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How Many More Infants Are Likely to Die in Africa as a Result of the Global Financial Crisis?

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Abstract

The human consequences of the current global financial crisis for the developing world are presumed to be severe yet few studies have quantified such impact. The authors estimate the additional number of infant deaths in sub-Saharan Africa likely due to the crisis and discuss possible mitigation strategies. They pool birth-level data as reported in female adult retrospective birth histories from all Demographic and Health Surveys collected in sub-Saharan Africa nations. This results in a data set of 639,000 births to 264,000 women in 30 countries. The authors use regression models with flexible controls for temporal trends to assess an infant's likelihood of death as a function of fluctuations in national income. They then apply this estimated likelihood to expected growth shortfalls as a result of the crisis. At current growth projections, their estimates suggest there will be 30,000–50,000 excess infant deaths in sub-Saharan Africa. Most of these additional deaths are likely to be poorer children (born to women in rural areas and lower education levels) and are overwhelmingly female. If the crisis continues to worsen the number of deaths may grow much larger, especially those to girls. Policies that protect the income of poor households and that maintain critical health services during times of economic contraction should be considered. Interventions targeted at female infants and young girls may be particularly beneficial.

This paper—a product of the Poverty and Inequality Team and Human Development and Public Services Team, Development Research Group—is part of a larger effort in the department to explore the economic and human consequences of economic crises. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The author may be contacted at jfriedman@worldbank.org.

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1. *Introduction*

The US subprime crisis, and the likelihood that the attendant downturn will spread from developed to developing countries has left policy-makers and academics concerned about the "human" costs of the crisis for poor countries. These human costs could in principle take a variety of forms—lower income and consumption levels, higher unemployment, lower investments in education by families, and worse health and nutrition outcomes. Of particular concern are changes that could have irreversible consequences for the wellbeing of children throughout their lives—for example, school dropout or impaired child development at critical, early ages. No outcome is more dramatic than infant death, and in no region is infant mortality higher than in Sub-Saharan Africa (henceforth Africa, for short).[1] In this note we assess the likely impact of the current financial crisis on infant mortality in Africa. To do this, we first use data from all available Demographic and Health Surveys (DHS) for the region to construct retrospective birth and death histories, and assess the impact of past crises on infant mortality in Africa. We then use the most recent (April 2009) IMF growth projections to estimate the likely impact of the current downturn on infant mortality.

The basic messages of our analysis are two. First, although severe, the consequences of the current economic crisis for infant mortality in Africa are likely to be much smaller than many of the estimates that have been frequently cited on blogs or in the popular press.[2] Specifically, our estimates suggest approximately 30,000 to 50,000 excess infant deaths in Africa in 2009. Second, however, we find that virtually all of these excess deaths take place to girls, not boys. Furthermore, these asymmetries in the impact of the crisis by gender are particularly apparent for sharp (rather than modest) contractions in per capita GDP—a finding that is important if the current growth projections were to be revised further downward.

2. *Data and methods*

The DHS ask women a set of questions about the date of birth, current vital statistics, and date of death (if deceased) of all children ever born. We use the responses to these questions to construct retrospective birth and death histories for every woman in the surveys. Our measure of infant mortality is an indicator that takes on the value of one if a child died at a reported age of 12

[1] In 2005, the IMR per 1,000 children born was 90.8 in Sub Saharan Africa. As a comparison, in this same year the rate was 24.2 in Latin America and the Caribbean, 62.2 in South Asia (57.7 in India), and 24.8 in East Asia (21.4 in China).

[2] See http://africacan.worldbank.org/a-sub-prime-crisis-in-the-us-and-infant-deaths-in-africa; Harvey Morris, "Forgotten victims of the downturn", Financial Times March 11, 2009, p. 4; Nicholas Kristof, "At Stake Are More Than Banks", New York Times, April 1, 2009.

months or younger.[3] After removing trends from GDP in various ways, we compare the probability of infant death in years in which GDP was below trend with other years. This approach closely follows Baird Friedman and Schady (2007) (henceforth BFS; see also Paxson and Schady 2005 on a crisis in Peru and Bhalotra 2009 on cyclicality in infant mortality in India).[4]

Table 1 gives the list of countries (30) and DHS (62) in Africa. These surveys collect information on approximately 260,000 women and 640,000 live births, and are the basis for our calculations. Yearly GDP per capita numbers are taken from the IMF; for every country, Table 2 gives the average growth rate between 1993 and 2008, the growth rate in 2008, and the April 2009 IMF projection of the growth rate for 2009; the last column, finally, gives the "growth shortfall"—the difference between the 2008 growth rate and the 2009 projected growth rate.[5] This difference is a (simple) measure of how much lower growth rates in 2009 are expected to be than they would have been in the absence of the financial crisis, and are important for our calculations of "excess deaths". We discuss this in more detail below.

The basic approach we take involves pooling data from all of the surveys and running regressions of the following form:

(1) $$\mathrm{D}_{\mathrm{imct}} = \alpha_{\mathrm{c}} + \mathrm{f}_{\mathrm{c}}(t) + \beta \log \mathrm{GDP}_{\mathrm{ct}} + \varepsilon_{imct}$$

[3] We use this measure of infant mortality, rather than the standard definition of mortality for children *younger than* 12 months, because of age heaping in reports of mortality. Further, we discard information for children born within 12 months of the survey when calculating mortality rates to avoid complications with censored data. Results are largely unchanged if we restrict our mortality measure to those infants who died at an age *younger than* 12 months.

[4] Although the DHS are a rich source of data, they also have some limitations for our analysis. We briefly discuss two of these limitations, both of which are related to the use of *retrospective* information in the DHS to construct birth and death histories. First, recall bias may be a concern if women are less likely to accurately remember more distant births and deaths. To minimize recall errors, we do not use information on births that occurred more than 11 years prior to the date of the survey. However, our results are robust to different cut-offs for the recall period. Second, any given survey is representative of women ages 15-49 at the time of the survey, but is not representative of all births and child deaths in earlier years. To see this, note that a woman aged 49 in a survey carried out in 2000 would have been 39 in 1990. If no surveys were carried out between 1990 and 2000 in this country, no data would be available on births to women aged 40 or older in 1990. Children born to older women may respond to economic fluctuations differently than those born to younger women. To avoid this problem, we discard from the sample births to women age 40 or older. Our analysis therefore provides meaningful estimates of the relationship between income fluctuations and infant mortality for women aged 15 to 39. (We note, however, that a very small fraction, less than 3 percent, of births in our sample of DHS countries occur to women age 40 or older.) This retrospective construction of births and infant deaths to women aged 15-39 results in series of varying lengths and with varying start periods depending on the number and dates of DHS surveys in each country.

[5] For four countries in the table – Djibouti, Eritrea, Lineria, and Zimbabwe – growth information was missing for either 2008 or 2009 (or both). In these cases, we replace the missing value with the Africa-wide average. These four countries represent 2.9% of the SSA population and 2.5% of births and so any mis-measurement as a result of these imputations is highly unlikely to bias the aggregate results for the continent.

where D_{imct} is an indicator that takes on the value of one if child i born to mother m in country c and year t died in her first year of life, zero otherwise; α_c is a set of country fixed effects; $f_c(t)$ are country-specific time trends—in practice, we consider linear, quadratic, and cubic trends. These trends are important to ensure that we do not confound the effect of downturns in GDP with long-term trends in mortality (which may vary by country); $\log GDP_{ct}$ is the natural logarithm of per capita GDP; and ε_{imct} is the regression error term. Standard errors are clustered by country which corrects for any autocorrelation in shocks to infant mortality across years within country.

It is also possible to restrict the sample to women who have had more than one child—in the African DHS this is approximately 85 percent of women—and include a set of mother fixed effects. This compares the probability of death for two children, born to the same woman, in different economic times. This specification has the advantage that it controls for all time-invariant characteristics of mothers. The characteristics of mothers giving birth have been shown to vary with economic circumstances in some settings, and it is important to parse out differences in mortality to comparable children and families from compositional changes.[6]

The impact of a downturn on mortality may be more or less severe for different kinds of children. For example, more educated (and wealthier) mothers may be better able to smooth consumption of critical inputs into child health. In practice, because we construct retrospective birth and death histories for children born in the past to a given woman, we can only analyze heterogeneity in outcomes for mother or household characteristics that are arguably time-invariant. We focus on two: urban-rural location, and education. This approach implicitly assumes that place of residence at the time of the survey is correlated with place of residence at the time of reported child birth, and that schooling has been completed by age 15; these should be reasonable approximations for most of the countries and years in our sample. (When we restrict our sample to women age 18 or older we get very similar results.) We also consider the possibility of differential impacts for boys and girls.

Finally, it is possible that households respond differently to positive and negative shocks to GDP. It is also likely that households are better able to protect investments in child health and nutrition during relatively modest negative shocks than when these shocks are deep or sustained—as would be the case, for example, if credit constraints are important. In terms of estimation, this implies that the β coefficient in (1) above will vary with the sign and magnitude

[6] For example, Dehejia and Lleras-Muney (2004) find that, among blacks in the United States, the fraction of births to high-risk mothers goes up during recessions; while Bhalotra (2009) estimates that higher-risk women are more likely to defer fertility in India. On the other hand, BFS and Paxson and Schady (2005) do not find important changes in the composition of women giving birth in crisis and non-crisis years.

of the shock. There are different ways of exploring heterogeneity of this kind. In practice, we run a series of spline regressions.

The spline regressions we run are motivated by the fact that the one-step specification in (1) is very closely related to a two-step approach. This involves first calculating $\overline{D_{ct}}$, the average mortality rate in country c in year t, then regressing this mean on country fixed effects and a flexible, country-specific formulation of time, as before:

$$\text{(2)} \qquad \overline{D}_{ct} = \alpha_c + f_c(t) + \upsilon_{ct}$$

The residual from this regression gives de-trended measures of the infant mortality rate, D^*_{ct}. Similarly, a regression of $\log GDP_{ct}$ on country fixed effects and a flexible, country-specific formulation of time gives de-trended measures of $\log GDP_{ct}$. In the second step, D^*_{ct} is regressed on detrended $\log GDP_{ct}$, with each country-year cell being weighted by the number of live births.

$$\text{(3)} \qquad D^*_{ct} = \beta \log GDP^*_{ct} + \varepsilon_{ct}$$

In practice (and as expected) the coefficient β in (3) is very close in value to the coefficient β in (1). However, the two-step process lends itself naturally to a spline specification, as follows:

$$\text{(4)} \qquad D^*_{ct} = \beta_1 \log GDP^*_{ct} + \beta_2 [\log GDP^*_{ct} * I(K=1)] + \omega_{ct}$$

Where I(K=1) is an indicator value that takes on the value of one if the de-trended value of $\log GDP^*_{ct}$ is below a given value (the "knot" in the spline).

We consider spline specifications in which the knot is at zero, -1, and -1.5 standard deviations of $\log GDP_{ct}$, respectively. (For our sample of African countries, a one standard deviation corresponds to a 3.4 percentage point change from trend GDP.) In all of these specifications, the impact of a negative shock of a given magnitude is given by the sum of the β_1 and β_2 coefficients. For example, when the knot is fixed at zero, β_1 gives the change in infant mortality for a one-unit, *positive* deviation in $\log GDP^*_{ct}$ from expected trends, while the sum of β_1 and β_2 gives the change in infant mortality for a one-unit, *negative* deviation in $\log GDP^*_{ct}$.

3. *Results*

Main results: The basic set of results for the full sample is reported in Table 3. The first row shows that a 1 percent reduction in per capita GDP is associated with an increase in infant mortality of between 0.34 per thousand (in the specification that accounts for linear trends) and 0.62 per thousand (in the specification that accounts for cubic trends).

Should we think of these as “large” or “small” effects? We consider two ways of putting the magnitude in context. First, the average infant mortality rate for countries and years in our sample is 106.7 per 1,000 children born; this implies that a 1 percent change in per capita GDP is associated with a 0.32 to 0.58 percent change in mortality, implying an elasticity of mortality with respect to GDP of between -0.32 and -0.58. Second, the average annual decline in infant mortality for countries and years in our data is 2.56 per thousand. A 1 percent decline in GDP from expected trends is therefore associated with an increase in infant mortality that is equivalent to between 0.13 (0.34/2.56) and 0.24 (0.62/2.56) of the average annual decline in infant mortality in the sample. More meaningfully, perhaps, in countries in which per capita GDP growth was below trend, the average deviation from trend was -2.6 percentage points. The average event of below-trend growth in our data was therefore associated with an increase in mortality of between 0.34 and 0.62 percent of the average annual decline in IMR.

Changes in the composition of women giving birth: The second and third rows of Table 3 focus on possible changes in the composition of women giving birth. We first re-estimate our basic model, but limit the sample to women who have had at least two live births. The coefficients on log per capita GDP for this somewhat smaller sample are very similar to those for the full sample of women—a little bit larger in the linear specification, and a little bit smaller in the quadratic and cubic specifications. In the third row of the table we then present the results from regressions that include mother fixed effects. These results are reasonably similar to those in the second row, which suggests that changes in the composition of women giving birth explain at most a small fraction of the increases in infant mortality we observe during negative shocks to GDP in Africa.

Heterogeneity by gender, place of residence, education: In Table 4, we consider the possibility that shocks to per capita GDP have different effects on the mortality of boys and girls (upper panel), on the mortality of children born to women living in urban and in rural areas (middle panel), and on the mortality of children born to women with more or less education (lower panel). The table suggests that, in Africa, the mortality of girls is substantially more sensitive to income shocks than is the mortality of boys: A 1 percent deviation in GDP results in approximately 0.33 more boy deaths per thousand, but 0.62 more girl deaths per thousand; note, moreover, that the differences in percentage terms are even larger because of the higher average mortality of boys than girls—a well-known finding in the demographic literature.[7] The middle and lower panels of the table suggest that the mortality of children in rural areas, and of children

[7] For example, the World Health Organization (2006) estimates that the male-to-female ratio in neonatal mortality and in early neonatal mortality in developing countries is 1.3.

born to mothers with lower levels of education is also more sensitive to deviations from GDP trend (although base infant mortality rates for women in rural areas and those with less education tend to be higher; as a result, the *proportional* increases in mortality tends to be more closely similar to each other).

Heterogeneity by size of shock: Table 5 presents the results from a variety of spline specifications, as described above, separately for boys (left-hand side of the table) and girls (right-hand side). In each case, the right-hand panel, corresponding to positive shocks (or negative shocks of smaller magnitude) reports the coefficient β_1, while the left-hand panel, corresponding to negative shocks of increasingly large magnitude, reports the sum of the β_1 and β_2 coefficients.

The table makes clear that deep, negative shocks to GDP have particularly dire consequences for the infant mortality of girls. Thus, in the specification that fixes the knot at zero, a 1 percent negative deviation in GDP results in an increase in infant mortality of 0.25 per thousand boys born, but 0.90 per thousand girls born; for negative deviations of 1 standard deviations or larger, the comparable coefficients imply increases in mortality of 0.14 per thousand for boys, and 1.73 per thousand for girls; finally, for the deepest shocks of 1.5 standard deviations or larger, every percentage point reduction in GDP results in an increase in mortality of 0.046 per thousand boys born, and 2.14 per thousand girls. All of the coefficients for girls are highly significant, but none of those for boys. Thus, a negative shock that would lower the growth rate of per capita GDP by 10 percentage points from its underlying (cubic) trend would result in approximately 22 more deaths per thousand girls born, but have no impact on boy mortality. Put differently, for the largest negative shocks to GDP, the elasticity of infant mortality with respect to GDP is -2.1 for girls, but not significantly different from zero for boys.[8]

The very stark differences in the impact of aggregate shocks on the mortality of boys and girls are surprising, as Africa is not a region with clear patterns of "son preference" (unlike South Asia, for example). One possible explanation is that households protect sons over daughters when their incomes fall (even if they do not necessarily do so at other times). An alternative explanation is that there is selection in births. In comparison to females, male fetuses have a relatively difficult time surviving pregnancy (see Perls and Fretts, 1998; Mizuno, 2000) and this difference may be exacerbated during hardship periods. Almond et al. (2007) argue that, during the economic chaos associated with the Great Leap Forward in China, the ratio of male to female

[8] This finding of differential responses in male and female infant mortality is not limited to the cubic functional form. The same patterns are found with a quadratic polynomial in time, or if the relationship between infant mortality and GDP is estimated with first differenced data.

births fell because of an increase in spontaneous abortions of male fetuses. Given this, the health endowment of girls born would on average then be lower than that of boys, and this could result in higher mortality of girls *after birth*.

To investigate this possibility, we calculated the ratio of male to female births when deviations in per capita GDP was negative, and compared it to cases where it was positive; when per capita GDP was below -1 standard deviations, and compared it to cases where it was above this value; and when per capita GDP was below -1.5 standard deviations, and compared it to cases where it was above this value. (In each case, a cubic trend is first removed from GDP, as before.) In each of these cases, the ratios of female to male births were very similar, and we can never reject the null that they are the same. For example, the ratio of male to female births was 1.031 when deviations from GDP were negative, and 1.019 when positive. Similarly, the ratio of male to female births was 1.022 when deviations from trend GDP were less than -1.5 standard deviations, and 1.026 when above. In neither comparison is the difference in the ratios statistically significant at conventional levels. By contrast, and consistent with the results we present above, the ratio of male to female deaths in the first year is always higher when detrended GDP is negative, especially when the negative shocks are large. We conclude that the data are not consistent with a selection story along the lines described above. Rather, they are likely to reflect differences in behavior towards boys and girls by parents or health providers at times of economic distress.

<u>Calculation of "excess deaths"</u>: In Table 6, we present some basic calculations of the number of excess infant deaths that are likely to take place in Africa in 2009. To do this, we first calculate the number of children born in each country (using the total population and crude birth rates for 2008 taken from the World Bank DDP database). We then calculate excess deaths corresponding to three scenarios. In the first scenario, we compare the April 2009 IMF projected growth rates for 2009 with *actual* growth rates in 2008—see Table 2. The difference between these two values then gives the decline in per capita GDP that can plausibly be attributed to the global financial crisis. This difference, multiplied by the coefficient in Table 3 (or Table 5, for the spline specification), and scaled by the number of children born in a given country, gives a country-specific estimate for excess deaths. (In the table, we report the sum for all of Africa.) These calculations, summarized in the top row in the table, suggest that, using the most recent IMF projections, we could expect there to be somewhere between 28,000 and 49,000 excess deaths in Africa in 2009.[9,10]

[9] All of these calculations make a number of important assumptions. First, that negative shocks to GDP do not have an effect on aggregate fertility rates. This is because the number of deaths depends not only on the

Suppose, however, that the IMF growth projections were too conservative, so that the "true" contractions in GDP were larger. In the middle and bottom row we assume that every country in Africa were to have a growth rate that was 6 percent (middle row) or 10 percent (bottom row) below trend. Under these much more dire scenarios, excess deaths would be approximately 61,000 to 166,000 for the 6 percent reduction, and 101,000 to 322,000 for the 10 percent reduction—a very large number by almost any measure, but still substantially below many of the numbers discussed in the popular press. We note, however, that Table 5 suggests that essentially *all* of these excess deaths would take place to girls, rather than boys. In Africa, there appears to be a very important gender dimension to the likely impact of negative shocks to aggregate GDP.

4. *Discussion and conclusion*

Aggregate economic shocks can have serious, deleterious consequences for the wellbeing of children. In practice, these consequences depend on the nature and depth of the shock; on the extent to which households have access to credit or other mechanisms that allow them to smooth out the effects of an income shortfall; on public and other investments in education and health; and on the outcome being considered. There may also be important differences in the impact of a systemic shock by place of residence, socioeconomic status, and gender. In practice, aggregate economic shocks, whether from macroeconomic crises, collapses in the price of key exports, or weather shocks, appear to have had negative implications for child health and education in Africa (Ferreira and Schady 2009).

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mortality rate, but also on the number of children *born*. However, in regressions of the crude birth rate on country-specific intercepts, country-specific time trends and a variable for $\log GDP_{ct}$, the coefficient on GDP is small and not significant at conventional levels. Second, we assume that the coefficients estimated above can be "applied" to the full list of African countries—including those that have never fielded a DHS, and were therefore not part of our sample. This assumption seems reasonable given the large number of countries that have carried out DHS in Africa—see Table 1. Third, we assume that a given change in per capita GDP will on average have the same effect on infant mortality in 2009 as it has in the past. There is obviously no way to test this assumption. Conceivably, the fact that the crisis is global (unlike the trend deviations in per capita GDP that form the basis for the calculations in the tables in the paper) could mean that the impacts of contractions in GDP will be larger—for example, if developed countries are less able or willing to provide aid—or smaller—if widespread awareness of the potential consequences of such a crisis on mortality prompts African countries or donors to take measures that counteract its effects.

[10] An alternative approach to estimating the growth impacts of the financial crisis compares the World Bank's latest growth projections for 2009 (as of mid-April, 2009) with earlier projections (from 2007) for the same calendar year. This approach, as adopted in Chen and Ravallion (2009), yields a smaller growth shortfall for Sub-Saharan Africa than the IMF projections used here – a cross-country average contraction of 1.7% of GDP in comparison with a 2.5% contraction – and consequently somewhat fewer excess deaths, ranging from 16,000 to 23,000 depending on the specification. Because the IMF growth projections are more current (at the time of writing) we report the excess deaths based on these figures.

In this note, we use household level data on mortality, national accounts data on past shocks, and the most recent IMF projections of future growth to estimate the impact of the current global slowdown on infant mortality. Our estimates suggest that there will be on the order of 30,000 to 50,000 excess deaths in Africa in 2009—deaths that would not have taken place had the subprime crisis which began in the United States not spread to African countries. This is a large number. Nevertheless, it is substantially smaller than alternative estimates, generally based on aggregate (rather than household) data, and with cruder if any controls for household characteristics. The increase in infant mortality that can be attributed to the global slowdown is also a small fraction of overall infant deaths in Africa: In Africa, approximately 30 million children are born, and more than 3 million of them die before they reach their first year of life. The bigger tragedy is perhaps not that 30,000 to 50,000 additional children are likely to die in Africa in 2009, but rather that so many children die in any given year.

Nevertheless, the likely increase in infant mortality presents some important policy challenges, as does the fact that the bulk of the additional children who will die is likely to be found among poorer households (in rural areas, and those with lower education levels) and is concentrated among girls. This note cannot discuss the benefits and limitations of individual policies in great detail. However, we briefly mention a handful of policy responses that are perhaps important for policy-makers to consider:

- *Policies that limit the extent to which the aggregate GDP shortfalls translate into income shortfalls for households*: Such policies could include a well-designed public works scheme, perhaps with guaranteed employment at low wages (the latter, to ensure self targeting), or cash transfers to households in poor areas, areas that appear to have been particularly hard-hit by the contraction, or to households with characteristics that are correlated with low incomes (for example, low education levels).

- *Policies that limit the extent to which the contraction in aggregate GDP leads to a decline in the quantity or the quality of critical health services*—such as prenatal and post-natal check-ups for women, attended birth deliveries, and growth monitoring for children. Paxson and Schady (2005) show that, in Peru, public health expenditures fell by more than 50 percent during the crisis of the late 1980s, and that the utilization of critical health services by households also declined. Ferreira and Schady (2009) show that, by contrast, in Indonesia there was a much smaller contraction in public expenditures in 1997-98, and that this contraction was made up by increases donor assistance; they argue that this may explain, in part, why infant mortality appears to have spiked much more sharply in Peru than in Indonesia.

- *Interventions targeted at girls*: The fact that, in crises past, increases in infant mortality have been almost exclusively concentrated among girls presents a serious challenge to policy-makers in the region. We do not have a good understanding of the mechanisms whereby aggregate economic contractions translate into more deaths for girls, but not boys in Africa—a critical element to designing effective policies (although selection into birth does not appear to be an important part of the story). Nonetheless, policies that ensure that girls receive sufficient food and critical services are worth considering; conditional cash transfers that focus on conditions for girls may also be effective. More broadly, it is important to track inputs and outcomes at the household and provider level, and to disaggregate the findings by gender.

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Table 1. List of DHS datasets used in the analysis, including information on country, year of survey, number of mothers, and number of births

Country	Survey Years	Total Mothers	Total Births
Benin	1996, 2001	7515	18891
Burkina Faso	1993, 1999, 2003	16362	39410
Burundi	1987	2416	6464
Central African Republic	1995	3373	7962
Cameroon	1991, 1998, 2004	11444	27350
Chad	1997	4655	11829
Comoros	1996	1405	3838
Cote d'Ivoire	1994, 1999	6660	15993
Ethiopia	2000	8436	20484
Gabon	2001	3371	7084
Ghana	1988, 1994, 1999, 2003	11841	25675
Guinea	1999	4549	11224
Kenya	1989, 1993, 1998, 2003	18457	44289
Liberia	1986	3419	8669
Madagascar	1992, 1997	7592	19195
Malawi	1992, 2000	11368	27292
Mali	1987, 1996, 2001	17915	47710
Mozambique	1997	5535	12468
Namibia	1992, 2000	6674	13550
Niger	1992, 1998	9468	26714
Nigeria	1990, 1999, 2003	14333	36543
Rwanda	1992, 2000	9317	23607
Senegal	1986, 1993, 1997	11881	30636
South Africa	1998	6017	9970
Sudan	1990	4242	11314
Tanzania	1992, 1996, 1999	12826	29743
Togo	1988, 1998	7611	18582
Uganda	1989, 1995, 2001	11883	30062
Zambia	1992, 1997, 2002	13776	32044
Zimbabwe	1989, 1994, 1999	9346	19913
Total: 30 Countries	62 Surveys	263687	638505

Table 2. Past growth and 2009 projected growth in Sub-Saharan African nations

Country	Average Growth 1993-2008	2008 Growth	IMF 2009 projections	Growth shortfall
SubSaharan Africa	3.9	4.9	2.5	-2.4
Angola	8.1	14.3	-3.6	-17.9
Benin	4.5	4.9	3.8	-1.1
Botswana	5.6	3.0	-10.4	-13.4
Burkina Faso	4.8	4.1	3.5	-0.6
Burundi	0.4	4.4	3.5	-0.9
Cameroon	3.1	3.9	2.4	-1.5
Cape Verde	6.1	6.7	2.5	-4.2
Central African Republic	2.0	3.4	2.4	-1.0
Chad	5.5	1.6	2.8	1.2
Comoros	1.5	0.6	0.8	0.2
Congo, Dem. Rep.	0.3	8.7	2.7	-6.0
Congo, Rep.	2.8	9.1	9.5	0.4
Cote d Ivoire	1.8	2.7	3.7	1.0
Djibouti*	3.9	4.9	2.5	-2.4
Equatorial Guinea	30.0	8.1	-5.4	-13.5
Eritrea	4.2	1.2	1.1	-0.1
Ethiopia	7.0	10.8	6.5	-4.3
Gabon	2.1	3.0	0.7	-2.3
Gambia, The	4.1	5.3	4.0	-1.3
Ghana	4.9	6.4	4.5	-1.9
Guinea	3.6	3.0	2.6	-0.4
Guinea-Bissau	1.3	2.9	1.9	-1.0
Kenya	3.2	2.4	3.0	0.6
Lesotho	3.6	4.1	0.6	-3.5
Liberia*	3.9	4.9	4.9	0.0
Madagascar	3.4	6.8	-0.2	-7.0
Malawi	3.9	7.0	6.9	-0.1
Mali	4.8	5.0	3.9	-1.1
Mauritania	3.9	2.1	2.3	0.2
Mauritius	4.7	5.0	2.1	-2.9
Mozambique	7.5	6.5	4.3	-2.2
Namibia	3.9	2.7	-0.7	-3.4
Niger	3.6	4.9	3.0	-1.9
Nigeria	4.4	6.1	2.9	-3.2
Rwanda	5.0	8.4	5.6	-2.8
Senegal	3.9	4.5	3.1	-1.4
Sierra Leone	4.0	5.8	4.5	-1.3
South Africa	3.4	3.1	-0.3	-3.4
Sudan	6.4	6.1	4.0	-2.1
Swaziland	2.3	2.2	0.5	-1.7
Tanzania	5.1	7.2	5.0	-2.2
Togo	3.0	0.8	1.7	0.9
Uganda	6.6	6.9	6.2	-0.7
Zambia	3.2	5.5	4.0	-1.5
Zimbabwe	-1.7	-4.9	2.5	7.4

Note: where missing (Djibouti, Liberia, 3rd column Eritrea, 4th column Zimbabwe) missing value replaced with SSA average

Table 3. Estimates of relation between IMR and GDP for Sub-Saharan Africa, by various trend accountings

Dependent variable	Linear	Quadratic	Cubic
		Unadjusted	
IMR	-33.73	-46.07	-47.67
	[16.70]*	[15.95]***	[22.05]**
		Unadjusted, restricted to mothers with multiple births	
IMR	-38.68	-41.91	-46.38
	[17.74]**	[15.17]***	[25.77]*
		Mothers' fixed effects	
IMR	-42.93	-39.54	-34.76
	[18.79]**	[18.07]**	[25.87]

Note: Number of observed births equals 613,468 in panel, 532,419 in bottom two panels. Robust standard errors are clustered at the country level - there are30 countries. GDP is measured in year 2000 international (PPP) dollars.* p<.10, ** p<.05, *** p<.01

Table 4. Estimates of relation between IMR and GDP by child or mother characteristics, quadratic trend

Dependent variable	Characteristics	
	Boy	*Girl*
IMR	-32.91	-61.94
	[25.03]	[25.72]**
Mean IMR	113.68	100.35
N	310265	303203
	Urban	*Rural*
IMR	-29.70	-53.45
	[25.77]	[23.32]**
Mean IMR	83.24	116.36
N	171649	441819
	Primary or greater	*Less than primary*
IMR	-28.67	-51.24
	[21.44]	[26.95]*
Mean IMR	71.58	119.93
N	162881	450587

Note: Robust standard errors are clustered at the country level - there are30 countries. GDP is measured in year 2000 international (PPP) dollars.
* p<.10, ** p<.05, *** p<.01

Table 5. Heterogeneity in IMR and GDP relation by size of GDP deviation from cubic trends, by gender

	Boys		***Girls***	
	<= 0	*> 0*	*<= 0*	*> 0*
Knot at zero	-24.47	-39.80	-90.25	-24.80
	[26.39]	[40.75]	[29.32]***	[36.96]
	<= -1 sd	*> -1 sd*	*<= -1 sd*	*> -1 sd*
Knot at -1 s.d.	-14.21	-36.47	-172.68	-28.30
	[29.11]	[29.74]*	[46.64]***	[28.32]
	<= -1.5 sd	*> -1.5 sd*	*<= -1.5 sd*	*> -1.5 sd*
Knot at -1.5 s.d.	-4.16	-35.46	-214.12	-38.14
	[26.87]	[27.73]	[56.93]***	[25.69]

Note: Slope coefficients are estimated from a continuous spline specification. Robust standard errors are clustered at the country level. GDP is measured in year 2000 international (PPP) dollars.* p<.10, ** p<.05, *** p<.01

Table 6. Summary estimates of excess infant deaths as a result of the economic crisis, by various growth forecasts and impact specifications

Independent variable	Linear	Quadratic	Cubic	Cubic, restricted to FE sample	Cubic, mother fixed effects	Spline, cubic
Difference between 2009 IMF growth projections and 2008 growth	28472	38888	40229	39140	29334	49370
Posited 6% decline in projected growth	60719	82933	85913	83491	62573	165901
Posited 10% decline in projected growth	101198	138221	143022	143022	139151	321746