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Macroeconomic Determinants of Retirement Timing

Yuriy Gorodnichenko
Jae Song
Dmitriy Stolyarov

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Yuriy Gorodnichenko
UC Berkeley,
NBER and IZA

Jae Song
U.S. Social Security Administration

Dmitriy Stolyarov
University of Michigan

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IZA

P.O. Box 7240
53072 Bonn
Germany

Phone: +49-228-3894-0
Fax: +49-228-3894-180
E-mail: iza@iza.org

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ABSTRACT

Macroeconomic Determinants of Retirement Timing*

We analyze lifetime earnings histories of white males during 1960-2010 and categorize the labor force status of every worker as either working full-time, partially retired or fully retired. We find that the fraction of partially retired workers has risen dramatically (from virtually 0 to 15 percent for 60-62 year olds), and that the duration of partial retirement spells has been steadily increasing. We estimate the response of retirement timing to variations in unemployment rate, inflation and housing prices. Flows into both full and partial retirement increase significantly when the unemployment rate rises. Workers around normal retirement age are especially sensitive to variations in the unemployment rate. Workers who are partially retired show a differential response to a high unemployment rate: younger workers increase their partial retirement spell, while older workers accelerate their transition to full retirement. We also find that high inflation discourages full-time work and encourages partial and full retirement. Housing prices do not have a significant impact on retirement timing.

JEL Classification: E24, H55, J26

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Corresponding author:

Yuriy Gorodnichenko
549 Evans Hall #3880,
Department of Economics
University of California, Berkeley
Berkeley, CA 94720-3880
USA
E-mail: ygorodni@econ.berkeley.edu

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"We have 10,000 baby boomers retiring every day. It's time for us to get serious about ensuring that [major entitlement programs] are going to be there for them."

House Speaker John Boehner
September 19, 2011

I. Introduction

Every day, about 10,000 people reach the age of 65 in the U.S. The rapid aging of the US population makes labor force attachment of older workers a key question for policymakers. What factors determine a worker's exit from the labor force? While retirement decisions crucially depend on individual characteristics, such as health, work history, accumulated savings etc., macroeconomic factors such the state of the labor market, inflation rate, and housing prices can play a big role as well. How cyclical macroeconomic factors affect retirement timing is a question with immediate and far-reaching policy implications.

The impact of macroeconomic forces on retirement timing is not unambiguous. On the one hand, adverse macroeconomic conditions can deplete household wealth. The life-cycle model predicts that households should optimally extend their working lives when their wealth unexpectedly declines. On the other hand, a weak labor market in a recession can induce early retirement if older workers become discouraged about the future job prospects. Similarly, a high rate of inflation can negatively affect the purchasing power of household wealth, which should encourage continued labor force participation. However, inflation can also lead to erosion of real wages thereby encouraging workers to retire earlier than they would otherwise. The response of retirement timing to inflation is of current importance, because some fear that the large balance sheet of the Federal Reserve may lead to out-of-control inflation in the future. Fluctuations in housing prices create yet another wealth effect for households. Real estate prices may significantly affect retirement timing because housing wealth is a major part of portfolios of the US middle class. This paper documents the dynamics of employment/retirement choices of older workers and estimates the sensitivity of retirement timing to unemployment, inflation and housing prices using the data from the past 50 years.

Our analysis uses Continuous Work History Sample (CWHS) dataset of the Social Security Administration (SSA). This dataset includes comprehensive, administrative-quality information on the complete records of lifetime earnings of 1 percent of the U.S. population since early 1950s. The long time series enables us to exploit large variations in macroeconomic indicators. Furthermore, the large sample size based on administrative records lends more precision to our estimates.

We associate retirement with a permanent withdrawal from the labor force. This definition of retirement provides several advantages over defining retirement as Social Security benefit claiming age. First, defining retirement as permanent labor force exit is more accurate, since many individuals continue working even after claiming Social Security benefits. Second, our definition is more flexible. The available evidence (e.g., Ruhn, 1990) points to the fact that for many workers retirement is not a one-step process. The traditional career job followed by full retirement is becoming less of a norm. Instead, workers transition from career jobs to lower-paying "bridge" jobs that they hold for a number of years after their career end date. Workers in career and bridge jobs may have different incentives and degrees of flexibility with respect to retirement timing, and one may expect that they show differential responses to macroeconomic conditions.

We analyze lifetime earnings records to construct the labor force status for every worker. We categorize workers as either fully employed, partially retired, or fully retired. We start by documenting important changes in the labor force status of older workers at different levels of lifetime earnings. Consistent with other studies, we document a general decline in full employment of older white males during 1960-1990. Although full employment rates declined for all workers, the trends diverge substantially by earnings level. For example, the recent full-time employment rate for 60 year olds in the bottom earnings quintile is 1.5 times less than average for their age group, and for 65 year olds in the bottom earnings quintile it is 2 times less than their age group average. On the other hand, the 65-67 year old workers in the top quintile of earnings exhibit a full-time employment trend that diverges from the rest of the population. While average full-time employment rates stayed relatively stable since 1990, the full-time employment rate for 65-67 year old top earners bottomed out in the 1990s and has been rising since, suggesting longer careers for this group.

At the same time, partial retirement has been on the rise across all age and income groups. While partial retirement was virtually non-existent for 60-62 years olds in 1960, over the past 20 years more than 15 percent of workers in this age group are categorized as partially retired. For 65-67 year olds, the recent partial retirement rate is over 20 percent, up from 5-10 percent in 1960.

We think that transitions to partial and full retirement should be analyzed as separate labor market events, especially given that partial retirement became much more widespread in the past 20 years. It is often believed that at least some end-of-career events for older workers are involuntary and driven by the employer's response to economic conditions. If so, the observed shift towards earlier end of careers may leave workers with less control over their retirement timing.

On the other hand, at least two factors may have contributed to more flexibility in retirement timing. First, since 1970, Social Security removed the financial incentive to retire at age 65 by introducing a gradual increase in the delayed retirement credit. Second, the coincident decline in defined-benefit pension plans may have reduced instances when workers face age-specific work disincentives. One can hypothesize that full-time workers and partially retired face different degrees of retirement flexibility and, perhaps, different incentives. We, therefore, propose to analyze the behavioral responses for these two groups separately.

We consider the influence of macroeconomic indicators on the timing of partial and full retirement for 55-75 year old workers. Our econometric specification is non-parametric in that it estimates sensitivity parameters separately for each age. We find robust evidence that flows from full-time work into both partial and full retirement rise significantly in recessions. Workers around normal retirement age (63-67 years old) are especially sensitive to changes in the national unemployment rate. We estimate that a 1 percent rise in the national unemployment rate leads to about 1 percent drop in the full employment rate of all 55-75 year olds, with the full employment rate among the 63-67 age subgroup dropping as much as 2 percent. The same 63-67 age subgroup experiences the largest increase in the flow into partial and full retirement associated with recessions. Among the partially retired, the response to a higher unemployment rate differs by age: workers younger than 63 extend their partial retirement spell while workers older than 63 accelerate their transition to full retirement.

Somewhat surprisingly, we find that high inflation is associated with increased exit from the labor force, through partial as well as full retirement. One explanation for this may be that during high inflation episodes wages do not keep up with inflation, and lower real wages discourage labor force participation.

Our results also indicate that housing prices do not have a significant effect on retirement timing, which is consistent with the modest sensitivity of retirement timing to movements in the rate of return on financial assets documented elsewhere (e.g., Bosworth and Burtless, 2011). The result suggests that either the wealth effects associated with housing prices are small or that housing price increases are correlated with other macroeconomic variables that encourage labor force participation.

We further investigate if retirement timing of wealthier workers is less sensitive to changes in macroeconomic conditions (we use the present value of lifetime earnings as a proxy for wealth). Wealthy individuals may have more control over their retirement timing either because of their

abundant resources or because of more flexible careers in high-paying occupations. However, we find that retirement decisions of wealthy workers are only marginally less sensitive to fluctuations in macroeconomic conditions. The sensitivity of retirement transitions to the unemployment rate and inflation is quite similar across lifetime earnings quintiles, with the 63-67 year old age group responding most to changes in the unemployment rate.

The Great Recession generated a renewed interest in how macroeconomic factors influence retirement choices. In a closely related study, Bosworth and Burtless (2010) use public-use micro data on retired-worker benefit awards published by the SSA as well as the data collected in the March Supplement of the Current Population Survey (CPS). Bosworth and Burtless relate unemployment rate of prime-age males as well as stock/bond returns on Social Security benefit acceptance and labor force exit. They find that while these business cycle effects are statistically significant, they are economically small, yet sufficiently large to offset the impact of negative wealth shocks in 2007-2009 on old-age labor force participation.

In another closely related paper, Coile and Levine (2011) use data from the CPS to measure labor force participation and Social Security benefit receipt of 55-69 year olds. Their main related finding is that a higher unemployment rate decreases labor force participation of workers around retirement age, and that the effect is the strongest after age 62. Our results paint a more detailed picture as we have several retirement states (partial and full), analyze longer time series, use a large set of macroeconomic variables and provide sensitivities by narrowly defined age and income groups. For example, we show that even though a higher unemployment rate generally accelerates retirement, workers younger than 63 who are partially retired actually stay in partial retirement longer when the unemployment rate is high.

Much of previous work was constrained by available data. For example, recent studies on macroeconomic determinants of retirement timing focus mostly on the Great Recession (e.g., Bosworth (2012), Hurd and Rohwedder (2010)). This line of work is certainly informative but it may be hard to generalize from the experience of the Great Recession given particular characteristics of this downturn (e.g., financial crisis and high leverage of households). Studies using longitudinal data typically cover only a handful of years. For example, SSA's Retirement History Survey data used in Blau (1994) covers only 1969-1979. One may obtain longer time series by using synthetic cohorts from the Current Population Survey (CPS; see e.g., Coile and Levine 2011) but this can deteriorate measurement of transitions between employment/retirement states

as different people are used in each cross-section. These data constraints limit our understating of retirement choices over the business cycle.

The key advantages of our approach relative to previous studies are that (*i*) CWHS gives us access to a complete history of earnings for each worker; (*ii*) CWHS has much less top-coding than public-use micro data published by the SSA; (*iii*) CWHS provides much longer time series; iv) CWHS provide much larger sample sizes so that we can have precise estimates even for narrowly defined population groups.

The rest of the paper is structured as follows. In the next section, we describe the data we use for the analysis of employment/retirement states and transitions across states. Section 3 defines employment/retirement states. Section 4 documents trends in retirement timing since 1960. Section 5 reports trends in transition probabilities across employment/retirement states. Section 6 studies how macroeconomic factors such as unemployment rate, inflation rate, and housing prices influence transition probabilities between employment and retirement states. We conclude in Section 7.

II. Data

We use the Continuous Work History Sample (CWHS) dataset.[1] This dataset is a result of a continuous effort of the Social Security Administration to collect comprehensive data on work histories to study work patterns for the entire working life of individuals.[2] The CWHS file includes longitudinal earnings and Social Security program entitlement information for a 1-percent sample. The 1-percent samples is selected based on digits of the Social Security number (SSN) and is generally considered to be a random sample. The sample is selected from all individuals, workers and non-workers, with valid Social Security numbers. There are two parts of the CWHS—active and inactive files. The active file includes those who have ever reported earnings, and the inactive file includes those who have never reported earnings, covered or uncovered.

The CWHS is an analytical master file that provides a complete work and Social Security program participation history of the 1-percent sample. Data elements in the CWHS are taken from several Social Security Administration Master files, including the Numident, the Master Earnings File (MEF), the Master Beneficiary Record (MBR), and the Supplemental Security Record (SSR). The Numident file contains birth and death dates, place of birth, race, and sex. The MEF contains

[1] Some prior studies that use CWHS are Song and Manchester (2007) and Kopczuk *et al.* (2010).
[2] More information about CWHS is available at http://www.ssa.gov/policy/docs/ssb/v52n10/v52n10p20.pdf.

annual FICA summary earnings from 1937 to the present. It also contains annual detailed earnings, Medicare taxable compensation, and total compensation from 1978 to the present for the U.S. population. The earnings records are taken directly from W-2 forms. The MBR file contains information related to the administration of the OASDI program, such as application and entitlement dates, benefit amounts for all individuals who have ever applied for Title II benefits. The SSR file maintains information on all persons who have ever applied for Title XVI SSI benefits.

The CWHS provides the full history of individuals' annual earnings (both capped and uncapped), Old-Age, Survivors, and Disability Insurance (OASDI) benefit entitlements, Supplemental Security Income (SSI) program participation, and death records. Key data elements are: 1) demographic characteristics—year of birth, sex, race, and date of death (if any); 2) annual Social Security covered earnings from 1951 to date; 3) annual uncapped total wages from covered or non-covered employment from 1978 to date; 4) annual Social Security taxable self-employment income from 1951 to date; 5) number of years employed, first and last years employed, and number of quarters of coverage from 1937 to date; (3) OASDI insurance status; (8) OASDI and SSI benefits status and dates of entitlement; (9) Medicare taxable earnings.

This dataset has several key advantages over previously used data. First, CWHS has a long time series dimension: Social Security earnings are covered since 1937. Accordingly, we can use multiple recession episodes to study the cyclical properties of retirement timing. Likewise, these long time series will allow us to exploit significant variation in inflation rate which is not available to researchers using other data sets (e.g., Survey of Income and Program Participation).

Second, CWHS tracks workers over their lives and hence has effectively complete data on lifetime earnings. In contrast, previously used datasets typically have repeated cross sections (e.g., CPS) or short panels with the duration of one to four years (e.g., Survey of Income and Program Participation). By using CWHS, we can avoid relying on the synthetic cohort approach used in much previous work.

Third, CWHS is based on administrative records. Numerous studies (e.g., Haider and Solon, 2006; Bound et al., 2001; Moore et al., 1997; Bound and Krueger, 1991) report that survey measures of income exhibit nontrivial biases when compared with administrative records. A disadvantage of the CWHS is top-coding at the Social Security earnings maximum prior to 1978.

(It includes W-2 data after 1978.) Nevertheless, we can extrapolate annual incomes in censored cases from the quarter in which SSA limits were reached (see Kopczuk *et al*., 2010).[3]

Fourth, CWHS has records for millions of workers, which is a much larger sample than a standard dataset such as the Panel Study of Income Dynamics (PSID), SIPP, CPS, or Consumer Expenditure Survey (CE). The massive size of CWHS allows us to study narrowly defined groups of the population without having to make parametric assumptions or sacrificing precision of the estimates. This aspect is particularly important for us since we focus on workers approaching retirement and the size of this population group is rapidly shrinking with age.

While CWHS is a random one percent sample of Social Security numbers and thus is nationally representative, we use several filters to minimize selection effects potentially affecting retirement choices of individuals. First, we restrict our sample to white males since the racial and gender composition of labor force, occupations, etc. has changed dramatically over time. By focusing on white males, we minimize the effects of such changes in labor force participation and employment. Second, we restrict the sample only to individuals who have at least five years of continuous earnings above $5,000 (in 1984 dollars). This filter removes observations with irregular working histories. Finally, we set earnings to zero in the year of death to eliminate any confusion of reduced earnings in the years of death.

The main downside of using administrative data like CWHS is that we have limited information in demographics and other characteristics of workers or employers. For example, CWHS does not have information on the educational attainment of workers or hours of work. While one would obviously want to condition on many demographic characteristics in addition to race and gender, this constraint is not necessarily binding. Economic theory suggests that the history of earnings may be a sufficient statistic summarizing a variety of individual's characteristics. In part, this theoretical prediction motivates our analysis of behavioral responses of retirement timing to macroeconomic conditions by quintiles of life-time earnings.

III. Definition of full and partial retirement

Our analysis utilizes information in the individual earnings records to measure the extent of labor force participation. Our definition of retirement is based on changes in earnings. Since about 15

[3] See also the treatment of censored Social Security earnings data in House et al. (2008).

percent[4] of individuals keep working even after claiming Social Security benefits, this approach offers more flexibility compared to the definition of retirement as benefits claiming age.

An individual is considered working full time (denoted state F) until his real earnings permanently decline to less than 50 percent of his lifetime maximum annual earnings.[5] Anyone whose future annual earnings are less than 50 percent of their lifetime maximum and more than $5,000 (constant 1984 dollars) is considered partially retired (state P). As soon as a person's earnings permanently drop below the $5,000 floor, this person is entering full retirement (state R). By construction, retirement age is the last age when the earnings exceed the floor, and partial retirement age is the last age when the earnings exceed 50 percent of lifetime maximum. Put differently, retirement is defined as the last continuous spell of non-employment before the individual's death, and partial retirement (if any) is the spell of employment at income not exceeding 50 percent of lifetime maximum that immediately precedes retirement. Consequently, retirement states are ordered: individuals never transit from retirement back to either partial retirement or full-time work, and they never go from partial retirement back to full-time work. Figure 1 illustrates a hypothetical life-cycle earnings profile and the corresponding retirement states.

The $5,000 cutoff is based on the historical record of minimum wages in the U.S. Specifically, we assume that a person is not retired if he earns more than the product of the federal minimum wage rate and 1,000 hours of work, which roughly corresponds to a 40-hour work week over 6 months or approximately a 20 hour work week over 12 months. While there has been some variation in the real minimum wage since the inception of minimum wages, the resulting threshold earnings fluctuate around $5,000 per year. We prefer using a fixed threshold rather than a threshold that varies with the minimum wage rate because nominal minimum wage rates were revised periodically rather than continuously and the discreet nature of these revisions can create episodes where we observe spurious flows into retirement due to movements in minimum wage rather than due to macroeconomic forces.[6]

Earnings records for younger workers who are still alive at the end of the sample period are truncated. If such an earnings record ends with a period of long-term unemployment, our procedure may miscatergorize the unemployment event as partial or full retirement. To address

[4] See Friedberg, 2000, Table 2
[5] We deflate nominal earnings with the Consumer Price Index into constant 1984 dollars.
[6] We have experimented with the cutoffs based on actual minimum wages and found similar results.

the potential effects of the truncation, we shorten the sample to exclude observations for 2006-2010 in our robustness checks.

The classification of states into full employment, partial retirement and full retirement are similar to classifications in previous work. For example, Blau (1994) considers full employment, partial retirement, and out-of-labor force,[7] and Gustman and Steinmeier (2000) compare several definitions of full and partial retirement. The main difference from previous studies lies in what information we use to classify individuals into states. Previous studies typically use hours of work, self-reported status, or the timing of when workers start to collect retirement benefits, however, we observe none of these characteristics in the CWHS, and use earnings instead.[8] A key advantage of classification based on earnings is that earnings effectively combine intensive and extensive margins of labor market participation.

IV. Trends in retirement timing

Figure 2 depicts shares of white male workers by retirement status for 1960-2010 for a few age groups. The figure shows the trend toward lower labor force participation during the 1970s and 1980s, a phenomenon that is well documented in the labor economics literature (e.g., Anderson *et al*, 1999). Another important trend is the rising prevalence of partial retirement among older workers. Many workers appear to depart their career jobs well before reaching their normal retirement age and transition into so-called "bridge jobs" with substantially lower earnings prior to taking full retirement. Partial retirement was virtually non-existent for 60-62 year olds in the 1960s. The share of partially retired 60-62 year olds rose to 15 percent by 1990 and has stayed relatively stable ever since. Partial retirement is even more prevalent among 65-67 year old workers. The share of partially retired 65-67 year olds rose dramatically during 1960-1990 and topped 20 percent in the last 20 years of the sample. This finding is consistent with Giandrea et al. (2009) who conclude that "traditional one-step retirement appears to be fading".

We analyze the time trends in labor force status in more detail by splitting our sample into lifetime earnings quintiles. Specifically, for each individual in our sample, we calculate the present

[7] Most studies do not differentiate between partial and full retirement.
[8] In principle, one could merge CWHS with other SSA's databases and link the histories of earnings to the timing of when workers start to collect retirement benefits. However, as we discussed above, workers have been ending full employment well before they can claim retirement benefits and hence using the official timing of claiming benefits may be misleading.

value of his earnings between the ages of 25 and 54. We use a 2-percent discount rate for present value calculations, but results are similar for other discount rates. The individual is assigned to a quintile based on the ranking of his present value of earnings compared to others in the same birth cohort. We restrict the ages to 25-54 instead of using all ages because people enter and exit the labor force at different times and we do not want to mix the extensive margin of earnings (i.e., how many years a person works) with the intensive margin (i.e., how much a person makes per year). The first quintile corresponds to the lowest income group and the fifth quintile corresponds to the highest income group. By construction, an individual stays in his earnings quintile throughout his life.

Figure 3 illustrates several significant patterns that emerge. Full-time employment rates started roughly equal across lifetime earnings quintiles in 1960, but subsequent trends are quite different. In particular, the bottom 40 percent of earners (quintiles 1 and 2) exhibit the most significant drop in full-time employment. Most strikingly, the full-time employment rate in the bottom quintile dropped from almost 1 percent in 1960 to below 0.4 percent in 1990 for 60-62 year olds and from 0.9 percent to about 0.25 percent for 65 year olds. By contrast, the full-time employment rate of 60 year olds in the top lifetime earnings quintile dropped only slightly, from 0.95 to 0.8 percent. The workers in the top earnings quintile behave differently from the rest in another important respect as well. While the full-time employment rate has stayed relatively stable for the bottom 80 percent of earners since 1990, it grew substantially for 65-67 year olds in the top earnings quintile. One interpretation of this is that workers in the professional occupations that presumably populate the highest earnings quintile choose to have longer careers.

In most years of the sample, the full retirement rate is consistently higher for workers with lower earnings. We see that about 50 percent of 60 year olds in the bottom earnings quintile are fully retired by age 60. It is interesting to note that the trend towards earlier retirement of males during 1960-1990 coincided with the increase in female labor force participation. One interpretation of trends towards earlier retirement that we observe is that a dual earner household does not have to rely on male income as a sole source of financial support, allowing the man to retire earlier.

Retirement rates have become more similar across earnings quintiles as workers age. The upward trends in full retirement over time mostly mirror the downward trends in full employment, with the full retirement rate rising most dramatically among the workers in the bottom earnings quintile. Figure 3 shows a dramatic rise in the full retirement rate among the bottom quintile of the population age 60-62. Importantly, the full retirement rate for 60-62 year olds in the bottom

quintile kept climbing in the 2000s as their partial retirement rate kept dropping, with a substantial uptick during the Great Recession. The permanent exit of these workers from the labor force is especially concerning, since this population group is too young to qualify for Social Security old age benefits and presumably has little in the way of assets to cushion their transition to the retirement benefits claiming phase. This group is more likely to claim Social Security old age benefits early, which permanently reduces their lifetime income. For example, Bound and Waidmann (1992) report that a substantial portion of workers leaving the labor force prior to retirement age receive disability benefits. Thus, the recent upward trend in labor force exit of the low income 60-62 year olds may have contributed to the dramatic growth in the Social Security disability program (Duggan and Imberman, 2009).

Partial retirement rates by earnings quintile exhibit somewhat diverging trends. Among the 60-62 year olds, the workers at the extremes of the earnings distribution have lower rates of partial retirement than middle earners. For top earners, the relatively low rate of partial retirement reflects the high rate of full-time employment for this group. For the lowest earnings quintile, by contrast, the low rate of partial retirement is driven by the high rate of full retirement. All earnings groups exhibit rates of partial retirement that rise from 1960 to 1990 and remain relatively stable afterwards, with the exception of 65-67 year olds in the bottom quintile. For the latter group, the rate of partial retirement has remained relatively low and stable since the early 1970s. The dispersion of partial retirement rates by earnings quintile rises both over time and with workers' age.

V. Transitions between retirement states

We study transitions of workers between four states: full employment (F), partial retirement (P), full retirement (R) and death (D). Let $PR(S \to Q|age,t)$ denote the probability of transitioning from state S to state Q conditional on worker's age and year. Note that by construction of the states, $PR(P \to F|age,t) = 0$, $PR(R \to F|age,t) = 0$, and $PR(R \to P|age,t) = 0$ for all ages and times. We calculate each probability as follows:

$$PR(S \to Q|age = A,t) \equiv \frac{\sum_i \mathbf{1}\left(i \in Q_{A_t,t} \cap i \in S_{A_t,t-1}\right)}{\sum_i \mathbf{1}\left(i \in S_{A_t,t-1}\right)}$$

where i indexes individuals, $S_{A_t,t-1}$ is the set of people in status S at time $t-1$ and age A at time t, $Q_{A_t,t}$ is the set of people in status Q at time t and age A at time t, $\mathbf{1}(\cdot)$ is the indicator function. Figure 4 illustrates the transition probabilities, by year, for workers age 60, 62, 65 and 67.

The probability of remaining in full employment, $PR(F \rightarrow F|age, t)$, remains relatively stable over time for 60-65 year olds. By contrast, for 67 year olds, the probability of remaining in full employment rises dramatically after 1980. We conjecture that this is evidence of a selection effect that strengthens over time: workers who stay attached to the labor force until age 67 are increasingly more likely to continue their full employment spell. The selection may arise because of health: the less healthy members of the cohort drop out of the labor force early, and those who stay employed have better than average health that drives stronger labor force attachment. This interpretation is consistent with the diminishing flow from full employment into partial retirement $PR(F \rightarrow P|age = 67, t)$ for 67 year olds. The probability of transitioning from full employment to partial retirement has been rising over time for other ages as well. For example, for 65 year olds, the probability increased from less than 5 percent in the early 1960s to about 10 percent in the 2000s. For $PR(F \rightarrow R|age, t)$, there is a discernible downward trend for 67 year olds but there is not a clear trend for other age groups. Specifically, $PR(F \rightarrow R|age = 67, t)$ fell from about 20 percent in the early 1960s to about 5 percent in the 2000s, while $PR(F \rightarrow R|age = 60, t)$ stayed approximately constant at 2-3 percent.

The probability of remaining in partial retirement, $PR(P \rightarrow P|age, t)$, rises over time for all age groups, meaning that partial retirement spells have been increasing in length. This is consistent with some earlier evidence. For example, Ruhm (1990, Table 2) reports that more than 40 percent of workers who end their career at age 60-64 spend at least one year in partial retirement, and 17 percent spend more than 5 years in partial retirement. The nature of the partial retirement might have changed as well. In particular, during the 1960s and 1970s, partially retired workers were dying very quickly: the death rate among the partially retired, $PR(P \rightarrow D|age, t)$, has been around 0.3. This suggests that early on most transitions to partial retirement were driven by health concerns. As bridge jobs after careers end became more common, the composition of the partially retired has changed to include an increasing number of healthy bridge job holders. Consequently, the death rate among partially retired has dropped over time and converged to the population average.[9]

Figure 5 presents time series of transition probabilities by income quintile. We observe differential trends across age groups for all quintiles so that the dynamics of transition we reported on Figure 3 above are not driven by any single income group. The behavior of these trends is, by

[9] $PR(F \rightarrow D|age, t)$ and $PR(R \rightarrow D|age, t)$ have been declining over time, but the magnitude of these declines was very modest (1-2 percent) relative to $PR(P \rightarrow D|age, t)$.

and large, similar across income quintiles. While transition probabilities by quintile have more erratic variation than those for the pooled sample, one can discern some differentiation by income even within age groups. For example, even though the full employment rate for 65-67 year olds in the bottom earning quintile is lower than average (Figure 3), this group has the highest probability of labor force attachment, $PR(F \rightarrow F)$. This pattern may arise if there is strong selection by health status: by the time the cohort reaches age 67, the less healthy workers have already retired and the remaining ones have a higher probability of labor force attachment. The probability of labor force attachment for 65-67 year old workers shows an upward trend since late 1970s (Figure 5, column 1, row 3-4). We believe that this may be a response to the gradual relaxation of the Social Security retirement earnings test that happened during 1978-1999 and affected workers over the age of 65. The retirement earnings test withholds Social Security benefits for individuals who continue working after claiming benefits and their earnings exceed a certain level called the exempt amount. The exempt amounts were gradually raised for workers older than 65 starting in 1978, strengthening the incentive to keep working even after claiming Social Security benefits.

VI. Sensitivity of retirement timing to macroeconomic variables

In the previous section, we document significant movements in the shares of population by employment/retirement status as well as in transition probabilities across employment/retirement. Visual inspection of the figures may suggest that some of the variation can be caused by business cycles. To formally explore this conjecture, we estimate the following econometric specification:

$$PR(S \rightarrow Q|age, t) = \alpha_{age} + \beta_{age} BC_t + \gamma_{age} t + error \quad (1)$$

where, as before, $PR(S \rightarrow Q|age, t)$ is the probability of transitioning from state S to state Q (with three states: full employment (F), partial retirement (P), full retirement (R), BC is a variable measuring the business cycle (which is either the unemployment rate or a dummy variable for a recession as defined by the NBER), and t is a time trend. Note that we estimate specification (1) for each age separately. To provide an "aggregate" measure of the sensitivity of retirement timing to business cycles, we also estimate a pooled specification

$$PR(S \rightarrow Q|age, t) = \alpha_{age} + \beta BC_t + \gamma_0 t + error, \quad (2)$$

where β and γ are constrained to be the same across ages but intercepts can vary with age. We also estimate versions of specifications (1) and (2) without trends or with quadratic trends. The estimations are performed for ages ranging between 55 and 75. Because the error term is likely to

be correlated across ages and time, we use Driscoll and Kraay (1998) standard errors for inference. Figure 6 and Table 1 report the results.[10]

A. Retirement timing and unemployment rate

The unemployment rate is a major business cycle indicator that impacts labor force status. Our results strongly indicate that a high unemployment rate accelerates transitions from full-time employment to both full and partial retirement, and that it also accelerates transitions from partial to full retirement.

A 1 percentage point increase in the unemployment rate results in roughly a 1 percentage point decrease in the fraction of 55-75 year-olds working full time. However, the impact of the national unemployment rate differs dramatically by age subgroup. For example, the fraction of 64-67 year olds working full time drops by 2 percentage points when the national unemployment rate moves up 1 percentage point. Younger and older workers working full time are not as sensitive to the movements in the unemployment rate. A lower sensitivity of older workers to the unemployment rate is likely to reflect a selection effect. Fully-employed workers at ages 67 and above are probably professionals in good health and in industries which are less sensitive to business cycle fluctuations. For example, doctors, lawyers, professors and similar professions are typical of this subgroup that continues working well after the typical retirement age.

The decline in full-time work associated with a higher unemployment rate results in accelerated transitions into both partial and full retirement. For 55-75 year olds, each percentage point increase in the unemployment rate results in a 1.05-fold increase in the flow from full-time work into full retirement, a 1.07-fold increase in the flow from full-time work into partial retirement and a 1.05-fold increase in the flow from partial to full retirement.[11] As Figure 6 shows, flows into retirement increase the most among workers around normal retirement age, 64 to 67 years old.

Workers who are already partially retired show a differential response to an increase in unemployment rate. While workers younger than 63 extend their partial retirement spell when unemployment rate is high, 64-75 year olds accelerate their transition into full retirement.

[10] Results are similar (Appendix Table 1) if we use a shorter sample (1960-2005) that excludes the Great Recession.
[11] Changes in flows are calculated by dividing the regression coefficient by the corresponding transition probability.

B. Retirement timing and inflation

While the state of the labor market may be a key determinant of retirement timing, inflation can play an important role too. To the extent that household portfolios include assets with nominal returns (such as nominal bonds), households approaching retirement can be exposed to significant inflation risks. Doepke and Schneider (2006) and Meh and Terajima (2011) show in calibrated models that even modest increases in the inflation rate can lead to significant redistribution of wealth. Doepke and Schneider (2006) estimate, for example, that with a 5 percent increase in the price level (i.e., a one-time 5 percent inflation shock) wealthy older households in the U.S. can lose between 5.7 and 15.2 percent of GDP in present value terms. These wealth losses would be even more dramatic if inflation increases gradually and more persistently. The main factor behind these calculations is that older households hold a significant fraction of their wealth in assets bearing nominal returns. Although recent financial innovations (e.g., inflation-protected bonds) helped to reduce these risks to some extent, inflation risk remains an issue. These concerns are reminiscent of events in the 1970s when the SSA and retiring workers had to address a number of issues associated with rising and persistent inflation. For example, a series of studies sponsored by the SSA (e.g., Thompson, 1978; Parnes, 1981) were specifically concerned with understanding inflation's effect on accumulated savings of retiring households and retirement timing. These previous studies found that while inflation created strong incentives for continued labor force participation by older workers, the actual response of retirement timing was weak.

This "inflationary" incentive to postpone retirement may be reinforced by other factors. For example, high inflation can indicate a boom when earnings are higher and thence the opportunity cost of retirement is higher. In short, one may be led to expect a positive relationship between inflation and decisions to stay in the workforce (full employment).

To assess the sensitivity of retirement decisions to inflation, we augment the baseline specification (2) with annual CPI inflation rate. Columns 4 through 6 in Table 1 show the results: high inflation *reduces* full-time work and accelerates transition to partial and full retirement. Figure 7 demonstrates that this negative relation is typical and is not dependent on outliers or unusual episodes. For example, this surprising result is not driven by the stagflation of the late 1970s and early 1980s.

One may argue that the negative relationship between the inflation rate and the full-time employment rate reflects a combination of (i) a gradual disinflation in the U.S. economy since

Volcker's fight on inflation, and (ii) a gradual increase in the prevalence of partial and full retirement. To address this concern, we include time trends as controls but these have no material effect on the estimates. In addition, inflation rose over the course of the 1960s and early 1970s, while the trend towards more partial and full retirement has been fairly continuous since the 1960s. This combination of changes in inflation and retirement patterns in the early part of our sample is inconsistent with a negative correlation.

Alternatively, inflation may influence the level of macroeconomic volatility which can push workers into earlier retirement. While increased inflation can be related to increased macroeconomic volatility in the U.S. (Coibion and Gorodnichenko, 2011), a decrease in macroeconomic volatility induced by declining inflation should induce (not reduce) early retirement, because workers facing lower macroeconomic risks should accumulate less (precautionary) wealth and hence should be able to retire earlier.

Another possibility is that inflation marks times that are most conducive to self-employment, and to the extent that the self-employed fail to report their earnings to SSA, we may observe declining full employment after inflationary shocks. While older workers are more likely to be self-employed, the share of self-employed has been gradually declining since late 1960s and has shown little if any cyclical variation (e.g., Karoly and Zissimopoulos, 2004).

A plausible explanation of this negative relationship is likely to lie in the nature of how nominal wages respond to inflation. Barattieri et al. (2013) and others document that nominal wages are more rigid than prices. A rise in inflation is unlikely to be matched by a rise in wages of similar size. An inflation shock is likely to reduce real wages and, hence, make retirement a more attractive option. Inflation-indexed benefits of many Social Security programs probably reinforce incentives to retire.

C. Retirement timing and housing prices

A significant portion of middle class wealth is in the form of housing equity. One should expect, therefore, that movements in housing prices should substantially affect household wealth, which may alter decisions about when to retire. We have not found a strong association between housing price levels and labor force status transitions, with one exception. High home prices seem to accelerate the flow from partial to full retirement (which is consistent with a wealth effect), but have an ambiguous effect on other transitions (Table 1, columns 7-12). This low sensitivity of

retirement timing to movements in home prices may indicate that (potential) retirees do not use their housing wealth as a source of immediate income. Since retirees are more likely to own houses, have lower outstanding mortgages, and receive relatively stable income from other sources (SSA benefits, financial savings, part-time work, etc.), they are unlikely to face systematic, immediate pressure to capitalize homes in recessions. In other words, potential retirees can continue to enjoy the flow of services from their housing and postpone the sale of their homes until the housing market improves. This flexibility can rationalize the low estimated sensitivity of retirement to housing prices.[12]

D. Sensitivity of retirement transitions by earnings quintile

We proceed by estimating specification (2) separately for each lifetime earnings quintile. This analysis is interesting for several reasons. First, in the context of the life-cycle model, theoretically optimal behavior implies that the present value of lifetime earnings is proportional to wealth at retirement. Hence, individuals in the top lifetime earnings quintile should have considerably more in retirement wealth (housing, financial assets, and SSA benefits) than individuals in the bottom lifetime earnings quintile (some housing, but mostly SSA benefits). One may expect that a higher wealth level makes one less sensitive to macroeconomic conditions. This may be because individuals with more resources may have more control over their retirement timing and be better able to withstand adverse macroeconomic conditions. Besides, income quintiles are likely to reflect differences in occupations with varying degrees of career flexibility and control over the retirement timing. For example, top income quintile is likely to be populated by professional workers such as doctors, lawyers, engineers with flexible work schedules and low risk of unemployment during recessions, while the bottom income quintile is likely to be populated with low-education, manual workers such as secretaries, clerks, assembly line workers with fairly inflexible work schedules (e.g., 40 hour work week) and relatively high risk of unemployment during recessions. The latter group is particularly interesting given recent trends in job polarization (see Jaimovich and Sui 2013) and using disability claims to make transitions to retirement (see Autor and Duggan 2006). In short, one may expect large differences in the sensitivity of transition probabilities across income quintiles.

[12] We also experimented with including returns on equity and bonds as potential determinants of retirement timing. Similar to Bosworth and Burtless (2010), we did not find any strong and robust relationship between returns and retirement timing. Results are available upon request.

We find (Table 2) some differences in the sensitivities but these differences are not statistically significant. For example, in the specification with the linear time trend for the bottom income quintile (column 2), the sensitivity of staying in full employment is -0.77 while the sensitivity for the top income quintile in the same specification (column 14) is -0.54, which is consistent with more insulation from business cycles for the top income quintile. This difference is considerable but we cannot statistically reject the null at conventional significance levels that these sensitivities are the same. Figure 8 shows that the sensitivity is broadly similar across age groups and, in this sense, the result is robust.[13] A similar pattern emerges for sensitivity to inflation and housing prices although there is some variation across specifications and sometimes the differences across income quintiles are statistically significant. For example, high inflation appears to be associated with a higher probability of exiting full employment for the bottom income quintile than for the top income quintile. In summary, the sensitivity of retirement to unemployment, inflation and housing prices is similar across income quintiles.

E. Robustness

In the previous sections, we document that the timing of retirement is sensitive to recessions: when unemployment rises, workers are more likely to transition to partial or full retirement. In this section, we present a series of checks to establish the robustness of this result. Specifically, we examine the sensitivity of retirement timing to alternative measures of business cycles and using alternative samples.

First, the key limitation of our approach to identify the employment/retirement state is that it may be sensitive to the end-of-sample truncation. For example, if a worker is laid off in the last year of our sample, we classify this worker as retired because we do not observe positive or large earnings of this worker. This end-of-sample issue is potentially exacerbated by the fact that the Great Recession happens in the end of our sample. Indeed, in the end of the sample we observe an increase in transitions to retirement. While this may be a genuine effect of the Great Recession, we can separate it from the end-of-sample issue only as more years of data become available.

To address this concern, we re-estimate our baseline specification on the sample that ends in 2005. With this shorter estimation sample, we minimize the adverse effects of the end-of-sample issue because we have additional five years of earnings for each worker and we have enough time

[13] See also Appendix Figures 1 and 2.

after 2005 to establish whether a worker returns to full employment. Figure 9 shows that results based on this shorter sample are barely changed and, if anything, more precise than the results in the full sample.

Second, the data exhibits trends and one may be concerned that including a linear trend can drive our results or, alternatively, that using linear trends does not provide enough flexibility in capturing low-frequency variation in transitions. As a check, we experiment with including no trends (Figure 10) and including a quadratic trend (Figure 11). None of these modifications changes the results materially.

Third, we use the unemployment rate as a measure of recessionary periods. The unemployment rate is the headline rate which is calculated for both men and women of all ages. On the other hand, the retirement hazards are calculated for white males. Since the dynamics of unemployment may be different across demographics groups, we examine whether our results are sensitive to using unemployment rates for subsets of the population. To control for possible differences between men and women, we explore the sensitivity to the unemployment rate for males and find no change in the results (Figure 12). In Figure 13, we further narrow the set of workers used to calculate the unemployment rate to include only men in prime working ages (25-54). This alternative rate is likely to minimize feedbacks from retirement to unemployment for the 55+ year old group we study. Again, we observe no tangible difference in the results. Finally, we use dummy variables equal to 1 for times declared as recessions by the NBER and 0 otherwise, to measure the state of the economy. Since recessions declared by the NBER may cover only fractions of years while the hazard rates are calculated at the annual frequency, we experiment with several approaches to measure recessions: (i) a recession dummy variable is equal to 1 in a given year if at least one month of that year was in a recession; (ii) a recession variable is equal to the fraction of months in recession in a given year. While the scale of the estimated sensitivity is not comparable to the sensitivity based on the unemployment rate, the qualitative patterns are preserved (Figure 14 and Figure 15).

VII. Concluding remarks

This paper analyzed individual earnings histories to document the trends in labor force participation of older workers and to investigate how macroeconomic factors influence retirement timing. The full retirement rate for white males shows a pronounced increase during 1960-1990.

This increase was especially dramatic for the workers in the bottom lifetime earnings quintile: half of bottom earners are out of the labor force by age 60. To the extent that labor force exit is correlated with poor health, this increases the potential pool of applicants for disability benefits. The increase in the full retirement rate was accompanied by a significant increase in the partial retirement rate for all age and earnings groups. Currently, as many as 15 percent of workers age 60-62 are partially retired, a phenomenon that was virtually non-existent in the 1960s. The partial retirement spells have grown longer for all workers.

Our results indicate that during periods of high unemployment, transitions into full and partial retirement accelerate substantially, with workers around the normal retirement age being particularly sensitive to the unemployment rate. Therefore, demand for Social Security old age benefits is likely to rise in downturns. As recessions induce a permanent exit of older workers from the labor force, one can expect a decline in the employment to population ratio following recessions. This response, for example, can help explain persistent declines in employment to population ratio in recent recessions, which were characterized by jobless recoveries and occurred against the backdrop of an aging population.

We also find that the behavioral response of retirement to inflation is such that inflationary shocks can accelerate retirement. While SSA does not have control over inflation, the Federal Reserve System (the Fed) does. We see two key policy implications in this context. First, the Fed's decision on long-term inflation targets can influence retirement choices of the aging workforce. Specifically, persistently low inflation should make people work longer and help relieve some pressures that the Social Security system is now facing. While the benefits of low inflation targets are discussed elsewhere in detail (e.g., Coibion, Gorodnichenko and Wieland 2012), we are not aware of the connection between inflation and retirement timing established in the previous literature. Second, the Fed often uses the employment to population ratio to gauge the health of labor markets. For example, the recent expansionary policies of the Fed appear to be motivated by a big decline in employment to population ratio even when the unemployment rate fell below 8 percent. To the extent that expansionary monetary policy can generate inflation, older workers may retire earlier and thus reduce the employment to population ratio, thus calling for even more expansionary policies, which appears to be a counterargument to the recent call to raise inflation targets. Analyzing this potentially vicious circle is beyond the scope of this paper, but policymakers should be aware of this potential drawback.

Changes in housing prices are found to have only minor effects on retirement timing, suggesting that wealth effects may be modest. Moreover, individuals with different wealth levels respond to macroeconomic conditions in very similar ways, which further supports the conclusion that wealth level is not a major factor in retirement timing.

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Figure 1. Retirement states for a hypothetical age-earnings profile

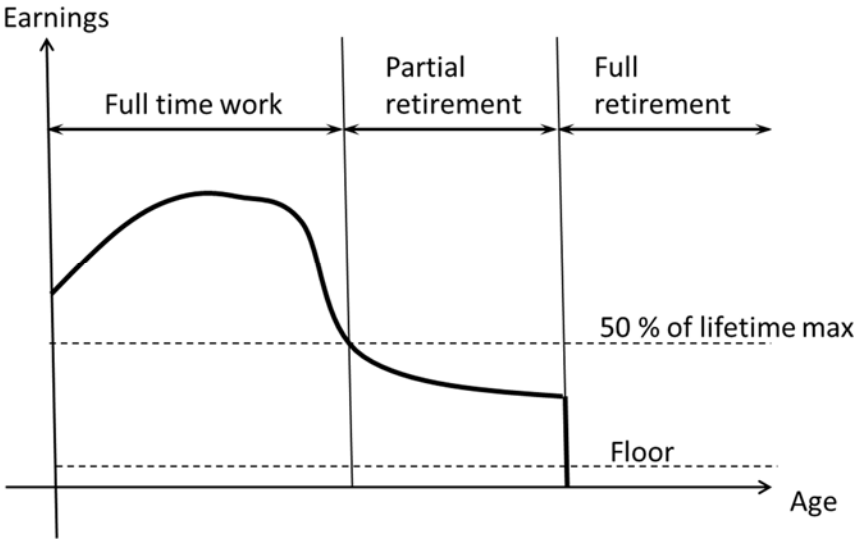
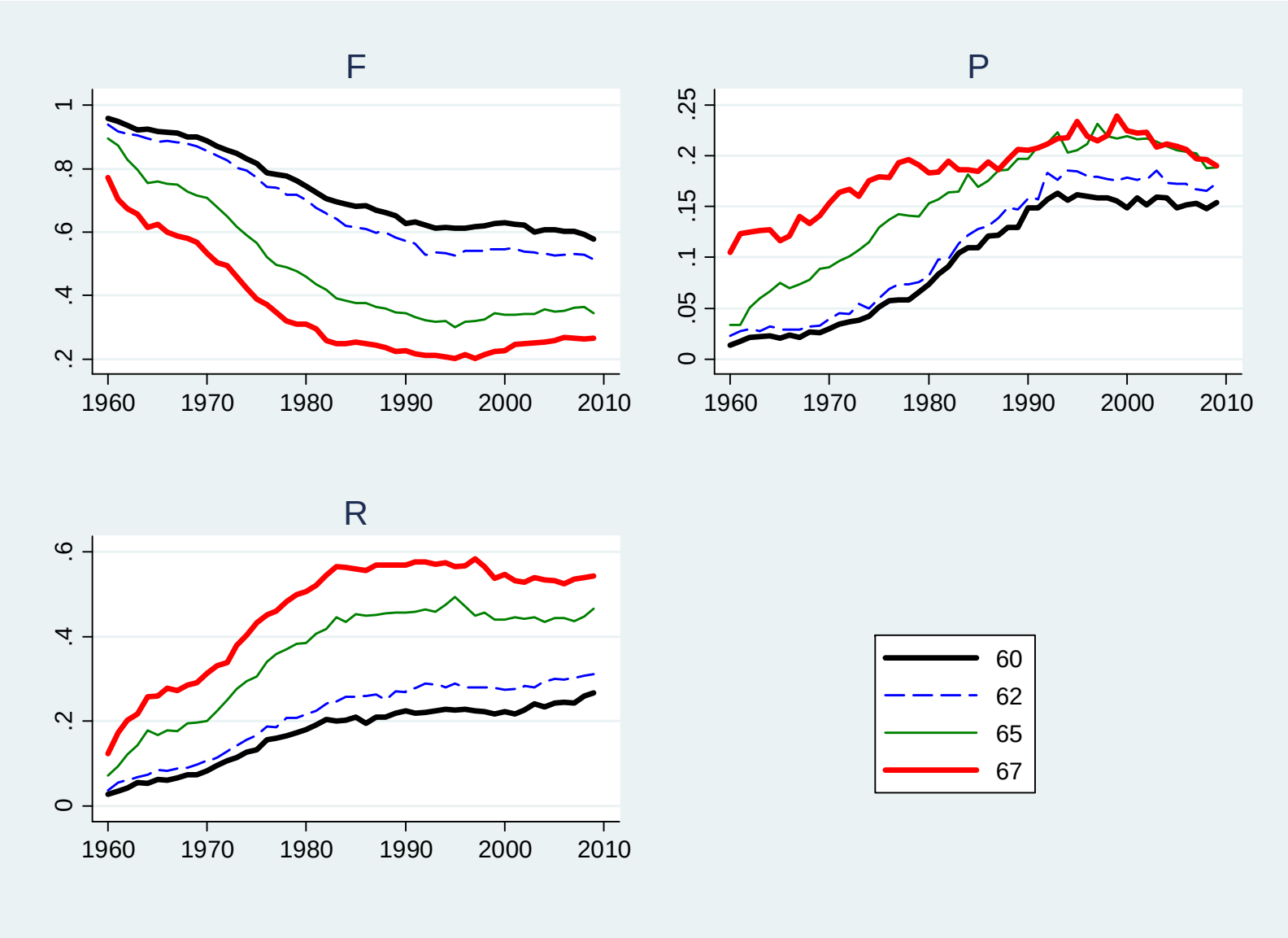
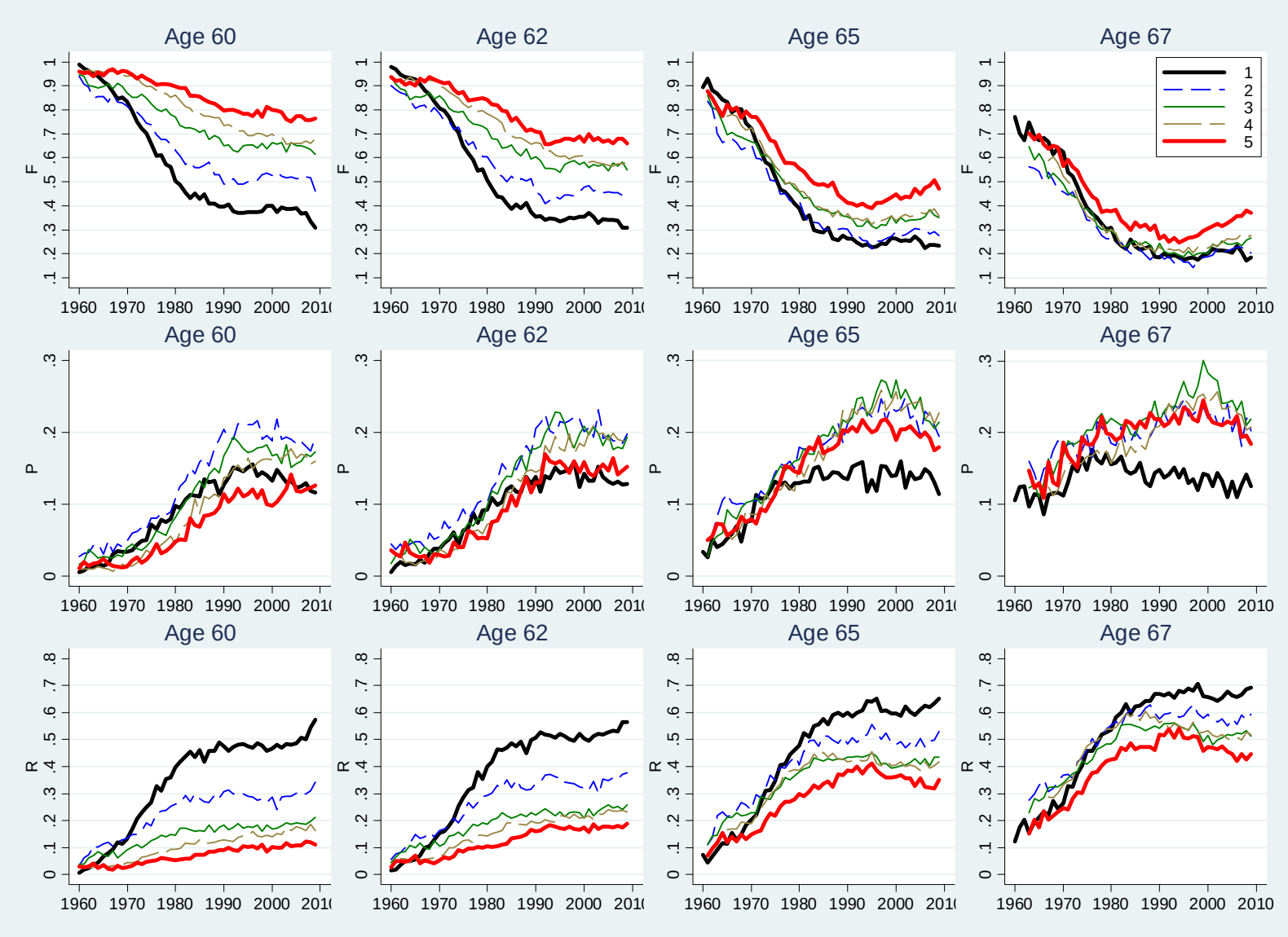


Figure 2. Share of population by employment status.



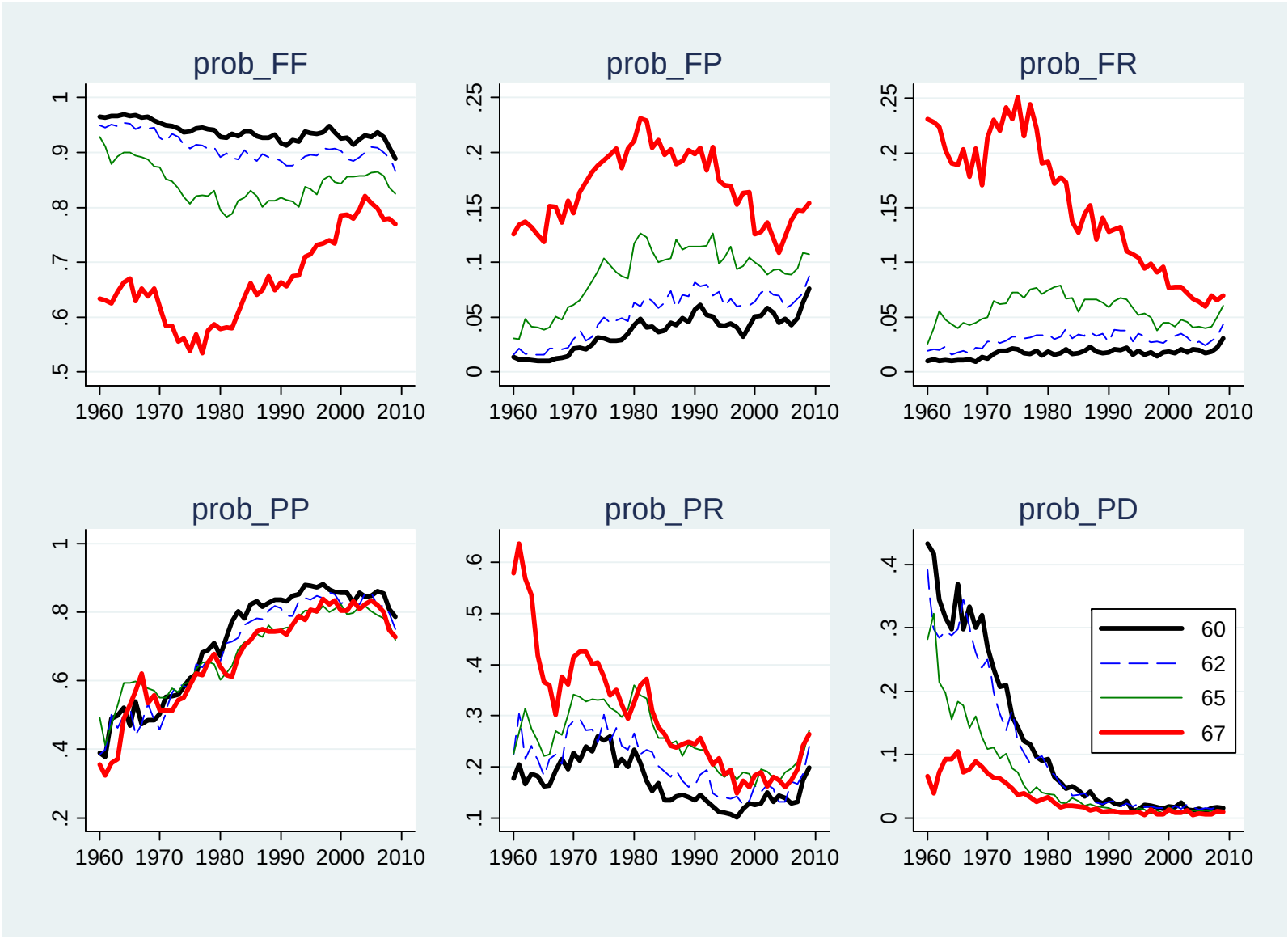
Notes: the figure plots time series of shares of (living) population by employment/retirement status for selected ages. *F* denotes full employment, *P* denotes partial retirement, *R* denotes full retirement.

Figure 3. Share of population by employment status by quintile of PV life-time earnings (quintile 5 = top quintile)



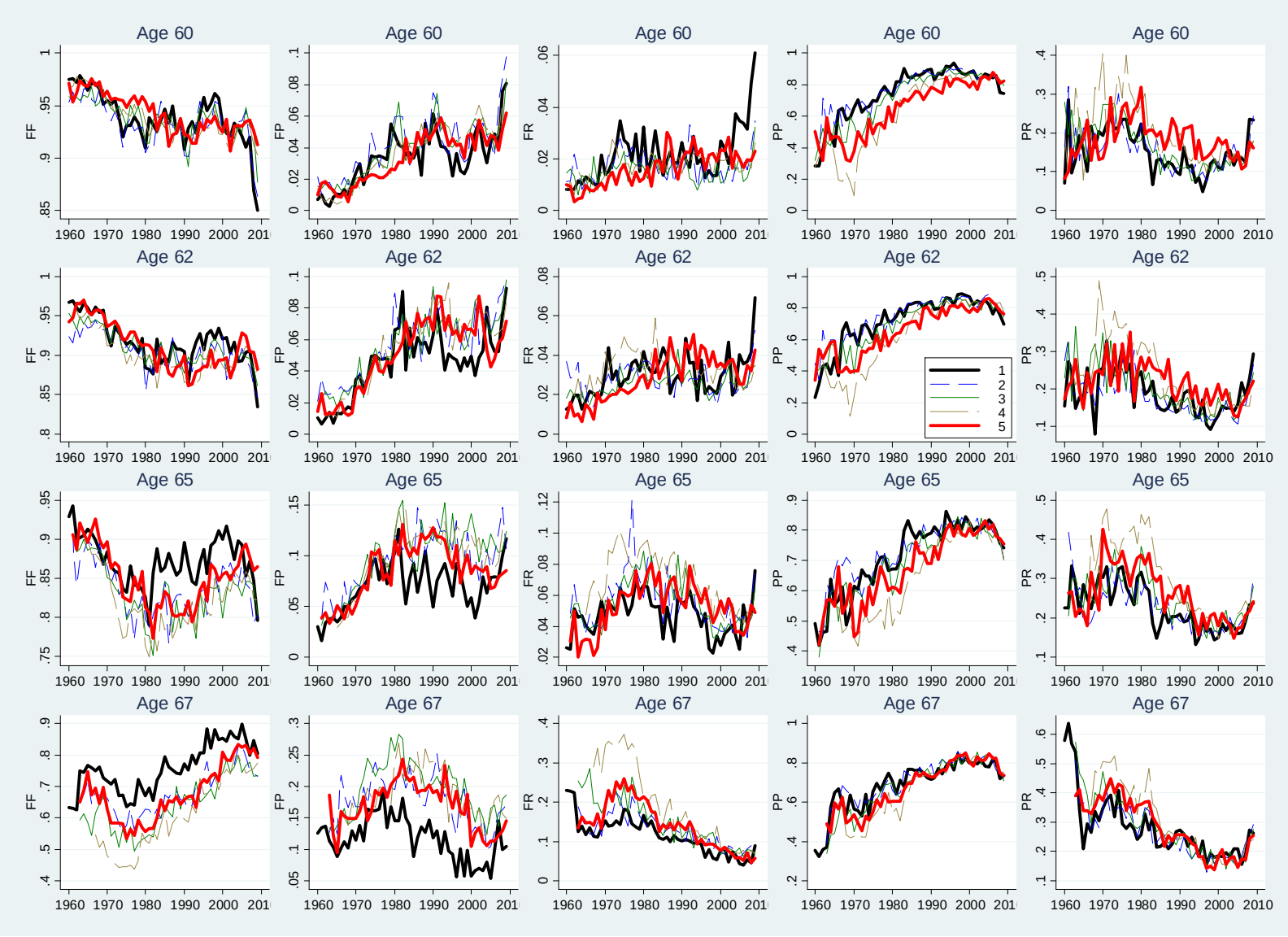
Notes: the figure plots time series of shares of (living) population by employment/retirement status and by quintile of life-time earnings for selected ages. The present value of earnings for each worker is calculated for ages between 25 and 54 years. *F* denotes full employment, *P* denotes partial retirement, *R* denotes full retirement.

Figure 4. Time series of transition probabilities by age.



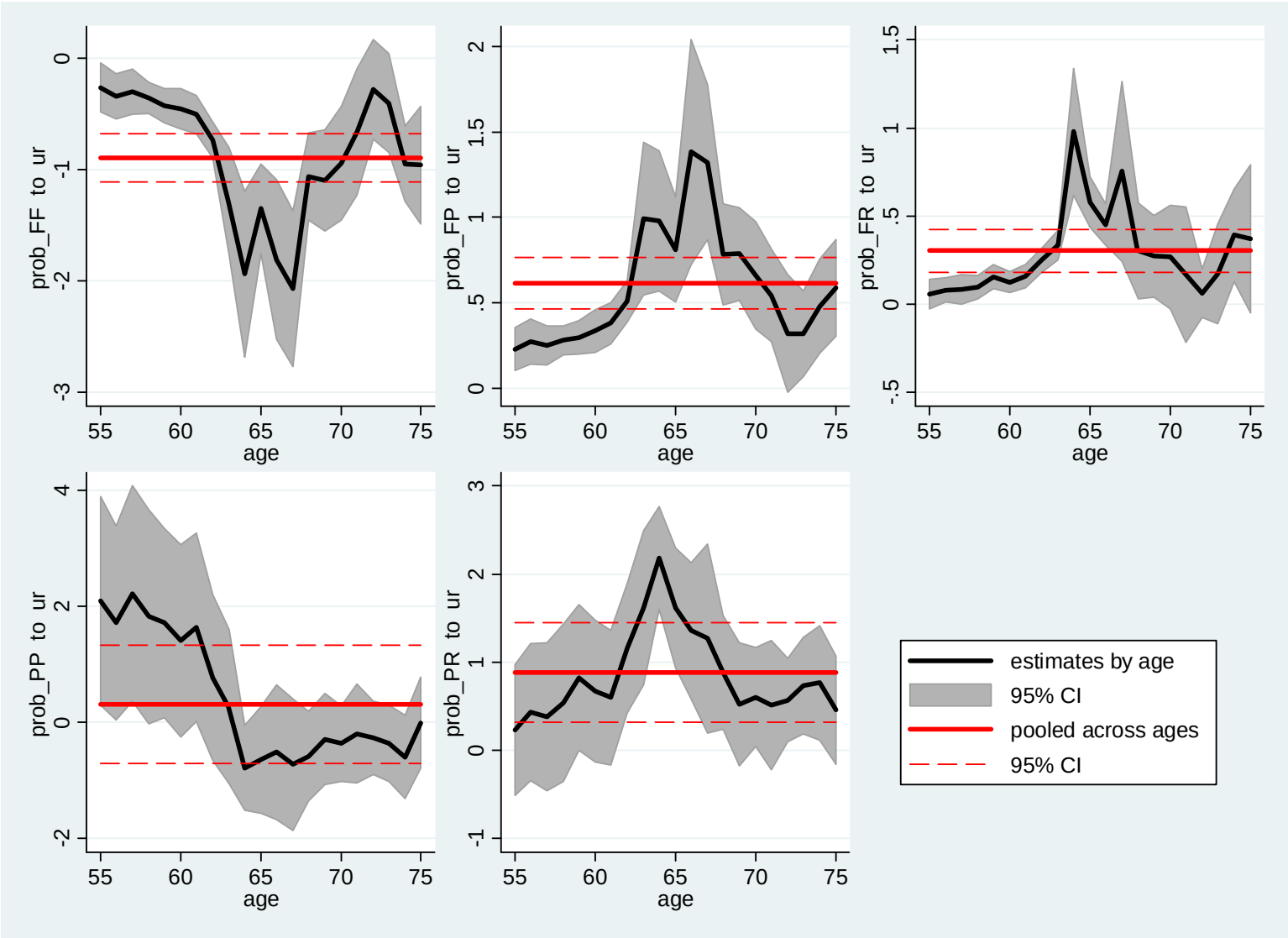
Notes: the figure plots time series of transition probabilities across employment/retirement states for selected ages. *prob_XY* denotes the probability of moving from state *X* to state *Y*. *F* denotes full employment, *P* denotes partial retirement, *R* denotes full retirement, *D* denotes death.

Figure 5. Time series of transition probabilities by age and income quintile.



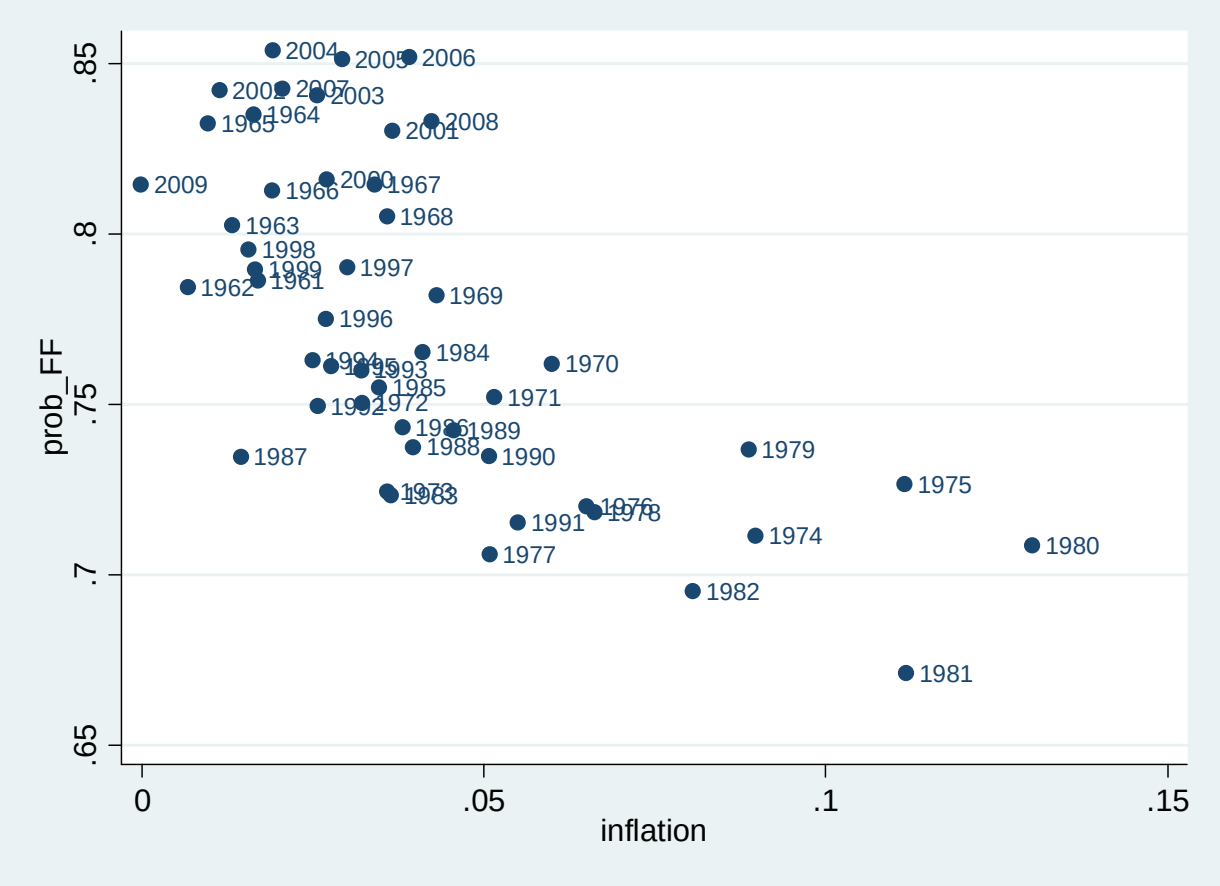
Notes: the figure plots time series of transition probabilities across employment/retirement states for selected ages. *prob_XY* denotes the probability of moving from state *X* to state *Y*. *F* denotes full employment, *P* denotes partial retirement, *R* denotes full retirement, *D* denotes death.

Figure 6. Response of transition probabilities to unemployment rate, linear trend.



Notes: each panel shows the estimated sensitivity of *prob_XY* (the probability of transition from state *X* to state *Y*) to unemployment rate. The black, solid line plots the sensitivity estimated for each age separately as in equation (1). The shaded region is the 95% confidence interval. The red, solid line shows the estimated sensitivity of *prob_XY* to the unemployment rate pooled across ages as in equation (2). The red, dashed lines show the 95% confidence interval for the pooled estimate of the sensitivity.

Figure 7. Probability of staying in full employment vs. inflation. Age = 65.

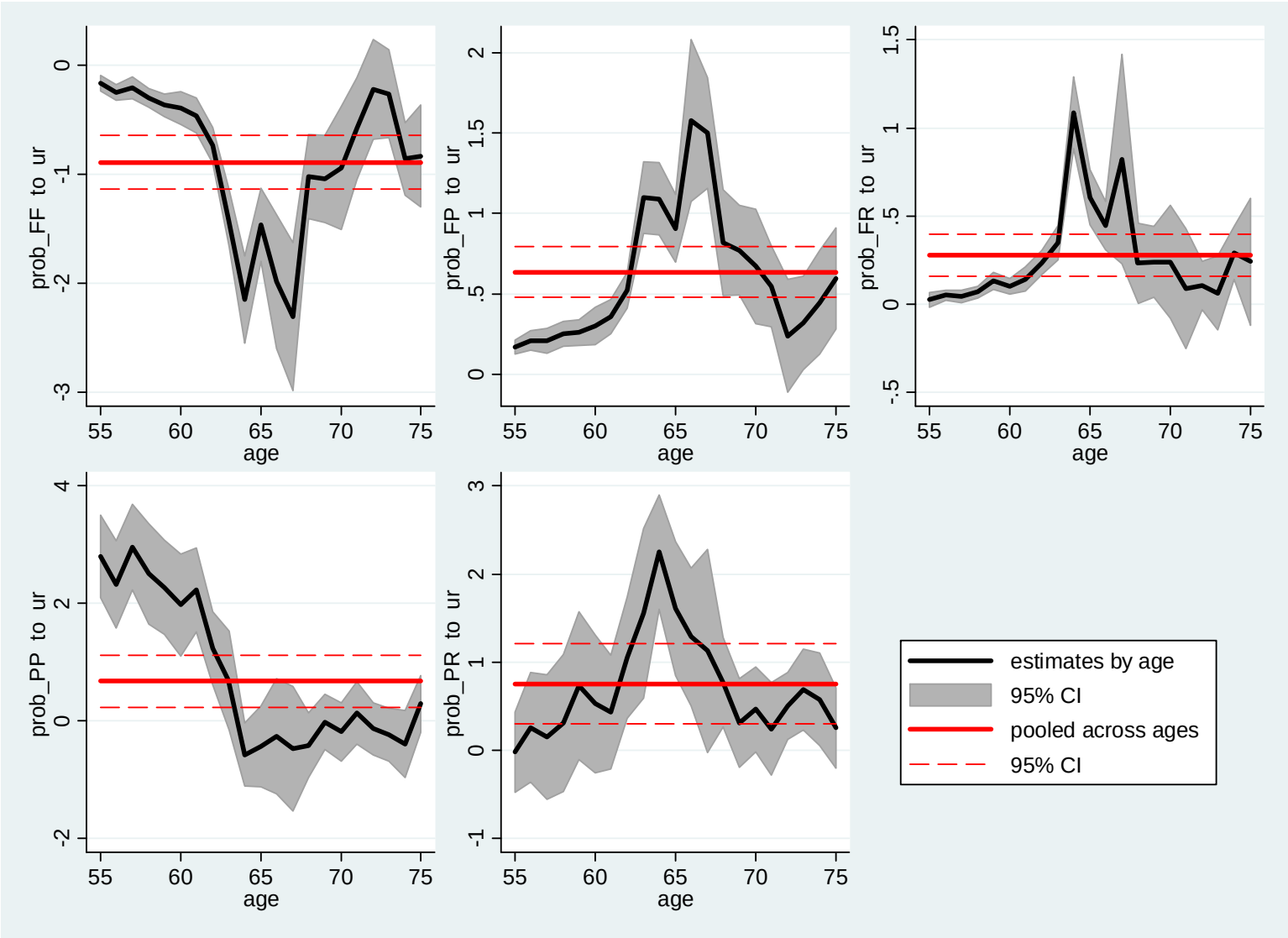


Notes: The figure presents a scatter plot of probability of staying fully employed vs. inflation rate for 65 year olds. 0.1 inflation corresponds to a 10 percent annual inflation rate.

Figure 8. Response of transition probabilities by income quintile to UR (unemployment rate), linear trends.

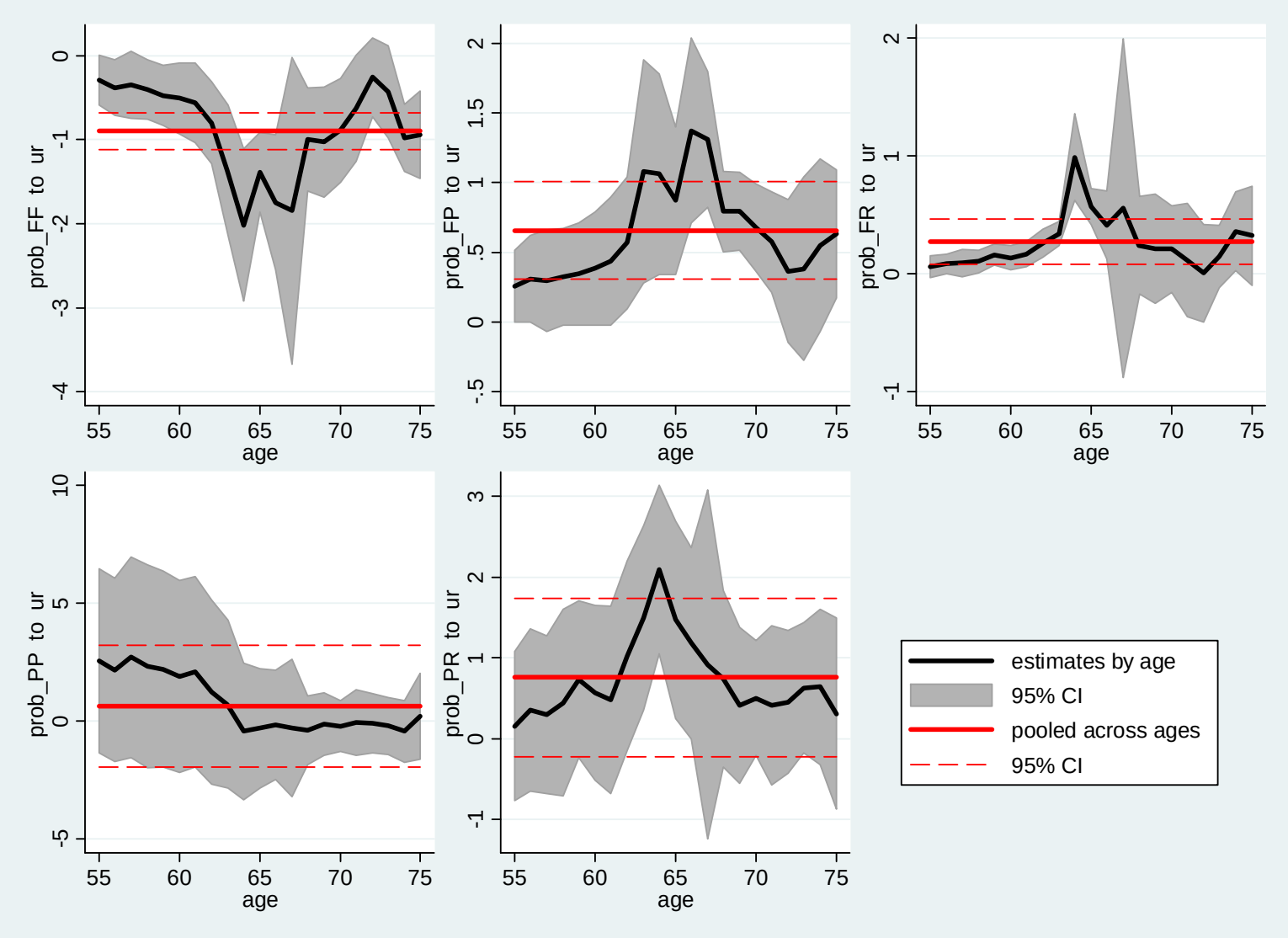
Notes: each panel shows the estimated sensitivity of *prob_XY* (the probability of transition from state *X* to state *Y*) to unemployment rate. Quintile 1 corresponds to the bottom income quintile. Each line plots the sensitivity estimated as in equation (1) separately for each age and income quintile.

Figure 9. Response of transition probabilities to unemployment rate. Estimation sample 1960-2005 (exclude the Great Recession).



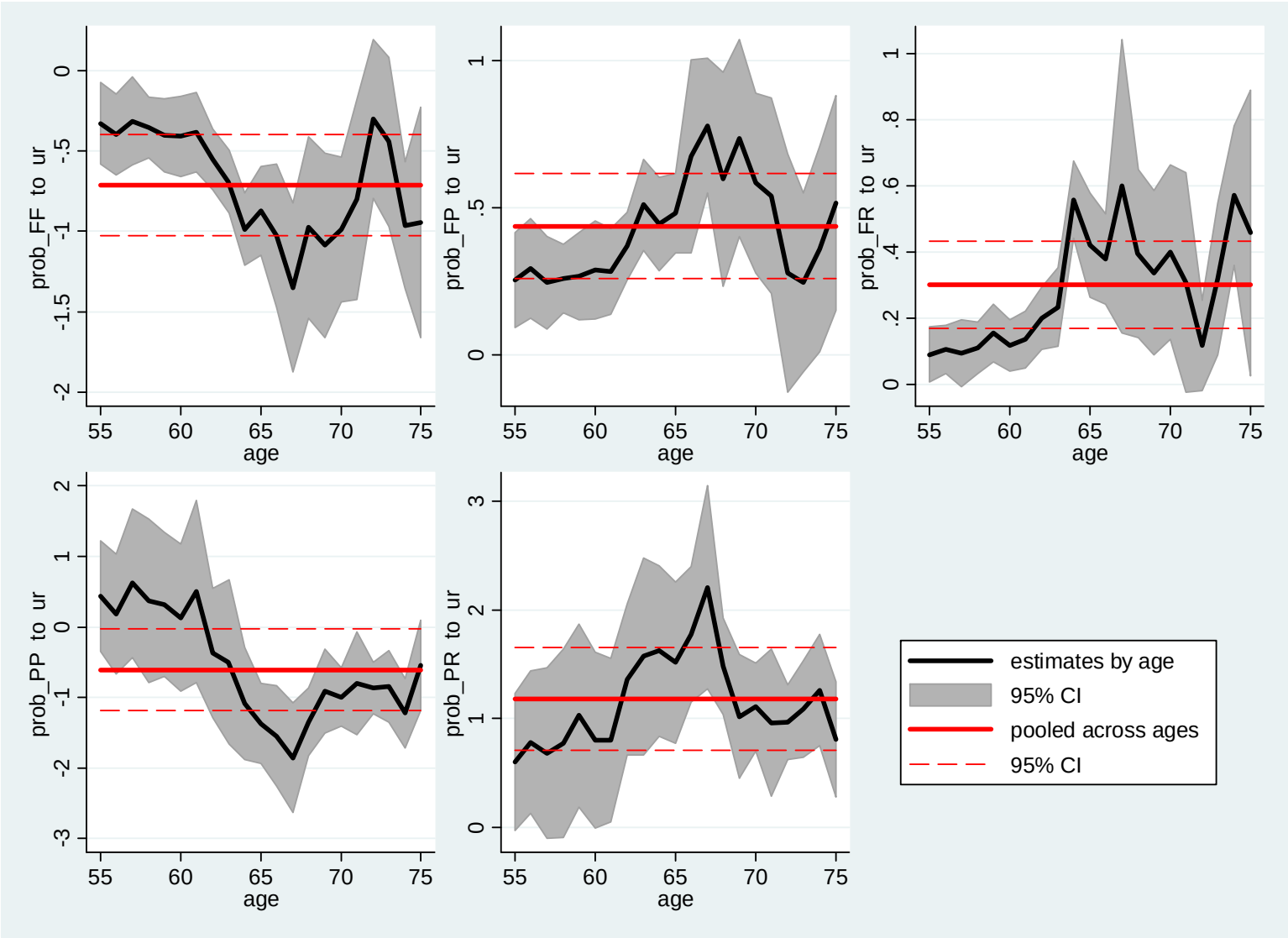
Notes: each panel shows the estimated sensitivity of *prob_XY* (the probability of transition from state *X* to state *Y*) to unemployment rate. The black, solid line plots the sensitivity estimated for each age separately as in equation (1). The shaded region is the 95% confidence interval. The red, solid line shows the estimated sensitivity of *prob_XY* to unemployment rate pooled across ages as in equation (2). The red, dash lines shows the 95% confidence interval for the pooled estimate of the sensitivity. Estimation sample covers 1960-2005.

Figure 10. Response of transition probabilities to unemployment rate, no trends.



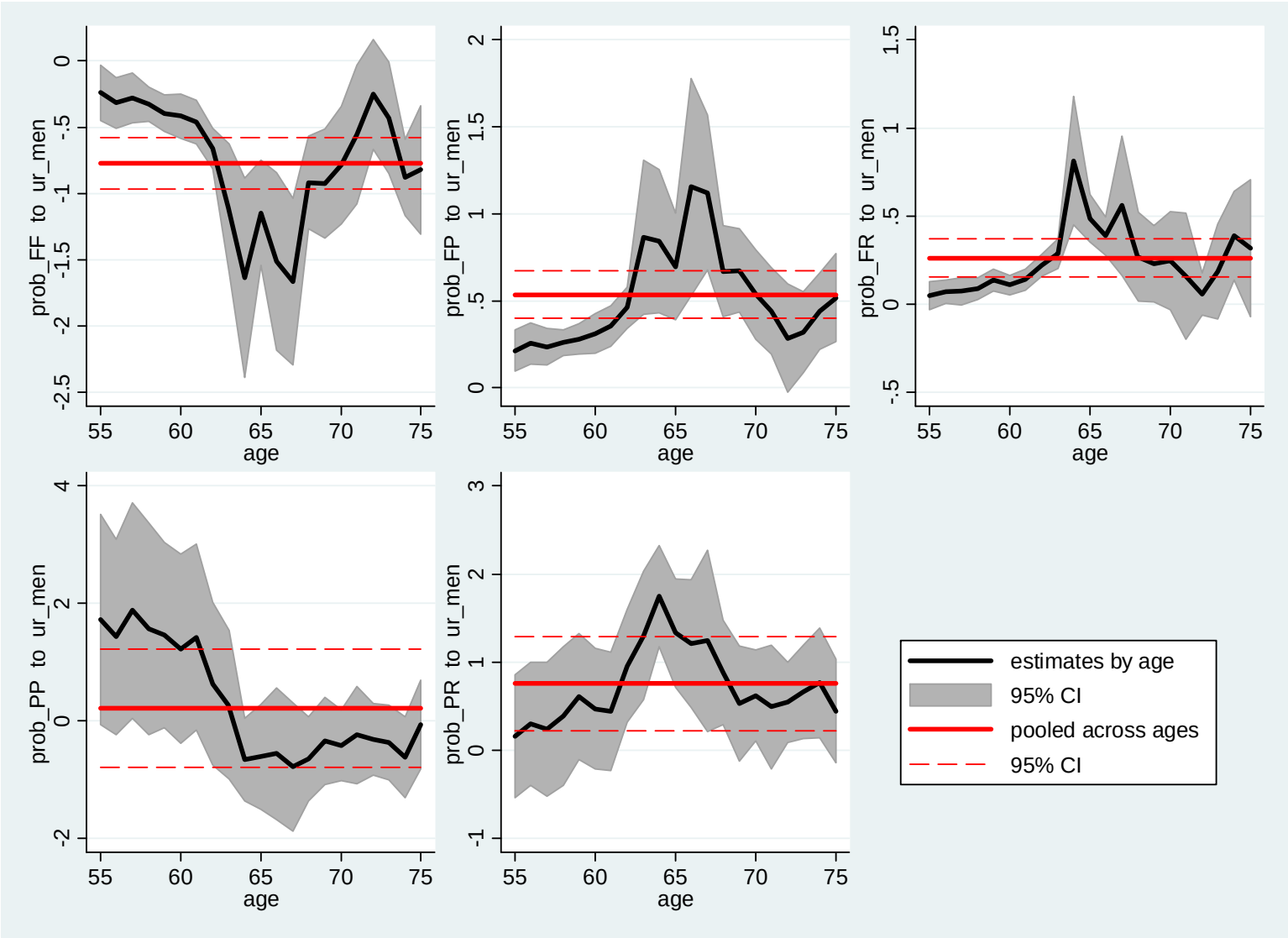
Notes: each panel shows the estimated sensitivity of *prob_XY* (the probability of transition from state *X* to state *Y*) to unemployment rate. The black, solid line plots the sensitivity estimated for each age separately as in equation (1), with no trends. The shaded region is the 95% confidence interval. The red, solid line shows the estimated sensitivity of *prob_XY* to unemployment rate pooled across ages as in equation (2), with no trends. The red, dashed lines show the 95% confidence interval for the pooled estimate of the sensitivity.

Figure 11. Response of transition probabilities to unemployment rate, quadratic trends.



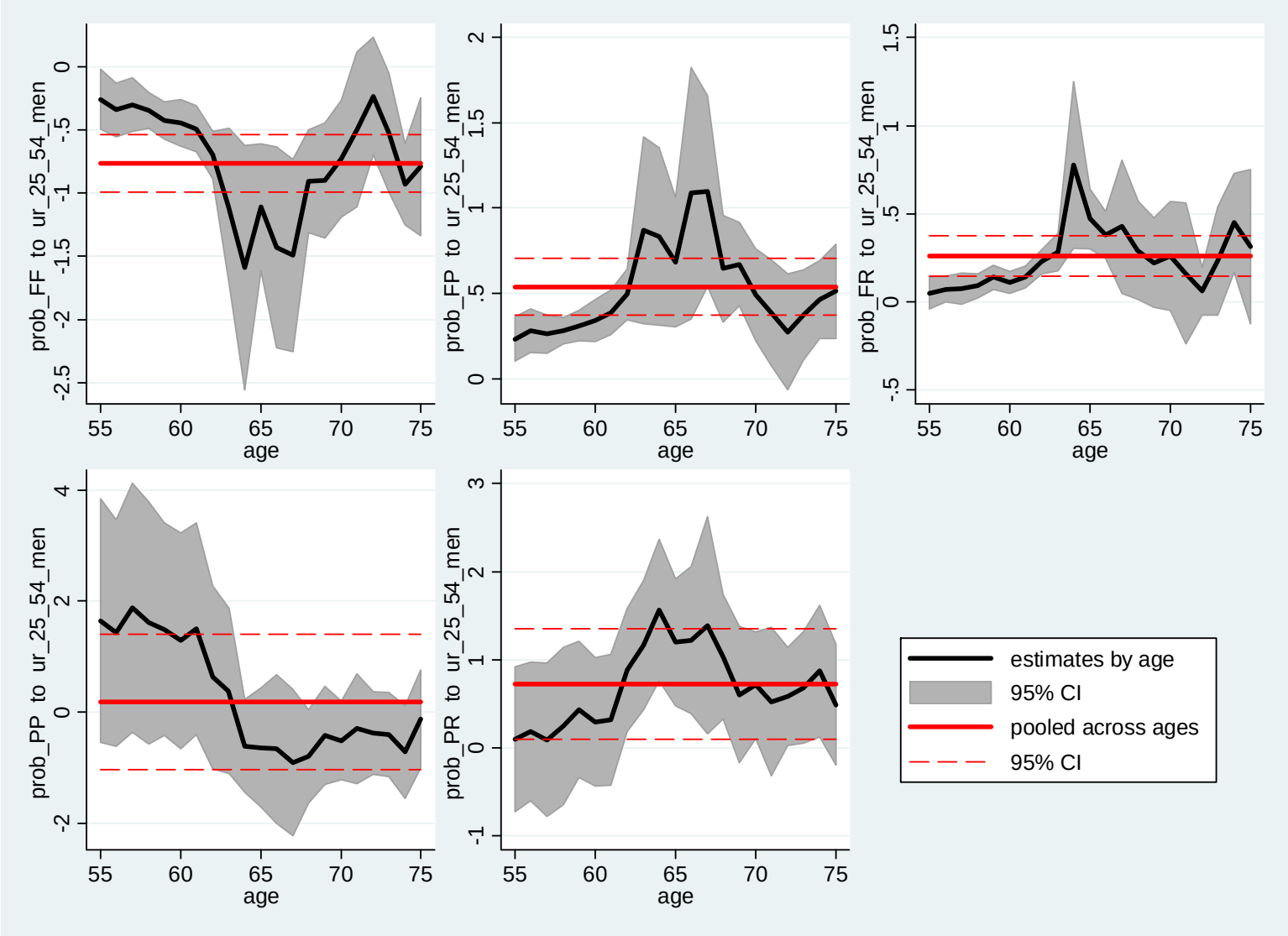
Notes: each panel shows the estimated sensitivity of *prob_XY* (the probability of transition from state *X* to state *Y*) to unemployment rate. The black, solid line plots the sensitivity estimated for each age separately as in equation (1), with quadratic trends. The shaded region is the 95% confidence interval. The red, solid line shows the estimated sensitivity of *prob_XY* to unemployment rate pooled across ages as in equation (2), with quadratic trends. The red, dashed lines show the 95% confidence interval for the pooled estimate of the sensitivity.

Figure 12 Response of transition probabilities to unemployment rate for males.



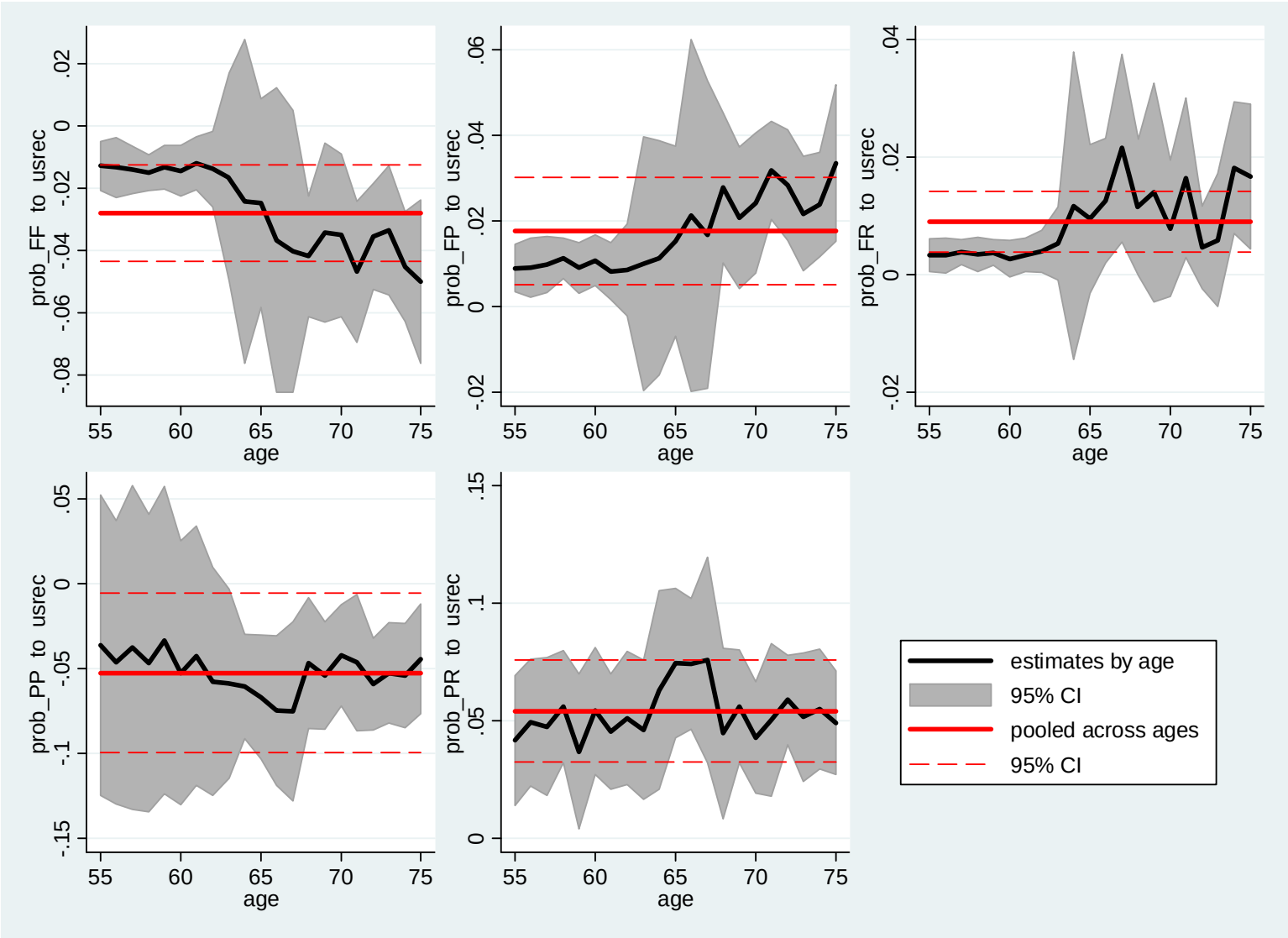
Notes: each panel shows the estimated sensitivity of *prob_XY* (the probability of transition from state *X* to state *Y*) to unemployment rate for males. The black, solid line plots the sensitivity estimated for each age separately as in equation (1). The shaded region is the 95% confidence interval. The red, solid line shows the estimated sensitivity of *prob_XY* to unemployment rate pooled across ages as in equation (2). The red, dashed lines shows the 95% confidence interval for the pooled estimate of the sensitivity.

Figure 13. Response of transition probabilities to unemployment rate for males with ages between 25 and 54 years old.



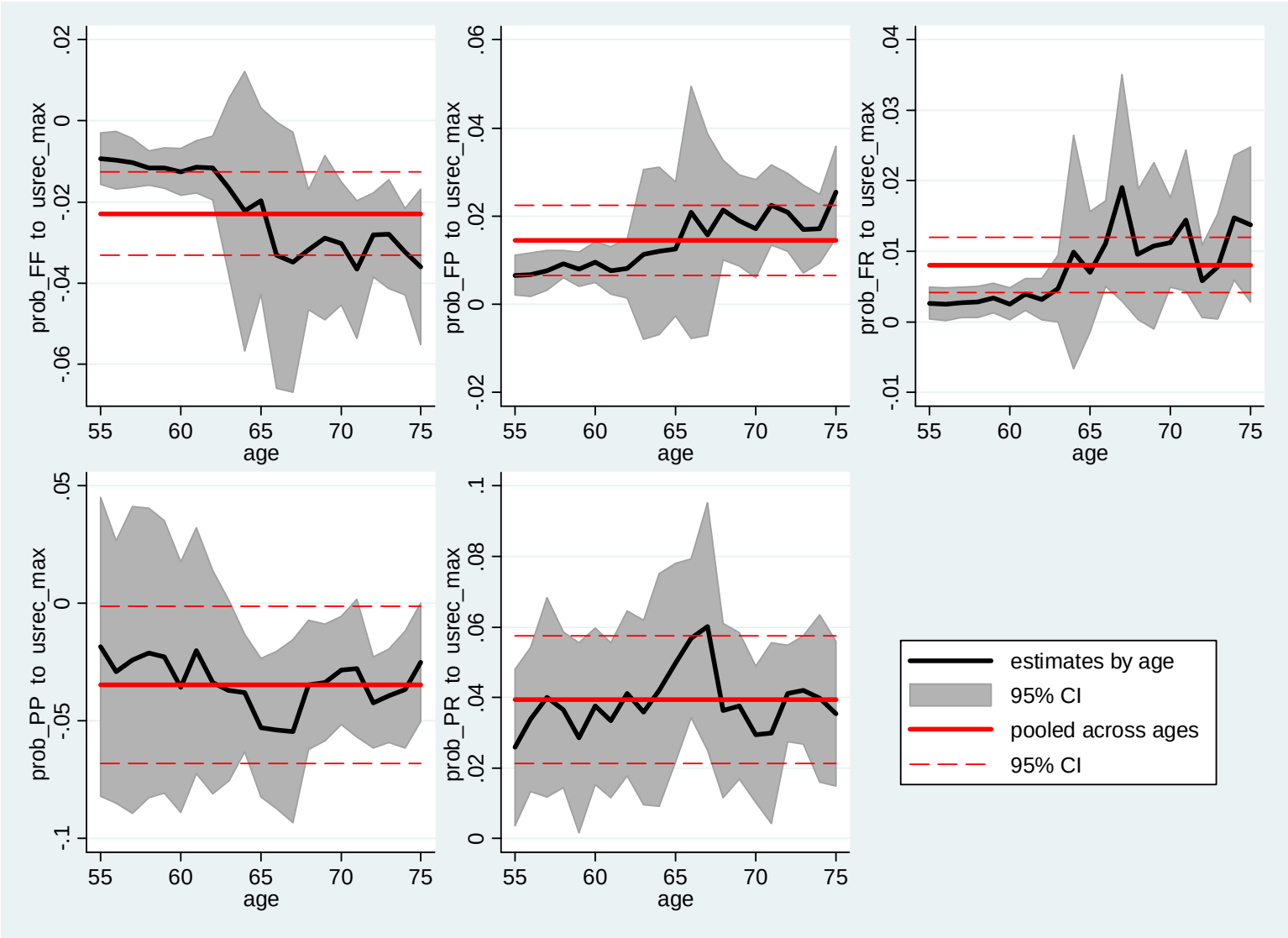
Notes: each panel shows the estimated sensitivity of *prob_XY* (the probability of transition from state *X* to state *Y*) to unemployment rate for males with ages between 24 and 55 years old. The black, solid line plots the sensitivity estimated for each age separately as in equation (1). The shaded region is the 95% confidence interval. The red, solid line shows the estimated sensitivity of *prob_XY* to unemployment rate pooled across ages as in equation (2). The red, dashed lines shows the 95% confidence interval for the pooled estimate of the sensitivity.

Figure 14. Response of transition probabilities to NBER recessions, measure i).



Notes: each panel shows the estimated sensitivity of *prob_XY* (the probability of transition from state *X* to state *Y*) to NBER recessions measure i), which is dummy variable is equal to one in a given year if at least one month of that year was in a recession. The black, solid line plots the sensitivity estimated for each age separately as in equation (1). The shaded region is the 95% confidence interval. The red, solid line shows the estimated sensitivity of *prob_XY* to the NBER recession measure (i) pooled across ages as in equation (2). The red, dashed lines show the 95% confidence interval for the pooled estimate of the sensitivity.

Figure 15. Response of transition probabilities to NBER recessions, measure ii).



Notes: each panel shows the estimated sensitivity of *prob_XY* (the probability of transition from state *X* to state *Y*) to NBER recessions measure ii), which is equal to the fraction of months in recession in a given year. The black, solid line plots the sensitivity estimated for each age separately as in equation (1). The shaded region is the 95% confidence interval. The red, solid line shows the estimated sensitivity of *prob_XY* to NBER recessions measure (ii) pooled across ages as in equation (2). The red, dashed lines shows the 95% confidence interval for the pooled estimate of the sensitivity.

Table 1. Sensitivity of transition probabilities to macroeconomic factors: $Prob(X \to Y|age,t) = \alpha_{age} + \beta X_t + \gamma_0 t + \gamma_1 t^2 + error$

Trend	No (1)	Linear (2)	Quad (3)	No (4)	Linear (5)	Quad (6)	No (7)	Linear (8)	Quad (9)	No (10)	Linear (11)	Quad (12)
Panel A: $F \to F$												
unemployment rate	-0.90***	-0.90***	-0.71***	-0.70***	-0.68***	-0.62***	-0.86***	-0.82***	-0.72***	-0.69***	-0.60***	-0.60***
	(0.11)	(0.11)	(0.16)	(0.13)	(0.12)	(0.17)	(0.13)	(0.13)	(0.16)	(0.14)	(0.13)	(0.15)
inflation				-0.30***	-0.32***	-0.24***				-0.29***	-0.32***	-0.26***
				(0.06)	(0.06)	(0.04)				(0.06)	(0.05)	(0.06)
log(HousePrice)							0.01	0.03	-0.01	0.01	0.03	0.01
							(0.02)	(0.02)	(0.03)	(0.01)	(0.02)	(0.03)
Panel B: $F \to P$												
unemployment rate	0.66***	0.61***	0.44***	0.58***	0.45***	0.38***	0.74***	0.53***	0.44***	0.65***	0.37***	0.37***
	(0.18)	(0.08)	(0.09)	(0.19)	(0.06)	(0.09)	(0.16)	(0.10)	(0.09)	(0.15)	(0.07)	(0.08)
inflation				0.12	0.23***	0.14***				0.16	0.24***	0.15***
				(0.11)	(0.04)	(0.03)				(0.10)	(0.03)	(0.05)
log(HousePrice)							0.04**	-0.03**	0.00	0.04**	-0.03**	-0.01
							(0.02)	(0.01)	(0.02)	(0.02)	(0.01)	(0.02)
Panel C: $F \to R$												
unemployment rate	0.28**	0.30***	0.30***	0.20**	0.27***	0.28***	0.19**	0.31***	0.30***	0.14*	0.27***	0.27***
	(0.10)	(0.06)	(0.07)	(0.09)	(0.07)	(0.07)	(0.08)	(0.06)	(0.07)	(0.08)	(0.07)	(0.06)
inflation				0.12**	0.05*	0.07**				0.09*	0.05*	0.07**
				(0.06)	(0.03)	(0.03)				(0.05)	(0.03)	(0.03)
log(HousePrice)							-0.04***	0.00	0.00	-0.03***	0.00	-0.00
							(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Panel D: $P \to P$												
unemployment rate	0.64	0.31	-0.61*	1.05	0.15	-0.41	1.41	-0.20	-0.63**	1.59	-0.36	-0.36
	(1.33)	(0.52)	(0.30)	(1.33)	(0.66)	(0.32)	(1.14)	(0.52)	(0.29)	(1.11)	(0.65)	(0.28)
inflation				-0.61	0.23	-0.51***				-0.30	0.24	-0.56***
				(0.70)	(0.29)	(0.11)				(0.65)	(0.27)	(0.11)
log(HousePrice)							0.33***	-0.19***	-0.02	0.33***	-0.19***	0.03
							(0.10)	(0.03)	(0.04)	(0.11)	(0.03)	(0.03)
Panel E: $P \to R$												
unemployment rate	0.76	0.88***	1.18***	0.39	0.71*	0.96***	0.49	1.13***	1.24***	0.22	0.96**	0.95***
	(0.50)	(0.29)	(0.24)	(0.52)	(0.38)	(0.25)	(0.46)	(0.27)	(0.25)	(0.49)	(0.38)	(0.22)
inflation				0.56*	0.26	0.59***				0.46*	0.26	0.59***
				(0.28)	(0.15)	(0.09)				(0.26)	(0.15)	(0.10)
log(HousePrice)							-0.12**	0.09***	0.05	-0.10**	0.09***	-0.00
							(0.04)	(0.03)	(0.04)	(0.04)	(0.02)	(0.03)
Observations	980	980	980	980	980	980	980	980	980	980	980	980
Number of age groups	20	20	20	20	20	20	20	20	20	20	20	20

Notes: The estimated specification is $Prob(X \to Y|age,t) = \alpha_{age} + \beta X_t + \gamma_0 t + \gamma_1 t^2 + error$ where X is a vector of macroeconomic factors. Driscoll and Kraay (1998) standard errors are in parentheses. ***, **, * denote statistical significance at 1, 5, and 10 percent levels respectively.

Table 2. Sensitivity by income quintile

	Quintile 1			Quintile 2			Quintile 3			Quintile 4			Quintile 5		
	No	Linear	Quad	No	Linear	Quad	No	Linear	Quad	No	Linear	Quad	No	Linear	Quad
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Panel A: $F \rightarrow F$															
unemployment rate	-0.76**	-0.77**	-0.77***	-0.67**	-0.61*	-0.62**	-0.62***	-0.52***	-0.52***	-0.78***	-0.63***	-0.61***	-0.69***	-0.54***	-0.52***
	(0.29)	(0.27)	(0.23)	(0.31)	(0.29)	(0.29)	(0.17)	(0.16)	(0.17)	(0.15)	(0.14)	(0.16)	(0.13)	(0.13)	(0.12)
inflation	-0.39***	-0.39***	-0.50***	-0.28**	-0.31***	-0.34***	-0.34***	-0.39***	-0.37***	-0.21***	-0.30***	-0.17**	-0.27***	-0.33***	-0.14**
	(0.10)	(0.09)	(0.06)	(0.11)	(0.10)	(0.10)	(0.09)	(0.08)	(0.08)	(0.07)	(0.09)	(0.08)	(0.08)	(0.09)	(0.06)
log(HousePrice)	-0.02	-0.03	0.01	-0.01	-0.00	0.01	0.00	0.03	0.02	0.02	0.06***	0.02	0.03*	0.07***	0.01
	(0.02)	(0.02)	(0.03)	(0.02)	(0.03)	(0.04)	(0.01)	(0.02)	(0.03)	(0.02)	(0.02)	(0.03)	(0.01)	(0.02)	(0.03)
Panel B: $F \rightarrow P$															
unemployment rate	0.60***	0.45***	0.45***	0.53***	0.32**	0.32**	0.64***	0.35***	0.34***	0.71***	0.41***	0.40***	0.58***	0.36***	0.34***
	(0.15)	(0.12)	(0.11)	(0.17)	(0.15)	(0.15)	(0.18)	(0.08)	(0.10)	(0.19)	(0.08)	(0.08)	(0.14)	(0.10)	(0.08)
inflation	0.22***	0.26***	0.27***	0.11	0.20***	0.20***	0.17*	0.30***	0.27***	-0.02	0.17***	0.08	0.10	0.20***	0.06
	(0.07)	(0.05)	(0.05)	(0.08)	(0.05)	(0.06)	(0.09)	(0.04)	(0.05)	(0.09)	(0.05)	(0.06)	(0.07)	(0.05)	(0.04)
log(HousePrice)	0.04***	0.00	-0.00	0.04**	-0.01	-0.01	0.05**	-0.03**	-0.02	0.04*	-0.04***	-0.01	0.01	-0.04***	-0.00
	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.01)	(0.02)	(0.02)	(0.01)	(0.02)	(0.01)	(0.01)	(0.02)
Panel A: $F \rightarrow R$															
unemployment rate	0.26*	0.36**	0.36***	0.22	0.29*	0.30**	0.08	0.19**	0.20**	0.14	0.23***	0.22***	0.21***	0.21***	0.20***
	(0.15)	(0.14)	(0.10)	(0.15)	(0.15)	(0.14)	(0.09)	(0.07)	(0.08)	(0.09)	(0.06)	(0.08)	(0.06)	(0.06)	(0.07)
inflation	0.14**	0.11**	0.20***	0.12**	0.09*	0.11**	0.12**	0.06	0.07	0.15**	0.10	0.05	0.12**	0.12**	0.07
	(0.06)	(0.05)	(0.02)	(0.05)	(0.05)	(0.04)	(0.05)	(0.05)	(0.04)	(0.06)	(0.07)	(0.06)	(0.05)	(0.06)	(0.05)
log(HousePrice)	-0.01	0.02**	-0.00	-0.01	0.01	-0.00	-0.03***	-0.00	-0.00	-0.04***	-0.02*	-0.00	-0.02***	-0.02**	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Panel A: $P \rightarrow P$															
unemployment rate	1.26	-0.45	-0.45*	0.96	-0.64	-0.73***	1.80	-0.37	-0.47**	3.13	0.33	0.17	2.14	0.02	-0.05
	(1.04)	(0.74)	(0.26)	(0.99)	(0.72)	(0.24)	(1.22)	(0.71)	(0.17)	(2.03)	(1.04)	(0.40)	(1.27)	(0.65)	(0.32)
inflation	-0.01	0.46	-0.49***	-0.38	0.36	-0.43***	-0.45	0.54	-0.33***	-1.02	0.77*	-0.30**	-0.89	0.08	-0.58***
	(0.64)	(0.32)	(0.08)	(0.51)	(0.31)	(0.08)	(0.63)	(0.32)	(0.06)	(0.77)	(0.42)	(0.13)	(0.58)	(0.26)	(0.12)
log(HousePrice)	0.23**	-0.22***	0.04	0.20**	-0.21***	0.02	0.31**	-0.24***	0.02	0.48***	-0.28***	0.06**	0.40***	-0.14***	0.06
	(0.09)	(0.04)	(0.03)	(0.08)	(0.04)	(0.03)	(0.11)	(0.04)	(0.02)	(0.16)	(0.04)	(0.03)	(0.11)	(0.04)	(0.04)
Panel A: $P \rightarrow R$															
unemployment rate	0.14	0.75	0.75**	0.26	0.94*	0.99***	0.07	0.84**	0.88***	0.51	0.99**	1.00**	0.48*	0.77***	0.77***
	(0.59)	(0.50)	(0.30)	(0.58)	(0.50)	(0.27)	(0.55)	(0.39)	(0.22)	(0.56)	(0.43)	(0.42)	(0.27)	(0.23)	(0.23)
inflation	0.39	0.22	0.67***	0.45	0.14	0.56***	0.59**	0.24	0.55***	1.11***	0.80***	0.84***	0.69***	0.56***	0.58***
	(0.26)	(0.19)	(0.12)	(0.27)	(0.19)	(0.10)	(0.24)	(0.14)	(0.09)	(0.23)	(0.26)	(0.21)	(0.14)	(0.14)	(0.12)
log(HousePrice)	-0.06	0.10***	-0.02	-0.06	0.12***	-0.01	-0.09**	0.10***	0.01	-0.09**	0.04	0.02	-0.08***	-0.01	-0.01
	(0.04)	(0.02)	(0.04)	(0.04)	(0.03)	(0.03)	(0.04)	(0.03)	(0.03)	(0.04)	(0.04)	(0.04)	(0.03)	(0.03)	(0.04)
Observations	980	980	980	925	925	925	925	925	925	875	875	875	925	925	925
Number of age groups	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20

Notes: The estimated specification is $Prob(X \rightarrow Y|age,t) = \alpha_{age} + \beta X_t + \gamma_0 t + \gamma_1 t^2 + error$ where X is a vector of macroeconomic factors. This specification is estimated for each quintile separately. Driscoll and Kraay (1998) standard errors are in parentheses. ***, **, * denote statistical significance at 1, 5, and 10 percent levels respectively.

APPENDIX TABLES AND FIGURES

Appendix Figure 1. Response of transition probabilities by income quintile to unemployment rate, no trends.

Notes: each panel shows the estimated sensitivity of *prob_XY* (the probability of transition from state *X* to state *Y*) to the unemployment rate. Quintile 1 corresponds to the bottom income quintile. Each line plots the sensitivity estimated as in equation (1), without time trends, separately for each age and income quintile.

Appendix Figure 2. Response of transition probabilities by income quintile to UR (unemployment rate), quadratic trends.

Notes: each panel shows the estimated sensitivity of *prob_XY* (the probability of transition from state *X* to state *Y*) to the unemployment rate. Quintile 1 corresponds to the bottom income quintile. Each line plots the sensitivity estimated as in equation (1), with quadratic trends, separately for each age and income quintile.

Appendix Table 1. Sensitivity of transition probabilities to macroeconomic factors: Estimation sample 1960-2005.

Trend	No (1)	Linear (2)	Quad (3)	No (4)	Linear (5)	Quad (6)	No (7)	Linear (8)	Quad (9)	No (10)	Linear (11)	Quad (12)
Panel A: $F \rightarrow F$												
unemployment rate	-0.89***	-0.89***	-0.44***	-0.58***	-0.56***	-0.36***	-0.85***	-0.82***	-0.42***	-0.56***	-0.51***	-0.36***
	(0.13)	(0.12)	(0.11)	(0.11)	(0.09)	(0.12)	(0.15)	(0.14)	(0.11)	(0.12)	(0.11)	(0.11)
inflation				-0.35***	-0.36***	-0.20***				-0.34***	-0.36***	-0.17***
				(0.06)	(0.06)	(0.04)				(0.06)	(0.05)	(0.05)
log(HousePrice)							0.02	0.04	-0.04***	0.01	0.03*	-0.02*
							(0.02)	(0.03)	(0.01)	(0.02)	(0.02)	(0.01)
Panel B: $F \rightarrow P$												
unemployment rate	0.66***	0.63***	0.28***	0.52**	0.41***	0.24***	0.73***	0.57***	0.27***	0.57***	0.35***	0.24***
	(0.19)	(0.08)	(0.07)	(0.21)	(0.06)	(0.08)	(0.17)	(0.10)	(0.07)	(0.17)	(0.07)	(0.08)
inflation				0.16	0.25***	0.11***				0.19*	0.24***	0.10**
				(0.11)	(0.04)	(0.03)				(0.11)	(0.03)	(0.04)
log(HousePrice)							0.04	-0.04*	0.02**	0.04*	-0.03**	0.01
							(0.02)	(0.02)	(0.01)	(0.02)	(0.01)	(0.01)
Panel C: $F \rightarrow R$												
unemployment rate	0.26**	0.28***	0.21***	0.14	0.21***	0.18**	0.19*	0.28***	0.20***	0.10	0.21***	0.18***
	(0.11)	(0.06)	(0.06)	(0.09)	(0.05)	(0.06)	(0.09)	(0.06)	(0.06)	(0.08)	(0.06)	(0.06)
inflation				0.13*	0.08**	0.06*				0.10*	0.08**	0.05
				(0.06)	(0.03)	(0.03)				(0.05)	(0.03)	(0.03)
log(HousePrice)							-0.04***	-0.00	0.01**	-0.04***	-0.00	0.01
							(0.01)	(0.01)	(0.00)	(0.01)	(0.00)	(0.00)
Panel D: $P \rightarrow P$												
unemployment rate	0.93	0.68***	-0.15	1.58	0.69**	0.05	1.65	0.36	-0.12	2.01	0.40	0.05
	(1.45)	(0.23)	(0.23)	(1.50)	(0.29)	(0.22)	(1.19)	(0.21)	(0.23)	(1.18)	(0.26)	(0.22)
inflation				-0.72	-0.02	-0.50***				-0.44	-0.04	-0.47***
				(0.82)	(0.19)	(0.11)				(0.74)	(0.17)	(0.10)
log(HousePrice)							0.42***	-0.16***	-0.07**	0.41***	-0.16***	-0.03
							(0.13)	(0.03)	(0.03)	(0.14)	(0.03)	(0.03)
Panel E: $P \rightarrow R$												
unemployment rate	0.65	0.75***	0.80***	0.05	0.39*	0.58***	0.37	0.89***	0.75***	-0.11	0.52***	0.58***
	(0.56)	(0.24)	(0.21)	(0.55)	(0.19)	(0.19)	(0.48)	(0.21)	(0.21)	(0.45)	(0.17)	(0.19)
inflation				0.68**	0.41***	0.55***				0.57*	0.42***	0.49***
				(0.32)	(0.10)	(0.09)				(0.29)	(0.10)	(0.09)
log(HousePrice)							-0.16***	0.07***	0.10***	-0.15***	0.07***	0.05**
							(0.05)	(0.02)	(0.02)	(0.05)	(0.01)	(0.02)
Observations	980	980	980	980	980	980	980	980	980	980	980	980
Number of age groups	20	20	20	20	20	20	20	20	20	20	20	20

Notes: The estimated specification is $Prob(X \rightarrow Y|age, t) = \alpha_{age} + \beta X_t + \gamma_0 t + \gamma_1 t^2 + error$ where X is a vector of macroeconomic factors. Driscoll and Kraay (1998) standard errors are in parentheses. ***, **, * denote statistical significance at 1, 5, and 10 percent levels respectively. Estimation sample is 1960-2005.