

Child Health and Economic Crisis in Peru

Christina Paxson and Norbert Schady

The effect of macroeconomic crises on child health is a topic of great policy importance. This article analyzes the impact of a profound crisis in Peru on infant mortality. It finds an increase of about 2.5 percentage points in the infant mortality rate for children born during the crisis of the late 1980s, which implies that about 17,000 more children died than would have in the absence of the crisis. Accounting for the precise source of the increase in infant mortality is difficult, but it appears that the collapse in public and private expenditures on health played an important role.

Over the past two decades, a large number of countries, including Argentina, Indonesia, Mexico, Peru, and Russia, experienced economic crises that led to sharp reductions in incomes and living standards. A growing body of literature has examined whether these crises had adverse effects on health outcomes. To the extent that crises lead to declines in health outcomes, it is important to identify the specific mechanisms that are responsible, with an eye toward developing policies that can ameliorate adverse health effects in the future.

This article considers how economic shocks affect health by examining the effect of one crisis—that experienced by Peru in the late 1980s—on infant mortality. The Peruvian case is noteworthy because the crisis was unusually sharp: per capita gross domestic product (GDP) declined by 30 percent, and real wages in the capital city of Lima fell by more than 80 percent. The sheer depth of the economic collapse makes Peru a useful place in which to study the health effects of economic crises. In addition, Peru has good information on infant mortality from a set of household surveys—the Demographic and Health Surveys

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(DHS)—collected at regular intervals since 1986. The surveys are used to construct a time series on infant mortality that spans the period before, during, and after the economic crisis. These data can then be used to analyze the extent to which changes in infant mortality are departures from preexisting trends and whether there is a return to these trends after the crisis.

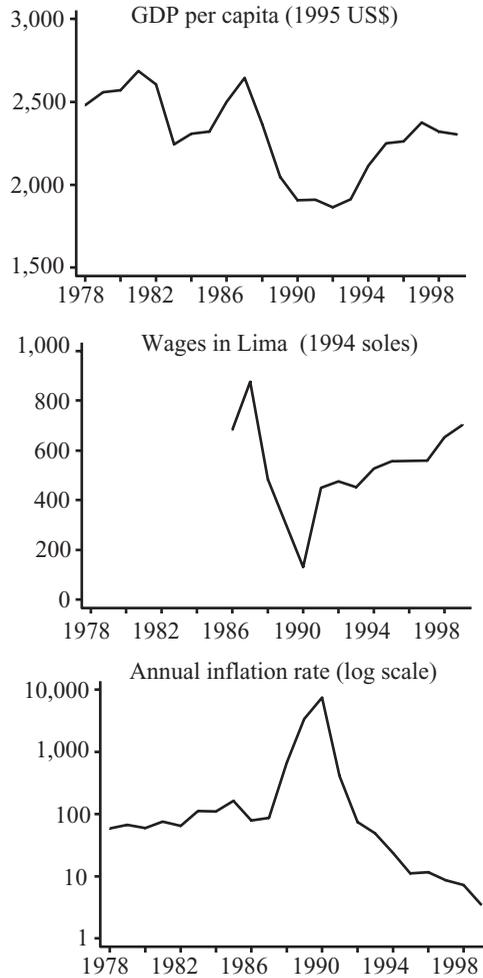
Before discussing the details of the Peruvian case, it is useful to consider why economic crises might affect infant mortality. One possibility is that crises prompt households to reduce spending on inputs to child health, including nutritious foods or medical care for mothers and infants. Another possibility is that crises cause public health services to deteriorate, which may increase the price of healthcare or reduce its quality.

Although economic crises may have an effect on infant mortality in developing economies, they do not have to. Governments can implement programs that mitigate the health effects of crises, and households may be able to smooth consumption or at least buffer expenditures on goods that protect health. Furthermore, families could avoid infant deaths by delaying fertility until the crisis has passed (Ashton and others 1984; Ben-Porath 1973; Coale 1984; Stein and others 1975). Deferred fertility may lead to more widely spaced births and to fewer births to very young women, which lowers mortality (Palloni and Hill 1997). Whether economic crises adversely affect health is therefore an empirical question.

The literature suggests that the relationship between infant mortality and economic fluctuations varies a great deal by country. Evidence from the United States shows that infant mortality decreases during recessions due to changes in maternal behavior, shifts in the composition of women giving birth, and declines in air pollution (Chay and Greenstone 2003; Dehejia and Lleras-Muney 2004; Ruhm 2000). Results from poorer countries with sharper economic fluctuations have yielded mixed results. The collapse in income in many countries of the former Soviet Union in the 1990s was associated with dramatic increases in adult mortality, particularly from alcoholism and suicide, but no obvious change in child health (Brainerd 1998, 2001; Brainerd and Cutler 2005; Shkolnikov and others 1998). During the 1998 Indonesian financial crisis, infant mortality increased by about 1.4 percentage points (Rukumnuaykit 2003). In Latin America the financial crisis of the late 1990s in Argentina did not affect the infant mortality rate (Rucci 2004), whereas the economic crises in Mexico in the 1980s and 1990s increased mortality for the very young and the elderly (Cutler and others 2002).¹ The results for Peru presented here are most

1. Similarly mixed results can be found in studies that examine the effects of crises on children's anthropometric outcomes. See, for example, Jensen (2000) on Côte d'Ivoire; Yamano and others (2003) on Ethiopia; Hoddinott and Kinsey (2001) on Zimbabwe; Foster (1995) and del Ninno and Lundberg (2002) on Bangladesh; and Frankenberg and others (1999), Cameron (2002), Waters and others (2003), and Strauss and others (2002) on Indonesia.

FIGURE 1. Economic Indicators for Peru, 1978–99



Source: Data on per capita GDP and inflation, World Bank databases; data on wages, annual labor force surveys conducted in Lima since 1986, provided by Jaime Saavedra, director of Grupo de Análisis para el Desarrollo.

consistent with those from Indonesia and Mexico in that the economic crisis is shown to have had a large effect on infant mortality.

I. SETTING AND DATA

Figure 1 shows GDP per capita, wages (in Lima only), and inflation in the 1980s and 1990s. Each indicator provides clear evidence of a macroeconomic collapse in 1988. The reasons for this crisis—a “heterodox” stabilization program involving reduced foreign debt payments, wage increases, and job creation programs

that quickly proved unsustainable—and the impact that the crisis had on poverty and education outcomes have been documented elsewhere (Glewwe and Hall 1994; Schady 2004). Figure 1 makes the depth of the crisis obvious. Real GDP per capita contracted by almost 30 percent between 1987 and 1990 and did not begin to recover until 1993. The collapse in wages in Lima was even more dramatic, with a fall in real wages of more than 80 percent between 1987 and 1990 and a gradual recovery thereafter. Data from multipurpose income and consumption surveys conducted in Lima in 1985 and 1990 suggest that per capita consumption in 1990 was less than half its 1985 level, although there appears to have been a recovery in consumption thereafter (Glewwe and Hall 1994; Schady 2004). Inflation skyrocketed during the crisis—rising from 86 percent a year in 1987 to almost 7,500 percent in 1990, before falling to 410 percent in 1991 and 74 percent in 1992.

By any measure, the extent of the economic collapse in Peru in the late 1980s is staggering. Indeed, as a consequence of this crisis, per capita GDP and real wages in 2000 were still well below their 1987 levels, despite respectable growth rates during most of the 1990s. Consider, as points of comparison, crises in the 1990s in Argentina, Indonesia, Mexico, and Russia. In Argentina the 1998–2002 crisis resulted in an 18 percent reduction in per capita GDP and a 32.4 percent reduction in wages in 2002 (McKenzie and Schargrotsky 2004). In Indonesia per capita GDP fell by 12 percent in 1997, and per capita consumption in 1999 was 23 percent below its 1996 value (World Bank 2004). In Mexico the 1995 crisis resulted in a 6.3 percent reduction in per capita GDP and a 19 percent reduction in per capita consumption (McKenzie 2004). Only the collapse of the Russian economy presents a crisis of a magnitude similar to that of Peru: between 1992 and 1998 per capita GDP fell by 29 percent, and monthly income contracted by 43 percent (Mroz and others 2001).²

Two additional points about Peru's crisis are noteworthy. First, although the beginning of the crisis is clear—1988—the end is not. Data on wages and inflation suggest that the recovery began in 1991, whereas the data on per capita GDP suggest that the recovery began in earnest in 1993. The results here are consistent with a shorter crisis—one that had an effect on child health between 1988 and 1990. Second, the GDP data show an economic crisis earlier in the 1980s, involving a 14 percent contraction in per capita GDP in 1983. These points are discussed next.

The Peru Demographic and Health Surveys

The main data source for this article is Peru's DHS. The surveys sampled 4,999 women ages 15–49 in 1986, 15,882 women in 1991/92, 28,951 women in 1996, and 27,843 women in 2000 (see www.measuredhs.com). The surveys are nationally representative, although in 1986 and 1991/92 some areas were

2. All changes in per capita GDP are calculated from World Bank databases.

not surveyed due to high levels of terrorist activity.³ All four surveys included a set of questions on the date of birth, current vital statistics, and the date of death (if deceased) of all children ever born to the respondent. More extensive information was collected on children born to the respondents within five years of the survey. The 1991/92, 1996, and 2000 survey data contain information on circumstances surrounding the births of children younger than 60 months old and on the heights and weights of children who were still living. All the surveys also collected information on a range of household sociodemographic characteristics, including urban status, maternal education, housing characteristics, and ownership of durable goods.

In addition to the DHS, administrative data on health expenditures and the number of terrorist incidents as well as household survey data on consumption patterns from the 1985/86 and 1991 Peru Living Standards Measurement Study (LSMS) were used. These are discussed in more detail shortly.

II. INFANT MORTALITY IN PERU DURING THE CRISIS

This section begins by examining how infant mortality rates evolved over the 1980s and 1990s. Retrospective birth and death histories from each DHS were used to construct mortality rates, by date of birth, in the first and second half of each calendar year from 1978 to 1999. The main measure of mortality is an indicator for whether a child died at age 12 months or younger, referred to as *infant mortality*. This definition, rather than the standard definition of mortality for children *younger than* 12 months of age was chosen because of “age heaping” in reports of mortality. However, the results reported are not sensitive to this choice. Results for mortality rates for children age 1 month or younger, referred to as *neonatal mortality*, and age 6 months or younger are also shown. Mortality rates were constructed using the sample weights provided in the survey.

To avoid problems with censored data, information on children born within 23 months of the survey was discarded when calculating mortality rates for children age 12 months or younger. In theory only information on children born at least 12 months before survey should have been discarded, because it is unknown whether these children survived past 12 months. However, a more conservative approach was adopted in this article because of age heaping. Similarly, records for children born within 5 months of the survey were discarded when computing 1-month mortality rates, as were those for children born within 11 months of the survey when computing 6-month mortality rates. Results are very similar when a less conservative approach to censoring is used.

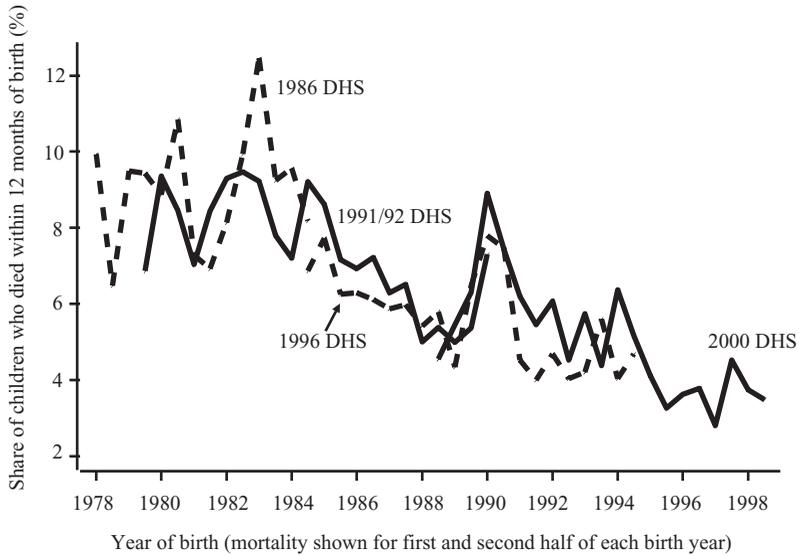
3. In 1986 three departments—Ayacucho, Apurímac, and Huancavelica—with 6 percent of the population were excluded. In 1991/92 special precautions, including escorts of enumerators by the army or police, were taken in high-terrorism “emergency areas.” Despite these efforts, 66 districts with approximately 5 percent of the population were excluded due to security concerns. Terrorism abated by the mid-1990s and did not pose a problem for the 1996 and 2000 surveys.

Although each DHS is representative of women ages 15–49 at the time of the survey, it is not representative of all births (and child deaths) at earlier years. For example, the mothers who were 15–49 years old at the time of the 2000 DHS were 5–39 years old in 1990, and any births and deaths reported for that year occurred when the women were in this (younger) age range. In theory, this feature of the data could bias measures of the infant mortality rate in either direction, with the direction of bias depending on whether the children of the older mothers who were excluded had higher or lower average infant mortality rates than the younger age group that was included. Because mortality rates may be highest for the youngest mothers, information on births that occurred when the mother was younger than 15 years old was discarded. An additional source of bias is error in recalling the dates of more distant births and deaths. To reduce problems of recall error, information on births that occurred more than 12 years before the survey was not used. The results are not, however, sensitive to these choices of maternal age ranges and recall periods. Finally, maternal mortality will bias the estimates of infant mortality. There is no information in the sample on births to mothers who died before the survey, because these women are not alive to be sampled. If their children were at higher risk of death, the infant mortality estimates reported in this article would be too low.

Infant mortality rates were first calculated from each DHS separately, so mortality rates computed for the same date of birth but using different rounds of the DHS could be compared (figure 2). The results 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 calculated using up to 12 years of 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 1991/92, 1996, and 2000 surveys, begins with children born in the second half of 1989 and peaks for children born in the first half of 1990. This increase in the infant mortality rate—from approximately 50 per 1,000 live births to 75—is large. The Peruvian population was nearly 22 million in 1990, with a crude birth rate of 31.73 per 1,000 people, implying that nearly 700,000 children were born in 1990 (U.S. Census Bureau 2004). The rise in the mortality rate observed during the crisis implies there were 17,184 “excess” infant deaths among children born in 1990. The fact that the mortality spike appears in all three surveys indicates that it is not the result of sampling error.

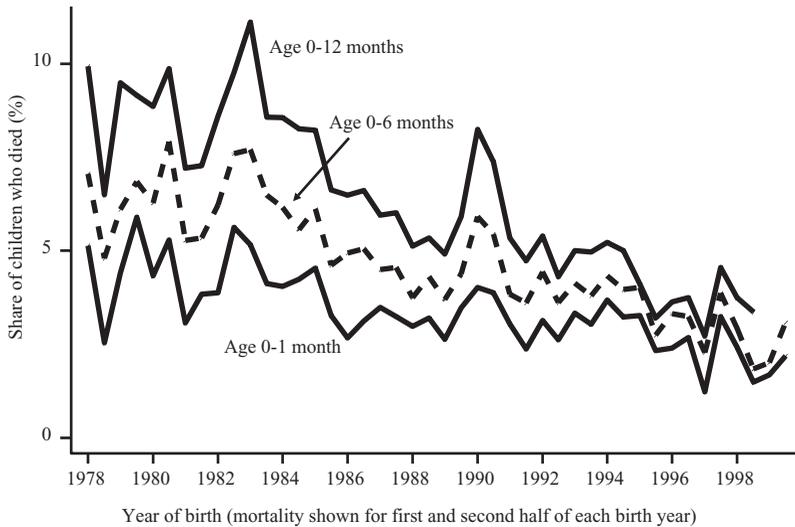
Because each DHS yields similar infant mortality rates for children born at the same date but recorded in different surveys, it makes sense to average mortality rates across surveys. The results for the neonatal mortality rate, the rate of mortality in the first 6 months of life, and the infant mortality rate are shown in figure 3. A comparison of figure 3 with figure 1 shows that the spike in mortality among children born in 1990 coincides with the worst of the economic crisis, when per capita GDP was falling to its lowest levels and real wages had not yet recovered. A similar spike is observed in 1983, when Peru experienced a smaller economic crisis. But the spike in infant mortality in 1983 appears in data

FIGURE 2. Infant Mortality Rates, by Survey Year, 1978–99



Source: 1986, 1991/92, 1996, and 2000 DHS.

FIGURE 3. Child Mortality Rates, Average from all Survey Years, by Age Group, 1978–99



Note: The figure reflects unweighted averages of the infant mortality rates from the relevant surveys, with sample weights used to construct mortality rates for each survey.

Source: 1986, 1991/92, 1996, and 2000 DHS.

from the 1986 DHS but not from the 1991/92 DHS (see figure 2). Because the 1986 survey was quite small and the estimates of mortality based on these data are imprecise, this spike provides much less clear evidence of 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 log of the infant mortality rate on the log of per capita GDP, including a time trend, implies that the elasticity of infant mortality with respect to per capita GDP is -0.64 ($t=2.35$). (This regression allows for first-order serial correlation of the error terms.)

Figure 3 also indicates that the increase in mortality in 1990 was not confined to infants in specific age ranges. Children born in the second half of 1989 through 1990 were more likely to die in the first month of life. They were also more likely to die in the first 6 and 12 months of life. This is not a mechanical result of a higher mortality rate in the first month of life—for example, of children born in the first half of 1990 who survived at least 1 month, 20 per 1,000 died between age 6–12 months, in contrast to the conditional death rate of 8 per 1,000 for children born in the first half of 1988. Similarly, the mortality rate of those age 6–12 months (conditional on survival to 6 months) rose from 14 per 1,000 to 25 between the two periods. Using the 1996 and 2000 surveys, which have comparable region codes, it is also possible to examine whether the increase in mortality appears in urban and rural areas and in the coast, highlands, and jungle regions. The infant mortality spike appears in all areas except the jungle, where the estimates are very imprecise due to small sample sizes. As will be discussed, this is important because it rules out explanations for the increase in mortality that affect only some parts of the country.

Vital statistics data on the registered number of deaths, by age group, can also be used to inspect mortality trends in the 1980s and 1990s. These statistics show no increase in the number of reported deaths in 1989–91. However, the vital statistics data for Peru are not reliable. The Pan American Health Organization (PAHO) estimates that fewer than half of all deaths are recorded in Peru, and the number of recorded deaths is lowest in the poorest departments—for example, in Amazonas, Ayacucho, Huancavelica, and Loreto fewer than a quarter of deaths are reported, compared with more than three-quarters in the three wealthiest departments of Ica, Lima, and Tacna (PAHO 1998). A comparison of the vital statistics data with the number of infant deaths calculated from the 1992 DHS using the appropriate survey expansion factors suggests that the vital statistics covered 63 percent of infant deaths in 1988, 65 percent in 1989, 50 percent in 1990, and 47 percent in 1991.

Underreporting in Peru's vital statistics data seems to be a serious problem—especially if, as seems likely, the estimates of infant mortality from the DHS are downward-biased because the sample does not include children born to very young or very old mothers or to mothers who died before the survey. Moreover, coverage of the vital statistics data appears to have worsened during the crisis, possibly because of budget cuts in the Ministry of Health, which is responsible

for collection and verification of the data and because of less use of health facilities—both of which are documented below.

III. SOURCES OF DECLINES IN CHILD HEALTH

The evidence presented in the previous section indicates that infant mortality increased during the economic crisis in Peru. Although many factors affect infant mortality—for example, maternal education and knowledge about basic health practices and nutrition, water supply, nutritional content of food intake, access to and quality of health services for children and their mothers—there are two main channels through which the crisis could have worked. First, the crisis could have caused public health services to deteriorate. Second, it could have led to reductions in household expenditures on inputs to child health, including nutritious foods or medical care for mothers and infants. This section presents evidence on the importance of each of these factors. In addition, it examines whether the increase in mortality was driven by a change in the composition of women giving birth and whether it could have been due to other factors—such as a cholera outbreak or increases in terrorist activity—that happened to coincide with the crisis.

Declines in Healthcare Use

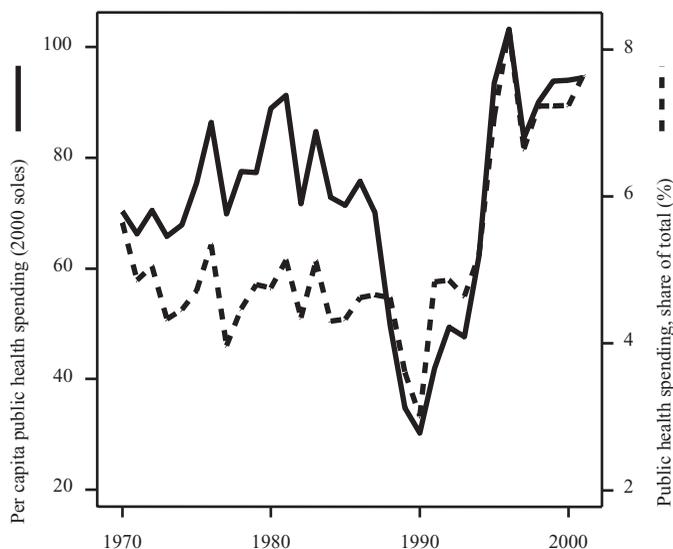
Public health expenditures fell sharply during the economic crisis—by 58 percent between 1985 and 1990, declining from 4.3 percent of the budget to 3 percent (figure 4). One consequence of deep budget cuts in health (combined with high inflation) was a reduction in real wages for health workers, which led to labor unrest. Ministry of Health workers went on strike in March–July 1991, which forced public hospitals and clinics to close, and again in early 1992 (Associated Press 1991, 1992).

It seems likely that the decline in public health expenditures during the crisis would have led to reductions in the use of health services. This can be examined using the DHS data. The 1991/92 and 1996 DHS asked where all children born within 59 months of the survey were delivered and how many antenatal health visits the mother had while pregnant. This information is used to examine whether there were increases in home births and declines in antenatal care during the crisis. Specifically, for each DHS, the following model was estimated:

$$(1) \quad Y_{ibt} = \beta_0 + X_i\beta_1 + Z_{ibt}\beta_2 + \sum_{\tau=\tau_0}^{\tau_T} \alpha_\tau I(t = \tau) + \varepsilon_{ibt},$$

where Y_{ibt} is an outcome (number of antenatal visits or an indicator for home delivery) for child b born to mother i in year t , and X_i is a set of maternal characteristics that are assumed not to change over time, including level of schooling (with no school omitted), age group (with ages 15–19 omitted), and whether the mother lived in an urban area at the time of the survey (the

FIGURE 4. Public Health Spending, 1978–2000



Note: Public health expenditure includes all expenditures of the Ministry of Health, including centrally administered and locally executed programs. It does not include expenditures on health by local governments, which are negligible in Peru, or expenditures made by the health insurance system that covers formal sector workers. No data on private health expenditures over time are available.

Source: Data provided by Pedro Francke, professor at Pontificia Universidad Católica del Perú.

mother's location at the date of birth is unknown). Because mothers may choose different levels of healthcare for first births, an indicator Z_{ibt} is included for first births. The parameters of interest are the terms α_τ , which capture differences in the outcome across years, controlling for maternal and child characteristics. Equation 1 is estimated using linear regression models, including either mother-specific random effects or mother-specific fixed effects. In the fixed-effects models the time-invariant, mother-specific variables are necessarily excluded.⁴

4. For the dichotomous outcomes, conditional logit models were also estimated, with similar results. In theory, the two surveys could have been pooled and equation 1 estimated using the combined sample. This was not done for two reasons. First, when mother-specific fixed effects are included, it is not possible to identify changes in the outcomes that occurred across the survey years, because mothers in the 1996 survey were not asked about the outcome measures for births occurring before 1992. For these results pooling the data would yield identical results to those presented shortly. Second, the question on where the child was delivered was coded somewhat differently between the two surveys, and the responses to this question may not be completely comparable. In 1996 a new category of "birth in the midwife's home" was added. It is not clear whether these births would have been coded as "home births" or as "other" in 1991/92. In addition, the coding of types of births at public and private facilities other than the home changed between 1991/92 and 1996, so that it is not possible to construct consistent series on other places of birth.

Table 1 provides descriptive statistics on healthcare and birth outcomes. The table shows that the average number of antenatal visits in both surveys is roughly 3.5, whereas slightly more than half of births take place at home in both survey years. Table 2 reports results from estimations of equation 1—specifically, values of α for 1988–91 when using the 1991/1992 data and for 1993–96 when using the 1996 data. The left side of the table shows that the number of antenatal visits fell steadily from 1987 through 1991 and increased steadily from 1992 to 1996. Focusing, for example, on the random effects results, women who gave birth in 1991—many of whom were pregnant in 1990—had 0.28 fewer antenatal visits than those in 1987, whereas women who gave birth in 1992—many of whom were pregnant in 1991—had 0.38 fewer visits than those in 1996. Note that this sort of seesaw pattern is not consistent with any obvious form of recall bias—for example, if women remember fewer antenatal visits for pregnancies that occurred further in the past. The right side of the table shows that the fraction of home births was highest in 1990 (using the 1991/92 survey) and 1992 (using the 1996 survey).

The results in table 2 suggest that there were important declines in the use of health services during the years in which the crisis was most profound. These declines could have occurred either because of declines in public expenditures on health, as shown in figure 4, or because declines in household incomes made it more difficult for households to make co-payments at health facilities.⁵ It is impossible to distinguish between these two possibilities with the available data.

Changes in Household Consumption Patterns

Because the crisis entailed large reductions in household income and consumption, it is possible that households were unable to protect expenditures on items of importance in determining child health. This issue cannot be examined using the DHS, both because information on births is retrospective and because expenditure information was not collected. Instead, the 1985/86 and 1991 Peru LSMS surveys are used to analyze patterns of consumption before and during the crisis.

The 1985/86 LSMS was a nationwide, multipurpose household survey. By contrast, the 1991 LSMS survey covered only Lima, the urban areas of the coast and the highlands (but not the jungle), and the rural areas of the highlands (but not the coast or the jungle). There are serious concerns with the quality of data from the rural highlands in the 1991 LSMS survey, as detailed in Schady (2004). Moreover, the 1985/86 and 1991 LSMS surveys were not conducted in the same months of the year, and seasonal differences in consumption patterns are likely to be important in rural areas, where a large part of food consumption comes from own-food production. The analysis here is therefore limited to

5. In health facilities run by the Ministry of Health, labor costs are heavily subsidized, but drugs and medical inputs are financed from user fees and are charged to the user at full cost plus a markup. Co-payments also apply to users of facilities run by the public health insurance system, which covers formal sector employees (World Bank 1999).

TABLE 1. Descriptive Statistics for Healthcare and Birth Outcomes

Statistic	1991/92 DHS	1996 DHS
Average number of antenatal visits	3.81 (4.07)	3.48 (3.63)
Share of births at home (%)	53.4	54.9
Share of births that are first births (%)	24.2	25.3
<i>Observations</i>		
Number of births in 5 years preceding the survey	9,027	16,669
Number of mothers	6,193	12,014
Number of mothers with two or more births in 5 years preceding the survey	2,392	4,093
Number of mothers with two or more births who had change in number of antenatal visits	1,254	2,100
Number of mothers with two or more births who had change in "birth at home"	307	480

Note: SDs are in parentheses. Means are calculated with the expansion factors in the survey.
Source: 1991/92 and 1996 DHS.

comparisons of the urban areas of Lima, the coast, and the highlands. The 1994 and 1997 LSMS surveys are not used because there were important changes in the way they collected information on the consumption of food and nonfood items, which makes comparisons between 1991 and later surveys problematic.

The 1985/86 and 1991 LSMS surveys asked respondents whether they purchased a particular item and, in the case of food items, semidurables, and services, the amount spent on each item. No questions were asked about quantities, and the extremely high rate of inflation during the crisis makes it impossible to accurately deflate expenditures to real terms. The focus here is therefore on whether specific goods were purchased by the household—specifically, on the share of households in a survey that reported consuming a given food item in the past two weeks, purchasing a given semidurable or service in the past three months, and purchasing a given durable in the last three years. (In the case of food items households are coded as having consumed a particular item if they reported purchasing it or providing it themselves “from their own store, business, or plot.”)

The results from these calculations suggest that by and large, there were no important changes in consumption patterns of food during the crisis. Consumption of some items (bread, potatoes, yams, yucca, poultry, eggs, oil, margarine, legumes, and fresh vegetables) increased between 1985/86 and 1991, whereas consumption of others (maize, cookies, cake, other meat products, fish, seafood, milk, dairy products, and frozen, dried, or canned vegetables and fruits) decreased. There is no clear substitution out of “expensive” sources of protein—for example, meat, poultry, fish, and seafood. Moreover, the magnitude of the changes is generally quite small—only in the case of dairy products other than milk does the share of households that reported consuming it appear to fall by a large amount (from 72 percent to 39 percent).

TABLE 2. Healthcare and Birth Outcomes

Estimation Method	Number of Antenatal Visits		Home Birth	
	Mother-Level Random Effects	Mother-Specific Fixed Effects	Mother-Level Random Effects	Mother-Specific Fixed Effects
<i>1991/92 DHS (birth year = 1987 is the omitted category)^a</i>				
Birth year = 1988	-0.014 (0.084)	-0.033 (0.102)	-0.007 (0.011)	0.007 (0.013)
Birth year = 1989	-0.017 (0.020)	0.032 (0.095)	0.001 (0.010)	0.016 (0.013)
Birth year = 1990	-0.151 (0.086)	-0.064 (0.106)	0.031 (0.011)	0.042 (0.014)
Birth year = 1991	-0.277 (0.086)	-0.208 (0.107)	0.014 (0.011)	0.037 (0.014)
First birth	0.630 (0.076)	0.711 (0.100)	-0.074 (0.010)	-0.035 (0.013)
Test: Year effects jointly 0 (p-value)	0.001	0.149	0.004	0.006
<i>1996 DHS (birth year = 1992 is the omitted category)</i>				
Birth year = 1993	0.064 (0.057)	0.035 (0.074)	-0.017 (0.008)	-0.015 (0.010)
Birth year = 1994	0.121 (0.054)	0.104 (0.066)	-0.027 (0.007)	-0.029 (0.009)
Birth year = 1995	0.264 (0.056)	0.256 (0.073)	-0.041 (0.007)	-0.034 (0.010)
Birth year = 1996	0.382 (0.062)	0.410 (0.080)	-0.047 (0.008)	-0.039 (0.011)
First birth	0.523 (0.054)	0.517 (0.076)	-0.092 (0.007)	-0.066 (0.010)
Test: Year effects jointly 0 (p-value)	0.000	0.000	0.000	0.000

^aThe 1991/92 DHS was completed by March 1, 1992, and there were only reported 55 births in 1992. These are excluded from this analysis.

Note: SEs are in parentheses. Linear probability models are used throughout. Mother-level random effects models also control for the mother's level of schooling (with no school omitted), mother's age at the time of the survey (with ages 15–19 omitted), and whether the mother lived in an urban area.

Source: Authors' calculations based on 1991/92 and 1996 DHS.

By comparison, consumption of all semidurables and services fell, and some of the changes are large. The share of households that reported purchasing child and adult clothing or footwear is 8 percentage points lower in 1991 than in 1985/86 in every category, and the share of households that reported purchasing medicines dropped by almost half. Declines over the period in the share of households that reported spending on healthcare are even larger, although the questions were not asked the same way in both surveys. Finally, purchases of durable goods show a more mixed picture—in crisis years households were more likely to purchase some items (such as radios, televisions, and other electronics) and less likely to purchase others (cars, motorbikes, and machines such as sewing or weaving machines, floor waxing machines, and washing machines). Purchasing durable goods may be a reasonable way for households to protect their income during hyperinflation, so these findings are not surprising.

Although this analysis of changes in consumption patterns is by no means definitive—it is unknown how much households consumed of each item and whether households substituted cheaper or less nutritious alternatives in a given category—it suggests that households did not seriously change their patterns of food consumption; instead, they drastically cut back on medicines and healthcare expenditures. This pattern is consistent with a smaller income elasticity of demand for food than for healthcare expenditures, as seems likely—or with models in which health investments act as a form of saving or consumption smoothing (Strauss and Thomas 1998; see also McKenzie 2004 and Stillman and Thomas 2004 for evidence that there were no large declines in food expenditures during crises in Mexico and Russia, respectively). Healthcare spending by households could have also been affected by disruptions in the public sector. Some health services may not have been available because of health worker strikes, while the reduction in public health expenditures could have increased the price of health services.

Maternal Selection and Infant Health

Another explanation for the decline in child health during the crisis is changes in the composition of women giving birth. Infant mortality rates vary by sociodemographic group, with lower rates observed for women who have more education and live in urban areas and higher rates observed for very young mothers. In theory, the spike in mortality in 1990 could be due to a relative increase in the number of high-risk women giving birth during the economic crisis, although this runs counter to the evidence from the United States (Dehejia and Lleras-Muney 2004).

To examine this hypothesis, Oaxaca-type decompositions of the changes in infant mortality across years were calculated. This involves estimating linear regressions for each year of birth, from 1978 to 1999:

$$(2) \quad M_{it} = \alpha_t + X_{it}\beta_t + \varepsilon_{it},$$

where M_{it} is an indicator for whether a child born in year t to mother i died in the first year of life and X_{it} is a set of maternal characteristics, including level of

schooling, age, and whether she lived in an urban area at the time of the survey—all coded in the same way as in the estimations of equation 1.⁶ Next, the parameter estimates are used to decompose changes in the mortality rate between years:

$$(3) \quad \Delta \bar{M}_t = [(\hat{\alpha}_t - \hat{\alpha}_{t-1}) + \bar{X}_{t-1}(\hat{\beta}_t - \hat{\beta}_{t-1})] + [(\bar{X}_t - \bar{X}_{t-1})\hat{\beta}_t],$$

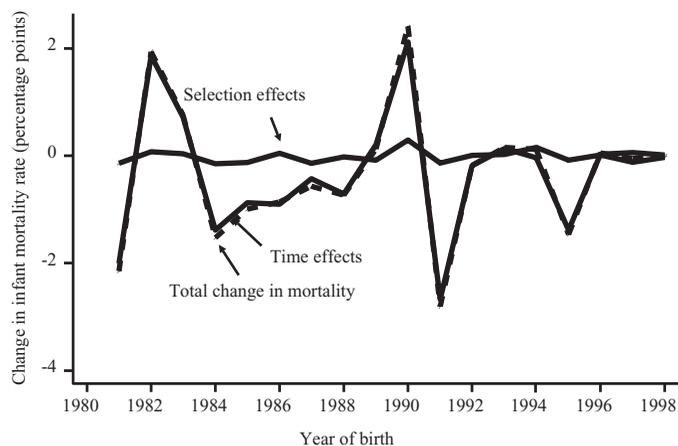
where $\Delta \bar{M}_t$ is the change in the mortality rate between children born in years t and $t-1$ and \bar{X}_t represents (appropriately weighted) means of the maternal characteristics in year t . The first term in brackets measures time effects—that is, changes in the mortality rate between years, holding the average characteristics of mothers fixed at the previous year's values. The second term in brackets measures selection effects—that is, the change in the mortality rate attributed to changes in the average characteristics of women giving birth. If changes in the composition of women giving birth account for patterns of mortality over time, a large part of the changes in mortality should be due to selection effects.

Estimates of equation 2, not shown, yield unsurprising results. Infant mortality is systematically higher for women with less education, especially in the 1980s and early 1990s, for the youngest women (ages 15–19) and oldest women (ages 40–49) (although differences in infant mortality across maternal age groups are smaller and less precisely estimated than those across education groups), and for women in rural areas. These differences make it possible for shifts in the composition of women giving birth to have sizable effects on the overall infant mortality rate. But the results also show that infant mortality increased during the crisis for all groups—prima facie evidence that the increase in infant mortality during the crisis was not due solely to compositional changes.

The results of the decomposition exercise are shown in figure 5, which graphs year-to-year changes in infant mortality, along with the time effects and selection effects from equation 3. There is some evidence of a shift toward high-risk mothers in 1990 and toward low-risk mothers in 1991, but the time effects account for the bulk of the observed changes in mortality, both in the crisis years and across the entire time period. These results indicate that the selection of high risk women in or out of pregnancy cannot account for the year-to-year changes in infant mortality observed.

6. Ordinary least squares estimates rather than probit estimates are used because ordinary least squares estimates produce exact linear decompositions. However, probit models yield very similar results.

FIGURE 5. Decomposition of Change in Infant Mortality into Time Effects and Selection Effects



Source: Authors' calculations based on 1986, 1991/92, 1996, and 2000 DHS.

Cholera and Other Diseases

An alternative explanation for the deterioration in child health is that adverse circumstances happened to coincide with the economic crisis. An example is cholera, which broke out along the coast north of Lima in January 1991. Coastal areas of Peru were affected first, but the disease rapidly spread throughout the country and by the summer to neighboring countries (Colwell 1996). 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 the disease abated. There were 2,909 deaths reported in 1991 and 727 in 1992 (PAHO 2003), although these numbers are somewhat unreliable because the primary symptom of cholera—diarrhea—is associated with a number of diseases, especially in childhood.

In theory, the cholera epidemic could have caused large increases in infant mortality, but three pieces of evidence suggest that it was not responsible for the spike in infant mortality observed during the economic crisis. First, the magnitude of the cholera epidemic was simply not large enough. The estimated 17,000 excess infant deaths among children born in 1990 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 likely that cholera was responsible for the bulk of the increase in infant mortality.

Second, the timing and age distribution of the mortality spike suggest that cholera was not responsible. The World Health Organization (WHO) notes that in endemic areas cholera is mainly a disease of young children, although “breastfeeding infants are rarely affected” (WHO 2000). Breastfeeding offers protection by reducing a child’s exposure to infected water and food. In

addition, some evidence indicates that antibodies in breast milk protect against cholera (Glass and others 1983; Hanson and others 2003). But the results in figure 3 indicate that children born in 1990 had high rates of mortality in the first month and the first 6 months of life, even through breastfeeding would have protected many of these children. (The DHS data indicate that median length of time for breastfeeding in Peru is 15 months, and only 10 percent of children are breastfed for 5 or fewer months.) More important, the upward spike in infant mortality is apparent among children born in the first half of 1990, who died before the cholera epidemic began.

Finally, diseases other than cholera are unlikely to explain the mortality increase. PAHO (1998) reported steady increases in malaria cases between 1989 and 1996; malaria in Peru affected only some areas of the jungle and the coast. The distribution of mortality and the timing of the increase in malaria cases do not coincide with the spike in mortality. 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 is a plausible explanation for the increase in infant mortality in 1990. A dengue epidemic that took place in 1990 coincides with the increase in mortality, but the total number of reported dengue cases in that year (9,623) is substantially smaller than the estimated number of excess infant deaths. Moreover, like malaria, dengue affects only the jungle and some coastal areas in Peru, whereas the increase in mortality during the crisis was nationwide.

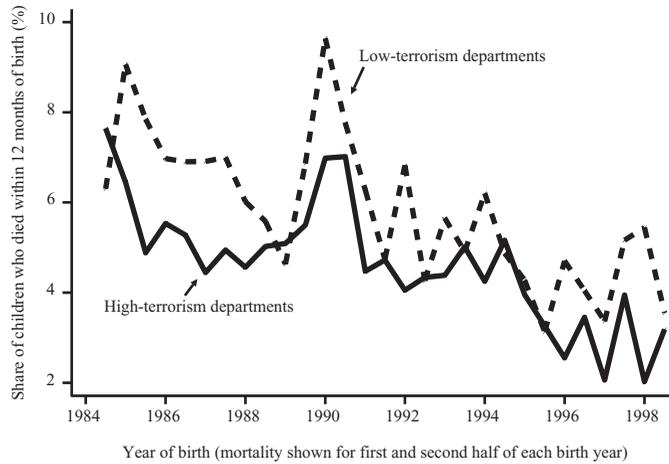
Terrorism

Terrorism could explain some of the increase in child mortality if it hampered the government's ability to deliver health services in affected areas or if it happened to bias the estimates of infant mortality due to lack of coverage of some areas. The Peruvian Ministry of the Interior has data for 1989–95 on the number of terrorist incidents broken down by department and by year (INEI 1996). These data show an increase in the number of terrorist incidents roughly coinciding with the economic crisis. The total number of reported terrorist incidents increased from 2,489 in 1987 to 3,149 in 1989, stayed at roughly the same level between 1989 and 1992, and dropped sharply from 2,995 in 1992 to 1,232 in 1995.

Terrorism was highly concentrated in some areas of Peru—predominantly in departments in the central and southern highlands, as well as in Lima. Using the data on the number of terrorist incidents, departments were classified as having either high or low rates of terrorism, with high rates of terrorism defined as more than 0.1 incidents per 1,000 people in every year between 1989 and 1995 or more than 0.2 incidents per 1,000 people in any year. This classification yielded roughly equal numbers of respondents in high- and low-terrorism departments.⁷

7. High-terrorism departments were Ancash, Apurímac, Ayacucho, Huancavelica, Huánuco, Junín, Lima, Pasco, San Martín, and Ucayali. Low-terrorism departments were Amazonas, Arequipa, Cajamarca, Cusco, Ica, La Libertad, Lambayeque, Loreto, Madre de Dios, Moquegua, Piura, Puno, Tacna, and Tumbes.

FIGURE 6. Infant Mortality by High- and Low-Terrorism Departments, 1996 and 2000



Source: Authors' calculations based on INEI 1996 and 1996 and 2000 DHS.

Infant mortality series were then estimated for each group with the 1996 and 2000 DHS. (The 1996 and 2000 surveys have consistent geographic identifiers and national coverage.) These calculations suggest that the increase in infant mortality during the economic crisis occurred in high- and low-terrorism departments—if anything, the increase was larger in the departments with low terrorism (figure 6). It is not possible to rule out an indirect effect of terrorism on infant mortality—for example, if expenditures on the military diverted funds that would otherwise have gone to healthcare. However, the results show that disruptions in access to healthcare or changes in the composition of the samples caused by terrorism cannot account for the changes in infant mortality observed.

IV. CONCLUSION

The extent to which macroeconomic crises affect child health is an important policy question. This article shows that the infant mortality rate increased by 2.5 percentage points during a deep economic crisis in Peru in the late 1980s. As a result, there were more than 17,000 excess infant deaths. Infant mortality peaked in 1990, when real wages hit rock-bottom, healthcare use had fallen dramatically, and public health expenditures were at their lowest level in decades. The available data do not allow for a complete parsing out of the causes of the increase in infant mortality—particularly because information on the economic circumstances of households over the crisis period is limited. As a whole, however, the evidence supports the hypothesis that the collapse in public and private expenditures on health contributed to the observed increases in infant mortality. There is no evidence that the unexpectedly high levels of infant mortality were due to changes

in the consumption of food, changes in the composition of women giving birth, outbreaks of infectious disease, or terrorism.

Social expenditures in Latin American countries tend to be procyclical (De Ferranti and others 2000). The fact that the increase in infant mortality in Peru appears to be at least in part a result of a decline in healthcare use suggests there may be scope for public policies to protect households during macroeconomic crises. Reforms to budgeting processes—for example, to establish contingency funds for social expenditures during economic downturns—could be important to minimize the effects of future crises on child health.

Compared with the changes in mortality during crisis periods documented in other countries, the change in infant mortality in Peru is large. In Argentina the financial collapse of the late 1990s did not result in increases in infant mortality (Rucci 2004). In Indonesia the 1998 financial crisis was associated with an increase in infant mortality of about 1.4 percentage points (Rukumnuaykit 2003). In Mexico macroeconomic crises in the 1980s and 1990s were associated with increases in child mortality relative to trend rates (Cutler and others 2002). Although the collapse of Russia's economy led to increases in adult mortality, there were no changes in infant mortality rates (Brainerd 1998, 2001; Brainerd and Cutler 2005; Shkolnikov and others 1998). The estimates for Peru suggest a high elasticity of infant mortality with respect to income (0.64).

There are several possible explanations for the cross-country differences in the effects of crises on infant mortality. One is that the data on vital statistics, which are used for the analysis of infant mortality trends in Argentina, Mexico, and Russia, are too inaccurate to pick up changes in infant mortality. The fact that increases in mortality in Peru are observed with the DHS data but not with the vital statistics data lends some credence to this hypothesis—although the quality of the vital statistics data in richer countries such as Russia is likely to be far superior to that in Peru. Other explanations for these differences across countries could be the depth of the crisis—particularly severe in the case of Peru—or the extent to which healthcare expenditures changed—in Argentina, for example, healthcare expenditures do not appear to have fallen during the crisis (Rucci 2004). Future research on the reliability of different sources of mortality data and on the importance of changes in household income and consumption relative to changes in public expenditures on health and other services would be important for the design of policies to protect child health during macroeconomic crises.

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