3]

A final concern is about causal interpretation. In regression studies, researchers worry that statistical associations between teen pregnancy and schooling might simply reflect previous socioeconomic disadvantage, rather than causal connection (Ribar 1999; Levine and Painter 2002). A similar concern is justified under a life table approach, even if inferences are drawn from respondents' reports and not from statistical correlation. If pregnancies occur predominantly among girls who would have dropped out prematurely anyway, life table simulations would overestimate the influence of pregnancies on gender inequality. Our simulation results must therefore be considered upper-bound estimates for the payoff of reducing pregnancy-related dropouts.

FINDINGS

Simulation Results

Table 3 summarizes the simulation results for the total gender-equity payoffs from reducing pregnancy-related dropouts. The first block of columns shows the change in the F/M ratio in response to gradual reductions, from 0 to 100 percent, in the incidence of pregnancy-related dropouts. The second block of columns (1) summarize the impact of policies to reduce pregnancy-related dropouts, focusing on results when the incidence of pregnancy-related dropouts is reduced by 50 percent and 100 percent, respectively; (2) describe these impacts in percentage terms and (3) specify whether or not a country could reach the goal of gender parity by averting pregnancy-related dropouts. Figure 3 shows some of these results graphically. In this graph, the bottom and top tips of the small bars indicate the F/M ratio under the baseline

[3] For instance, we made the conversions and simulations while assuming that all these countries had the same age/grade pattern in the etiology of school dropout and differed only in the total enrollment levels and overall distribution of dropout reasons. Cameroon was used as a common standard because we had detailed information on the grade pattern of dropout process in this country. Results (available on request) showed similar conclusions.

situation and the "eradication" scenario, respectively, while the tick mark in the middle shows the F/M ratio under the "halving" scenario. The large bars in Figure 3 indicate the raw DHS estimates of the total percentages of female dropouts due to pregnancies.

Findings indicate that the gender gap in this group of countries as a whole would shrink by 17.6 percentage points if pregnancy-related dropouts were eradicated and by 8.0 percentage points if these dropouts were halved. If one considers the weighted averages, these reductions amount to 22.1 and 10.1 percentage points, respectively. The size of these reductions varies widely across countries as shown by the large differences in the length of the thin bars in Figure 3. Reductions are quite small in Benin (2.9 percentage points), the Comoros (2.5 percentage points), and Niger (1.8 percentage points) for instance. They are substantial on the other hand in Zambia, Cameroon, Gabon, Mozambique, the Central African Republic, Uganda, and Kenya for instance, where gender gaps are estimated to narrow by 23.1, 23.7, 25.2, 27.9, 34.5, 36.1, and 71.6 percentage points, respectively. In percentage terms, the payoffs are substantial. Overall, the region's (weighted) baseline gender gap (40.5 percentage points) would be reduced by about 54.6 percent. Excluding South Africa (that initially had a very small gender gap), current gender gaps would be halved or nearly halved in seven countries, including Zambia (48.9%), the Central African Republic (54.8%), Uganda (55.9%), Tanzania (56.8%), Cameroon (62.0%), Gabon (144.1%), and Kenya (162.2%).

Figure 3 suggests two important conclusions. The first is that pregnancy-avoidance programs are neither always necessary nor always sufficient to close gender gaps. Despite a substantial incidence of pregnancy-related dropouts, South Africa had already almost closed its gender gap in secondary school completion. The South African example illustrates that countries can achieve educational parity even while they incur pregnancy-related dropouts, so long as society compensates by supporting girls in other respects. While South Africa's example indicates that a total eradication of pregnancy-related dropouts is not necessary to achieve gender equity, the example of other countries indicates that such eradication is not sufficient either. Only three countries in this group could close their gender gap in education by eliminating all pregnancy-related dropouts. One of these countries (South Africa) was already very close to parity. Two of the countries (South Africa and Gabon) stand out economically, with per capita Gross National Incomes over $3,500, against an average of about $360 for the remaining countries in the sample. Although several countries would substantially narrow their gender gaps, these gaps would not close because they were initially large or because other factors matter. In Cameroon, the Central African Republic, Gabon, Uganda, and Zambia for instance, gender gaps in educational attainment would narrow but not close if these countries only addressed pregnancy-related dropouts.

Another insight from Figure 3 is that raw data on the distribution of dropout reasons (such as compiled by DHS) do not reliably gauge the potential payoff from reducing pregnancy-related dropouts. As suggested earlier, payoffs also depend on the timing of pregnancy-related dropouts and the extent discrimination at the primary and secondary levels. If these raw DHS percentages were a good indicator, then countries with the largest percentages should also (a) have the largest baseline gender gap, but also (b) respond most to pregnancy-avoidance programs. Figure 3 shows that this is not the case. If proposition (a) were true, then the bottom tip of the impact bars in Figure 3 should become lower and lower as one moved from the left to the right, i.e., as the raw DHS percentage increased. Some downward sloping is indeed visible in the first tier of the countries in the list (from Comoros to Eritrea), but this pattern subsequently reverts. Indeed, South Africa and Gabon, two countries where the percentage of dropout attributed to pregnancies is *highest* also have the *smallest* gender gaps initially. Similarly, if proposition (b) were true, the length of the impact bars should increase with the "DHS percentages" at the bottom of Figure 3. Again, this is not the case. For instance, Togo and Mozambique have the same raw DHS percentage of 7.9 percent. However, the absolute impact of pregnancy-avoidance programs in Mozambique would be over twice as large as it would be in Togo, because pregnancies occur earlier and discrimination is less severe in Mozambique. Because the gains from averting pregnancy-related dropouts thus depend on several factors, complete analyses using schooling life tables are needed to reach accurate conclusions about the countries and circumstances where investments in pregnancy-reduction programs would make a difference in closing gender gaps in education.

Partitioning the Gender Gap

Table 4 and Figure 4 describe the study findings about the components of gender gap in each of the 23 countries. First, it reiterates the total extent of gender inequality, measured both by the F/M ratio and the gender gap. For these 23 countries as a whole, the F/M ratio among secondary school graduates is 0.595, meaning that only about 59 females complete secondary school for 100 male pupils who do so. In other words, the gender gap (the complement of the F/M ratio) is 40.5 percentage points. Gaps vary widely across countries from a high of over 70 percentage points in Chad and Mozambique to a low of 3 percentage points in South Africa where the gap in secondary education completion has virtually closed.

More importantly, the countries differ markedly in the makeup of their gender inequality and the extent to which it is driven by "pregnancy-related" versus "non-pregnancy-related" factors as well as the extent to which it builds up predominantly at the primary versus post primary levels. The rightmost columns describe how each of our four conceptual components of the gender gap affects the F/M ratio as pupils progress through school. The first two columns (G_{1p} and G_{1s}) indicate how pregnancies lower the F/M ratio as pupils go through primary and secondary school, respectively. The last two (G_{0p} and G_{0s}) indicate how discrimination contributes to gender inequality as pupils go through primary and secondary school, respectively. Looking first at the results for the entire pool of countries, passage through primary school is associated with only a 4.1 percent increase (4.8 weighted) in gender inequality as a result of pregnancies and a 22.0 percent increase (14.5 weighted) as a result of other factors (discrimination). Passage through secondary school is associated with 19.9 percent and 13.6 percent increases in inequality as a result of pregnancies and discrimination, respectively.

These aggregate data conceal enormous variation in the makeup of gender inequality across these 23 countries. Pregnancy-related dropouts in secondary school are the largest factor in eight of the 23 countries (Cameroon (24.9); the Central African Republic (44.1%), Gabon (17.7%), Kenya (57.1%), Mozambique (39.1%), South Africa (27.9%), Uganda (47.3%), and

Zambia (23.9%)) while they are much less apparent in Benin (6.3%), the Comoros (2.3%), and Niger (3.5%). There is also variation in the influence of pregnancies at the primary level. While their impact is negligible in most countries, it exceeds 8 percent in the Central African Republic (8.1%), and Mozambique (9.0%), or Guinea (9.1%) for instance. Countries also differ in the levels and patterns of gender discrimination. Discrimination against girls is high in most countries, but a few countries do show remarkable equity, whether at the primary or secondary levels. Indeed, boys appear more likely to drop out of secondary school for all the non-pregnancy reasons in countries such as South Africa, Gabon, and Kenya. The timing patterns of discrimination are also noteworthy. One generally expects gender discrimination in educational investments to be more prevalent at the secondary school level, given the higher schooling fees and the lower normative expectations of school completion at this level. This pattern is indeed confirmed in a few countries, notably Eritrea, Madagascar, Mozambique, Zambia, and Zimbabwe. Yet the opposite is also true in several countries (Benin, the Central African Republic, Chad, Guinea, for instance) where many girls dropout early and the ones who enter secondary school are positively selected in ways that reduce their vulnerability. Such diversity in the levels and makeup of gender inequality precludes advocacy of blanket policies for the entire region. Instead, it reinforces the need to consider the situation of individual countries.

CONCLUSION

We find some support for the idea that reductions in pregnancy-related dropouts would significantly reduce the magnitude of current gender gaps in education in some African countries. For the 23 study countries, the female-to-male ratio in secondary school completion would increase from a current level of 0.51 to about 0.68 if all pregnancy-related dropouts were averted. This implies a reduction of current gender gaps by 17 points. While this reduction would not close the existing gender gap, it would shrink it by over a third (36 percent), and current gaps would be halved or nearly halved in seven of the 23 countries.

Such findings warrant interest in pregnancy-avoidance programs as a possible policy option to narrow the educational gaps between boys and girls in these specific African countries. Three points of caution must be noted. First, to the extent that pregnancy-related dropouts predominantly affect girls from disadvantaged backgrounds who would have dropped out early anyway, our estimates must be considered an upper-bound estimate for the payoff of reducing pregnancy-related dropouts. Second, our analyses cover only about half of the sub-Saharan African countries and patterns could differ for the remaining 26 countries that represent 37 percent of the African population. Similarly, further exploration of differences within countries is warranted, given the often large differences in the levels and patterns of school dropouts between rural and urban areas and across socioeconomic groups. Third, our analyses focus on proximate causes of dropout and on hypothetical policy reductions in the incidence of pregnancy-related dropouts. The following and important question is how these pregnancy-related dropouts can be reduced and whether such reductions can be achieved at costs that are not prohibitive.

Still, our analysis of recent DHS data suggests that it is reasonable to expect some gender-equity payoff from reducing unintended teen fertility in several African countries. A focus on teens is especially appropriate given the current demographic importance of teens in the region, the growing educational aspirations, and the rising age at marriage. A reduction in unintended fertility among teens can also have more immediate and longer-term socioeconomic effects, at least when compared to the intergenerational influences expected from programs to reduce adult fertility. As such, it is quite relevant to the pressing UN goal of closing gender gaps by 2015.

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Table 1. Summary of simulation and partitioning methods used in the study

		INPUT DATA						LIFE TABLE SIMULATION				PARTITIONING METHOD			
		Probability of school drop out							**Percent pupils remaining in school**			Components of gender		Gender inequality in school survivorship	
		From pregnancy		Other reasons		Overall						Pregnancy	Other	In grade	Up to grade
		M	F	M	F	M	F		M	F	F/M ratio				
Grade (t)	Median age										(Gt)	G_{k1}	G_{k0}	$G_{k0} - G_{k1}$	(Gt) Π(Gk0 - Gk1)
(1a)	*(1b)*	*(2a)*	*(2b)*	*(2c)*	*(2d)*	*(2e)*	*(2f)*	(1a)	(3a)	(3b)	(3c)	*(4a)*	*(4b)*	*(5a)*	*(5b)*
K+first	5	0.000	0.0000	0.0087	0.0071	0.0087	0.0071	***K+first***	*1.00*	*1.00*	*1.000*	0.000	1.002	1.002	1.000
Grade 2	7	0.000	0.0000	0.0168	0.0159	0.0168	0.0159	***Grade 2***	*0.99*	*0.99*	*1.002*	0.000	1.001	1.001	1.002
Grade 3	8	0.000	0.0000	0.0226	0.0323	0.0226	0.0323	***Grade 3***	*0.97*	*0.98*	*1.002*	0.000	0.990	0.990	1.002
Grade 4	9	0.000	0.0026	0.0311	0.0384	0.0311	0.0410	***Grade 4***	*0.95*	*0.95*	*0.992*	0.003	0.992	0.990	0.992
Grade 5	11	0.000	0.0061	0.0431	0.0621	0.0431	0.0682	***Grade 5***	*0.92*	*0.91*	*0.982*	0.006	0.980	0.974	0.982
Grade 6	12	0.000	0.0381	0.2612	0.2554	0.2612	0.2935	***Grade 6***	*0.88*	*0.84*	*0.957*	0.052	1.008	0.956	0.957
Primary school								***Primary school***				**0.060**	**0.973**		
Grade 7	13	0.000	0.0181	0.0569	0.0372	0.0569	0.0553	***Grade 7***	*0.65*	*0.60*	*0.915*	0.019	1.021	1.002	0.915
Grade 8	14	0.000	0.0254	0.0830	0.0370	0.0830	0.0624	***Grade 8***	*0.62*	*0.56*	*0.916*	0.028	1.050	1.022	0.916
Grade 9	15	0.000	0.0357	0.0775	0.0645	0.0775	0.1001	***Grade 9***	*0.56*	*0.53*	*0.937*	0.039	1.014	0.975	0.937
Grade 10	16	0.000	0.1056	0.2368	0.1778	0.2368	0.2835	***Grade 10***	*0.52*	*0.48*	*0.914*	0.138	1.077	0.939	0.914
Grade 11	18	0.000	0.0061	0.0793	0.1346	0.0793	0.1407	***Grade 11***	*0.40*	*0.34*	*0.858*	0.007	0.940	0.933	0.858
Grade 12	19	0.000	0.0619	0.1635	0.1549	0.1635	0.2168	***Grade 12***	*0.37*	*0.29*	*0.801*	0.074	1.010	0.936	0.801
Grade 13	20	0.000	0.0284	0.2574	0.2553	0.2574	0.2837	***Grade 13***	*0.31*	*0.23*	*0.750*	0.038	1.003	0.965	0.750
Secondary school								***Secondary school***				**0.301**	**1.115**		
Grade 14	22	0.000	0.0000	0.0814	0.0658	0.0814	0.0658	***Grade 14***	*0.23*	*0.16*	*0.723*	0.000	1.017	1.017	0.723
Grade 15	23	0.000	0.0000	0.0530	0.0714	0.0530	0.0714	***Grade 15***	*0.21*	*0.15*	*0.735*	0.000	0.981	0.981	0.735
Grade 16	24	0.000	0.0000	0.2973	0.0541	0.2973	0.0541	***Grade 16***	*0.20*	*0.14*	*0.721*	0.000	1.346	1.346	0.721
Grade 17	25	0.000	0.0000	0.2754	0.2581	0.2754	0.2581	***Grade 17***	*0.14*	*0.13*	*0.971*	0.000	1.024	1.024	0.971
Post secondary school								***Post secondary school***				**0**	**1.37**		

Source: Data from Cameroon survey (see Eloundou-Enyegue 2004)

Table 2. Input data for simulating the effects of reducing pregnancy-related dropouts on the female-to-male ratio in school completion

	INPUT DATA AND SOURCES														
	Enrollment ratios DHS (2004)						% female dropouts due to pregnancy DHS (2004)					Structure of school system UN (2004) WB (2001)			
	Males			Females			Primary		Secondary		University	Age of entry	Duration of schooling		Efficiency in grade progression
COUNTRY	10--15	16--20	21--24	11--15	16--20	21--24	Incompl.	Complete	Incompl	Complete			Primary	Secondary	
Benin 1996	55	29.4	11	29	11.3	3.4	0.3	2.8	4	4	0	6	6	7	61.2
Burkina Faso 1998	26.5	13.8	7.1	19.2	7	2.6	0	0	13.9	0	0	6	6	7	73.5
Cameroon 1998	78.1	42.7	18.9	70.8	27.2	11.4	5.7	3.2	22	0	0	6	6	7	63.7
CAR 1994/95	68.6	38.6	15	45.8	15	5.3	5	13.8	37	-	-	6	6	7	63.7
Chad 1996/97	50.7	39.7	22.6	26.6	9.2	3.6	3.3	6.3	20	0	0	6	6	7	63.7
Comoros 1996	73.4	53.6	30.6	57.4	41.8	17.8	0.9	1.4	5	0	0	6	6	7	42.8
Cote d'Ivoire 1998	60.3	27.6	14.8	40.8	14.5	6.7	0.3	2.4	12.1	19.8	0	6	6	7	66.7
Eritrea 1995	66.4	57.5	24.6	59.3	29.1	6.6	3.6	3.1	10.6	1.2	0	7	5	6	73.5
Gabon 2000	95	68.6	39.6	92.6	61.4	31	29.8	26.5	26.1	0	0	6	6	7	63.7
Guinea 1999	37.4	31	16.1	24.6	11	5.3	4.3	6.6	9.7	41.2	0	7	6	7	61.2
Kenya 1998	89.9	46.8	8.5	86.9	35.4	3.7	11.3	8.7	30.8	1.1	0	6	7	5	66.7
Madagascar 1997	52.7	16.3	5.8	49.5	11.4	2.2	1.7	0	4.1	0	8.3	6	5	7	63.7
Mali 2001	43.5	26	15.4	30.9	12.5	5.9	0.7	2.3	12.4	-	-	7	6	6	66.6
Mauritania 2000/0	70	38.6	21	58.6	28.7	14.5	1	1.5	7.8	8	0	6	6	7	68.5
Mozambique 1997	68.9	33.4	9.9	53.7	10.3	2.4	6.5	24.3	25.8	0	0	6	5	5	66.7
Niger 1998	28.3	10.4	6.2	20	4.3	2.5	0	0.7	2.5	0	-	7	6	7	68.6
Nigeria 1999	68.8	49.1	26.4	64.9	33.9	17.4	8.6	2.9	13	1.3	2.3	6	6	6	63.7
South Africa 1998	94.1	74	27.8	94.8	68.5	26.9	27.8	31.5	36.1	7.6	4.5	7	7	5	75.1
Tanzania 1999	68.9	19.1	2.9	67.2	16.4	0.3	11.1	1.8	6.4	0	-	7	7	6	95.8
Togo 1998	81.5	58.7	27.5	62.8	29.3	7.1	6	10.2	15.2	-	0	6	6	7	66.7
Uganda 2000/01	89.6	53.5	15.5	87.5	30.4	4.2	4.4	6.9	28	18.8	0	6	7	6	66.7
Zambia 1996	73.9	42.4	9.2	71.2	23.3	2.6	5.9	13.3	25.9	-	4.9	7	7	5	95.8
Zimbabwe 1999	89.8	45.4	6.9	87.2	31	3.1	3.6	2.5	8.2	0	0	6	7	6	99.1

Table 3. Results of life table simulations for the impact of reducing pregnancy-related dropouts on gender inequality in secondary school completion,
(23 sub-Saharan African countries)

	DETAILED RESULTS FROM SCHOOLING LIFE TABLE SIMULATIONS (a)											ESTIMATED IMPACT					
	Female-to-male ratio among secondary school graduates if incidence of pregnancy-related dropouts (PRD) is reduced by											**Total impact** Reduction in gap if PRD reduced by		**% improvement** % reduction in gap if PRD reduced by		**Reaching parity** Do gaps close if PRD reduced by	
COUNTRY	**0%**	**10%**	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**	**100%**	**50%**	**100%**	**50%**	**100%**	**50%**	**100%**
Benin 1996	0.3308	0.3336	0.3365	0.3393	0.3421	0.345	0.3479	0.3508	0.3537	0.3567	0.3597	0.014	0.029	2.1%	4.3%	No	No
Burkina Faso 1998-99	0.399	0.4096	0.4204	0.4315	0.4428	0.4543	0.4661	0.4782	0.4905	0.503	0.5159	0.055	0.117	9.2%	19.4%	No	No
Cameroon 1998	0.6182	0.6392	0.6607	0.6829	0.7056	0.7289	0.7528	0.7774	0.8025	0.8284	0.8548	0.111	0.237	29.0%	62.0%	No	No
CAR 94-95	0.3701	0.3969	0.4253	0.4552	0.4868	0.5201	0.5553	0.5923	0.6313	0.6723	0.7155	0.150	0.345	23.8%	54.8%	No	No
Chad 1996-97	0.187	0.1942	0.2016	0.2093	0.2172	0.2254	0.2338	0.2425	0.2514	0.2606	0.2701	0.038	0.083	4.7%	10.2%	No	No
Comoros 1996	0.6229	0.6254	0.6279	0.6304	0.6329	0.6354	0.6379	0.6404	0.643	0.6455	0.648	0.012	0.025	3.3%	6.7%	No	No
Cote d'Ivoire 1998-99	0.4654	0.4751	0.485	0.4951	0.5053	0.5157	0.5263	0.5371	0.548	0.5591	0.5704	0.050	0.105	9.4%	19.6%	No	No
Eritrea 1995	0.3583	0.3643	0.3704	0.3766	0.3828	0.3891	0.3956	0.4021	0.4087	0.4154	0.4222	0.031	0.064	4.8%	9.9%	No	No
Gabon 2000	0.8253	0.848	0.8712	0.895	0.9193	0.9441	0.9695	0.9955	1.0221	1.0492	1.077	0.119	0.252	68.0%	144.1%	No	Yes
Guinea 1999	0.3395	0.3461	0.3528	0.3596	0.3666	0.3736	0.3808	0.3881	0.3955	0.403	0.4106	0.034	0.071	5.2%	10.8%	No	No
Kenya 1998	0.5586	0.6119	0.6689	0.7296	0.7942	0.863	0.936	1.0135	1.0956	1.1827	1.2748	0.304	0.716	69.0%	162.2%	No	Yes
Madagascar 1997	0.5385	0.5454	0.5524	0.5595	0.5666	0.5739	0.5812	0.5885	0.596	0.6035	0.6112	0.035	0.073	7.7%	15.8%	No	No
Mali 1995-96	0.4117	0.4184	0.4252	0.4321	0.439	0.4461	0.4532	0.4604	0.4678	0.4752	0.4827	0.034	0.071	5.8%	12.1%	No	No
Mauritania 2000-01	0.7063	0.7133	0.7203	0.7274	0.7345	0.7417	0.749	0.7563	0.7636	0.7711	0.7785	0.035	0.072	12.0%	24.6%	No	No
Mozambique 1997	0.2882	0.3101	0.3332	0.3575	0.3831	0.4101	0.4385	0.4684	0.4997	0.5327	0.5672	0.122	0.279	17.1%	39.2%	No	No
Niger 1998	0.4073	0.4091	0.411	0.4128	0.4146	0.4165	0.4183	0.4202	0.422	0.4239	0.4258	0.009	0.018	1.5%	3.1%	No	No
Nigeria 1999	0.6715	0.6832	0.6952	0.7073	0.7196	0.732	0.7447	0.7575	0.7705	0.7838	0.7972	0.061	0.126	18.4%	38.3%	No	No
South Africa 1998	0.9672	1.0055	1.0451	1.0861	1.1283	1.172	1.217	1.2635	1.3114	1.3609	1.4119	0.205	0.445	na	na	Yes	Yes
Tanzania 1996	0.7541	0.7671	0.7804	0.7938	0.8075	0.8213	0.8354	0.8497	0.8642	0.8789	0.8938	0.067	0.140	27.4%	56.8%	No	No
Togo 1998	0.3051	0.3162	0.3277	0.3396	0.3518	0.3644	0.3773	0.3907	0.4044	0.4185	0.433	0.059	0.128	8.5%	18.4%	No	No
Uganda 1996	0.3545	0.3826	0.4123	0.4436	0.4767	0.5116	0.5483	0.587	0.6276	0.6704	0.7152	0.157	0.361	24.3%	55.9%	No	No
Zambia 1996	0.5263	0.5464	0.5672	0.5886	0.6106	0.6334	0.6568	0.6809	0.7058	0.7313	0.7577	0.107	0.231	22.6%	48.9%	No	No
Zimbabwe 1994	0.673	0.6799	0.6867	0.6937	0.7007	0.7077	0.7148	0.722	0.7292	0.7365	0.7439	0.035	0.071	10.6%	21.7%	No	No
Unweighted average	0.508	0.523	0.538	0.554	0.571	0.588	0.606	0.624	0.644	0.664	0.684	0.080	0.176	16.3%	35.8%	no	no
Weighted average (b	0.595	0.614	0.633	0.653	0.674	0.695	0.718	0.741	0.765	0.790	0.816	0.101	0.221	24.8%	54.6%	no	no

Notes: (a) Schooling life tables and simulation sheets for individual countries available on request; (b) weighted by 2000 population size; (na) not computed if initial gap was very small

Table 4. Extent and sources of gender inequality in secondary school completion (23 sub-Saharan African countries)

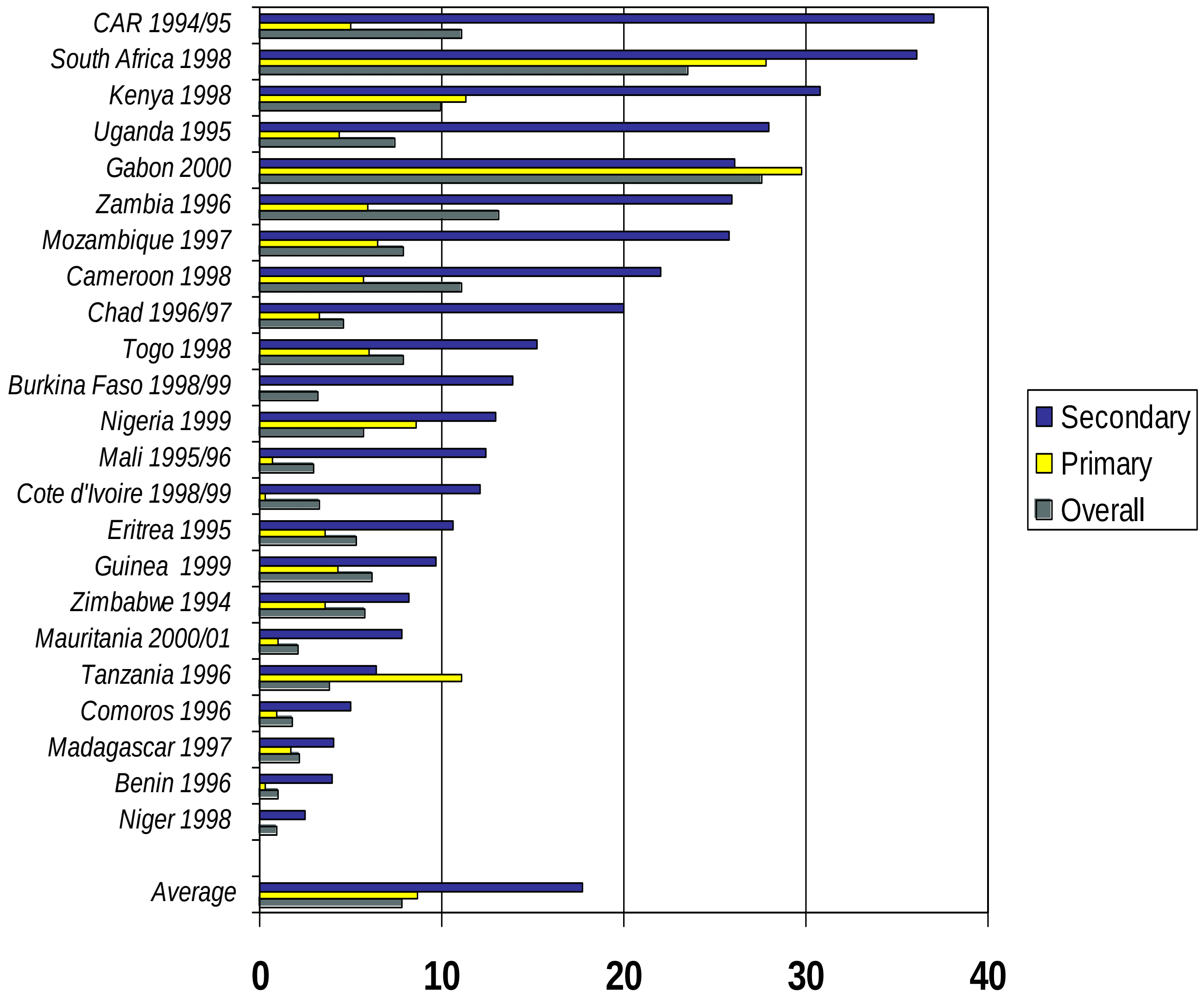
COUNTRY	Population size (millions) (a)	% female dropouts due to pregnancy (b)	Extent of Inequality: Gender inequality in secondary school completion		Sources of Inequality: Percent reduction in F/M ratio associated with			
					Pregnancy		Other factors	
			F/M ratio G_t	Gender gap $1-G_t$	Primary $[G_{1p}]$	Secondary $[G_{1s}]$	Primary $[G_{0p}]$	Secondary $[G_{0s}]$
Benin 1996	6.27	1	0.331	0.669	1.2%	6.3%	52.4%	24.4%
Burkina Faso 1998-99	11.54	3.2	0.399	0.601	0.0%	21.6%	30.5%	25.8%
Cameroon 1998	14.88	11.1	0.618	0.382	3.4%	24.9%	15.5%	-1.1%
CAR 1994-95	3.72	11.1	0.370	0.630	8.1%	44.1%	37.3%	-14.2%
Chad 1996-97	7.89	4.6	0.187	0.813	6.2%	22.5%	56.8%	37.5%
Comoros 1996	0.71	1.8	0.623	0.377	1.2%	2.3%	26.6%	11.8%
Cote d'Ivoire 1998-99	16.01	3.3	0.465	0.535	0.9%	17.1%	35.3%	11.9%
Eritrea 1995	3.66	5.3	0.358	0.642	2.1%	11.9%	14.3%	50.8%
Gabon 2000	1.23	27.6	0.825	0.175	7.2%	17.7%	-1.5%	-6.1%
Guinea 1999	8.15	6.2	0.340	0.660	9.1%	7.3%	51.1%	16.0%
Kenya 1998	30.67	9.9	0.559	0.441	7.1%	57.1%	8.2%	-38.8%
Madagascar 1997	15.97	2.2	0.538	0.462	1.0%	10.0%	6.5%	34.6%
Mali 1995-96	11.35	3	0.412	0.588	1.6%	12.4%	38.8%	21.2%
Mauritania 2000-01	2.67	2.1	0.706	0.294	0.8%	8.4%	17.7%	5.4%
Mozambique 1997	18.29	7.9	0.288	0.712	9.0%	39.1%	16.6%	32.0%
Niger 1998	10.83	0.9	0.407	0.593	0.3%	3.5%	38.2%	31.1%
Nigeria 1999	113.86	5.7	0.671	0.329	5.1%	10.9%	11.2%	10.2%
South Africa 1998	43.31	23.5	0.967	0.033	7.4%	27.9%	-3.4%	-36.6%
Tanzania 1996	35.12	3.8	0.754	0.246	5.3%	10.8%	-1.9%	5.6%
Togo 1998	4.53	7.9	0.305	0.695	4.9%	23.2%	28.0%	39.9%
Uganda 1995	23.30	7.4	0.354	0.646	4.0%	47.3%	22.6%	7.5%
Zambia 1996	10.42	13.1	0.526	0.474	7.2%	23.9%	3.6%	21.4%
Zimbabwe 1994	12.63	5.8	0.673	0.327	0.5%	8.6%	2.6%	23.6%
Average (unweighted)		7.3	0.508	0.492	4.1%	19.9%	22.0%	13.6%
Average (weighted by population)		7.4	0.595	0.405	4.8%	21.2%	14.5%	5.8%

Sources:

(a) UN World Population Prospects (UN 2001); (b) DHS compiler (http://www.statcompiler.com/)

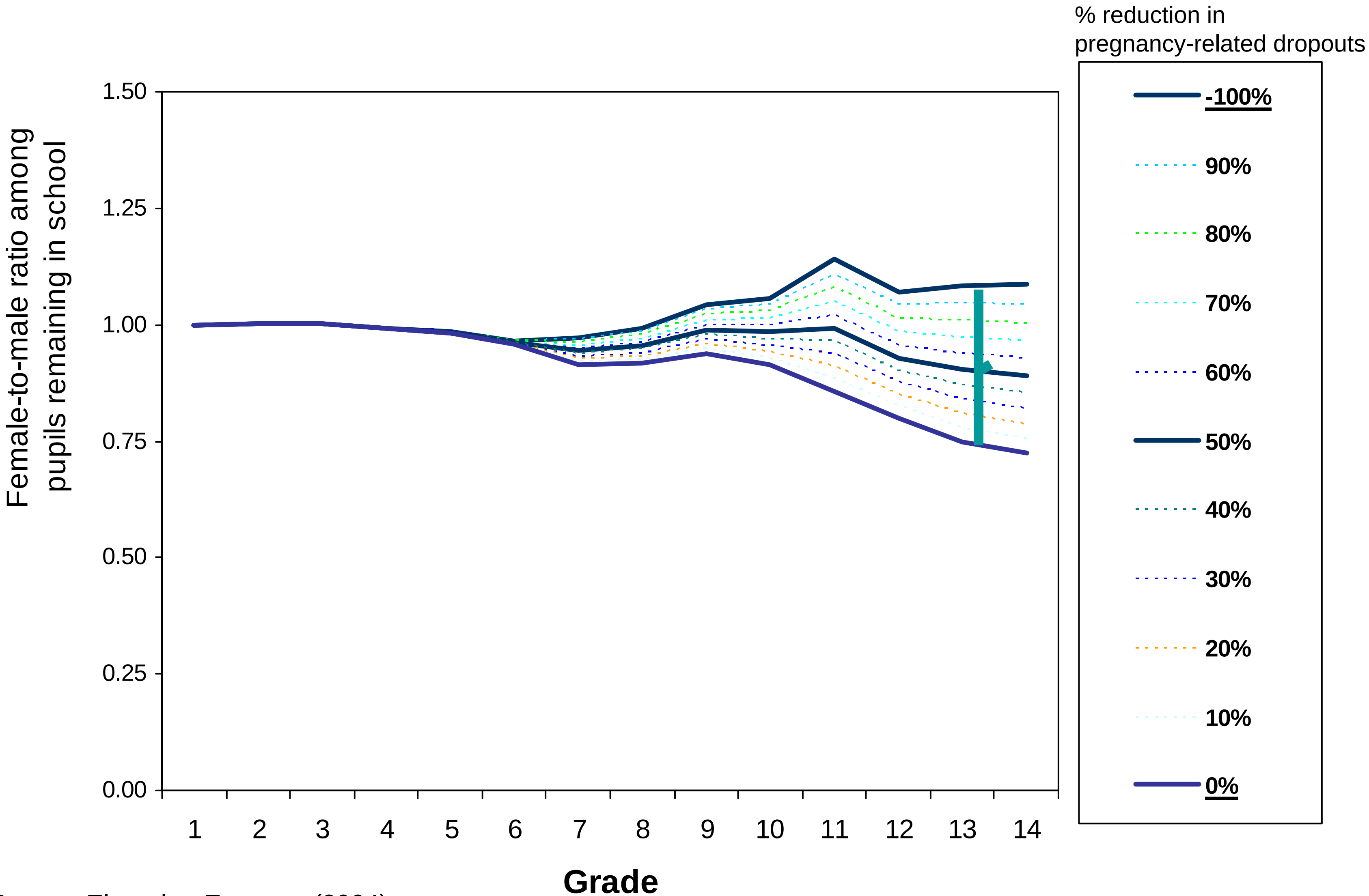
Rest of data based on computations by authors

Figure 1. Percentage of all female dropouts caused by pregnancy, by level of education



Source: DHS (2003). Average computed by author, using countries' population size in year 2000 used as weights

Figure 2. Illustrative simulation results for the effects of reducing pregnancy-related dropouts on the female-to-male ratio in school survivorship



Data Source: Eloundou-Enyegue (2004)

Figure 3: Simulation results for the impact of reducing pregnancy-related dropouts on the female-to-male ratio in secondary school completion (23 sub-Saharan countries)

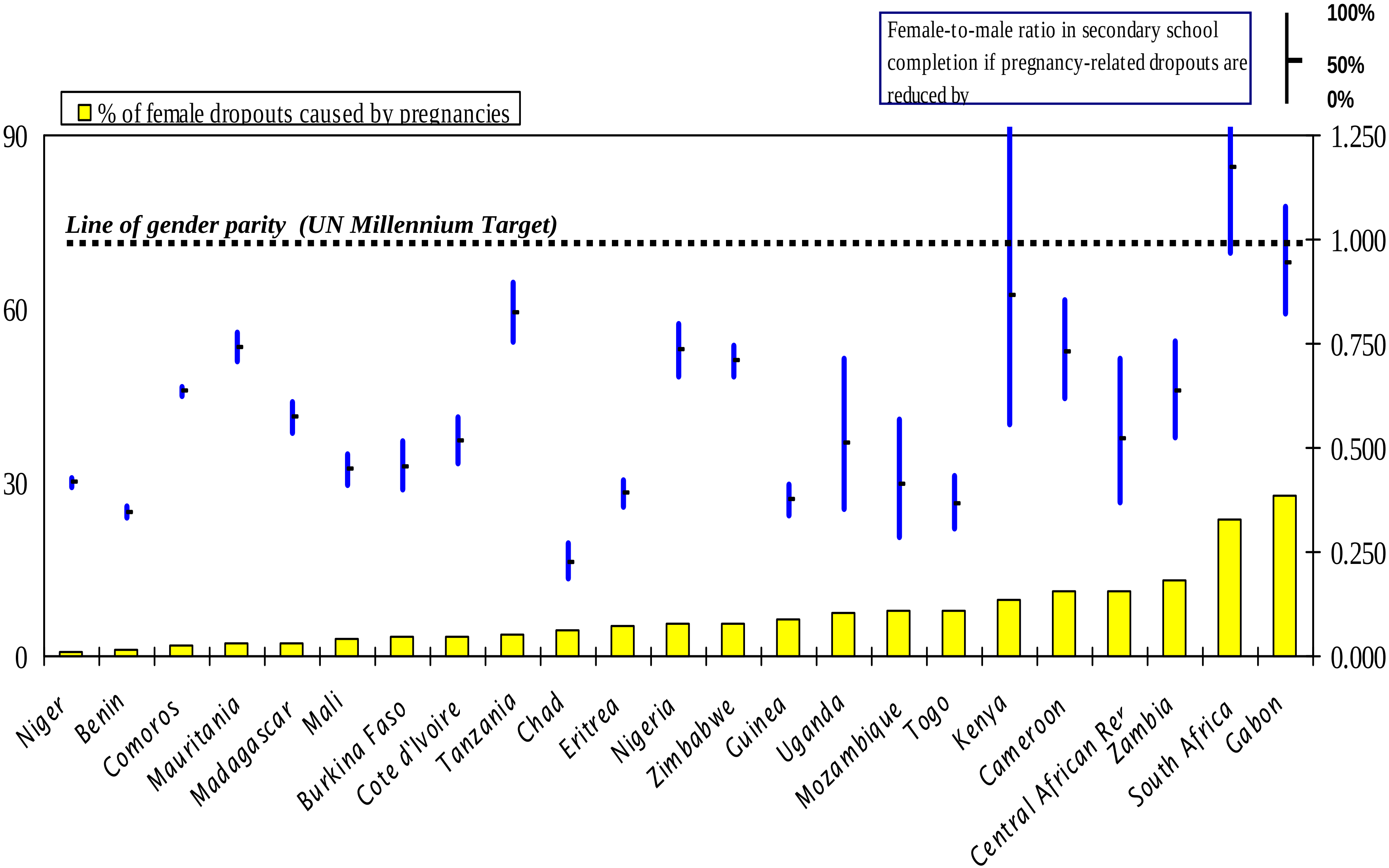


Figure 4. Percent reduction in the female-to-male survivorship associated "pregnancy" and "non pregnancy" factors at the primary and secondary levels, respectively (23 sub-Saharan countries)