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Does Population Composition Explain the U.S. Advantage in Old-Age Mortality?

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Abstract: Previous research indicated that once Americans achieve age 80, they have longer life expectancy than European populations. A number of potential explanations for this finding have been proposed. This paper investigates whether the inclusion of immigrants in the American population deflates mortality rates enough to explain the crossover. First, mortality rates are calculated controlling for nativity; second, mortality of second-generation Americans is taken into account. Excluding these populations from the white, non-Hispanic American population is not sufficient to remove the crossover, although it does push the crossover two years older. Analyses indicate that Hispanic ethnicity (often included within the "white" population in American demographic data) may exert a more powerful compositional effect than nativity.

Although the United States health care system has been called the most expensive in the world (Hilts 1991), the overall picture of health in the United States is not as bright as in some other developed countries. In twenty-two developed countries, life expectancy at birth for males is higher than in the United States (NCHS 1996). Infant mortality in the United States is also ranked outside the top twenty in the world, although more money is spent on care for premature infants in the US than anywhere else in the world (NCHS 1996). The one place where the United States health care system appears to shine is in the health of the oldest population. Although life expectancy is lower in the United States than in much of Europe and Japan, the additional years of life that can be expected once an American gets to age 80 is greater than that of a European or Japanese (Manton and Vaupel 1995). Why is this so?

A number of explanations have been proposed to explain the crossover in mortality at extreme old ages. Manton and Vaupel (1995) argue that much of the explanation is due to the reduction of heterogeneity in socioeconomic and health insurance status for older Americans due to such government programs as Medicare, Medicaid and Social Security. A second explanation is the more standard frailty argument: heterogeneity has been reduced due to the selective survival of only the strongest Americans (Sallar, Hogg and Schechter 1996). A third explanation might be that health care is simply better for older Americans than for older citizens of other developed countries. A fourth explanation might be that various cohort effects are leading to different mortality patterns for older and younger Americans. For example, as described by Manton and Vaupel (1995), older Americans were more likely to be educated than older Europeans. The educational difference is not maintained for younger populations. There could be other cohort effects as well, such as exposure to infectious disease over the life of the cohort.

This paper will examine another cohort explanation: the effect of immigration. The United States is a nation of immigrants and the descendants of immigrants. Especially among the elderly, population composition, particularly immigrant status, may possibly influence mortality rates.

Many authors have previously examined how immigrant mortality compares with native-born mortality. Marmot, Adelstein and Bulusu (1984) looked at four common migrant groups in England and compared their mortality rates (using standardized mortality ratios) with those of England as a whole, and with the country of origin. They found that immigrants tended to have lower mortality than both persons born in England and persons who remained in the sending country, with the exception of Irish immigrants. There have been several papers that examined differential mortality of immigrants in the United States (Kestenbaum 1986; Rosenwaike 1987; Rosenwaike and Hempstead 1990; Rogot, Sorlie, Johnson and Schmitt 1992; Sorlie, Backlund, Johnson, and Rogot 1993; Swallen 1996; Fang, Madhavan and Alderman 1997; Hummer, Rogers and Nam 1999); all the authors reached the conclusion that foreign-born persons residing in the United States live longer than US-born persons.

While many of these individual studies report potential problems in data quality, the overall descriptive data seems to clearly indicate that the mortality of the foreign-born population is lower than that of the native-born population.

There have been a few studies in other countries that compared immigrants with those in sending countries. As mentioned above, Marmot, Adelstein and Bulusu (1984) looked at four common migrant groups in England, and compared their mortality rates (using standardized mortality ratios) with those of England as a whole, and with the country of origin. They found that immigrants tended to have lower mortality than both persons born in England and persons who remained in the sending country, with the exception of Irish immigrants. Valkonen, Brancker and Reijo (1992) compared Scandinavian immigrants to Canada with Canadians and Scandinavians. Again, they report that immigrants have lower mortality. Swallen (1996) compared American immigrants with sending countries and also found decreased mortality among the immigrants. A few researchers have pointed out that this advantage is not evenly spread across the age-range; death rates appear high among foreign-born adolescents, for example (Rosenwaike 1987; Rosenwaike and Hempstead 1990; Ostberg 1997). Additionally, mortality is not reduced for all causes of death for the immigrant population; immigrants had higher death rates for stomach cancer, for example (Marmot, Adelstein and Bulusu 1984).

While an interesting question, the goal of this paper is not to examine the causes of low immigrant mortality, but to use the descriptive data to address another question. The goal of this paper is to predict what the mortality experience of the American population would be if there were no immigrants in the American population. In addition, since research indicates that some of longevity is genetically based, the children of immigrants are also excluded from the American population. If excluding immigrants and their children causes the cross-over in mortality between European countries and the United States to disappear, then it can be argued that it is population composition in the United States that causes the cross-over in mortality at old age. On the other hand, if omitting the immigrant (and second-generation) Americans does not cause the cross-over to disappear, then population composition is an insufficient explanation for the old-age mortality cross-over.

Data

To examine the influence of nativity and immigration on mortality of the elderly population, a number of data sources are examined. For the American population, the complete mortality statistics of the United States in 1990 are compared with the 1990 Census. Although this method introduces potential biases by requiring matching between the two sources, no other source is available with a large enough sample of non-US-born persons. For this project, foreign-born white non-Hispanics are compared to Europeans. American death certificates contain information on race, ethnicity and nativity. In the United States, race and ethnicity (Hispanic or non-Hispanic) are collected separately. Specific nativity is reported on death certificates, but is masked in the complete mortality statistics. For this project, nativity was divided into two classes: US-born and non-US-born. White, non-Hispanic persons stratified by nativity are compared with European populations (see Swallen 1999 for details on mortality calculations, data sources and data quality). For European mortality rates, the Berkeley Mortality Database is used for 1990 for France and Sweden (Wilmoth 1999). Race-specific rates are not calculated. Similar results are obtained by using the United Nations Demographic Yearbook for other European countries (Swallen 1997).

Neither the vital statistics nor the American census includes information on parental nativity. To obtain estimates of the percent of the American population who can be considered second generation (both parents born outside the United States) or partial second generation (either mother or father born outside the United States), the March 1994 Current Population Survey was used (US Census Bureau 1994). For this paper, any place of birth other than the 50 United States plus the District of Columbia, including Guam and Puerto Rico, were counted in the “foreign-born” category in all cases.

Population Composition of the United States

In 1997, the United States was 9.7% percent foreign-born (Schmidley and Alvarado 1998). However, this statistic does not account for race or nativity. While only 7.6% of native-born Americans are Hispanic, 27.2% of naturalized citizens and 53.3% of non-citizen American residents are Hispanic (Schmidley and Alvarado 1998).

By examining the 1990 US Census, the white non-Hispanic population of the United States can be divided into native-born and foreign-born components. Overall, the white non-Hispanic population is only 4% foreign-born. However, the elderly white non-Hispanic population is much more likely to be foreign-born (see Figure 1). Among the oldest-old, 10% of the 80-84, 13% of the 85-89, and 15% of the 90+ population are foreign-born. Elderly males are even more likely to be foreign-born: 18% of the 90+ males are foreign-born.

In addition to being a country of immigrants, the United States is a country of immigrant children. While the US Census stopped collecting information on parent's birthplaces after the 1970 census, the Current Population Survey collected information on parental nativity from 1994 to 1998. Since the mortality calculations in this paper are based on 1990, I used the 1994 CPS as the closest to 1990. The CPS only reports age groups up to 75+; thus I have assumed that persons 90+ and persons 75-79 are just as likely to be second generation Americans. This is probably not true. Likewise, all persons up to age 15 are assumed to have identical rates of second generation. **Figure 1** depicts the population of white non-Hispanic Americans distributed by nativity and second-generation. (In this Figure, partial and full second-generations are combined in one line). For the oldest populations, over 30% of US-born Americans are second generation. Thus, 1^{st} and second-generation Americans make up almost half of the oldest-old Americans.

Immigrant Mortality

Figures 2 and 3 show a comparison of white non-Hispanic American mortality with French and Swedish mortality. For males, American mortality falls below Swedish mortality at age 75 and below French mortality at age 83. For females, American mortality falls below Swedish mortality at age 76 and below French mortality at age 82. Another way to consider the question and the one used by Manton and Vaupel (1995) is to look at survival. That is, if a person survives to age 65, what is the chance that they survive to age 66? Survival analysis was not used here since the assumptions made about the open-ended interval influence these curves (Hinde 1998). Although not shown here, the survival analyses using this data lead to similar conclusions. Extinct cohort methods may be preferable for these types of analyses (Manton and Stallard 1996), but the data is unavailable at the level of specificity (race, ethnicity and nativity) required for these analyses. Figures 4a and 5 show survival for the same populations as in Figures 2 and 3. In the male picture (Figure 4a), it appears that survival is lower for Americans at all ages. However, Figure 4b demonstrates that when only the oldest age groups are considered, again as Manton and Vaupel found using extinct cohort analyses, extremely old American men have better survival rates than Swedish men and French men (only after 85). The advantages are not nearly as large as were found in that paper however (Manton and Vaupel 1995).

How much of the advantage in American mortality is due to the inclusion of a subsample of extremely healthy immigrants in the American population? To examine this question, the mortality of the native-born American population (excluding the foreign-born) can be compared with European mortality. Figures 4 and 5 demonstrates that plotting separate nMx curves for US-born and foreign-born Americans minimizes the American advantage at young ages, but changes are only minor after age 80. For both sexes, the difference is approximately one year. Male US-born mortality falls below Swedish mortality at age 74 and French at age 82. For females, US-born mortality falls below Swedish mortality at age 75 and below French mortality at age 81. Thus, these data only support a very modest effect of long-term immigration patterns in the United States on mortality at old age.

Mortality of Immigrant Descendents

If we accept the arguments that longevity is at least partly genetically determined, and that immigrants are longer-lived, then immigrant children should also be longer-lived. Although simply excluding immigrants from the American population was insufficient to eliminate the American advantage in longevity in old age for males, perhaps excluding both immigrants and their children would eliminate the advantage. If not, then it seems that an explanation other than population composition due to the "healthy migrant" must be considered to explain the American survival advantage.

It is impossible to directly ascertain mortality rates for second generation Americans. The information necessary is available neither on the death certificate nor in the census. Therefore, the analysis proposes some simple models of what second-generation mortality may look like. To calculate the second-generation expected mortality, we use the information we have about the US- and foreign-born mortality. Algebraically, the mortality of the second generation should be the mortality of the foreign-born (the parents) multiplied by the appropriate genetic contribution plus the mortality of the US-born multiplied by the appropriate non-genetic contribution (or one minus the genetic contribution). Thus,

$$nMx(fb) * genetic + nMx(US) * (1\text{-}genetic) = nMx(2^{nd})$$

Using McGue *et al.*'s (1993) estimate that 23% of longevity is genetic, we insert .23 for genetic and .77 for 1-genetic. Thus, second-generation 65-69 year old males would have a mortality of (0.0219) * (0.23) + (0.0276)*(0.77) = 0.005037 + .021252 = 0.026289. Thus, second-generation 65-69 year-olds are predicted to have a mortality rate approximately 98% of that of US-born Americans 65-69 years old. Several caveats are important as this model is over-simplified. For these calculations, I assume that immigrant mortality and native-born mortality have not been changing with time. A more accurate estimate might be based ratios of US- and foreign-born mortality of persons approximately 25 years ago as a proxy for parental mortality. A brief examination of the data for 1980 indicates that data quality for nativity was considerably inferior and the data simply unusable in that time period. In addition, the calculation of nMx(US) is based on all US-born persons, which includes second-generation Americans. Thus, nMx(US) as calculated here may be underestimated compared with a true measure of fourth-plus generation Americans (the point at which genetic contributions due to the "healthy migrant" hypothesis appears to disappear).

Using this method and the data for white non-Hispanic US-born Americans, mortality rates and counts of deaths are created for second generation Americans. The deaths and second-generation population counts are then subtracted from the total death and population counts for white non-Hispanic US-born Americans. Then, death rates and mortality curves are created for third generation and greater Americans and compared to Sweden and France. That is, a new population and death counts that exclude both immigrant and second-generation Americans is created. Overall, the third-generation-plus population has a mortality picture very close to that of the total American population. Figure 6 shows the mortality curve for French, Swedish and American third-generation-plus men from age 70 to 90-plus. Removing both immigrants and their children pushes the American advantage out another year, with American third-generation-plus mortality falling below Sweden at 77 and below France at 83.

If No Immigration From France

Although the work above makes many adjustments to American mortality patterns, it does not adjust the European population at all. White, non-Hispanic immigrants to the United States were mainly from Europe (and Europe via Canada). The story told in the above sections shows how the US mortality pattern would look if only third generation and higher Americans were included. It does not describe how French mortality would look if all French immigrants (and their children) had remained in France. One line has been brought down, but the other has not been brought up.

Using information about immigrants and second-generation Americans from France in the March 1994 CPS, some adjustments were tried. In fact, the adjustment makes very little difference for France (not shown), which was not a major sender of this generation of immigrants to America. These results are driven by fairly poor estimates of levels of French immigration however, and should be treated with caution. Including more appropriate sending countries may improve the estimate, but it appears unlikely that the entire American advantage could be eliminated through this process.

Other Explanations

This research indicates that part of the explanation for the American-European crossover in mortality is previous immigration and childbearing by immigrants. One additional consideration should be mentioned here. Crossovers have been seen before in demographic research. However, sometimes these crossovers have been found to be due to poor data quality rather than true differences. For example, recent investigations of the black-white mortality cross-over indicate that age misreporting among blacks has led to artificially low estimates of old-age black mortality (Coale and Kisker 1986; Preston, Elo, Rosenwaike and Hill 1996). Thus, caution appears warranted when we consider other anomalous mortality patterns. Age misreporting has recently been reported as unimportant among the oldest-old whites including both Hispanics and non-Hispanics (Hill, Preston and Rosenwaike 1999). However, since age misreporting generally biases mortality estimates downward (Preston, Elo and Stewart 1999), this is a potential problem with this research, and other research using matching between death and population records.

Manton and Vaupel (1995) tried to control for data quality, which has been reported as less than adequate for aging populations in the United States (Kannisto, Lauritsen, Thatcher and Vaupel 1994), by using Medicare data for whites. They found extremely high survival in the United States after age 80. Using vital statistics data and census data for 1990, the differences are much less than those reported by Manton and Vaupel (1995). However, when I looked at all whites in the United States, the American advantage reappeared. (See Figure 7). In other words, removing the Hispanic population from the US white population made a much larger difference than did removing the foreign-born population. The Hispanic advantage in health has been referred to as the “Hispanic paradox” (Markides and Coreil 1986), and future research is needed on this topic. Is this a valid advantage, or is it an artifact of poor data quality?

Using the vital statistics of the United States for 1990, I was unable to duplicate the findings of Manton and Vaupel (1995) which indicated a large mortality advantage for American whites over Europeans at old age. While the data sets used were not equivalent, a larger (rather than smaller) survival advantage might have been anticipated with the complete mortality records, since presumably Medicare records are more accurate (remembering the findings of Preston, Elo and Stewart 1999, which indicate age misreporting always should bias mortality downward). Future research might use the exact data Manton and Vaupel used and then try excluding Hispanics and foreign-born persons. A more definitive answer to the question could then be achieved. Preston and Elo (1996) also have raised concerns about data quality for the elderly population. For now, it can be said that removing Hispanics seems to have a larger effect than removing foreign-born persons. Phrased differently, the “Hispanic paradox” appears more powerful than the “healthy migrant” explanation. Both Hispanics and the foreign-born survive longer than do native-born American white non-Hispanics. Finally, it should be considered that perhaps the Medicare data are not of significantly better quality than the vital statistics. An examination of the mortality data for 1980 indicates much more severe data problems than by 1990. Perhaps the 1990s are a brief era where national mortality files can be used accurately, since in 2000 the added complication of racial and ethnic classification revisions in the Census will arrive.

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Figure 1. US population composition by age.

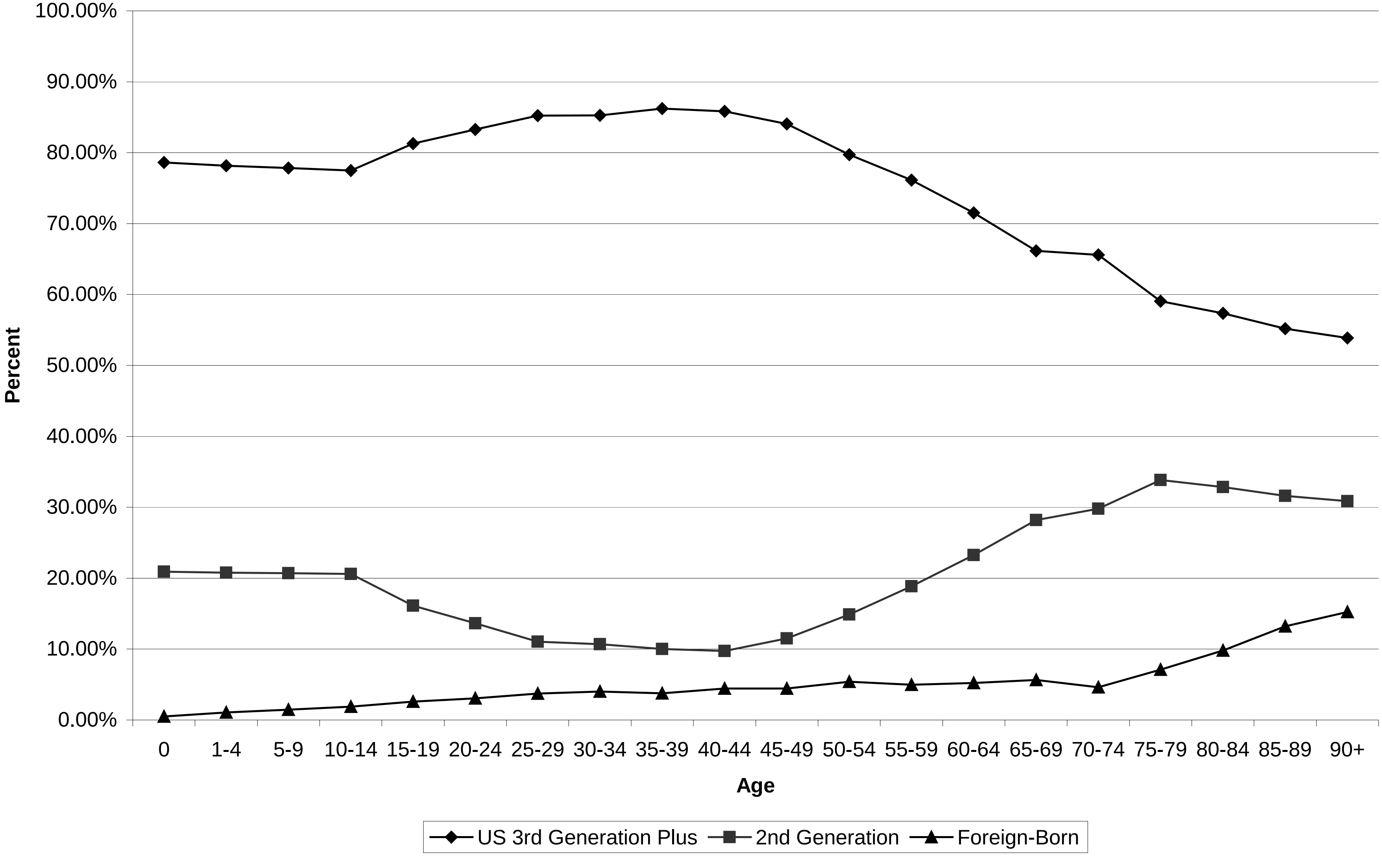


Figure 2. Male Mortality

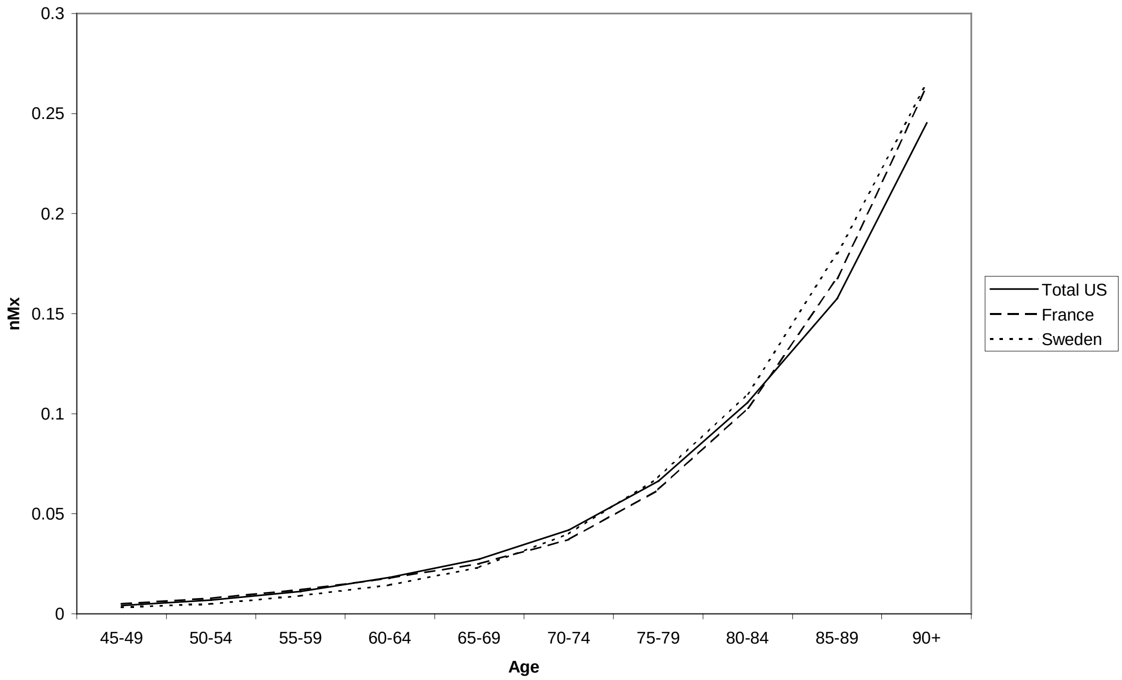


Figure 3. Female Mortality

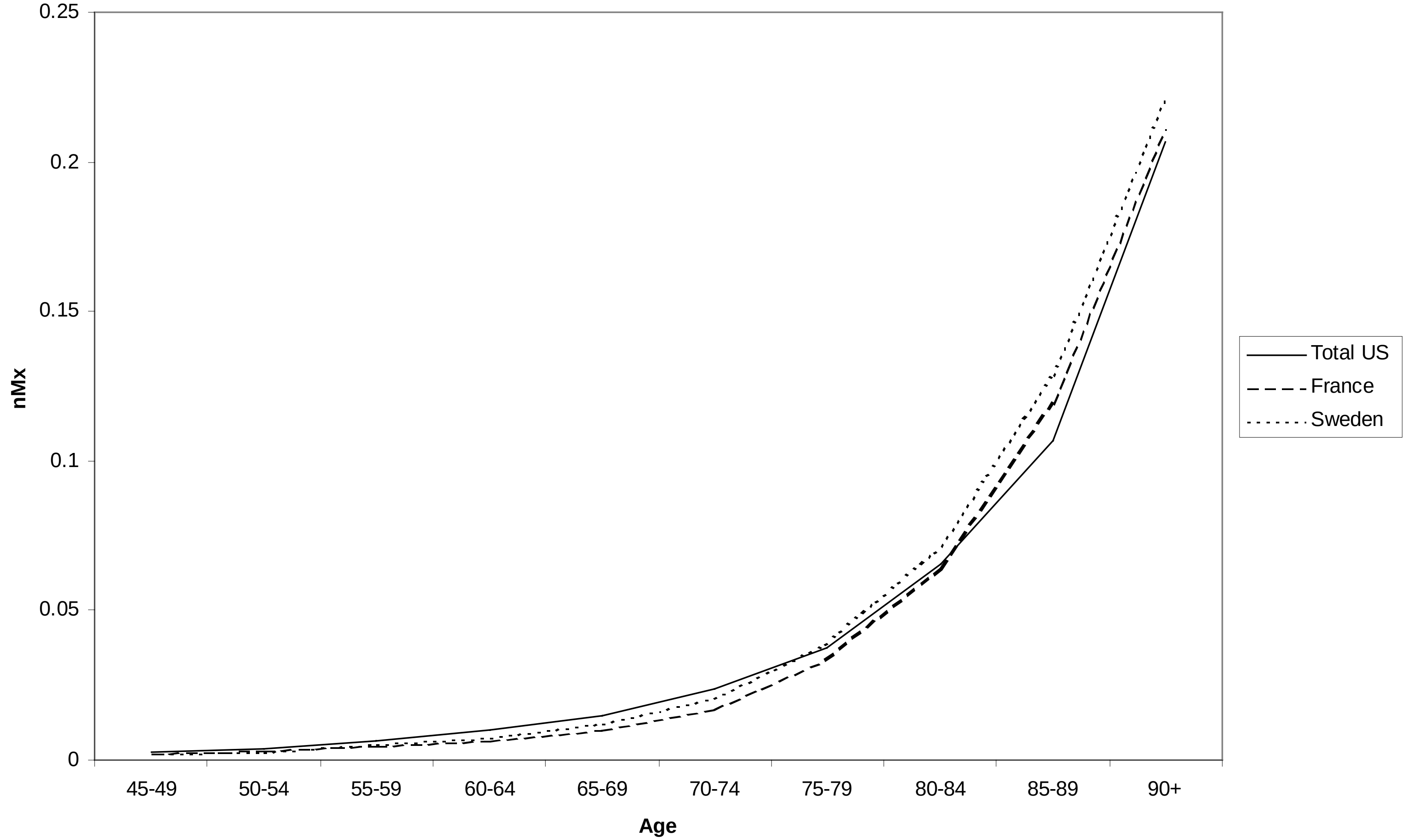


Figure 4. Male mortality, controlling for nativity.

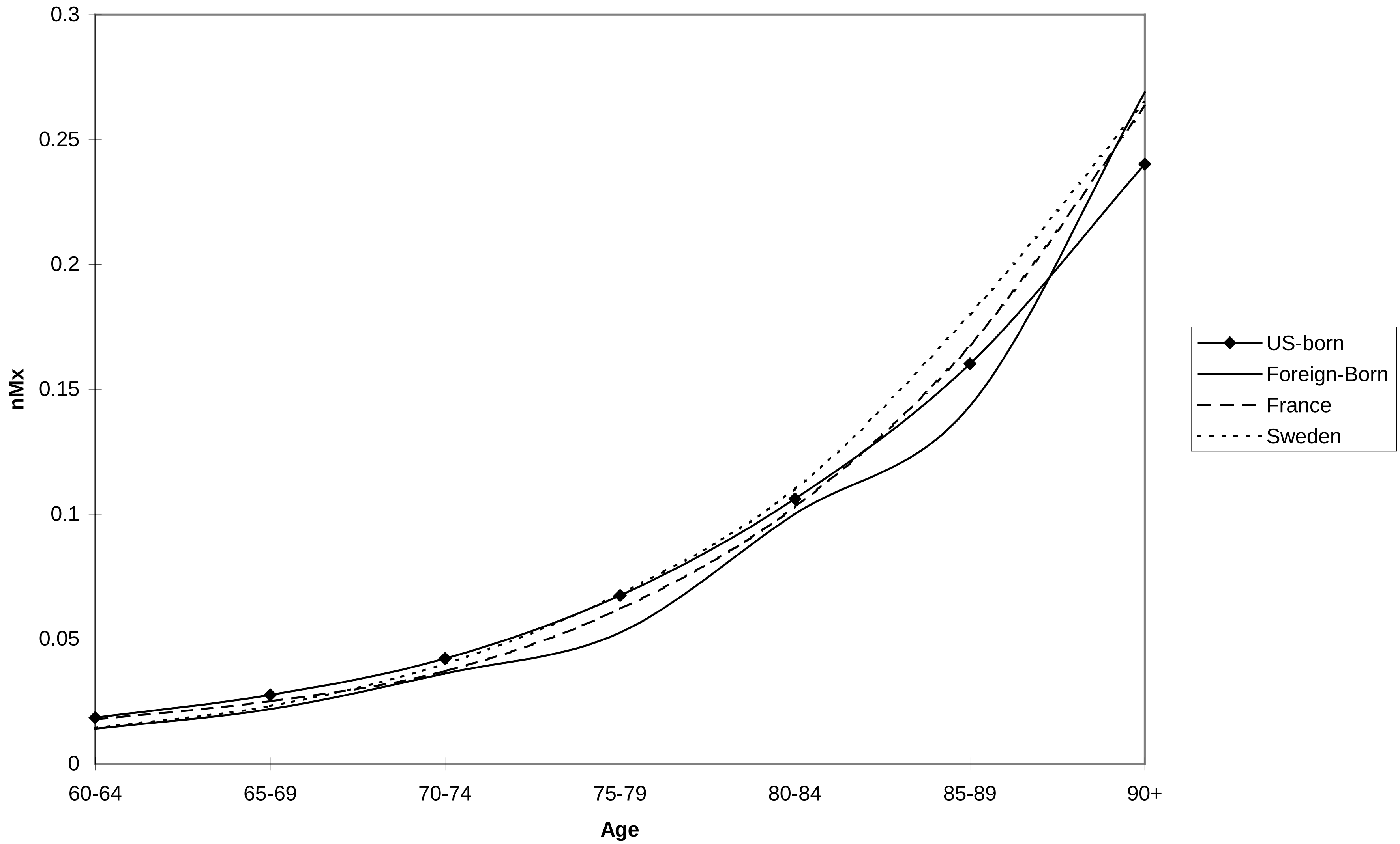


Figure 5. Female mortality, controlling for nativity.

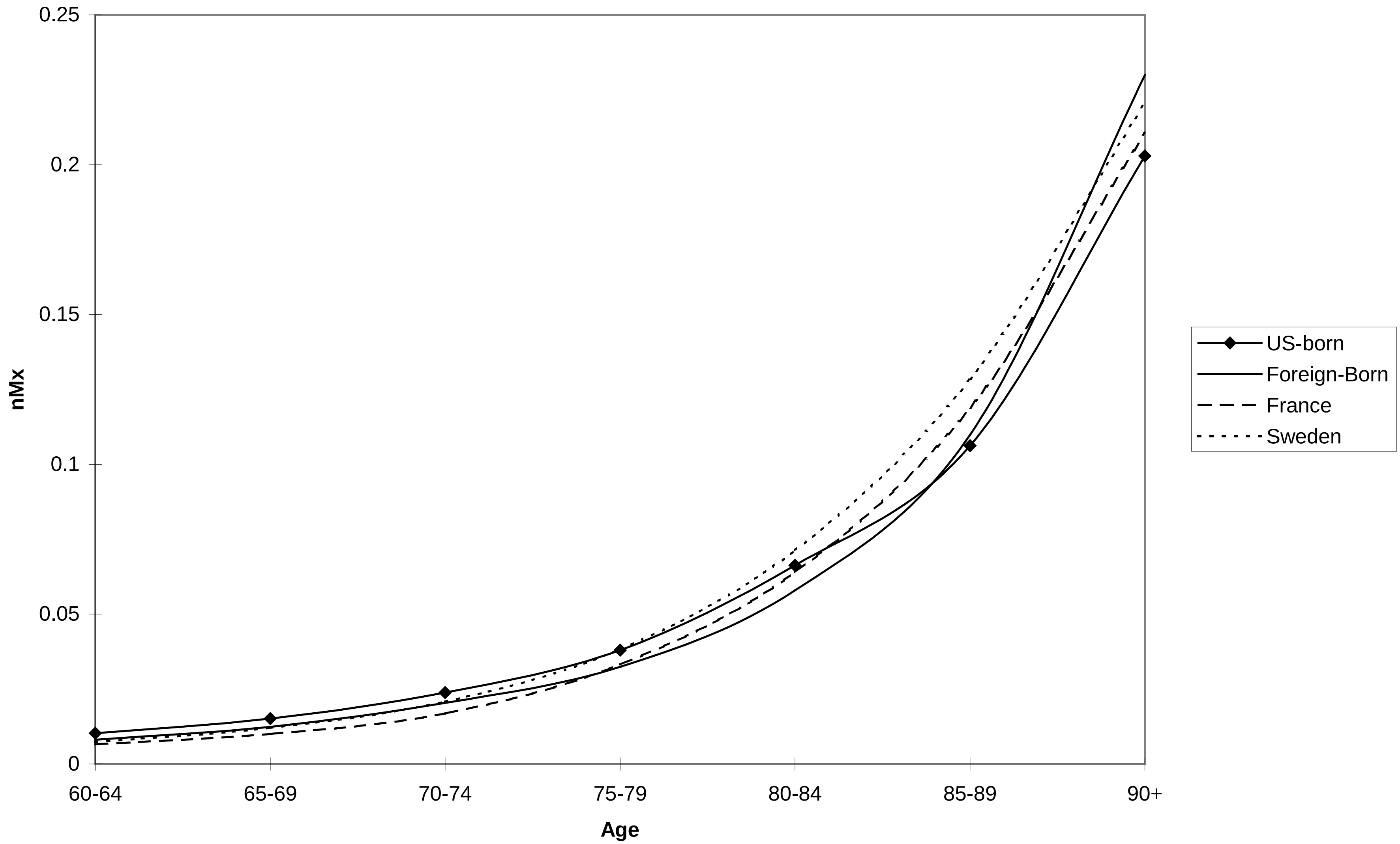


Figure 6. Male Mortality, Remove Immigrant and 2nd Generation Americans.

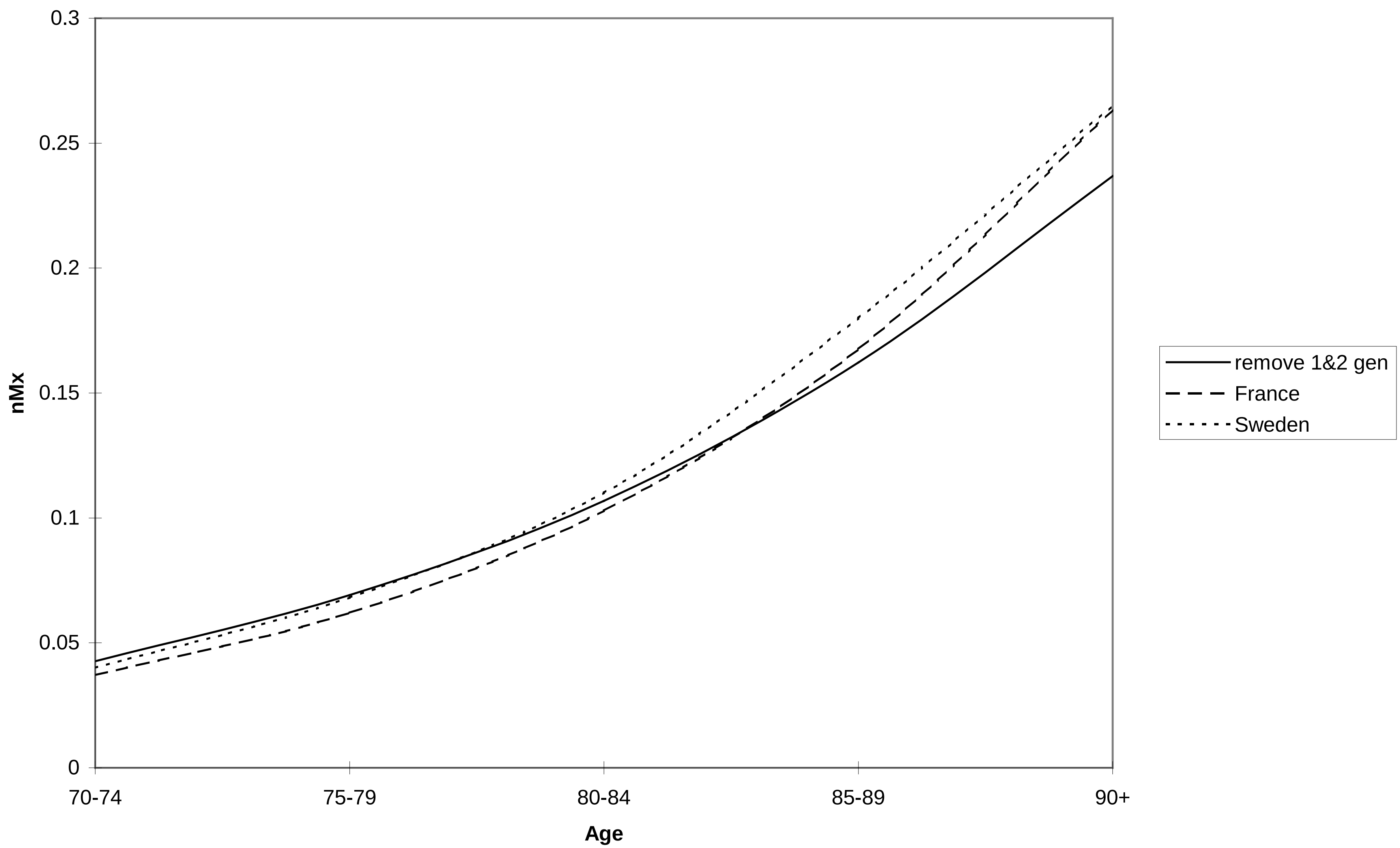
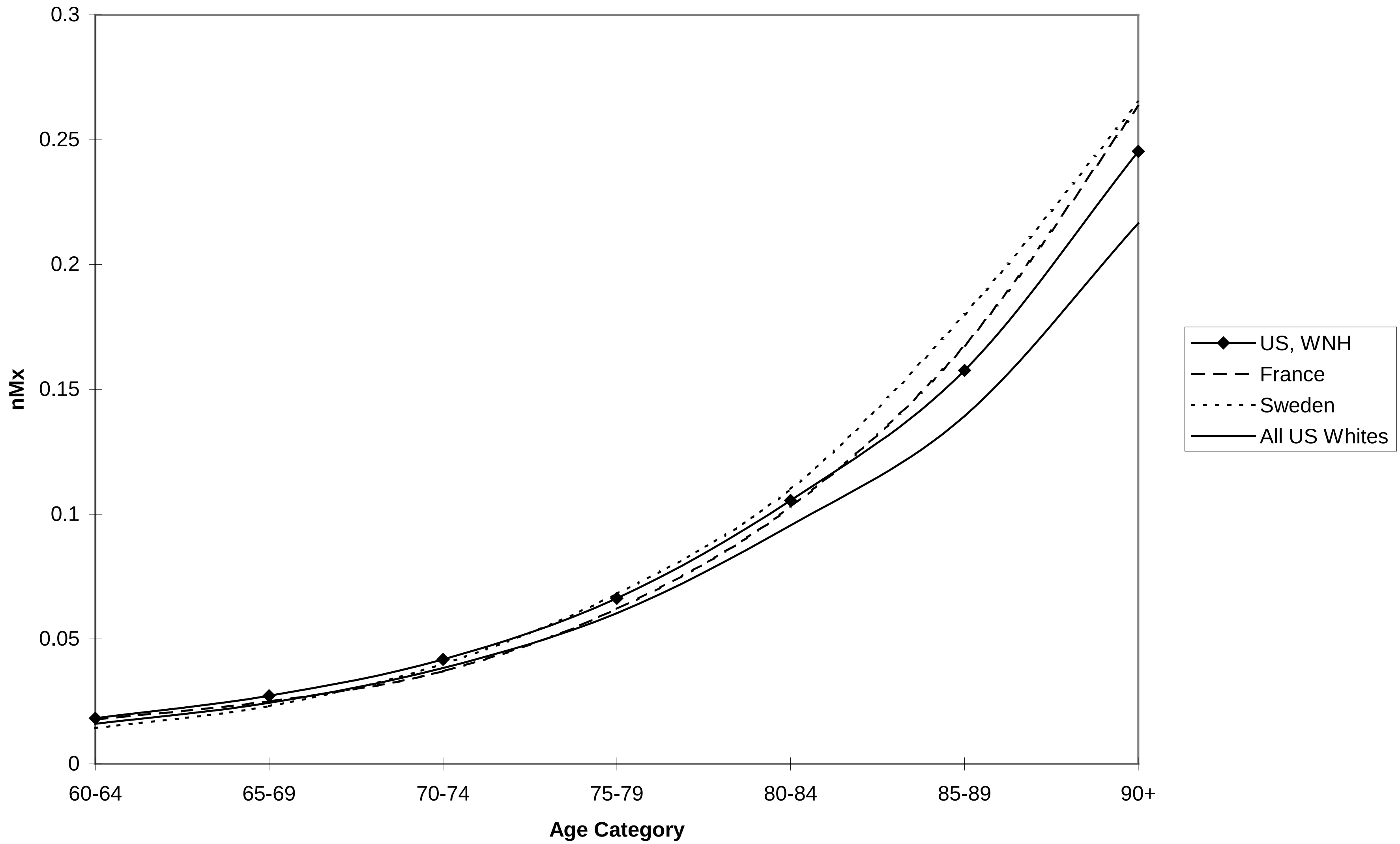


Figure 7. Male Mortality, Controlling for Ethnicity.



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