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Poverty and Survival Prospects of Vietnamese Children under Doi Moi

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Abstract

By international standards, and given its relatively low per capita income, Vietnam has achieved substantial reductions in, and low levels of, infant and under-five mortality. Wagstaff and Nguyen review existing evidence and provide new evidence on whether, under the economic liberalization program known as Doi Moi, this reduction in child mortality has been sustained. They conclude that it has, but that the gains have been concentrated among the better-off. As a result, socioeconomic inequalities in child survival are evident in Vietnam—a change from the early 1990s when none were apparent. The authors develop survival models to find the causes of this differential decline in child mortality, and conclude that a number of factors have been at work, including reductions among the poor (but not among the better-off) in coverage of health services and in women's educational attainment. They argue that if the experience of the late 1990s is a guide to the future, the lack of progress among the poor will jeopardize Vietnam's chances of achieving the international development goals for child mortality.

The authors examine various policy scenarios, including expanding coverage of health services, water and sanitation, and find that such measures, while useful, will have only a limited effect on the mortality of poor children. They find that programs aimed at narrowing the gap between the poor and better-off may have large beneficial effects on the various determinants of child survival.

This paper—a product of Public Services, Development Research Group—is part of a larger effort in the group to investigate the links between health and poverty. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Hedy Sladovich, mail stop MC3-311 , telephone 202-473-7698, fax 202-522-1154, email address hsladovich@worldbank.org. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The authors may be contacted at awagstaff@worldbank.org or nnga@worldbank.org. April 2002. (35 pages)

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1. Introduction

In the mid-1980s, under a policy known as Doi Moi, Vietman started dismantling its command economy, creating in its place a market-oriented domestic economy, and opening its doors to international trade, foreign direct investment and development assistance. Under Doi Moi, Vietnam has achieved impressive rates of economic growth (5–10 percent per annum) and has reduced levels of absolute poverty (Glewwe, Gragnolati, and Zaman 2000). But Doi Moi has also seen a reduction in the scale and quality of public health services (at least in some areas), the introduction of user fees, and the encouragement of a private health sector (World Bank and others 2001). Some have expressed concerns that these developments may be having damaging effects on health outcomes, especially among poorer households (Dahlgren 2000). The broad issue this paper addresses is how one dimension of human development—namely child survival—has changed under Doi Moi. In doing so, we pay special attention to the situation facing poor households.

By international standards, and especially given its relatively low per capita income, Vietnam has achieved substantial reductions in, and low levels of, infant and under-five mortality. By the mid-1980s, its rates were among the lowest in the developing world. The first issue we address is whether under Doi Moi this reduction in child mortality has been sustained. The Vietnamese government's own goal was to reduce the infant mortality rate (IMR) to 30‰ (i.e., 30 per thousand live births) by the year 2000. There is some debate over the exact level of the IMR in Vietnam and hence over whether the government's goal for 2000 has been achieved. We assess the evidence on recent trends in child mortality from a variety of sources, and present some new estimates derived from the 1993 and 1998 Vietnam Living Standards Survey (VLSS).

The second issue we address is the issue of socioeconomic differentials in child survival. Previous research by one of the authors (Wagstaff 2000) suggested that by international standards, inequalities in infant and under-five mortality between poor and better-off children were extremely low in Vietnam. These results were based, however, on VLSS data covering survival and deaths among children over the period 1984–93. It is quite possible—and indeed the fear has been expressed by some—that gaps in child survival prospects between the poor and better-off may have started to open up in Vietnam. In this paper we use data from the 1998 VLSS to measure the extent of socioeconomic inequalities in child mortality over the period 1989–98. Comparing inequalities over the periods 1984–93 and 1989–98, we can see whether any recent reductions in child mortality have been evenly spread across the population, or whether the gains have been concentrated among better-off children.

The third question we address is: What factors have caused the recent changes in child mortality and any changes in inequalities in child mortality? What role, for example, has economic growth played? Have changes in the health care sector affected child survival prospects, and if so to what extent? Have changes impacted equally on all groups? To answer these questions we estimate child survival models linking child survival to the underlying determinants of survival, such as the child's age and gender, the education level of the mother, the income of the household, its water and sanitation, and variables capturing the success of local health services in delivering key maternal and child health interventions such as immunization and antenatal care. We then undertake a decomposition analysis to see how different factors contribute to the overall decline in mortality and to the changing inequalities.

The fourth question we ask is: How are child survival prospects likely to evolve over the next 15 years. Vietnam is currently preparing a poverty-reduction strategy paper (PRSP) to qualify for continued development assistance through the International Development Association (IDA). In the PRSP, countries set out not only their poverty-reduction strategies but also commit themselves to achieving targets for poverty and human development indicators.[1] Among the targets being set by other countries include rates of infant and under-five mortality, since these are among the seven key international development goals (IDGs).[2] The latter involve *inter alia* a reduction by all countries of infant and under-five mortality rates by two-thirds between 1990 and 2015. We address the issue of whether such a reduction is possible for Vietnam, and whether commitment to such a path would be realistic for Vietnam's PRSP. To do this, we use the survival model described briefly above, and project forward to 2015, making assumptions about income growth, as well as the evolution of water and sanitation, and health services.

The plan of the paper follows these four questions. Section 2 reviews the evidence on recent trends in child survival at the population level. Section 3 explores trends in socioeconomic inequalities in child survival. Section 4 outlines the empirical model we use in the remainder of the paper. Section 5 presents and discusses the parameter estimates, and then uses these parameter estimates to explain recent changes in the levels of and inequalities in child mortality. Section 6 uses the model to explore likely trends in child survival up to 2015—the year by which the IDGs are supposed to be reached. Finally, section 7 contains a discussion of the issues raised by our findings and discusses some policy options.

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[1] See http://www.worldbank.org/poverty/strategies/review/index.htm.
[2] See http://www.developmentgoals.org/.

2. Recent trends in child mortality in Vietnam

A number of sources are available for estimation of recent trends in infant and under-five mortality in Vietnam. In this section, we assemble published estimates and report our own estimates derived from the 1993 and 1998 VLSS.

Published estimates include those based on the 1989 Census, the 1994 Inter-Censual Demographic Survey (ICDS), the 1997 USAID-funded Demographic and Health Survey (DHS) (Government of Vietnam 1999), the 1999 Census (Central Census Steering Committee 2000), and the 2000 UNICEF Multiple Indicator Cluster Survey (MICS) (Government of Vietnam 2000).[3] In addition, fertility histories were collected in the 1993 and 1998 VLSS, and in what follows we also report infant and under-five mortality rate estimates based on these surveys. In the censuses, the ICDS and the MICS, incomplete fertility histories were collected—i.e., women of fertile age were asked how many children they had ever given birth to and how may of these were still alive, but not the dates of birth and death (if applicable) of these children. Such data require that mortality estimates be estimated using the so-called indirect estimation method, which involves taking the data on fertility and proportions of children surviving and superimposing them on model life tables. In the DHS and VLSS, by contrast, complete fertility histories were obtained—i.e., women reported when each child was born and when each died if applicable. With such data, mortality estimates can be obtained using standard life table methods (the "direct" method of mortality estimation) and standard errors can be computed for the estimates. The complete fertility history is clearly more demanding in terms of recall than the incomplete fertility history, but potentially leads to more accurate estimates. Of course, since the data also contain the information collected in the incomplete fertility history, the indirect method can be used as well, so that one can compare the direct and indirect estimates for the DHS and VLSS.

In this section we compare the published estimates from the 1989 and 1999 censuses, the 1994 ICDS and the 2000 MICS with indirect estimates we have computed from the 1997 DHS and 1993 and 1998 VLSSs. We then compare these indirect estimates with estimates obtained using the direct method from the DHS and the two VLSSs.

Indirect estimates of infant and under-five mortality in Vietnam

Figures 1 and 2 show the infant and under-five mortality rates obtained from the censuses and the household surveys using the indirect method (United Nations 1983). This involves superimposing on model life tables the data on live births and deaths.

[3] In this paper, data from the 1989 Census and the 1994 ICDS were taken from the other sources listed here.

Estimates were obtained using the computer program QFIVE (United Nations 1983). The full technical details and assumptions made in their derivation are contained in the Appendix. With the indirect method one obtains separate mortality estimates for women in different age groups, the age bands typically used in these exercises being 15–19, 20–24, 25–29, 30–34, 35–39, 40–44 and 45–49. Obviously, the rates among the older age groups capture mortality rates in earlier periods than those among the younger age groups. Typically, the rates among the youngest group—and often those among the second-youngest group as well—are ignored on the grounds they reflect the higher risks associated with pregnancies among younger women.

Figure 1. Indirect estimates of IMR, Vietnman

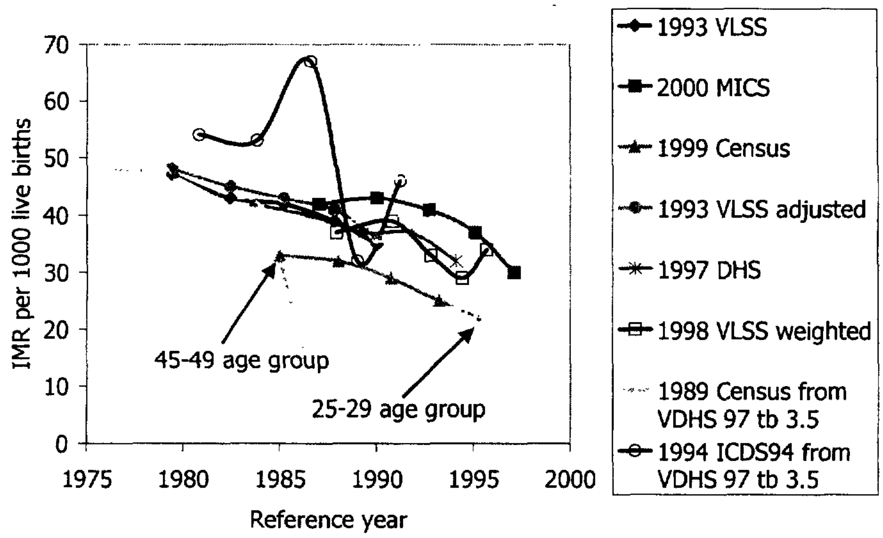
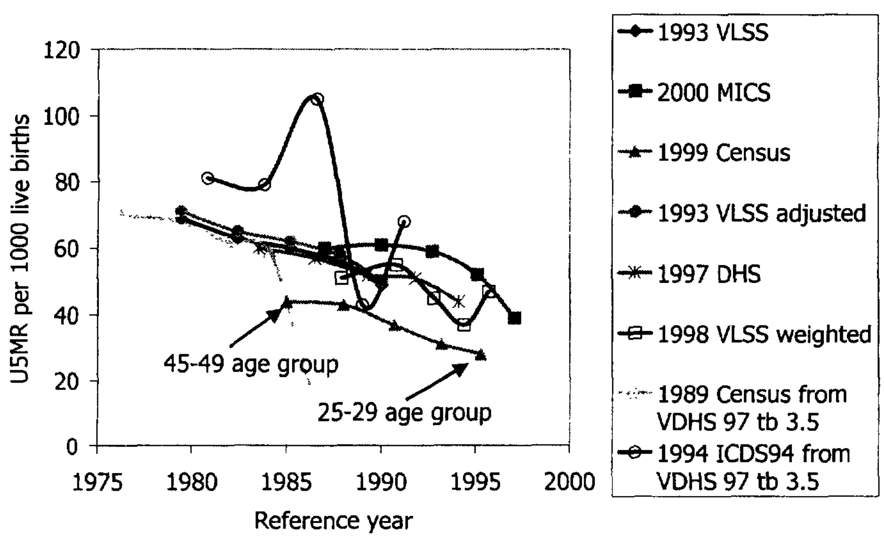


Figure 2. Indirect estimates of U5MR, Vietnam



One striking feature of both Figure 1 and 2 is the high level and odd pattern to the estimates derived from the ICDS. Hill and others (1999) noted this in their analysis of trends in child mortality in Vietnam, and decided in the event to discard the ICDS-based estimates. The 1989 Census also gives some rather implausible numbers for the 25–29 and 30–34 age groups. The other estimates give a clear picture of declining infant and under-five mortality rates with little sign of any stagnation in recent years. There is clearly some uncertainty, however, over the actual levels of infant and under-five mortality. The DHS and VLSS give very similar rates—around 30‰ and 40‰ for infant and under-five mortality, respectively, in 1995. These figures are precisely the same as the consolidated estimates reported by Hill and others for that year. The reason for the higher MICS figures is unclear. The authors of the Census argued that the rates implied by the raw Census data (those reported here) were too low since the Census appeared to have caused an underreporting of deaths in the previous year. They used the results from a post-enumeration survey to "correct" the mortality rates, concluding that the IMR for Vietnam was probably around 37‰ rather than the figure of 25‰ or so implied by the crude data (Central Census Steering Committee 2000). It has to be said it is unclear why the Census should be any more prone to this difficulty than any of the other sources, and why any such underreporting should lead to such a large upward adjustment.

Direct estimates of infant and under-five mortality in Vietnam

The mechanics of the direct method are illustrated in Table 1 for data from the 1998 VLSS, where for the purpose of the table children born in the previous ten years were included. This resulted in 5,316 children being selected. The first row of column 4 indicates that 195 children were "withdrawn" during the first six months (the interval used in this example), meaning that 195 children were born within the six months before the survey and therefore had less than six months of exposure. The assumption is that these 195 children were, on average, exposed for only half of the six months,[4] so that the total number of children exposed during the first six months was 5,316 less half of 195, or 5219 (column 5). Of the 5,316 born during the previous ten years, 114 died during the first six months, so that the proportion surviving was (5,219 – 114)/5,219, or 0.9782. The mortality rate for the first six months, ${}_{0.5}q_0$, is equal to (1 – 0.9782) x 1,000, or 21.8 per 1,000 births. The number of children starting the second six months is 5,316 – 195 – 114, or 5,007. Of these 159 are exposed less than six months—i.e., were born less than one year before the survey. Of the 4,928 children exposed to the risk of death in the second half of their first year of life, 15 died before their first birthday, giving a cumulative

[4] It is because of this assumption that the choice of interval width matters. The mortality rates reported below are, in fact, obtained using non-fixed intervals, with smaller intervals for the first year of life than later years. This is easily accomplished within the computer program Stata.

proportion of children surviving from birth to their first birthday of 0.9752. Column 7 thus shows the survival function, S(t). From this we obtain an infant (i.e., under-one) mortality rate of 24.8 per 1,000 live births. Column 9 gives the standard error of the cumulative proportion surviving, or equivalently the standard error of the mortality rate from birth to the end of the interval in question. Column 10 gives this expressed as a proportion of the mortality rate. The final column shows the hazard rate, λ(t)—the rate at which $S(t)$ decreases over time, $-d\ln S(t)/dt$. Finally, the bottom row of column 8 gives the under-five mortality rate, ${}_5q_0$, which in this case is 35.8 per 1.000 live births, with a standard error equal to 7.5 percent of the mortality rate.

Table 1. Life table from 1998 VLSS

1 Start of interval	2 End of interval	3 No. entering interval	4 No. withdrawn during interval	5 No. exposed to risk	6 No. deaths	7 Cumul. proportion surviving at end	8 Mortality rate ${}_xq_0$	9 Std error of cumul. proportion surviving	10 Relative std error	11 Hazard rate
0.0	0.5	5316	195	5219	114	0.9782	21.8	0.0020	0.0917	0.044
0.5	1.0	5007	159	4928	15	0.9752	24.8	0.0022	0.0887	0.006
1.0	1.5	4833	176	4745	12	0.9727	27.3	0.0023	0.0842	0.005
1.5	2.0	4645	190	4550	4	0.9719	28.1	0.0023	0.0819	0.002
2.0	2.5	4451	198	4352	15	0.9685	31.5	0.0025	0.0794	0.007
2.5	3.0	4238	189	4144	0	0.9685	31.5	0.0025	0.0794	0.000
3.0	3.5	4049	226	3936	13	0.9653	34.7	0.0026	0.0749	0.007
3.5	4.0	3810	228	3696	0	0.9653	34.7	0.0026	0.0749	0.000
4.0	4.5	3582	232	3466	4	0.9642	35.8	0.0027	0.0754	0.002
4.5	5.0	3346	286	3203	0	0.9642	35.8	0.0027	0.0754	0.000

Figure 3 compares the infant and under-five mortality rates estimates from the 1993 and 1998 VLSS and the 1997 DHS. In each case, for ease of comparison, the rates shown are those computed using children born in five-year intervals. The markers in the chart are placed at the year in the middle of the five-year interval. In the case of the DHS, all the rates reported were computed using data in the 1997 DHS,[5] whereas in the case of the VLSS we have shown the rates for the corresponding VLSS—i.e., the rate for 1990 is computed on births recorded in the 1993 VLSS over the preceding five years, and the rate for 1995 is computed on births recorded in the 1998 VLSS in the five years prior to the survey.[6,7] Two points are worth making. First, the DHS and VLSS, once again, show a fair amount of consistency, especially the rates computed from the 1998 VLSS which are well in line with simple projections from the DHS estimates. Second, the directly estimated rates are somewhat lower than the majority of the indirectly estimated rates,

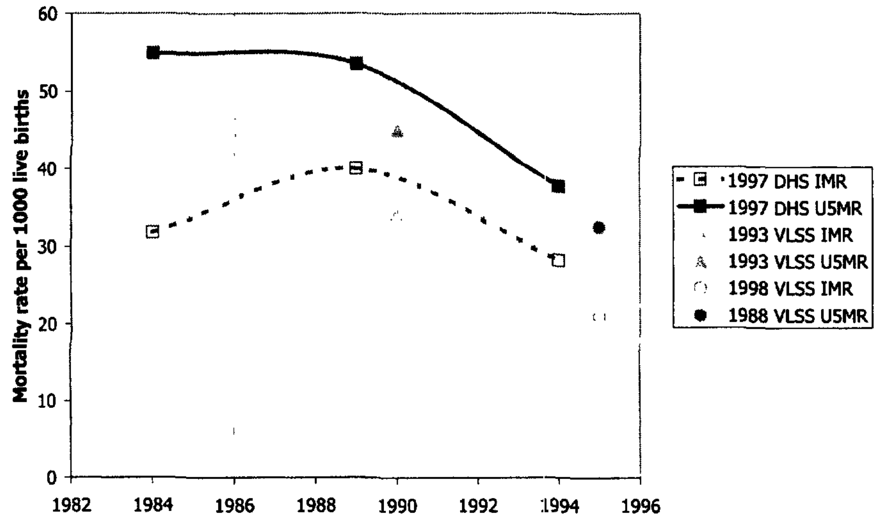
[5] The rates are those reported in Table 7.4 (p. 84) of the DHS report.

[6] The 1998 VLSS estimates were based on data that were weighted using the sampling weights.

[7] The mortality estimates obtained from the 1998 VLSS for the five years 1988–92 were somewhat lower than those obtained from the 1993 VLSS data for the same period.

including those from the DHS and VLSS themselves. The direct estimates are, however, close to the unadjusted 1999 Census-based estimates shown in Figures 1 and 2.

Figure 3. Direct estimates of infant and under-five mortality



Key points

The first key point to emerge from this section is that infant and under-five mortality appear to have continued to fall under Doi Moi—there is no sign in the data of any decrease in the rate of reduction. The second key point is that the infant mortality rate would appear to have fallen below the target figure for 2000 of 30‰. Indeed, the evidence suggests this target was probably reached in the mid-1990s, and the figure now may well be around 25‰ and may even be below this.

3. Changing inequalities in child mortality under Doi Moi

We turn now to the issue of socioeconomic inequalities in child survival. Previous research by one of the authors (Wagstaff 2000) suggested that by international standards inequalities in infant and under-five mortality between poor and better-off children were extremely low in Vietnam. These results were based, however, on VLSS data covering survival and deaths among children over the period 1983–92. The question we address in this section is whether under Doi Moi a gap in survival prospects between poor and better-off children has opened up. Have the apparent continued gains in child survival under Doi Moi been spread equally across the population?

Data and methods

We have two sources of data that enable us to shed light on this issue. First, we can replicate the earlier analysis of the 1993 VLSS using the 1998 VLSS data. As in the earlier VLSS analysis, we include deaths over the preceding ten years in our analysis of the 1998 VLSS data.[8] We rank households by equivalent household consumption in the analysis of the 1993 and 1998 VLSS data, and then sort the children born during the preceding ten years into quintiles. Our quintiles are therefore quintiles of live births. We then produce quintile-specific life tables for each year, and thereby obtain quintile-specific infant and under-five morality rates. Second, we can compare these two sets of VLSS results with the DHS-based results reported by Gwatkin and others (2000). These show infant and under-five mortality rates for different quintiles of "wealth," where the wealth measure is obtained by means of a principal components analysis on a variety of indicators of household living standards[9] along the lines proposed by Filmer and Pritchett (1999). A point to bear in mind is that the quintiles in Gwatkin and others are quintiles of *households*, not of live births. This makes comparison of the VLSS and DHS results somewhat awkward, since the lower wealth groups have higher fertility rates and hence have a share of live births that is in excess of their population share. This problem can be overcome, however, using concentration curves (Wagstaff, Paci, and van Doorslaer 1991; Kakwani, Wagstaff, and van Doorslaer 1997). In this case, these are formed by ranking live births by the living standards of the child's household, and then plotting on the horizontal axis the cumulative percent of live births so ranked and on the vertical axis the cumulative percent of deaths (infant or under-five). If deaths are concentrated among poorer households, the resultant curve—the *concentration curve*—will lie above the diagonal, or *line of equality*. The further above the line of equality it lies, the greater the degree of concentration of deaths among poorer households.

Results on trends in socioeconomic inequalities

Figure 4 shows for each of the three surveys the under-five mortality rates for each quintile of living standards. Over the period 1983–92, there was very little difference between the survival prospects of poor and better-off children in Vietnam. By

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[8] As elsewhere in the paper, we weight the 1998 data using the sample weights.

[9] In the case of Vietnam, the list includes the following (mostly binary) indicators: has electricity; has radio; has television; has refrigerator; has bicycle; has motorcycle; has car; has telephone; has sewing machine; has a boat; has a plowing machine; has a motor scooter; number of members per sleeping room; if piped drinking water in residence; if piped drinking water in public tap; if inside well drinking water; if uses river, canal or surface water for drinking; if uses shared flush toilet; if has traditional pit latrine; if uses VIP latrine; if uses bush or field as latrine; if has a finished floor; if has concrete roofing; if has a roof of galvanized iron/aluminum; if has earth or sand floor; if has rough wood or bamboo flooring; if has natural material roofing; if rain for drinking water; if uses a public well; if has own flush toilet; if uses water from a tanker truck; if uses bottled water; if roof made of asbestos or iron sheeting; if floor is made of other materials.

contrast, over the periods 1987–96 and 1988–97 there were marked inequalities between the poor and better-off. The VLSS data are more directly comparable given in each year the quintiles are quintiles of live births, and the ranking variable is the same (equivalent consumption). What the VLSS results suggest is that the national reductions in child mortality uncovered in the previous sections have not been spread evenly across the Vietnamese population—the upper socioeconomic groups have seen appreciable reductions in child mortality, but the poorer Vietnamese children have seen little improvement in their survival prospects in recent years. By using the concentration curve device, we can get round the problem of the DHS data being quintiles of households. Figure 5 shows the concentration curves for under-five deaths, the nonalignment of the markers for the DHS data with the quintile cut-offs reflecting the higher fertility of poorer households. It is striking how close the 1997 DHS and the 1998 VLSS concentration curves are to one another, and how far they are from the curve for the 1993 VLSS.

Figure 4. Trends in under-five mortality in Vietnam, by consumption quintile

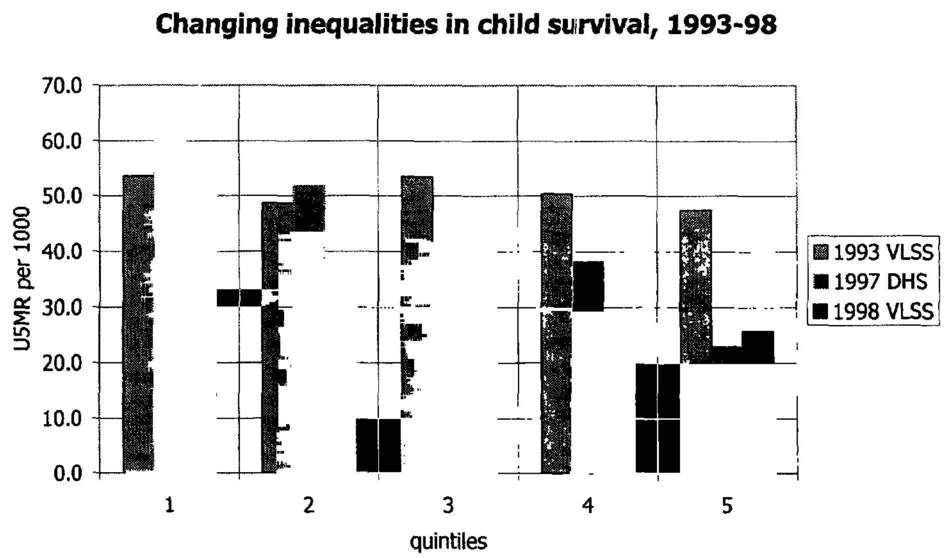
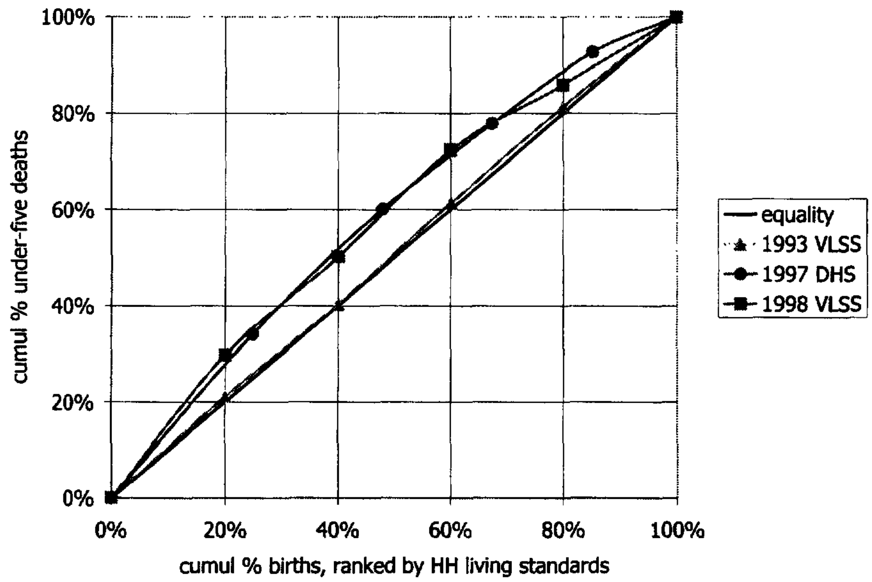


Figure 5. Concentration curves for under-five mortality, Vietnam



Key points

There are just two key points from this section. First, both the 1997 DHS data and the 1998 VLSS data indicate that inequalities in child survival between poor and less poor children now exist in Vietnam. Second, these inequalities appear to be a recent phenomenon—they were not evident in the 1993 VLSS data. Under the recent years of Doi Moi, reductions in child mortality have not been spread evenly, being heavily concentrated among the better-off. Poorer Vietnamese children do not appear to have seen any appreciable improvement in their survival prospects in recent years.

4. Modeling child survival in Vietnam

The estimates discussed in the previous sections suggest, then, that rates of infant and under-five mortality continued to fall during the last decade in Vietnam at the population level, but that these improvements were heavily concentrated among better-off children. In this section we outline and estimate a model intended to help explain these differential changes in survival prospects.

The basic model

We could model child survival using either a production function (an equation linking survival to the proximate determinants of survival, such as usage of health care, dietary and sanitary practices, etc.) or a reduced-form or "demand" equation for child survival (an equation linking survival to the variables that influence households in the choices they make over the proximate determinants of survival) (Schultz 1984). We opt for the demand equation, and thus link survival to household resources and variables affecting the "shadow price" of child survival (Grossman 1972). Variables that lower the shadow price of child survival—such as parents' education, the availability and quality of medical services locally, health insurance coverage, etc.—ought to increase the household's "demand" for child survival. By contrast, variables that *raise* the shadow price of survival—such as poor local sanitary conditions and bad environment—would be expected to be *negatively* associated with survival in the survival demand function. Increases in mean survival time could be due either to movements along the demand equation (e.g., rising incomes allowing households to feed their children better) or shifts in the demand equation (e.g., households being able to buy more or better quality food from a given amount of income).

We use the complete fertility history data over the first ten years of life to estimate the determinants of child survival. It makes sense in such a context to use a duration model. Like Lavy and others (1996), we use a Weibull model with covariates (Greene 1997). Let $S(t)$ be the survival function at time t, and $\lambda(t)$ be the hazard rate at time t. The latter measures the rate at which the survival function decreases over time, and is equal therefore to $-d\ln S(t)/dt$. The basic Weibull model assumes the existence of a basic time-invariant hazard rate, λ, to which the hazard rate a time t is linked by the equation:

$$\lambda(t) = \lambda p(\lambda t)^{p-1}, \tag{1}$$

where p is a parameter, with $p<1$ indicating that λ(t) falls continuously over time, while $p>1$ indicates the opposite. In the case of child survival, it is likely that p will be less than one, since $S(t)$ drops sharply in the first year and then starts to level out. It is linked to the basic hazard, λ, and the parameter p by the function:

$$S(t) = e^{-(\lambda t)p}, \tag{2}$$

so a higher basic hazard reduces the proportion of children surviving to any specific age. The econometric model then seeks to explain variations in λ. The model takes the form:

$$-\ln \lambda_i = \beta x_i, \tag{3}$$

where λ_i is the basic hazard rate for child i, β is a vector of parameters, and x_i a vector of determinants of child survival. Notice the dependent variable is decreasing in the hazard and hence increasing in survival duration—a positive β thus indicates a longer life. Although the hazard rate is unobserved at the individual level, survival times *are* observed Using this information, a maximum likelihood estimator can be derived, the application of which results in estimates of the coefficient vector β as well as the parameter p. This estimator takes into account any censoring—children who were alive in 1993 (or 1998) but had not yet reached their tenth birthday and who had therefore not been exposed to the risk of death for the full ten-year period over which the Weibull model is estimated.

Decomposing sources of change

Our interest is in uncovering the reasons behind the uneven distribution of child survival improvements across socioeconomic groups. Using an Oaxaca-type decomposition (Oaxaca 1973) over time, we can distinguish between two sources of mortality decline: movements along a regression equation, and shifts in it (see Figure 6). The increase from $-\ln\lambda_{93}$ to $-\ln\lambda_{98}$ in Figure 6 represents an improvement in survival prospects. If we use Δ to denote "change," we can view this as the result of a move along the 1993 equation, giving rise to a change in $-\ln\lambda$ equal to $\Delta x \cdot \beta_{93}$, and then a shift from the resultant point on the 1993 equation to the final point on the 1998 equation, giving rise to a further change in $-\ln\lambda$ equal to $\Delta\beta{\cdot}x_{98}$. Thus we have:

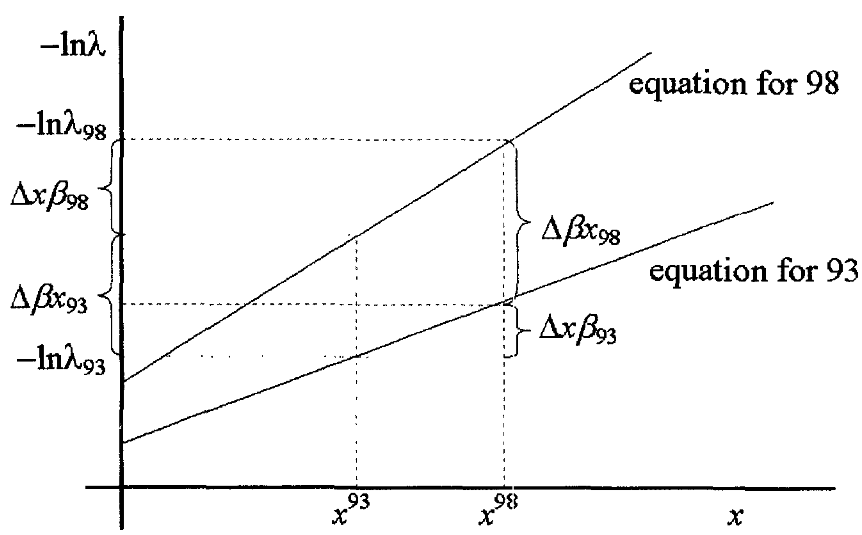
(4) $$\Delta[-\ln\lambda] = \Delta x\cdot\beta_{93} + \Delta\beta\cdot x_{98}\,.$$

Alternatively, we could have reached the final point in Figure 6 by first shifting from the 1993 equation to the 1998 equation, giving rise to a change in $-\ln\lambda$ equal to $\Delta\beta{\cdot}x_{93}$, and then moving along the 1998 equation to the final point, giving rise to a further change in $-\ln\lambda$ equal to $\Delta x{\cdot}\beta_{98}$. Thus an alternative decomposition is:

(5) $$\Delta[-\ln\lambda] = \Delta x\cdot\beta_{98} + \Delta\beta\cdot x_{93}\,.$$

The LHS in each case can be interpreted as the negative of the percentage change in the hazard between 1993 and 1998, so a rise in this quantity indicates improved survival prospects.[10] The first term on the RHS indicates the percentage change in the hazard attributable to changes in the means of the covariates, while the second term on the RHS indicates the percentage change in the hazard attributable to changes in the coefficient vector.

Figure 6. Decomposing the sources of changes in child mortality



The decomposition could be undertaken for the sample as a whole to understand the sources of the continued decline in child mortality at the population level. But it can also be applied to different socioeconomic groups. Our particular interest is in

[10] The LHS is equal to $-[\ln(\lambda_{98}/\lambda_{93})]$.

understanding why mortality has declined among better-off children but not among poor children. To investigate this, we divide the births in our sample into two groups: the poorest quartile of children (the "poor"), and the richest three quartiles (the "nonpoor"). The smaller decline in mortality among poor children may be due to any or all of four reasons: (i) the poor experienced less advantageous changes in the x's; (ii) changes in the x's mattered less for the poor since they face a worse set of coefficients linking survival determinants to survival outcomes; (iii) the poor experienced less advantageous changes in the β's; and (iv) changes in the β's mattered less to the poor since they have worse determinants to start with. Thus in a similar vein to Makepeace and others (1999), we can write a decomposition for the *differential* change in mortality across poverty groups:

$$\Delta\left[-\ln\lambda^{NP}\right]-\Delta\left[-\ln\lambda^{P}\right]=D_1+D_2+D_3+D_4, \tag{6}$$

where the LHS indicates how much more $-\ln\lambda$ has risen for the nonpoor as compared to the poor, and

$$D_1=\left(\Delta x^{NP}-\Delta x^{P}\right)\beta_{98}^{NP},$$

$$D_2=\left(\beta_{98}^{NP}-\beta_{98}^{P}\right)\Delta x^{P},$$

$$D_3=\left(\Delta\beta^{NP}-\Delta\beta^{P}\right)\Delta x_{93}^{NP}, \text{ and}$$

$$D_4=\left(x_{93}^{NP}-x_{93}^{P}\right)\Delta\beta^{P}.$$

Terms $D_1 - D_4$ correspond to (i) – (iv) above. There is no reason, of course, why D_1, D_2, D_3 and D_4 should all be positive—it may well be some changes have worked to make for a smaller reduction in mortality among the nonpoor (i.e., one or more of the terms in eqn. (6) might be negative).

Components (i) and (iv) are straightforward to rationalize—one would expect that the poor and nonpoor will have different mean values of the x's in any one year, and that these means may change differently across the two consumption groups. Jalan and Ravallion (2001) develop a theoretical model which rationalizes differential β's across the poor and nonpoor. In their model, child health depends on parental inputs and other inputs (such as piped drinking water). If parental inputs and, say, piped water are complements, parents will increase their own inputs when piped water increases, and it is likely that child health will increase. Jalan and Ravallion also show that if parents inputs and water are complements, the impact of water on health is likely to rise with income, while if they are substitutes, the impact of water on health may well fall with income. All *this applies* equally to other non-parental inputs, such as sanitation.

If the β's differ across the poor and nonpoor at any point in time, it seems likely they may also change differently over time in the two groups, and hence D_3 in eqn (6) may be nonzero. We explored this possibility, but the model we estimated in which the β's were allowed to change differently across the two consumption groups produced predicted values of the infant and under-five mortality rates that were a long way from the actual values (see Table 4 below). We therefore settled on a model that allows D_1, D_2 and D_4 to be nonzero, but in which D_3 is constrained to be zero. We allow, in other words, for poor and nonpoor children to experience different changes in the means of the their health determinants, and for them to have different values of and different impacts of these determinants at the relevant point in time. But we do not allow for *differential* changes in the impacts of the determinants. In our Weibull model, we thus include the x's, a 1998 dummy, a vector of interactions between the x's and the 1998 dummy, a dummy indicating whether the child is poor, and a vector of interactions between the x's and the "poor" dummy. In so doing, we constrain the parameter p to be constant over time. Tests revealed this to a be a reasonable assumption.

Data and variable definitions

We include three sets of variables in our survival demand equation—child-level, household-level, and community-level variables (see Table 2 for variable definitions) . At the level of the child, we include the child's gender and age. The hazard is likely to decreasing with age, at least up a point. From previous research, we would expect the coefficient on "boy" to be negative. Among our household-level variables, we include the number of years of schooling of the mother, the logarithm of equivalent household consumption, and dummies indicating whether the household had safe drinking water and satisfactory sanitation facilities.[11] The equivalence scale we used was simply the square root of the number of household members, which allows for economies of scale in household production but not for differences in food and other requirements across people of different ages and genders. Consumption was measured in the same way in each year and the 1993 data were expressed in 1998 prices using the Vietnam CPI. For the drinking water and sanitation dummies, we aimed to get as close as possible to the UNICEF definitions (Government of Vietnam 2000), though in the case of sanitation our figures are probably somewhat conservative.[12]

[11] We also included an ethnic minority dummy, but dropped it as its coefficient was never significant. This is probably due to the concentration of the ethnic minorities in specific regions, for which we control.

[12] Safe drinking water was defined here as: tap or standpipe; deep dug well with pump; or rain water. Satisfactory sanitation was defined as flush toilet or latrine. Both differ slightly from the definitions used by UNICEF in its analysis

At the community level, we included seven regional dummies (the omitted region being the Mekong Delta), and variables intended to capture the quality and availability of medical services locally.[13] The latter are not straightforward to define. Several recent studies (Lavy and others 1996; Thomas, Lavy, and Strauss 1996) have included variables capturing whether or not local health facilities had drugs and essential medicines in stock, the numbers of nurses and other medical staff, and so on. This approach is not unproblematic, especially in the present context. In urban areas, it is far from clear which facilities one ought to include in one's assessment of input availability, and indeed most facility surveys undertaken alongside a household survey do not collect such information in urban areas. The VLSS is no exception to this pattern. Furthermore, even in rural areas, there is the scope for missing important potential providers of services, especially in the private sector, which are often not included in such assessments. This is problematic in the case of the VLSS, where the focus in the facility survey (which in any case was only undertaken in 1998) was on commune health centers. Recently, these have diminished in importance, as other providers—including private physicians—have become more important. There is one other problem, which concerns the ability of inventory-type facility surveys to capture the ability of facilities to deliver services. Childhood immunization—which is clearly potentially very important in the context of child survival—is a case in point. In Vietnam, immunization in rural areas is typically delivered through a concerted outreach campaign over a limited space of time, with the necessary equipment (refrigerators, cold boxes, vaccines, etc.) being borrowed or procured for the period of the campaign. An inventory approach is ill-equipped to capture the ability of a facility to deliver such a service.

In the light of these problems, we have opted instead to capture the availability and quality of medical care locally by variables that capture the output of the local health care facilities.[14] We focus on primary care preventive activities, and include as proxies for the quality of local services coverage rates and average utilization rates of certain key MCH services in the child's village, namely vaccinations (the full course of four key vaccinations, namely measles, diphtheria, pertussis (or whooping cough), and tetanus (DPT)), antenatal visits (2 or more visits), and deliveries by medically trained personnel and deliveries in medical facilities. We computed the rates and the averages from household data on services used in respect of last-born children. Because the number of observations can be fairly small in each village, we computed the nonself (or "drop-out")

of the MICS data, but the categories in the VLSS data are somewhat different from those in the MICS. For both water and sanitation, we explored using the original categories in the VLSS rather than aggregating into 'safe' dummies, but in the end opted for the present approach which facilitates interpretation of the decomposition results.

[13] We also included an urban dummy, but dropped it as its coefficient was never significant.

[14] The variables we use are not entirely under the control of the health system, so the term "output"—though often used in this context—is a slightly misleading term.

mean, not the actual mean. This reduces the likelihood of endogeneity and ensures that the variables are the arguments of a demand function not a production function.

Table 2. Variable definitions, means, and standard deviations

		1993		1998	
Variable group	*Variable*	*Mean*	*Standard deviation*	*Mean*	*Standard deviation*
Regional (omitted = Mekong Delta)	Northern Uplands	0.18	0.38	0.21	0.41
	Red River Delta	0.23	0.42	0.17	0.37
	North Central Coast	0.15	0.35	0.16	0.37
	Central Coast	0.10	0.30	0.11	0.31
	Central Highlands	0.04	0.20	0.06	0.24
	South East	0.10	0.31	0.10	0.30
Child's characteristics	Boy	0.52	0.50	0.51	0.50
	Child's age	5.12	2.84	5.69	2.77
Household characteristics	Log equivalent HH consumption	8.12	0.52	8.38	0.55
	Years schooling of mother	6.45	3.79	6.68	3.88
	Safe water	0.20	0.40	0.31	0.46
	OK sanitation	0.13	0.34	0.19	0.39
Community characteristics	Vaccination coverage—nonself mean (%)	45.54	27.06	62.11	30.11
	Antenatal visit coverage—nonself mean (%)	39.45	28.35	49.98	28.92
	Medically trained delivery coverage—nonself mean (%)	70.14	31.86	70.35	32.46
	Facility delivery coverage—nonself mean (%)	50.93	37.45	53.93	37.94

5. Causes of the recent changes in child survival in Vietnam

In this section, we apply the decomposition method outlined above to try to uncover the reasons for the faster decline in mortality among better-off children over the period 1993–98.

Estimation results

Table 3 shows the parameter estimates of the model. The p-values are based on standard errors adjusted for clustering at the village level.[15] Nonpoor children living in the central highlands and southeast have significantly better survival prospects than those

[15] This adjustment of the standard errors invalidates traditional likelihood tests. Hence the use of Wald tests in Table 3.

living in the Mekong delta, but among the poor living in these areas significantly *reduces* survival prospects. This does not change over time, and none of the other regional coefficients are significant. The child's gender and age have no significant effect on survival prospects—this is the same for 1993 and 1998, and for the poor and nonpoor. Consumption of itself has no significant effect, but the evidence suggests its impact may have risen over time—albeit not significantly. The effect of consumption appears through the interaction terms, several of which *are* significant. Mother's education significantly improves survival prospects, and there is no significant difference across consumption groups or over the two time periods. This is consistent with several other studies of child survival (Hobcraft, McDonald, and Rutstein 1985; Merrick 1985; Lee, Rosenzweig, and Pitt 1997; Guilkey and Riphahn 1998), though some studies have found little evidence of a link (Benefo and Schultz 1996; Lavy and others 1996). Having access to satisfactory drinking water also significantly improves a child's survival prospects. Again, this is consistent with several previous studies (Merrick 1985; Ridder and Tunali 1999) but the effect is not found everywhere (Benefo and Schultz 1996; Lee and others 1997). At the 15 percent level, the effect of drinking water is lower among the poor (indeed it is negative)—this difference is consistent with earlier studies of child mortality (Esrey and Habicht 1988) and with recent work on child morbidity (Jalan and Ravallion 2001). Satisfactory sanitation, by contrast, has no significant effect on survival prospects, and the evidence suggests that, if anything, this effect is larger (though not significantly so) among the poor. The lack of significance of the sanitation coefficient is consistent with some recent studies (Lee, Rosenzweig, and Pitt 1997), but not others (Ridder and Tunali 1999), and the tendency toward a larger effect among the poor is consistent with Esrey and Habicht (1988), who found a larger effect of sanitation among the better-educated.

Turning to the effects of the health service variables, vaccination coverage in the child's village is associated with significantly better survival prospects—a result that is consistent with previous studies using different methods (Koenig, Bishai, and Ali Khan 1990). There is no significant difference over time or across consumption groups, which goes against some recent work in Bangladesh that suggests that the poor benefit more from vaccination (Koenig and others 2001). The only significant coefficient on the antenatal visit coverage variable is that on the interaction with the "poor" dummy, which is negative. Taken at face value, this implies a negative impact of such visits on child survival among the poor and no significant effect on the nonpoor. By contrast, among the poor, the coverage of medically attended deliveries has a positive and significant effect on survival prospects of poor children, but not on those of nonpoor children. This is consistent with recent evidence from Brazil (Furquim De Almeida and others 2000), suggesting that home births carry a higher neonatal mortality risk, but only among poorly educated mothers. All else constant, coverage of facility deliveries has no significant effect on child survival, holding constant the proportion of deliveries by medically trained personnel.

The Wald tests at the bottom of Table 3 indicate that while the x's are jointly significant, and the interactions between the x's and the 'poor' dummy are jointly significant, the interactions between the x's and the year dummy are *not* jointly significant. Dropping the year interactions from the model, however, produces predicted infant and under-five mortality rates that are, on average, inferior to the predictions produced by the model in Table 3—see Table 4. In what follows we kept with the estimates reported in Table 3 and used all reported coefficients in the decompositions.

Table 3. Weibull parameter estimates

	Base		*Year interactions*		*Poor interactions*	
Variable	*Coef.*	*p-value*	*Coef.*	*p-value*	*Coef.*	*p-value*
Northern Uplands	2.054	0.13	–2.862	0.17	–0.418	0.87
Red River Delta	–0.087	0.95	–1.170	0.62	–3.129	0.21
North Central Coast	–0.067	0.96	0.695	0.78	0.857	0.73
Central Coast	0.609	0.66	–1.134	0.58	–0.998	0.67
Central Highlands	2.573	0.06	–2.550	0.23	–4.412	0.06
South East	2.869	0.04	–2.704	0.20	–5.827	0.06
Child=male	–0.657	0.31	–0.877	0.37	–1.405	0.17
Child's age	–0.094	0.46	–0.061	0.74	0.084	0.62
Log equivalent HH consumption	–1.099	0.18	1.034	0.40	0.072	0.97
Years schooling of mother	0.294	0.01	–0.118	0.51	–0.017	0.94
Safe water	1.920	0.06	0.212	0.89	–2.619	0.15
OK sanitation	0.490	0.64	–1.995	0.20	2.714	0.36
Vaccination coverage	0.032	0.06	–0.012	0.52	–0.009	0.67
Antenatal visit coverage	0.000	1.00	0.005	0.82	–0.058	0.03
Medically trained delivery coverage	–0.017	0.27	0.008	0.68	0.071	0.00
Facility delivery coverage	0.016	0.31	0.003	0.88	–0.010	0.72
Constant	19.600	0.01	–4.968	0.62	–0.512	0.97
Wald test of joint significance	35.53*	0.00	17.70	0.41	31.97	0.02
p	0.236					

* Excludes constant term in Wald test of joint significance.

Table 4. Predicted infant and under-five mortality rates

	Mortality rates				Rates expressed as percent of estimated values			
	1993		*1998*		*1993*		*1998*	
	Poor	*Nonpoor*	*Poor*	*Nonpoor*	*Poor*	*Nonpoor*	*Poor*	*Nonpoor*
Estimates from VLSS								
IMR	38.50	32.30	36.90	21.80				
U5MR	55.90	49.10	51.10	31.40				
Model in Table 3								
IMR	34.30	35.20	34.60	23.36	89%	109%	94%	107%
U5MR	49.76	51.06	50.19	33.97	89%	104%	98%	108%
Model as in Table 3 but no year interactions								
IMR	32.99	32.52	37.34	26.58	86%	101%	101%	122%
U5MR	47.86	47.18	54.12	38.62	86%	96%	106%	123%
Model with separate regressions for each year and poverty group								
IMR	35.45	34.10	24.02	24.07	92%	106%	65%	110%
U5MR	51.14	50.45	35.53	33.94	91%	103%	70%	108%

Decomposition results

Table 5 shows how the various determinants of child survival have changed over time for the "poor" and "nonpoor." Some of these changes reflect sampling variability. Some households were in the 1993 VLSS but not in the 1998 VLSS, and vice versa. Children over the age of five in the 1993 VLSS would have been excluded from our 1998 sample of births even if they had been in the 1998 VLSS sample because they would have been too old in 1998 for our ten-year window. Furthermore, in 40 percent of households in both VLSS samples, a different woman was randomly selected for the fertility questions, so the children (and their mothers) selected for the survival analysis in many "panel" households were different. Some inconsistencies in responses among the panel households are also evident, and we have not attempted to "correct" them. Some people reported a lower completion schooling grade in 1998 than in 1993, and some households reported worse sanitation in 1998 than in 1993. The socioeconomic profiles of the various regions have changed over time. Equivalent consumption in households with small children has risen for both the "poor" and "nonpoor," but in the poorest quartile the percentage increase has been marginally smaller than in the richest three quartiles (24 compared to 28 percent). In the poorest quartile, the data imply a decline in the average years of maternal schooling among families with small children, though the comments above need to be borne in mind. The proportions of poor and nonpoor households with satisfactory drinking water have increased, but the increase has been considerably larger for the better-off. Access to satisfactory sanitation appears to have *fallen* in the period 1993–98 among the poorest quartile. Vaccination coverage and antenatal visit coverage have increased for both consumption groups. By contrast, the proportions of newborns delivered by medically trained persons and in medical facilities have *fallen* among the poorest quartile, while they have increased among the top three quartiles.

What caused the faster reduction in mortality between 1993 and 1998 among the better-off? Table 6 and 7 show the results of the decompositions of mortality change for each poverty group based eqns. (4) and (5), respectively. Our interest lies more, however, with the *differential* decline in mortality between the poor and nonpoor. Table 8, which presents the results of the decomposition in eqn. (6), shows that the more rapid decline in mortality among the nonpoor was roughly equally due to: (i) the poor experiencing less advantageous changes in the determinants of child survival (D_1); (ii) these changes mattering less for the poor since they faced a worse set of coefficients linking survival determinants to survival outcomes (D_2); and (iii) changes in coefficients mattering less for the poor since they had worse determinants to start with (D_4).

Table 5. 1993 and 1998 means of determinants of child survival, by poverty group

	Poorest quartile			*Richest three quartiles*		
Variable	*Mean 1993*	*Mean 1998*	*Δ mean*	*Mean 1993*	*Mean 1998*	*Δ mean*
Northern Uplands	0.23	0.34	0.11	0.17	0.17	0.00
Red River Delta	0.26	0.13	−0.14	0.22	0.18	−0.03
North Central Coast	0.21	0.18	−0.02	0.13	0.16	0.03
Central Coast	0.08	0.13	0.05	0.11	0.10	−0.01
Central Highlands	0.05	0.08	0.03	0.04	0.05	0.01
South East	0.05	0.02	−0.04	0.12	0.13	0.01
Child=male	0.52	0.51	−0.01	0.51	0.51	0.00
Child's age	4.52	5.26	0.73	5.31	5.83	0.52
Log equivalent HH consumption	7.52	7.76	0.24	8.31	8.59	0.27
Years schooling of mother	5.79	5.38	−0.41	6.67	7.12	0.45
Safe water	0.09	0.14	0.05	0.24	0.37	0.13
OK sanitation	0.05	0.02	−0.02	0.16	0.25	0.08
Vaccination coverage	40.92	55.53	14.61	47.08	64.31	17.22
Antenatal visit coverage	30.24	39.57	9.32	42.51	53.46	10.94
Medically trained delivery coverage	62.73	57.27	−5.46	72.61	74.71	2.09
Facility delivery coverage	43.08	33.35	−9.73	53.54	60.79	7.25

D_1 captures the fact that the poor experienced less advantageous changes in the x's. The weights applied to these changes are the nonpoor coefficients in 1998. In D_1 it is differential changes in health service coverage that stand out as the single largest contributory factor to the faster mortality decline among the better-off. This reflects the faster growth in vaccination coverage and antenatal visit rates among the nonpoor, and the fact that facility deliveries apparently declined among the poor but increased among the nonpoor. Offsetting these effects is the effect of the decline in deliveries attended by medical staff, which is given a negative weight by the nonpoor coefficient in 1998. Also noteworthy in D_1 are the parts played by water and mother's education. In the case of water, this stems from the faster growth of access to safe drinking water among the better-off, and the positive coefficient on water among the nonpoor in 1998. In the case of mother's education, the positive contribution to D_1 reflects the decline in mother's education among the poor, compared to the increase among the better-off, and the positive coefficient on mother's education among the nonpoor in 1998. Differential growth of household consumption played a negligible part, as did differential changes in the regional distribution of children and differential changes in child characteristics. The offsetting effect of differential changes in satisfactory sanitation (coverage declined among the poor but increased among the better-off) is somewhat counter-intuitive, reflecting the negative coefficient on sanitation among the nonpoor in 1998. However, this should not be interpreted too literally since none of the sanitation coefficients in Table 3 is statistically significant at conventional levels.

D_2 captures the fact that the changes in the x's mattered less for the poor since they faced a worse set of coefficients. These coefficient differences are weighted by the change in the x's among the poor. Once again it is health services that stand out as the single largest contributory factor to the faster mortality decline among the nonpoor. In the cases of immunization and antenatal coverage, this reflects the larger impact among the nonpoor, and the fact that the poor experienced a rise in coverage (Δx^P is positive in D_2). In the case of medically trained deliveries, it reflects the *larger* impact among the poor and the fact that the poor experienced a *decline* in coverage. In the case of facility deliveries, the contribution is negative, reflecting the smaller impact among the poor coupled with the decline in coverage in this group. Of these terms, only two (antenatal and medical deliveries) are based on statistically significant differences in coefficients between the poor and nonpoor. Also noteworthy in D_2 is the role of water. This reflects the larger impact of water on survival prospects among the better-off—a difference that is significant at the 15 percent level—and the fact that water access increased among the poor. Of note too is the role of region, though the contribution reflects a variety of offsetting tendencies, and it should be borne in mind that only two of the interactions between the 'poor' dummy and the regional dummies are significant.

D_4 captures the fact that the changes in coefficients over time mattered less for the poor than the nonpoor since the poor had worse child survival determinants to start with. These differences in determinants are weighted by the changes in the coefficients (assumed in this exercise to be the same for the poor and better-off). Given the joint insignificance of the interactions between the x's and the year dummy in Table 3, D_4 should not be interpreted too literally. Differences in levels of household consumption stand out as the largest single contributory factor—the poor, by definition, are worse-off than the nonpoor, and the coefficient on consumption increased between 1993 and 1998, though not significantly so. A positive contribution is evident too from health services, reflecting the fact that the poor have lower levels of coverage, and the fact that, for the most part, the coefficient increased between 1993 and 1998. Again, however, the change was not significant.

Table 6. Decompositions of changes in survival, based on eqn (4)

	Poorest quartile			*Richest three quartiles*		
	Percent change in hazard	*Change in determinants*	*Change in coefficients*	*Percent change in hazard*	*Change in determinants*	*Change in coefficients*
	$\Delta[-\ln\lambda]$	$\Delta X\,\beta_{98}$	$\Delta\beta\,X_{93}$	$\Delta[-\ln\lambda]$	$\Delta X\,\beta_{98}$	$\Delta\beta\,X_{93}$
Region	−0.768	0.417	−1.185	−1.124	0.069	−1.193
Child characteristics	−0.758	−0.026	−0.731	−0.846	−0.072	−0.774
Household consumption	7.774	0.002	7.772	8.576	−0.018	8.594
Mother's education	−0.746	−0.065	−0.681	−0.704	0.080	−0.784
Water	−0.004	−0.024	0.020	0.335	0.284	0.051
Sanitation	−0.122	−0.030	−0.093	−0.451	−0.127	−0.325
Health services	−0.445	−0.771	0.325	0.945	0.513	0.432
Constant	−4.968	0.000	−4.968	−4.968	0.000	−4.968
Total	−0.037	−0.497	0.460	1.763	0.729	1.033
Implied new IMR	34.60	38.49	30.83	22.76	29.72	27.69
Implied new U5MR	50.19	55.78	44.76	33.10	43.16	40.23

Table 7. Decompositions of changes in survival, based on eqn (5)

	Poorest quartile			*Richest three quartiles*		
	Percent change in hazard $\Delta[-\ln\lambda]$	*Change in determinants* $\Delta X\,\beta_{93}$	*Change in coefficients* $\Delta\beta\,X_{98}$	*Percent change in hazard* $\Delta[-\ln\lambda]$	*Change in determinants* $\Delta X\,\beta_{93}$	*Change in coefficients* $\Delta\beta\,X_{98}$
Region	–0.768	0.630	–1.398	–1.124	0.053	–1.177
Child characteristics	–0.758	0.011	–0.768	–0.846	–0.045	–0.801
Household consumption	7.774	–0.245	8.018	8.576	–0.302	8.878
Mother's education	–0.746	–0.113	–0.633	–0.704	0.133	–0.837
Sanitation	–0.004	–0.034	0.030	0.335	0.256	0.079
Water	–0.122	–0.079	–0.043	–0.451	0.041	–0.493
Health services	–0.445	–0.564	0.119	0.945	0.626	0.319
Constant	–4.968	0.000	–4.968	–4.968	0.000	–4.968
Total	–0.037	–0.394	0.357	1.763	0.762	1.000
Implied new IMR	34.60	37.59	31.57	22.76	29.49	27.90
Implied new U5MR	50.19	54.48	45.83	33.10	42.83	40.54

Table 8. Decompositions of changes in survival, based on eqn (6)

	D_1 *Different changes in x's* $(\Delta x^{NP} - \Delta x^{P})\beta_{98}^{NP}$	D_2 *Different levels of β's* $(\beta_{98}^{NP} - \beta_{98}^{P})\Delta x^{P}$	D_4 *Different levels of x's* $(x_{93}^{NP} - x_{93}^{P})\Delta\beta^{P}$	*Nonpoor-poor difference in* $\Delta[-\ln\lambda]$
Region	0.038	–0.386	–0.008	–0.356
Child characteristics	0.028	–0.074	–0.043	–0.088
Household consumption	–0.002	–0.017	0.822	0.803
Mother's education	0.151	–0.007	–0.103	0.041
Water	0.181	0.127	0.030	0.338
Sanitation	–0.164	0.067	–0.232	–0.329
Health services	0.320	0.964	0.106	1.390
Constant	0.000	0.000	0.000	0.000
Total	0.552	0.674	0.573	1.800

Key points

There is no single factor explaining the faster decline in mortality among better-off children in Vietnam over the period 1993–98. Rather it was due to three sets of factors: (i) the poor experiencing less advantageous changes in the determinants of child survival; (ii) these changes mattering less for the poor, since they faced a worse set of coefficients linking survival determinants to survival outcomes; and (iii) changes in coefficients mattering less for the poor since they started with worse determinants. These three factors made roughly equal contributions. In (i) differential changes in health service coverage stand out as the single largest contributory factor to the faster mortality decline among the better-off, though differential changes in mother's education and access to safe water were also important. In (ii) health services were also a major factor, reflecting *inter alia* the lower impact of antenatal visit coverage among the poor. But other coefficient differences also left their mark, including the smaller effect of drinking water among the poor. In (iii) the lower levels of consumption and health service coverage among the poor meant that the increases in the impacts of these factors on survival resulted in smaller reductions in mortality among the poor. These increased impacts were not, however, significant at conventional levels.

6. Child survival prospects to 2015

The next question we address is how child survival prospects are likely to evolve over the next 15 years. Vietnam is currently preparing a PRSP—Vietnam's Comprehensive Poverty Reduction and Growth Strategy (CPRGS)—to qualify for continued support through IDA. Like other countries preparing PRSPs, Vietnam is setting out in its CPRGS broad poverty-reduction strategies as well as targets for poverty and human development indicators. In other countries these targets have included rates of infant and under-five mortality, since these are among the seven key international development goals (IDGs). The latter involve *inter alia* a reduction by all countries of infant and under-five mortality rates by two thirds between 1990 and 2015. In this section, we address the issue of whether such a reduction is possible for Vietnam, and whether commitment to such a path would be realistic for Vietnam's CPRGS.

Methods and assumptions

Using the Oaxaca decomposition methodology, we can write the hazard rate for the year 2015 for the "poor" and "nonpoor" separately as follows:

(7) $$-\ln\lambda_{15}^{j} = -\ln\lambda_{98}^{j} + \left(x_{15}^{j} - x_{98}^{j}\right)\beta_{98}^{j} + \left(\beta_{15}^{j} - \beta_{98}^{j}\right)x_{15}^{j}, j = \text{“poor”, “non-poor”}$$

where the notation is self-evident. So, the (negative of the log of the) hazard in 2015 will depend on the hazard in 1998, the change in the means of the determinants of survival during the period 1998–2015, and the changes in the *impacts* of these determinants over the same period. We know the first term on the RHS. The other terms are unknown, and some assumptions are required to operationalize the method.

We need to make some assumptions about the changes in the x's and the β's. For the nonpoor, we assume with respect to the x's that the annual average rate of growth (or decline) over the period 1993–98 is continued over the period 1998–2015, with two exceptions. First, we assume no further redistribution of young children across the eight regions in our model, and that the child population is stable in the sense of showing no change in the age and gender composition. Second, we have to restrict the variables capturing proportions to be in the interval [0,1]. We replace values in excess of one (or 100 percent) by one (or 100 percent) in the first year it exceeds the limit and for all years thereafter. For the top three quartiles, full coverage is achieved for water in 2010, for sanitation in 2015, for vaccinations in 2006, and for antenatal care in 2012. With respect to the β's, we make a more conservative assumption and assume simply that $\Delta\beta$ for the entire period 1998–2015 will simply be the same as that for the five years 1993–98. For the poor, we explore four scenarios. In scenario A, we apply the analogous assumptions made for the nonpoor: the x's grow or decline over the period 1998–2015 at the same annual rate as over the period 1993–98 subject to the qualifications as above; and $\Delta\beta$ for the entire period 1998–2015 will simply be the same as that for the five years 1993–98. In scenario B, we employ the poor group's β_{98} coefficient vector but assume the poor will experience the same annual rates of growth of the X's as the nonpoor. In scenario C, we assume that the poor will experience the same growth rates as in scenario A and B, but that they will face the nonpoor group's coefficient vector β_{98}. Finally, in scenario D we assume the poor will experience the same growth rates and the same coefficient vector β_{98} as the nonpoor. The implied growth rates and terminal values of the x's are indicated in Table 9 for scenario A.

Table 9. Assumptions concerning progress on determinants of survival

	Bottom quartile		*Top three quartiles*	
	Average annual percentage change	*Value at 2015*	*Average annual percentage change*	*Value at 2015*
Equivalent HH consumption (log)	0.6%	8.625	0.7%	9.592
Years schooling of mother	–1.4%	4.200	1.3%	8.888
OK sanitation	8.6%	0.584	9.3%	1.000
Safe water	–14.0%	0.002	8.7%	1.000
Vaccination coverage	6.3%	100.000	6.4%	100.000
Antenatal visit coverage	5.5%	98.653	4.7%	100.000
Medically trained delivery coverage	–1.8%	42.033	0.6%	82.283
Facility delivery coverage	–5.0%	13.971	2.6%	93.617

Results—survival prospects to 2015

Table 10 shows the result of the analysis of likely future trends in child survival. The implied values of the U5MR corresponding to the second and third terms on the RHS of eqn (7) are the predicted values in the event that only the x's change or only the β's change. Thus, if for the richest three quartiles, the β's were to change between 1998 and 2015 as they did in the period 1993–98, but the x's stayed at their 1998 values, the U5MR would fall from 34.0‰ in 1998 to 30.1‰ in 2015. If, by contrast, the β's were to remain unchanged at their 1998 values, but the x's were to grow (or decline) at similar rates to those observed over the period 1993–98, the U5MR for the richest three quartiles would fall to 21.6‰. The net effect of *both* sets of changes is to reduce the U5MR by just under two thirds below its 1990 value. These two sets of changes would, in other words, ensure that among the richest three quarters of children in Vietnam the MDG for under-five mortality would be hit.

In the case of the poorest quartile, the picture is quite different. Under the same two sets of assumptions as made above for the richest three quartiles, the U5MR among the poorest quartile would actually rise by 78 percent—a reduction in mortality due to beneficial changes in the β's, being more than offset by deleterious changes in the x's. The prospects for the poor look somewhat better in Scenario B where they are assumed to experience the same growth rates in the x's as experienced by the nonpoor. But even in this case, the under-five mortality rate among the poorest quartile would barely change from its 1990 value. In both scenarios C and D, the prospects for the poor look decidedly better. In scenario C, where the poor are assumed to experience the same growth rates as in scenario A but are assumed to face the coefficient vector of the nonpoor, a 53 percent reduction in the under-five mortality rate between 1990 and 2015 is predicted. A 61 percent reduction is predicted in scenario D where the poor are assumed to enjoy the nonpoor's growth rates and to face the nonpoor's coefficient vector. In both scenarios A and B, what holds the poor back are the negative coefficients on the water and antenatal visit variables. Caution ought to be exercised in interpreting these negative coefficients too literally, but the results for contrast between the results for scenarios A and B, on the one hand, and scenario C and D, on the other, do point towards the importance of ensuring that poor children benefit more from water and from antenatal visit programs than they appear to at present.

Table 10. Decompositions of changes in survival to 2015

Scenario		*Value*	*Implied U5MR*	*Percent change on 1998 value*
	Top 3 quartiles			
	$-\ln\lambda_{98}$	15.86	33.97	
	$(x_{15}-x_{98})\beta_{98}$	1.95	21.55	-59%
	$(\beta_{15}-\beta_{98})x_{15}$	0.44	30.69	-41%
	$-\ln\lambda_{15}$	18.25	19.46	-63%
A—poorest quartile's growth and coefficients	*Bottom quartile*			
	$-\ln\lambda_{98}$	14.17	50.19	
	$(x_{15}-x_{98})\beta_{98}$	-4.20	129.50	127%
	$(\beta_{15}-\beta_{98})x_{15}$	1.11	38.87	-32%
	$-\ln\lambda_{15}$	11.08	101.28	78%
B—poorest quartile's coefficients but top three quartiles' growth	*Bottom quartile*			
	$-\ln\lambda_{98}$	14.17	50.19	
	$(x_{15}-x_{98})\beta_{98}$	-1.41	69.24	21%
	$(\beta_{15}-\beta_{98})x_{15}$	0.92	40.63	-29%
	$-\ln\lambda_{15}$	13.68	56.16	-1%
C—poorest quartile's growth but top three quartiles' coefficients	*Bottom quartile*			
	$-\ln\lambda_{98}$	14.17	50.19	
	$(x_{15}-x_{98})\beta_{98}$	1.64	34.37	-40%
	$(\beta_{15}-\beta_{98})x_{15}$	1.11	38.87	-32%
	$-\ln\lambda_{15}$	16.92	26.57	-53%
D—coefficients and growth of top three quartiles	*Bottom quartile*			
	$-\ln\lambda_{98}$	14.17	50.19	
	$(x_{15}-x_{98})\beta_{98}$	2.56	27.75	-51%
	$(\beta_{15}-\beta_{98})x_{98}$	0.92	40.63	-29%
	$-\ln\lambda_{15}$	17.65	22.41	-61%

Note: assumes IMR in 1990 is 40‰ and 36‰ for the poor and nonpoor respectively, and that the U5MR figures for 1990 are 57‰ and 52‰ for the poor and nonpoor, respectively.

Key points

Achieving a reduction of two thirds of the 1990 levels of child mortality in Vietnam as implied by IDTs is very challenging. Even under quite optimistic assumptions about annual income growth, as well as the evolution of water, sanitation and health services, projected levels of child mortality are likely to be higher than the targets by 2015. The key problem seems to be the slow recent progress among Vietnam's poor. Central to tackling this problem would seem to be: reversing the backward moves along the survival demand curve among the poor (especially vis-à-vis women's education and birth-related health services); and ensuring that it is not just the better-off who benefit from improvements that increase the impact of health determinants on child survival.

7. Discussion and policy implications

The previous analysis has shown that while child mortality for the population as a whole has continued to fall under Doi Moi, progress has been much faster at the top end of the income distribution. Indeed, the poorest 25 percent of children saw virtually no improvements in their survival prospects at all in the mid-late 1990s. The recent slow rate of decline of child mortality among poorer Vietnamese children, which is apparently due to a variety of factors, makes it doubtful whether Vietnam will achieve the reductions in infant and under-five mortality envisaged by the international development goals (IDGs). In this last section, we discuss some policy options for accelerating the pace of decline of child mortality among Vietnam's poor.

The previous sections showed that in two key respects the poorest 60 percent of Vietnamese children appear to slip backwards between 1993 and 1998—their mothers were less educated than their predecessors; and they were less likely to be delivered by trained birth attendants and in medical facilities. What would the impact of reversing these declines be on child survival prospects among the poorest 25 percent of Vietnamese children? In 1993, mothers in the bottom quartile averaged 5.8 years of schooling. In 1998, this figure had fallen to 5.4. In 1993, 62.7 percent of births in the poorest quartile were attended by a medically trained person and 43.1 percent of births took place in a medical facility. In 1998 these figures had fallen to 57.3 and 33.3 percent, respectively. Applying the 1998 coefficient vector to the 1993 values of these variables, keeping the other variables at their 1998 values, gives us an estimate of how far mortality would fall if these declines were reversed. The figures in Table 11 indicate that the impact on the U5MR of reversing the decline in maternal schooling would be smaller than the impact of reversing the decline in deliveries attended by medical personnel and deliveries in medical facilities. Reversing both sets of changes together would reduce the U5MR by around 5.4‰—an eleven per cent reduction in the U5MR.

Table 11. Reversing declines in determinants of survival among poorest 25 percent

	IMR	U5MR
Values among poorest 25 percent in 1998	34.6	50.2
Mother's education back to 1993 value	34.1	49.4
Attended deliveries and deliveries at medical facility back to 1993 values	31.3	45.4
Both mother's education and deliveries back to 1993 values	30.8	44.8

We consider next the effects of targeted improvements in health services, drinking water and sanitation. In all three areas the poorest 25 percent of children lag far behind the richest 75 percent, and closing these gaps—by bringing the poor up the levels enjoyed by the better-off—seems likely to have a sizeable effect on child mortality among the poor. Table 12 shows the effects of raising the levels among the poorest 25 percent of children to the levels enjoyed by the richest 75 percent of children. In each case apart from drinking water, child mortality would fall. This reflects the fact that among the poorest 25 percent all determinants except water are estimated to have beneficial effects on survival, as are most health services. The largest impact would derive from extending health service coverage among the poorest quartile to the level of coverage enjoyed by the richest three quartiles.

Table 12. Targeted improvements in health services, water and sanitation among poorest 25 percent

	IMR	U5MR
Values among poorest 25% in 1998	34.6	50.2
Improving sanitation quality to level of top 75%	32.5	47.1
Improving drinking water quality to level of top 75%	35.5	51.5
Improving health service coverage to level of top 75%	29.3	42.6

The changes in Table 12—while useful—are fairly small in absolute terms and relative to the reductions envisaged by the IDGs. For example, effecting all three sets of improvements in Table 12 simultaneously would reduce the U5MR among the poorest 25 percent of children from 50.2‰ to 41.1‰—a reduction of 6 percent on the 1998 value. It is worth considering what other measures might be taken to accelerate further the decline in mortality among Vietnam's poor. Looking back at Table 3, it is striking that when the coefficients differ significantly across the two consumption groups, in all cases except one (medically trained delivery coverage) the poor fare worse. When variables contribute positively to child survival—such as living in the central Highlands and the southeast, good drinking water and antenatal visit coverage—the impact is larger for the better-off. When variables contribute negatively to survival—as is the case with being male—the impact is larger in absolute size for the poor. The impact of medically trained deliveries runs counter to this pattern—this contributes positively to survival for the poor, but not for the better-off.

This pattern suggests that some effort could usefully be directed at exploring the reasons for the apparent gaps in impacts between the poor and nonpoor, and finding ways to reduce them. For example, the gap in the impact of drinking water may well reflect the fact that the nonpoor know better how to use water to promote the health of their children—e.g., taking advantage of its plentiful supply to wash hands after defecation, before preparing meals, and before feeding their children. The gap in the gender impact may reflect a tendency for poor boys to be more likely to be involved than their better-off counterparts in accidents. The smaller impact of antenatal coverage among the poor probably reflects a failure of poorer households to take full advantage of such programs and to comply less with the instructions of the staff delivering them. The pace of mortality decline among Vietnam's poor can be accelerated by coupling targeted programs (changing the x's for the poor) with measures such as behavioral change and communication (BCC) programs aimed at raising the impacts of these determinants (raising the β's of the poor).

The potential impact of BCC and similar measures can be appreciated by considering what would happen if, in addition to implementing the three measures in Table 12, a program succeeded in equalizing the impacts of the x's across the poor and nonpoor, by replacing the β's of the poor with those of the nonpoor. Under this scenario, the U5MR for the poorest 25 percent of the population would fall not to 42.6‰ as in Table 12, but to 36.1‰—a reduction of 28 percent below the 1998 rate. This suggests strongly that a strategy for accelerating the mortality decline among Vietnam's poor ought to focus not just on improving their coverage of health services and access to drinking water to this group, but also on enhancing the impacts among the poor of these key determinants of child survival.

Appendix.

Computation of indirect estimates of infant and under-five mortality rates

The indirect estimates pertaining to the 1989 Census, the 1994 ICDS and the 1997 DHS were computed by the authors using the computer program Q5 (United Nations 1983) using the data on children born and children surviving reported in Table 3.5 (p.32) of the 1997 DHS report (Government of Vietnam 1999). (The mortality estimates reported in the DHS report are computed using the direct method.) The "North" family of life tables was used throughout, as in Hill and others (1999). The IMR and U5MR reported in Figure 3 (p. 46) of the MICs report (Government of Vietnam 2000) are used here. (Identical results are obtained if one passes through the computer program Q5 the data on children born and children surviving reported in Table 2.2 (p.92) of the MICS report.)

The VLSS estimates are obtained using the same methods. One issue that arises in the context of both VLSSs is that of weighting. There are two issues. First, in both surveys fertility histories were obtained from only one woman of fertile age per household. If women in households with more than fertile woman are alike in their fertility histories to fertile women in the population at large, this will not create a problem. Desai (1998) has shown, however, that this is not the case. There are proportionally fewer women in the lower and upper age groups responding to the fertility module of the 1993 VLSS than there are in the VLSS as a whole. Since death rates among children tend to be higher among women aged 15–19, 20–24 and 40–45 than among women in the age groups in between, the VLSS will tend to produce lower estimates of child mortality than is warranted unless some adjustment is made for the under-representation of younger and older women. A simple way of correcting for this is to weight respondents according to their degree of under-representation in the fertility data—i.e., by a number that is the ratio of the number of women in the age group in the VLSS generally to the number of women in the age group responding to the fertility questions. This was done for 1993 and produced estimates that differed very little from those in Table 2. The reason for this is that the fertility rates among younger and older women in Vietnam are relatively low, with only 0.036 of births in 1993 being to women aged 15–19 and only 3.79 of births to women aged 40–45. The relatively small number of births occurring to young women is probably due in part to there being a fairly widely accepted consensus about the ideal age to start a family and in part to the widespread availability of abortion, while the relatively small number of births to older women is probably in part a reflection of the official policy of discouraging more than two children per family.

There is a second issue involving weighting. Unlike the 1993 VLSS sample, the 1998 VLSS sample is not nationally representative. Of the 6000 households surveyed in the 1998 VLSS, 4305 were included in the 1993 VLSS sample. To make the households surveyed in 1998 nationally representative the VLSS designers have included household-level weights or expansion factors. These were applied to the fertility data throughout.

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