A. INTRODUCTION

Accurate knowledge of adult mortality levels and trends in the developing world is hampered by a widespread lack of complete vital registration systems. Although knowledge of infant and child mortality once faced similar barriers, survey-based techniques – indirect methods and birth histories – have been more successful at measuring child than adult mortality, and we know correspondingly less about the latter than the former.

A relatively small number – and smaller share by population -- of developing countries do have close to complete registration of adult deaths and population censuses of high quality. A larger number of countries have national or sample vital registration systems that are complete enough to be promising candidates for methodolog14 T68 1BDCBTdea1 0 0 10.98 471.08 397.1639 597.7814 Tm27 T6902BTdea1 0 0 10 mathematical models of population age distributions to relate the age pattern of deaths to the age pattern of the population in such a way that the completeness of death registration can be estimated. The key assumption underlying these methods is that recording of deaths (after childhood) should not vary with age.

The Brass (1975) and Hill (1987) methods estimate the completeness of age recording by comparing an observed death rate for the population aged x and over to a residual estimate obtained by subtracting the growth rate of the population aged x and over from an estimate of the entry rate into the population aged x and over, both obtained from the population age distribution. I refer to these methods as "Growth Balance" (GB) methods. The more flexible Hill method (which uses data from two censuses and does not assume that the population is stable) estimates both the completeness of coverage of deaths relative to population enumerations and the possible change in coverage between two census enumerations. The Preston et al. (1980) and Bennett and Horiuchi (1984) methods use population growth rates above age x to expand recorded deaths over age x to estimate the number of deaths over age x in the corresponding stationary population; completeness of death recording is then estimated by comparing the population aged x to the sum of stationary population deaths above age x. I will refer to these methods as "Synthetic Extinct Generations" (SEG) methods. The more flexible Bennett and Horiuchi method (which also uses data from two censuses and does not assume that the underlying population is stable) estimates the completeness of coverage of deaths relative to the populations, but is sensitive to changes in census coverage.

Hill (2001) uses simulations to show that the GB methods are more sensitive to possible errors in age reporting than the SEG methods, whereas the SEG methods are much more sensitive to any changes in census coverage. He suggests a two-stage process, by which the GB method is applied first to estimate any change in census coverage, and the SEG method is then applied to data after adjusting the census numbers for possible coverage change.

Sibling Survival

Analogous to the use of a birth history to measure infant and child mortality is the use of a sibling history (essentially the birth history of the respondent's mother) to measure adult mortality. Such a history has been asked in a considerable number of DHSs, particularly in sub-Saharan Africa, originally with the intent of estimating maternal mortality (Rutenberg and Sullivan, 1991). A respondent is asked about every sibling born of the same mother: the age of surviving siblings, and the year of birth and date of death of siblings who have died. The data provide deaths and exposure time by age, sex and time period, from which age-specific mortality rates can be calculated directly. Key assumptions of the method are that surviving siblings and siblings who have died are equally likely to be reported, and that the data are not affected by substantial selection bias. Comparisons with other sources suggest that sibling survival tends to underestimate adult mv the estimates tend to refer to a time period somewhat more recent than the mid-point of the respondents' age (because the mortality

TABLE 1: SOURCES OF ESTIMATES OF LIFE EXPECTANCY FOR COUNTRIES

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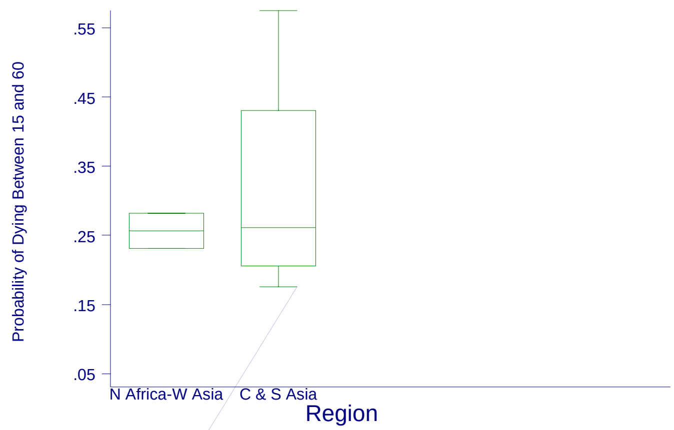
Republic of Korea to a maximum of 575 per 1,000 for males in Mongolia. The corresponding expectations of life at age 10, e , are 70.3 and 42.8 years respectively.

Figure I. Estimates of the Probability of Dying between Ages 15 and 60 by Sex and Region; 15 AMDC Project Countries with Estimates for the 1990s

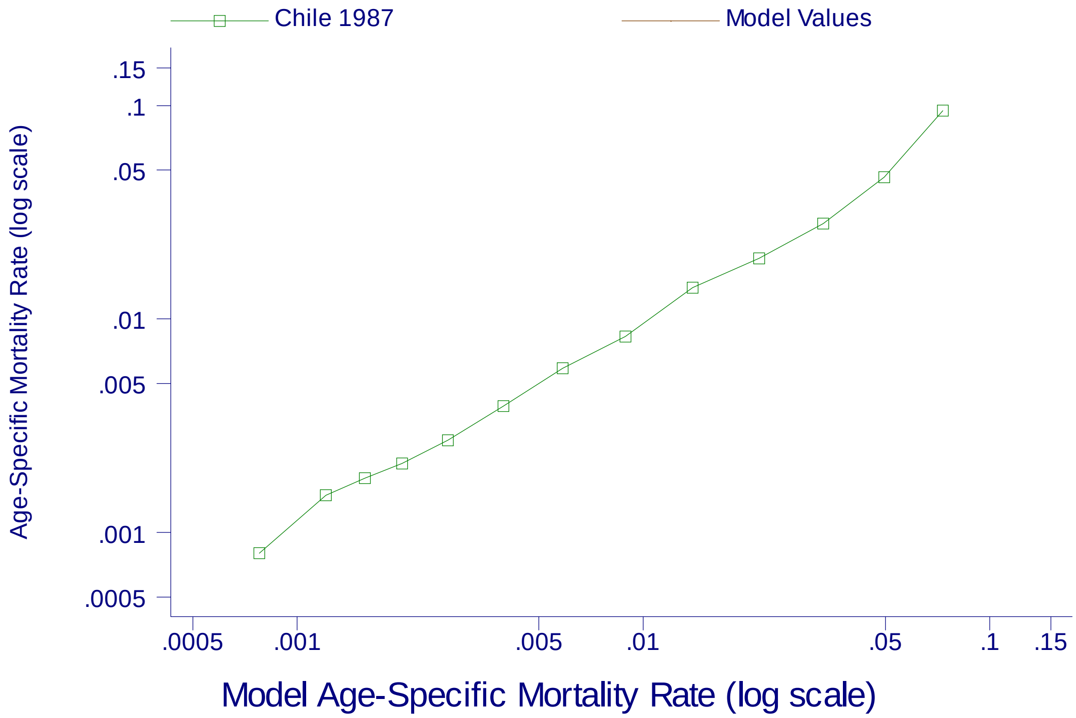


Age Patterns

One of the major advantages of basing estimates of adult mortality on adjusted registered deaths (or deaths in a defined reference period recorded by a census) is that the estimates include information about the age pattern of mortality. Sibling histories (as implemented by the Demographic and Health Surveys program) provide information only up to age 50, survival of parents provides no indication of age patterns of mortality, and intercensal survival techniques are typically so affected by age exaggeration as to provide little useful information. This section compares AMDC estimates of age-specific mortality rates for individual countries with the patterns expected by matching the observed ${}_{45}q_{15}$ with that of a model in the appropriate family of the U.N. *Model Life Tables for Developing Countries* (UN; 1982). Given problems with age misreporting, ar esenecteonmily

Figure III. Age-Specific

c) Males, Chilean Standard



e) Males, Far Eastern Standard

Age-Specific Mortality Rate (I

g) Males, General Standard

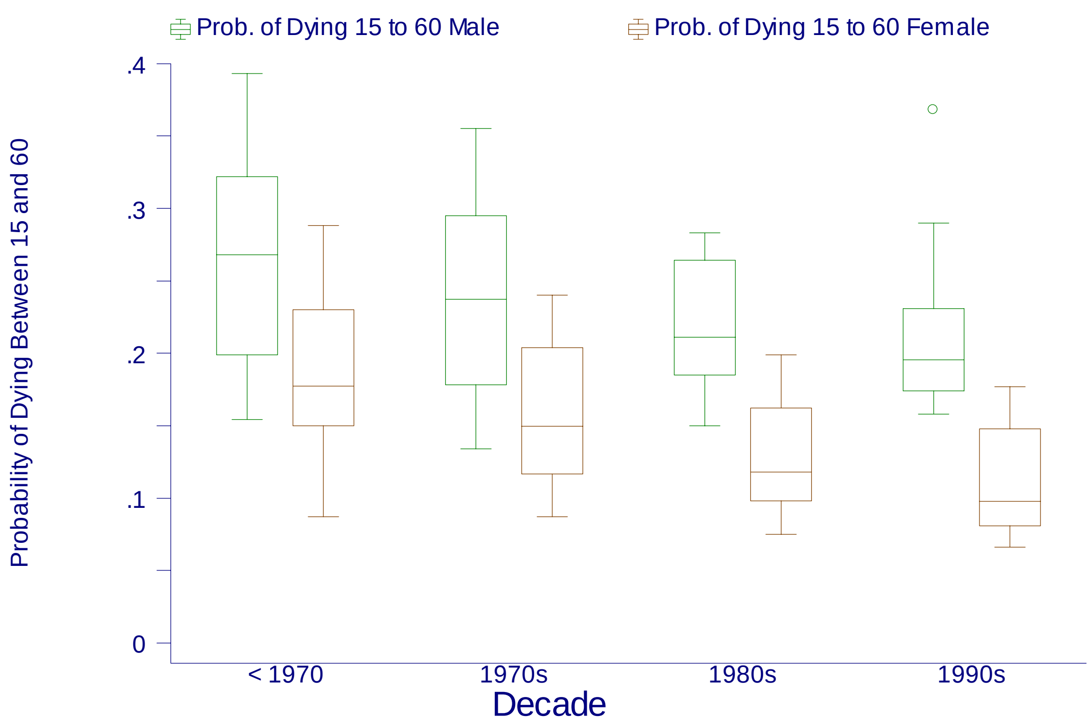
Age-Specific Mortality Rate (log

By and large, the observed patterns are reasonably well fitted by the models. The Latin American model fits the data for Brazil and Argentina females very well, and the Chilean family fits the Chilean data very well. The largest relative differences are typically for younger adults: Cuba and Panama both have higher mortality under the ages of 30 (females) or 35 (males) than the Latin American family would predict, and both males and females in China and the Republic of Korea have higher mortality under age 40 than the Far Eastern model would suggest, with correspondingly lower mortality between 40 and 75. The worst fits are clearly for the two populations of the former Soviet Union, Azerbaijan and Mongolia, fitted for want of a better alternative by the General Standard: mortality rates are lower than the models would suggest under age 35 or 40, and higher above.

Trends

For 16 of the 27 countries examined, estimates are available for two or more time periods, allowing examination of trends. Figure IV shows the probabilities of dying between the ages of 15 and 60 by sex and decade for countries with multiple observations. There is a steady downward trend over time for both males and females, the median ${}_{45}q_{15}$ dropping from 0.268 before 1970 to 0.196 in the 1990s for males, and from 0.178 before 1970 to 0.098 for females. Regression of ${}_{45}q_{15}$ on reference date using a country fixed effects model indicates an annual rate of decline of one percent per annum for males and two percent per annum for females (corresponding rates of decline for the Under-Five Mortality Rate, U5MR, are approximately four percent per annum (Hill et al., 1999)). Rates of decline have not differed significantly by decade.

Figure IV. Estimates of ${}_{45}q_{15}$ by Sex and Decade, 1950s to 1990s



Effects of HIV/AIDS on Adult Mortality

The inclusion of only two countries from sub-Saharan Africa among the 27 countries for which data are presented in this paper greatly reduces the timeliness of the results for studying the effects of the HIV/AIDS epidemic. There can be no doubt, however, that the epidemic has had dramatic effects on adult mortality in certain populations. Timæus (2003) has used regression models with data on survival of siblings from Demographic and Health Surveys to document very large increases in adult mortality in a number of African populations. The only country included in the data base used in this paper that has a generalized HIV epidemic and data recent enough to show an effect is Thailand. Figure V shows unadjusted male and female age-specific mortality rates for selected years from the late 1980s to the late 1990s for Thailand. For males, mortality rates in 1997 are higher than in 1988 for ages between 15 and 50; mortality is somewhat higher even in 1991 than in 1988, but the big increase is from 1991 to 1994. The age-specific mortality rate for the age group 25 to 29 is two and a half times higher in 1997 than in 1988. The pattern for females is also clear, though somewhat different: the mortality increase is largely limited to ages 20 to 35, the big increase was between 1994 and 1997, and the maximum increase from 1988 to 1997, for the age group 25 to 29, was somewhat smaller than for males at a factor of two. Male and female mortality rates at other ages appear to have declined between 1988 and 1997.

F. CONCLUSIONS

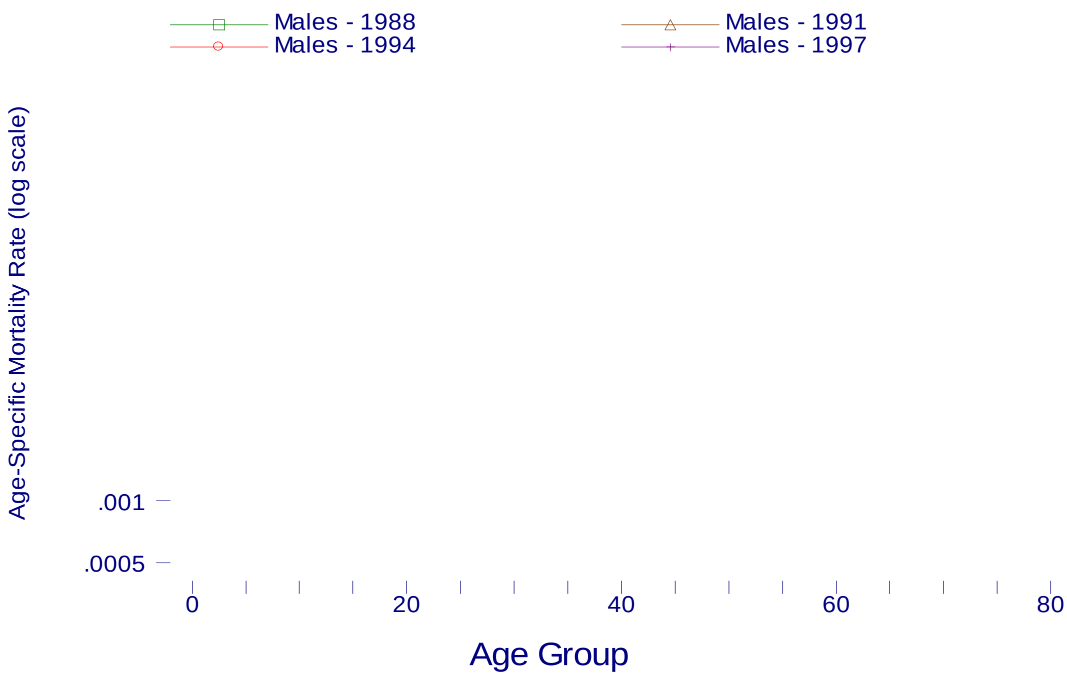
Estimates of adult mortality for the developing world are less satisfactory than estimates of child mortality for two main reasons: no equivalent of the birth history for estimating child mortality from household surveys has been developed for adult mortality, and indirect estimation techniques do not seem to be as robust as indirect estimates of childhood mortality based on summary birth histories. As a result, much of what we know about adult mortality in the developing world is based on vital registration data (or household deaths recorded by a population census) evaluated (and if necessary adjusted) using death distribution methods. Although such data cover over two-thirds of the population of the developing world, we know very little about adult mortality in sub-Saharan Africa. In the era of HIV/AIDS, with adult mortality acquiring a new salience, action is needed to increase the number of countries for which death distribution methods are applicable. The most effective way of achieving this goal seems likely to be by encouraging the inclusion in population censuses of questions on household deaths by age and sex.

Twenty-seven countries have so far been studied by the Adult Mortality in Developing Countries project. On the basis of these countries, the following conclusions are drawn:

1. There is very wide variability in levels of adult mortality in the developing world even between populati98 129.9925 306.844519.5044 Tm( )Tj0.000e35 Tm(or ow(eveloping CouThe Tm( )Tj0.0tt(le effecdedbyf HIV/A

Figure V. Unadjusted Age-Specific Mortality Rates for Selected Years: Thailand

a) Males



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Brass, W. (1975).

Appendix. Countries and Time Periods Covered by AMDC Project Estimates

Country	Time Periods				
Argentina	1947-1960, 1960-1970, 1970-1980, 1980-1991				
Azerbaijan	1991-2000	1ef92.52	695.94	0.48	1