The Effect of Population Aging on the Aggregate Labor Market

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Abstract

As in most industrialized economies, the average age of the population in the U.S. is increasing. Not only is longevity rising, but the unusual population bulge known as the baby boom is having a pronounced effect on the age distribution. Age is an important determinant of labor market behavior, particularly any measure associated with labor supply. In this paper we document how the shifting age distribution of the population has influenced some major measures of the state of the labor market, and we project how these influences are likely to evolve in the future. The aging of the baby boom has had noticeable effects on the evolution of the unemployment rate and the labor force participation rate, as well as less pronounced influences on measures of gross flows and mean wages. The aging of the baby boom is likely to play an important role in the evolution of some of these series in the years ahead.

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I. Introduction

In 1946 the U.S. fertility rate leapt by an astounding 19 percent. In 1947, it jumped another 11 percent. After peaking in 1957, 40% above the World War Two levels, the fertility rate declined. By 1973 fertility had fallen back to below World War II rates, and indeed to well below any fertility rate since 1909 when the National Center for Health Statistics' published series begins.[1] This rapid surge in births created an extraordinary population bulge now known as the baby boom. Not only are there a lot of baby boomers, but they are expected to live longer than cohort that preceded them. In 1949, a 55 year old American expected to live another 21 years. In 2002, a 55 year old expected to live another 26 years.

The large non-linearity in fertility in turn influenced the age distribution of the U.S. population. In the years ahead, the aging of the baby boom is expected to dramatically increase the share of the population in older ages commonly associated with lower levels of labor supply. Figure 1 shows history and projections of age shares of the age 16 and over Civilian Noninstitutional Population (CNIP) taken from the Current Population Survey (CPS), and grown out by Census Bureau projections. Around 2002, the share of individuals age 55 and over began to grow, while at the same time the share aged 35 to 44 was shrinking. In the past year, the share of the over age 65 age groups has begun to rise, and this increase will accelerate until 2010 with the share growing until around 2030. This figure highlights the pronounced aging of the U.S. population already underway.

Population aging is changing the U.S. economy. Demographic shifts can affect related headline measures of labor market activity because individuals' labor market behavior varies substantially with age. For example, labor force participation rates rise sharply with age through the early to mid 20's, level off at a high level through about age 50 or 55, and then decline precipitously. In the past decade, as the oldest baby boomers turned 50, then 55, and then 60, the aging of the population began to put downward

[1] Fertility data is available from the National Center for Health Statistics web site at http://www.cdc.gov/nchs/data/statab/natfinal2002.annvol1_01.pdf. Life expectancy tables can be found at http://www.cdc.gov/nchs/products/pubs/pubd/lftbls/life/1966.htm, for example. In 1945 in the U.S. there were 85.9 births per 1,000 women aged 15 to 44. In 1946 there were 101.9 and in 1947 there were 113.3. In 1957 there were 122.7 births per 1,000 women aged 15 to 44, but by 1973, the fertility rate had fallen to 68.8.

pressure on aggregate labor supply (Aaronson *et al*, 2006). This marked the start of what is likely to be a sharp deceleration in labor input that will last another half-century. In contrast to labor supply growth of 2% a year for much of the 1960s, 1970s, and 1980s, the Social Security Administration (SSA) projects labor supply growth will slow to 0.5% by 2015, and 0.3% by 2025, a remarkable deceleration.

Indeed, the maturation of the baby boomers may affect a variety of current and future macroeconomic trends. In this paper we estimate the effect of the shifting population age distribution on aggregate statistics commonly derived from the CPS, including the unemployment rate, the participation rate, gross labor force flows, and wages. Because the baby boom is slowly moving its way up the age distribution we also provide projections for how these measures are likely to be influenced in the years ahead. To preview, the largest effects of population shifts on the aggregate labor force participation rate are in the future, but the effects on the unemployment rate have mostly run their course. The baby boomers' movement into their high-earnings age groups has pushed up mean wages and changed the average flows though labor market states over time.

The paper proceeds as follows: In section II we briefly review the literature on population aging and note earlier work that has studied or grappled with the demographic shifts caused by the baby boom aging as they entered the labor force and as they are now expected to leave. In section III we describe the CPS data. In sections IV through VII we consider the influence that aging has had on several major labor market statistics. Covering each statistic in turn, we also project how the statistics are likely to evolve going forward as the baby boom will continue to age. Section VIII concludes.

II. Literature Review

Richard Easterlin (1961) described the baby boom as an "abrupt break with historical experience." Although he points out that fertility can be described in terms of Kuznet's cycles,[2] the comment reflects the uniqueness of the event in the context of US history. In fact, without the baby boom, population growth in the US would otherwise have been trending down through most of the twentieth century. Prior to World War

[2] See Simon Kuznets (1956, 1958).

Two, how economies would grapple with *declining* population growth was an important economic question (Hansen 1939 and Keynes 1937). But that changed with the baby boom. Although fertility was declining, and immigration in the U.S. had slowed, Easterlin notes the baby boom provided an extraordinary reversal of the historical trends. However, what followed the baby boom was a large pendulum swing the other direction—the unwinding of the cycle led to a fertility trough which only re-enforced the uniqueness of the baby boom. Despite cycles in fertility and population growth, no similar boom has happened since, nor would such a boom appear to be much of a possibility in the foreseeable future.

Economists have long noted the role that population growth plays in economic growth and measured economic statistics. Hagen (1959) and Kuznets (1956, 1958) noted the importance of population growth to economic growth, and the related movements in measured output. More recently population aging has become a well researched sub-field of economics. Weil (1997) outlined a broad overview of the field, summarizing the state of the literature on retirement, demographic change, dependency ratios and intergenerational transfers. He notes age relates to labor supply, and that young workers have higher unemployment rates than old. However, he stops short of considering how an aging population puts downward pressure on labor force participation. Instead, like the economics literature more generally, his overview of the field focuses largely on the influence of population aging on old age programs like social security and the related estimates of the dependency ratio, rather than the participation rate with an emphasis on macroeconomic growth and measurement.[3]

Because the cohort behind the boomers is relatively small, the aging of this population bubble has had a pronounced influence on the population distribution and thus any labor market statistic that varies over the life cycle, sometimes hiding and confounding more structural changes in the economy. Perry (1970) was among the first to realize the increase in baby boom teenagers in the labor force was confounding interesting economic measurement. He was interested in inflation, and the role the unemployment rate played as a proxy for labor market tightness. However, increases in

[3] See Axel Borsch-Supan (2001) for discussion of the labor market effects of population aging in European countries.

the share of teens in the labor force had increased the share of a demographic group with relatively high unemployment rates, and this demographic shift alone put upward pressure on the unemployment rate during the 1970s. Clearly, this made using the level of the unemployment rate as a proxy for labor market tightness inconsistent over time. Perry constructed a demographically adjusted unemployment rate to abstract from this change, holding constant fixed labor force shares to remove the fluctuations in the relative share of boomers.

Not surprisingly a long list of authors studying the unemployment rate have had to account for the influence of the shifting population shares, notably Summers (1986) and Flaim (1990), and more recently Shimer (1998), Shimer & Abraham (2001), and Valletta & Hodges (2005). Below we note that more recently, the declines in the share of teenagers in the labor force has started to put measurable downward pressure on unemployment rates. Although these and many other authors have employed demographically-adjusted unemployment rates in research, what was once grappling with the baby boom as teens has now become grappling with the baby boom as retirees.

The fact that labor supply declines with age after about age 40 has been known for a long time.[4] Although we fondly think of forefathers who diligently worked all the way up until death, participation has declined sharply with age for most of the nation's history and retirement has been a feature of life cycle labor supply since at least 1870, as noted by Ransom & Sutch (1988).[5] The fact that participation declines rapidly at older ages has forced economists to account for the influence of demographics on the measured rate to make time series comparable over long periods, or for forecasting reasons. Durand (1948), in a seminal work on forecasting participation rates, modeled demographic shifts and trends toward early retirement. In attempting to isolate cyclical swings Wachter (1977) noted individual groups' behavior could obscure measurement of interest.

More recently, however, during the labor market downturn of 2002, the shifting population age shares began to put noticeable downward pressure on the aggregate

[4] Due to the volume and depth of research on female labor supply (see Claudia Goldin (2006) for example), we omit discussion here and focus directly on the influence that the shifting population age distribution has on labor market statistics measured from the Current Population Survey.
[5] See also Nancy Brandon Tuma and Gary Sandefur (1988).

participation rate. This was documented by Aaronson et. al. (2006), who also showed that the pronounced shift in the population toward older age groups would likely put substantial downward pressure on participation for the next 30 years.[6] Again, this pressure is not only because the baby boom is aging and moving into age groups with progressively lower participation, but also because a small cohort is moving into the age groups with the highest participation rates. As we detail below, the effect is quite dramatic, and is already forcing forecasters to consider demographic shifts when making projections.[7]

Any measure associated with labor supply will be influenced by the behavioral differences across age groups as the distribution changes. For example, Blanchard & Diamond (1990) note that labor force transitions vary by age. Younger individuals are more likely to flow from out of the labor force to employment, while a prime age male is quite likely to enter unemployment after job loss instead of going back to school. However, little research has addressed how the changing age distribution has altered aggregate flows over time, and Blanchard and Diamond's sample ends in 1986. We update their observation, describe how the shifting age distribution has changed the evolution of labor market flows over time, and how they are likely to evolve going forward as the baby boom ages.

Wage inequality is among the most examined lines of inquiry in economics (see Piketty & Saez (2003) and Autor, Katz & Kearney (2007) to name only two). The literature has long contended with shifting education, occupation and age distributions in order to accurately assess the widening of the wage distribution.[8] In addition, another line of research concerning population aging has addressed whether relative cohort size influences earnings. As the baby boomers entered the labor force,evidence suggested that the sheer number of less skilled young workers depressed wages for those workers. Murphy, Plant & Welch (1988) review the literature and in their own analysis estimate that in the earliest years in the labor market the baby boom's sheer size may have depressed their wages by as much as 10%. The research consensus seems to be, yes,

[6] See also Mitra Toosi (2006).
[7] See Bruce Fallick and Jonathan Pingle (2007a, 2007b), Chinhui Juhn and Simon Potter (2006), Edward Frees (2003), and Toosi (2006).
[8] For example, see John Bound and George Johnson (1992), Lawrence Katz and Kevin Murphy (1992), Kevin Murphy and Finus Welch (1992), and Chinhui Juhn, Murpy and Brooks Pierce (1993).

relative cohort size does influence earnings somewhat, although the effect diminishes as the cohort ages. Murphy, Plant & Welch (1988) estimate that the total impact on lifetime wages was likely 3% or less.

Although cohort-size effects are likely to play some role going forward (see Sapozhnikov & Triest 2007), we show below that the mere shifting of the baby boom in and out of high wage age groups has measurably altered mean wages. Wages vary substantially over the life cycle, as does participation, and the shifting age distribution has put upward pressure on mean wages in the last two decades. Research on wage inequality has accounted for the effect of aging on wage dispersion; we update and document the effect on mean wages, as estimates are not readily available from the literature.

In sum, because of the pronounced shifts in the age distribution of the population, the measurement of any labor market statistic that varies over the life cycle has the potential to be influenced. At present, the vast majority of the research literature on how population aging influences the labor market has focused on the retirement decision. Our contribution is to focus more specifically on quantifying the impact of the shifting population shares on some of the major aggregate measures of labor market activity (derived from the CPS) and project how these measures are likely to be influenced in the years ahead. The paper updates the literature that has noted the influence of shifting population shares on the unemployment rate and the labor force participation rate. We then link these effects to how the shifting share influence gross flows through the labor market, and how the shifting age shares influence average wages, as well as the variance of wages.

III. Data

The official statistics on the labor force published by the BLS come from the Current Population Survey (CPS), a survey of roughly 60,000 households, conducted monthly by the U.S. Census Bureau. We use these published data along with the underlying CPS micro data to analyze labor force participation, unemployment, movements in labor force status, and levels of earnings.

The labor force questions are asked of all civilians age 16 and over. Individuals are in the sample for four months, get an eight month break and are then interviewed for another four months. At the fourth and eighth interview months workers are asked about earnings and hours of work (these are the "outgoing rotation groups") which form the basis of the wage measures used below. The survey includes data on the labor force status of each individual, as well as basic demographic information that allows the construction of labor force measures by age group. We have adjusted the data for the effects of survey redesigns, revisions to population weights, and other inconsistencies that would influence the interpretation of time series constructed from the microdata.

The individual observations in the CPS are weighted according to estimates of the population provided by the U.S. Census Bureau. These estimates are real-time assessments of the size and make-up of the U.S. population.The Census Bureau, of course, conducts the decennial census. In between the decennial censuses, which serve as benchmarks, the agency produces estimates that update how many people are living in the U.S. based on a variety of sources ranging from the National Center for Health Statistics to the Department of Defense and incorporating estimates from surveys such as the American Community Survey. Despite their best efforts, these estimates are often found to have missed substantially when data from the next decennial census become available. For example, the estimate of the national population from the 2000 decennial census was 6.8 million individuals above the previous estimates. Four million of that gap was due to improved methodology (reduction in undercounting) which would have raised pre-census estimates had it been applied to the 1990 census. Only 2.8 million was due to underestimated population growth, disproportionately Hispanic, which appears to be attributable to underestimating net international migration.[9] Nevertheless, the Census Bureau's estimates provide the nation's best estimate of the population over history.

In addition, the Census Bureau is one of the two primary sources of projections of the future population of the U.S. These projections are based on the sizes of birth cohorts, assumptions about fertility rates, estimated death rates, and assumptions for net

[9] See West, Kirsten K. and J. Gregory Robinson, "Understanding Factors that Contributed to the Large Error of Closure in Census 2000, a note available online at : http://paa2005.princeton.edu/download.aspx?submissionId=51262

international migration. The levels of the population at each age are currently projected out to 2050.[10]

The other major source of population projections is the Social Security Administration (SSA). The SSA produces its own projections while using the Census estimates over history. The assumptions used by these two government agencies in making their projections overlap substantially, the primary differences being in the assumptions for net international migration, including undocumented immigration. Although the two agencies' projections differ slightly different in how the population will be distributed across age groups, each is in agreement that the distribution is shifting markedly toward older age groups. Our analysis below relies on Census Bureau projections, but qualitatively there would be little difference if we had used SSA projections. In particular, the differences between the assumptions about undocumented immigration in the two projections are not substantial enough to alter any of the conclusions presented below.[11]

IV. The Labor Force Participation Rate

Of all the major labor market indicators, the labor force participation rate is likely to be the most profoundly influenced by the aging of the population. Figure 2 shows the aggregate participation rate since 1948. Broadly speaking, the participation rate over the second half of the 20th century has had three regimes: a period of relative stability until the mid-1960s, a period of steady increase between the mid-1960s and the late 1980s, and another recent period of relative stability. This experience was dominated by movements in women's labor force participation, which rose sharply over the 25 years following 1965, and leveled off after about 1990. As noted above, the aging of the population

[10] The Census population estimates are updated annually while the Census projections are updated about twice a decade. Therefore, the Census projections for population levels may not be consistent with the Census's best current estimate of the historical population. This highlights where some projection risks may lie. For example, the age distribution in the population estimates reflected in the 2005 CPS population shares imply more downward pressure from aging on aggregate labor force participation than does the age distribution in the projections that the estimates have superseded. Similarly, revisions to population estimates in January of 2006 prompted revisions to the weights in the Current Population Survey, from which participation is officially measured. The resulting new population estimates, taken alone, caused the labor force participation rate to revise down by two basis points.

[11] For more details on the sensitivity of projected labor force estimates to varying assumptions concerning undocumented immigration see Fallick and Pingle (2007b).

appears already to be making itself felt in the decline in participation since about the year 2000, which likely marks the beginning of a fourth regime of falling participation.

A. The aging of the population

The reason that the aging of the population has the potential to drastically slow labor supply growth is that labor force participation rates decline precipitously after age 50. Thus as the baby boomers move into their 60s and as life expectancies continue to lengthen, the rising proportion of older Americans has the potential to lower the share of Americans who are working or looking for work. For example, by 2035 the share of the 16 and over population who are aged 80 or above is expected to double to approximately 15 percent, and 97 percent of this age group currently do not participation in the labor force. The current downward pressure of the age distribution on participation is primarily because two forces – the aging of the baby boom and longer life expectancies – are now pushing in the same direction, after many years in which the upward pressure of baby boomers moving into high participation rate ages offset the downward pressure from longer life expectancies.

Figure 3 shows the age profiles of labor force participation rates for men and women using 2005 annual averages for 14 age categories, and the aggregate participation rate for reference. Among women, the groups over 55 years of age have below-average labor force participation rates. Among men, the age groups over age 60 have below average labor force participation rates. In both cases, participation rates begin to fall after about age 50. Whether this is due to failing health, disability, retirement income or wealth, it is a feature of life-cycle labor supply unlikely to change fundamentally in the next few decades. While the slope age-participation function may change, it is quite likely to remain strongly negative.

The implication for labor force participation is striking. Figure 4 shows the history of the labor force participation rate through 2006, along with a projection that uses the 2005 labor force participation rate for each age group and allows the population shares to evolve as projected by the Census projections. Although other starting years can produce mildly different patterns, the implications are essentially the same: Absent other changes, projected population aging will lower the aggregate labor force

participation rate by 6 full percentage points over the next 35 years. This pace of decline dwarfs the 0.4 percentage point that shifting population shares have lowered the aggregate rate over the past four years. In sum, the projected aging of the labor force is likely to have a sizeable influence on participation, with the potential to completely unwind the increases in participation attributable to the earlier entry of more women in the workforce.

B. The aging of particular cohorts

There is another aspect of aging that has implications for the aggregate labor force participation rate -- not changes in the age distribution, but the movement of particular cohorts through the age distribution.

Most of the low-frequency change in the labor force participation rate in the second half of the 20th century came from changes in participation rates within age groups rather than changes in the age distribution of the population. For women, much of this increase in participation appears to have resulted from the entry into the working-age population of birth cohorts with higher average participation rates than those who preceded them, and the progress of these higher-participation cohorts through the age distribution. As these cohorts have aged, and earlier cohorts have left the scene, the population of women has come to be dominated by cohorts who have proved to have generally higher participation rates throughout their lives. A similar effect seems to have been at work among men, but in the opposite direction, as successive cohorts of men have had generally lower participation rates as their predecessors.

This evolution of participation rates by cohort likely reflects numerous factors -- such as evolving tastes, reproductive technology, wealth, education, social attitudes, and retirement, welfare, and financial systems -- some of which were internalized into the behavior of new generations more easily than into the behavior of mature cohorts who had already made “sticky” choices, an idea that goes back at least as far as Durand (1948).

The phenomenon is illustrated in figure 5, which shows the labor force participation rates for three age groups of women: age 35 to 44, age 45 to 54 and age 55 to 64. Each line shows the participation rate of an age group over time. However, the

horizontal axis shows the birth year for the middle age of the group, rather than the year of observation. In this way, the lines are shifted so that each birth cohort is vertically aligned with itself at different ages. The participation rate of the 45-54 year old group (the dashed line) appears to exhibit three rough inflections, in the vicinity of years 1960, 1975, and 1997. These correspond to the cohorts born around 1910, 1925, and 1947. The first two of these inflections line up well with the 55 to 64 year old group (the dotted line), meaning that the inflection points in both age groups seem to occur when the cohorts born in 1910 and 1925 passed through those age groups. The cohort associated with the third inflection (those born around 1947) are not quite old enough to exhibit that inflection in the older group, but it can be seen when that cohort was 35-44 years old (the solid line). Similarly (not shown), beginning in the mid-1960s and ending in the late 1970s, successive cohorts of 16-24 year old women had higher participation rates than their predecessors. Participation rates of successive cohorts 25-34 year olds stopped rising about ten years later, in the late 1980s, suggesting that the participation rate in each of these age groups at a given time is at least partly related to which birth cohort is passing through that age at that time.

Of course, not all inflection points in all age groups line up so well by birth year; clearly, there have been developments in participation that are not well-represented by the aging of birth cohorts. However, the coincidences that do exist are sufficient to indicate that birth cohort has played a significant role in describing participation rates. Consequently, the aging of particular birth cohorts has played an important role in the evolution of the aggregate participation rate. In particular, the long increase in the aggregate participation rate from the early 1970s through the late 1980s can be attributed largely to the successively higher participation rates of cohorts born up through the beginning of the baby boom. And the end of that long period of increase can be attributed to the baby boom cohorts, who have roughly similar average participation rates, coming to dominate the population as they moved through the age distribution. Looking ahead, the same phenomenon of the aging of particular cohorts can be expected to put downward pressure on the aggregate participation rate, as successive cohorts of men and women appear to have generally lower propensities to participate.

These ideas are developed more fully in Fallick & Pingle (2007a), which develops a model of aggregate labor force participation that incorporates both changes in the age distribution of the population and the movement of cohorts through the age distribution, as well as exploring other measurable factors that appear to influence participation rates. While we will not explicate that model here, figure 6 shows its implications for the future of the participation rate under one reasonable set of assumptions. The combination of the aging of population in general, the aging of cohorts in particular, and other factors imply a steeply falling participation rate over the next decade or so.

V. Unemployment Rate

Looking back over the past 40 years, figure 7 shows that the movements in the aggregate unemployment can be divided into two phases: From the mid-1960s through the early 1980s, the unemployment rate moved higher; since then the unemployment rate has shown a pronounced downtrend. These movements reflect more than business cycle fluctuations: The lowest unemployment rate achieved at the cyclical peaks and the highest unemployment rate hit at the cyclical troughs both ratcheted up from the 1960s through the early 1980s. Subsequently, both cyclical high and low unemployment rates have declined consistently, with the unemployment rate bottoming out in 2000 at its lowest level since 1969.

The apparent trends in the unemployment rate have not been associated with changes in inflationary pressures. On the contrary, core price inflation moved higher through the 1970s, and has trended downward since. This suggests that at least some of the low frequency movements in the aggregate unemployment rate have reflected changes in the structural or natural rate of unemployment rate. In this section, we examine several factors that help explain these low frequency movements in the aggregate unemployment rate. To preview, we show that shifting labor force shares related to the age distribution of the population can explain a good deal of both the earlier rise and subsequent decline in the aggregate unemployment rate. However, even after accounting for the effects of changing labor force shares, significant movements in the aggregate unemployment rate remain unexplained by these “between” group factors.

A. The age distribution of the population

The most obvious way in which the aging of the population affects the aggregate unemployment rate is simply that some age groups tend to have higher unemployment rates than others. Figure 8 shows the average unemployment rates in 1997 for men and women in various age groups. The variation in unemployment rates across age is substantial but is concentrated among the younger age groups. In particular, unemployment rates fall from the 16-17 group to the 25-29 group, then are pretty stable from age 30 on. Thus, as population shares change, the aggregate unemployment rate can be expected to change.

For many years it has been a common practice to adjust the unemployment rate for such changes in the age/sex composition of the labor force. The usual method is to recalculate the unemployment rate by weighting the unemployment rates of the various demographic groups by their labor force shares in some base year (Perry 1970) rather than allowing those shares to change over time.

Here we follow this practice with a couple of variations. First, most demographic adjustments to the unemployment rate are performed using fairly broad age groups, which may miss some subtleties in the evolution of the unemployment rate; we use fourteen age groups. Second, we are interested in decomposing changes in the demographic shares of the labor force into the two components of changes in population shares and changes in relative participation rates. Therefore, to compute the contribution to changes in the unemployment rate of the aging of the population alone, we hold group-specific labor force participation rates and group-specific unemployment rates constant at their 1997 average levels, and apply those rates to changing population shares to yield a counterfactual aggregate unemployment rate. The difference between this counterfactual unemployment rate and the actual unemployment rate in 1997 provides one measure of the direct influence of changes in the age distribution of the population on the aggregate unemployment rate. This difference is shown in Figure 9.

Because the differences in unemployment rates across age groups are concentrated at younger ages, the changing age distribution of the population had its most notable accounting influence on the aggregate unemployment rate from the 1960s through the 1980s, when the baby boom was moving through and out of these younger

ages. In contrast, the influence of shifts in the age distribution on the unemployment rate over the past decade has been small, as the baby boom moved through ages with fairly similar unemployment rates. From 1967 to 1976, the aging of the population pushed the unemployment rate up through this channel by 0.2 percentage point; since 1976, this channel has reduced the unemployment rate by 0.6 percentage point, but only 0.2 percentage point of this decline has come since 1991. As the population continues to age in coming years, we can expect this downward pressure on the unemployment rate to increase somewhat, but not to the degree that we saw in the 1980s.

B. The age distribution of the labor force

There is, however, another way in which the aging of the population can be thought of as influencing the unemployment rate. Beyond changing the age distribution of the population, over time different cohorts of people come to dominate the labor market. Above, and in previous work, we argued that as newer cohorts came to replace older cohorts in particular age groups, the labor force participation rates of those age groups changed. This is not the only source of changes in age-specific participation rates, but it has been an important one. These changes in age-specific participation rates have meant that the age distribution of the labor force has often changed more than has the age distribution of the population. In particular, as the cohorts of women with higher participation rates moved into the younger age groups and then into older groups, the share of these high-unemployment-rate age groups in the labor force rose and then fell in excess of what population shares alone would dictate. This is illustrated in Figure 10, which shows the share of 16-24-year-olds in the population and in the labor force.

The implications for the aggregate unemployment rate have been substantial. The dashed line in Figure 11 reproduces the measure of the direct influence of changing population shares on the unemployment rate, while the solid line shows the influence of labor force shares, which comprises both changing population shares and changing participation rates. We construct the latter by holding within-group unemployment rates constant at their 1997 levels, but allowing both the population shares and participation rates to change, and subtracting this counterfactual unemployment rate from the 1997 unemployment rate. The difference between the two lines is a measure of the influence

of the changing participation rates. In total, changes in labor force shares raised the unemployment rate by 0.4 percentage point from 1967 to 1977—about twice as much as the change due only to changing population shares. Since 1977, shifts in the labor force shares have lowered the aggregate unemployment rate by 0.9 percentage point, 0.3 percentage point of which has come since 1991. Once again, the decline is bigger than can be accounted for by changing population shares alone, owing largely to the declining participation rates for young men and women.

C. Within-age unemployment rates

A third element in the evolution of the aggregate unemployment rate has been changes in within-age unemployment rates. Figure 12 shows how unemployment rates within age group have moved over time. As one can see, a major development in the demographics of the labor market over the past several decades has been the convergence of female and male unemployment rates.

For our current purposes, we would like to know whether this convergence in unemployment rates reflects one aspect of the aging of the population -- not changes in the age distribution, but the movement of particular cohorts through the age distribution. As we note above, the rise in female labor force participation occurred as cohorts of women with participation rates more similar to men's entered the population and replaced cohorts of women with less similar participation rates. By our estimates, the cohorts of the baby boom marked the end of decades of steadily rising cohort-specific participation rates for women. As these cohorts moved through the age distribution, they raised the aggregate participation rate. A natural question is whether the convergence of female and male unemployment rates can be described the same way. That is, did female unemployment rates converge toward male unemployment rates because cohorts of women with unemployment rates more similar to men's entered the working-age population and replaced cohorts of women with unemployment rates less similar to men's?

In order to begin to answer this question, we estimated a model similar to the basic model in Fallick & Pingle (2007a). In this setup, within each gender, the unemployment rate of an age group in a particular year is a function of an age-specific

constant and the identity of the birth cohorts passing though those ages in that year, as well as cyclical controls. That is,

$$\log UR_{g,t} = \alpha_g + \lambda_g X_t + \frac{1}{n_g} \sum_{b=1907}^{1989} C_{g,b,t}\beta_b + \varepsilon_{g,t} \qquad \text{g = 1 to 14} \qquad (1)$$

where g indexes the age groups, t indexes the calendar year, and b indexes birth years. The $C_{g,b,t}$ are indicator variables that equal one if the corresponding cohort b appears in that age group g at time t, and n_g is the number of ages in age group g. X_t is a vector of cyclical control variables, the α are age group fixed effects, and the β are birth year or cohort fixed effects. The degree of cyclical sensitivity (λ) varies by age group, while the cohort effects do not -- that is, the cohort effects are constrained to be the same across all equations in which the cohort appears. The age effects (α) are constant.

In this set-up, the shape of the age-unemployment rate profile is common to all persons of the same gender, but each birth cohort has a particular "propensity" to be unemployed that shifts the age profile up or down.

An alternative formulation assumes that, within each gender, the unemployment rate of an age group in a particular year is a function of an age-specific constant and a common effect of calendar time.

$$\log UR_{g,t} = \alpha_g + \lambda_g X_t + \beta_t + \varepsilon_{g,t} \qquad \text{g = 1 to 14} \qquad (2)$$

In this alternative, the shape of the age-unemployment profile is likewise common to all persons of the same gender, but this age profile is shifted by conditions that change over time but affect the unemployment rates of all ages proportionately.

Comparing the fit of these two specifications provides an indication of whether the aging of specific cohorts can explain the evolution of the unemployment rate. In the case of women, the evidence in favor of a cohort effect in explaining the increase in labor force participation was so strong that we expected the evidence to favor a cohort explanation of the evolution of unemployment rates as well. In fact, as shown in figure 13, the estimated trend from the basic cohort specification does a reasonably good job of

capturing the low frequency movements in women's unemployment rates, at least since the mid-1970s, suggesting that the decline in women's unemployment rates over that span can be usefully described in terms of lower-unemployment cohorts replacing higher-unemployment cohorts. However, the specification that substitutes time effects—modeled as a cubic time trend—for cohort effects, does a somewhat better job of capturing the initial increase in female unemployment rates through the mid-1970s.

Table 1 reports measures of model fit. For women, the adjusted R-squared (column 3) for these two specifications are the same, when the model is estimated over the period 1967 to 2006. However, the adjusted R-squared for the full panel regression (14 age groups times 40 time periods) measures the model's ability to explain both the "between" group differences in average unemployment rates as well as the "within" group variation that is of more interest here. As a result, the adjusted R-squared overstates how well the model fits the data for any one age group.

Columns 5 and 7 report the average R-squared (not adjusted for degrees of freedom) for the youngest 11 age groups—from age 16 to 64--(column 5) and for the full complement of groups (column 7). We omit the oldest age groups from these columns because the specification with cohort dummies can "overfit" the unemployment rate for these groups. This is because most of the cohorts included in the 65 and older age groups are not well represented in younger age groups in our data. Moreover, as shown in the last three panels of figure 12, the unemployment rates for the two oldest age groups are more idiosyncratic and less cyclical than those for those ages 16 to 64. The average R-squared for the groups between ages 16 and 64 is a little higher for the model with the cubic time trend, even though this model has many fewer explanatory variables.

As shown on the third line, adding the cohort dummies to the specification with the cubic time trend does not improve the model's ability to explain female unemployment rates for women ages 16 to 64. Thus, we find little evidence for a substantial role for birth-year cohort effects on women's unemployment rates, in contrast to the earlier results for labor force participation.

For men, the results suggest a somewhat more nuanced interpretation. As shown on figure 14, the model with only cohort effects does a poor job of capturing either the increase in male unemployment rates through the early 1980s or their subsequent

decline.[12] In contrast, the specification with the cubic time trend rises and falls more closely with the actual unemployment rate. These visual impressions are borne out by the measures of model fit. As shown in column 4 of table 1, the average R-squared for the 11 age groups aged 16 to 64 improves more notably when cohort effects are replaced by a cubic time trend.

But, unlike the results for women, the model fit is notably improved when we include both cohort effects and time effects. Thus, it seems that the movements of relative unemployment rates for the different age groups are more important for men than for women, which may in turn reflect that age plays a more significant role in how men have responded to aggregate labor market developments.

Clearly there is much more work to be done in modeling the trends in unemployment rates, and a discussion of the economic factors at work is beyond the scope of the current paper. Nevertheless, we are confident that the aging of the population *per se* is playing only a relatively minor role in the evolution of the aggregate unemployment rate at present.

VI. Labor Market Flows

A. The age profile of unemployment rates

The modest size of the effects of population aging on the unemployment rate in recent years stems from the fact that although unemployment rates fall rapidly with age from the teenage years through the early 30s, unemployment rates are fairly stable across ages from the early 30s into the 70s. Some of this, no doubt, reflects selection biases, as those types of persons who would tend to have higher unemployment rates leave the population or the labor force at different rates than those who tend to have lower unemployment rates. But the stability is nevertheless surprising given the profundity of the changes in labor force attachment over the life cycle. Indeed, the stability of the unemployment rates masks large but offsetting changes in labor force behaviors that, taken individually, might be expected to significantly affect unemployment rates.

[12] The rise and subsequent decline in the trend unemployment rate from the cohort model primarily reflects the changing demographics of the labor force that we discussed above. Holding labor force shares fixed at their 1997 values, estimated trend from the cohort model is nearly flat from 1967 to 2006.

The most obvious of these is retirement behavior and associated withdrawal from the labor force. Figures 15 and 16 show the average monthly hazard rates, by age, out of the labor force from employment and from unemployment, for the period 1996-2006, calculated from matched CPS data. Both rates rise rapidly beginning at ages in the 50s, increases that we would associate with retirements. At least qualitatively, the changes in these flows as persons age offset each other in terms of their implications for the unemployment rate.

However, other labor force flows vary over the entire range of ages over which unemployment rates are stable. Job finding rates -- the hazard rates from unemployment to employment and from not in the labor force into employment -- both fall over the entire range from about age 30 on (figures 17 and 18). One would expect that because of this unemployment rates would rise with age, but over the same age range the rate at which new entrants and re-entrants move from out of the labor force into unemployment falls (figure 19). Meanwhile, the flow that one might associate most directly with the unemployment rate, the hazard rate from employment to unemployment, remains fairly stable throughout life once past the turbulent younger ages (figure 20) [13]

B. Employment to Unemployment

Although the age profiles of labor force flows have relatively small implications for the aggregate unemployment rate, some of the particular flows are interesting in their own right. Among these is the rate of movement from employment to unemployment (the EU flow). Changes in this rate induced by demographic shifts may have implications for trends in prominent indicators of labor market conditions, such as claims for unemployment insurance, as well as for the relative importance of job separations in

[13] An aging population might be expected to affect the duration of unemployment in contradictory ways. As the population ages away from the high turnover young years to the more attached prime years, durations might lengthen, while as the population ages from the more attached prime years to the less attached older years, durations would shorten. We have taken a quick look at this question by approximating the expected duration of unemployment within each age group by the reciprocal of the mean hazard rate for leaving unemployment (to any destination). By this measure, aging has little influence on the expected durations, especially on the duration of unemployment. For E and N, we are looking at top differences of ½ and 1-1/2 months on levels of 32 and 48 months, respectively—for unemployment, a top difference of less than a day on levels of 60 days. However, for a more detailed analysis of the influence of the baby boomers on unemployment durations, see Shimer and Abraham (2001).

explaining movements in the unemployment rate, a topic that has attracted considerable attention of late (e.g., Shimer 2007, Ramey & Fujita 2006).

As noted above, however, the hazard rate for EU transitions is relatively stable after age 30, despite falling rapidly from the teenage years. Therefore, as with the unemployment rate, the direct effect of aging on the EU rate is modest. Figure 21 shows the effect of shifts in the age distribution of the population on the EU hazard rate, relative to the rate in 1996, by holding constant both the within-age EU hazard rates and the within-age employment-to-population (e/p) ratios while letting population shares evolve. The mean aggregate EU hazard rate over this period is about 1.4%, and the aging of the population changes the rate by only hundredths of a percentage point, even out as far as 2015.

Figure 22 puts this in terms of numbers of workers rather than rates. If we hold the level of payroll employment constant at its 2006 level, the difference in the EU flow from the change in the aggregate EU hazard between 1996 and 2006 is on the order of 30,000 workers per month; between 1996 and 2015, it is 50,000 workers per month. The largest effects of aging on the EU flow come not from the induced changes to the hazard rate, but from the changes to the base of employment to which these rates can be applied. Mainly because the aggregate participation rate falls as the population ages, this base of employment falls. Holding the aggregate population and age-specific e/p ratios constant at their 2006 levels, but allowing the age distribution to evolve, yields a decrease in the level of the aggregate EU flow of close to 45,000 workers per month between 1996 and 2006, and about 125,000 per month between 1996 and 2015 (figure 22). Whether this number is small or large depends upon the context. In terms of the importance of EU flows for the unemployment rate, 125,000 is still only a small percentage of the overall EU flow. However, it implies a substantial reduction in the number of weekly claims for unemployment insurance that one would expect to associate with a healthy rate of economic growth.

C. Unemployment vs. Nonparticipation

A related issue is the degree to which nonparticipation is replacing unemployment as the alternative to employment as the population ages. Not only in the sense of

retirement, but also as the state in which potential workers reside between stints of employment. Put another way, to what extent are movements into and out of employment mediated by a period of unemployment? Much of the literature that models or investigates labor market flows recognizes in the importance of movements between employment and nonparticipation, and the importance of these flows rises as the population ages.

Figure 23 shows the percentage of transitions into employment for which nonparticipation, rather than unemployment, is the state of origin, that is, new entrants and re-entrants who move into employment without a period of unemployment as measured by the CPS. The figure also shows the percentage of transitions out of employment for which nonparticipation, rather than unemployment, is the destination state. These transitions may include retirements, discouraged workers, persons going back to school, leaving work to raise families, and a number of other categories.

As the population has ages, the percentage of transitions that involve nonparticipation rises. But the differences are not large. Between 1996 and 2015, we can expect the shifting age distribution of the population to increase the percentage of transitions that involve nonparticipation by about 1 point.

D. Aggregate turnover

One typically thinks of older persons as being more stable in their jobs, but the relationship is not monotonic. Figure 24 shows average separation rates by age. These include both transitions out of employment, and transitions from one main employer to another, which can be measured using matched CPS data since the redesign of that survey in 1994. (See Fallick & Fleischman 2004). Overall separation rates fall sharply with age into the late 20s, decline further gradually through the late 40s, then rise into and through retirement ages.

As a result, the direct effect of the shifting age distribution on the aggregate separation rate, graphed in figure 25, is also not monotonic. Aging has mostly driven the aggregate separation rate down since 1996 as the youngest of the baby boomers entered the low-separation ages and the oldest of the baby boomers had not left those ages. Beginning a few years ago, however, the oldest of the baby boomers began to enter the

upward-sloping part of the separation rate profile, and this began to push up the aggregate separation rate.

Again, however, the implications for the separation rate are relatively small, in the hundredths of a percentage point on a level of 6.8% per month. And again, the larger effects come from the implications of aging for the level of employment, which reduce the level of aggregate turnover (figure 26).

VII. Hourly Wages

Upward sloping age-earnings profiles have long been recognized as a feature of the labor market and an influence on life cycle-labor supply. Human capital theory provided an explanation for why young workers would work for low wages and as skills and experience increase so too does marginal productivity and thus wages, as noted by Mincer (1958) and detailed by Willis (1986). Kotlikoff (1986) further argued that productivity rose over the life cycle, but not by as much as wages. Workers were paid low wages at the start of their career and high wages at the end as part of contracts with employers that provided other benefits to both parties like retention and income security. Hourly wages generally rise with age, and then decline slightly in older age groups above 60.

We use the reported earnings from the outgoing rotation groups in the CPS, provided by the National Bureau of Economic Research (NBER) CPS extraction file. Earnings were converted to an hourly wage, aggregated to an annual frequency, and deflated by the Consumer Price Index.[14] Figure 27 plots the age-wage profile of men in three different years: 1979 the earliest data for the reported wage measures in the NBER data, 1990, and 2005, the most recent data. The profiles follow roughly the same pattern in each year. Although, as the authors noted earlier have suggested, the sheer size of the

[14] Data cleaning was kept to a minimum, to be as close to respondent tabulations as possible. However, implausibly high earnings were often the result of low reported hours combined with high weekly earnings, and thus hourly workers reporting fewer than 5 hours of work a week combined with weekly earnings over $1000 were dropped. Workers with implausibly low hourly earnings were also dropped. Workers earnings above the CPS topcodes were imputed, within each age-sex category, using a lognormal distribution. Pareto distributions proved too unstable for imputation within narrowly defined demographic categories. For discussion of the sensitivity of the imputation and trimming procedures see John Schmitt (2002), who convincingly argues in favor of using a lognormal distribution instead of a pareto distibution. John was also nice enough to provide STATA code for imputations, as well as comparable wage series over time for comparison. The details are described in his paper.

baby boomers' cohort may have depressed their wages all else equal, the opposite pattern is observed in these profiles. Teen wages have declined since the baby boomers left those age groups and earnings of older workers have risen as the boomers have entered those age groups. No doubt the higher levels of education of the boomers are swamping other microeconomic effects.

Not only does the mean wage vary substantially over the life-cycle, but variance of wages does as well. Figure 28 shows the age-variance profile for men in 1979, 1990 and 2005. As has been well-established in the literature on wage inequality, the variance of wages has risen at almost every age group for men over the few decades, with a noticeably increase across age groups between 1979 and 1990. There has been an especially noticeable widening of the wage distribution among older workers, no doubt due to the rising return to skills and experience for some members of the oldest age groups. If this trend continues, as shares of the work force begin to shift toward older age groups, this has the potential to put additional upward pressure on aggregate wage variance as the higher variance among older age groups interacts with the population shifts into those age groups.

Wages are determined in equilibrium as a function of supply and demand, and labor is a derived demand. In addition, wages are cyclical. These forces confound decomposing the "pure" effects of population aging on the mean and the variance of wages. However, as with the other measures above, we attempt to estimate a first-order effect by using fixed weight alternatives to observe how the shifting population shares have influenced the path of wages over time. That is, we fix wages and the employment-to-population ratios to a base year (we choose 2005 in the graphs), and allow the population shares to evolve as they have in the past and are projected to do in the future. Other base years yield similar conclusions.

Figure 29 shows the mean real hourly wage from the CPS plotted against a fixed-weight alternative where the employment-to-population ratios and mean wage rates within each wage-sex group were held at their 2005 averages. The actual real wage has risen from $16.39 an hour (in 2005 dollars) in 1979 to $18.17 an hour in 2005. For much

of the 1980s the real wage hovered around $16 an hour, before rising in the late 1990s, and then leveling off in recent years.[15]

The fixed-weight alternative, where the increases in the series are due only to shifting population shares, rises significantly as well. At face value, the fixed-weight alternative rose by $0.89 between 1979 and 2005 while actual real wages rose by $1.78. Thus, although the timing differs, half the increase in real wages over the period is accounted for simply by the baby boomers moving into their high wage years. Although, noting the sharp drop in actual real wages in 1979, the exact proportion will depend on one's starting point, clearly the shift in the age distribution of the population contributed a substantial portion of the real wage gains made by workers in the last two decades. However, as the projections in the figure show, this upward pressure on mean real wages from aging has pretty much ended, as the baby boomers have completed their transition into high wage age groups.

Similarly, the mere shifting of the population shares has put upward pressure on wage variance. However, the amount of pressure has been small. The actual variance of log wages since 1979, deflated using the CPI, is shown as the solid line in figure 30. The variance, although volatile, shows the steep upward trend since 1979 that one would expect to see given the long literature on wage inequality (see similar series in Schmitt 2003). The long-dashed line shows the change in variance due to shifting population shares, holding within-group variances constant at their 2005 values and allowing the employment to population ratios to vary.

As is readily apparent, although shifting population shares have put upward pressure on wage variance, the effect is small relative to the secular trend since the end of the 1970s. The effect is small partly because under the surface there have been two offsetting effects at work. This is shown in figure 31. As one would expect, as the population has aged it has shifted towards older age groups which have higher within-group variances. This increase in within-group variance has worked to push the overall

[15] Average hourly earnings reported by the payroll survey of establishments was $16.13 in 2005, compared to our CPS-based series of $18.17 an hour. The payroll survey excludes non-production and supervisory workers in addition to the self-employed, among other conceptual differences. The payroll survey series has a similar path as the series shown here, except for one difference: the payroll survey's average hourly earnings shows more decline in real wages between 1979 and the early 1990s than the series we derive from the CPS.

variance up. However, at the same time the aging of the population has reduced the between-age-group variance, which has largely offset the increase in average within-group variance. In any case, even such upward pressure as there has been has pretty much run its course, and we can expect little influence further pressure in the years ahead.

VIII. Conclusion

Although changes in behavior within age groups may offset some of the influence of the shifting age shares, the aging of the baby boom, increased longevity, and other sources of change in the age distribution have been and are likely to remain important. In the years ahead, the macroeconomic measure in the labor market likely to be affected in the most pronounced way is the labor force participation rate, as the share of labor market participants continues to shrink in the years ahead at even a faster pace than over the last several years. Baby boomers are expected to remain in the labor force longer than prior cohorts. However, labor supply declines severely with age and, even among the baby boomers, it is unlikely that a someone born in 1950 will be nearly as likely to work at age 65 than they were at age 45. Given this feature of labor supply over the life cycle, the shifting age distribution of the population is likely to put substantial downward pressure on the aggregate participation rate for the next 30 years.

Economists have long noted the influence of labor force composition on unemployment rates. In order to assess labor market slack, wage pressure, or the health of the labor market over time, movements in the unemployment rate must be decomposed into cyclical movements and more structural changes like an aging population. However, in contrast to the participation rate, for which large aging-induced changes lie ahead, the influence of the aging of the baby boom on the unemployment rate has largely run its course. More important to the aggregate unemployment of late are other factors, such as the decline in teenage participation that continues to shrink the share of a high unemployment rate age group in the labor force.

The again population has also changed how individuals flow through the labor market states, their persistence in a given state and the likelihood they drop out of the labor force entirely. Although the projected changes are small, we anticipate the

transitions through nonparticipation will continue to rise in the years ahead. In addition, the corresponding influence on the separation rate, which fell over time and has begun to rise again has been relative modest. However small these effects might be, the influence aging has on interpreting labor market statistics remains important. As we note above, the analysis implies a substantial reduction in the number of weekly claims for unemployment insurance (one of the most watched high frequency economic indicators) that one would expect to associate with a healthy rate of economic growth.

Finally, mean earnings derived from the CPS have also been influenced by population aging. The baby boomers moving into their high earnings years has put upward pressure on mean wages. Although this is a partial equilibrium accounting that does not account for such offsetting influences as how the relative supply or skill supply might have offset the influence of population aging, the effect is still dramatic. The upward pressure the baby boomer aging has had on mean wages has largely run its course. Without that influence the gains in mean real wages in the 1990s likely would not have been as great. Going forward, the shifting age distribution is no longer going to put upward pressure on mean wages. Thus this contribution to related measures like the aggregate wage bill will diminish in the years ahead.

None of the projections for population are set in stone. That said, the baby boom exists and is aging. Projections of shifts in the age distribution of the population have wide confidence intervals, but carrying forward the baby boomers from age group to age group as they pass through each year is not as uncertain as, say, projecting undocumented immigration. Life expectancy will lengthen, perhaps faster than projected (which would cause the aggregate labor force participation to decline even more quickly than projected). All in all, the population is shifting toward older age groups and, short of a substantial shift in policy not currently on the horizon, nothing will change that feature of population growth in the U.S. As economists continue to study economic time series, accounting for these shifts will remain at least as important in the future as it has in the past, if not more so. Accounting for such changes will also shed clearer light on pressing economic issues and problems, analysis of which might otherwise be confounded by the influence of population aging on economic measures.

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Table 1
Measures of model fit: Unemployment rate model

	Adjusted R^2		Average R^2 (11 age groups, ages 16-64)[1]		Average R^2 (All age groups)	
Model Specification	Men	Women	Men	Women	Men	Women
Long Sample (1967-2006)						
Cohort dummies	0.934	0.954	0.77	0.82	0.73	0.74
Cubic time trend	0.936	0.954	0.81	0.85	0.68	0.71
Cohort dummies and cubic time trend	0.961	0.959	0.86	0.85	0.80	0.76
Short Sample (1977-2006)						
Cohort dummies	0.944	0.959	0.75	0.85	0.75	0.76
Cubic time trend	0.949	0.953	0.81	0.83	0.70	0.69
Cohort dummies and Cubic time trend	0.961	0.959	0.86	0.86	0.82	0.76

[1] To construct R-squared for individual age groups, we calculated the variances of the group-specific unemployment rates and the group-specific residuals from the regressions using all 14 age groups. We did not correct for differences in degrees of freedom across specification.

Figure 1
Population Shares
(History and Projection)

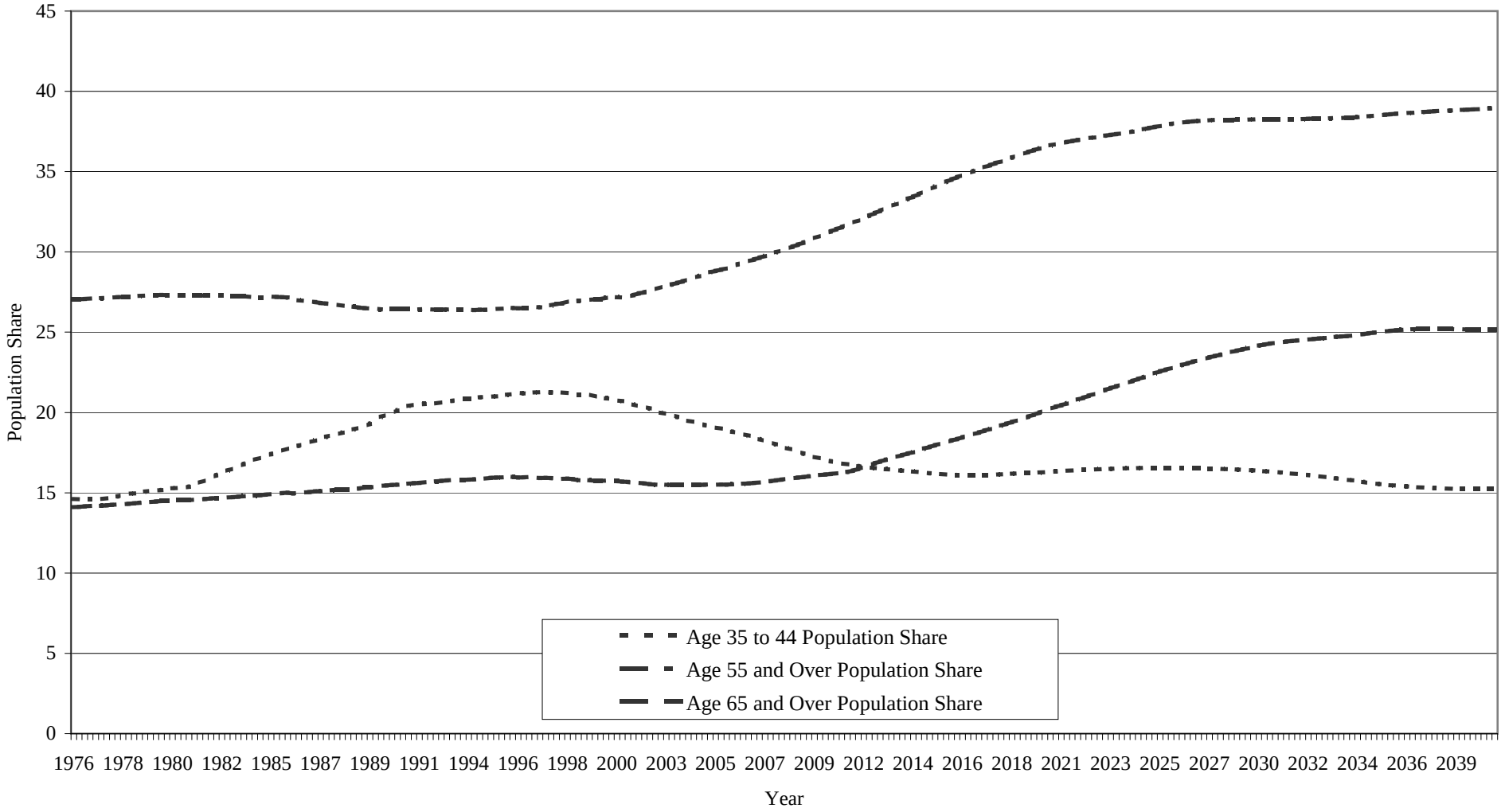
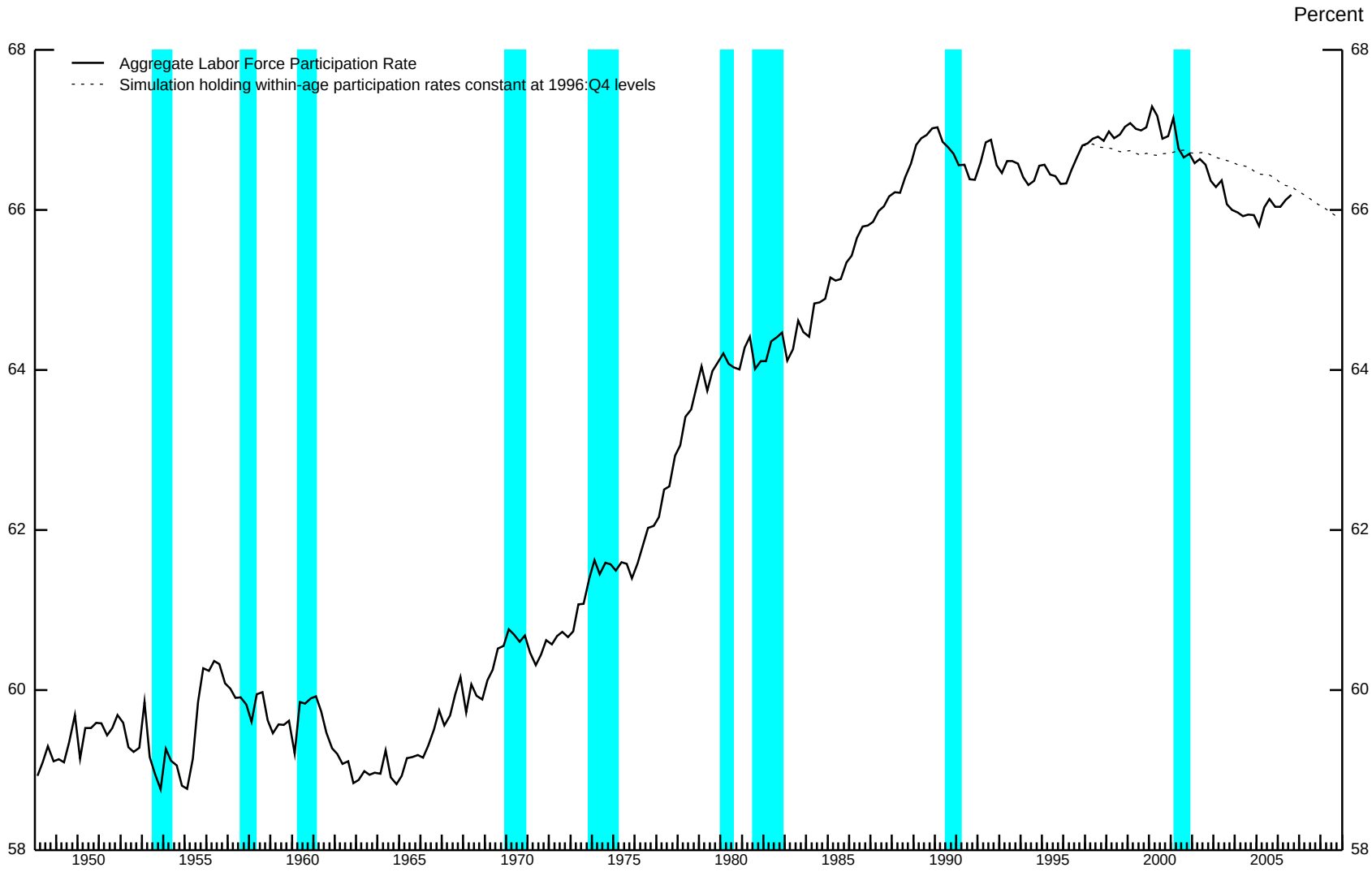


Figure 2

Aggregate Labor Force Participation Rate, 1948:Q1-2006:Q3



Source. Bureau of Labor Statistics
Note. Shaded area is NBER dated recessions.

Figure 3
Labor force participation rates by age and gender (2005)

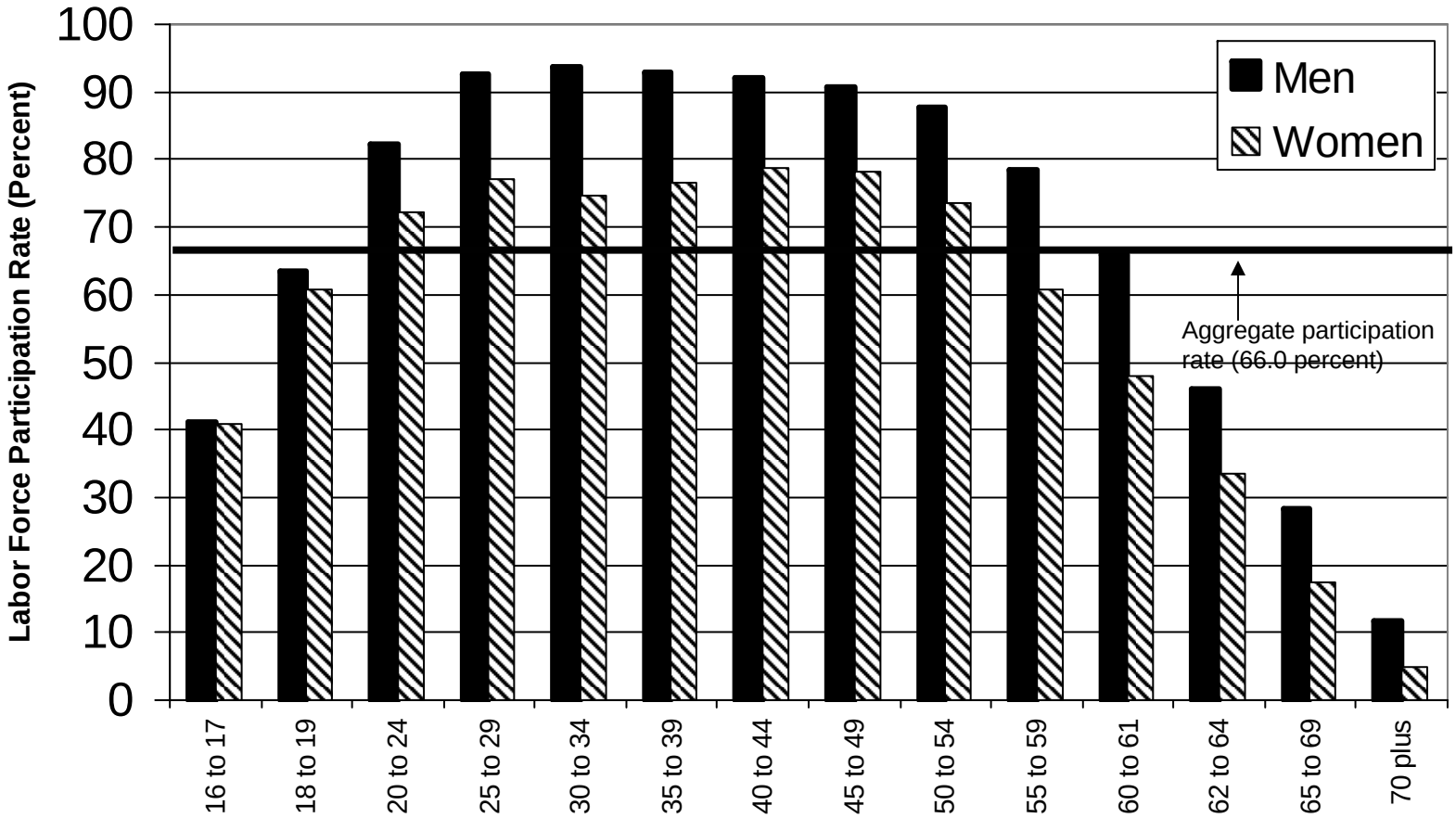
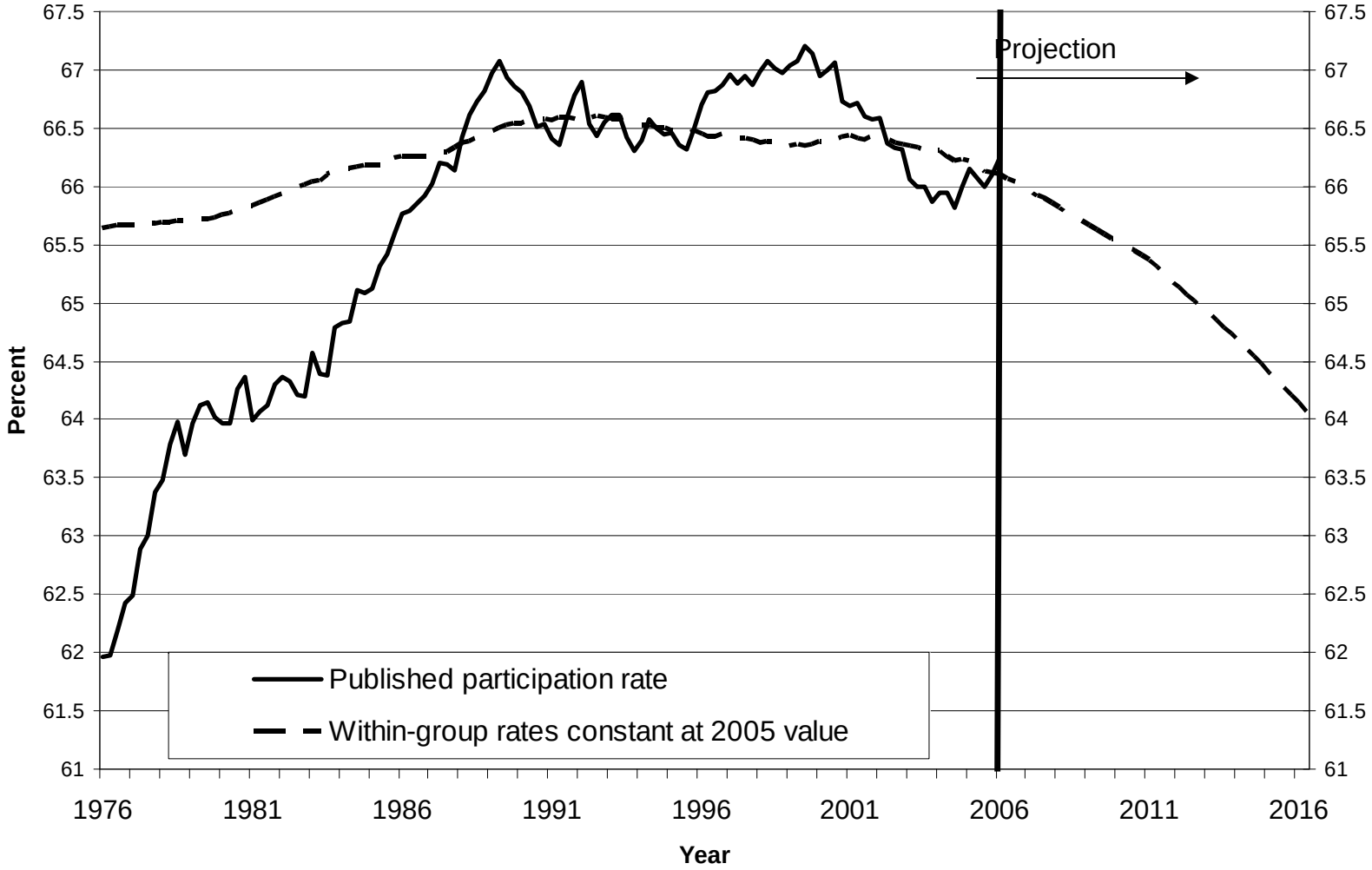


Figure 4
An Accounting of Effect of Aging on the Labor Force Participation Rate



Note: Within group participation rates refer to 14 age groups for men and women

Figure 5
Participation by Birth Cohort
(Actual data - not a projection)

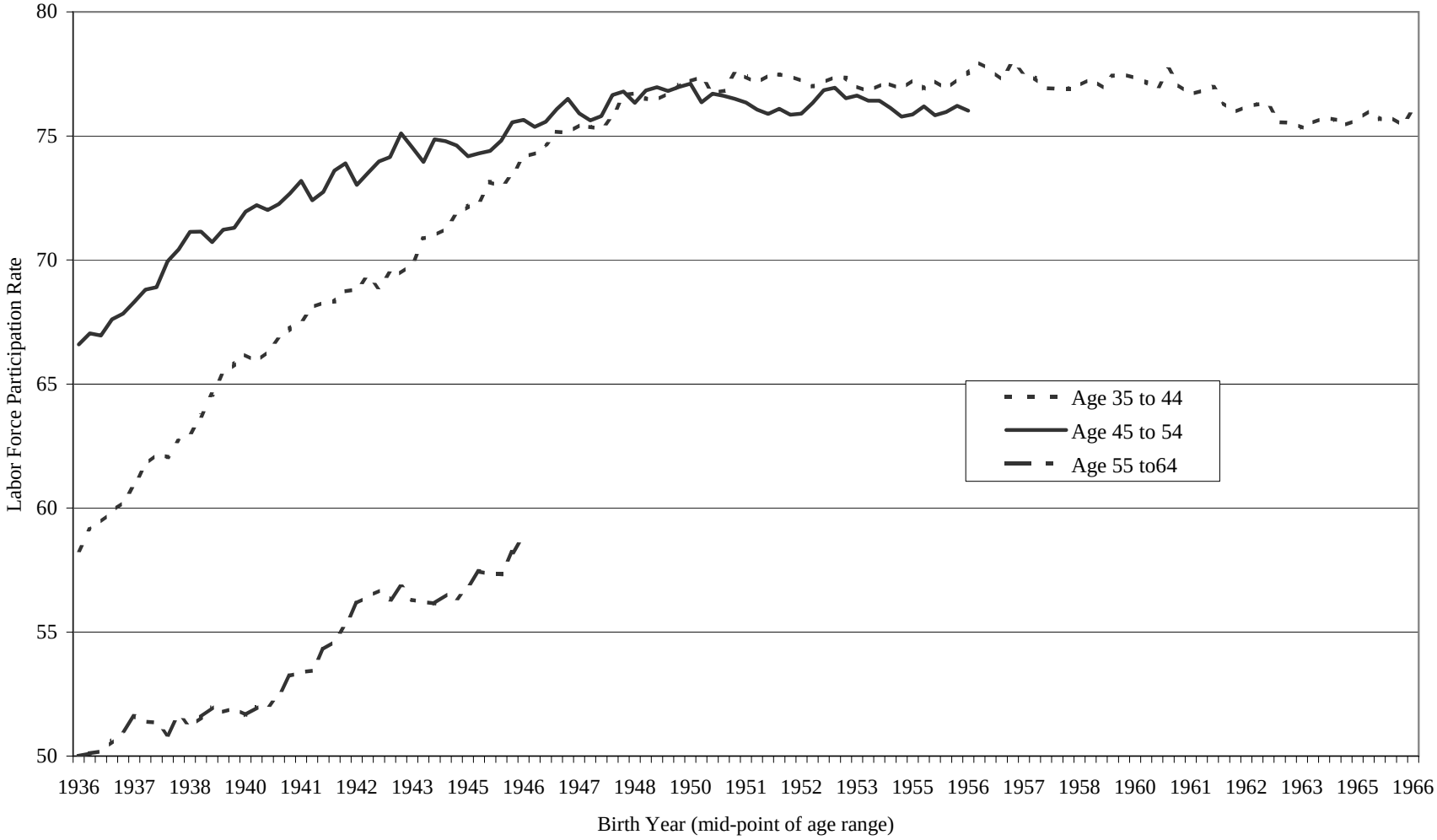
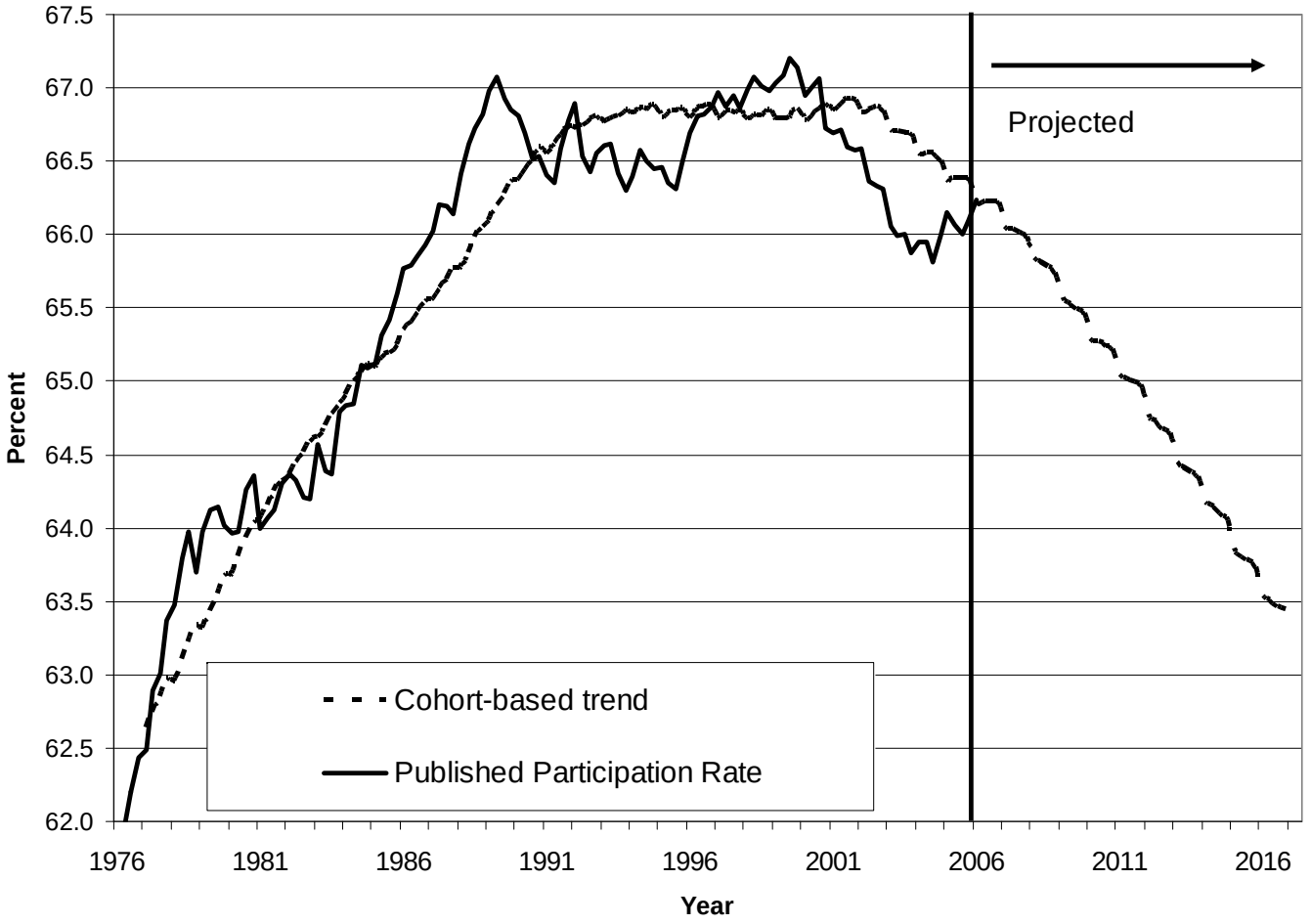


Figure 6
Projected Labor Force Participation Rate



Model-based trend is from the model in Fallick and Pingle (2007a)

Figure 7
Aggregate U.S. Unemployment Rate, 1967-2006

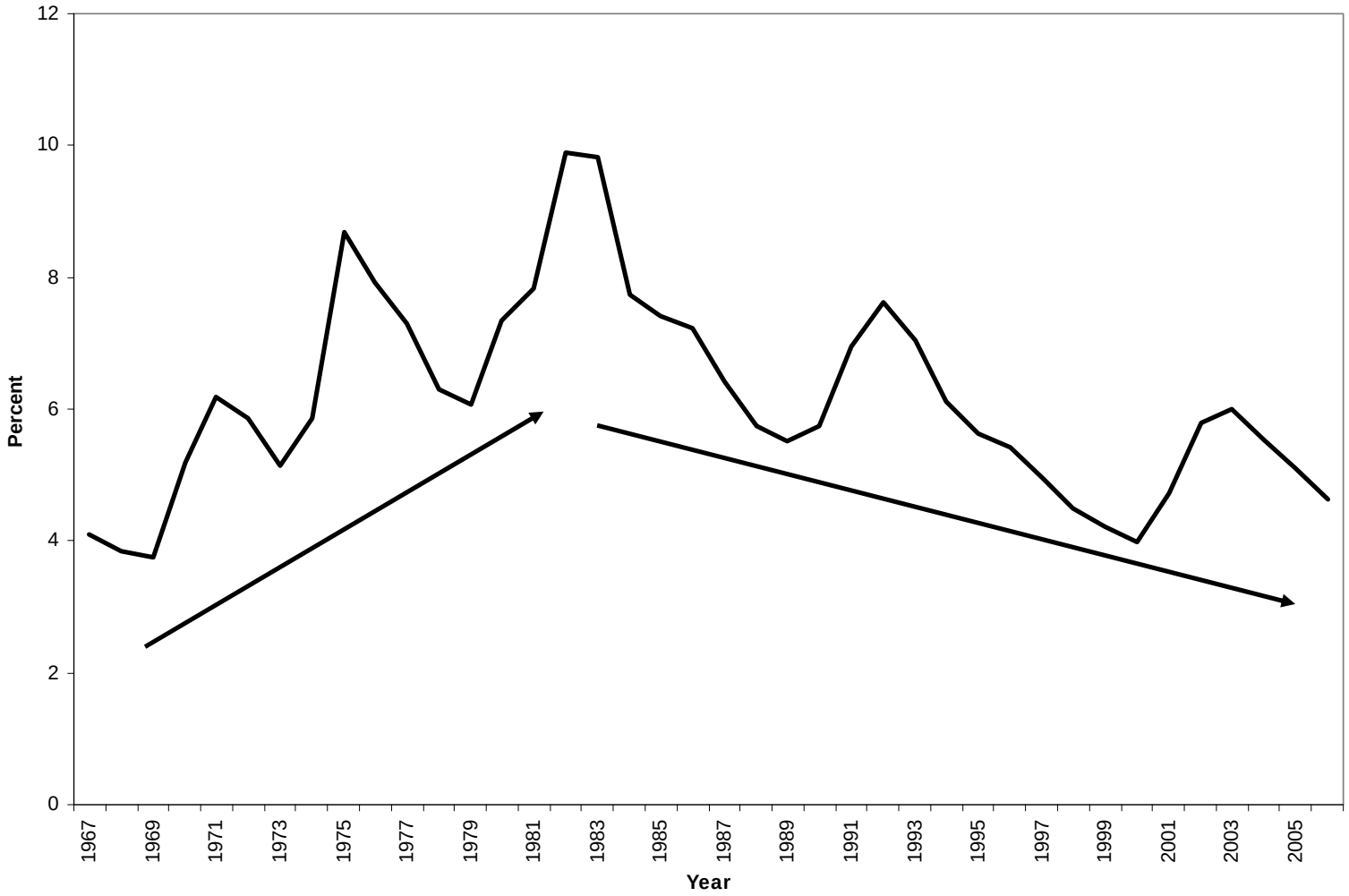


Figure 8
Unemployment rates by age and sex (1997)

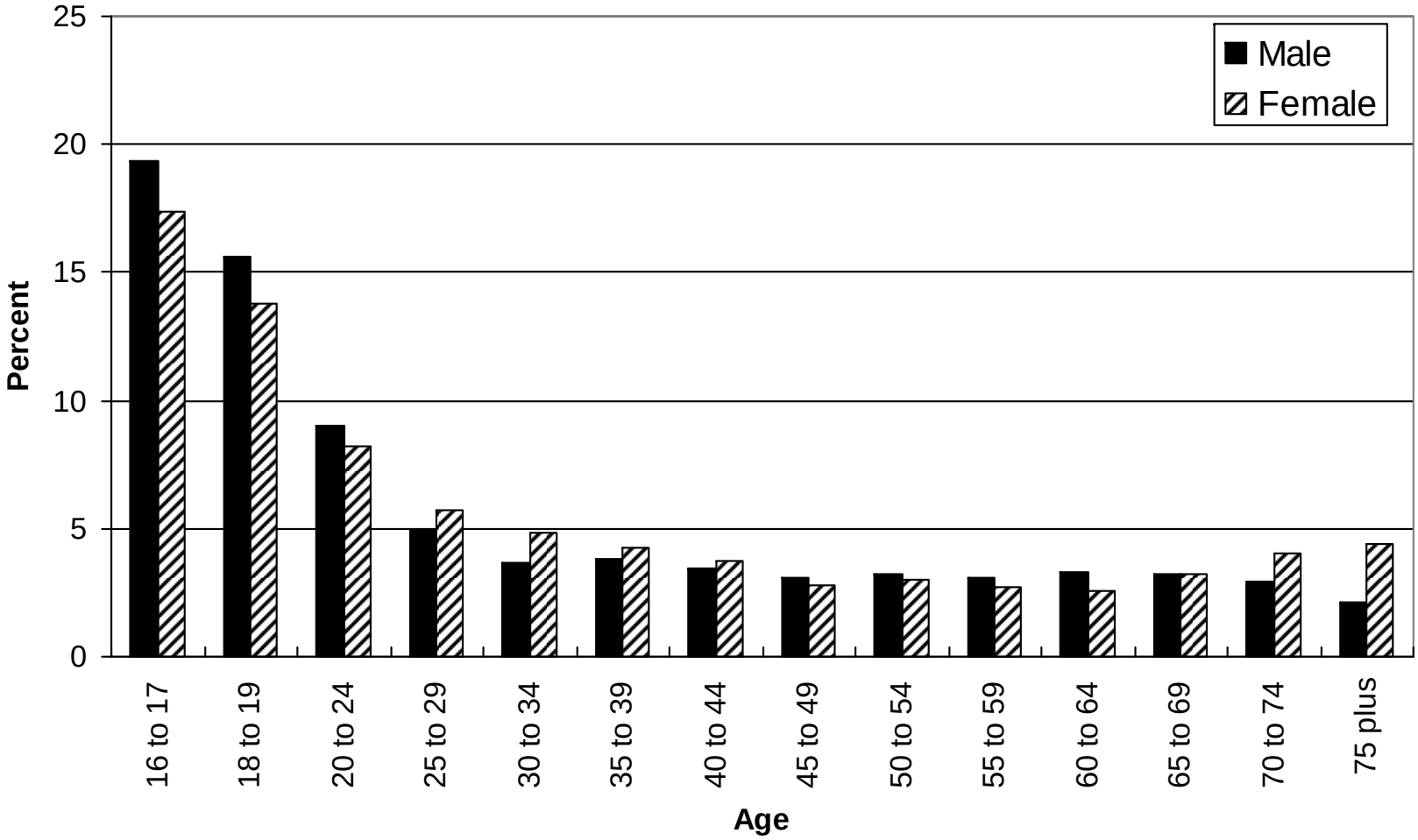
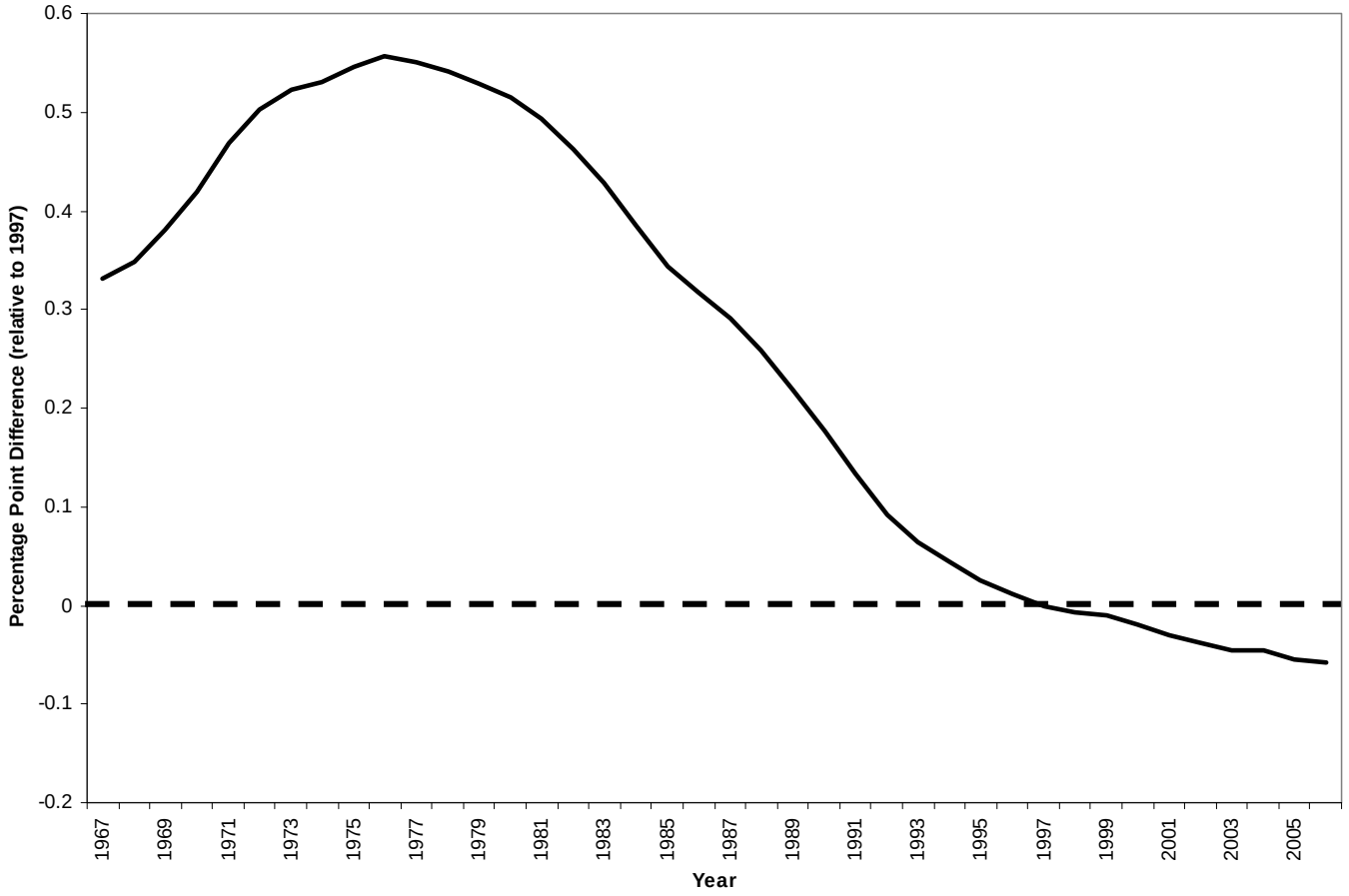


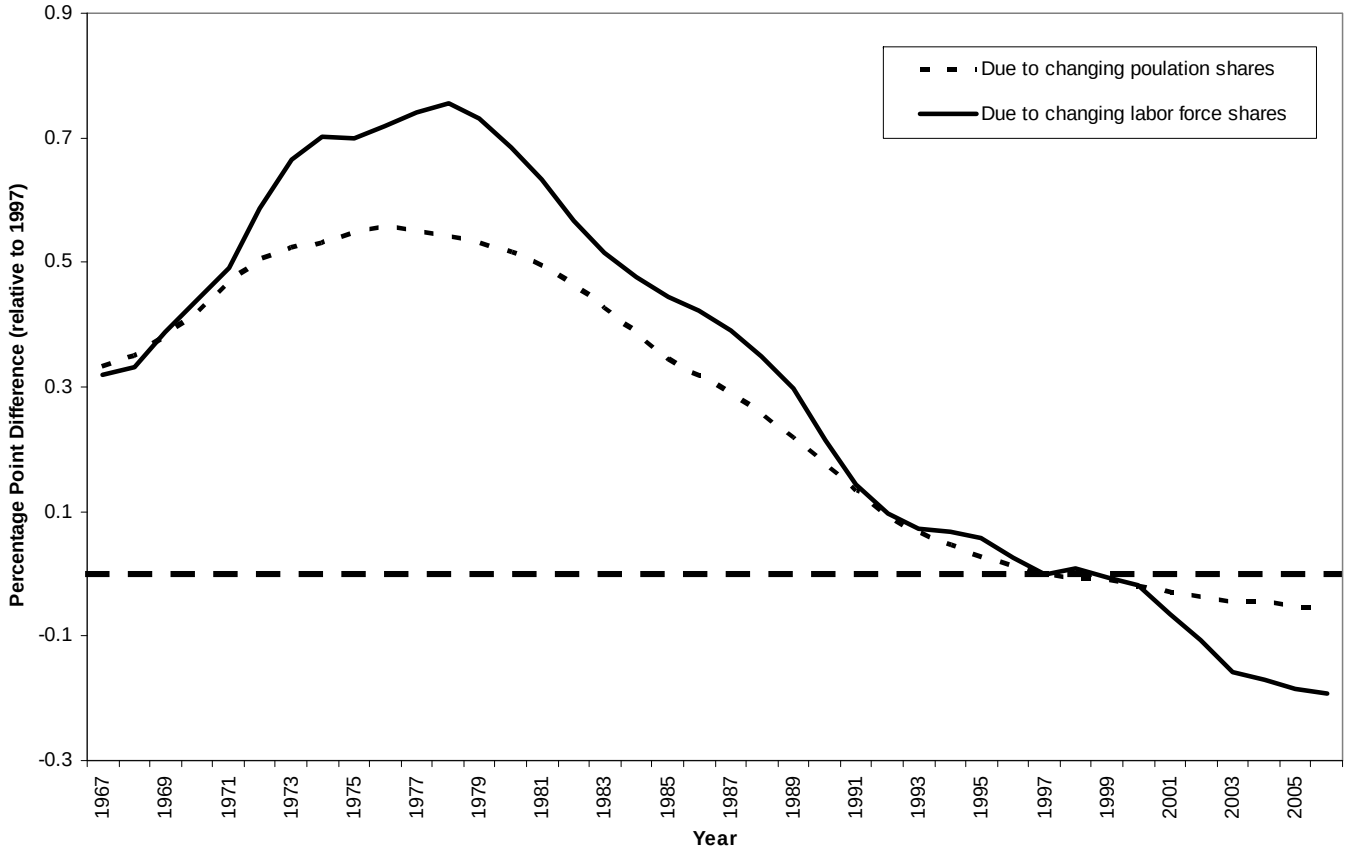
Figure 9
Effect of Changing Population Shares on the Aggregate Unemployment Rate (relative to 1997 actual unemployment rate)



Difference between reweighted 1997 age-sex specific unemployment rates (weights are age-sex specific population shares times the 1997 labor force participation rates) and the 1997 aggregate unemployment rate.

Figure 10
Population and Labor Force Shares ages 16-24

Figure 11
Effect of Changing Population and Labor-Force Shares on the Aggregate Unemployment Rate (relative to 1997 actual unemployment rate)



Solid line is the difference between reweighted 1997 age-sex specific unemployment rates (weights are the age-sex specific labor force shares) and the aggregate unemployment in 1997. Dashed line is the difference between reweighted age-sex specific unemployment rates (weights are age-sex specific population shares times the 1997 labor force participation rates) and the 1997 aggregate unemployment rate.

Figure 12

Unemployment Rate by Age and Sex

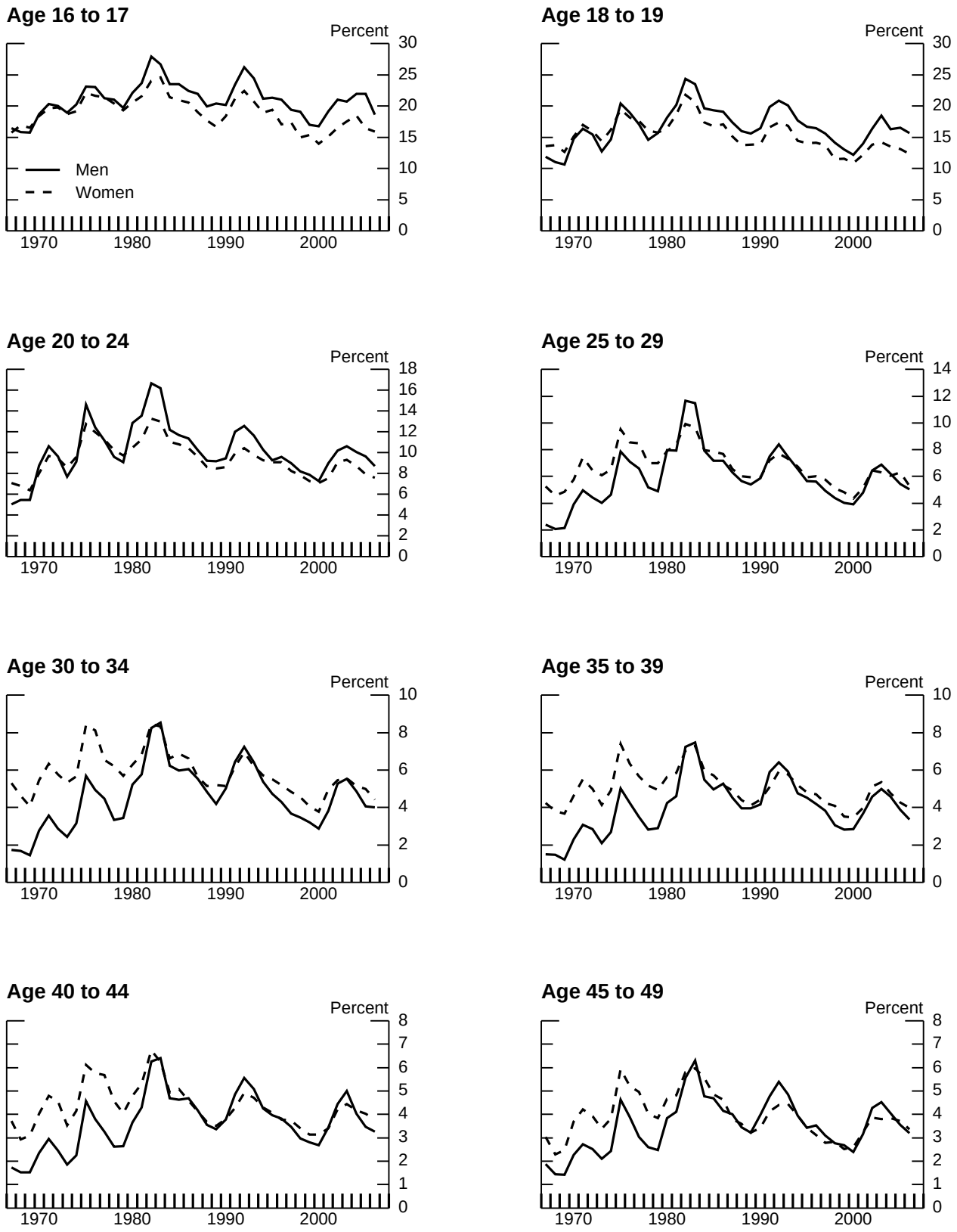


Figure 12, continued

Unemployment Rate by Age and Sex

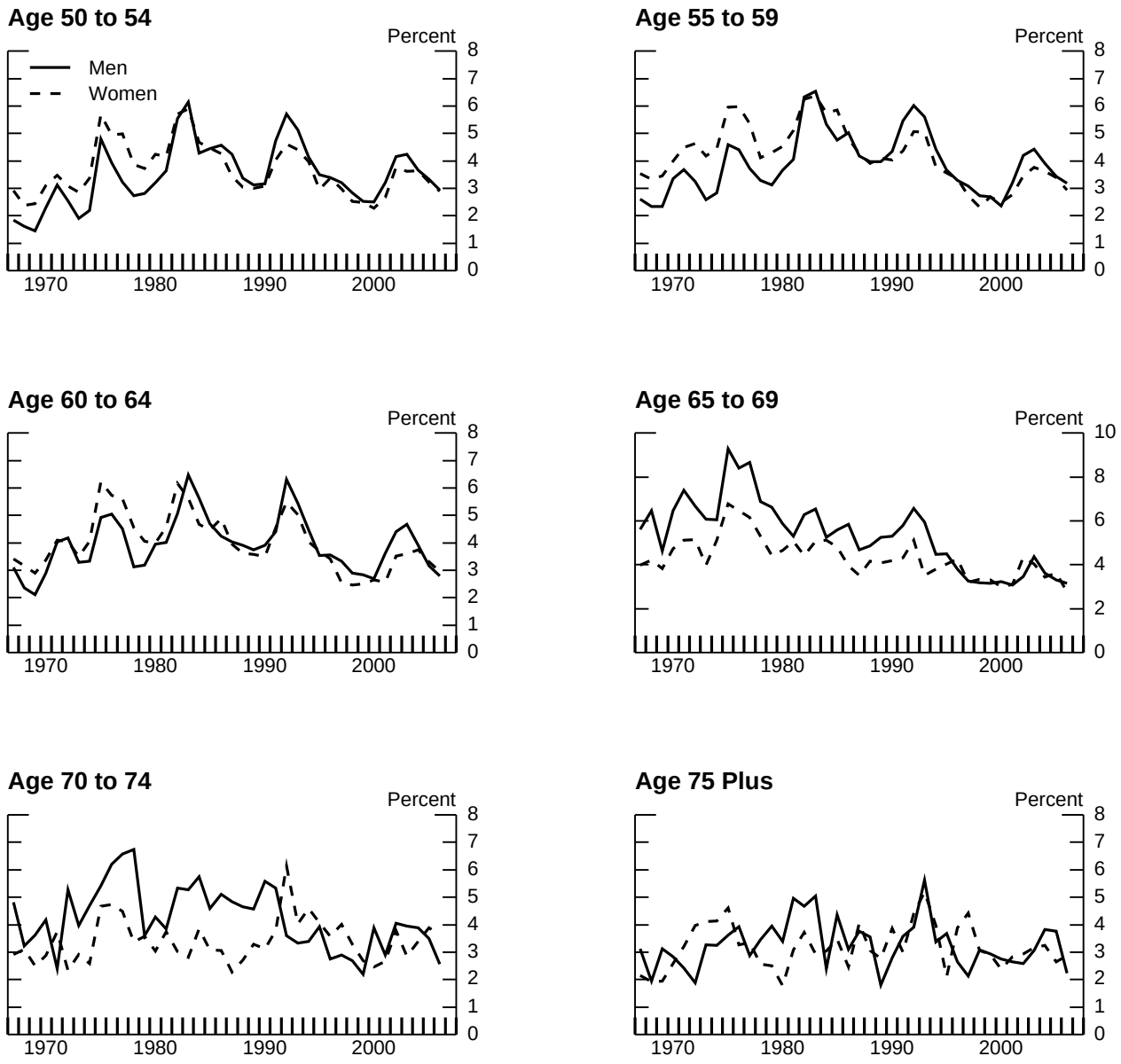


Figure 13: Estimates of Trend Unemployment Rates: Women

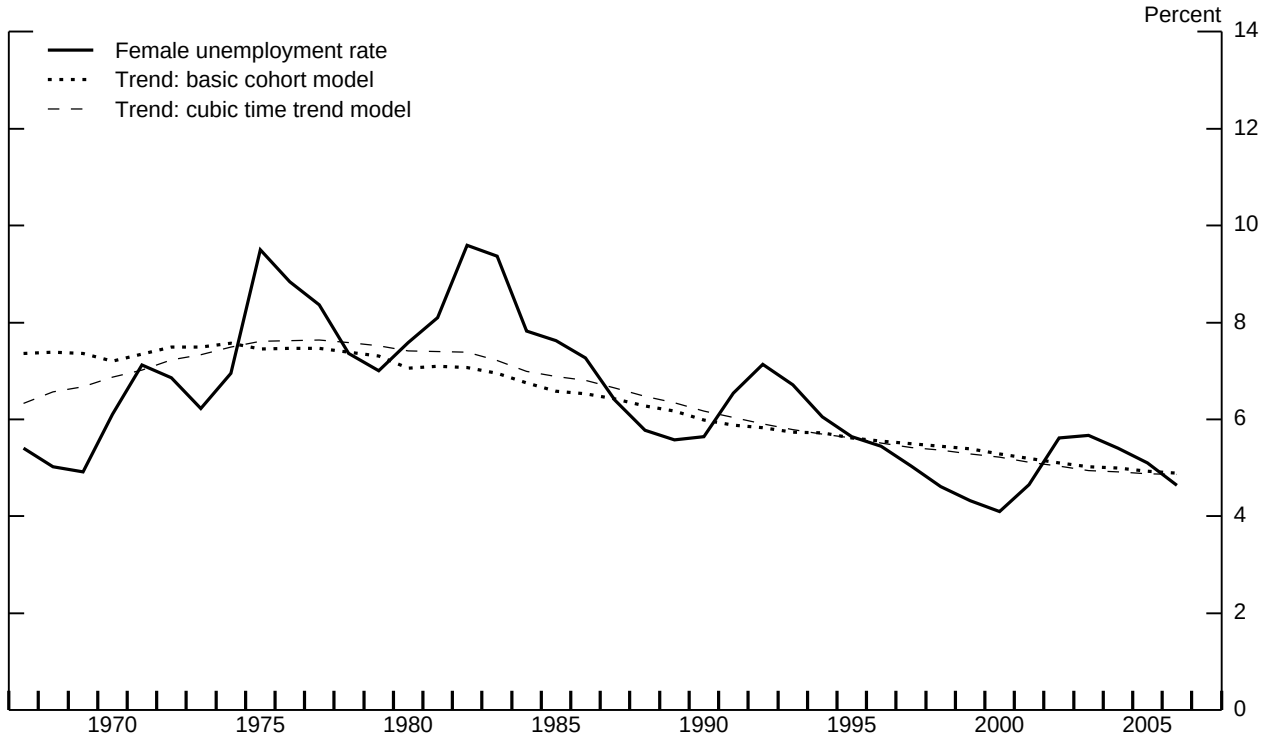


Figure 14: Estimates of Trend Unemployment Rates: Men

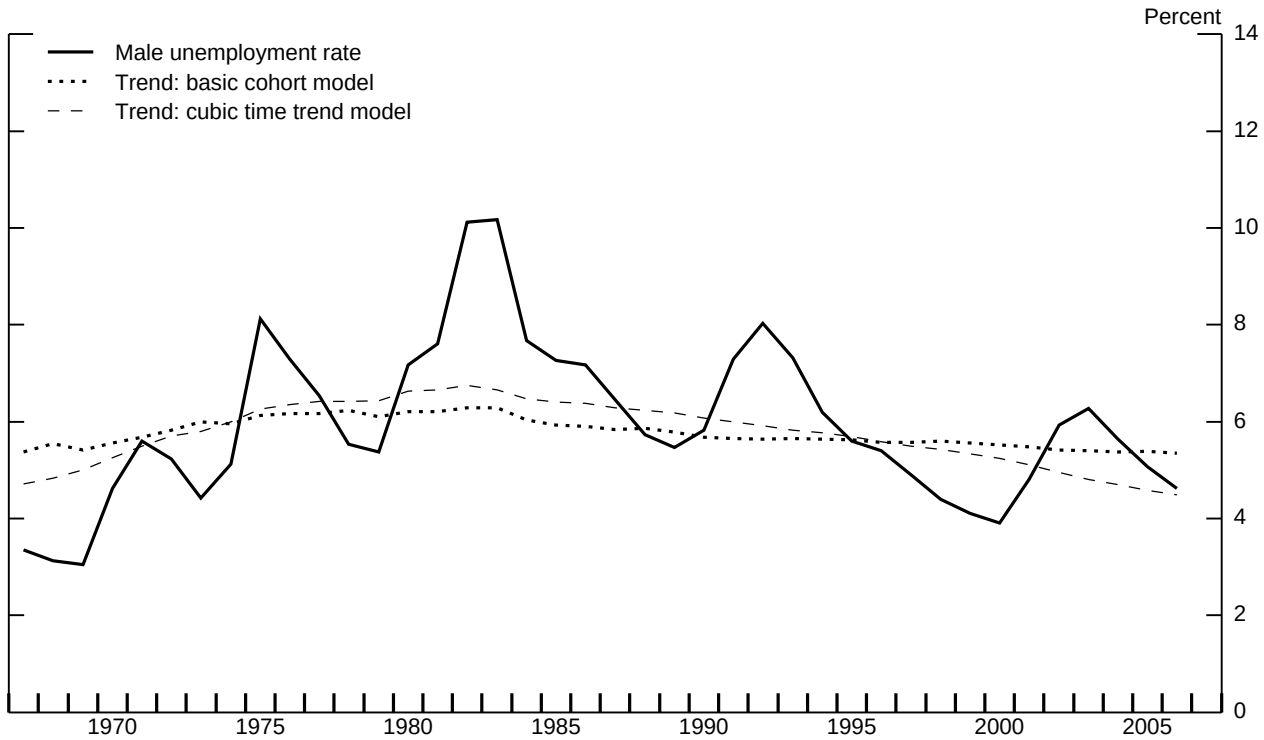


Figure 15: Hazard Rates from Employment to NLF (1996-2006)

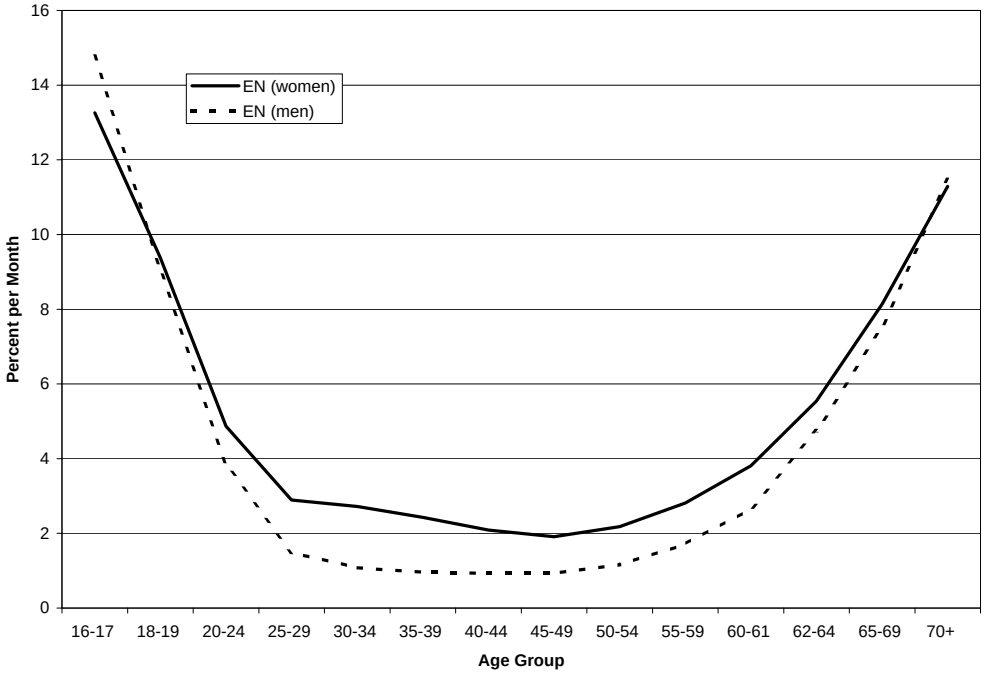


Figure 16: Hazard Rates from Unemployment to NLF (1996-2006)

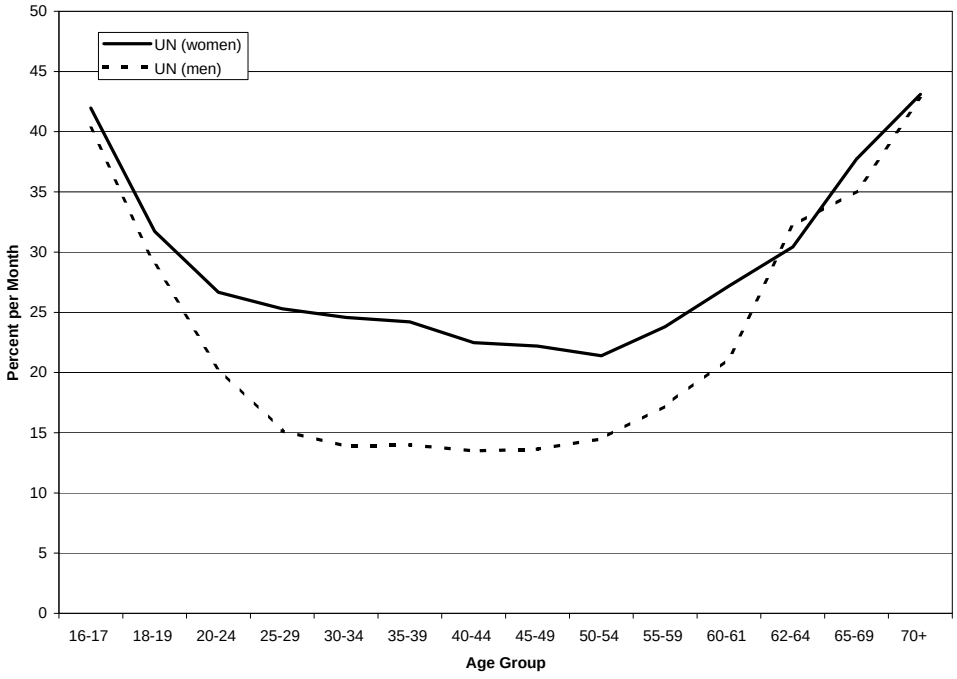


Figure 17: Hazard Rates from Unemployment to Employment (1996-2006)

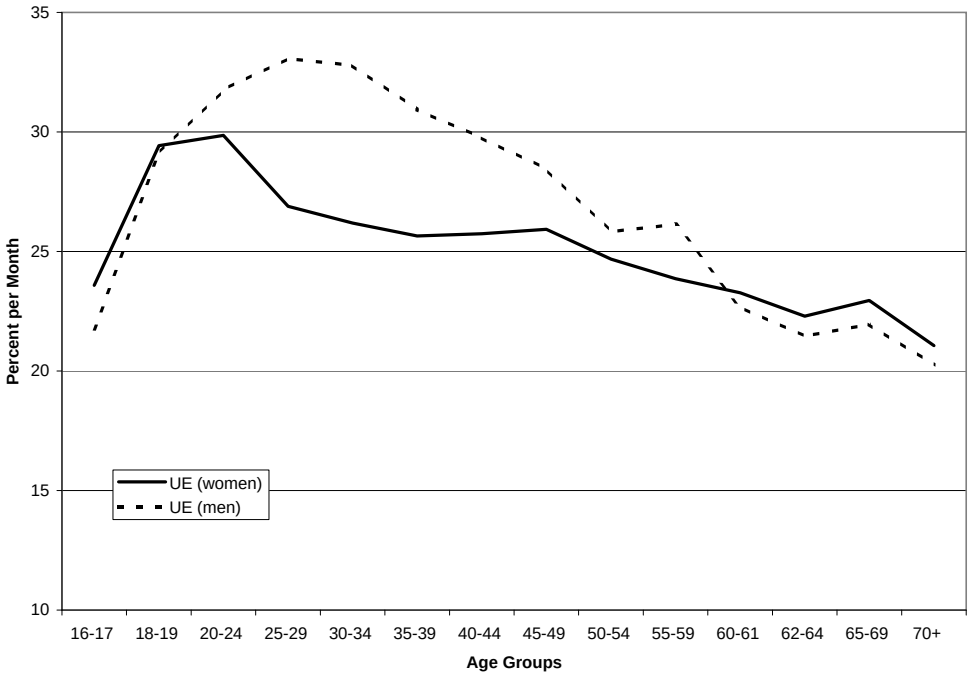


Figure 18:Hazard Rates from NLF to Employment (1996-2006)

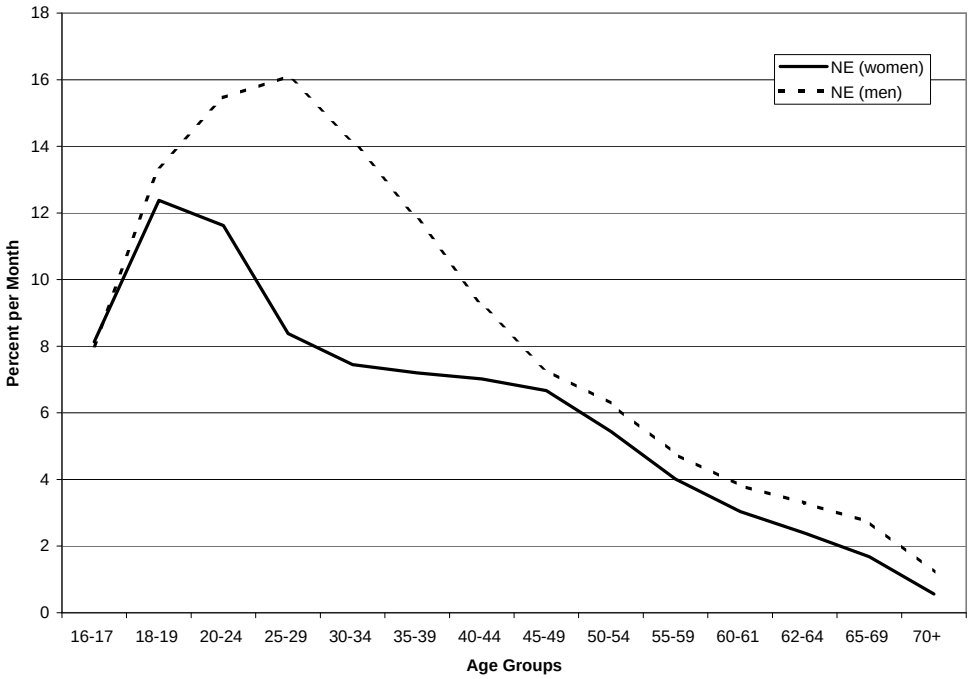


Figure 19: Hazard Rates from NLF to Unemployment (1996-2006)

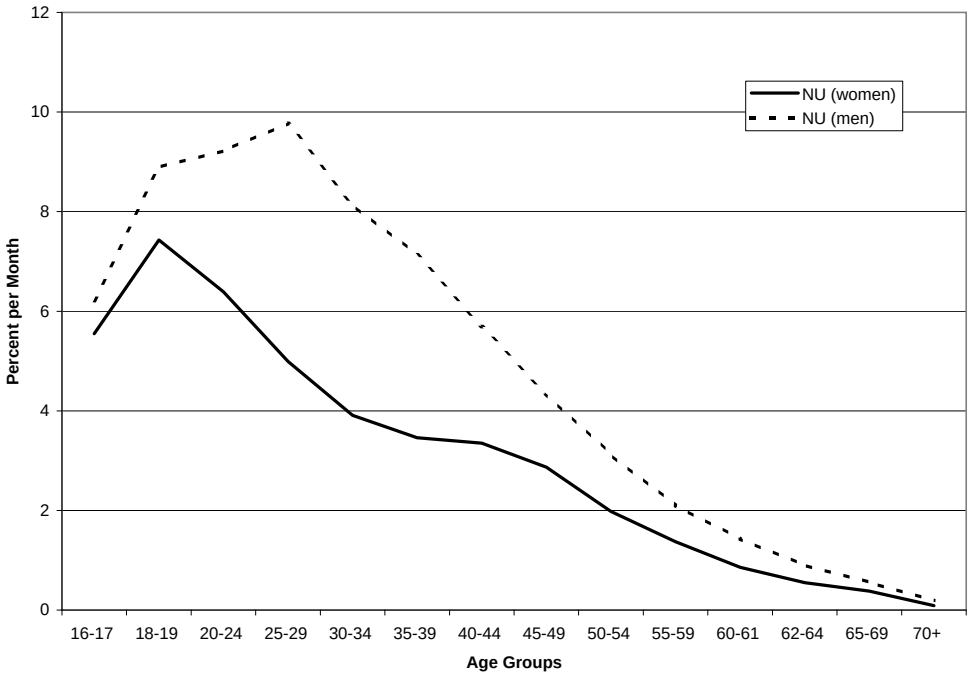


Figure 20: Hazard Rates from Employment to Unemployment

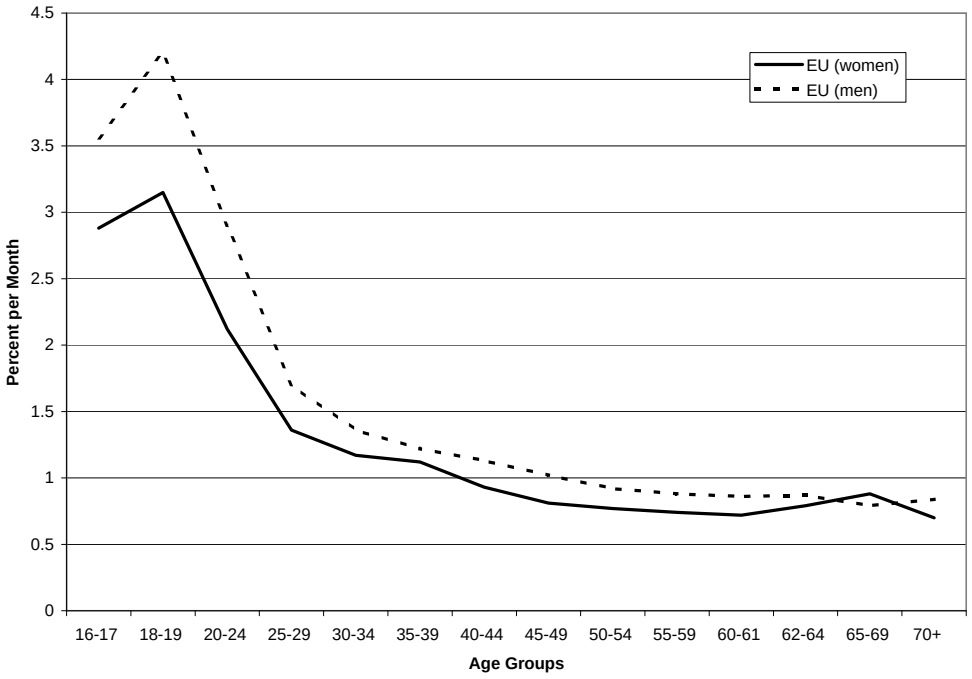


Figure 21: Effect of Aging on the EU Hazard Rate
(Relative to 1996)

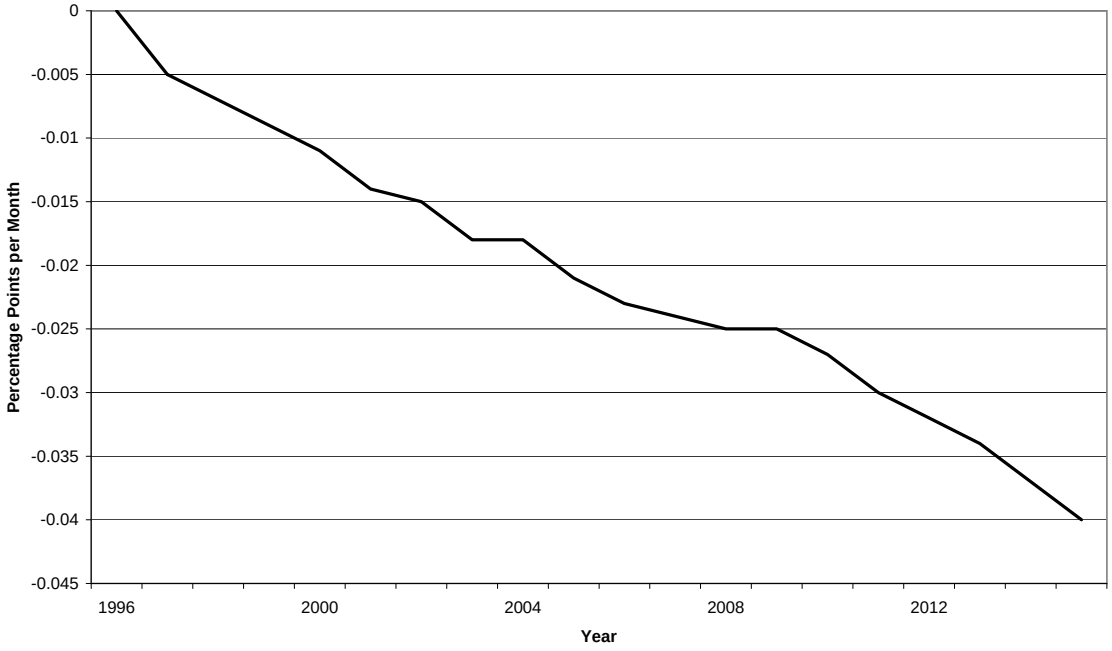


Figure 22: Effect of Aging on EU Flow

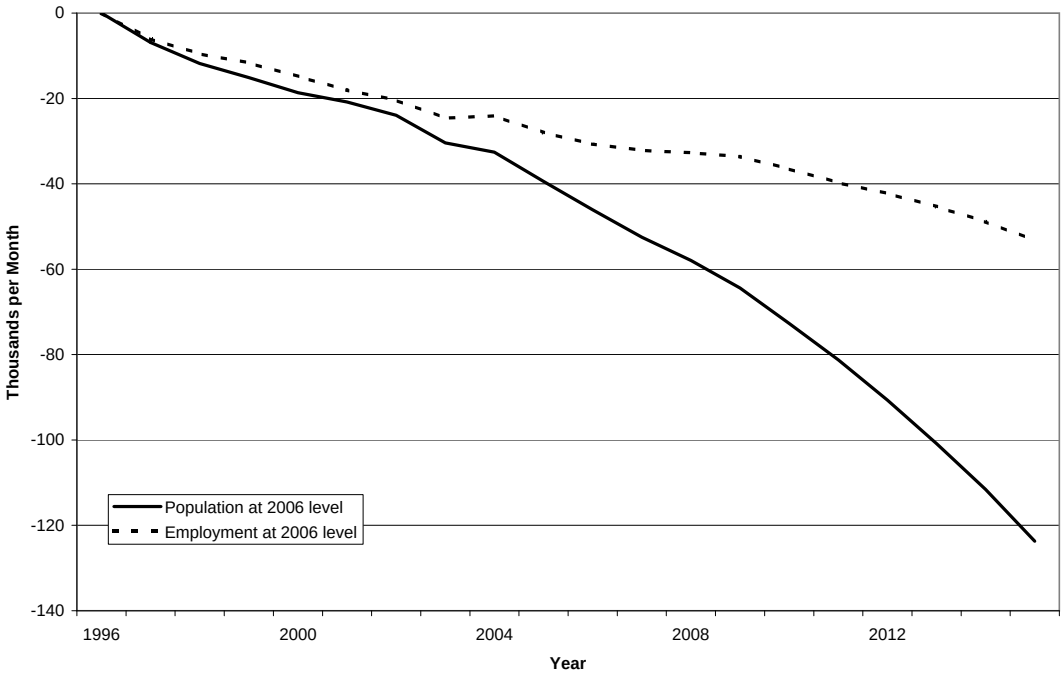


Figure 23: Percent of Flows Involving Employment that Involve NLF

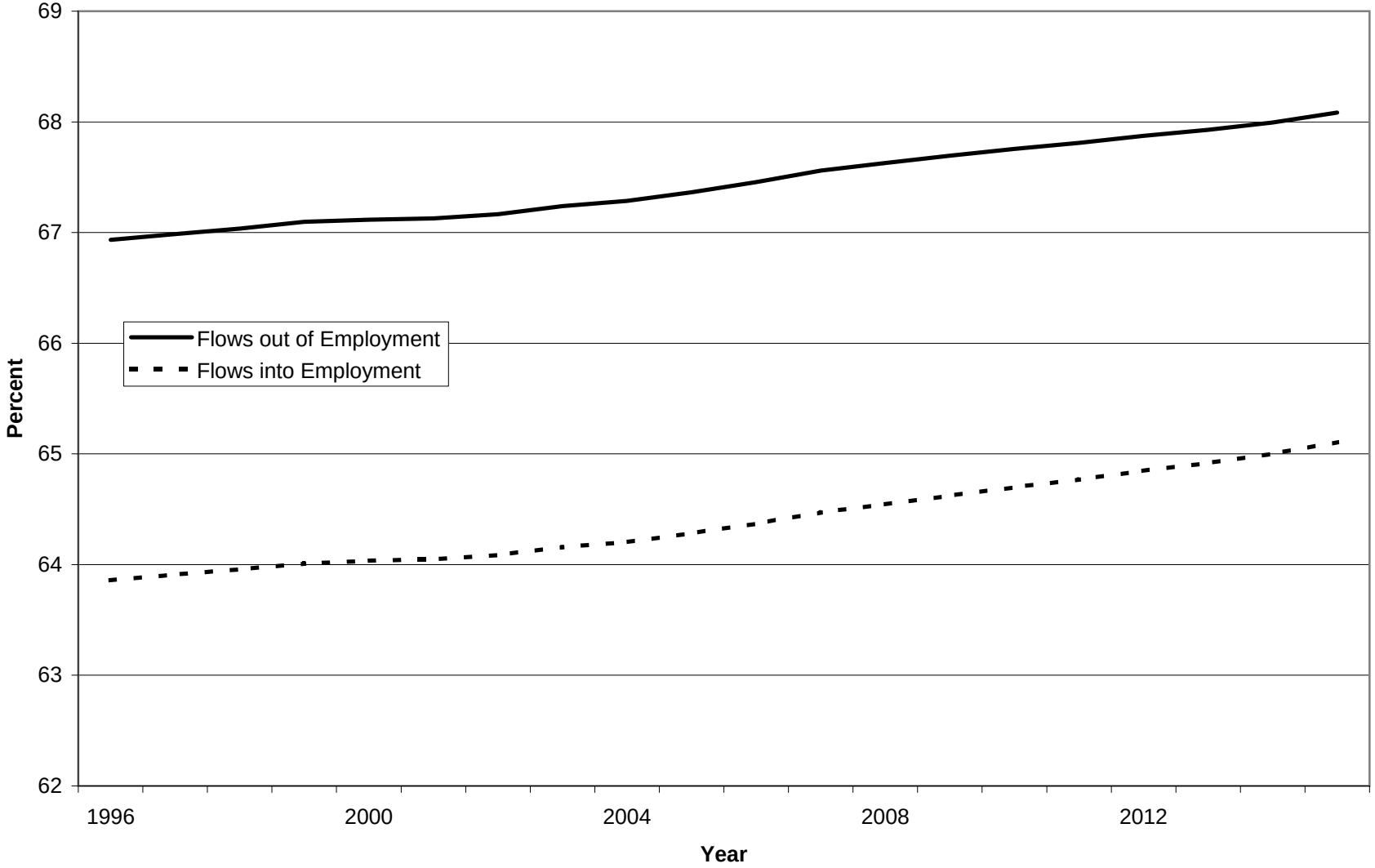


Figure 24: Separation Rates by Age

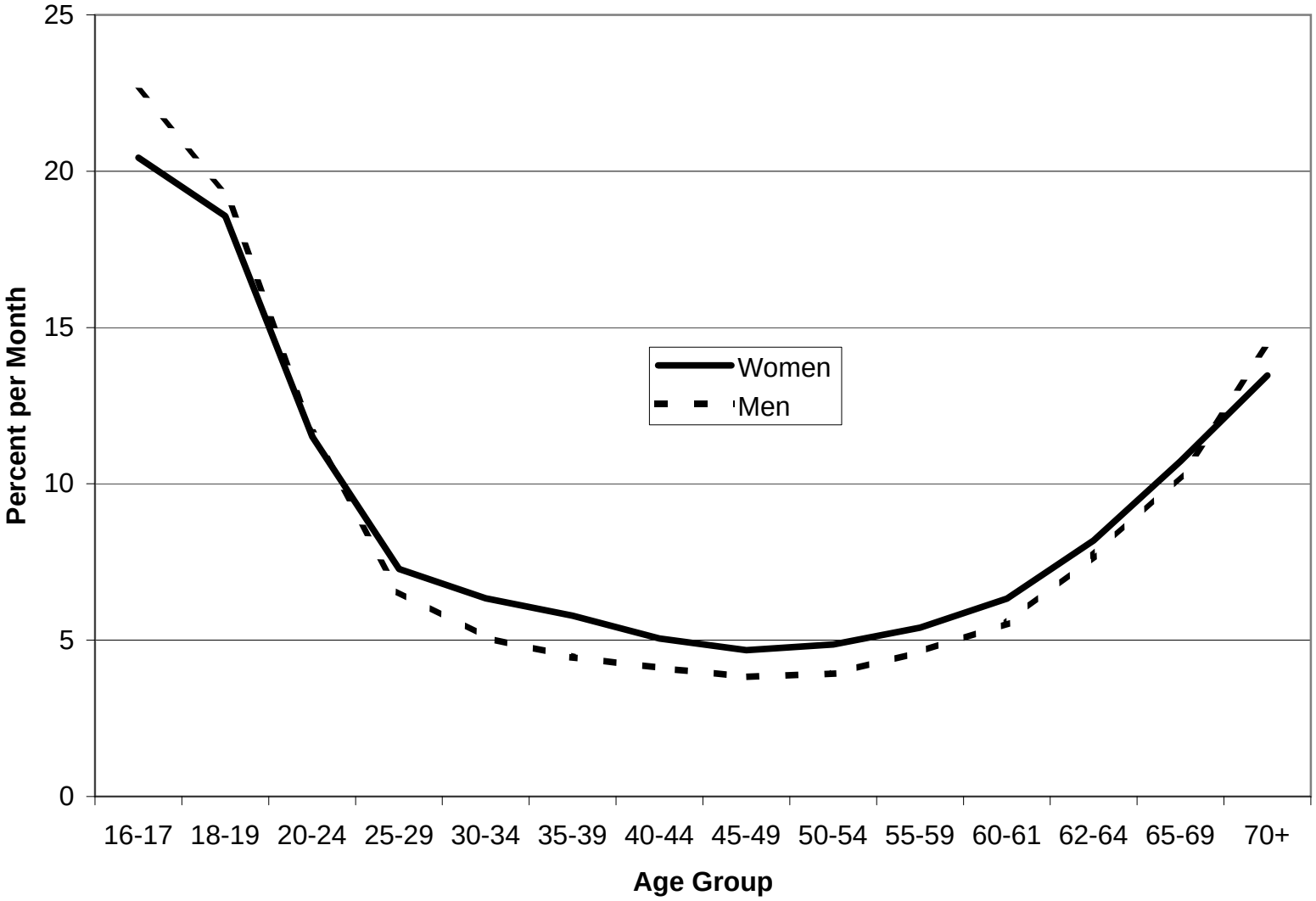


Figure 25: Effect of Aging on the Monthly Separation Rate
(Relative to 1996)

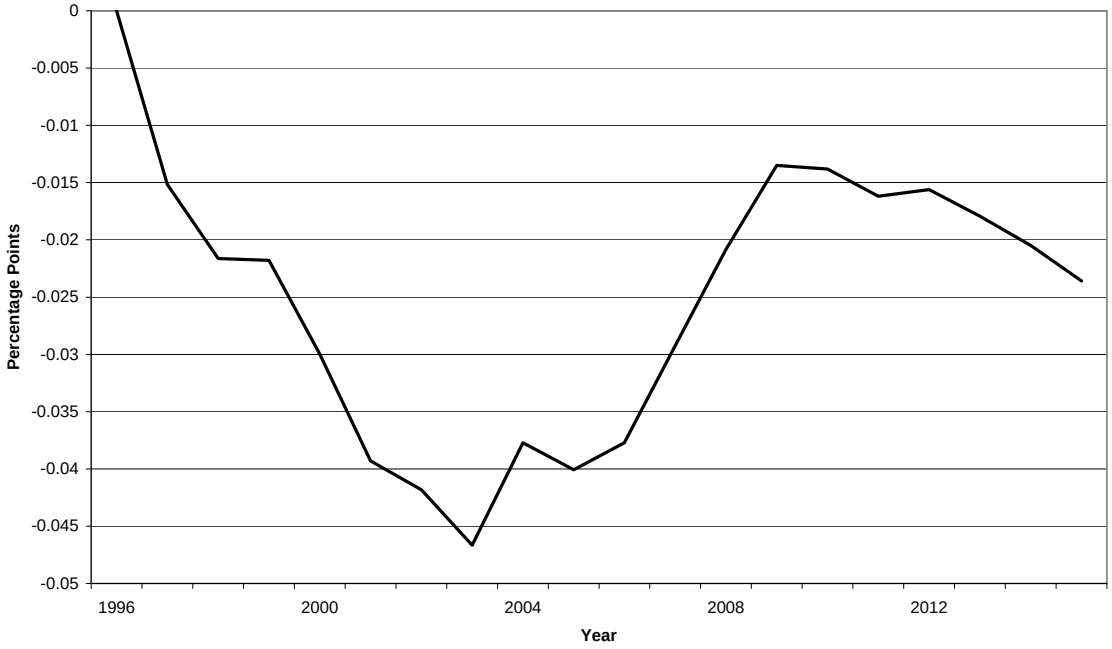


Figure 26: Effect of Aging on Separations

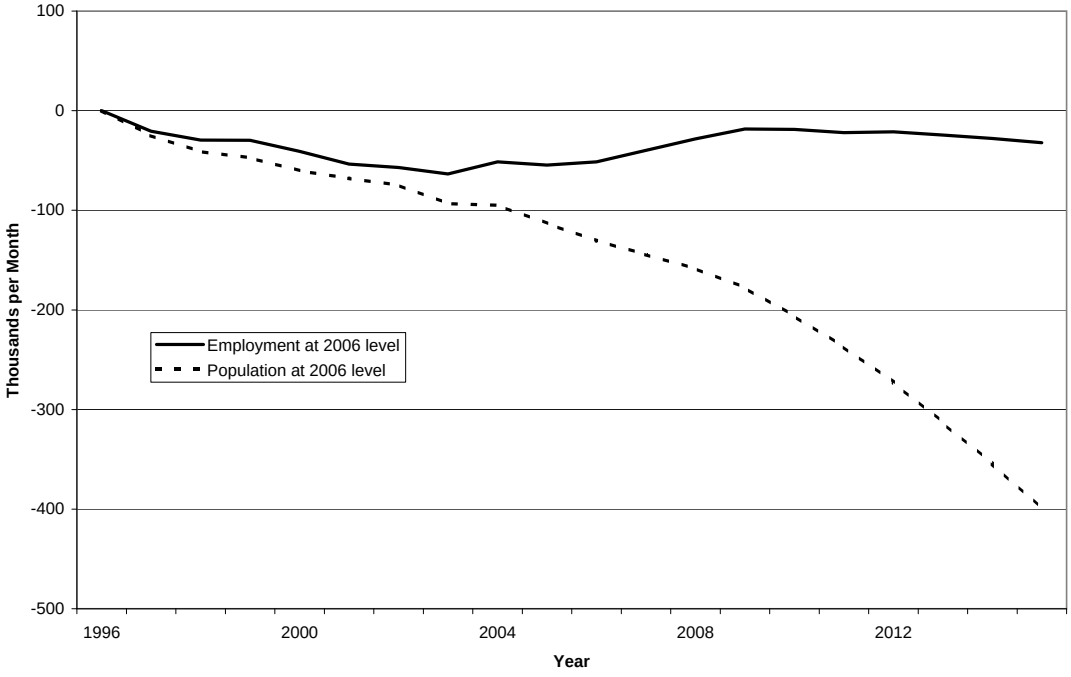


Figure 27: Age - Wage Profiles for Men

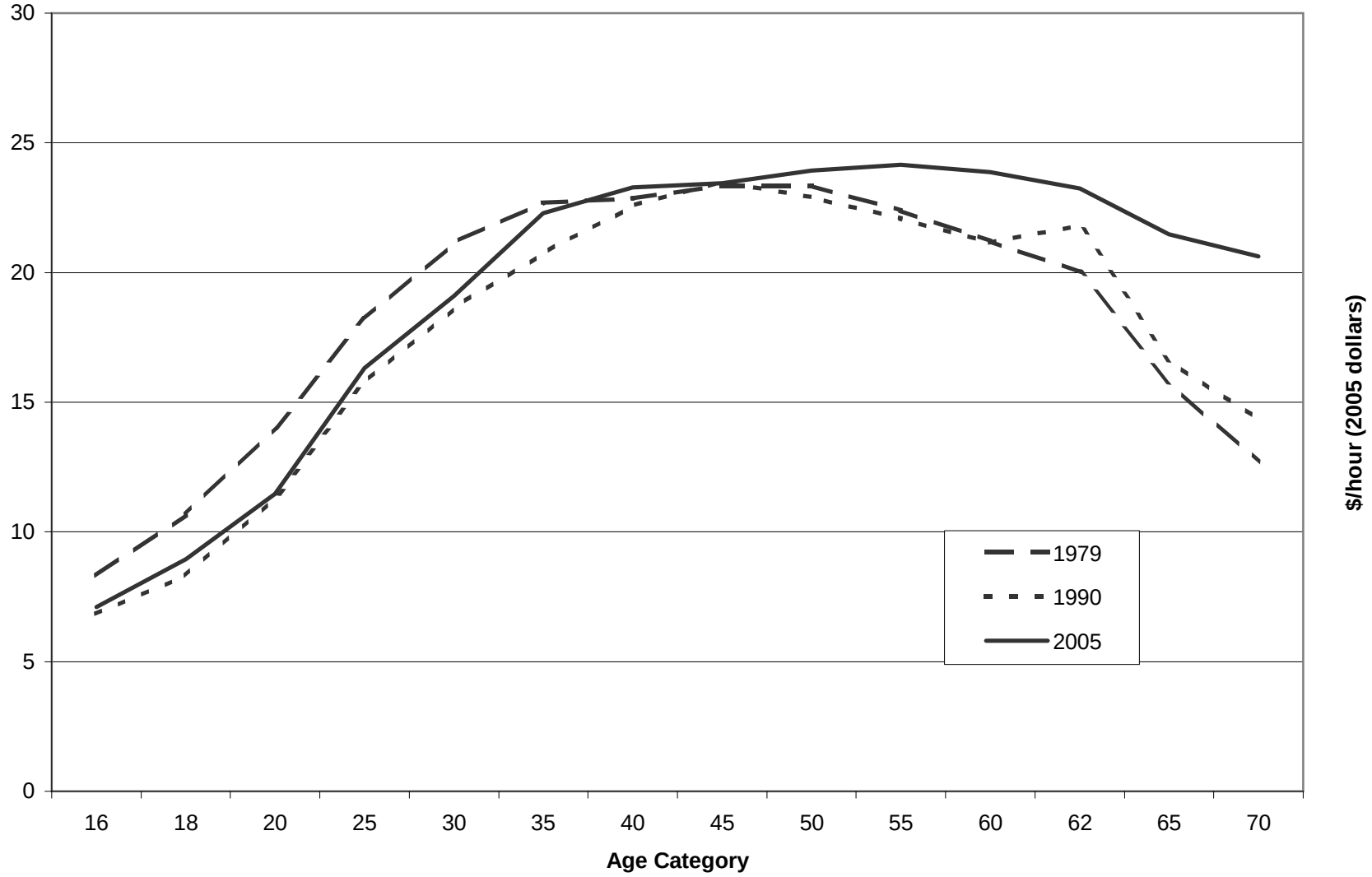


Figure 28: Age - Variance Profile for Men

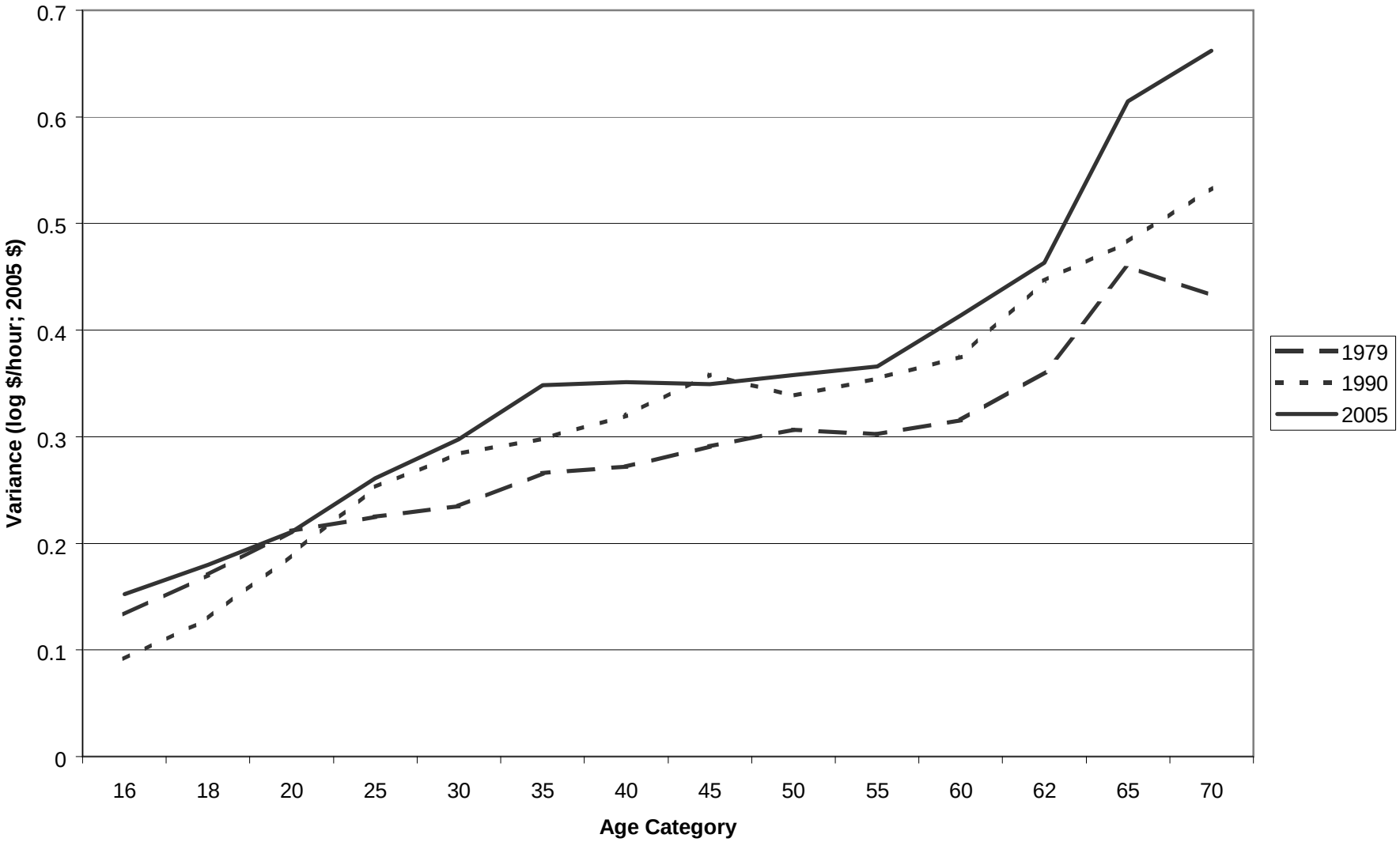


Figure 29: Mean Real Wages and Fixed - Weight Comparison

Figure 30: Effect of Changing Age Distribution on Wage Variance
(Variance Log Real Wage; Within age/gender group variance set at 2005 values)

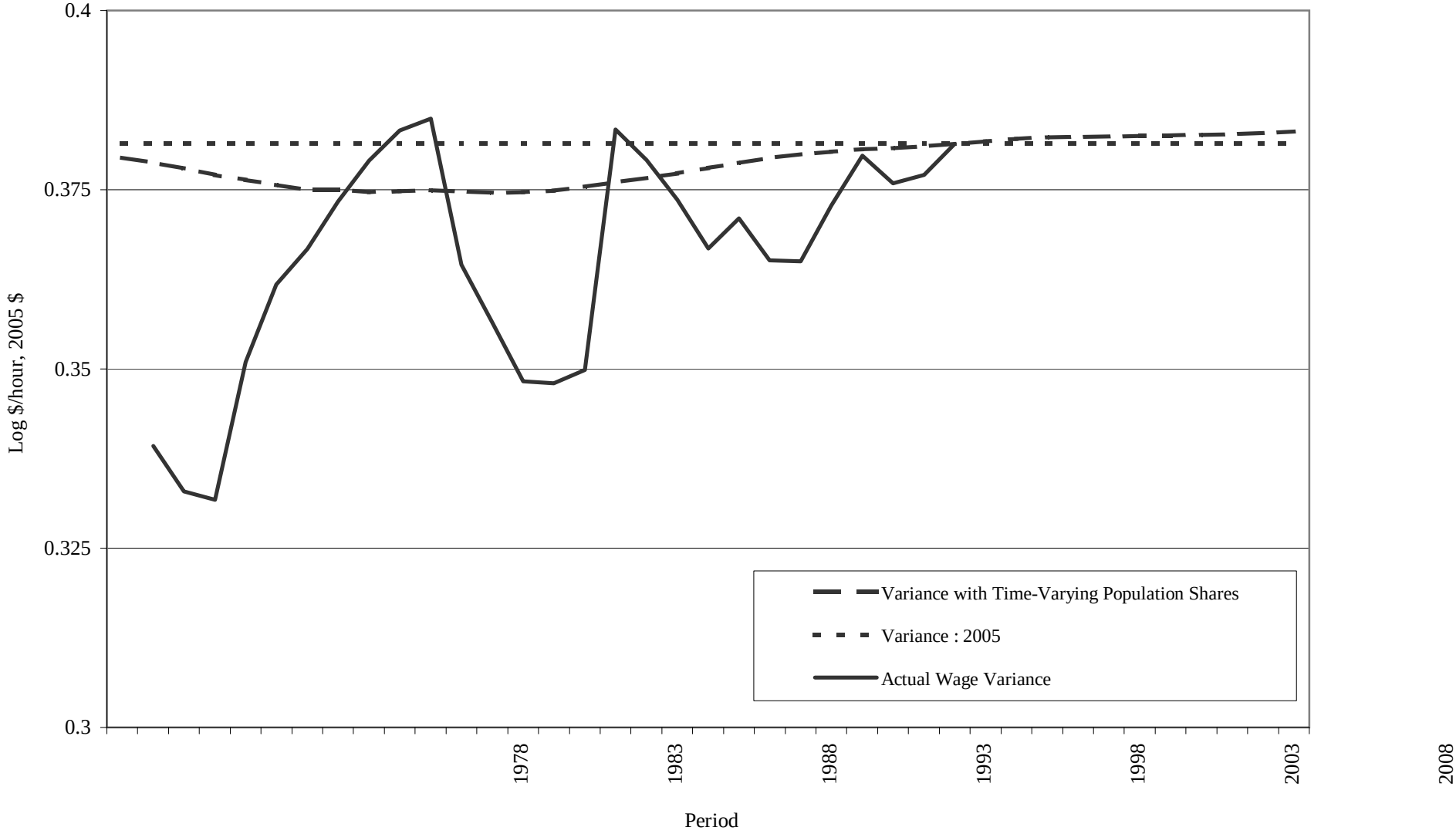


Figure 31: Effect of Changing Age Distribution on Wage Variance
(Variance of log(wage); Within age/gender group variance set at 2005 values)