3-1997

# Mortality in Vietnam, 1979-1989

M. Giovanna Merli
*University of Washington*



Recommended citation:
Merli, M. Giovana. 1997. "Mortality in Vietnam, 1979-1989." PARC Working Paper Series, WPS 97-01.
This working paper was published in a journal:
Merli, M.Giovana. 1998. "Mortality in Vietnam, 1979–1989." *Demography* 35:345-360. https://doi.org/10.2307/3004042.

## Mortality in Vietnam, 1979-1989


### Abstract

Until not long ago, scanty information on the profile of the Vietnamese population and the poor quality of the available data have complicated efforts to present reliable estimates of mortality levels in Vietnam. Only recently, have official data on Vietnamese mortality become available through the 1979 and the 1989 population censuses. This paper makes use of such data to estimate Vietnam s mortality levels during the intercensal period.



### Keywords

mortality, Vietnam, age reporting, vital registration, Vietnam Life History Survey (VLHS)


### Disciplines

Demography, Population, and Ecology | Family, Life Course, and Society | Social and Behavioral Sciences | Sociology

### Comments

Recommended citation:

Merli, M. Giovana. 1997. "Mortality in Vietnam, 1979-1989." PARC Working Paper Series, WPS 97-01.

This working paper was published in a journal:

Merli, M.Giovana. 1998. "Mortality in Vietnam, 1979–1989." *Demography* 35:345-360. https://doi.org/10.2307/3004042.

# Population Aging Research Center, University of Pennsylvania
# Working Paper Series No. 97-01

---

***MORTALITY IN VIETNAM, 1979-1989****

M. Giovanna Merli
Center for Studies in Demography and Ecology
University of Washington

March 1997

---

* Direct correspondence to M. Giovanna Merli, Center for Studies in Demography and Ecology, Box 353340, University of Washington, Seattle, WA 98195-3340. The research for this project was funded by a Andrew W. Mellon Foundation Postdoctoral Fellowship at the Center for Demography and Ecology at the University of Washington, a NICHD Predoctoral Trainee Fellowship at the University of Pennsylvania, and a Rockefeller Foundation grant to Dr. Herbert Smith. I am also grateful to Dr. Samuel Preston for his many suggestions, and to Dr. Irma Elo, Dr. Charles Hirschman, and Dr. Herbert Smith for helpful comments.

## MORTALITY IN VIETNAM, 1979-1989

### INTRODUCTION

Until not long ago, scanty information on the profile of the Vietnamese population and the poor quality of the available data have complicated efforts to present reliable estimates of mortality levels in Vietnam. Only recently, have official data on Vietnamese mortality become available through the 1979 and the 1989 population censuses. This paper makes use of such data to estimate Vietnam's mortality levels during the intercensal period.

The problems posed by census data to estimate mortality are well known. First, one must rely on the reported age distributions. In Vietnam, little is known about the accuracy of age reporting, except that, by virtue of Vietnam's proximity to the East-Asian cultural sphere, age reporting is considered to be fairly accurate. There is little evidence of heaping from the single-year age structure of the 1989 census,[1] and only a small amount of exaggeration at the oldest ages (80+) is seen in the 1979 census age structure.[2] Second, enumerations in the two censuses must be equally complete. Yet, the population at the time of the 1989 census was very mobile as a result of loosened controls under the economic reforms of the 1980s,[3] thus complicating the effort to enumerate persons away from their usual place of residence. Third, the population must be closed to migration.

[1] J. Banister, 'Vietnam: Population dynamics and prospects', *Indochina Research Monograph*, No. 6. Berkeley: Institute of East Asian Studies, University of California-Berkeley , 1993.

[2] G. Feeney, 'Untilting age distributions: A transformation for graphical analysis', *Asian and Pacific Population Forum*, 4 (1990), pp. 13-20.

[3] Banister, *op. cit.* in fn 1.

The aftermath of the war against the US between 1965 and 1975 and the reunification of Vietnam under Communist rule opened the population to massive emigration. This nullifies efforts to estimate mortality using intercensal survival techniques if no correction for migration is performed. Finally, because Vietnam's fertility and mortality have not been constant over the last four decades, three of which have been marked by the shocks of the first Indochina war in the 1950s and the Vietnam War in 1965-75, traditional methods of mortality estimation that rely on stable population theory are not adequate.

The process of estimation of Vietnamese intercensal mortality featured in this article incorporates several attempts to minimize bias from these sources. First, I adjust the 1989 census age distribution on an age-specific basis for the effect of net intercensal migration, using an estimated sex-age distribution of emigrants during the intercensal period. To deal with Vietnam's population departures from stability, I apply methods of mortality estimation that relax the assumption of stability by use of the age-specific growth rates from two census age distributions. I further propose steps to reduce the impact of errors in the growth rates caused by differential census enumeration completeness and “residual” emigration that could not be incorporated in the estimates of intercensal migration.

I begin by providing a general picture of mortality in the colonial and post-colonial period up to the end of the 1970s. I then present previous estimates of mortality for the 1980s and discuss the validity of their underlying theoretical approaches. Next, I estimate intercensal mortality using two distinct procedures. The results of the application of these techniques to Vietnam’s 1979 and 1989 census data are reconciled in light of the sensitivity of the various methods to violations of the underlying assumptions, especially differential census enumeration completeness, and “residual” intercensal emigration.

Finally, I identify a set of estimates that provide the most accurate measurement of the mortality levels prevailing in Vietnam during the 1979-1989 intercensal period. A byproduct of this process is the measurement of census enumeration completeness.

## MORTALITY ESTIMATES PRIOR TO 1979

The paucity of information on mortality in Vietnam and the poor quality of available data has complicated efforts to present reliable estimates of mortality levels and trends over time. French analysts of the population dynamics of colonial Vietnam,[4] deplored the poor quality of vital registration, and the spuriousness of the censuses taken during the colonial period, which differed little from compilations of local estimates.[5] Furthermore, massive North-South population movements coinciding with Vietnam's partition along the 17th parallel that settled the end of the First Indochina War in 1954, as well as internal and international migratory flows following the reunification of Vietnam in 1975 have made the collection and analysis of demographic data difficult if at all possible.[6]

Yet, despite their poor quality, data prior to 1980 still suggest that mortality

---

[4]The term "colonial Vietnam" refers here to three of the five administrative units that made up French Indochina, presently corresponding to the territory of the Socialist Republic of Vietnam. These are Cochinchina, Annam, and Tonkin. Cambodia and Laos, the other two administrative units of French Indochina, are not the subject of this study. South and North Vietnam, the two parts of a divided country between 1954 and 1975, correspond respectively to Cochinchina and Southern Annam, and to Tonkin and Northern Annam.

[5] P. Gourou, *The Peasants of the Tonkin Delta: A Study of Human Geography*, 2 vols, (translated by Richard R. Miller), (New Haven: Human Relations Area Files, 1955); T. Smolski , 'Les Statistiques de la population indochinoise'. In Congrès International de la Population, *Démographie de la France d'Outremer. Vol. VI* (Paris, Hermann et C.ie, Éditeurs, 1937), pp. 56-67.

[6] In the absence of a national census of South Vietnam, Demeny attempted to give an account of mortality in this region from vital registration data and scattered population surveys. He argued that the poor registration of vital statistics does not allow to obtain accurate estimates of mortality levels and trends (See P.G. Demeny, *Final Report: A Population Survey in Vietnam* (New York, The Simulmatics Corporation, 1967). A similar conclusion was reached by Ng about the population of North Vietnam, where the results of the limited censuses of 1960, 1974 and 1976, mainly conducted for administrative purposes, remain unpublished. (See S.M. Ng, *The Population of Indochina: Some Preliminary Observations* (Singapore, Institute of Southeast Asian Studies, 1974).

dropped substantially from very high levels during the colonial period to very low levels in the 1950s and 1960s. Local estimates of mortality during the colonial period obtained from various sources, exhibit levels of 28 deaths per thousand in the Hanoi-Namdinh region for 1910-1912,[7] of 22.7 for 1934 in Haiphong,[8] and an annual mean of 24 in Cochinchina for the 1928-1935 period.[9]

Based on data from the Vietnamese Ministry of Health, Jones reported that crude death rates in North Vietnam dropped from 26 per thousand in 1936 to 12.2 in 1957, 12 in 1960, 6.7 in 1965, 6.6 in 1970, and 5.5 in 1975.[10] Banister, on the other hand, provides estimates of mortality in the South that are nearly twice as high at 12 per thousand for the first half of the 1970s. Also drawing from Vietnamese data sources, Banister concluded that the life expectancy at birth for the whole country increased from around 30-35 years in 1936, to 50 years in 1970, 58 in 1975 and 60 in 1978.[11] Similarly, mortality estimates

---

[7] This estimate derives from a survey of 20,000 people in 4 villages conducted yearly between 1910 and 1912 (See H. Brenier, *Essai d'Atlas Statistique de l'Indochine Française* (Hanoi-Haiphong, Imprimérie d'Orient, 1914)). Gourou lauded the accuracy of these data relative to estimates obtained from vital registers, but acknowledged the presence of underreporting of infant deaths (Gourou, *op.cit* in fn. 5, p. 231).

[8] This estimate is a mean of the death rates calculated from the registers of 46 parishes of the vicariate of Haiphong (Gourou, *op.cit* in fn. 5). This figure is also presented in C.Hirschman, S.H. Preston and V.M. Loi, 'Vietnamese casualties during the American War: A new estimate', *Population and Development Review*, 21 (1995), pp. 783-812. Although the vital registers of the Catholic missions were regarded as the most reliable data sources on mortality in the colonial period, they still underestimate death rates because of failure to report infant deaths that occur prior to baptism (See Gourou, *op.cit* in fn. 5, p. 225).

[9]These are vital registration estimates for the colony of Cochinchina (Smolski, *loc. cit*. in fn. 5). French analysts agreed that the published figures obtained from this colony's vital registers were more reliable than those of the French protectorates of Tonkin and Annam. See Brenier, *op. cit* in fn 7, p. 7; Smolski, *loc. cit*. in fn. 5, p. 60; H.Ulmer, 'Quelques données démographiques sur les colonies françaises', in Congrès International de la Population, *Démographie de la France d'Outremer. Vol. VI* (Paris, Hermann et C.ie, Éditeurs, 1937), pp. 111-117; C. Robequain, *The Economic Development of French Indochina* (translated by I.A. Ward), (London, Oxford University Press, 1944), p. 46. These authors believed that Cochinchina's outright status of French colony allowed the French authorities to apply better and more direct means of supervision on the system of *état civil* established in the colonies.

[10] See G.W. Jones, 'Population trends and policies in Vietnam', *Population and Development Review*, 8 (1982), pp. 783-810. But Jones failed to note that in 1959 the recorded death rate was reported at 7.4, preceded and followed by a death rate of 12.2 and 12 for 1957 and 1960 respectively (See J. Banister, *The Population of Vietnam*, (International Population Reports, Series P-95, No. 77, Washington, D.C., US Bureau of the Census, 1985)). This clearly points at the poor quality of vital registration.

[11] Banister, *ibid.*.

provided by the United Nations for five-year intervals from 1955 to 1990 show a substantial reduction in mortality, with gains in life expectancy of 10 years between 1950-55 and 1970-75, from 40.4 to 50.3.[12]

A trend of declining mortality is also shown by data collected for the Vietnam Life History Survey (VLHS), a small sample survey conducted in four sampling areas in one Northern and one Southern province.[13] Using VLHS data, Hirschman *et al*. showed that adult mortality in Vietnam declined dramatically from very high levels in the colonial period to very low levels in the 1955-64 period. Mortality rates dropped from 26.1 per thousand in the period prior to 1955 to 9.8 per thousand between 1955 and 1964, and continued to decline well into the war decade 1965-75, albeit with slower gains than in earlier periods.[14] Although mortality rates before 1955 may have been higher than normal because of the 1945 famine and other dislocations caused by World War II and its aftermath, there is little doubt that Vietnam, like many other developing countries in the post-World War II period, witnessed a dramatic mortality decline.

## MORTALITY ESTIMATES FOR THE 1980S

The first "official" data on Vietnamese mortality were published in the 1979 census. More recently, additional mortality estimates have become available with the 1988 Vietnam Demographic and Health Survey, and the 1989 census.

The 1979 volume only reports values of life expectancy ($e_x$) by single year of age,

---

[12] United Nations, *World Population Prospects: The 1994 Revision*. (New York, United Nations, 1995), p. 872.

[13] Hirschman *et al., loc. cit*. in fn. 8. The Vietnam Life History Survey (VLHS), was conducted in 1991 by Charles Hirschman of the University of Washington, with colleagues from the Institute of Sociology of the National Center for the Social Sciences and Humanities in Hanoi and the Institute for the Social Sciences in Ho Chi Minh City (See Center for Studies in Demography and Ecology, *1991 Vietnam Life History Survey: Documentation and Codebook, (*Seattle, Center for Studies in Demography and Ecology, University of Washington, 1993).

[14] These rates are reported in an earlier version of the Hirschman *et al*. paper cited in fn. 8.

based on death rates computed from 1978 and 1979 vital registration deaths and census population counts. Mortality rates reported in the 1989 census derive from a census question on deaths in the household in the past year asked to a 5 percent sample of the total civilian population.

The 1979 abridged life tables in Table 1 are produced from the estimates of life expectancies by single year of age and sex contained in the 1979 census volume.[15] The 1989 life tables in Table 2 derive from the age-specific death rates based on the population counts enumerated in the 5 percent sample in the denominator and the reported number of household deaths in the numerator.[16]

[Tables 1 and 2 about here]

Values of life expectancy at each age and survival probabilities ${}_nP_x$ are translated into levels of mortality in the Coale and Demeny West model life table system.[17] This system embodies a modal age pattern of mortality widely observed in European, and some Asian, populations. Each increase in level corresponds to a gain of about 2.5 years in female life expectancy at birth. An inspection of the levels in the model life table system implied by the life expectancies at each age in the current life table allows one to assess the overall level of mortality, while the levels implied by the survival probabilities make it possible to evaluate the consistency of the age pattern of mortality.

Life expectancy at birth calculated in the 1979 life table is 63.66 for males and 67.89 for females. Although estimates of life expectancy based on deaths recorded in

---

[15] Vietnam General Statistical Office, *1979 Vietnam Census Report (*Hanoi, 1983).
[16] Vietnam, General Statistical Office, V*ietnam Population Census - 1989. Detailed Analysis of Census Results (*Hanoi, 1991).
[17] A.J. Coale, and P. Demeny. *Regional Model Life Tables and Stable Populations. Second Edition (*New York, Academic Press, 1983).

vital registers are likely to be biased upward by underregistration typical of this data source, the age patterns of mortality are plausible. Banister[18] concluded that the patterns of mortality of the 1979 census were internally consistent, and similar to patterns in neighboring China, a country that in 1973-75 reported a life expectancy at birth of 63.59 for males and 66.28 for females.[19] The mortality levels implied by the ${}_{n}P_{x}$ values in Table 1 are quite consistent, especially at adult ages. They deviate only at the youngest ages, where they are unusually low, and at the oldest ages, where they are unusually high.

Conversely, the 1989 life tables based on deaths in the household in the year prior to the census suggest implausibly low mortality, with life expectancy at birth of 73 years for males and 81 for females, much higher than in neighboring China, a country that, in 1990, reported life expectancies at birth of 67.87 for males and 71.24 for females.[20] In Vietnam's 1989 life tables, the levels of mortality implied by the $e_x$ values are very high. Among older males and females at all ages, they exceed level 25, the highest level in the West model life table representing life expectancy at birth of 76.65 years for males and 80 years for females. Similarly, the levels implied by the ${}_{n}P_{x}$ values increase steadily with age, indicating a lack of internal consistency of the age pattern of mortality.

Vietnam's General Statistical Office acknowledged the poor quality of household death data and adjusted these rates upward for incompleteness of death reporting. They doubled the number of reported deaths, based on completeness of death registration estimated at 45 percent for females and 55 percent for males by the Preston-Coale method.[21] The new life tables calculated from the adjusted age-specific death rates have

[18] Banister, *op. cit.* in fn. 1.

[19] J. Banister, 'China: Recent mortality levels and trends' (Paper presented at the Annual Meetings of the Population Association of America, Denver, May 1992).

[20] Banister, *ibid.*.

[21] S.H. Preston, A.J. Coale, J. Trussel, and M. Weinstein. 'Estimating the completeness of reporting of adult deaths in populations that are approximately stable', *Population Index,* 46 (1980), pp. 179-202.

life expectancy at birth of 63 for males and 67.5 for females.[22] Thus, the adjusted figures for 1989 show little improvement from the estimated levels for 1979. However, the adjustment procedure used is appropriate only for a stable population, one in which mortality and fertility have been constant for a long period of time. If mortality prior to the census has been declining, as it seems plausible for Vietnam, this method underestimates the completeness of death reporting, hence survival probabilities and life expectancy at each age.[23]

Notwithstanding the small size and unrepresentativeness of the VLHS sample survey, and several measurement problems inherent in the kin survival method, adopted to obtain information on mortality,[24] the survey yields quite plausible mortality estimates for the most recent period. The difference in West mortality levels implied by VLHS survival probabilities, ${}_nP_x$, for the period 1976-1990 is generally less than one level from one or both of the estimates based on 1979 and 1989 census death rates, the latter adjusted for underregistration completeness. In the VLHS, the average level of mortality for both sexes combined in the West model life table implied by the values of ${}_{15}P_{15}$, ${}_{15}P_{30}$, ${}_{15}P_{45}$, and ${}_{15}P_{60}$ is 21.4, and compares well with the average level of corresponding survival probabilities of 20.9 in the 1979 census life table and 20.3 in the 1989 census life table.[25]

The United Nations Population Division gives a somewhat different account of the recent mortality trends in Vietnam. Compared with a life expectancy at birth for both

---

[22] Vietnam General Statistical Office, *op. cit* in fn. 16.

[23] See S.H. Preston, 'Use of direct and indirect techniques for estimating the completeness of death registration systems', *Data Bases for Mortality Measurement* (Population Studies, No. 84. New York: United Nations, 1984).

[24] The kin survival method may miss patterns of clustered deaths, because no survivors of families exterminated by bombing campaigns during the Vietnam war would be alive in 1991 to report on prior deaths, thus underestimating mortality. On the other hand, selective emigration of members of higher socioeconomic groups with lower mortality would be expected to bias upward the mortality of those who did not emigrate (See Hirschman *et al*. *loc. cit*. in fn. 8).

sexes combined of 65.8 in the 1979 census, and of 65.2 based on the 1989 adjusted age-specific mortality rates, the UN estimates life expectancy at birth at 55.8 for the period 1975-79, and at 62.6 for the period 1985-89.[26] The difference in life expectancy at birth between the UN estimates and Vietnamese sources is most remarkable for the late 1970s. Based on the assessment by Banister,[27] the UN regarded the reported values from the 1979 census as too high, and relied instead on an interpolation of the 1970 reported value of life expectancy of 50 years[28] and a life table value of 65 years based on data from the 1989 census.[29]

Although it is not known whether the mortality rates in the 1979 census have been adjusted for incompleteness of death registration, it is generally assumed they have not, and that they are biased downward by death underregistration. Unlike the 1979 mortality rates, the rates estimated from 1989 census household death data adjusted by the Preston-Coale method are generally taken as a plausible indicator of the mortality level in 1989. In the official 1989 census report, they are used as a benchmark against which to assess the external consistency of mortality estimates obtained by the application of other techniques.[30] Yet, the assumptions about vital rates inherent in the employed methods of

---

[25] Hirschman *et al*., *ibid.*

[26] United Nations, *op. cit*. in fn. 12.

[27] This value is reported in Banister, *op. cit*. in fn. 1.

[28] Banister, *op. cit*. in fn. 10.

[29] Based on Hirschman *et al*.'s personal communication with Bhakta Gubhaju, United Nations Population Division, 7 June 1995, in Hirschman *et al*., *loc. cit*. in fn. 8, p. 787.

[30] Vietnam, General Statistical Office, *op. cit*. in fn. 16. The census survival procedure was employed to estimate female intercensal mortality, and the Trussell method based on a census question on children ever born and children surviving was applied to obtain estimates of childhood mortality. The median of the $e_0$ values in the North model life table system implied by the life expectancies estimated by the census survival method for females, was 67.2, very close to the life expectancy at birth of 67.5 estimated from household death data adjusted for incompleteness of death reporting. Similarly, the probabilities of dying, ${}_nq_x$, based on data derived from questions on children ever-born and surviving were quite similar to those based on household death data. The small difference between ${}_nq_x$ values based on children ever born and household death data, with the former lower than the latter, was within the range of error consistent with the common failing of children ever born data to accurately enumerate all deceased children, especially because older women may fail to recollect deaths of children born in the more distant past.

mortality estimation do not fit Vietnam's population well. Moreover, at the time when the 1989 census report was produced, adequate information on emigration was not available, and adjustments of census counts for the effects of migration were not possible. Based on the rationale that emigration during Vietnam's intercensal period was concentrated among males, the authors of the report acknowledged the uselessness of estimating male mortality by means of intercensal survival procedures. They only produced results for females, and accepted them on the basis of their consistency with results yielded by alternative approaches.[31] Yet, the sex ratio of Vietnamese refugees resettling in the US, Canada and Australia estimated from pairs of censuses of the countries of destination is rather balanced.[32] This suggests that estimates of female mortality based on intercensal survival techniques are likely to be biased if census totals are not adjusted for intercensal migration.

## DISTORTIONS IN THE 1979 AND 1989 CENSUS ENUMERATIONS

The age and sex distribution in a population's two successive enumerations can provide a basis for estimating intercensal mortality, as long as the population is closed to migration, and the census enumerations are accurate. Yet, examining the age-sex structure of the 1979 and 1989 original census counts (*i.e.* the reported counts not corrected for emigration), Hirschman *et al*. noted inconsistent patterns of sex ratios within and across censuses with a stark male deficit for cohorts aged 15-19 and above in 1979, and considerable flux in cohort survival rates, that is not always consistent with the expected impact of male war casualties and the gradual increase in male mortality relative to female mortality as age advances. They attributed these patterns to failure of the 1989

[31] Author's personal communication with Griffith Feeney, July 22, 1996.

[32] M. G. Merli, 'Estimation of international emigration for Vietnam, 1979-1989'. *CSDE Working*

census to enumerate emigrants who had left Vietnam during the intercensal period, because migration may be more pronounced among males, to census underenumeration (often selective of young males), and to sex differential in age misstatement.[33]

Table 3 shows population counts, and sex ratios by five-year age groups from the 1979 and 1989 censuses. 1989 census counts are based on the 100 percent census tabulations, and are adjusted for the effects of intercensal emigration on an age and sex specific basis. The volume and age-sex distribution of intercensal emigrants was estimated using a combination of data on refugee movements collected by the United Nations High Commissioner for Refugees (UNHCR), and data on the Vietnamese-born population enumerated in successive censuses of the major receiver countries of Vietnamese refugees, the US, Canada and Australia. This approach yielded a total of 551,476 emigrants who survived to the end of the period, and would have been counted in the 1989 census, had they not departed Vietnam.[34] Ten-year cohort survival rates are presented in the table together with the levels of mortality implied in the West model life table system.[35]

[Table 3 about here]

The age-specific adjustment for migration of 1989 census counts is the reason for somewhat higher sex ratios at younger ages, because male emigrants outnumber female

---

*Paper Series* (Seattle, Center for Studies in Demography and Ecology, 1997)

[33] Hirschman et al., *loc. cit.* in fn. 8, pp. 791-793.

[34] For further details on the procedure used to estimate Vietnamese intercensal emigration, see Merli, *loc.cit.* in fn. 32.

[35]To approximate the population corresponding to the nearest date defining an interval of 10 years, the 1989 age distribution was moved forward by half a year to October 1, 1989, based on the assumption that the age distribution and the observed age-specific intercensal growth rate will remain unchanged during the six months to be added to the actual intercensal period. The 9.5-year intercensal interval was lengthened to 10 years by multiplying each age group at the second census by a factor equal to $e^{[r(10-9.5)]}$, where $r$ is the age-

emigrants, and for slightly higher cohort survival rates. Yet, patterns of sex ratios within and across censuses continue to show the same inconsistencies observed by Hirschman *et al*. Sex ratios rise with increasing age and start dropping at relatively young ages, as would be expected in the presence of higher male war mortality, but they show no difference between the cohort who were teenagers in the early 1970 (ages 20-24 in 1979) and earlier cohorts who experienced the war for a longer period of time. West mortality levels implied by cohort survival rates are highly inconsistent. Low survival rates at younger ages, especially among males, and implausibly high survival rates of males aged 20-24 in 1979, and of females aged 35-54 in 1979 suggest faulty enumeration of selected groups of the population.

A number of factors may account for the observed patterns. Undercounting of 20-24 year-old males in the 1979 census,[36] and age exaggeration among middle-aged females, partly because women above age 45 are exempt from public service, [37] may produce survival rates that are too high. On the other hand, low survivorship at younger ages, especially among males, suggests a range of possible explanations: the process employed to produce the estimates of intercensal migration, on which the adjustment of 1989 census counts is based, may have underestimated the number of emigrants, especially at younger ages where emigration is concentrated. However, to produce low survival rates at these ages, a very large number of young male emigrants would have had to be missed by this procedure. Although this is possible, it is unexpected. There was a fair degree of consistency among the data sources from which information on Vietnamese emigration was drawn. Moreover, the underestimation of young male emigrants from Vietnam would imply an undercount of young adult male immigrants in the US census,

---

specific intercensal growth rate of the population.

[36] Banister, *op. cit*. in fn. 1.

[37] Vietnam General Statistical Office, *op. cit*. in fn. 16; also see Feeney, *loc. cit*. in fn. 2.

since the estimation procedure of intercensal emigration assumed that all Vietnamese emigrants had the same age structure as those who resettled in the US.[38] One alternative explanation is that the absence of information on Vietnamese emigration to Cambodia after this country was invaded by Vietnam in 1979 prevented the incorporation of these migratory flows into the measurement of emigration.[39] Failure to add this "residual" portion of emigration to 1989 census counts would introduce a downward bias in the estimation of the age-specific growth rates from two successive census age distributions, and an upward bias in the estimate of intercensal mortality. By the same token, differences in completeness of census coverage may also give rise to misleading results, because they swamp the effect of mortality from two successive census age distributions. Among the factors responsible for differential census enumeration completeness is the incomplete enumeration of the "Special Enumeration Groups" in the 1989 census,[40] as the 1989 Census Central Steering Committee simply incorporated the reports of the various ministries in the census counts without questioning their accuracy.[41]

In sum, although it can be argued that the socio-political climate at the time of the censuses posed serious problems for a complete enumeration of the population, the absence of direct external evidence on enumeration completeness makes only rough speculations possible, and does not allow to identify a preferred explanation. Nonetheless, knowledge of the nature of the flaws in the data is useful because it allows to focus on possible sources of bias in the estimation of intercensal mortality, and identify a procedure that minimizes the size of these biases.

---

[38] Merli, *loc. cit*. in fn. 32.

[39] Merli, *Ibid*.

[40] This category, separately enumerated by the Ministries of Internal, Foreign Affairs and National Defense is believed to include a large number of Vietnamese men on military duty in Cambodia, cadres, technicians, experts and advisors sent to Cambodia after Vietnam's occupation on Christmas day 1978, and those studying and working in Eastern Bloc countries (Banister, *op. cit* in fn.1: Appendix B).

[41] Personal communication with Nguyen Minh Thang, Vietnam National Committee for Population

## MORTALITY ESTIMATION IN VIETNAM, 1979-1989

In this study, I employ two distinct procedures to estimate mortality in Vietnam during the intercensal period. Each one of them has some comparative advantages over the other, in terms of robustness to various sources of error in the data and ability to diagnose the sensitivity of estimates to violations in the underlying assumptions. Both techniques are designed to estimate mortality in a destabilized population. The first one relies on two successive census age distributions. It is typically employed when registration of deaths is poor or virtually nonexistent, and it infers mortality conditions directly from census age distributions and age-specific growth rates.[42] The second procedure can estimate mortality directly from a set of incompletely registered deaths, and works well in populations with fairly accurate age reporting.[43]

### *Mortality Estimation Using Two Successive Age Distributions and Age-specific Growth Rates*

The Preston-Bennett method relates the number of persons in any two age groups at any particular time to each other from age-specific mortality conditions and growth rates between those ages as:

$$N(x) = N(0) \exp\left[-\int_{o}^{x} r(a)\, da\right] p(x) \qquad (1)$$

and, rearranging terms,

$$p(x) = \frac{N(x) \exp\left[\int_{o}^{x} r(a)\, da\right]}{\phantom{N}}, \qquad (2)$$

and Family Planning, May 23, 1996).

[42] S.H. Preston, and N.G. Bennett. ‘A census-based method for estimating adult mortality’, *Population Studies* 37 (1983), pp. 91-104.

[43] S.H. Preston, I.T. Elo, I. Rosenwaike, and M. Hill. ‘African-American mortality at older ages: Results of a matching study’, *Demography*, 33 (1996), pp. 193-209.

N(0)

where N($x$) and N(0) are respectively the number of persons aged $x$, and the number of persons aged 0 (*i.e*. births), r($a$) is the annual growth rate of persons aged $a$, and p($x$) the probability of survival from birth to age $x$. Since p(x) is equal to $l_x/l_0$ in conventional life table notation, the numerator in (2) is analogous to $l_x$ and the denominator to $l_0$, the radix of the life table of arbitrary size. Thus,

$$ {}_nL_x = \int_x^{x+n} N(x)\exp\left[\int_o^x r(a)da\right] dx , \qquad (3)$$

and, to construct the abridged life table, the discrete version of equation (3) is:

$$ {}_5L_x = {}_5N_x \exp\left(2.5\,{}_5r_x + 5\sum_{a=0}^{x-5} {}_5r_a\right) \qquad (4)$$

If an independent estimate of N(0), *i.e*. births, is not known, the number of person-years lived in the interval during the intercensal period, ${}_nL_x$, and the expectation of life at age $x$, $e_x$, can only be computed for intervals above age 0.[44]

This method has several advantages over other intercensal procedures. It is easy to implement when the intercensal period is not a multiple of five. It estimate mortality directly from the data, and does not require a model life table system, and makes no assumption about population stability. Relative to methods that use deaths as an input, the Preston-Bennett procedure yields mortality estimates that are more robust to age misreporting. Yet, similar to other techniques that rely on intercensal growth rates, it is sensitive to age distortions produced by differential census coverage and intercensal net

[44] Preston and Bennett, *loc. cit,* in fn. 42, p. 92.

migration. Preston and Bennett have shown that, in the presence of errors resulting from differences in completeness of census coverage or migration that are constant by age, all age-specific intercensal growth rates will be in error by the same amount $\Delta r$, and, for $\Delta r$ closer to 0, the proportionate error in the estimated life expectancy will equal the error in growth rates multiplied by a factor that is largest at younger ages, and diminishes as age increases, regardless of the level and pattern of mortality. Thus the proportionate effect on estimated life expectancy at age *x* is:

$$\Delta e_x/e_x \cong \Delta r\,(A^s_x - x) \tag{5}$$

where $A^s_x$ is the mean age of the stationary population above age *x* corresponding to the intercensal life table. Similarly, if the rate of net migration is constant by age, the proportionate effect on the estimated life expectancies will be:

$$\Delta e_x/e_x \cong M\,(A^s_x - x) \tag{6}$$

where M is the annual rate of net emigration .[45] This implies that if the set of growth rates used in the calculations is too low ($\Delta r < 0$), because the second census is less complete than the first one, or because growth rates have not been adjusted for the full volume of emigration, the estimated life expectancy will also be too low, proportionately more so at younger ages. Preston and Bennett have also shown that overreporting of age at some age above that for which life expectancy is being estimated will bias upward the $e_x$ estimates, although this effect is relatively small even under the extreme assumption of age misstatement.[46]

Table 4 presents the application of the procedure to Vietnamese males and females and the corresponding West mortality levels implied by the estimates of life

[45] *Ibid*., pp. 94-98.

expectancy at all ages.[47] It can be seen that, among males, mortality levels are fairly consistent for the age range 20-80, except for the values corresponding to $e_{50}$ and $e_{55}$ which are higher than the preceding and the following values. However, the mortality levels implied by the $e_x$ values below age 20 are 6-7 levels lower than those implied by the $e_x$ values at higher ages and are equivalent to a 10-15 year difference in implied life expectancy at birth. For females, the age sequence of estimates of life expectancy is much smoother. Mortality levels are very consistent above age 20, and the difference in implied life expectancy at birth between ages below and above 20 is not as great as for males.

[Table 4 about here]

How can one explain these patterns? Unlike the scenario hypothesized by Preston and Bennett in which differential census coverage and rates of emigration are constant by age, in Vietnam, underenumeration and emigration are likely to be concentrated in just a

---

[46] *Ibid*., pp. 98-99.

[47] To determine which family most resembles the age pattern of mortality in Vietnam's intercensal period, an index of dissimilarity (ID) was constructed to measure how closely estimated life expectancies match those in the families of model life tables (See C. D. Campbell. 'Chinese Mortality Transitions: The Case of Beijing, 1700-1990'. Ph.D. Dissertation, University of Pennsylvania, 1995). For each family of model life table, the index consists of the arithmetic mean of the absolute deviations of the life expectancies at birth e0 implied by each of the estimated ex values from the median of the predicted $e_0$ values. A low index indicates that the implied life expectancies at birth are tightly clustered, and that the pattern of mortality in Vietnam's intercensal period closely matches that of a family of model life tables. The index of dissimilarity was calculated for the age ranges 5-80 and 20-75, and indicates that the West model life table generally provides the best fit to the age pattern of mortality in Vietnam's intercensal period. For females, the index for the West pattern of mortality is smallest for both age ranges 5-80 and 20-75. In these age categories , it is respectively 1.90 and 0.98. It is higher in the age range 5-80 than in the age range 20-75 because of the observed inconsistencies in mortality levels at younger ages. It is noteworthy that, contrary to the conclusions of the authors of the Vietnam's 1989 census report (Vietnam General Statistical Office, *op. cit*. in fn. 16, p. 106), the North mortality pattern does not provide the best fit for Vietnamese females. Among males, the large discrepancy in mortality levels at younger ages relative to ages above 20, is evident from a much higher index for the West pattern of mortality between ages 5 and 80 (ID = 4.07) than between ages 20 and 75 (ID = 1.95). Although the North model fits the observed pattern of mortality between 5 and 80 best -- the index for the North family is 3.55 and it is lower than that for the West --, this is inconclusive given its high value.

few age groups.  Yet, the direction of the bias on the estimates of life expectancy should be similar, regardless of whether migration and underenumeration are constant by age or they occur only at one age *x*.  The difference is that in the latter case only the estimates of life expectancy at ages *x* below the age in which migration and underenumeration occur will be artificially deflated, while estimates at ages above *z* would remain unaffected. Thus, low mortality levels implied by the estimated $e_x$ values of males at ages 5, 10 and 15 in Table 4 suggest underenumeration of males in young and mid-adult ages, or distortions in the 1989 age structure resulting from "residual" emigration.

Finally, the surge in the levels for males, and to a lesser extent for females, in age groups 50-54 and 55-59 may be due to age overstatement.  Age overstatement among older males in 1979, because men older than 60 received higher benefits and were exempt from social work (Vietnam General Statistical Office, 1991:20), would result in a transfer of people from age groups 55-59 to age group 60-64 thus biasing upward the estimates of life expectancy below age 60.

How do these results compare with those obtained from the application of other methods of intercensal mortality estimation?  Elsewhere, I have applied conventional forward and backward projection methods[48] to Vietnamese census data.  In general, the mortality levels implied by the results of these procedures were higher (*i.e*. indicative of lower mortality) and less variable than those implied by the Preston-Bennett procedure, especially for males. Compared with the results of the Preston-Bennett procedure, the mean of the West levels associated with life expectancy values estimated by forward and backward projection were equivalent to life expectancies at birth and at age 5, that were

[48] A.J. Coale and P. Demeny, *Manual IV: Methods for Estimating Basic Demographic Measures from Incomplete Data*.  Population Studies No. 42. (New York, United Nations, 1967); A. Palloni and R. Kominski, 'Estimation of adult mortality using forward and backward projections', *Population Studies*, 38 (1984), pp. 479-493.

2.9 and 1.7 years higher in the forward projection and 3.6 and 2.1 years higher in the backward projection than those produced by the application of the Preston-Bennett procedure. Results from any one of the three procedures applied to females showed a higher degree of internal consistency and compared fairly well among each other.[49] Yet, because the results of the application of the Preston and Bennett procedure to Vietnam census data do not depend on a chosen model life table age pattern of mortality, they illustrates more clearly the sensitivity of intercensal survival procedures to distortions introduced by intercensal net migration and differential census enumeration completeness. Also, there is an element of arbitrariness in conventional intercensal survival procedures that use model life tables, since different results are typically obtained through forward and backward projection.[50] In the following sections, the results from the Preston-Bennett procedure are contrasted with those obtained by the application of a method based on the reported age distribution of intercensal deaths. This comparison should allow to illustrate the relative importance of different sources of bias, and to identify a procedure that minimizes their impact.

### ***Mortality Estimation from the Age Distribution of Intercensal Deaths***

A procedure used to construct an accurate life table from the distribution of incomplete intercensal deaths that does not require previous adjustments for death registration completeness was developed by Preston *et al*.[51] The method derives from a generalization of stable population theory, and is based on a set of demographic identities

---

[49] Merli, M.G., "Vietnamese mortality during the 1979-1989 intercensal period', in M.G. Merli 'Demographic Processes in China and Vietnam: Three Essays', Ph.D. Dissertation, University of Pennsylvania, (1996): Table 3.11.

[50] Preston and Bennett, *loc. cit*. in fn. 42, p. 104.

[51] Preston *et al*., *loc. cit.* in fn. 43.

developed by Preston and Coale[52] who showed that the number of deaths in the life table at each particular age can be inferred from the age distribution of deaths in a population by means of intercensal age-specific growth rates.  Preston *et al*. have proposed this approach to estimate African-American mortality rates at ages 65 and above.  In this paper, I employ their procedure to construct a complete life table.

The Preston *et al.* method is closely related to an approach of mortality estimation from registered deaths developed by Bennett and Horiuchi,[53] who expressed the population at any age $y$ in terms of the number of deaths above age $x$, where $y > x$, and of the age-specific growth rates. By using the age distribution of registered deaths directly, Preston *et al.* make more limited use of information on the population age distribution. The method consists of applying a growth correction to convert the distribution of deaths in the population into the distribution of deaths in the underlying life table, under the assumption that underregistration of deaths is constant by age,[54] as:

$$d(y)/d(x) = D(y)/D(x) \exp\left[\int_x^y r(a)da\right] \qquad (7)$$

where $d(y)$ and $d(x)$ are the number of deaths at exact ages $y$ and $x$ in the life table, where $y > a$; $D(y)$ and $D(x)$ are the number of deaths in the population at exact ages $y$ and $x$, where $y > x$, and $r(a)$ is the intercensal annualized growth rate of the population of exact age $a$.  All other life table functions can be derived once the life table deaths are inferred

52 S. H. Preston and A.J. Coale, ‘Age structure, growth attrition and accession: A new synthesis’, *Population Index* 48 (1982), pp. 217-259.

53 N.G. Bennett and S. Horiuchi, ‘Mortality estimation from registered deaths in less developed countries’. *Demography* 21 (1984), pp. 217-233.

54 S.H. Preston and P. Heuveline, ‘Introduction to Demography’, (Unpublished manuscript, Population Studies Center, University of Pennsylvania, 1996): Chapter 8.

to an arbitrary scalar from the deaths in the actual population.[55]

The age distribution of deaths ought to refer to the middle of the intercensal period. Here, it is taken to be equal to the average of the distribution of vital registration deaths in the 1979 census and the distribution of household deaths in the year prior to the 1989 census, centered within the intercensal period of 9.5 years.[56]

Because the Preston *et al.* death-based method employs intercensal growth rates, it is not immune to the effects of missing information on intercensal emigration and differential census coverage. The nature of the errors in the growth rates and their effects on estimated life expectancy are not too different from those described with respect to the Preston-Bennett census-based method, in terms of the direction of the bias, the proportionality of the errors in the expectation of life at age *x* to the error in the growth rates, and the greater sensitivity of the $e_x$ estimates at younger ages to such errors.[57]

---

[55] The specific application to the Vietnamese population uses census-based age-specific growth rates corrected for migration to transform a set of incompletely recorded deaths into a life table. The aim is to reflect the true mortality conditions of the 1979-1989 intercensal period. The cumulation of the ${}_nd_x$ column from the bottom up gives the $l_x$ column. To estimate the number of person-years lived in each of the 5-year categories, ${}_5L_x$, it was assumed that deaths are evenly distributed throughout the interval between ages *x* and *x+5*, or, alternatively, that all deaths occur in the middle of the interval at exact age $x + 2.5$, though, in the age group 0 to 5, where most deaths are concentrated at the beginning of the interval, this is a poor assumption. To obtain a more accurate estimate of ${}_5L_0$, the appropriate separation factor ${}_5a_0$, was selected in the West model life table corresponding to the ${}_5q_0$ value of the current life table. Similarly, an arbitrary procedure to close out the life table was chosen, where the number of person-years lived above age 85, $T_{85}$, can be found by multiplying the $e_{85}$ value in the West model life table corresponding to the ratio $l_{85}/l_{75}$ in the observed life table by $l_{85}$, the number of survivors to age 85 in the stationary population corresponding to the intercensal life table.

[56] This approach raises one main concern. Differential death registration completeness in one census relative to the other would produce $e_X$ values estimated from the separate schedules of 1979 and 1989 deaths that are different from those derived from the average of the two schedules. A comparison between the life table constructed from the average of 1979 and 1989 death counts centered within the intercensal period and the life tables based respectively on 1979 and 1989 death counts (results not shown here) revealed a striking similarity in terms of the level and age pattern of mortality. This allows one to accept with greater confidence mortality estimates based on the average distribution of deaths as an adequate representation of the mortality conditions prevailing in the intercensal period.

[57] In their description of the death-based method of mortality estimation, Bennett and Horiuchi noted that when the proportionate difference in coverage completeness is invariant with age, the error in expectation of life at age *x* is proportionate to the error in growth rates by a factor that tends to be larger under high mortality conditions. The proportionate error in $e_x$ is always substantially larger at age 0 than at higher ages. At age 0, it is more than twice the error at age 5 under high mortality conditions, and it is about twice that error

However, the census-based method is far more sensitive than the death-based method to errors in the growth rates resulting from differential completeness of coverage between the two censuses and from insufficient information on age-specific net migration rates. In the death-based method, age-specific growth rates serve to convert the age structure of deaths to that of a stationary population, while the Preston and Bennett procedure relies more heavily on age-specific growth rates to convert the observed age structure of the population into that of the stationary population corresponding to the intercensal life table. The errors in the $e_x$ estimates associated with the Preston-Bennett method are therefore greater than those associated with the death-based method. Bennett and Horiuchi[58] have shown that, at the extreme, under low mortality conditions, the proportionate error in $e_5$ is more than 10 times as sensitive to an error in the growth rates with the application of the census-based method than with the application of the death-based method.

The procedure of estimating mortality from a set of intercensal deaths further requires constancy of death registration completeness by age. Violations of this assumption may not be rare in the Vietnamese population, due to a tendency in East-Asian cultures to underreport early infant deaths to a greater extent than childhood deaths.[59] Thus, estimates of $e_5$ and above will be more reliable than estimates of $e_0$. Among adults, deaths of older persons living alone are also more likely to be missed.

---

in low mortality regimes. An analogous situation occurs when growth rates are distorted by a failure to fully account for net migration, as long as the age-specific migration rates are constant by age. In the event that net migration, or changes in census enumeration completeness, occur at only one age *z*, and life expectancy is estimated for an age *x* younger than *z*, it can be seen that for small rates of net migration at age *z*, as *x* recedes from *z*, the error of estimation of $e_x$ increases, and the amount of error increases substantially as we proceed from age 5 to age 0, suggesting once again that estimates of $e_0$ are most sensitive to errors in the growth rates (Bennett and Horiuchi, *loc. cit*, in fn. 53, pp. 223-224).

[58] Bennett and Horiuchi, *Ibid*., pp. 223-224.

[59] See M.G. Merli, 'Underreporting of births and infant deaths in rural China: Evidence from field research in one county of Northern China', in M.G. Merli, 'Demographic Processes in China and Vietnam: Three Essays', *loc. cit*. in fn. 49.

Completeness of death registration declining with age distorts the D(y)/D(x) ratio, and has the same impact on the $e_x$ estimates as does a reduction of the age specific growth rates above the age for which life expectancy is being estimated: it introduces a downward bias in the estimates of life expectancy at all ages below the ages in which deaths are being omitted.

Finally, in the presence of age misstatement of the living population, the size of the errors in estimated life expectancy will most likely be small. The transfer of persons by age misstatement predominantly occurs between neighboring age groups, and not between the very young and the very old. With age misstatement, an implicit weighting process of age-specific growth rates in adjacent intervals ensures that the estimated growth rates will not differ too much from the true, underlying values, insofar as changes in past vital rates have been gradual.[60] But overstatement of ages at death, where deaths at age *z* are reported to occur at age *y*, where $y>z$, will bias upward the estimates of life expectancy at age *x*, where $x<z<y$. The size of the bias is greater in the application of a procedure where deaths are used as inputs, because, at the older ages, deaths are more heavily concentrated than persons.[61]

Table 5 shows the application of the death-based method of Preston *et al*. to the Vietnamese population. The results yield a striking consistency of mortality levels across ages, especially between ages 10 and 50 for males and 10 and 65 for females. Only the levels implied by the $e_0$ and $e_5$ estimates are slightly lower than levels associated with life expectancies at higher ages.

[Table 5 about here]

---

[60] Bennett and Horiuchi, *loc. cit*. in fn. 53, p. 225.
[61] *Ibid*., p. 226.

As noted earlier, relative to life expectancy at other ages, life expectancy at birth estimated by the death-based method is more sensitive to violations of several assumptions underlying this procedure, namely errors in the growth rates resulting from selective underenumeration of persons at young adult ages, from age distortions produced by “residual”emigration, as well as to violations of the assumption of constancy of completeness in death registration across age.

***Comparison Between Mortality Estimates from the Death-Based Method of Preston et al. and the Census-based Method of Preston and Bennett***

Table 6 contrasts the life expectancies at each age estimated by means of the Preston *et al*. death-based method and their associated West mortality levels with those produced by the Preston and Bennett census-based method.

[Table 6 about here]

Among males, the difference in levels is striking between ages 5 and 15, with life expectancies at these ages estimated by the census-based method about 4 to 7 levels lower than the corresponding values obtained through the death-based method, but the estimates of life expectancy above this age imply quite similar levels of mortality, except for ages 50 and 55. At these ages, the Preston-Bennett estimates imply levels of mortality that are respectively 2 and 2.7 levels higher than those associated with the estimates produced by the death-based method. Unlike the estimates for males, the estimates for females below age 20 display a less striking difference, but, at age 20 and above female life expectancies estimated by the Preston-Bennett procedure are consistently higher than those estimated by the Preston *et al.* procedure.

How can these discrepancies be explained? The different impact of errors in the growth rates on the two sets of life expectancy estimates produced by the application of the two procedures may explain the difference in the implied levels between ages 5 and 15. Lower growth rates above age 15 resulting from age distortions produced by differential census enumeration completeness and/or “residual” emigration, have a greater impact on the estimates of life expectancy at ages 0-15 in the Preston and Bennett procedure than in the death based procedure. To show the robustness of the death-based method to errors in the growth rates and the relatively greater sensitivity of the census-based method, Table 7 displays the values of life expectancy estimated by each method with and without adjustment for intercensal emigration. It can be seen that while the life expectancy estimates at ages 5 through 25 produced by the Preston and Bennett procedure are 2-3 years lower when the 1989 census age structure is not corrected for migration, as would be expected because intercensal emigrants appear as excess deaths, the adjustment for migration appears to make only a trivial difference for the final mortality estimates of the death-based method, except for estimates of life expectancy at age 0 and, to some extent, at age 5.

[Table 7 about here]

Age overstatement of males and females age 50-54 may explain higher life expectancy at ages 50 and 55 in the Preston-Bennett procedure, because the transfer of living persons to age groups higher than that for which life expectancy is being estimated will have a greater impact on the census-based procedure.

But how can one explain consistently higher female life expectancies estimated by the Preston and Bennett method relative to those estimated by the death-based method? There are two possible explanations. Estimates of life expectancy that are higher in the census-based method than the death-based method may be due to age overstatement in the population greater than overstatement of ages at death. Age overstatement of women in their forties, because women above age 45 are exempt from public service, was confirmed by Vietnam's General Statistical Office (1991:18). But lower estimates of female life expectancy in the death-based method relative to the census-based method might also be explained by death registration completeness declining with age. Older women are more likely to live alone, due to their mortality advantage over men and to differences in ages at marriage, hence their deaths are more likely to go unreported. With the death-based method of mortality estimation, increasing underregistration of female deaths as age advances lowers the D(y)/D(x) ratios and results in underestimated life expectancies.

To further explore this second hypothesis, I produced estimates of completeness of death registration for both Vietnamese males and females. Among the procedures available to measure death registration completeness, the one developed by Bennett and Horiuchi[62] is promising because it is more robust to violations of the assumption that completeness is invariant with age.[63] Figure 1 plots the estimated values of death

---

[62] N.G. Bennett, and S. Horiuchi , 'Estimating the completeness of death registration in a closed population', *Population Index*, 47 (1981), pp. 207-221. In this article, Bennett and Horiuchi were the first to propose a conversion to a the variable-r case of a demographic identity obtaining from stable populations. They expressed the relationship between the number of people in a cohort now aged $a$ – N($a$) -- and the number implied by deaths experienced by the cohort now aged $a$ when it reaches age $x$, combined with age-specific growth rates, as

$$N(a) = \int_a^\infty D(x) \exp\left[ \int_a^x r(u)\, du \right] dx.$$

[63] Preston, *loc. cit.* in fn. 23, p. 71-72.

registration completeness by age for males and females. If there were no errors in the data and no flagrant violations of assumptions, the plots should represent horizontal lines drawn at the level determined by the degree of completeness of death registration. It is evident from this figure that the values of death registration completeness display a clear departure from a flat sequence, that is more marked for males than for females.

[Figure 1 about here]

For males, "residual" emigration not accounted for by the emigration estimation procedure and differential census enumeration completeness may be part of the explanation. The former would bias downwards the estimates of completeness of death registration because emigrants are missing from the second census and assumed dead, as suggested by lower estimates of death registration completeness at younger ages (ages 5-15) relative to higher ages. Underenumeration at the second census would have a similar effect on estimated death registration completeness, because deflated growth rates as a result of underenumeration of the young adult male population at the second census decreases the population at each age *a* calculated from deaths and growth rates over age *a* thus making registered deaths appear less complete than they actually are.

Registration of female deaths appears to be less complete than registration of male deaths. The set of estimates for females is consistently lower than for males, but relative to males, it is flatter, suggesting less serious violations of the assumptions of a population closed to migration and equally complete successive census enumerations. Values of death registration completeness appear to decrease with advancing age, an indication that underregistration of deaths of older women may be greater relative to younger ages. This provides support for the hypothesis that female death registration decreases with age as the preferred explanation of female life expectancies that are lower when estimated by means of the Preston *et al*. method than by means of the Preston and Bennett method.

Despite the greater ambiguity of the results for females, the robustness of the Preston *et al.* method to errors in the growth rates is a definite advantage for measuring mortality for a period in which the effort of accurate census enumeration was complicated by social instability and a very mobile population. The next section provides refined mortality estimates for Vietnam's intercensal period. The refinement of the estimates from the death-based method consists of purging the 1989 age distribution, hence intercensal growth rates, from the distortions introduced by differential census enumeration completeness and residual emigration.

***Final Adjustment of Vietnam's Intercensal Mortality Estimates and Use of the Death-based Method to Measure the Completeness of the 1989 Census Enumeration***

To reduce the bias of a distorted 1989 census age distribution associated with differential census enumeration completeness and "residual" intercensal emigration, the actual 1989 population can be inferred from the number of persons alive in 1979 who were exposed to the mortality conditions prevailing in Vietnam during the intercensal period, on the assumptions that the 1979 population is correctly enumerated, and that the age distribution of deaths centered within the intercensal period is correct. The population enumerated in the 1979 census is survived forward to 1989 with 10-year survivorship probabilities pertaining to the intercensal life table estimated by the Preston *et al*. method. This procedure yields two consecutive age distributions, 10 years apart, that pertain to a closed population. It also provides an alternative way to correct the sensitivity of the

Preston and Bennett method to differential completeness of census enumeration and residual emigration not accounted for by the measurement of intercensal migration.

Column 1 of Table 8 reproduces the Preston-Bennett $e_x$ estimates from Table 4 based on the observed 1989 census population adjusted for intercensal migration. Column 2 presents the new set of estimates from the census-based method based on the recorded 1979 age distribution, and the estimated 1989 age distribution, and Column 3 the array of life expectancies estimated by the death-based method in Table 5. The comparison should be limited to ages 10 and above, because the forward projection of the 1979 population includes none of the exposure of those born between the censuses.

[Table 8 about here]

It can be seen that the mortality estimates from the census-based method based on the estimated 1989 age distribution are very close to those obtained through the death-based method. Especially among males at the younger ages, expectation of life is significantly higher when the estimated 1989 population is incorporated in the estimation. This is not surprising, because the intercensal growth rates have virtually been corrected by the lower sensitivity of the death-based method to differential completeness of census enumeration and intercensal migration.[64]

Because the growth rates used in the application of the Preston *et al*. method derive from the 1989 age distribution distorted by census underenumeration and residual emigration, a final adjustment is required to obtain more refined estimates of mortality during the intercensal period. The adjustment consists of repeating forward projection on

[64]The intercensal growth rates used in the Preston and Bennett method are based on the 1979 observed age distribution and the estimated 1989 age distribution that are 10 years apart. The growth rates used in the Preston *et al.* method are based on the two original distributions 9.5 year apart.

the initial set of survival probabilities. A new 1989 population is generated, a new life table constructed by means of the death-based method, and new values of survival probabilities calculated, until convergence. Convergence is reached when the estimated life expectancies do not differ from the life expectancies obtained in the previous iteration at the second decimal. For both male and female estimates, convergence occurred after 7 iterations.

Table 9 presents the final estimates of the death-based method (in bold in the table), with the implied mortality levels in the West family of model life tables. The estimates clearly reveal the impact of purging the 1989 age distribution from the effects of selective underenumeration and residual intercensal emigration, especially among males. Because these factors bias mortality upward through their effects on the growth rates, expectation of life at all ages is higher with corrected than with uncorrected growth rates. The converse is true for females. At all ages, life expectancies estimated with the corrected growth rates are slightly lower than those based on uncorrected growth rates. A possible explanation is that forward projection of the population enumerated in the first census using survival ratios that are biased downward by underregistration of deaths increasing with age may result in deflated counts in the 1989 population, lower growth rates, lower expectation of life, lower survival ratios, and so on until convergence is reached.

[Table 9 about here]

A by-product of the procedure to correct growth rates is the estimation of the completeness of the 1989 census enumeration at ages above 10. Table 10 presents the observed population, *i.e.* the population enumerated in the 1989 census adjusted for migration, and the refined estimated population, resulting from the iterative process used to correct intercensal growth rates. The difference between the observed and actual population offers an indication of the extent of relative underenumeration in the 1989 census, and their ratio represents the estimated completeness factor in the 1989 census.

[Table 10 about here]

The undercount in the 1989 census appears to be particularly severe among males age 15-29 and to a lesser extent among 15-24 females. This supports the hypothesis of selective underenumeration of young males and/or emigration undocumented by the data. On the other hand, completeness factors for females above age 45 that are close to 1 or higher than 1 may result from the violations of the assumptions underlying this procedure. In the event of completeness of death registration declining with age, the projected counts in the 1989 population are deflated, thus conveying the wrong impression of overenumeration in the 1989 census selective of certain age groups.

Despite the greater ambiguity of the results for females, the model life table levels associated with the $e_x$ values for females in Table 9 show a high degree of coherence similar to that for males. Compared with the levels associated with expectation of life at each age estimated by the intercensal survival techniques, the death-based method also yields the least variable mortality estimates, in terms of mortality levels in a model life table system.

Are the mortality levels in Table 9 plausible? Compared with the implausibly low levels of mortality in the uncorrected life table, an indication of the omission of deaths from vital registers, and of impossibly low mortality in the 1989 life tables, the intercensal life tables suggest a more credible level of mortality pertaining to the 1979-

1989 intercensal period. Life expectancies at birth of 61.91 for males and 64.04 for females are about two years lower than life expectancies at birth of 63.6 and 68 in the 1979 life table and much lower than 73 years and 81 years in the 1989 life table.

Table 11 presents the probability of survival ($_{n}P_{x}$) for both sexes combined between ages 15 and 45 and 15 and 60 calculated from the reported 1979 life table, the 1989 life table corresponding to death rates adjusted for registration incompleteness by Vietnam's General Statistical Office,[65] and the life table based on death rates from VLHS survey data.[66]

[Table 11 about here]

The probabilities of survival calculated from the intercensal life table are about one level lower than those in the 1979 life table, while they are only slightly lower than the survival probabilities in the 1989 life table based on adjusted death rates. Lower mortality reported in the 1979 life table than in the intercensal life table is not surprising, because mortality in the 1979 census is underestimated by the omission of deaths from vital registers. But higher survival probabilities in 1989 than in the middle of the intercensal decade would suggest declining mortality, even more so if the 1989 estimates in the 1989 census report were biased downward by an overestimation of the underlying death rates, due to the inappropriateness of the Preston-Coale method for estimating completeness of death registration in a destabilized population. Compared with estimates of mortality levels based on death rates derived from VLHS kin survival questions that refer to approximately the same period, 1976-1990, the levels implied by the intercensal life tables are 1 to 1.5 levels lower. This difference is not surprising, for, unlike the

[65] Vietnam General Statistical Office, *op. cit.* in fn. 16, p. 116.

censuses, the VLHS survey is not nationally representative, but covers two areas that, because of their proximity to Hanoi and Ho Chi Minh City, may display lower mortality than the national average. Finally, it is noteworthy that male and female expectation of life at birth estimated by the death-based method at 61.9 and 64.00 in Table 9 compare well with the United Nations estimates of 60.6 and 64.8 for the 1985-1989 period.[67] Yet, the UN results rely on an interpolation of the 1970 value of life expectancy and the 1989 life table value adjusted for death underregistration in the 1989 census report, while the measurement of mortality performed here is based on real data carefully corrected for various sources of errors.

## CONCLUSIONS

This article uses Vietnam's 1979 and 1989 census data to provide new estimates of Vietnamese mortality for the period between 1979 and 1989. Two techniques designed for estimating mortality in a destabilized population, the census-based method of Preston and Bennett and the death-based method of Preston *et al*. are applied to the data. Their result demonstrate the relative sensitivity of each of these methods to sources of error in the growth rates introduced by differential census enumerations and "residual" emigration even after census totals have been adjusted for the effects of intercensal migration. The distortions in the census age distributions produced by these sources of error represent a threat to the accuracy of the final estimates especially for the intercensal survival technique of Preston and Bennett, and its application to Vietnamese males, among whom enumeration in the second census is particularly incomplete.

On the other hand, the death-based method of Preston *et al*., which relies on

[66] Hirschman *et al*., *loc. cit.* in fn. 8, p. 802.
[67] United Nations, op. cit. in fn. 12, p. 872.

intercensal growth rates and the age distribution of intercensal deaths, is able to yield robust, consistent mortality estimates even in the presence of differential census coverage, intercensal migration and incomplete death registration, a result that is quite striking for a country with deficient civil registration and problematic census enumerations. The paper develops a new iterative method to correct the sensitivity of the census-based method to differences in completeness of coverage between the two censuses and intercensal emigration, as well as to gauge the extent of census underenumeration.

Despite the clear advantages of the application of the death-based method of mortality estimation to Vietnamese males, the results for females are more ambiguous. The suspicion is that the death-based method underestimates expectation of life at various ages because of death registration completeness declining with age, as older women are more likely to live alone and their deaths to go unreported. Estimates of completeness of death registration provided in the paper seem to yield support to this explanation, although, in the absence of evidence from other sources on additional possible patterns of error, a firmer conclusion cannot be drawn.

Notwithstanding the fact that female mortality in Vietnam may be in fact somewhat lower than the death-based method estimates of life expectancy would suggest, it is also the case that a comparison with independent mortality estimates shows that the life tables constructed by means of the death-based method, after adjustment of the second age distribution for underenumeration and intercensal emigration, provide a plausible representation of the mortality conditions prevailing in Vietnam in the 1979-1989 period. Relative to the levels of mortality recorded in the 1979 and 1989 life tables, respectively based on vital registration deaths and household deaths not adjusted for underregistration, the intercensal life table shows higher mortality. This suggests that the uncorrected 1979 and 1989 life table estimates are too low.

If we accepted the UN estimates of life expectancy at birth for 1975-80 of 55.8 years, or the Vietnamese estimates of 50 years in 1970 and 60 years in 1978 reported in Banister (1985), as approximately reflecting mortality in Vietnam's in the 1970s, then the combined estimate of life expectancy at birth of 63 years from the intercensal life tables estimated by the death-based method would suggest a trend of declining mortality between the 1970s and the 1980s. This result adds solid empirical evidence to the existing debate over whether mortality in Vietnam has been deteriorating or improving.[68]

---

[68] Banister, *op. cit.* in fn. 1, pp. 12-19.

Table 1. Vietnam, Male and Female 1979 Abridged Life Tables, As Reported

MALE LIFE TABLE

| Age | l(x) | nqx | ndx | nmx | nLx | T(x) | e(x) | West level implied by npx | West level implied by e(x) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 100000 | 0.04581 | 4581 | 0.04725 | 96946 | 6366000 | 63.66 | 20.63 | 20.01 |
| 1 | 95419 | 0.03155 | 3010 | 0.00800 | 376127 | 6269054 | 65.70 | 17.55 | 19.75 |
| 5 | 92409 | 0.01423 | 1315 | 0.00287 | 458238 | 5892927 | 63.77 | 15.83 | 20.46 |
| 10 | 91094 | 0.00608 | 554 | 0.00122 | 454041 | 5434689 | 59.66 | 19.11 | 20.08 |
| 15 | 90541 | 0.00720 | 652 | 0.00144 | 451130 | 4980648 | 55.01 | 20.82 | 20.97 |
| 20 | 89889 | 0.00911 | 819 | 0.00183 | 447445 | 4529518 | 50.39 | 21.23 | 20.99 |
| 25 | 89070 | 0.01074 | 957 | 0.00216 | 442993 | 4082073 | 45.83 | 20.66 | 20.96 |
| 30 | 88113 | 0.01249 | 1101 | 0.00251 | 437882 | 3639080 | 41.30 | 20.54 | 21.00 |
| 35 | 87013 | 0.01528 | 1330 | 0.00308 | 431064 | 3201198 | 36.79 | 20.67 | 21.05 |
| 40 | 85683 | 0.01944 | 1666 | 0.00392 | 424365 | 2770134 | 32.33 | 21.19 | 21.10 |
| 45 | 84018 | 0.02732 | 2295 | 0.00554 | 414673 | 2345769 | 27.92 | 21.68 | 21.09 |
| 50 | 81722 | 0.04479 | 3660 | 0.00914 | 400297 | 1931096 | 23.63 | 21.45 | 20.97 |
| 55 | 78062 | 0.07662 | 5981 | 0.01591 | 376067 | 1530800 | 19.61 | 20.63 | 20.80 |
| 60 | 72081 | 0.00373 | 8755 | 0.02577 | 339725 | 1154733 | 16.02 | 19.97 | 20.86 |
| 65 | 63326 | 0.18089 | 11455 | 0.03963 | 289032 | 815008 | 12.87 | 19.93 | 21.16 |
| 70 | 51871 | 0.26518 | 13755 | 0.06097 | 225622 | 525975 | 10.14 | 20.21 | 21.68 |
| 75 | 38116 | 0.37722 | 14378 | 0.09314 | 154366 | 300353 | 7.88 | 21.05 | 22.55 |
| 80 | 23738 | 0.47281 | 11223 | 0.12604 | 89047 | 145987 | 6.15 | 23.39 | 23.82 |
| 85 | 12514 | 0.61927 | 12514 | 0.18630 | 41599 | 56941 | 4.55 | 24.48 | 24.48 |
| 90 | 4765 | 0.77934 | 3713 | 0.28500 | 13029 | 15342 | 3.22 | | |
| 95 + | 1051 | 1.00000 | 1051 | 0.45455 | 2313 | 2313 | 2.20 | | |

FEMALE LIFE TABLE

| Age | l(x) | nqx | ndx | nmx | nLx | T(x) | e(x) | West level implied by npx | West level implied by e(x) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 100000 | 0.04387 | 4387 | 0.04520 | 97075 | 6789000 | 67.89 | 19.70 | 20.16 |
| 1 | 95613 | 0.02871 | 2745 | 0.00730 | 376021 | 6691925 | 69.99 | 17.66 | 20.34 |
| 5 | 92867 | 0.01257 | 1167 | 0.00253 | 460870 | 6315904 | 68.01 | 16.35 | 21.12 |
| 10 | 91700 | 0.00566 | 519 | 0.00113 | 457113 | 5855034 | 63.85 | 18.86 | 21.50 |
| 15 | 91181 | 0.00649 | 592 | 0.00130 | 454460 | 5397921 | 59.20 | 19.93 | 21.63 |
| 20 | 90589 | 0.00706 | 640 | 0.00142 | 451368 | 4943461 | 54.57 | 20.69 | 21.74 |
| 25 | 89950 | 0.00816 | 734 | 0.00164 | 447958 | 4492093 | 49.94 | 20.82 | 21.83 |
| 30 | 89215 | 0.01088 | 971 | 0.00219 | 443749 | 4044135 | 45.33 | 20.44 | 21.93 |
| 35 | 88245 | 0.01368 | 1207 | 0.00275 | 438322 | 3600385 | 40.80 | 20.41 | 22.07 |
| 40 | 87037 | 0.01748 | 1522 | 0.00353 | 431551 | 3162063 | 36.33 | 20.54 | 22.23 |
| 45 | 85516 | 0.02233 | 1909 | 0.00451 | 422984 | 2730512 | 31.93 | 21.18 | 22.40 |
| 50 | 83606 | 0.02843 | 2377 | 0.00576 | 412447 | 2307528 | 27.60 | 22.04 | 22.55 |
| 55 | 81229 | 0.04669 | 3792 | 0.00964 | 393575 | 1895081 | 23.33 | 21.51 | 22.63 |
| 60 | 77437 | 0.08166 | 6323 | 0.01699 | 372216 | 1501506 | 19.39 | 20.67 | 22.90 |
| 65 | 71114 | 0.12179 | 8661 | 0.02586 | 334889 | 1129290 | 15.88 | 21.48 | 23.42 |
| 70 | 62453 | 0.18108 | 11309 | 0.03968 | 285007 | 794401 | 12.72 | 22.57 | 24.06 |
| 75 | 51144 | 0.26280 | 13441 | 0.06031 | 222848 | 509393 | 9.96 | 23.95 | 24.71 |
| 80 | 37703 | 0.37354 | 14084 | 0.09199 | 153095 | 286545 | 7.60 | 24.69 | 26.00 |
| 85 | 23620 | 0.51391 | 12138 | 0.14053 | 86377 | 133450 | 5.65 | 26.00 | 26.00 |
| 90 | 11481 | 0.67114 | 7706 | 0.21353 | 36086 | 47073 | 4.10 | | |
| 95 + | 3776 | 1.00000 | 3776 | 0.34364 | 10988 | 10988 | 2.91 | | |

*Notes:*

The 1979 census volume reported only expectation of life by sex and single year of age. These life tables were derived from the estimates of life expectancy. They are based on death rates computed from national registered deaths in calendar year 1979 and single-year age data from the 1979 census.

*Source:*

Vietnam, General Statistical Office, '1979 Vietnam Census Report' (Hanoi, 1983).

Table 2. Vietnam, Male and Female 1989 Abridged Life Tables, As Reported

MALE LIFE TABLE

| Age | nMx (a) | nqx | lx | ndx | nLx | T(x) | e(x) | West level implied by npx | West level implied by e(x) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.00789 | 0.03867 | 100000 | 3867 | 490332 | 7283935 | 72.84 | 21.92 | 23.61 |
| 5 | 0.00123 | 0.00612 | 96133 | 588 | 479195 | 6793603 | 70.67 | 20.18 | 24.29 |
| 10 | 0.00091 | 0.00453 | 95545 | 433 | 476642 | 6314408 | 66.09 | 20.39 | 24.45 |
| 15 | 0.00104 | 0.00517 | 95112 | 491 | 474331 | 5837767 | 61.38 | 22.10 | 24.56 |
| 20 | 0.00143 | 0.00712 | 94620 | 674 | 471418 | 5363436 | 56.68 | 22.46 | 24.65 |
| 25 | 0.00127 | 0.00633 | 93947 | 595 | 468247 | 4892018 | 52.07 | 22.40 | 24.79 |
| 30 | 0.00147 | 0.00730 | 93352 | 682 | 465057 | 4423771 | 47.39 | 22.03 | 24.90 |
| 35 | 0.00215 | 0.01068 | 92671 | 989 | 460879 | 3958715 | 42.72 | 22.11 | >25 |
| 40 | 0.00311 | 0.01544 | 91681 | 1415 | 454867 | 3497836 | 38.15 | 22.19 | >25 |
| 45 | 0.00497 | 0.02453 | 90266 | 2214 | 445794 | 3042968 | 33.71 | 23.51 | >25 |
| 50 | 0.00600 | 0.02958 | 88052 | 2604 | 433748 | 2597175 | 29.50 | 24.44 | >25 |
| 55 | 0.00849 | 0.04156 | 85447 | 3551 | 418360 | 2163427 | 25.32 | 24.31 | >25 |
| 60 | 0.01483 | 0.07152 | 81897 | 5857 | 394840 | 1745067 | 21.31 | >25 | >25 |
| 65 | 0.02096 | 0.09957 | 76039 | 7571 | 361268 | 1350227 | 17.76 | >25 | >25 |
| 70 | 0.03639 | 0.16677 | 68468 | 11418 | 313795 | 988959 | 14.44 | >25 | >25 |
| 75 | 0.05765 | 0.25193 | 57050 | 14373 | 249318 | 675165 | 11.83 | >25 | >25 |
| 80 | 0.07520 | 0.31648 | 42677 | 13507 | 179620 | 425847 | 9.98 | >25 | >25 |
| 85 | 0.11847 | 1.00000 | 29171 | 29171 | 246227 | 246227 | 8.44 | >25 | >25 |

FEMALE LIFE TABLE

| Age | nMx (a) | nqx | lx | ndx | nLx | T(x) | e(x) | West level implied by npx | West level implied by e(x) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.00673 | 0.03308 | 100000 | 3308 | 491730 | 8111508 | 81.12 | 21.54 | >25 |
| 5 | 0.00120 | 0.00598 | 96692 | 578 | 482016 | 7619777 | 78.80 | 19.52 | >25 |
| 10 | 0.00074 | 0.00371 | 96114 | 357 | 479679 | 7137761 | 74.26 | 20.21 | >25 |
| 15 | 0.00064 | 0.00319 | 95757 | 306 | 478023 | 6658082 | 69.53 | 21.84 | >25 |
| 20 | 0.00086 | 0.00431 | 95452 | 411 | 476232 | 6180058 | 64.75 | 21.93 | >25 |
| 25 | 0.00066 | 0.00330 | 95041 | 313 | 474421 | 5703826 | 60.01 | 22.98 | >25 |
| 30 | 0.00082 | 0.00411 | 94728 | 389 | 472666 | 5229405 | 55.20 | 23.04 | >25 |
| 35 | 0.00097 | 0.00484 | 94339 | 457 | 470551 | 4756740 | 50.42 | 23.44 | >25 |
| 40 | 0.00160 | 0.00796 | 93882 | 748 | 467539 | 4286189 | 45.66 | 23.31 | >25 |
| 45 | 0.00201 | 0.00999 | 93134 | 931 | 463344 | 3818649 | 41.00 | 24.14 | >25 |
| 50 | 0.00327 | 0.01620 | 92204 | 1494 | 457284 | 3355305 | 36.39 | 24.17 | >25 |
| 55 | 0.00485 | 0.02397 | 90710 | 2175 | 448113 | 2898021 | 31.95 | 24.53 | >25 |
| 60 | 0.00690 | 0.03393 | 88535 | 3004 | 435165 | 2449908 | 27.67 | >25 | >25 |
| 65 | 0.01013 | 0.04938 | 85531 | 4223 | 417096 | 2014743 | 23.56 | >25 | >25 |
| 70 | 0.01872 | 0.08942 | 81308 | 7270 | 388362 | 1597647 | 19.65 | >25 | >25 |
| 75 | 0.02821 | 0.13177 | 74037 | 9756 | 345796 | 1209285 | 16.33 | >25 | >25 |
| 80 | 0.04915 | 0.21887 | 64281 | 14069 | 286234 | 863488 | 13.43 | >25 | >25 |
| 85 | 0.08698 | 1.00000 | 50212 | 50212 | 577254 | 577254 | 11.50 | >25 | >25 |

*Notes:*

(a) The population mortality rates were computed from census deaths last year and total population counts.
Population counts were adjusted for persons not classified by age by multiplying the population
classified by age by the ratio: Total population/(total population - population with ages unknown).
Death counts were adjusted pro rata for ages at death non stated.

*Sources:*

Vietnam General Statistical Office, 'Vietnam Population Census - 1989. Detailed Analysis of Census Results, (Hanoi, 1991).
Vietnam Central Census Steering Committee, 'Vietnam Population Census - 1989. Completed Census Results, (Hanoi, 1994).

Table 3. Population by Age and Sex : Vietnam, 1979 and 1989

| | Population 10-1-1979 | | Population 10-1-1989 (a) | | Sex ratio | | 10-year cohort survival rate: 1979-1989 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Age | Males | Females | Males | Females | 1979 | 1989 | Age in 1979 | Age in 1989 | Males | Implied West level | Females | Implied West level |
| 0-4 | 3,946,224 | 3,766,472 | 4,710,423 | 4,460,929 | 104.8 | 105.6 | 0-4 | 10-14 | 0.9879 | 21.18 | 0.9865 | 20.22 |
| 5-9 | 3,928,795 | 3,761,523 | 4,430,179 | 4,249,348 | 104.4 | 104.3 | 5-9 | 15-19 | 0.8724 | <1 | 0.9316 | 7.67 |
| 10-14 | 3,632,555 | 3,406,774 | 3,898,299 | 3,715,718 | 106.6 | 104.9 | 10-14 | 20-24 | 0.8188 | <1 | 0.9425 | 10.77 |
| 15-19 | 2,954,333 | 3,060,551 | 3,427,357 | 3,504,182 | 96.5 | 97.8 | 15-19 | 25-29 | 0.9586 | 16.04 | 1.0094 | >24 |
| 20-24 | 2,281,171 | 2,601,098 | 2,974,283 | 3,210,898 | 87.7 | 92.6 | 20-24 | 30-34 | 1.0353 | >24 | 0.9878 | 21.63 |
| 25-29 | 1,742,277 | 1,975,507 | 2,832,160 | 3,089,267 | 88.2 | 91.7 | 25-29 | 35-39 | 0.9212 | 12.87 | 0.9255 | 12.77 |
| 30-34 | 1,177,320 | 1,314,655 | 2,361,692 | 2,569,493 | 89.6 | 91.9 | 30-34 | 40-44 | 0.8904 | 11.26 | 0.9183 | 12.97 |
| 35-39 | 966,580 | 1,104,086 | 1,604,918 | 1,828,263 | 87.5 | 87.8 | 35-39 | 45-49 | 0.9079 | 15.15 | 0.9774 | 22.46 |
| 40-44 | 919,291 | 1,084,758 | 1,048,246 | 1,207,287 | 84.7 | 86.8 | 40-44 | 50-54 | 0.9429 | 21.61 | 0.9971 | >24 |
| 45-49 | 994,602 | 1,113,757 | 877,589 | 1,079,079 | 89.3 | 81.3 | 45-49 | 55-59 | 0.9233 | 22.53 | 0.9556 | 23.27 |
| 50-54 | 825,356 | 902,407 | 866,821 | 1,081,651 | 91.5 | 80.1 | 50-54 | 60-64 | 0.8785 | 22.59 | 0.9688 | >24 |
| 55-59 | 680,996 | 872,541 | 918,363 | 1,064,356 | 78.0 | 86.3 | 55-59 | 65-69 | 0.7833 | 21.17 | 0.8263 | 19.98 |
| 60-64 | 540,920 | 663,366 | 725,079 | 874,253 | 81.5 | 82.9 | 60-64 | 70-74 | 0.6085 | 15.92 | 0.7255 | 19.42 |
| 65-69 | 419,164 | 559,727 | 533,445 | 720,994 | 74.9 | 74.0 | 65-69 | 75-79 | 0.5141 | 18.79 | 0.6323 | 21.57 |
| 70-74 | 284,003 | 434,355 | 329,167 | 481,250 | 65.4 | 68.4 | 70+ | 80+ | 0.2551 | 21.38 | 0.3116 | 22.47 |
| 75-79 | 183,222 | 313,082 | 215,510 | 353,905 | 58.5 | 60.9 | | | | | | |
| 80-84 | 64,153 | 135,988 | 97,551 | 192,684 | 47.2 | 50.6 | | | | | | |
| 85+ | 39,620 | 90,537 | 48,128 | 110,822 | 43.8 | 43.4 | | | | | | |
| Total | 25,580,582 | 27,161,184 | 31,899,209 | 33,794,379 | 94.2 | 94.4 | | | | | | |

*Notes:*

(a) The 1989 population derives from the 100 percent census tabulations, and includes the Special Enumeration Groups. It was adjusted for ages non-stated, and for migration. It was moved forward to October 1, 1989 to reflect a 10 year intercensal period.

*Sources:*

Vietnam, General Statistical Office, '1979 Vietnam Census Report' (Hanoi, 1983).

Vietnam Central Census Steering Committee, 'Vietnam Population Census - 1989. Completed Census Results' (Hanoi, 1994).

Table 4. Application of Preston and Bennett Method to Vietnamese Population, by Sex. 1979-1989

MALES

| Age (x) | Mean number of persons in age interval 5Nx | Average annual growth rate in interval 5rx | Sum of age-specific growth rates to mid-point of interval S(x) | Stationary population in interval 5Lx | Stationary population above age x T(x) | Number surviving to age x in stationary population l(x) | Estimated life expectancy at age x e(x) | Implied West Level |
|---|---|---|---|---|---|---|---|---|
| 0 | 4,292,387 | 0.0177 | 0.0443 | 4,486,611 | 53,864,106 | - | - | - |
| 5 | 4,159,453 | 0.0120 | 0.1185 | 4,682,910 | 49,377,495 | 916,952 | 53.85 | 13.09 |
| 10 | 3,756,446 | 0.0071 | 0.1662 | 4,435,707 | 44,694,585 | 911,862 | 49.01 | 12.39 |
| 15 | 3,170,275 | 0.0149 | 0.2210 | 3,954,334 | 40,258,878 | 839,004 | 47.98 | 15.15 |
| 20 | 2,587,554 | 0.0265 | 0.3245 | 3,579,291 | 36,304,545 | 753,362 | 48.19 | 19.11 |
| 25 | 2,194,535 | 0.0486 | 0.5122 | 3,662,741 | 32,725,254 | 724,203 | 45.19 | 20.37 |
| 30 | 1,638,705 | 0.0696 | 0.8077 | 3,675,334 | 29,062,513 | 733,808 | 39.61 | 19.26 |
| 35 | 1,229,816 | 0.0507 | 1.1085 | 3,726,251 | 25,387,179 | 740,158 | 34.30 | 18.16 |
| 40 | 978,437 | 0.0131 | 1.2681 | 3,477,532 | 21,660,928 | 720,378 | 30.07 | 18.13 |
| 45 | 937,193 | -0.0125 | 1.2696 | 3,336,033 | 18,183,396 | 681,357 | 26.69 | 19.24 |
| 50 | 844,798 | 0.0049 | 1.2506 | 2,950,440 | 14,847,363 | 628,647 | 23.62 | 20.95 |
| 55 | 784,933 | 0.0299 | 1.3376 | 2,990,583 | 11,896,923 | 594,102 | 20.03 | 21.48 |
| 60 | 621,696 | 0.0293 | 1.4856 | 2,746,513 | 8,906,339 | 573,710 | 15.52 | 19.53 |
| 65 | 470,023 | 0.0241 | 1.6192 | 2,373,080 | 6,159,827 | 511,959 | 12.03 | 18.33 |
| 70 | 304,626 | 0.0148 | 1.7163 | 1,694,964 | 3,786,747 | 406,804 | 9.31 | 18.26 |
| 75 | 197,907 | 0.0162 | 1.7938 | 1,189,868 | 2,091,783 | 288,483 | 7.25 | 19.92 |
| 80 | 78,284 | 0.0419 | 1.9392 | 544,300 | 901,915 | 173,417 | 5.20 | 19.03 |
| 85 | 43,456 | 0.0195 | 2.1077 | 357,614 | 357,614 | - | - | - |

FEMALES

| Age (x) | Mean number of persons in age interval 5Nx | Average annual growth rate in interval 5rx | Sum of age-specific growth rates to mid-point of interval S(x) | Stationary population in interval 5Lx | Stationary population above age x T(x) | Number surviving to age x in stationary population l(x) | Estimated life expectancy at age x e(x) | Implied West Level |
|---|---|---|---|---|---|---|---|---|
| 0 | 4,081,716 | 0.0169 | 0.0423 | 4,258,096 | 59,910,720 | - | - | - |
| 5 | 3,985,832 | 0.0122 | 0.1151 | 4,472,022 | 55,652,624 | 873,012 | 63.75 | 18.35 |
| 10 | 3,550,181 | 0.0087 | 0.1673 | 4,196,623 | 51,180,601 | 866,865 | 59.04 | 18.19 |
| 15 | 3,263,799 | 0.0135 | 0.2228 | 4,078,444 | 46,983,979 | 827,507 | 56.78 | 19.98 |
| 20 | 2,874,782 | 0.0211 | 0.3093 | 3,916,878 | 42,905,535 | 799,532 | 53.66 | 21.15 |
| 25 | 2,442,939 | 0.0447 | 0.4737 | 3,923,372 | 38,988,657 | 784,025 | 49.73 | 21.68 |
| 30 | 1,807,398 | 0.0670 | 0.7531 | 3,837,989 | 35,065,285 | 776,136 | 45.18 | 21.81 |
| 35 | 1,402,959 | 0.0504 | 1.0467 | 3,995,884 | 31,227,296 | 783,387 | 39.86 | 21.30 |
| 40 | 1,141,326 | 0.0107 | 1.1995 | 3,787,530 | 27,231,412 | 778,341 | 34.99 | 21.05 |
| 45 | 1,097,148 | -0.0032 | 1.2184 | 3,710,194 | 23,443,882 | 749,772 | 31.27 | 21.81 |
| 50 | 983,507 | 0.0181 | 1.2558 | 3,452,597 | 19,733,687 | 716,279 | 27.55 | 22.50 |
| 55 | 958,912 | 0.0199 | 1.3507 | 3,701,635 | 16,281,091 | 715,423 | 22.76 | 22.03 |
| 60 | 756,307 | 0.0276 | 1.4694 | 3,287,450 | 12,579,456 | 698,908 | 18.00 | 21.03 |
| 65 | 631,255 | 0.0253 | 1.6017 | 3,132,031 | 9,292,006 | 641,948 | 14.47 | 21.31 |
| 70 | 456,031 | 0.0103 | 1.6907 | 2,473,067 | 6,159,975 | 560,510 | 10.99 | 20.92 |
| 75 | 331,850 | 0.0123 | 1.7469 | 1,903,801 | 3,686,908 | 437,687 | 8.42 | 21.64 |
| 80 | 160,468 | 0.0348 | 1.8647 | 1,035,649 | 1,783,108 | 293,945 | 6.07 | 21.35 |
| 85 | 99,662 | 0.0202 | 2.0149 | 747,459 | 747,459 | - | - | - |

*Sources:*
See Table 3

Table 5. Application of Preston et al. Death-based Method to Vietnamese Population, by Sex.  1979-1989

MALES

| Age (x) | Weighted average of intercensal deaths | Annualized age-specific growth rates in interval | Number of deaths in stationary population in interval ndx | Number surviving to age x in stationary population l(x) | Stationary population in interval 5Lx | Stationary population above age x T(x) | Estimated life expectancy at age x e(x) | Implied West level |
|---|---|---|---|---|---|---|---|---|
| 0 | 48,580 | 0.0177 | 48,580 | 556,261 | 2,576,077 | 34,013,929 | 61.15 | 18.97 |
| 5 | 8,029 | 0.0120 | 8,648 | 507,681 | 2,516,785 | 31,437,852 | 61.92 | 19.15 |
| 10 | 3,928 | 0.0071 | 4,437 | 499,033 | 2,484,071 | 28,921,067 | 57.95 | 19.57 |
| 15 | 3,783 | 0.0149 | 4,514 | 494,595 | 2,461,693 | 26,436,996 | 53.45 | 19.73 |
| 20 | 3,856 | 0.0265 | 5,103 | 490,082 | 2,437,652 | 23,975,303 | 48.92 | 19.73 |
| 25 | 3,469 | 0.0486 | 5,539 | 484,979 | 2,411,049 | 21,537,652 | 44.41 | 19.64 |
| 30 | 3,053 | 0.0696 | 6,550 | 479,440 | 2,380,826 | 19,126,603 | 39.89 | 19.55 |
| 35 | 3,093 | 0.0507 | 8,966 | 472,890 | 2,342,036 | 16,745,777 | 35.41 | 19.47 |
| 40 | 3,345 | 0.0131 | 11,373 | 463,924 | 2,291,188 | 14,403,741 | 31.05 | 19.45 |
| 45 | 4,836 | -0.0125 | 16,469 | 452,551 | 2,221,583 | 12,112,553 | 26.77 | 19.37 |
| 50 | 6,215 | 0.0049 | 20,766 | 436,082 | 2,128,497 | 9,890,969 | 22.68 | 19.26 |
| 55 | 9,138 | 0.0299 | 33,308 | 415,317 | 1,993,313 | 7,762,472 | 18.69 | 18.77 |
| 60 | 12,070 | 0.0293 | 51,015 | 382,009 | 1,782,505 | 5,769,160 | 15.10 | 18.33 |
| 65 | 13,645 | 0.0241 | 65,908 | 330,993 | 1,490,197 | 3,986,655 | 12.04 | 18.34 |
| 70 | 14,310 | 0.0148 | 76,174 | 265,085 | 1,134,993 | 2,496,457 | 9.42 | 18.80 |
| 75 | 14,357 | 0.0162 | 82,583 | 188,912 | 738,101 | 1,361,465 | 7.21 | 19.67 |
| 80 | 7,560 | 0.0419 | 50,288 | 106,329 | 405,925 | 623,364 | 5.86 | 22.92 |
| 85+ | 7,227 | 0.0195 | 56,041 | 56,041 | 217,439 | 217,439 | 3.88 | 21.20 |

FEMALES

| Age (x) | Weighted average of intercensal deaths | Annualized age-specific growth rates in interval | Number of deaths in stationary population in interval ndx | Number surviving to age x in stationary population l(x) | Stationary population in interval 5Lx | Stationary population above age x T(x) | Estimated life expectancy at age x e(x) | Implied West level |
|---|---|---|---|---|---|---|---|---|
| 0 | 41,629 | 0.0169 | 41,629 | 516,366 | 2,409,037 | 33,506,332 | 64.89 | 18.96 |
| 5 | 7,030 | 0.0122 | 7,561 | 474,737 | 2,354,783 | 31,097,295 | 65.50 | 19.51 |
| 10 | 3,230 | 0.0087 | 3,660 | 467,176 | 2,326,729 | 28,742,512 | 61.52 | 19.96 |
| 15 | 2,993 | 0.0135 | 3,585 | 463,516 | 2,308,615 | 26,415,783 | 56.99 | 20.13 |
| 20 | 3,114 | 0.0211 | 4,068 | 459,930 | 2,289,482 | 24,107,169 | 52.41 | 20.20 |
| 25 | 2,520 | 0.0447 | 3,880 | 455,863 | 2,269,614 | 21,817,686 | 47.86 | 20.23 |
| 30 | 2,397 | 0.0670 | 4,879 | 451,983 | 2,247,719 | 19,548,072 | 43.25 | 20.18 |
| 35 | 2,305 | 0.0504 | 6,293 | 447,104 | 2,219,789 | 17,300,353 | 38.69 | 20.14 |
| 40 | 2,761 | 0.0107 | 8,783 | 440,811 | 2,182,099 | 15,080,564 | 34.21 | 20.12 |
| 45 | 3,449 | -0.0032 | 11,180 | 432,028 | 2,132,190 | 12,898,465 | 29.86 | 20.18 |
| 50 | 4,268 | 0.0181 | 14,362 | 420,848 | 2,068,334 | 10,766,275 | 25.58 | 20.16 |
| 55 | 6,563 | 0.0199 | 24,285 | 406,486 | 1,971,717 | 8,697,941 | 21.40 | 20.01 |
| 60 | 8,325 | 0.0276 | 34,686 | 382,201 | 1,824,289 | 6,726,224 | 17.60 | 20.18 |
| 65 | 10,397 | 0.0253 | 49,449 | 347,515 | 1,613,952 | 4,901,935 | 14.11 | 20.48 |
| 70 | 12,691 | 0.0103 | 65,974 | 298,066 | 1,325,396 | 3,287,983 | 11.03 | 21.04 |
| 75 | 13,963 | 0.0123 | 76,784 | 232,092 | 968,500 | 1,962,587 | 8.46 | 21.76 |
| 80 | 10,892 | 0.0348 | 67,381 | 155,308 | 608,087 | 994,087 | 6.40 | 22.59 |
| 85+ | 12,385 | 0.0202 | 87,927 | 87,927 | 386,000 | 386,000 | 4.39 | 22.06 |

*Sources:*
See Table 3

Table 6. Life Expectancy at Age x from Preston-Bennett Census-based Method and Preston et al. Death-based Method. Vietnam Males and Females, 1979-1989

| | MALES | | | | FEMALES | | | |
|---|---|---|---|---|---|---|---|---|
| Age (x) | Preston & Bennett | Implied West level | Preston et al. | Implied West level | Preston & Bennett | Implied West level | Preston et al. | Implied West level |
| 0 | - | - | 61.15 | 19.0 | - | - | 64.89 | 19.0 |
| 5 | 53.85 | 13.1 | 61.92 | 19.1 | 63.75 | 18.4 | 65.50 | 19.5 |
| 10 | 49.01 | 12.4 | 57.95 | 19.6 | 59.04 | 18.2 | 61.52 | 20.0 |
| 15 | 47.98 | 15.2 | 53.45 | 19.7 | 56.78 | 20.0 | 56.99 | 20.1 |
| 20 | 48.19 | 19.1 | 48.92 | 19.7 | 53.66 | 21.1 | 52.41 | 20.2 |
| 25 | 45.19 | 20.4 | 44.41 | 19.6 | 49.73 | 21.7 | 47.86 | 20.2 |
| 30 | 39.61 | 19.3 | 39.89 | 19.5 | 45.18 | 21.8 | 43.25 | 20.2 |
| 35 | 34.30 | 18.2 | 35.41 | 19.5 | 39.86 | 21.3 | 38.69 | 20.1 |
| 40 | 30.07 | 18.1 | 31.05 | 19.5 | 34.99 | 21.1 | 34.21 | 20.1 |
| 45 | 26.69 | 19.2 | 26.77 | 19.4 | 31.27 | 21.8 | 29.86 | 20.2 |
| 50 | 23.62 | 20.9 | 22.68 | 19.3 | 27.55 | 22.5 | 25.58 | 20.2 |
| 55 | 20.03 | 21.5 | 18.69 | 18.8 | 22.76 | 22.0 | 21.40 | 20.0 |
| 60 | 15.52 | 19.5 | 15.10 | 18.3 | 18.00 | 21.0 | 17.60 | 20.2 |
| 65 | 12.03 | 18.3 | 12.04 | 18.3 | 14.47 | 21.3 | 14.11 | 20.5 |
| 70 | 9.31 | 18.3 | 9.42 | 18.8 | 10.99 | 20.9 | 11.03 | 21.0 |
| 75 | 7.25 | 19.9 | 7.21 | 19.7 | 8.42 | 21.6 | 8.46 | 21.8 |
| 80 | 5.20 | 19.0 | 5.86 | 22.9 | 6.07 | 21.4 | 6.40 | 22.6 |
| 85+ | - | - | 3.88 | 21.2 | - | - | 4.39 | 22.1 |

*Sources:*
Tables 4-5

Table 7. Life Expectancy at Age x from Preston-Bennett Census-based Method and Preston et al. Death-based Method, with and without Adjustment for Intercensal Emigration. Vietnamese Males and Females, 1979-1989

| | MALES | | | | FEMALES | | | |
|---|---|---|---|---|---|---|---|---|
| Age (x) | Preston & Bennett with adj. for migration | Preston & Bennett without adj. for migration | Preston et al. with adj. for migration | Preston et al. without adj. for migration | Preston & Bennett with adj. for migration | Preston & Bennett without adj. for migration | Preston et al. with adj. for migration | Preston et al. without adj. for migration |
| 0 | - | - | 61.15 | 60.43 | - | - | 64.89 | 64.29 |
| 5 | 53.85 | 51.56 | 61.92 | 61.58 | 63.75 | 61.36 | 65.50 | 65.22 |
| 10 | 49.01 | 46.86 | 57.95 | 57.68 | 59.04 | 56.80 | 61.52 | 61.30 |
| 15 | 47.98 | 45.95 | 53.45 | 53.21 | 56.78 | 54.72 | 56.99 | 56.79 |
| 20 | 48.19 | 46.30 | 48.92 | 48.71 | 53.66 | 51.82 | 52.41 | 52.24 |
| 25 | 45.19 | 43.59 | 44.41 | 44.23 | 49.73 | 48.13 | 47.86 | 47.71 |
| 30 | 39.61 | 38.37 | 39.89 | 39.74 | 45.18 | 43.86 | 43.25 | 43.12 |
| 35 | 34.30 | 33.42 | 35.41 | 35.28 | 39.86 | 38.89 | 38.69 | 38.58 |
| 40 | 30.07 | 29.50 | 31.05 | 30.94 | 34.99 | 34.36 | 34.21 | 34.12 |
| 45 | 26.69 | 26.32 | 26.77 | 26.68 | 31.27 | 30.86 | 29.86 | 29.78 |
| 50 | 23.62 | 23.37 | 22.68 | 22.61 | 27.55 | 27.27 | 25.58 | 25.52 |
| 55 | 20.03 | 19.88 | 18.69 | 18.63 | 22.76 | 22.59 | 21.40 | 21.35 |
| 60 | 15.52 | 15.42 | 15.10 | 15.06 | 18.00 | 17.88 | 17.60 | 17.56 |
| 65 | 12.03 | 11.97 | 12.04 | 12.01 | 14.47 | 14.40 | 14.11 | 14.08 |
| 70 | 9.31 | 9.26 | 9.42 | 9.39 | 10.99 | 10.94 | 11.03 | 11.01 |
| 75 | 7.25 | 7.22 | 7.21 | 7.19 | 8.42 | 8.39 | 8.46 | 8.44 |
| 80 | 5.20 | 5.18 | 5.86 | 5.85 | 6.07 | 6.04 | 6.40 | 6.40 |
| 85+ | - | - | 3.88 | 3.87 | - | - | 4.39 | 4.39 |

Table 8. Life Expectancy at Age (x) Estimated from the Preston and Bennett Census-based Method Based on the Observed 1989 Age Distribution and the Estimated 1989 Age Distribution. Vietnamese Males and Females, 1979-1989

| | MALES | | | FEMALES | | |
|---|---|---|---|---|---|---|
| Age (x) | Preston and Bennett life expectancy at age x based on the 1989 observed age distribution (a) (1) | Preston and Bennett life expectancy at age x based on the 1989 estimated age distribution (2) | Preston et al. life expectancy at age x (b) (3) | Preston and Bennett life expectancy at age x based on the 1989 observed age distribution (a) (1) | Preston and Bennett life expectancy at age x based on the 1989 estimated age distribution (2) | Preston et al. life expectancy at age x (b) (3) |
| 0 | - | - | 61.15 | - | - | 64.89 |
| 5 | 53.85 | 61.35 | 61.92 | 63.75 | 64.94 | 65.50 |
| 10 | 49.01 | 57.16 | 57.95 | 59.04 | 60.81 | 61.52 |
| 15 | 47.98 | 54.87 | 53.45 | 56.78 | 57.82 | 56.99 |
| 20 | 48.19 | 50.19 | 48.92 | 53.66 | 52.86 | 52.41 |
| 25 | 45.19 | 44.94 | 44.41 | 49.73 | 48.92 | 47.86 |
| 30 | 39.61 | 40.76 | 39.89 | 45.18 | 44.81 | 43.25 |
| 35 | 34.30 | 35.44 | 35.41 | 39.86 | 38.55 | 38.69 |
| 40 | 30.07 | 29.84 | 31.05 | 34.99 | 32.65 | 34.21 |
| 45 | 26.69 | 25.79 | 26.77 | 31.27 | 28.96 | 29.86 |
| 50 | 23.62 | 22.73 | 22.68 | 27.55 | 25.96 | 25.58 |
| 55 | 20.03 | 19.43 | 18.69 | 22.76 | 21.68 | 21.40 |
| 60 | 15.52 | 15.23 | 15.10 | 18.00 | 17.50 | 17.60 |
| 65 | 12.03 | 12.10 | 12.04 | 14.47 | 14.45 | 14.11 |
| 70 | 9.31 | 9.42 | 9.42 | 10.99 | 10.83 | 11.03 |
| 75 | 7.25 | 7.19 | 7.21 | 8.42 | 8.36 | 8.46 |
| 80 | 5.20 | 5.31 | 5.86 | 6.07 | 6.16 | 6.40 |
| 85+ | - | - | 3.88 | - | - | 4.39 |

(a) From Table 4
(b) From Table 5

Table 9. Life Expectancy at Age (x) from the Preston et al. Method with Corrected Growth Rates
Vietnamese Males and Females, 1979-1989

MALES

| Age (x) | Population 10-1-1979 | Estimated population 4-1-1989 | Corrected age-specific growth rates | Estimated e(x) with corrected growth rates | Implied West level | Estimated e(x) with uncorrected growth rates (a) | Implied West level (a) |
|---|---|---|---|---|---|---|---|
| 0 | 3,946,224 | 4,668,915 | 0.0168 | **61.91** | 19.28 | 61.15 | 18.97 |
| 5 | 3,928,795 | 4,403,654 | 0.0114 | **62.00** | 19.20 | 61.92 | 19.15 |
| 10 | 3,632,555 | 3,827,050 | 0.0052 | **57.89** | 19.52 | 57.95 | 19.57 |
| 15 | 2,954,333 | 3,854,304 | 0.0266 | **53.32** | 19.61 | 53.45 | 19.73 |
| 20 | 2,281,171 | 3,571,913 | 0.0448 | **48.73** | 19.56 | 48.92 | 19.73 |
| 25 | 1,742,277 | 2,896,864 | 0.0508 | **44.19** | 19.41 | 44.41 | 19.64 |
| 30 | 1,177,320 | 2,228,921 | 0.0638 | **39.67** | 19.30 | 39.89 | 19.55 |
| 35 | 966,580 | 1,692,973 | 0.0560 | **35.18** | 19.18 | 35.41 | 19.47 |
| 40 | 919,291 | 1,133,141 | 0.0209 | **30.80** | 19.10 | 31.05 | 19.45 |
| 45 | 994,602 | 915,713 | -0.0083 | **26.52** | 18.96 | 26.77 | 19.37 |
| 50 | 825,356 | 850,976 | 0.0031 | **22.48** | 18.85 | 22.68 | 19.26 |
| 55 | 680,996 | 887,161 | 0.0264 | **18.54** | 18.37 | 18.69 | 18.77 |
| 60 | 540,920 | 685,874 | 0.0237 | **15.01** | 18.01 | 15.10 | 18.33 |
| 65 | 419,164 | 505,462 | 0.0187 | **12.00** | 18.12 | 12.04 | 18.34 |
| 70 | 284,003 | 342,948 | 0.0189 | **9.38** | 18.46 | 9.42 | 18.80 |
| 75 | 183,222 | 206,873 | 0.0121 | **7.17** | 19.16 | 7.21 | 19.67 |
| 80 | 64,153 | 100,866 | 0.0453 | **5.83** | 22.52 | 5.86 | 22.92 |
| 85+ | 39,620 | 44,065 | 0.0106 | **3.86** | 21.01 | 3.88 | 21.20 |

FEMALES

| Age (x) | Population 10-1-1979 | Estimated population 4-1-1989 | Corrected age-specific growth rates | Estimated e(x) with corrected growth rates | Implied West level | Estimated e(x) with uncorrected growth rates (a) | Implied West level (a) |
|---|---|---|---|---|---|---|---|
| 0 | 3,766,472 | 4,423,345 | 0.0161 | **64.04** | 18.62 | 64.89 | 18.96 |
| 5 | 3,761,523 | 4,223,518 | 0.0116 | **64.85** | 19.08 | 65.50 | 19.51 |
| 10 | 3,406,774 | 3,631,833 | 0.0064 | **60.91** | 19.53 | 61.52 | 19.96 |
| 15 | 3,060,551 | 3,684,564 | 0.0186 | **56.39** | 19.69 | 56.99 | 20.13 |
| 20 | 2,601,098 | 3,349,420 | 0.0253 | **51.83** | 19.74 | 52.41 | 20.20 |
| 25 | 1,975,507 | 3,005,387 | 0.0420 | **47.30** | 19.74 | 47.86 | 20.23 |
| 30 | 1,314,655 | 2,550,216 | 0.0663 | **42.72** | 19.66 | 43.25 | 20.18 |
| 35 | 1,104,086 | 1,928,967 | 0.0558 | **38.19** | 19.58 | 38.69 | 20.14 |
| 40 | 1,084,758 | 1,272,899 | 0.0160 | **33.74** | 19.53 | 34.21 | 20.12 |
| 45 | 1,113,757 | 1,055,799 | -0.0053 | **29.44** | 19.59 | 29.86 | 20.18 |
| 50 | 902,407 | 1,021,828 | 0.0124 | **25.25** | 19.62 | 25.58 | 20.16 |
| 55 | 872,541 | 1,021,864 | 0.0158 | **21.14** | 19.50 | 21.40 | 20.01 |
| 60 | 663,366 | 788,476 | 0.0173 | **17.43** | 19.80 | 17.60 | 20.18 |
| 65 | 559,727 | 707,613 | 0.0234 | **14.00** | 20.18 | 14.11 | 20.48 |
| 70 | 434,355 | 477,768 | 0.0095 | **10.96** | 20.82 | 11.03 | 21.04 |
| 75 | 313,082 | 332,827 | 0.0061 | **8.42** | 21.67 | 8.46 | 21.76 |
| 80 | 135,988 | 197,732 | 0.0374 | **6.39** | 22.56 | 6.40 | 22.59 |
| 85+ | 90,537 | 105,848 | 0.0156 | **4.38** | 22.00 | 4.39 | 22.06 |

(a) From Table 5

Table 10. Observed and Estimated Population Enumerated in Vietnam's 1989 Census, by Sex

| Age interval | MALES: Observed number of persons in age interval (a) (1) | MALES: Estimated number of persons in age interval (b) (2) | MALES: Difference observed - estimated population (3) = (1) - (2) | MALES: Ratio observed to estimated population (4) = (1)/(2) | FEMALES: Observed number of persons in age interval (a) (1) | FEMALES: Estimated number of persons in age interval (b) (2) | FEMALES: Difference observed - estimated population (3) = (1) - (2) | FEMALES: Ratio observed to estimated population (4) = (1)/(2) |
|---|---|---|---|---|---|---|---|---|
| 0-4 | 4,668,915 | 4,668,915 | - | - | 4,423,345 | 4,423,345 | - | - |
| 5-9 | 4,403,654 | 4,403,654 | - | - | 4,223,518 | 4,223,518 | - | - |
| 10-14 | 3,884,561 | 3,827,050 | 57,512 | 1.02 | 3,699,625 | 3,631,833 | 67,792 | 1.02 |
| 15-19 | 3,402,000 | 3,854,304 | -452,304 | 0.88 | 3,480,545 | 3,684,564 | -204,018 | 0.94 |
| 20-24 | 2,935,087 | 3,571,913 | -636,826 | 0.82 | 3,177,262 | 3,349,420 | -172,158 | 0.95 |
| 25-29 | 2,764,189 | 2,896,864 | -132,675 | 0.95 | 3,020,971 | 3,005,387 | 15,585 | 1.01 |
| 30-34 | 2,280,903 | 2,228,921 | 51,983 | 1.02 | 2,484,824 | 2,550,216 | -65,392 | 0.97 |
| 35-39 | 1,564,740 | 1,692,973 | -128,233 | 0.92 | 1,782,736 | 1,928,967 | -146,232 | 0.92 |
| 40-44 | 1,041,388 | 1,133,141 | -91,753 | 0.92 | 1,200,844 | 1,272,899 | -72,054 | 0.94 |
| 45-49 | 883,098 | 915,713 | -32,615 | 0.96 | 1,080,787 | 1,055,799 | 24,988 | 1.02 |
| 50-54 | 864,699 | 850,976 | 13,722 | 1.02 | 1,071,896 | 1,021,828 | 50,069 | 1.05 |
| 55-59 | 904,734 | 887,161 | 17,573 | 1.02 | 1,053,833 | 1,021,864 | 31,969 | 1.03 |
| 60-64 | 714,534 | 685,874 | 28,660 | 1.04 | 862,270 | 788,476 | 73,794 | 1.09 |
| 65-69 | 527,053 | 505,462 | 21,591 | 1.04 | 711,925 | 707,613 | 4,311 | 1.01 |
| 70-74 | 326,747 | 342,948 | -16,201 | 0.95 | 478,789 | 477,768 | 1,021 | 1.00 |
| 75-79 | 213,768 | 206,873 | 6,895 | 1.03 | 351,743 | 332,827 | 18,916 | 1.06 |
| 80-84 | 95,528 | 100,866 | -5,338 | 0.95 | 189,356 | 197,732 | -8,376 | 0.96 |
| 85+ | 47,662 | 44,065 | 3,598 | 1.08 | 109,707 | 105,848 | 3,859 | 1.04 |
| Total | 31,523,261 | 32,817,672 | -1,294,411 | 0.96 | 33,403,977 | 33,779,904 | -375,927 | 0.99 |

(a) 1989 census counts have been corrected for intercensal emigration
(b) From Table 9

Table 11. Survival Probabilities in Vietnamese Life Tables, and in Vietnam Life History Survey

| Probability of survival (nPx) between ages | 1979 (a) (nPx) | 1979 (a) Implied West level | 1989 (b) (nPx) | 1989 (b) Implied West level | 1979-1989 (c) (nPx) | 1979-1989 (c) Implied West level | 1976-90 VLHS (d) (nPx) | 1976-90 VLHS (d) Implied West level |
|---|---|---|---|---|---|---|---|---|
| 15 and 45 | 0.933 | 20.6 | 0.925 | 20.2 | 0.922 | 20.0 | 0.938 | 21.0 |
| 15 and 60 | 0.822 | 21.2 | 0.801 | 20.2 | 0.788 | 19.8 | 0.834 | 21.4 |

*Sources:*
(a) Hirschman et al. 'Vietnamese casualties during the American War: A new estimate' loc. cit. in fn. 8, p. 802.
(b) Hirschman et al. 'Vietnamese casualties during the American War: A new estimate' loc. cit. in fn. 8, p. 802.
(c) Intercensal life table derived by the Preston et al. death based method. The estimates are based on the average of male and female estimates presented in Table 9 of this paper.
(d) Hirschman et al. 'Vietnamese casualties during the American War: A new estimate' loc. cit. in fn. 8, p. 802.

Figure 1. Estimated Values of Completeness of Death Registration Using the Bennett and Horiuchi Procedure, Vietnam, Males and Females, 1979-1989