Child Health and the 1988-1992 Economic Crisis in Peru

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Abstract

The effect of economic crises on child health is a topic of great policy importance. We use data from the Demographic and Health Surveys (DHS) to analyze the impact of the profound 1988-92 economic crisis in Peru on infant mortality and anthropometrics. We show that there was an increase in the infant mortality rate of about 2.5 percentage points for children born in late 1989 and 1990, implying that about 17,000 more children died than would have in the absence of the crisis. We also present suggestive evidence that the crisis affected children's nutritional status. In 1992, children under the age of 6, who had been exposed to the crisis, were shorter than same-aged children in 1996 and 2000. We do not have data on child height prior to the crisis, but the age profile of changes in nutritional status and the fact that the 1996 and 2000 height-for-age schedules are very similar to each other both suggest that the 1992 values represent declines from previous levels. Accounting for the precise source of the increase in infant mortality and in malnutrition is difficult, but it appears that both the decrease in household incomes and the collapse in expenditures on public health played an important role.

I.   Introduction

The positive relationship between income and health has been well documented across countries and within countries—both developed and developing (see, for example, Preston 1975 on international comparisons; Case, Lubotsky and Paxson 2003 on the United States; and Strauss and Thomas 1998 and the references therein for developing countries). Numerous studies have also shown that much of the correlation between income and health persists even after taking into account differences in education or access to services: Children from richer households are less likely to be malnourished, and they suffer fewer instances of health problems such as diarrhea and acute respiratory infections, as well as from diseases like malaria and tuberculosis. Wealthier people have higher life expectancy, and they are less afflicted with health problems during their lives.

Disentangling the effect of income on health status from the effect of health status on income is no easy matter, as the causality is likely to flow in both directions. Despite these identification difficulties, some recent work in developing countries suggests that at least part of the observed association reflects a causal effect of income on health (for example, Case 2001; Duflo 2000). Under these circumstances, one might expect that sudden, sharp downturns in aggregate income, such as those caused by macroeconomic crises, droughts or floods might all lead to the deterioration in health outcomes. This could happen in a number of ways. If households are unable to buffer their consumption, income shocks may result in declines in the nutritional status of children and pregnant women. Maternal malnutrition when children are *in utero* is associated with higher infant mortality and, for children who survive, with health problems in middle age (Barker 1987). Malnutrition in childhood is associated with increased morbidity and mortality (for example, Martorell and Ho 1984; Livi-Bacci 1991; Lunn 1991). Finally, economic crises may also affect health through reductions in public sector spending on health care.

Although sudden contractions in income may lead to worse health outcomes, this need not be so. If households see crises as a transient shock to income, and if they are able to smooth consumption, health status may not suffer. Even if they cannot fully smooth out income shocks, households may be able to protect some expenditures—for example, nutritious foods, or health care—within the budget. And governments could put in place programs to mitigate the effects of a crisis. There could also be other, offsetting effects on health status. There is considerable evidence that couples are more likely to defer conception during economic crises (for example, Ben-Porath 1973 on Israel; Ashton and Hill 1984 and Coale 1984 on China during the "Great Leap Forward"; and Stein, Susser, and Marolla 1975 on the impact of the Dutch famine of 1944-45). Deferred fertility may lead to more widely spaced births and to fewer births to very young women, and may therefore *lower* mortality (Palloni and Hill 1997). In affluent countries, where the underlying health status of the population is relatively high, economic recessions may compel people to do more exercise, eat healthier diets, and smoke less—all of which could improve health outcomes (see Ruhm 2000 on the United States).

Empirical work on the effect of economic crises on health status has proceeded in two ways. A large body of work has used historical data from national registries on vital rates—births, marriages, and deaths—in particular for pre-industrial European populations as early as the sixteenth century. These studies use changes in the price of basic staples or weather shocks as a measure of economic downturns, and trace out contemporaneous or lagged changes in vital rates (see especially Lee 1981 and 1990; Galloway 1988; Fogel 1992). Similar techniques have also been applied to Latin America. Reher (1989) uses Mexican data for the eighteenth century, and finds a clear impact of changes in food prices on nuptiality, fertility, and mortality. Research with these techniques on more recent data in Latin America and other developing countries finds weaker demographic responses to economic downturns. In particular, the effect of changes in income or wages on the mortality of both children and adults is generally small and statistically insignificant (for example, Hill and Pebley 1988; Palloni and Hill 1992; and the collection of papers in the volume edited by Tapinos, Mason, and Bravo 1997).

The historical work on Europe and Latin America as well as more recent work on developing countries is informative, but suffers from two important data limitations. First, it is based on national registries, and these registries are likely to be very incomplete (as the authors generally acknowledge). Moreover, the likelihood of reporting marriages, births and deaths may itself change during an economic downturn, which makes interpretation of the results difficult. Second, these registries generally have very limited (if any) information on individual characteristics, such as education levels, employment, access to health services and other factors that could change during crises, especially prolonged ones, and that could themselves have a causal effect on morbidity and mortality. In part because of these shortcomings of the data, a second body of work on the effect of economic downturns on mortality has made use of household surveys. These surveys generally take a representative sample of the population of a country, and collect information on household composition, assets, education levels, health-seeking behavior and health status, and (more infrequently) household consumption or income. We briefly review some of this literature below.

Research on African countries suggests that sudden contractions of household income lead to a deterioration of the nutritional status of young children. Jensen (2000) shows that rainfall shocks in Cote d'Ivoire led to fewer sick children being taken for medical consultation, and increased the fraction of children with low weight for height by 3-4 percent; Yamano, Alderman and Christiaensen (2003) find that children between the ages of 6 and 24 months in Ethiopia experience about 1 cm less growth over a six-month period in communities with crop damage by drought; Alderman, Hoddinott and Kinsey (2002) find that exposure to the 1982-84 drought resulted in a permanent loss of stature of 2.3 cm in Zimbabwe. In Bangladesh, both the 1988 and 1998 floods resulted in lower-than-expected growth among exposed children (Foster 1995; del Ninno and Lundberg 2002). In East Asia, early work on the Indonesian financial crisis showed no significant effects on weight-for-height and height-for-age (Frankenberg, Thomas and Beegle 1999; Cameron 2002; Waters, Saadah and Pradhan 2003). Analysis based on more recent data, which compares child health between 1997 and 2000, shows improvements in anthropometric

outcomes, although it is not clear whether these changes are a result of recovery from the crisis or of underlying secular trends (Strauss and others 2002). The collapse in income and consumption levels in many countries of the former Soviet Union in the 1990s was associated with a dramatic decrease in life expectancy and increases in adult mortality (particularly from alcoholism and suicide), but no important change in child health (Shkolnikov et. al 1998; Brainerd 1998 and 2002). In sum, the effect of income shocks on the health status of children seems to vary a great deal by country, with the largest effects being found in the poorest countries.

While there is some research on the effects of macroeconomic crises on schooling outcomes in Latin America (de Ferranti and others 2000; Schady, forthcoming 2004), there is no comparable research using micro-level data on health outcomes. In this paper, we focus on Peru, and present several pieces of evidence that suggest that child health status worsened during the severe 1988-1992 macroeconomic crisis and (less clearly) during an earlier crisis in the 1980s. Between 1988 and 1992 GDP per capita fell by almost 30 percent in Peru, while the 1982-83 crisis lead to a contraction in per capita GDP of almost 14 percent. Both crises occurred at the same time as other shocks: In 1982-83 Peru suffered from the worst El Niño weather shock in a century, and in 1991 there was a large cholera epidemic.

Peru has relatively good data on child health, with Demographic and Health Surveys (DHS) conducted in 1986, 1992, 1996, and 2000. We use these data to show that there was an increase in the infant mortality rate of about 2.5 percentage points for children born in late 1989 and 1990, implying that about 17,000 more children died than would have in the absence of the crisis. We also present suggestive evidence that the crisis affected children's nutritional status: In 1992, children under the age of 6, who had been exposed to the crisis, were shorter than same-aged children in 1996. We do not have data on child height prior to the crisis, and sorting out secular improvements from the effects of shocks is difficult. However, the age profile of changes in nutritional status and the fact that the 1996 and 2000 height-for-age schedules are very similar to each other (but different from the 1992 schedule) both suggest that the 1992 values represent declines from levels that would have prevailed in the absence of the crisis.

The rest of the paper proceeds as follows. In section II we describe economic shocks in Peru in the 1980s and 1990s in greater detail, while section III describes data sources. Section IV presents the main results for infant mortality and nutritional status. In section V we discuss alternative possible explanations for our findings. Section VI concludes.

II.   Economic Shocks in Peru

The 1980s were a troubled decade for the Peruvian economy. After the return to democracy in 1980, the economy performed reasonably well during the first two years of the presidency of Fernando Belaúnde (1980-85), with growth rates of 4.7 and 4.5 percent in per capita GDP in 1980 and 1981, respectively (see Figure 1). By 1982, however, the combination of the world recession, a decline in the

price of key Peruvian exports like copper and oil, and the Mexican debt crisis all damaged growth prospects. Matters got worse in 1983, as the economic decline was compounded by the worst El Niño weather shock in a century, which led to heavy flooding along the northern coast, and a serious drought in the southern highlands. The economy went into recession, with a 3.0 percent contraction in per capita GDP in 1982, and a further 13.9 percent contraction in 1983.

The election of Alan García to the presidency (1985-90) brought more economic turmoil to Peru. Peru posted healthy growth rates in 1986 (7.8 percent) and 1987 (5.8 percent), but García's "heterodox" stabilization program, which relied on reduced foreign debt payments, a price freeze, and economic reactivation via wage increases, job creation programs, and increased investments in education and health, quickly proved to be unsustainable. In 1988, the country went into a deep recession and hyperinflation. Per capita GDP fell by approximately 28 percent in the last three years of the García presidency, and the inflation rate reached an incredible 7,482 percent in 1990. Real wages collapsed: Estimates based on labor force surveys conducted annually in Lima suggest that wage income in 1990 was barely 15 percent of its 1987 level (Figure 1).[1]

The Fujimori government, which took office in 1990, opted for more orthodox economic remedies. Economic reforms included the elimination of controls on prices, interest rates, and foreign exchange transactions, the reduction of tariffs, labor market de-regulation, and a far-reaching program of privatization. The new policies sharply brought down inflation to 74 percent in 1992, and to less than 12 percent by 1995. Price stabilization had an immediate effect on wages, which rose sharply in 1991. Growth increased after 1992, and Peru posted very high growth rates in the 1993-97 period (10.6 percent in 1994 alone). Like the crisis, the recovery appears to have been far-reaching, affecting all regions and most households. Poverty fell significantly between 1991 and 1997 (World Bank 1999).[2] But economic performance between 1998 and 2001 was disappointing. Even worse, per capita GDP in 2001 was still below its 1970 level.

The 1988-92 economic crisis did not have an important negative impact on schooling outcomes. In an earlier paper, Schady (forthcoming 2004) shows that school attendance rates were unchanged, the fraction of children who combined school with work dropped significantly, and children exposed to the crisis had completed a higher number of grades for their age than the comparable unexposed. This took place in spite of a dramatic reduction in public expenditures on education, and a decrease in the rate of return to schooling. But the fact that the 1988-92 crisis did not have obvious negative effects on schooling

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[1] These estimates are based on Saavedra and Pasco Font (2001). The first labor force survey was conducted in 1986, and there were no surveys in 1988 or 1996. Glewwe and Hall (1994) use the Living Standards Measurement Surveys (LSMS) conducted in Lima in 1985/86 and 1990 to estimate that real wages fell by 60 percent between 1985 and 1990.

[2] Strict comparisons in poverty measures are not possible because of differences in the coverage of the 1985/86, 1991, 1994, and 1997 LSMS.

does not necessarily imply that the same would hold for child health.[3] Investments in schooling may be more sensitive to changes in the opportunity cost of children's time that take place during economic crises—for example, if the demand for education increases during recessions because of reduced employment opportunities for children.

III.   The Data

The bulk of the analytical work in this paper is based on data from the 1986, 1992, 1996 and 2000 Peru Demographic and Health Surveys (DHS). The DHS are nationally representative samples of women aged 15 to 49. The sample sizes vary across the survey years. The 1986 DHS contained information on 4,999 women aged 15-49. Sample sizes for 1992, 1996 and 2000 were considerably larger: 15,882 women, 28,951 women, and 27,843 women, respectively. All surveys contain a set of questions on the date of birth, current vital status, and the date of death (if deceased) of all children ever born to the respondent. More extensive information was collected on children born within five years of the survey. The 1992, 1996 and 2000 DHS data contain information on the heights and weights of currently-living children aged 59 months and less, and information on the circumstances surrounding the births of these children (for example, where the child was delivered). The surveys also collect information on a range of household socio-demographic characteristics, including urban status, maternal education, housing characteristics and ownership of durable goods.[4]

We supplement data from the DHS with data on public expenditures on health, per capita GDP, and wage income. The health expenditure data were compiled from budgetary data kept by the Ministry of Economy and Finance in Peru.[5] They refer to actual (rather than budgeted) expenditures, and are generally thought to be comparable over time. Public health expenditures include all expenditures made by the Ministry of Health, both by the centrally administered programs and by programs executed locally. They do not include expenditures by local governments on health, although these are generally thought to be negligible in Peru. Health expenditures also do not include expenditures made by ESSALUD, the health insurance system that covers formal sector workers in Peru, as these data are not available. The GDP per capita data are taken from World Bank data bases, and are in constant 1995 US dollars. Data on real wage income are taken from the labor force surveys conducted in Lima, as published in Saavedra and Pasco Font (2001).[6]

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[3] These estimates may be unreliable. Measurement of the number of cases of and deaths from cholera is difficult, especially in children, because the primary symptom of cholera—diarrhea—is associated with a number of diseases that are common in childhood.

[4] For further information on the DHS surveys see http://www.measuredhs.com/.

[5] We would like to thank Pedro Francke for making these data available to us.

[6] We would like to thank Jaime Saavedra for making these data available to us.

IV.   Child Health in Peru

A.   Infant Mortality

We begin by examining how infant mortality, defined here as children who die at 12 months of age or less, evolved over the 1980s and 1990s.[7] We use the retrospective birth and death histories from each DHS survey to construct infant mortality rates, by date of birth, in the first and second half of each calendar year. To avoid problems with censored data, we discard information on all children born within 23 months of the survey.[8] We also discard births that occurred when the mother was less than 15 years of age and births that occurred more than 12 years prior to the survey date. Mortality rates were constructed using the sample weights provided in the survey.

Although each DHS is representative of women aged 15 to 49 at the time of the survey, it is not representative of all births (and child deaths) at earlier years. For example, the results for infant mortality among children born in 1990, using the 2000 DHS, represent the death rate among children born to women aged 15 to 39 in 1990. Births to women aged 40 to 49 in 1990 are not included, since these women were too old to be included in the 2000 sample. It is not clear how this feature of the data biases our measures of the infant mortality rate: The direction of bias depends on whether the children of the older mothers who were excluded have higher or lower infant mortality rates on average than the younger age group that is included. An additional source of bias is error in recalling the dates of more distant births and deaths.

We first show mortality rates calculated from each DHS separately, so that we can compare mortality rates computed for the same date of birth but using different rounds of the DHS. The results, shown in Figure 2, have two important features. First, the patterns of infant mortality rates by date of birth are similar across surveys. Thus, there do not appear to be systematic biases in the rates we calculate using retrospective information on births. Second, there is a sharp increase in the infant mortality rate around 1990. This increase, which appears in data from the 1992, 1996 and 2000 surveys, begins with infants born in the second half of 1989, and peaks for infants born in the first half of 1990. This increase in the infant mortality rate—from approximately 5 percent to 7.5 percent—is large. The Peruvian population was 21,988,912 in 1990, with a crude birth rate of 31.73 per thousand,[9] implying that approximately 697,708 children were born in the country in 1990. An increase in the infant mortality rate

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[7] The DHS data display age heaping in mortality, so that more children are reported to have died at exactly 12 months than at 11 or 13 months. There is generally heaping at 6 month intervals (6 months, 12 months, 18 months, etc.) We measure infant mortality as mortality at 12 months or less rather than under 12 months (as is conventional) since many of the children who are reported to have died at 12 months may in fact have died earlier. Our results are not sensitive to the exact age cutoff we use.

[8] In theory we should only have to discard data on children born within 12 months of the survey, since we do not know if these children survive past 12 months. However, given the age heaping we discussed we adopt a more conservative approach.

[9] These numbers are the from the U.S. Census Bureau's online International Data Base, found at http://www.census.gov/ipc/www/idbacc.html .

from 5 percent to 7.5 percent implies there were 17,184 "excess" infants deaths among children born in 1990. The fact that the mortality spike appears in all three surveys that cover this time period indicates that it is unlikely to be the result of sampling error.

Because the different DHS surveys yield similar infant mortality rates for children born at different dates, we average across surveys and superimpose the time series for per capita GDP and wage income.[10] Figure 3 highlights the fact that the spike in infant mortality among children born in 1990 coincides with the worst portion of the economic crisis, when per capita GDP was falling to its lowest levels and real wages had not yet recovered. A similar spike in infant mortality is observed in 1983, when Peru experienced a smaller economic crisis. But the spike in infant mortality in 1983 appears in data from the 1986 DHS but not from the 1992 DHS (Figure 2). Because the 1986 survey was quite small and the estimates of mortality based on these data are noisy, this spike provides much less clear evidence on a possible increase in mortality in 1982-83. Mortality and per capita GDP are clearly inversely related over this time period: a regression of the logarithm of the mortality rate on the logarithm of per capita GDP, including a time trend, implies that the elasticity of the mortality rate with respect to per capita GDP is

-0.973 (t=2.92).

Did the increase in infant mortality during the crisis affect some households more than others? This certainly would seem plausible—for example, if households with more education or higher levels of wealth were better able to buffer their families against the effects of the crisis. To investigate this hypothesis, we next turn to probit regressions of the following form:

$$P(M_{t,t+1} \mid B_t) = \delta^M (YEAR_t) + f^M(age_t) + g^M(recall_t) + \beta^M URB + \alpha^M EDUC + \phi^M (EDUC * YEAR_t) + \varepsilon_t^M$$

where $M_{t,t+1}$ is an indicator for whether a child died within a year of birth in year t, $YEAR_t$ is an indicator for year t, and the functions $f(age_t)$ and $g(recall_t)$ are cubics in maternal age and the recall period in year t (with the recall period measured as the number of years between t and the survey year); URB is an indicator that the respondent lived in an urban area in the survey year, $EDUC$ is her schooling in years, and $EDUC*YEAR$ is an interaction between the years of maternal education and the year dummies. The parameters δ^M are year effects that measure the time pattern in mortality rates after sweeping out the effects of age, the recall period, urban status and education, while the parameters ϕ^M measure differences in the year effects by the level of education of the mother.[11]

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[10] The DHS surveys have different sample sizes and we do not want to give more weight to larger samples. The rates in Figure 3 reflect unweighted averages of the infant mortality rates from the relevant surveys, with sample weights used to construct mortality rates for each survey.

[11] Ideally, we would control for a large set of each woman's characteristics, including marital status and household wealth, in the relevant year. However, because births and deaths are constructed from retrospective information, we only have information on characteristics at the time of the survey. We control for the woman's education and whether she lived in an urban or rural area, since these are less likely than other characteristics to have changed over time. We also control for the length of the recall period

The results are presented in Figure 4. The upper panel graphs three sets of year effects when the interaction between maternal education and the year effects is omitted. The first set consists of year effects from regressions that contain no other controls, the second of year effects after adding controls for age and the recall period, and the third of year effects after adding controls for urban status and education. To avoid clutter, we have not graphed confidence intervals for these estimates. However, in all three models the year effects are highly jointly significant. Tests of the hypothesis that the year effect in 1990 is equal to year effects for "nearby" years are rejected. For example, in the model with no controls, the test that the year effects for 1990 and 1988 are equal yields a chi-square statistic of 37.5 (p-value=0.000); the chi-square for the test of equality of 1990 and 1992 is 89.0. Similar results are obtained when the controls are added.

The results make clear that the increase in the infant mortality rate is not accounted for by any of the maternal characteristics for which we control. Adjustments for age and the recall period produce almost no change in the estimates of the year effects, while a comparison of the lines that do and do not control for maternal education and urban status indicates that approximately 0.5 percentage points of the overall decline (of approximately 4 percentage points) in infant mortality from 1978 to 1998 can be explained by increases in maternal education and urbanization.[12] Although these variables explain a portion of the trend in the death rate, they do not account for the spike in mortality in 1990.

Turning next to the results that include the interaction between maternal education and the year effects, we graph the year effects at five different levels of maternal education in the lower panel of Figure 4: 0 years (which corresponds to the 10th percentile of schooling in the sample), 3 years (25th percentile), 5 years (50th percentile), 10 years (75th percentile) and 11 years (90th percentile). The figure indicates that increases in mortality were largest among infants born to women with less education. For example, the results imply that the infant mortality rate among women with no education rose from 9.4 percent in 1988 to 12.8 percent in 1990, an increase of 3.4 percentage points. Among women with 10 years of schooling, this increase was from 2.7 percent to 3.8 percent, an increase of 1.1 percentage points. (In relative terms, these results are similar, with an increase in infant mortality of over 30 percent in both groups.) Figure 4 also shows a compression over time of the difference in infant mortality for women with more and less education. Finally, we examined whether the spikes in mortality appear in all regions in Peru. To do so, we divided the country into four regions: Lima, the coastal region excluding Lima, the sierra (highlands) and the jungle region. The region codes in the DHS are not comparable across all surveys, so we can do this using only the 1996 and 2000 DHS. The increase in infant mortality appears in all areas except the jungle region, for which the estimates are very noisy due to small sample sizes. As we

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(the time interval between the survey and the date the birth occurred), in case births or infants deaths that occurred in the more distant past are systematically over- or under-reported.

[12] The parameter estimates indicate that each additional year of maternal education is associated with a 0.48 percentage point reduction in the probability that a child dies within the first year (t=21.4) and living in an urban area is associated with a 2.1 percentage point decline in the probability of death (t=11.6).

discuss below, this is important as it allows us to rule out explanations for the increase in mortality which would only affect some parts of the country.[13, 14]

One possible explanation for the increase in infant mortality we observe focuses on the composition of women giving birth. Conceivably, women whose children would have been at low risk of dying—for example, those with more education—may have been more likely to forgo or delay childbearing during the economic crisis. Although this explanation hinges on a behavioral response to the economic crisis, the welfare implications are quite different from an increase in the mortality rate holding the composition of births constant. We do not view this hypothesis as being particularly plausible, since it runs counter to existing evidence on how fertility responds to economic conditions. Recent evidence using both U.S. and cross-country data indicates that the average education and economic status of women who become pregnant *increases* during periods of higher unemployment (Dehejia and Lleras-Muney 2003). If this is in fact what happened in Peru, we could expect to see a *decline* in mortality during the crisis, at least for children conceived after the crisis had begun.

Despite these reservations, it is useful to examine whether the crisis was associated with changes in the probability that women gave birth, and whether more highly educated women were relatively less likely to give birth when the crisis started. We estimate probit models of the following form:

$$P(B_t) = \delta^B(YEAR_t) + f^B(age_t) + g^B(recall_t) + \beta^B URB + \alpha^B EDUC + \phi^B(EDUC*YEAR_t) + \varepsilon_t^B$$

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[13] Separately, we also sorted households by the amount of "wealth", where wealth is proxied by housing characteristics (such as the source of drinking water, presence of electricity, type of toilet facility, and material of the floor) and household durables (such as ownership of a bicycle, motorcycle, car, refrigerator, television or radio), and graphed the infant mortality rate, by year, at different points in the wealth distribution. Money measures of wealth are not available in the DHS. However, the DHS surveys contain a set of housing characteristics and ownership of household durables. We used this information, together with information on household expenditure, housing characteristics, and durables from the 1985-86 LSMS to construct a money index of "wealth" for the DHS households. Specifically, we took the LSMS survey and regressed the logarithm of household expenditure on the logarithm of household size, urban status, indicators for durables goods ownership (bicycle, motorcycle, car, television, refrigerator, radio), an indicator for whether the household had electricity, and indicators for the household's type of drinking water, flooring, and toilet facility. The parameter estimates from this regression were used to impute the logarithm of household expenditure for each of the DHS households. These results, which are not reported but are available from the authors upon request, are qualitatively very similar to those for maternal education, showing increases in infant mortality at all points in the distribution of wealth, with the largest absolute increases among the poorest households.

[14] We also examined whether there were increases in the mortality of children older than one year of age during the crisis, and found no clear patterns. Finally, we examined vital statistics data on the registered number of deaths, by age group, in the 1980s and 1990s. We do *not* find an increase in the number of reported deaths in 1989-91. However, we do not think that the vital statistics data for Peru are very reliable: The Pan American Health Organization estimates that less than half of all deaths are registered in Peru, and the number of registered deaths is lowest in the poorest departments—for example, in Ayacucho, Amazonas, Loreto and Huancavelica less than a quarter of deaths are reported, compared to more than three-quarters in the three wealthiest departments of Ica, Lima, and Tacna (PAHO 1998). The crisis may have led to further under-reporting of deaths, both because of budget cuts in the Ministry of Health, which is responsible for collection and verification of the data, and because of lower use of health facilities.

where the dependent variable is the probability of giving birth at time t, and the explanatory variables are defined in an analogous way to those for equation (1) above.

The results from these estimations, with and without the interaction terms are presented in Figure 5. The figures provide sketchy evidence of an effect of the economic crisis on fertility, although not in a way that can account for the mortality increase in 1989-1990. The upper panel, which corresponds to estimations without the interaction terms, shows a secular downward trend in the fertility rate. However, there was a relatively sharp decline in the probability of a birth from 1990 to 1991, and the birth rate rose from 1992 to 1993. The decline from 1990 to 1991 is consistent with a response of birth rates to changes in mean wage income, with a lag, as is the recovery between 1992 and 1993. The lower panel of Figure 5, which is based on the regressions which include the interaction terms, shows that there were reductions in fertility during the crisis period for all women, but the reductions started earliest and were sharpest among less-educated women—precisely those whose children would have the *highest* risk of dying. In sum, it seems quite unlikely that changes in the composition of women giving birth were responsible for the spike in mortality during the crisis.

B.   *Anthropometric Outcomes*

We next turn to a discussion of the nutritional status of children in Peru in the 1990's, focusing on height-for-age. Specifically, we compute percentiles of the z-scores by exact month of age, and graph these.[15] Even with surveys as large as the DHS, there are relatively few children of each month of age in each survey year, and the statistics are somewhat noisy. To make the figures easier to interpret we have "smoothed" each line using a kernel smoother. We do not consider weight-for-height because the three DHS were not collected at the same time of the year and there appear to be seasonal patterns in weight-for-height in Peru (but not in height-for-age) (Marín and others 1996).[16] Moreover, low weight-for-height, or wasting, is rare in Peru.

Stunting (height-for-age *z*-scores of less than –2) is a very serious problem in Peru, affecting more than a quarter of all children under the age of 6. These levels are roughly comparable to those in Bolivia, a neighboring country with about half the per capita income, and are about twice as large as those in Colombia, a neighboring country with income levels comparable to those in Peru. Is there evidence that the 1988-92 economic crisis led to a deterioration in nutrition outcomes in Peru? This question is difficult to answer because data on nutritional status, as measured by children's heights and weights, were not collected in the 1986 DHS. However, it is possible to compare children in the 1992 DHS with those in the

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[15] The *z*-scores are based on the Centers for Disease Control growth charts published in 2000 and were computed following the procedures recommended by the CDC. The data used to construct age-specific means and standard deviations used for the z-scores come from samples of U.S. children surveyed by the National Health and Nutrition Examination Study (NHIANES). Information on calculating z-scores can be obtained at http://www.cdc.gov/nccdphp/dnpa/growthcharts/sas.htm. Further information on the growth charts can be obtained at http://www.cdc.gov/growthcharts/ .

[16] The 1992 DHS was collected between October 1, 1991 and March 1, 1992; the 1996 DHS between August 1 and November 1, 1996; the 2000 DHS between July 1 and November 1, 2001.

1996 and 2000 surveys, to see if there were large gains in child nutritional status as Peru came out of the crisis.

Figure 6 presents results for height-for-age for the three survey years. If the 1992 height-for-age schedule represents, at least in part, a departure from earlier levels, we would expect to see a large difference between the 1992 and 1996 curves, but little (if any) difference between the 1996 and 2000 curves. Also, since height reflects cumulative nutritional status, we would expect 4-year-old children in 1992, who were born at the very beginning of the economic crisis, to display the lowest heights relative to their same-aged peers from the 1996 and 2000 surveys, who were not exposed to the crisis. This is fact what we see. Up to approximately 18 months of age there is no apparent difference in the standardized height of children across the three surveys; after 18 months of age the heights of children observed in 1992 fall ever-farther behind those born later. The 1996 and 2000 curves for these older children are both well above the 1992 curve, especially in the lower percentiles of the distribution, but essentially indistinguishable from each other. Both of these facts are consistent with a large, negative effect of the 1988-92 crisis on the height of children.[17, 18] Our results are also in keeping with earlier research that focuses on the nutritional status of children in a shantytown in Lima in the late 1980s and early 1990s: Using data that covers the 1986-1993 period, Marín and others (1996) show that height-for-age was lowest in 1990, a fact they, too, ascribe to dire economic circumstances in Peru.

How robust are the differences in anthropometric outcomes across years to the inclusion of other controls? To test this, we pool the data across the survey years and estimate regressions of the height-for-age z-scores on years of maternal education, years of education of the mother's spouse (interacted with an indicator for whether there is a spouse), an indicator for urban status, and a set of year dummies. We also include a set of indicators for month of age and an indicator for the child's gender. To account for the fact that the year effects appear to become larger as children grow older, we split the sample into younger (aged 23 months or less) and older (24 to 59 months) children.

The results in the columns marked "pooled" in Table 1 indicate that there were improvements in height-for age even when controls for urban status and parental education are included.[19] For the younger

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[17] The 1994 and 1997 Peru LSMS (but unfortunately not the 1985-86 or 1991 LSMS) include measures of child height and weight. In separate results, unreported but available from the authors upon request, we graphed the height-for-age schedules, by month of age, for children in both surveys. Consistent with an impact of the crisis on child height, the 1994 and 1997 schedules are essentially indistinguishable from each other except for children aged 5, who tend to be shorter in 1994.

[18] Selective mortality may also be important. First, selective mortality among children could result in better nutritional outcomes among children who survive. Second, note that only those children whose mother is alive will be included in the DHS samples. Insofar as the crisis resulted in some premature deaths of mothers, and if orphaned children are more likely to have worse nutritional outcomes than those whose mother is alive (as seems likely), nutritional outcomes in the child *population* may be worse than those in the DHS *sample* during crisis years. Our estimates of the impact of the crisis on infant mortality may also be biased down for this same reason.

[19] This does not mean that parental characteristics do not matter. Both maternal and paternal education are significantly associated with height, with the coefficient on maternal education typically twice as large as that of paternal education. Children who live in urban areas have better outcomes. In addition, the coefficients on education and urban status are larger among the older children, a result that is consistent with the idea that height reflects cumulative nutritional status.

children (left-hand side panel), the height-for-age z-score is significantly higher in 1996 than in 1992, although by 2000 it moved back toward the 1992 value. However, consistent with Figure 6, height for *older* children (right-hand side panel in Table 1) is significantly lower in 1992 than in both 1996 and 2000. The results in the other columns, in which the sample is limited to a single year, also provide some evidence that disparities in terms of stunting were more pronounced in 1992 than in the later years. The coefficients on paternal education (for both age groups) and maternal education (for younger children) becomes smaller in absolute value from 1992 to 2000, suggesting that education was more protective of children's health in the earlier periods.

V.   Discussion

The 1988-92 crisis in Peru was a profound shock to household income. The LSMS surveys show that between 1985-86 and 1991 mean household income per capita dropped by 24 percent in urban areas, and by 27 percent in the rural sierra (Schady, forthcoming 2004). (The 1991 LSMS did not cover the rural areas of the coast, or the urban and rural areas of the jungle, so national comparisons are not possible.) This contraction in household income affected households of all characteristics: For example, household income per capita fell by 27 percent in households where the head had primary education only, and 25 percent in households where the head had tertiary education. The crisis also led to dramatic reductions in public expenditures on health. Public sector spending on health fell 58 percent between 1985 and 1990, and declined from 4.3 percent to 3.0 percent of the budget during this period (Figure 7). Reductions in real wages for health sector workers led to labor unrest. Ministry of Health workers went on strike from March to July of 1991, forcing closures of public hospitals and clinics, and then went on strike again in early 1992 (Associated Press, July 20, 1991 and February 11, 1992).

The data available do not allow for a careful parsing out of the causes for the increases in infant mortality and stunting we observe, but we believe that the most likely explanation hinges on the decrease in household incomes and the collapse in public sector expenditures on health. Delivery of some health services seems to have been unaffected by the crisis. For example, we do not find evidence of a decrease in vaccination coverage between 1986 and 1992. But there is some, albeit limited evidence that decline in the use of other public health services had a negative impact on child health. The DHS surveys collect information on the place where children were born.[20] The majority of deliveries are either in mother's homes (47.4 percent of births within the last five years reported in the 1996 DHS) and public hospitals (37.0 percent); clinics and private facilities attracted approximately 6 percent of deliveries, with 2 percent of deliveries in "other" places. Figure 8 indicates that there was an increase in home deliveries and a

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[20] The DHS surveys also collect information on the use of prenatal care for children born within 5 years of the survey. Unfortunately, the information on prenatal care is not comparable across surveys because of changes in the possible response categories. A similar problem makes it impossible to compare the incidence of diarrhea among children in different years.

decrease in hospital deliveries between 1988 and 1990. Deliveries at home increased by 3.2 percentage points, and deliveries in public hospitals decreased by 4.1 percentage points.[21]

Although striking, the change in the rate of home deliveries cannot itself account for a large part of the increase in mortality among children born in 1990. Regressions of infant mortality on the place of delivery, including no controls for maternal characteristics, indicate that infants born at home are 3.7 percentage points more likely to die than those born in hospitals.[22] A 3.2 percentage point increase in the probability of delivering at home, combined with a 3.7 percentage point increase in mortality associated with home deliveries, implies an increase in the mortality rate of 1/10 of one percentage point, only a fraction of the increase that is observed. Still, the change in the place of delivery may be an indication that the quality of publicly provided medical care had deteriorated, in which case the health effects could be larger than our rough calculations would suggest. The movement to home births could also be a symptom of the decline in resources experienced by households during the economic crisis.

The combined effect of the decrease in household incomes and the collapse of public expenditures on health seems to us the most likely explanation for the observed deterioration in child health. We next discuss alternative explanations, including the 1991 cholera epidemic and the effects of increased expenditures on nutrition and health in the 1990s.

A.   *The 1991 Cholera Epidemic*

The analysis of the effects of the 1988-92 economic crisis on child health outcomes in Peru is complicated by the fact that it coincided with a cholera epidemic. Cholera broke out along the coast north of Lima in January, 1991. Coastal areas of Peru were affected first, but the disease spread rapidly throughout the country and, by the summer, to neighboring countries (Colwell 1996).[23] The number of recorded cases of cholera in Peru was 322,562 in 1991 (approximately 1.5 percent of the population) and 210,836 in 1992, after which time the disease abated. There were 2,909 deaths reported in 1991 and 727

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[21] These changes were not the result of compositional changes in the types of mothers giving birth. We regressed an indicator for delivering at home on a set of indicators for the year of birth, and included mother-level fixed effects. (Mothers are asked about the place of delivery for all children born in the past five years, and 38 percent of women with any births reported more than one birth in this period.) These results also indicate that there was a statistically significant shift to home births in the 1990-1992 period.

[22] Note that because wealthier and better-educated mothers (whose children have lower infant mortality rates) are more likely to deliver in hospitals, this is likely to be an upper bound on the true effect on mortality of delivering at home relative to a hospital.

[23] The precise source of the cholera epidemic is still in question. One hypothesis is that its source was contaminated water dumped from a freighter. Other research suggests that changes in water temperatures that accompanied El Niño weather patterns made conditions ripe for cholera (Colwell 1996). Whatever the original cause, it is likely that the cholera epidemic reinforced the economic crisis, by reducing earnings from tourism and seafood exports. In addition, the spread of the disease may have been exacerbated by the economic crisis. As shown in Figure 7, the start of the cholera epidemic came in the year following the lowest level of public sector health expenditures recorded in the 1970-2000 period. In addition, the four-month strike of Ministry of Health workers started in the third month of the cholera epidemic. Despite the lack of resources for public health, the recorded mortality rate from cholera was under 1 percent, and for this reason Peru has been credited with managing the epidemic well.

in 1992 (Pan American Health Organization 2003).[24] There are no reliable estimates of the distribution of the disease across age groups.

The cholera epidemic could, in theory, have caused large increases in infant mortality as well as a deterioration in the growth prospects of surviving children. We present three pieces of evidence which suggest that the cholera epidemic was not responsible for the spike in infant mortality. First, the magnitude of the cholera epidemic was simply not large enough for this to be the case. We estimate that there were more than 17,000 "excess" infants deaths among children born in 1990. This number is an order of magnitude higher than the total number of cholera deaths (2,909) reported for individuals of *all* ages in Peru in 1991. Even with gross underreporting of cholera deaths, it is not credible that cholera was responsible for the bulk of the increase in infant mortality.

Additional evidence that cholera is not the main reason for the increase in infant mortality is related to the timing and age distribution of the mortality spike. The World Health Organization notes that in endemic areas cholera is mainly a disease of young children, although "breastfeeding infants are rarely affected" (World Health Organization 2000). Breastfeeding offers protection by reducing the child's exposure to infected water and food. In addition, some evidence indicates that antibodies in breast milk are protective against cholera (Glass and others 1983; Hanson and others 2003). In results shown in Figure 9, we restrict the analysis of mortality to deaths that occurred at 6 months of age or less. The increase in mortality among those born in 1990 is evident among this age group, even through breastfeeding is likely to have protected many of these children. More importantly, the upward spike in infant mortality is still apparent among children born in the first half of 1990, who died before the cholera epidemic began.

Finally, we do not believe that the pattern of other diseases over the period in Peru can reasonably account for the increase in mortality which we observe. The Pan-American Health Organization (1998) reports steady increases in malaria cases between 1989 and 1996; malaria in Peru only affects some areas of the jungle and the coast. The distribution of mortality and the timing of the increase therefore do not coincide with the spike in mortality we observe. The last measles epidemic in Peru occurred in 1992, and resulted in 263 reported deaths. Again, neither the timing of the outbreak nor the magnitude of the epidemic are reasonable explanations for the increase in infant mortality in 1990. A dengue epidemic which took place in 1990 does coincide with the increase in mortality, although, as with cholera, the total number of reported dengue *cases* in that year (9,623) is significantly smaller than the "excess" number of infant *deaths* we estimate. Moreover, like malaria, dengue only affects the jungle and some coastal areas in Peru, whereas the increase in mortality we observe was nationwide.

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[24] These estimates may be unreliable. Measurement of the number of cases of and deaths from cholera is difficult, especially in children, because the primary symptom of cholera—diarrhea—is associated with a number of diseases that are common in childhood.

B.   *Increases in Social Expenditures in the 1990s*

Conceivably, the improvement in nutrition outcomes between 1992 and 1996 could be driven by changes in the amount and composition of public expenditures on social programs. There is some support for this view: Public expenditure data shows that real total social expenditures, including spending on education, health, nutrition, and social security were two-and-a-half times as large in 2000 as in 1991, while real expenditures on feeding programs were almost five times as large in 2000 as in 1991 (World Bank 2002, p. 204). The school breakfast, milk distribution and community soup kitchen programs which accounted for the bulk of the increased spending on nutrition in Peru seem to have reached poor households—if not disproportionately, as intended, at least no less than better-off households (Ruggeri 2001). We do not, however, believe that this is a convincing explanation for the changes in stunting rates we observe. First, it is not clear why the increase in expenditures would result in the peculiar age-pattern in improvements in stunting shown in Figure 6. Second, careful econometric work on the largest of the feeding programs, the Glass of Milk Program, finds no evidence whatsoever of an impact of spending on nutritional status (Stifel and Alderman 2003).

VI.   Conclusions

The extent to which economic crises affect child health is an important policy question. Child morbidity and mortality is of concern in its own right. In addition, short-run declines in health investments in childhood may have adverse consequences for health and productivity in adulthood (Foster and Rosenzweig 1993; Schultz 1996; Thomas and Strauss 1997). If so, child health may be one pathway through which short-term economic shocks can have long-lasting effects.

The empirical literature on the effects of economic crises on child health in developing countries is mixed, with some evidence of large negative effects (Jensen 2000, Alderman, Hoddinott, and Kinsey 2002, and Yamano, Alderman, and Kinsey 2003 on Africa; Foster 1995, and del Ninno and Lundberg 2002 on Bangladesh), and other instances where there appear to have been only very modest (if any) impacts (Frankenberg, Thomas and Beegle 1999, and Cameron 2002 on Indonesia; Shkolnikov et. al 1998, and Brainerd 1998 and 2002 on the countries of the former Soviet Union). Surprisingly, to the best of our knowledge there is no household-survey based analysis of the effect of aggregate crises on health outcomes in Latin America.

In this paper, we evaluate the effect of the deep, prolonged 1988-92 crisis in Peru on child mortality and morbidity. Using DHS data from before, during, and after the crisis we show that the crisis had a large effect on infant mortality: The infant mortality rate was 50 percent higher in 1990 than in the years before or after the crisis, implying more than 17,000 excess infant deaths to children born in that year. The increase in infant mortality was largest among households with low maternal education. We also present suggestive evidence that nutrition outcomes were worse for children exposed to the crisis. The data do not allow us to carefully distinguish between the various possible reasons for the

deterioration in child health outcomes we observe. But it appears that both the decrease in household incomes and the collapse in expenditures on public health may have played an important role.

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Table 1. Height and Household Characteristics

	Dependent variable: height-for-age z-score							
	Ages 0-23 months				Ages 24-59 months			
	pooled	1992	1996	2000	pooled	1992	1996	2000
Year=1996	0.113 (0.030)				0.281 (0.020)			
Year=2000	0.052 (0.029)				0.246 (0.020)			
Urban	0.337 (0.029)	0.324 (0.057)	0.161 (0.045)	0.518 (0.049)	0.415 (0.020)	0.391 (0.041)	0.385 (0.031)	0.460 (0.032)
Maternal education	0.058 (0.004)	0.064 (0.009)	0.064 (0.007)	0.046 (0.007)	0.076 (0.003)	0.075 (0.006)	0.078 (0.004)	0.075 (0.005)
Paternal education	0.029 (0.005)	0.035 (0.009)	0.030 (0.007)	0.021 (0.008)	0.048 (0.003)	0.069 (0.006)	0.032 (0.005)	0.042 (0.005)
N	12,523	3,032	5,179	4,312	20,428	4,526	8,846	7.056

Note: Each regression also included a set of indicators for the child's month of age and the child's sex. The measure of paternal education was interacted with an indicator for whether paternal education was non-missing. An indicator that paternal education is missing (typically because the mother has no spouse) was also included in each regression.

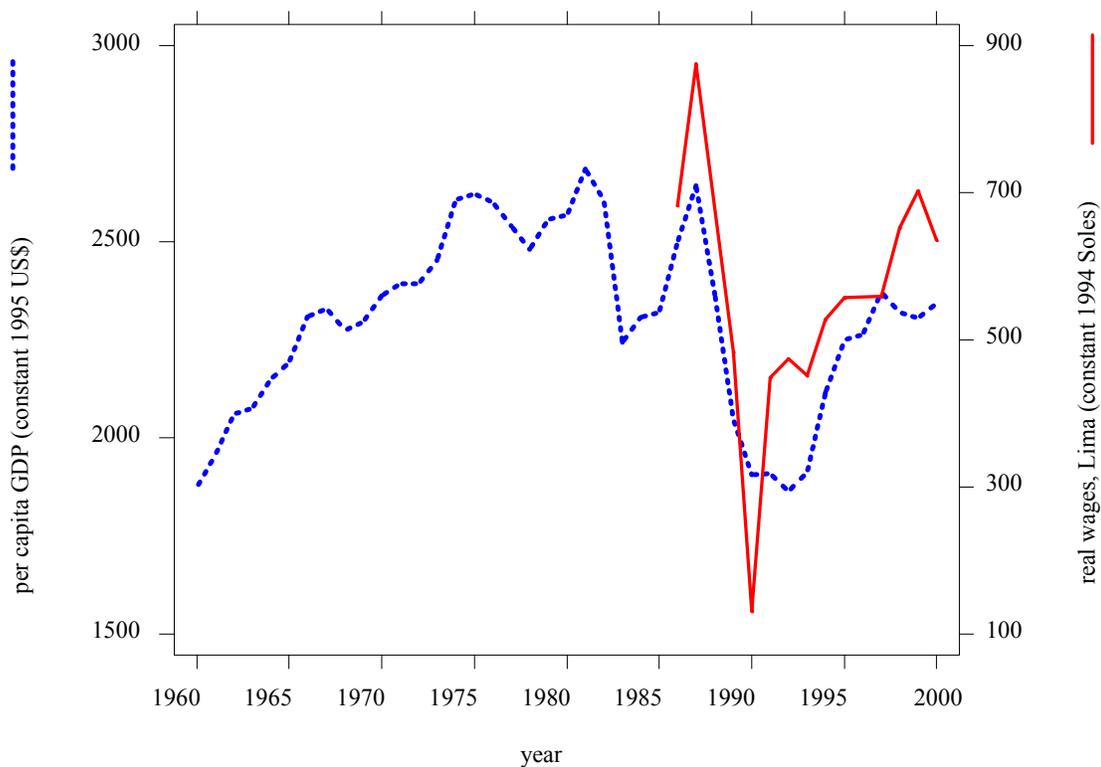**Figure 1. Real Per Capita GDP and Real Wages**
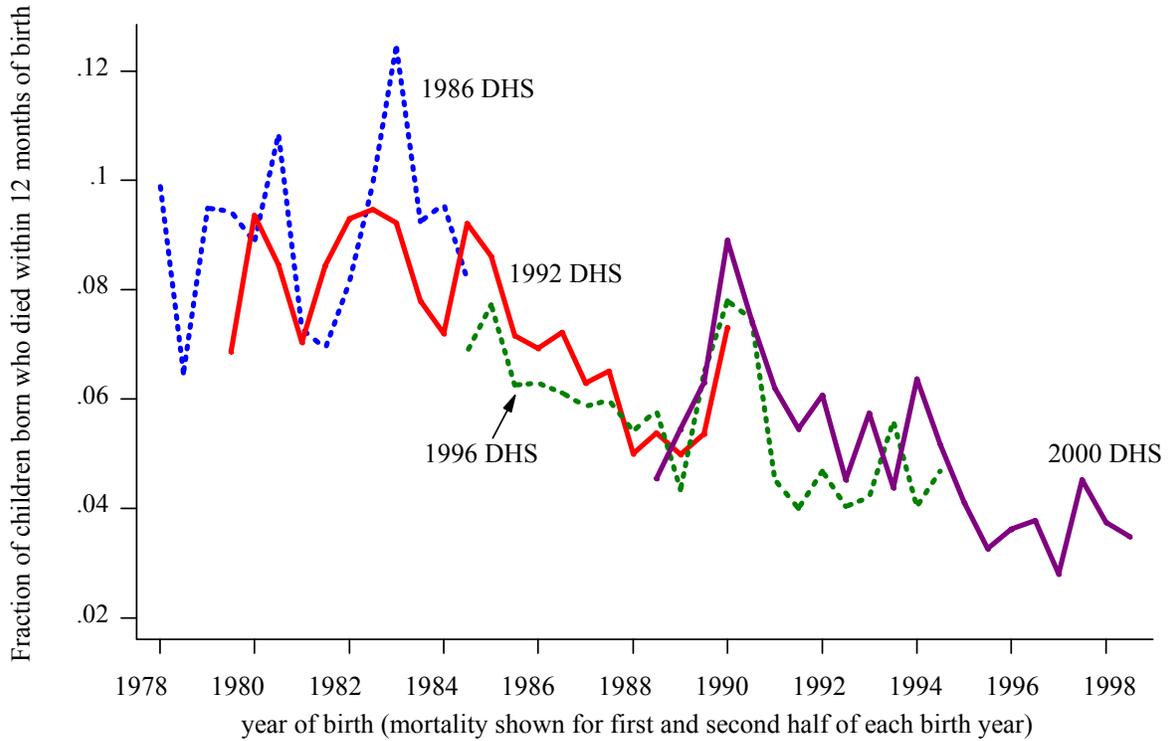
Figure 2. Infant Mortality by Survey Year

1986 DHS

1992 DHS

1996 DHS

2000 DHS

Fraction of children born who died within 12 months of birth

.12

.1

.08

.06

.04

.02

1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998

year of birth (mortality shown for first and second half of each birth year)

Figure 3. Infant Mortality, Per Capita GDP and Real Wages

mortality rate ——— real wages ·—·—· per capita GDP ·······

mortality rate in first year of life

per capita GDP and real wages (not shown on same scale)

.12

.1

.08

.06

.04

.02

1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998

year of birth
(mortality shown for first and second half of each birth year; GDP and wags are annual)

21
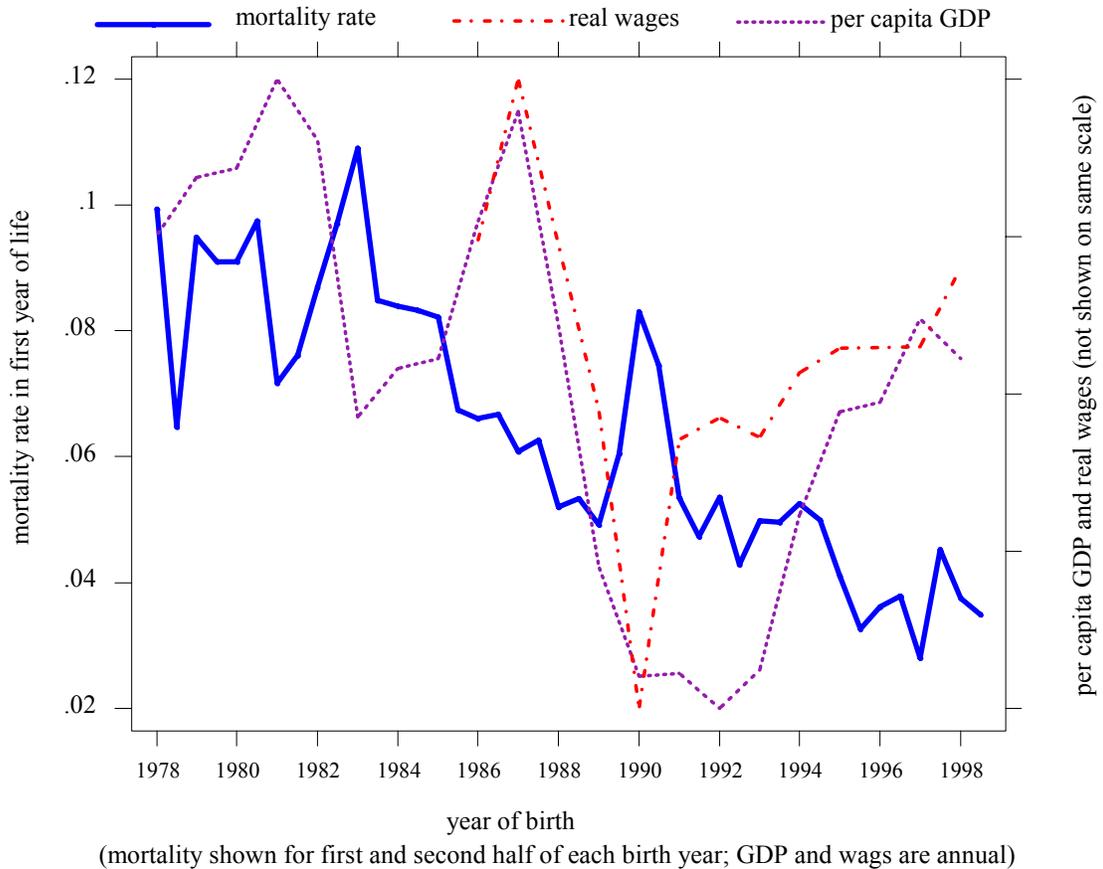
Figure 4. Adjusted Mortality and Mortality by Maternal Education

years of maternal education:
10th percentile or 0 years,
25th percentile or 2 years
50th percentile or 5 years
75th percentile or 10 years
90th percentile or 11 years
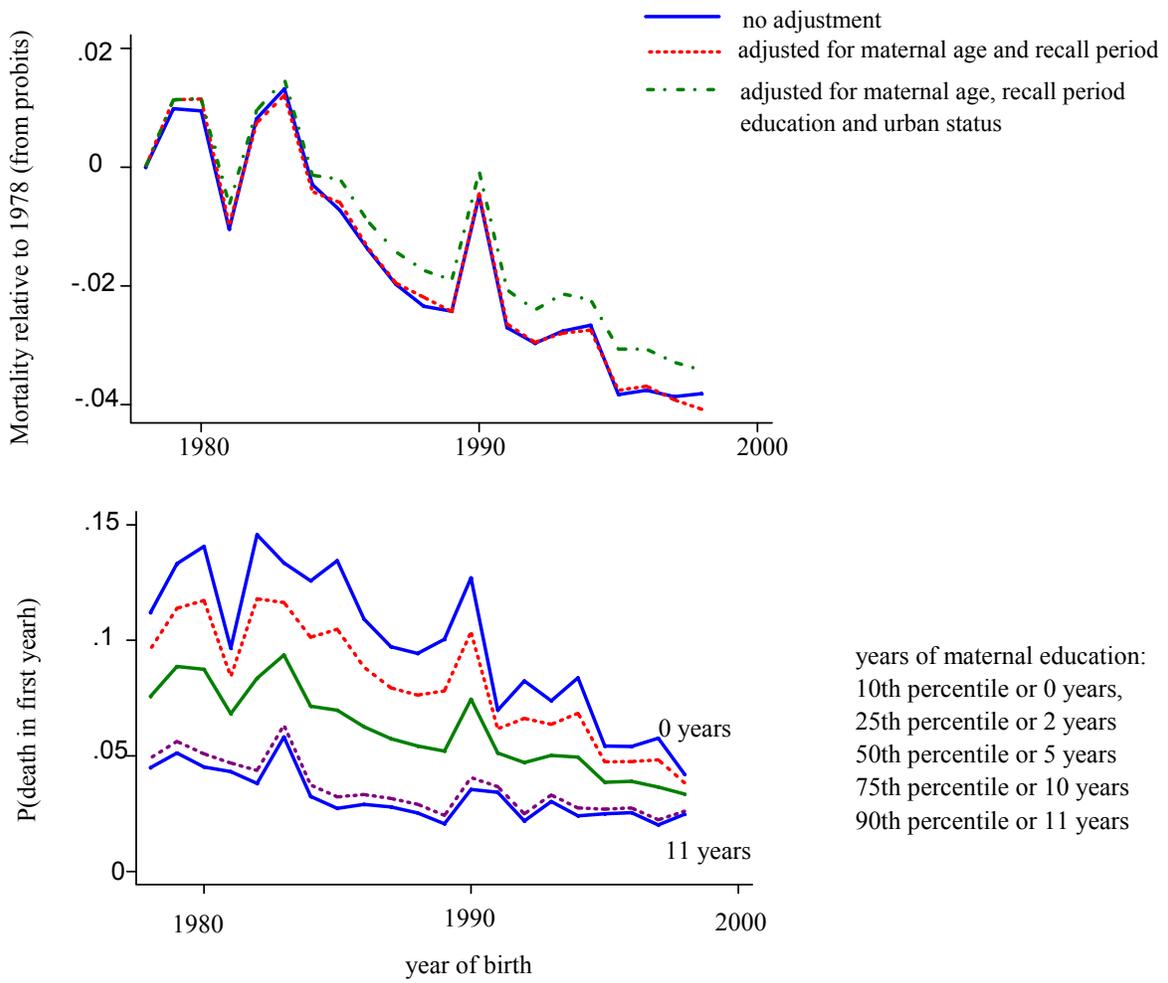
Figure 5. Adjusted Fertility and Fertility by Education

years of maternal education:
10th percentile or 0 years,
25th percentile or 2 years
50th percentile or 5 years
75th percentile or 10 years
90th percentile or 11 years
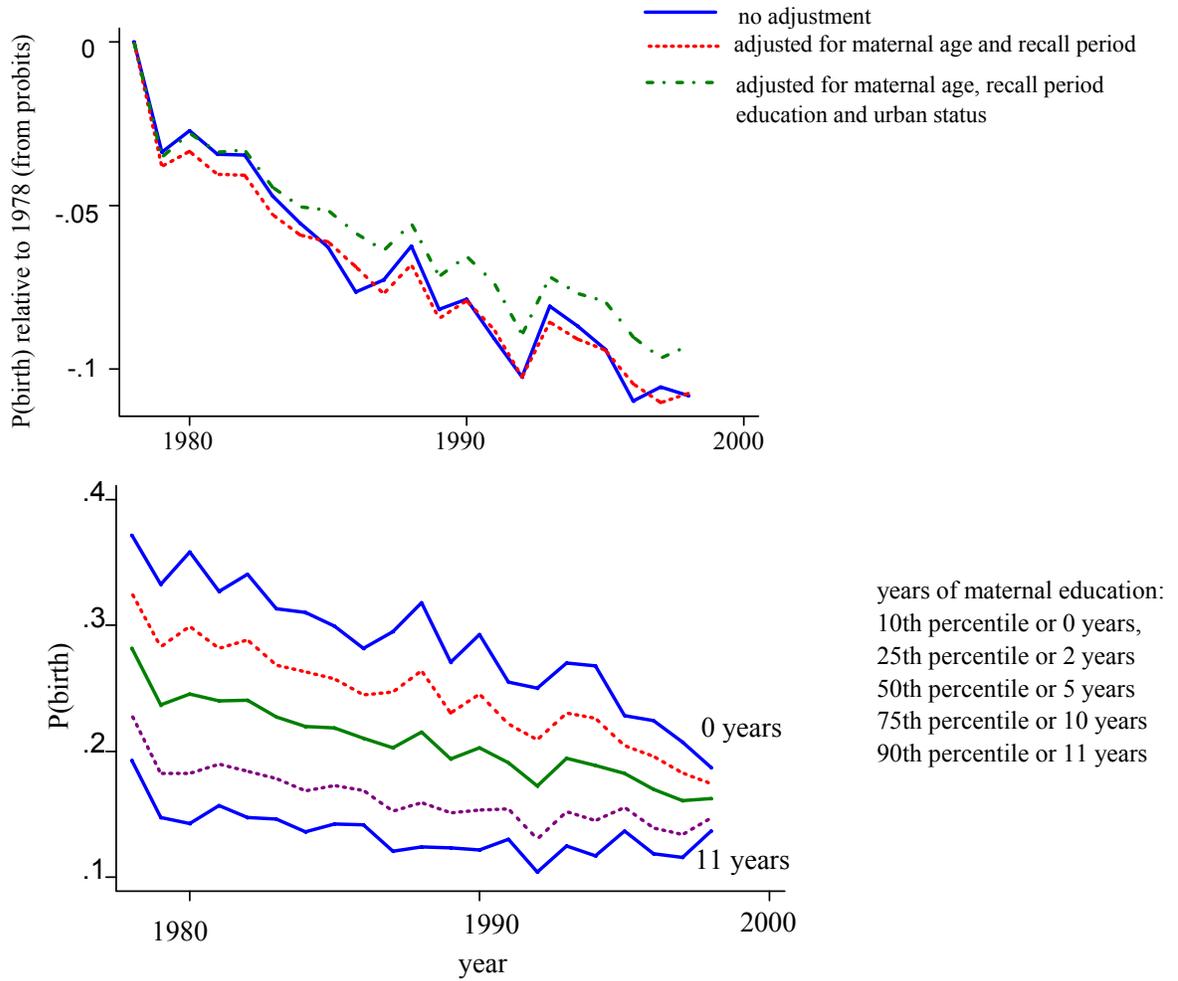
Figure 6. Smoothed Height-for-age Z-Scores

10th percentile

25th percentile

75th percentile

90th percentile

Age in months

Age in months
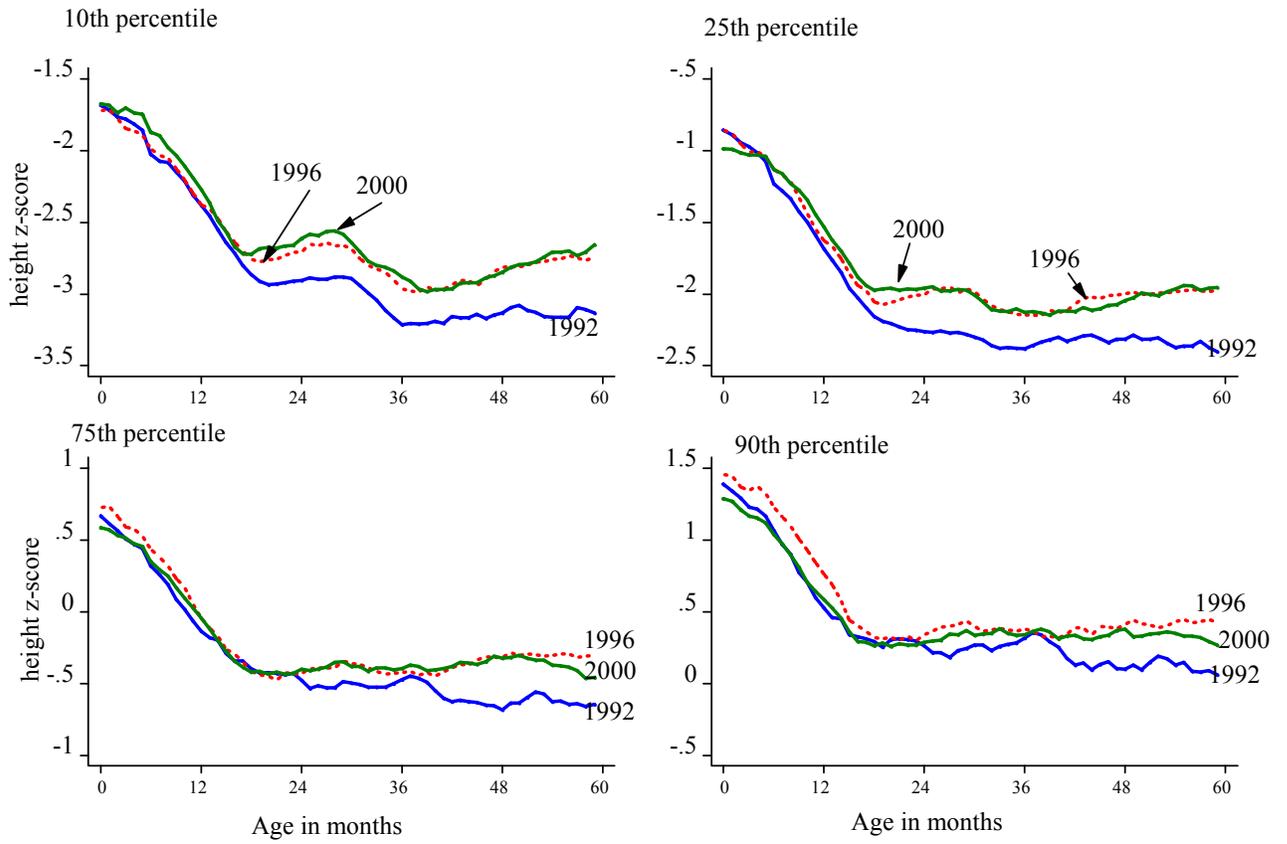
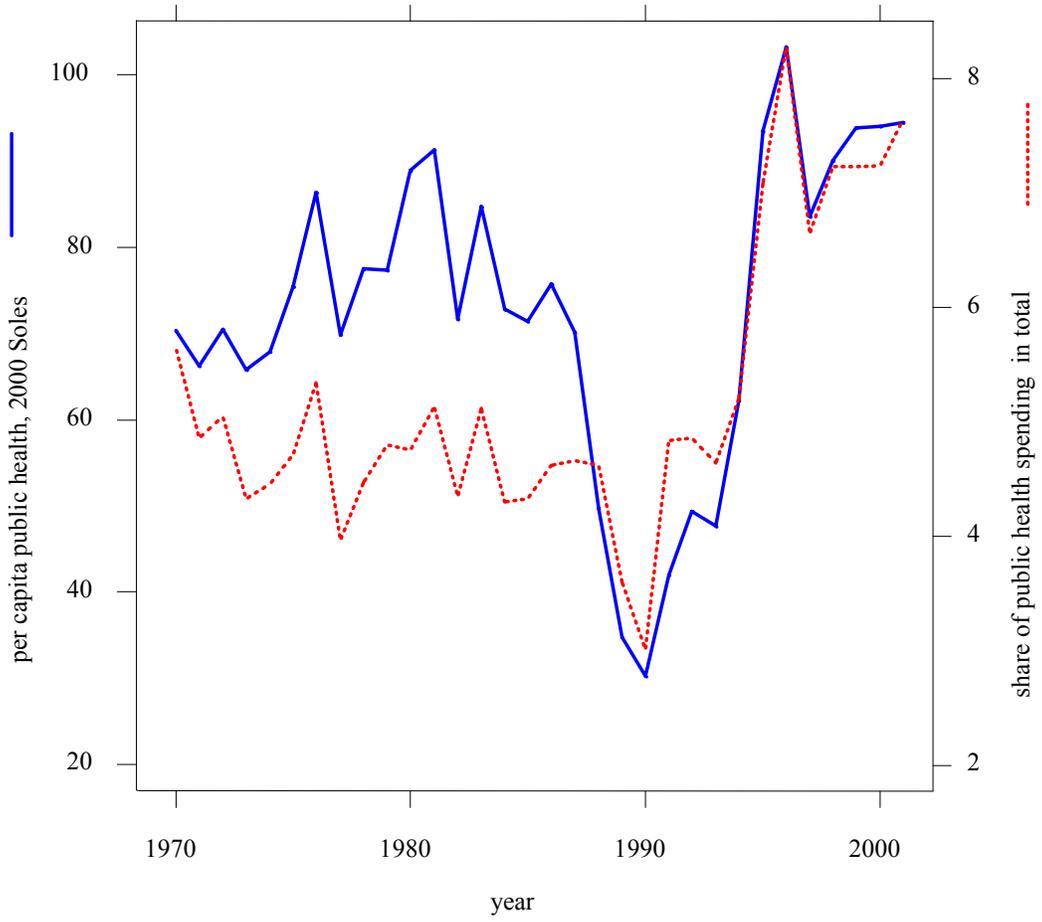**Figure 7. Public Health Spending**
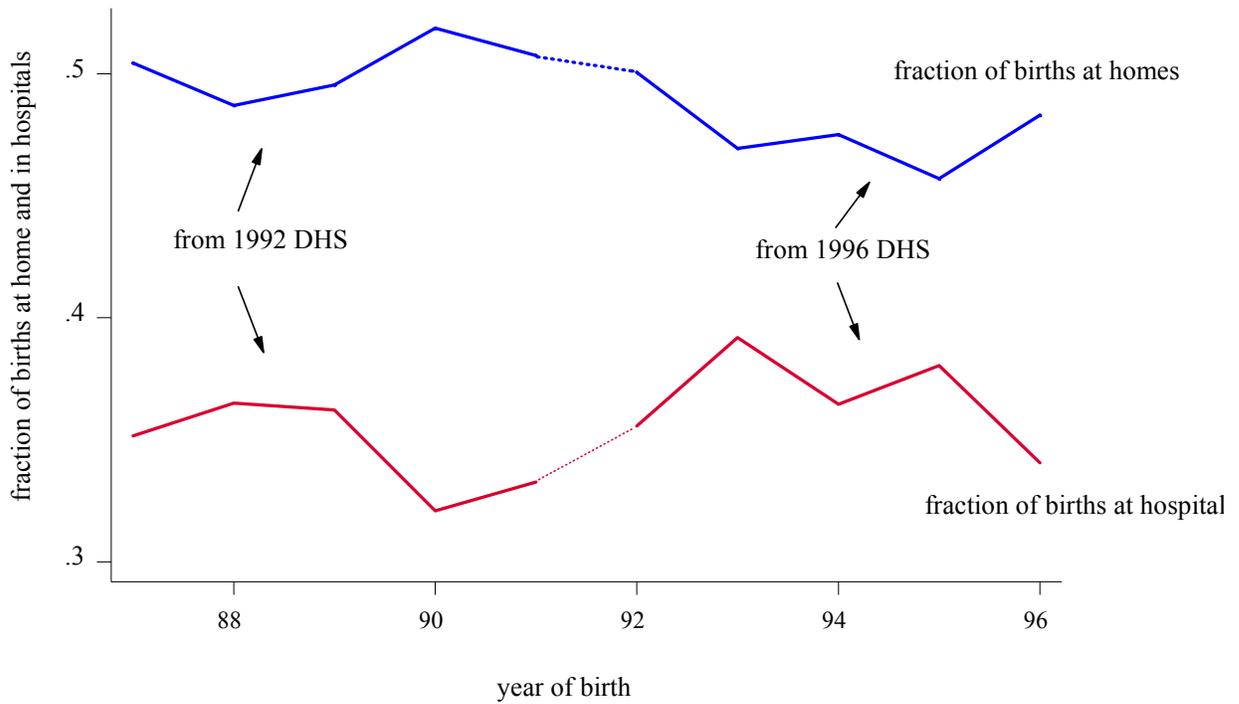
Figure 8. Births at Homes and in Hospitals

Figure 9. Mortality among Infants Ages 6 Months or Less