More questions, more bias?
An assessment of the quality of data used for direct estimation of infant and child mortality in the Demographic and Health Surveys

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Short abstract: *Expansions of the length and complexity of Demographic and Health Surveys (DHS) in recent decades has been hypothesized to affect data quality. I analyze 198 DHS Surveys to ascertain whether changes in the DHS survey instrument have led to poorer data quality and thus biased child mortality estimates. I explain the likely causes and consequences of one measure of data quality: birth displacement, disaggregated by child survival status. I then examine differences in displacement by DHS survey characteristics, including core questionnaire length and modules including HIV biomarker testing. Preliminary results indicate highlights serious problems with the birth history data. Data quality decreased in as the core questionnaire length increased from 1989-2008, and the problem—which likely biases infant and child mortality rates downwards—is greatest in sub-Saharan African surveys, net of other factors. Encouragingly, data quality appears to have improved since 2009 when the DHS questionnaire was shortened.*

Introduction: The vast expansion of the scope of the Demographic and Health Surveys (DHS)—the primary data source for measures of fertility and child mortality in low- and middle-income countries (UN IGME 2012)—has been hypothesized to affect data quality. First implemented in 1984 as a follow-on to the World Fertility Surveys, the original mandate of the DHS was to provide accurate demographic indicators, focusing predominantly on fertility and child mortality. In the past quarter-century, governments and funding agencies have added questions about nutrition, disease prevalence, sexual risk behaviors, knowledge about HIV/AIDS, and in some countries, detailed questions about domestic violence, maternal mortality, and biomarkers including blood collection for anemia and HIV testing.

This increase in complexity and length of the DHS questionnaire is likely to result in decreased training time and attention devoted to the original elements of the core questionnaire, specifically the birth history, used as the basis for both fertility and child mortality estimates. Such reduced attention is especially likely if, as suggested by anecdotal evidence from DHS staff, the duration of fieldworker training has not increased at the same rate that the questionnaire has grown, resulting in less time spent per section of the questionnaire. The increase in the length and complexity of the DHS questionnaire comes from 1) questions added to the core DHS questionnaire (which is revised with each five-year survey phase) such as detailed information on child feeding, which are asked in every country, and 2) additional modules that are not part of the standard DHS core questionnaire, generally added at the request of the host country government. Common modules include domestic violence, maternal mortality, anemia biomarker testing and, in countries with high suspected HIV prevalence, HIV biomarker testing. When such modules are added, fieldworker training must cover these detailed questions, including special protection procedures for respondents who answer the domestic violence questions and special informed consent procedures for blood collection to test HIV serostatus. In surveys with longer core questionnaires plus additional modules, the burden on the interviewers is even higher, and any problems with data quality are potentially exacerbated.

In this analysis, I will attempt to address the question of whether increasing the length and complexity of the DHS survey instrument leads to poorer data quality and thus biased mortality estimates. I first explain the likely causes and consequences of one measure of data quality: displacement of births out of the five years prior to each survey. I then examine differences in displacement by DHS survey characteristics, including core questionnaire length and implementation of modules including HIV biomarker testing. To document these patterns, I will analyze every available DHS since the inception of the project, for a total of 198 surveys,[1] and use the survey as the unit of analysis.

Data and methods

Why expect displacement? In the DHS questionnaire, the first section after the respondent's demographic characteristics is a complete birth history, recording the dates of birth and, if the child has died, date of death, for every child a woman has ever delivered. In later sections of the questionnaire, women who have given birth in the past five calendar years are asked a long series of questions about the prenatal care, delivery, postnatal care, vaccination record, recent illnesses, and feeding practices for their youngest child. Many of these questions are repeated for each child born in the five calendar years prior to the survey[2] so that a woman with multiple recent births would be asked many of the same questions multiple times. Savvy interviewers—and, perhaps, interviewed women[3]—quickly learn that the questionnaire can be shortened by "reducing" the number of births that occurred in the past five years by displacing births over this "boundary year." With more and more questions added to the child health sections in recent years, the incentive to displace births has increased.

In countries with stable or declining fertility rates, we would expect to see the number of births recorded in each calendar year to be roughly the same, or slightly lower, as time progresses. Figure 1, however, using the exemplar survey of Uganda 2006, shows a spike of births in 2000, followed by a sharp drop in the number of births in 2001, and then resumption of a relatively flat trend in 2002 through 2005.[4] Though some of this heaping on 2000 likely reflects digit preference for round numbers, it is unlikely that such displacement can be explained by heaping alone. A much more plausible explanation is that interviewers are selectively displacing births out of the five-year reference period, across the "boundary year" of 2001 and into 2000.

Consequences of displacement: This displacement affects the estimation of both fertility and mortality rates. Both rates use data from the most recent time period: the five- (or, depending on the level of estimation and degree of precision required, a three- or ten-) year period prior to survey. Age-specific and total fertility rates generally use a three-year period, and births in this period form the numerator for these rates. If births are displaced out of the recent time period and into the prior one, the

[1] Surveys that did not include a boundary year for the maternal and child health sections of the questionnaire are
[2] In some surveys these questions applied to the most recent 3 years; this is accounted for in analysis.
[3] Because birth dates are recorded in an earlier section of the questionnaire, however, it is unlikely that interviewed women would be able to recognize this pattern and change the reporting of their children's birth dates, unless there are multiple women interviewed in the household and women have observed each other's interviews. Because most households only have one eligible woman (ages 15-49), any interviewee-initiated displacement is likely minimal.
[4] Because data for 2006 are incomplete, this graph is truncated at 2005.

numerator will be reduced and fertility rates underestimated.[5] In infant and child mortality rate calculation, the number of children surviving until the beginning of the age interval during the period of observation form the denominator, and the number of children who died in the age interval form the numerator (details of this calculation are described in Rutstein and Rojas 2003). If displacement affected surviving and deceased children equally, mortality estimates would be largely unaffected by displacement. As Figure 1 shows, however, the birth dates of deceased children are displaced at a higher rate than those of living children. This differential displacement is understandable for two reasons: one, dates of birth for deceased children are more difficult to recall than for living children because the date of birth cannot be approximated from the child's current age. Two, interviewers seem reluctant to ask women questions about their dead children's prenatal care, delivery, birth weight, and duration of breastfeeding. Despite the fact that there are fewer questions asked about dead children than surviving children (feeding practices, child health status, and vaccination history are skipped for dead children), interviewers are still more likely to displace the birth dates for deceased children than for surviving children, as demonstrated below.

This differential displacement has clear consequences for mortality estimation, especially because a standard way to examine trends in mortality is to calculate and compare under-five mortality rates in the 0-4 years, 5-9 years, and 10-14 years prior to survey, using birth histories collected in a single survey. Though there are clear limitations to this approach due to truncation of maternal age[6] and increased exposure to the risk of mortality for births further back in time, this approach is widely used to examine mortality trends. The displacement shown in the figure above will clearly underestimate mortality in the most recent period and overestimate mortality in the prior period. Comparing these estimates to each other would, in turn, overestimate the downward slope of any real decline in child mortality.

Measuring birth displacement: To identify the level of displacement in each survey and by survey characteristics, I create a **boundary ratio** defined as $100 * (B_{\text{boundary year}}/B_{\text{boundary year-1}})$, where B is the reported number of births in the calendar year, and the boundary year is defined in the survey questionnaire, usually as the year of survey minus five.[7] If births were evenly distributed across years, the measure would equal 100. Minor fluctuations are expected due to random noise, but unless birth rates are changing quite dramatically, the number of births in two adjacent years should be approximately equal. Ratios under 100 therefore indicate displacement or bias. I calculate ratios for all births, and separately for surviving and deceased children. The difference in these ratios indicates the amount of differential displacement of deceased children compared to surviving children.

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[5] Omission, rather than displacement, of births is probably a more serious issue affecting fertility calculations – see Schoumaker 2014.

[6] DHS surveys only interview women 15-49. In periods 10-14 years in the past, interviewed women were 1-29 years old. Thus any births that occurred when mothers were ages 30+ will be omitted from estimates for earlier time periods. Recall of the timing of births and deaths may also be less accurate for periods further back in time.

[7] Curtis used a measure with the same numerator, but used as the denominator the average of $B_{\text{boundary year-1}}$ and $B_{\text{boundary year+1}}$ (Curtis 1995). This averaged denominator would be appropriate if we anticipated the births were heaped on the boundary year, rather than displaced only from one direction. As I see no evidence of displacement from the earlier time period into the boundary year, this averaged measure appears to conceal some of the displacement, and I believe the boundary ratio used here to be more appropriate.

Survey characteristics : To see if, as hypothesized, data quality (as measured by birth displacement) changes with the survey instrument, I use several measures of survey length and complexity. As a proxy for the number of questions in the DHS questionnaire (only obtainable by hand counting), I use the DHS survey phase. The approximate number of questions asked to the average woman (a sexually active married woman with one birth in the last five years) changed across survey phases (Macro international 2009): Phase 1, 1984-1989: 205 questions; Phase 2: 1989-93: 266 questions; Phase 3: 1993-97: 258 questions; Phase 4: 1997-2003: 292 questions; Phase 5: 2003-08: 439 questions; and Phase 6: 2008-13: 358 questions[8].

These are only rough approximations. Countries can, and do, add their own questions to the core questionnaire, and the actual number of questions asked depends in large part on women's responses and resulting skip patterns (i.e., women who have not heard of HIV are skipped out of all questions about HIV). To account for this variation, I also test an alternative measure: the median duration of interview, created from subtracting the start and end times of individual interviews.[9] This measure is used in tandem with two other indicators: the percentage of interviews that required a return visit (because durations cannot be calculated for interviews that were conducted over two sessions, as multiple start and end times cannot be recorded), and the average number of births per woman that occurred in the past five years, because of the repeated questions asked for each birth in this period.

To see if the addition of modules affects displacement, I create dummy variables for whether the survey included the four most common (and potentially burdensome) modules: HIV biomarker collection, anemia biomarker collection, domestic violence, and maternal mortality modules. I also disaggregate data by region of survey, which accounts for a great deal of variation in date reporting. In the multivariate regression models shown below, I include several controls relating to the accuracy of date reporting. It is widely believed (at least within the DHS) that interviewers are more likely to displace births of less educated women, in large part because such women are less likely to report the exact dates of birth of their children (Pullum 2006), giving the interviewer a larger role in determining the child's birth date. To adjust for this possibility, I include as a covariate the percentage of women with no education in each survey. Finally, if a child's birth date is not recorded, the data are imputed using a standardized hotdeck-style procedure described in Croft 1991. To account for any differences brought about by such imputation, I also control for the percentage of births for which any part of the birth date (day, month, or year) are imputed. Summaries of these characteristics are shown in Appendix Table 1, with details for each survey in Appendix Table 2.

Preliminary Results: As shown in Table 1, there is great variation in data quality, as measured with the boundary ratios described above, by survey characteristics. Boundary ratios were closest to 100, indicating the least amount of bias, in the earliest DHS phase, which also had the shortest questionnaire. The total boundary ratios (column 2) decrease fairly linearly with increasing survey phase until the most recent phase, in which the core questionnaire was reduced in size. It is important

[8] Number of questions for Phases 1-5 are from Macro International 2009; Phase 6 estimate from author's count.
[9] I remove from this calculation all durations under 10 minutes, including negative values, as implausible and likely due to coding errors. In four early surveys, the start and end times were not recorded and durations not be calculated.

to note, however, that some data from this survey phase are still being processed, and thus we are not assessing all data from Phase 6.

Consistent with other analyses of data quality (Curtis 1995; Pullum 2006), the boundary ratios detect the least amount of bias in the Latin American and Caribbean surveys, and the most bias in sub-Saharan African surveys. Data quality appears lower in surveys that included HIV testing, but this could simply be because most of the surveys that included HIV testing were in sub-Saharan Africa.

Columns 3 and 4 disaggregate the boundary ratios by the survival status of the child, and column 5 shows the difference in these two ratios. This difference is rather damning of the birth history data quality: on average, there is a gap of 20 percentage points between the ratios for surviving and deceased children, indicating not only a fair amount of displacement but also strong differential displacement by child survival. In some cases, this difference is likely the result of small sample sizes: in the Armenia 2010 survey, for example, this gap is 67 percentage points, but this is only because of the small total sample and low child mortality resulting in an absurdly low boundary ratio of 22 for deceased children (survey-specific data are in Appendix Table 3). In many cases, however, this marker of poor data quality cannot be explained away as a statistical quirk. The Mozambique 1997 survey had a sample of almost 30,000 births, and an estimated under-five mortality rate of 201 deaths per 1,000 live births. The total boundary ratio for this survey is 66, and among deceased children, the boundary decreased to 36. These clear markers of poor data quality must result in poor estimates of mortality and, to a lesser extent, fertility.

In Table 2, I examine factors associated with the total boundary ratio (all children). Regressions on the boundary ratios for deceased and surviving children (not shown) show largely the same results. Without controlling for other factors, the inclusion of HIV biomarkers in a survey does increase the degree of bias, reducing the boundary ratio from 88 to 84 as shown in Table 1. Similar results are seen for the inclusion of the maternal mortality module, but no statistically significant effects are seen with the domestic violence or anemia biomarker modules. Compared to Phase 1, all subsequent phases show significantly higher levels of bias, particularly Phases 4 and 5, which decrease the boundary ratio by 10 points compared to Phase 1. As expected based on Table 1, data quality is significantly worse in sub-Saharan Africa than in Latin America and the Caribbean. In multivariate models, the only statistically significant predictors of bias are the survey phase, location in sub-Saharan Africa vs. Latin America, and percentage of women with no education. HIV biomarker testing, which I hypothesized would be the strongest driver of poor data quality due to the increased burden, does not remain significant after controlling for region. Subsequent analyses (not shown) found no detectable difference in levels of bias by inclusion of HIV testing, even within region or survey phase, there was though it is possible that such a difference exists and I am underpowered to detect it. More plausibly, it seems that decreases in data quality are due to multiple factors, and that inclusion of HIV is simply one additional component that contributes to the overall survey burden.

Preliminary Conclusions: Despite the DHS's well-earned reputation for excellent data quality, this analysis highlights serious problems with the birth history data. Moreover, these results demonstrate that such problems have been increasing as the survey instrument has increased in length and complexity, and that bias is greatest in sub-Saharan African surveys, net of other factors. This is especially troubling given the great amount of attention paid to recent declines in child mortality

especially in this region. As described above, the bias detected in this analysis is quite likely to bias estimates of infant and child mortality downwards.

Fortunately, the fact that the causes of this displacement are (presumably) well known means that they can likely be remedied. Questionnaire changes, such as asking the child health questions for the two most recent births regardless of when the children were born, would eliminate the boundary year and thus the incentive to displace births.[10] In addition, or as an alternative, estimation strategies could be altered, to use a shorter reference period of 4 or 3 years when sample sizes allow (note that the shorter reference period would be used ONLY for estimation, and would not apply to data collection). Neither of these changes would completely eliminate the problems. Interviewers will still want to shorten their burden, and especially avoid asking mothers about their dead children, even if the clear incentive identified by the boundary year is removed. Additionally, if births are displaced by more than one year (as seems likely for deceased children in the Uganda example), shortening the reference period will not avoid bias entirely. But such changes, in addition to decreasing questionnaire length and increasing fieldworker training, would go a long way in improving the quality of vital estimates.

Though not causal, this analysis presents abundant evidence that increases in survey length and complexity are indeed strongly associated with reduced data quality. DHS has already taken steps to reduce the length of the core questionnaire in Phase 6, which seems to result in less bias. This analysis provides evidence that these changes are indeed moving in the right direction, and indicates that further reductions in the quantity of questions asked are likely to continue to improve the quality of DHS data in the future.

[10] Thanks to Ron Lee for this suggestion.

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Figure 1: Log number of births by calendar year and survival status
Uganda 2006 DHS
Boundary year = 2001

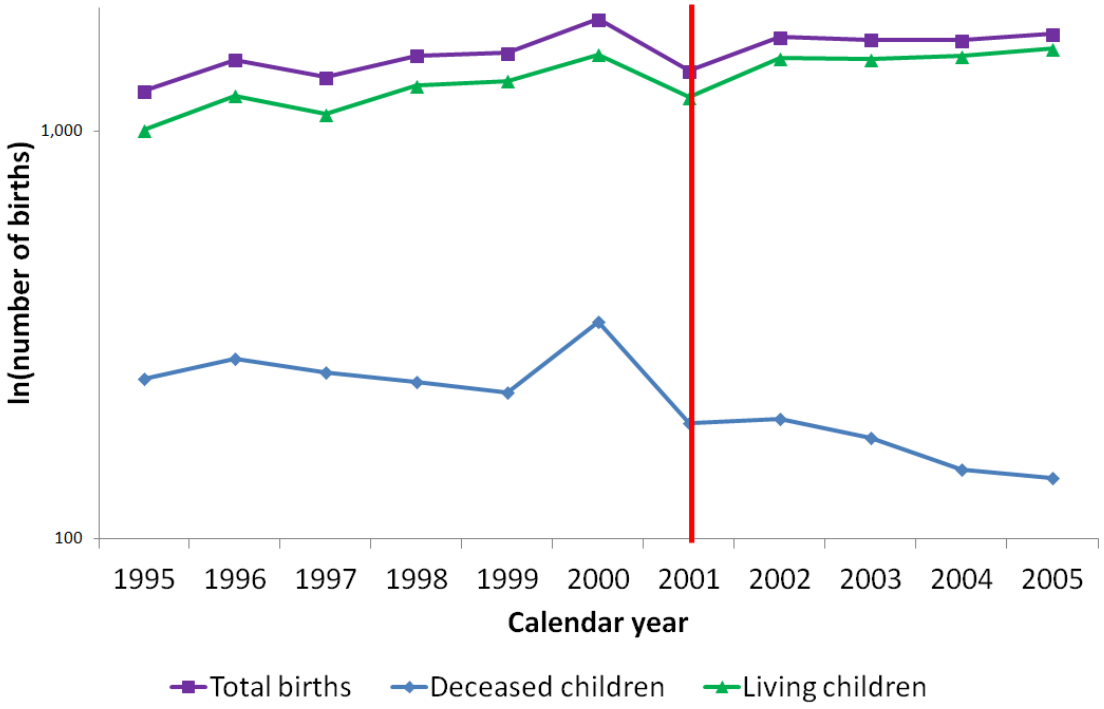

Table 1: Boundary ratios by DHS survey characteristics

	Boundary ratio, all children	Boundary ratio, surviving children	Boundary ratio, deceased children	Difference in boundary ratios (surviving - deceased)	Number of surveys
Survey phase					
Phase 1: 1984-99	94.3	94.9	76.1	18.8	26
Phase 2: 1989-93	87.0	92.0	70.4	21.6	23
Phase 3: 1993-97	86.9	90.7	77.6	13.0	41
Phase 4: 1997-2003	84.2	88.2	66.1	22.1	47
Phase 5: 2003-08	84.6	88.3	66.7	21.6	44
Phase 6: 2008-13	89.3	91.7	69.7	22.0	17
Region					
Latin America & Caribbean	93.0	95.3	76.3	19.0	36
North Africa/West and Central Asia/Europe	91.5	94.0	71.9	22.1	29
South & Southeast Asia	89.0	91.1	71.7	19.4	33
Sub-Saharan Africa	82.7	87.3	68.1	19.2	100
Survey includes HIV testing					
no	87.7	90.8	71.4	19.5	161
yes	83.7	88.3	68.0	20.4	37
Survey includes Anemia testing					
no	87.8	91.1	71.5	19.6	130
yes	85.2	89.0	69.3	19.7	68
Survey includes DV module					
no	86.3	89.9	70.2	19.7	146
yes	88.6	91.5	72.1	19.4	52
Survey includes Maternal mortality					
no	89.6	92.1	72.9	19.2	91
yes	84.7	88.9	68.9	20.0	107
Total	**86.9**	**90.4**	**70.7**	**19.6**	**198**

Boundary ratio is defined as $100^* (B_{\text{boundary year}}/B_{\text{boundary year-1}})$

Table 2: Univariate and multivariate regressions on the boundary ratio, all children

	Univariate regressions		Multivariate regressions							
	Model 1		Model 2		Model 3		Model 4		Model 5	
	B	95% CI	B	95% CI	B	95% CI	B	95% CI	B	95% CI
HIV biomarker testing	-3.9*	-8.0,0.1					0.1	-4.5,4.8	2.3	-2.5,7.1
Anemia biomarker testing	-2.6	-5.9,0.8							-2.0	-6.0,1.9
Domestic violence module	2.3	-1.3,5.9							3.0	-1.0,7.0
Maternal mortality module	-4.9***	-8.0,-1.8					-2.1	-5.5,1.3	-0.3	-3.8,3.1
DHS survey phase (ref = Phase 1: 1984-99)										
Phase 2: 1989-93	-7.2**	-13.4,-1.1					-6.0**	-11.9,-0.2	-6.5**	-12.2,-0.8
Phase 3: 1993-97	-7.4***	-12.8,-2.0					-7.0**	-12.5,-1.6	-7.4***	-12.9,-2.0
Phase 4: 1997-2003	-10.1***	-15.4,-4.8					-10.1***	-15.6,-4.5	-9.4***	-15.2,-3.5
Phase 5: 2003-08	-9.7***	-15.1,-4.4					-11.1***	-17.1,-5.1	-11.9***	-18.6,-5.2
Phase 6: 2008-13	-4.9	-11.7,1.8					-6.0	-13.5,1.5	-5.5	-13.8,2.7
Region (ref = Latin America & Caribbean)										
North Africa/West and Central Asia/Europe	-1.5	-6.6,3.7			-0.3	-5.5,5.0			2.8	-2.6,8.3
South & Southeast Asia	-3.9	-8.9,1.0			-1.4	-7.0,4.2			0.3	-4.8,5.4
Sub-Saharan Africa	-10.2***	-14.2,-6.2			-7.0***	-11.6,-2.4			-5.9**	-10.8,-1.1
Median duration of interview	-0.1	-0.2,0.0	0.0	-0.2,0.1	0.0	-0.1,0.1				
Percentage of interviews requiring revisit	0.3**	0.0,0.5	0.1	-0.1,0.4						
Average number of births in past 5 years	-10.3***	-17.6,-3.0	0.1	-9.1,9.2			-4.1	-13.5,5.4	1.6	-8.4,11.6
Percent of women with no education	-0.1***	-0.2,-0.1	-0.1***	-0.2,-0.1	-0.1***	-0.2,-0.0	-0.1***	-0.2,-0.1	-0.1***	-0.2,-0.0
Percentage of births with imputed information	-0.1**	-0.2,-0.0	0.0	-0.1,0.1	0.0	-0.1,0.2	0.0	-0.1,0.1	0.0	-0.1,0.1
Constant	87.7***	85.9,89.4	91.9***	83.4,100.3	93.7***	87.8,99.7	102.5***	94.9,110.1	99.2***	91.6,106.8
Number of observations	198		194		195		197		197	
R^2	0.0		0.1		0.2		0.2		0.3	

* p<0.1, ** p<0.05, *** p<0.01

Appendix Table 1: DHS survey characteristics

	Median duration of interview (minutes)	Percentage of interviews requiring a second visit	Average number of births in past 5 years for interviewed women	Percent of women with no education	Percentage of births with imputed date information	N of surveys
Survey Phase						
Phase 1: 1984-99	30.0	7.6	0.82	35.0	15.7	26
Phase 2: 1989-93	33.9	8.3	0.81	39.1	16.3	22
Phase 3: 1993-97	43.2	9.4	0.76	34.7	11.8	37
Phase 4: 1997-2003	49.4	7.7	0.69	32.4	8.2	45
Phase 5: 2003-08	52.6	9.2	0.62	23.9	5.2	43
Phase 6: 2008-13	50.8	11.4	0.63	26.0	2.7	16
Region						
Latin America & Caribbean	36.8	13.2	0.56	10.7	2.2	33
North Africa/West and Central Asia/Euro	35.1	5.6	0.67	27.9	11.6	28
South & Southeast Asia	54.4	7.1	0.61	31.8	5.5	32
Sub-Saharan Africa	46.9	8.7	0.81	39.7	13.3	96
Survey includes HIV testing						
no	42.7	8.6	0.71	31.0	10.5	152
yes	53.3	9.3	0.74	33.8	6.1	37
Survey includes Anemia testing						
no	41.6	8.5	0.74	33.8	12.2	124
yes	50.6	9.2	0.66	27.2	5.0	65
Survey includes DV module						
no	42.3	8.5	0.75	36.1	12.3	139
yes	51.6	9.5	0.63	18.9	2.5	50
Survey includes Maternal mortality						
no	39.8	8.1	0.68	29.6	9.5	88
yes	48.9	9.3	0.74	33.2	9.9	101
Total	**44.6**	**8.8**	**0.71**	**30.9**	**9.7**	**198**

Appendix Table 2: Survey characteristics by individual survey

	Median duration of interview (minutes)	Percentage of interviews requiring a second visit	Average number of births in past 5 years for interviewed women	Percent of women with no education	Percentage of births with imputed date information
Albania 2008-09	26	9.4	0.2	0.3	0.5
Armenia 2000	45	7.0	0.3	0.1	0.0
Armenia 2005	50	5.7	0.2	0.1	0.1
Armenia 2010	40	7.1	0.2	0.1	0.1
Azerbaijan 2006	33	3.2	0.3	1.1	0.2
Bangladesh 1993-94	67	7.4	0.7	58.1	0.5
Bangladesh 1996-97	58	2.3	0.7	54.6	1.0
Bangladesh 1999-00	60	2.9	0.6	45.9	3.2
Bangladesh 2004	85	3.8	0.6	41.2	0.2
Bangladesh 2007	82	2.8	0.6	34.1	0.4
Bangladesh 2011	77	1.9	0.5	27.7	0.6
Benin 1996	46	10.5	0.9	70.8	48.1
Benin 2001	45	6.7	0.9	64.1	45.7
Benin 2006	53	8.1	0.9	63.7	17.8
Bolivia 1989	25	14.5	0.7	17.4	5.4
Bolivia 1994	35	21.6	0.7	12.1	3.1
Bolivia 2003	50	20.2	0.6	6.2	2.5
Bolivia 2008	60	25.2	0.5	4.6	1.2
Botswana 1988	28	10.0	0.7	23.9	3.7
Brazil 1986	NA	NA	0.6	7.4	3.3
Brazil 1991	28	17.1	0.5	19.1	3.5
Brazil 1996	35	17.2	0.4	5.2	3.3
Burkina Faso 1993	36	10.0	0.9	82.9	30.6
Burkina Faso 1998-99	45	8.0	0.9	85.8	48.1
Burkina Faso 2003	48	6.4	0.9	80.3	7.7
Burkina Faso 2010	46	4.8	0.9	73.9	1.1
Burundi 1987	35	3.9	1.0	80.2	21.4
Burundi 2010	53	4.8	0.8	44.8	2.2
Cambodia 2000	60	1.0	0.6	28.3	0.6
Cambodia 2005	75	3.1	0.5	19.4	1.7
Cambodia 2010	53	3.7	0.4	15.9	1.1
Cameroon 1991	37	9.6	0.9	40.2	36.0
Cameroon 1998	46	13.6	0.7	28.1	7.2
Cameroon 2004	43	5.7	0.8	22.4	7.8
Cameroon 2011	46	6.9	0.8	20.0	5.4
Central African Republic 1994-95	41	8.4	0.8	51.6	7.4
Chad 1996-97	48	8.2	1.0	77.0	8.7
Chad 2004	45	8.5	0.9	74.8	2.2
Colombia 1986	NA	NA	0.5	5.7	2.0
Colombia 1990	30	10.1	0.4	4.2	1.6
Colombia 1995	40	18.0	0.5	3.8	0.8
Colombia 2005	31	14.1	0.4	2.6	1.0
Colombia 2010	33	19.1	0.3	1.6	0.7
Comoros 1996	30	6.2	0.7	53.6	40.1
Congo (Brazzaville) 2005	50	13.9	0.7	7.2	3.5
Congo Democratic Republic 2007	86	17.3	0.9	20.8	2.6
Cote d'Ivoire 1994	50	12.2	0.7	55.9	19.9

	Median duration of interview (minutes)	Percentage of interviews requiring a second visit	Average number of births in past 5 years for interviewed women	Percent of women with no education	Percentage of births with imputed date information
Dominican Republic 1986	23	6.6	0.6	4.8	2.0
Dominican Republic 1991	30	6.9	0.6	5.7	4.0
Dominican Republic 1996	38	7.3	0.6	7.0	2.0
Dominican Republic 2002	40	3.8	0.5	3.8	3.1
Dominican Republic 2007	40	5.7	0.4	3.4	2.0
Ecuador 1987	23	12.6	0.6	7.8	5.8
Egypt 1988	30	2.7	1.0	50.8	37.5
Egypt 1992	35	3.1	0.9	48.4	15.7
Egypt 1995	30	2.7	0.8	43.7	27.9
Egypt 2000	25	0.8	0.7	43.2	14.7
Egypt 2005	35	1.2	0.7	34.6	10.0
Egypt 2008	33	0.7	0.7	32.1	5.2
El Salvador 1985	17	21.1	0.6	21.2	1.6
Eritrea 2002	50	7.3	0.7	50.1	8.5
Ethiopia 2000	65	10.5	0.7	75.2	7.1
Ethiopia 2005	65	9.1	0.7	65.9	1.6
Ethiopia 2011	63	5.6	0.7	50.8	2.6
Gabon 2000	39	12.3	0.7	5.7	3.8
Ghana 1988	43	7.5	0.9	39.7	24.7
Ghana 1993	40	9.6	0.8	35.0	21.9
Ghana 1998	50	10.9	0.7	29.1	15.8
Ghana 2003	50	9.8	0.7	28.2	3.4
Ghana 2008	59	13.2	0.6	21.2	4.5
Guatemala 1987	30	6.3	0.9	38.4	3.8
Guatemala 1995	35	9.0	0.8	28.3	1.1
Guinea 1999	60	5.0	0.9	80.4	63.3
Guinea 2005	55	3.2	0.8	77.5	56.6
Guyana 2009	35	6.3	0.4	1.4	1.8
Haiti 1994-95	40	18.1	0.7	35.6	4.7
Haiti 2000	45	9.6	0.7	28.9	1.3
Haiti 2005-06	47	9.8	0.6	23.2	0.5
Honduras 2005-06	45	10.2	0.5	6.2	0.3
India 1992-93	35	5.3	0.5	61.5	3.4
India 1998-99	36	5.3	0.6	53.4	5.4
India 2005-06	50	9.6	0.4	40.6	2.3
Indonesia 1987	35	2.2	0.7	23.2	22.8
Indonesia 1991	40	1.5	0.7	19.1	22.4
Indonesia 1994	53	2.5	0.6	15.9	14.8
Indonesia 2002-03	45	2.0	0.5	7.9	15.2
Indonesia 2007	45	3.0	0.6	6.9	11.1
Jordan 1990	30	4.0	1.3	23.5	1.7
Jordan 1997	45	5.5	1.2	9.1	0.9
Jordan 2002	45	5.3	1.0	6.0	1.4
Jordan 2007	30	4.4	1.0	3.8	0.4
Kazakhstan 1995	36	9.3	0.3	0.4	0.2
Kenya 1989	29	6.0	1.0	25.1	3.8
Kenya 1993	39	16.9	0.8	17.9	10.8
Kenya 1998	45	12.7	0.7	11.5	2.9

	Median duration of interview (minutes)	Percentage of interviews requiring a second visit	Average number of births in past 5 years for interviewed women	Percent of women with no education	Percentage of births with imputed date information
Kenya 2003	53	15.4	0.7	12.7	7.1
Kenya 2008-09	60	10.8	0.7	8.9	2.4
Kyrgyz Republic 1997	30	9.8	0.5	0.1	0.6
Lesotho 2004	45	7.6	0.5	2.0	1.1
Lesotho 2009	57	52.3	0.5	1.2	1.0
Liberia 1986	25	3.6	1.0	62.7	16.3
Liberia 2007	53	7.5	0.8	42.4	3.4
Madagascar 1992	35	8.2	0.8	19.6	23.4
Madagascar 1997	32	5.0	0.9	21.2	24.9
Madagascar 2003-04	41	5.7	0.7	22.4	13.9
Madagascar 2008-09	44	5.9	0.7	18.5	2.2
Malawi 1992	44	8.9	0.9	47.2	5.6
Malawi 2000	60	6.2	0.9	27.0	2.0
Malawi 2004	60	5.4	0.9	22.6	1.3
Malawi 2010	53	4.8	0.9	15.2	0.7
Maldives 2009	28	13.0	0.5	23.4	14.8
Mali 1987	35	1.6	1.0	85.4	65.1
Mali 1995-96	49	5.3	1.1	81.1	4.3
Mali 2001	50	5.0	1.0	80.0	6.3
Mali 2006	56	5.2	1.0	78.2	9.2
Mauritania 2000-01	33	4.3	0.6	57.3	21.9
Moldova 2005	45	14.8	0.2	0.2	0.1
Morocco 1987	35	3.8	1.0	82.7	42.9
Morocco 1992	30	5.2	0.6	63.4	3.5
Morocco 2003-04	30	6.8	0.4	50.0	15.6
Mozambique 1997	30	7.8	0.8	42.9	44.5
Mozambique 2003	57	4.6	0.8	41.1	4.1
Namibia 1992	33	14.2	0.7	14.5	6.8
Namibia 2000	38	11.1	0.6	9.5	2.8
Namibia 2006-07	52	10.9	0.5	6.6	0.9
Nepal 1996	70	9.9	0.9	80.0	0.2
Nepal 2001	70	13.1	0.8	72.0	0.1
Nepal 2006	75	11.7	0.5	53.1	0.1
Nepal 2011	48	13.2	0.4	39.8	0.1
Nicaragua 1998	40	7.4	0.6	15.5	3.3
Nicaragua 2001	45	9.2	0.5	14.4	3.0
Niger 1992	39	8.1	1.1	89.3	45.4
Niger 1998	37	6.0	1.1	84.8	5.1
Niger 2006	50	4.7	1.0	83.5	18.9
Nigeria 1990	37	10.2	0.9	57.2	18.1
Nigeria 1999	50	10.0	0.6	37.7	17.5
Nigeria 2003	55	10.0	0.8	41.6	9.7
Nigeria 2008	63	5.3	0.9	35.8	3.4
Pakistan 1990-91	40	5.8	1.0	79.2	9.4
Pakistan 2006-07	50	5.4	0.9	65.0	28.0
Paraguay 1990	30	9.2	0.7	2.7	0.1
Peru 1986	28	16.3	0.6	10.9	2.1
Peru 1991-92	35	20.2	0.6	6.1	1.7

	Median duration of interview (minutes)	Percentage of interviews requiring a second visit	Average number of births in past 5 years for interviewed women	Percent of women with no education	Percentage of births with imputed date information
Peru 1996	43	17.9	0.6	6.2	2.2
Peru 2000	45	18.1	0.5	5.1	1.6
Peru 2004-06	50	21.7	0.4	3.6	1.2
Peru 2007-08	60	17.2	0.4	3.1	0.7
Philippines 1993	60	15.2	0.6	2.1	1.3
Philippines 1998	58	15.5	0.6	1.5	0.9
Philippines 2003	60	14.5	0.5	1.4	0.6
Philippines 2008	59	13.2	0.5	1.2	0.4
Rwanda 1992	30	10.9	0.8	38.0	9.4
Rwanda 2000	45	5.8	0.8	29.4	5.9
Rwanda 2005	56	8.0	0.8	23.4	4.0
Rwanda 2010	55	6.4	0.7	15.5	0.7
Sao Tome and Principe 2008-09	70	5.6	0.7	5.9	2.1
Senegal 1986	30	3.1	1.0	77.2	23.5
Senegal 1992-93	37	12.3	0.9	73.0	47.2
Senegal 2005	49	8.1	0.7	59.6	12.2
Senegal 2010-11	37	36.2	0.8	57.9	25.1
Sierra Leone 2008	65	13.8	0.8	65.9	4.7
South Africa 1998	30	10.5	0.4	6.8	3.1
Sri Lanka 1987	32	4.0	0.7	11.1	7.8
Sudan 1989-90	30	3.8	1.1	58.4	46.2
Swaziland 2006-07	44	6.6	0.6	8.1	0.9
Tanzania 1991-92	35	3.7	0.9	33.8	23.0
Tanzania 1999	45	8.4	0.8	27.1	8.9
Tanzania 2004-05	70	7.0	0.8	24.2	2.3
Tanzania 2010	56	6.0	0.8	19.1	0.6
Thailand 1987	29	16.2	0.5	9.7	9.1
Timor-Leste 2009-10	52	4.9	0.7	29.3	0.4
Togo 1988	55	6.9	0.9	58.2	50.0
Togo 1998	47	5.7	0.8	48.1	35.6
Trinidad and Tobago 1987	28	15.3	0.5	0.8	1.0
Tunisia 1988	25	3.2	1.1	56.7	5.2
Turkey 1993	34	4.9	0.6	27.1	3.6
Turkey 1998	29	9.0	0.4	16.7	14.5
Turkey 2003	35	5.5	0.6	16.4	7.0
Uganda 1988-89	34	5.8	1.0	37.8	0.1
Uganda 1995	56	5.8	1.0	30.6	7.3
Uganda 2000-01	64	5.5	1.0	21.9	7.4
Uganda 2006	70	8.2	1.0	19.3	4.4
Uganda 2011	20	3.3		11.9	2.1
Ukraine 2007	55	23.0	0.2	0.0	0.1
Uzbekistan 1996	30	4.8	0.5	0.1	0.5
Vietnam 1997	50	4.7	0.6	4.8	0.0
Vietnam 2002	60	7.7	0.4	6.4	0.9
Yemen 1991-92	NA	NA	1.2	89.0	58.5
Yemen 1997	45	4.2	1.2	81.5	67.5
Zambia 1992	35	9.7	0.9	16.4	2.8
Zambia 1996	42	7.5	0.9	13.3	1.4

	Median duration of interview (minutes)	Percentage of interviews requiring a second visit	Average number of births in past 5 years for interviewed women	Percent of women with no education	Percentage of births with imputed date information
Zambia 2001-02	55	5.3	0.9	12.1	2.1
Zambia 2007	60	9.3	0.9	10.4	1.0
Zimbabwe 1988	31	6.7	0.8	13.5	0.6
Zimbabwe 1994	40	14.6	0.7	11.1	0.5
Zimbabwe 1999	40	8.9	0.6	6.7	0.7
Zimbabwe 2005-06	44	7.0	0.6	4.3	0.7
Zimbabwe 2010-11	43	4.7	0.6	2.3	1.2

Appendix Table 3: Boundary ratios by survey

	Boundary ratio, all children	Boundary ratio, surviving children	Boundary ratio, deceased children	Difference in boundary ratios (surviving - deceased)	Number of births
Albania 2008-09	92.0	100.6	62.8	37.8	12,426
Armenia 2000	84.6	88.9	48.4	40.6	10,890
Armenia 2005	83.9	80.3	66.5	13.8	9,969
Armenia 2010	87.3	89.6	22.3	67.2	8,150
Azerbaijan 2006	83.7	83.2	40.7	42.5	13,263
Bangladesh 1993-94	110.1	114.3	86.3	27.9	32,860
Bangladesh 1996-97	86.2	83.8	79.9	3.9	29,584
Bangladesh 1999-00	97.5	97.8	57.6	40.2	32,346
Bangladesh 2004	102.6	103.3	75.5	27.8	33,873
Bangladesh 2007	93.4	97.3	70.4	26.8	30,474
Bangladesh 2011	88.7	83.3	97.5	-14.3	45,991
Benin 1996	88.3	95.9	68.3	27.6	18,872
Benin 2001	84.4	87.9	74.1	13.8	19,246
Benin 2006	68.3	74.5	54.6	19.9	56,204
Bolivia 1989	93.3	90.3	61.8	28.5	22,094
Bolivia 1994	106.3	107.7	106.0	1.7	27,679
Bolivia 1994	84.2	89.6	57.6	32.0	23,646
Bolivia 2003	92.1	96.4	75.7	20.7	44,129
Bolivia 2008	88.4	91.8	74.5	17.3	40,479
Botswana 1988	84.5	87.9	66.0	21.8	11,272
Brazil 1986	97.4	94.7	74.7	20.0	11,982
Brazil 1991	102.5	99.4	73.3	26.1	16,407
Brazil 1996	88.1	92.2	56.6	35.6	24,478
Burkina Faso 1993	65.0	74.5	51.6	22.9	22,205
Burkina Faso 1998-99	78.1	82.4	77.6	4.8	22,987
Burkina Faso 2003	76.9	80.8	57.5	23.3	41,270
Burkina Faso 2010	74.7	82.4	59.0	23.4	56,330
Burundi 1987	95.7	90.9	80.5	10.4	11,998
Burundi 2010	93.4	102.8	63.0	39.8	25,456
Cambodia 2000	64.3	66.9	60.4	6.5	39,681
Cambodia 2005	99.9	107.3	82.3	25.1	38,822
Cambodia 2010	88.3	88.6	57.7	31.0	37,779
Cameroon 1991	84.8	93.6	63.5	30.2	12,356
Cameroon 1998	81.9	82.8	58.7	24.1	16,017
Cameroon 2004	91.3	91.9	71.5	20.5	29,287
Cameroon 2011	111.7	112.0	92.7	19.3	42,071
Central African Republic 1994-95	88.6	92.9	74.7	18.1	17,012
Chad 1996-97	71.2	81.5	59.9	21.6	26,126
Chad 2004	70.4	79.0	62.0	16.9	22,571
Colombia 1986	99.5	101.1	38.5	62.6	11,615
Colombia 1990	97.2	98.8	70.5	28.3	16,688
Colombia 1995	91.3	94.4	75.9	18.5	21,498
Colombia 2005	93.5	95.6	84.2	11.5	68,060
Colombia 2005	96.0	99.2	65.1	34.1	20,786
Colombia 2010	93.0	94.2	90.5	3.8	83,918
Comoros 1996	79.3	87.2	56.0	31.2	7,913

	Boundary ratio, all children	Boundary ratio, surviving children	Boundary ratio, deceased children	Difference in boundary ratios (surviving - deceased)	Number of births
Congo (Brazzaville) 2005	93.5	104.1	77.9	26.2	16,798
Congo Democratic Republic 2007	92.1	98.1	75.0	23.1	29,827
Cote d'Ivoire 1994	73.4	77.9	89.6	-11.7	8,421
Dominican Republic 1986	104.8	107.3	78.2	29.1	18,321
Dominican Republic 1991	85.8	91.5	58.9	32.6	15,761
Dominican Republic 1996	99.4	105.7	98.0	7.6	18,079
Dominican Republic 1996	96.7	106.4	62.8	43.5	2,646
Dominican Republic 2002	100.3	99.5	63.3	36.2	49,952
Dominican Republic 2007	88.4	89.3	62.5	26.8	54,485
Ecuador 1987	104.7	107.7	75.8	32.0	11,835
Egypt 1988	106.5	106.3	100.3	6.0	35,795
Egypt 1992	93.9	104.9	72.6	32.3	38,211
Egypt 1995	92.9	97.1	70.3	26.8	54,720
Egypt 2000	79.4	87.9	64.6	23.3	54,622
Egypt 2005	85.0	88.7	77.2	11.5	59,884
Egypt 2008	71.3	78.9	51.0	27.9	47,239
El Salvador 1985	87.7	90.9	96.5	-5.7	6,590
Eritrea 2002	88.1	89.3	70.5	18.8	23,305
Ethiopia 2000	87.1	92.7	65.4	27.3	47,500
Ethiopia 2005	72.0	74.6	48.7	25.9	44,190
Ethiopia 2011	85.5	86.7	59.7	27.0	47,599
Gabon 2000	85.5	89.7	67.3	22.3	15,763
Ghana 1988	104.7	105.0	98.5	6.5	14,216
Ghana 1993	62.7	65.7	69.4	-3.7	13,298
Ghana 1998	86.4	92.2	62.3	29.9	12,758
Ghana 2003	76.1	83.3	50.3	33.1	14,412
Ghana 2008	73.9	74.5	79.7	-5.3	11,431
Guatemala 1987	80.2	82.4	74.0	8.5	14,698
Guatemala 1995	87.4	91.1	61.4	29.7	35,433
Guinea 1999	88.0	92.6	72.4	20.2	23,122
Guinea 2005	73.4	79.1	65.3	13.8	26,972
Guyana 2009	95.0	101.6	62.4	39.2	9,988
Haiti 1994-95	79.0	78.6	83.0	-4.4	12,758
Haiti 2000	83.6	95.3	79.5	15.8	25,411
Haiti 2005-06	84.1	93.8	55.4	38.4	23,928
Honduras 2005-06	94.0	98.1	85.5	12.6	47,452
India 1992-93	83.8	87.4	63.4	24.0	277,192
India 1998-99	86.2	90.7	65.4	25.3	270,073
India 2005-06	89.0	90.5	72.1	18.5	280,872
Indonesia 1987	94.4	99.7	79.9	19.9	40,391
Indonesia 1991	81.9	84.9	61.4	23.5	71,466
Indonesia 1994	77.4	79.2	63.5	15.7	81,262
Indonesia 1994	88.2	89.1	78.5	10.6	85,922
Indonesia 2002-03	72.3	74.1	56.1	18.0	78,324
Indonesia 2007	86.5	84.0	77.7	6.4	80,954
Jordan 1990	96.8	100.0	52.8	47.1	32,888
Jordan 1997	100.7	103.4	109.3	-6.0	23,940
Jordan 2002	84.4	85.8	50.9	34.9	24,323
Jordan 2007	97.2	98.2	107.6	-9.4	40,944

	Boundary ratio, all children	Boundary ratio, surviving children	Boundary ratio, deceased children	Difference in boundary ratios (surviving - deceased)	Number of births
Kazakhstan 1995	99.0	102.0	48.5	53.5	6,846
Kazakhstan 1995	91.4	93.9	96.5	-2.5	8,467
Kenya 1989	73.5	83.8	58.6	25.3	26,231
Kenya 1993	82.3	83.2	73.4	9.8	23,881
Kenya 1998	83.5	85.0	71.5	13.4	22,813
Kenya 2003	95.2	90.6	94.8	-4.2	22,548
Kenya 2008-09	77.6	81.8	70.9	10.8	22,605
Kyrgyz Republic 1997	96.3	95.0	151.6	-56.6	9,046
Lesotho 2004	88.3	90.6	66.3	24.3	14,584
Lesotho 2009	90.5	87.7	90.6	-2.9	13,722
Liberia 1986	71.2	67.8	66.5	1.3	16,342
Liberia 2007	60.6	67.5	41.0	26.6	21,987
Madagascar 1992	85.5	93.1	69.2	24.0	20,036
Madagascar 1997	82.3	86.2	70.8	15.5	22,696
Madagascar 2003-04	63.2	65.8	70.9	-5.1	23,388
Madagascar 2008-09	73.0	77.0	58.2	18.8	49,613
Malawi 1992	82.6	86.8	62.8	24.0	16,882
Malawi 2000	63.4	67.0	53.4	13.6	41,404
Malawi 2004	73.5	78.0	65.6	12.5	35,451
Malawi 2010	87.9	91.6	68.6	23.0	70,674
Maldives 2009	97.0	95.6	48.4	47.1	19,166
Mali 1987	83.7	93.9	45.2	48.7	12,681
Mali 1995-96	81.3	88.0	69.1	18.9	38,492
Mali 2001	83.3	100.3	61.1	39.3	49,285
Mali 2006	61.0	66.9	55.4	11.5	52,529
Mauritania 2000-01	58.7	64.3	35.4	28.8	20,137
Moldova 2005	97.3	100.8	53.1	47.7	10,271
Morocco 1987	94.9	96.2	73.4	22.8	25,518
Morocco 1992	100.7	105.6	81.4	24.2	22,657
Morocco 2003-04	92.0	94.9	63.2	31.7	31,696
Mozambique 1997	65.6	80.9	35.8	45.1	26,871
Mozambique 2003	76.1	79.5	70.9	8.6	38,950
Namibia 1992	91.2	91.3	98.5	-7.2	13,206
Namibia 2000	82.7	83.8	58.8	25.1	14,508
Namibia 2006-07	79.4	82.3	47.7	34.5	18,729
Nepal 1996	98.4	106.7	67.7	39.0	28,828
Nepal 2001	99.7	105.5	64.3	41.2	28,774
Nepal 2006	92.2	97.8	60.6	37.1	26,339
Nepal 2011	91.8	91.7	77.5	14.2	26,831
Nicaragua 1998	90.6	94.3	93.0	1.3	35,328
Nicaragua 2001	79.4	83.2	78.5	4.7	32,644
Niger 1992	79.9	86.9	64.4	22.5	25,047
Niger 1998	83.4	93.1	64.8	28.3	29,784
Niger 2006	59.2	71.5	54.0	17.6	36,860
Nigeria 1990	69.2	73.4	58.1	15.3	29,074
Nigeria 1999	78.5	85.1	70.0	15.1	23,375
Nigeria 2003	100.7	104.7	85.5	19.3	23,578
Nigeria 2008	80.2	86.2	62.3	23.9	101,977
Pakistan 1990-91	51.8	61.7	47.7	14.0	26,870
Pakistan 2006-07	77.0	79.0	61.5	17.5	38,824

	Boundary ratio, all children	Boundary ratio, surviving children	Boundary ratio, deceased children	Difference in boundary ratios (surviving - deceased)	Number of births
Paraguay 1990	99.5	96.6	114.1	-17.6	14,437
Peru 1986	101.3	99.8	115.2	-15.3	13,291
Peru 1991-92	91.3	93.5	79.9	13.6	35,909
Peru 1996	88.6	94.0	58.3	35.7	64,997
Peru 2000	89.9	91.6	63.9	27.7	58,784
Peru 2004-06	85.6	86.0	61.7	24.3	34,249
Peru 2007-08	103.4	100.5	91.2	9.2	44,044
Philippines 1993	95.8	100.7	82.1	18.6	34,560
Philippines 1998	95.2	92.8	74.7	18.1	30,141
Philippines 2003	88.3	92.0	57.9	34.1	29,714
Philippines 2008	89.2	90.9	96.6	-5.7	27,403
Rwanda 1992	95.5	103.5	73.6	29.9	20,106
Rwanda 2000	77.2	84.9	55.1	29.8	28,965
Rwanda 2005	98.2	108.8	77.9	30.9	30,376
Rwanda 2010	95.1	97.9	62.1	35.8	33,039
Sao Tome and Principe 2008-09	79.6	74.9	48.8	26.1	7,119
Senegal 1986	87.0	89.1	74.6	14.5	14,389
Senegal 1992-93	91.6	93.8	102.3	-8.6	26,366
Senegal 1992-93	80.0	88.2	62.3	25.9	20,815
Senegal 2005	86.3	94.2	72.5	21.7	38,769
Senegal 2010-11	83.2	91.1	67.7	23.4	39,357
Sierra Leone 2008	58.4	64.9	41.0	23.9	21,990
South Africa 1998	80.3	82.5	65.0	17.5	22,756
Sri Lanka 1987	93.5	92.5	59.1	33.5	17,644
Sudan 1989-90	102.3	100.2	89.0	11.2	25,805
Swaziland 2006-07	74.2	80.6	60.1	20.5	11,383
Tanzania 1991-92	87.0	96.7	58.6	38.0	28,687
Tanzania 1999	95.3	98.9	116.5	-17.7	11,786
Tanzania 1999	80.4	85.9	59.6	26.3	25,063
Tanzania 2004-05	94.5	101.3	51.5	49.7	30,076
Tanzania 2010	92.0	94.9	66.4	28.5	29,201
Thailand 1987	91.2	90.4	88.3	2.1	18,611
Timor-Leste 2009-10	75.2	78.7	51.8	26.9	35,888
Togo 1988	87.4	87.5	50.0	37.5	10,782
Togo 1998	85.4	92.1	55.7	36.4	25,119
Trinidad and Tobago 1987	102.9	102.4	110.0	-7.6	7,837
Tunisia 1988	103.7	98.3	66.7	31.6	16,463
Turkey 1993	74.9	75.8	79.3	-3.4	19,827
Turkey 1998	83.5	84.9	69.1	15.8	17,209
Turkey 2003	86.2	90.9	83.0	7.9	21,173
Uganda 1988-89	102.5	103.1	88.4	14.6	16,522
Uganda 1995	72.5	84.7	68.3	16.5	24,086
Uganda 2000-01	78.1	76.3	66.3	10.0	24,922
Uganda 2006	77.8	81.5	65.1	16.4	30,154
Uganda 2011	93.9	97.0	60.2	36.8	29,683
Ukraine 2007	104.2	101.1	35.5	65.6	7,649
Uzbekistan 1996	97.2	94.9	79.3	15.5	9,979
Vietnam 1997	103.3	99.6	145.1	-45.5	15,805
Vietnam 2002	95.8	97.3	76.7	20.6	14,393

	Boundary ratio, all children	Boundary ratio, surviving children	Boundary ratio, deceased children	Difference in boundary ratios (surviving - deceased)	Number of births
Yemen 1991-92	105.5	111.5	91.4	20.1	27,798
Yemen 1997	86.1	88.8	63.4	25.4	50,982
Zambia 1992	90.5	92.9	89.3	3.7	21,920
Zambia 1996	81.0	88.3	65.9	22.4	24,358
Zambia 2001-02	85.1	89.9	77.7	12.2	23,211
Zambia 2007	100.6	103.3	90.9	12.4	21,670
Zimbabwe 1988	102.8	97.9	69.2	28.7	12,405
Zimbabwe 1994	107.3	103.1	142.8	-39.6	16,495
Zimbabwe 1999	96.2	97.9	83.6	14.4	13,628
Zimbabwe 2005-06	96.3	100.2	116.6	-16.4	19,173
Zimbabwe 2010-11	86.5	88.9	97.9	-8.9	19,255

Boundary ratio is defined as $100^* (B_{\text{boundary year}}/B_{\text{boundary year-1}})$