

Old Age Labor:

The case of increase Intensive Margin

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1 Introduction

Aging is a process that is prevalent all around the world. As per the forecast by [Forum \(2020\)](#) the old age to working age ratio will almost double in the next four decades. Life expectancy at birth is expected to increase from 72.6 to 77.1 years by 2050 worldwide, with this being more prevalent in developed countries [Amorós et al. \(2024\)](#). There is a clear trend of aging in all the OECD countries, however there are variations in the rate of aging. Japan tops the list with highest proportion of the oldest population, with one third of its inhabitants already over the age of 65. Similarly, the population in USA is undergoing a likewise change in terms of aging of the labor force. As per [BLS \(????\)](#) in year 2000 12.5% of population above 65 were still in the labor force and by 2016 the share of those individuals had surged to 18.6%. The number of residents in US that are above the age of 55 in the labor force will grow from 35.7 million in 2016 to 42.1 million in 2026.

The increase in participation of older people in the workforce has profound implications. As per Centre of Disease Control and Prevention, the number of people above 65 living in US is projected to double by 2030 to 72 million, comprising one fifth of the US population [White et al. \(2018\)](#). This surge in labor force can alleviate labor shortages and contribute to the economic growth. But, at the same time it raises concerns about the sufficiency of the retirement savings. Conventionally, retirement has been categorized as a stage of life that is characterized by a decrease in working hours and an increase in time for leisure activities or self care. This expectation is based on several factors, such as a belief that individuals normally reach sufficient financial resources when they get retirement age or availability of social security and pension benefits to support their life expenditures. There is also

a strong desire for relaxation after long decades of hard working. Furthermore, getting aged often brings physical and cognitive disorders that could potentially prevent individuals from working as a full-time labor.

The trend in male's old age labor is very astonishing given that other age group for men between 21-55 demonstrated a substantial decline in work hours during the same period [Aguiar et al. \(2021\)](#). This period is marked by some key changes in US social security framework which might be the potential reasons to this increase in labor supply. For instance one of the key changes was the increase in the normal retirement age (NRA) from 65 to 67 for recent birth cohorts [Yu \(2024\)](#). There can be several possible reasons that can explain this demographic shift in the population. Financial instability is a key cause, particularly due to lack of sufficient retirement savings and changes in the social security rules [Munnell and Sass \(2009\)](#). In addition to that improvement in healthcare infrastructure and increased life expectancy serve as a key contributors to be active in labor force. Desire to stay active, socially engaged and mentally stimulated are also some key drivers of this peculiar phenomena [Cooper et al. \(2019\)](#)

The main purpose of this study is to investigate the underlying causes of this increase in the intensive margin (Working Hours) of individuals aged 65 and above. By analyzing economic, social and health related factors, this study aims to provide insights into implications of this shift. Using data mainly from ATUS (American Time Use Survey), we will explore the interplay of these factors and how their impact of labor force participation of old age people in terms of intensive margin. This will be a key contribution to this strand of the literature, as most of the studies in the recent past have focused on extensive margin and in our opinion this is first attempt taking into account the intensive margin side of the labor participation of this age group. The rest of the paper is structured as follows. Section 2 shed light on the literature, The dataset and descriptive statistics are described in section 3. Section 4 discuss empirical strategy and section 5 will represent the empirical results. Section 7 concludes the paper. Labor force participation rate has increased by 15 percentage points for male aged 62 to 66 since 1990, whereas this rate for prime age men labor continuously has decreased ([Tomaz et al. \(2023\)](#)). Theoretical models bring the idea that expenditures and time are substitutable. For example, [Attanasio et al. \(1999\)](#) developed the idea that individuals earn more and save in early stage of life cycle to enjoy smooth consumption during their retirement. The extensive literature on human life cycle behaviors suggest that hump shaped pattern for expenditures (both durable and nondurable), household size, income, hourly wages, and working hours ([Carroll and Summers \(1991\)](#), [Fernández-Villaverde and Krueger \(2007\)](#), [Aguiar and Hurst \(2013\)](#), for review). They

find the pattern that is low in the early of life cycle, then peaking throughout the middle age, and finally declining significantly when reaching retirement age. However, [Goldin and Mitchell \(2017\)](#) find that this hump shaped pattern for women labor force participation rate is disappearing due to flattening on older age tail. By studying labor force participation rate of women 60 years old and over, they find that it has increased extensively compared to earlier generations. [Tomaz et al. \(2023\)](#) focused on age group 62 to 66 years old and attribute this trend to only healthy individuals. They selected senior age group between 62 and 66 due to being in the stage of making decision about their retirement. This research focuses on the population of individuals aged 60 and above.

2 Literature Review

The transformation from a working to retirement life involves restructuring and reallocation of the daily activities. [Ghez and Becker \(1975\)](#) found that hours of work will rise at the start and reach a peak later than home time reaches its trough. [Sudman et al. \(1987\)](#) develops the idea of use of time as an investment and argued that about 10 % of the time use is allocated in chores like educating children, home care and personal care. While answering question that Americans have more free time than they did thirty years ago? [Robinson and Godbey \(1997\)](#) found that on average we have an hour more free time than in the 1960's. In their seminal work on the topic of time use [Aguiar and Hurst \(2007\)](#) concluded that leisure time for men went up by 6-8 hours as a result of decline in market hours and for the same reason the leisure hours for women increased by 4-8 hours per week. According to [Aguiar et al. \(2013a\)](#) discuss how individuals reallocate their forgone market hours of working to other categories of time use during great recession of 2008 by using micro level data of ATUS. Authors of this paper found that individuals, during recession of 2008, spent foregone time of working to searching for a job, leisure, home production like child care, shopping, health, and education. They also discovered that home production is highly elastic. They introduced unemployment across states as instrumental variable, to deal with endogeneity due to reduction in working hours during business cycles. However, they only focus on working-age population and drop elders from their analysis. According to [Sprod et al. \(2017\)](#) the usage of time differs after the retirement and it depends partly on the socio-demographic factors. Previous studies have found a surge in recreational physical activities at retirement, but a decrease in activities for the group of retired people belonging to socioeconomic backgrounds. In another working study by [Cacciatore et al. \(2023\)](#), they investigate the impact of uncertainty on time use and their macroeconomic implications. Using the same data set, ATUS, authors found that more uncertainty increases home production hours while decreasing market working hours, with just a mild effect on leisure hours. Their structural dynamic model suggests that time reallocation can lead to higher inflation during the time with higher uncertainty.

Previous studies had also been conducted for exploring the old age labor force participation and the reasons of this surge. [PLATTS \(2019\)](#) found women labor force participation has been large, participation for women in the age group of sixty to sixty four increased from 34 to 51 percent during the last twenty five years and from 45 to 61 percent for college graduates. One strand of literature argue that the increase in old age participation in USA is attributed to changes in the social security rules. For instance as per [Banerjee and Blau \(2016\)](#) [Blau and Goodstein \(2010\)](#) [Goldin and Katz \(2016\)](#) factors such as increase

in the normal retirement age and delayed retirement credit have played a significant role in explaining the increase in the male labor market participation. [Yu \(2024\)](#) found that the combined effect of three changes in social security (delayed NRA ,increased delayed retirement credit and change in the earning test) accounts for over 73% of the increase in extensive and intensive margin per worker by the 1950s cohort. [French and Jones \(2017\)](#) argued that the reforms in the pension programs to stimulate delayed retirement behaviour are unlikely to be effective if the old individuals have a deteriorating health condition. Using micro data from CPS and HRS [Tomaz et al. \(2023\)](#) found that over the last two decades the increase in the extensive margin in the context of employment is solely driven by good health conditions and this effect does not vary across educational and occupational groups. In another recent study. Most of the aforementioned studies are focused on the labor force participation and not much is done with respect to the intensity of this participation. We aim to contribute to a strand of literature which is specific to the increase in the working hours of the old age workforce or in other words the intensive margin component of the old age employment , which is still in rudimentary stages when it comes to empirical research.

3 Data

Among datasets tracking time use of individuals, the American Time Use Survey (ATUS) has drawn significant interest from researchers as a resourceful dataset for studying how individuals allocate their time. Several datasets, such as the Current Population Survey (CPS) and the National Longitudinal Surveys, collect market working hours, while the Panel Study of Income Dynamics (PSID) and the Health and Retirement Survey collect data on both market and nonmarket hours. However, these datasets often rely on nondiary recall data from interviewers, which can lead to inaccuracies.

The ATUS addresses this issue by surveying individuals about their previous day's activities from 4 AM to 4 AM of the interview day in 15 minutes intervals. The ATUS comprises approximately 237,000 interviews conducted by the Bureau of Labor Statistics (BLS), drawn from the existing CPS sample pool about three months after their last CPS survey, from 2003 to 2023. Only one individual per household is selected for the survey, and they are not tracked over time. One of the key advantages of the ATUS is its continuous data collection, allowing researchers to observe and analyze changes in time use patterns over extended periods, effectively making it a repeated panel dataset. The ATUS surveys individuals aged 15 and older about how, where, and with whom they spend their

time, providing comprehensive insights into both working and nonworking activities such as childcare, household chores, commuting, shopping, education, and volunteering. Respondents describe their previous day activities, which are then categorized by staff.

Although the ATUS sample size is relatively small compared to the overall US population, it is nationally representative due to weighting based on the demographics of respondents. Following the time use classifications in studies such as [Aguiar and Hurst \(2007\)](#), [Aguiar et al. \(2013b\)](#), and [Boppart and Ngai \(2021\)](#), we define similar categories for market work, home production, and leisure time. Literature categorizes daily activities into six major groups: market work, job search, home production, child care, education, and leisure. However, in this research, we decrease categories to four by merging job search and education into others and child care into leisure class. A comprehensive description of the time use categories used in this research is provided in the Appendix table ...

We downloaded data from the BLS and excluded individuals younger than sixty years old. The ATUS surveys respondents equally throughout the weeks of the year. However, within each week, weekdays constitute 10 percent of the sample, while weekends contribute 25 percent. To address this imbalance, the ATUS assigns weights to each individual to ensure the sample is nationally representative. For this paper, we use these weights in our analysis.

4 Trends in Time Use of Elderly

In this section, we utilize time diaries of the ATUS from 2003 through 2023 to document how the elderly have changed their allocation of their time since the early 2000s. Table 1 shows the results of this analysis for time categories of market work, nonmarket work, and leisure for age group older than 60 years old. We have detected a noticeable uptrend in market working hours of this group. For the full sample of data, working hours increased by 1.84 hours (or 23%). The intensity of increase is almost the same for both sexes, but at different levels. Percentage changes in market work hours of men and women are 20 and 22.7 percent, while males worked for 12.77 hours and women for 7.36 hours per week on average. For the other two main categories of nonmarket work and leisure, we do not find a significant trend in data. However, a deeper analysis uncover more facts about time use of this aged group that is presented in the following subsections. To study this trend, we take the average of three consecutive years, to mitigate volatility in data. However, due to emerge of the COVID 19 that affected daily time allocation of individuals especially aged groups, we study the trend for both time periods of before and after the pandemic. As

a result, we compare average hours of different time categories for three time periods of 2003-2005, 2016-2018, and 2021-2023; the results are presented in the table 1.

Table 1: Time Use by Elderly above 60 years old

Time Use Category	Average of 2003-2005 (I)	Average of 2016-2018 (II)	Average of 2021-2023 (III)	Difference (II) vs. (I) (IV)	Difference (III) vs. (I) (V)
Full Sample					
Market Work	8.01	9.51	9.85	1.5*** (0.41)	1.84*** (0.41)
Nonmarket Work	21.15	19.78	20.1	-1.37*** (0.34)	-1.05*** (0.33)
Leisure	134.63	134.59	134.38	-0.03 (0.47)	-0.24 (0.46)
Men					
Market Work	10.61	12.31	12.77	1.7** (0.71)	2.16*** (0.71)
Nonmarket Work	15.74	15.76	15.96	0.02 (0.48)	0.22 (0.47)
Leisure	137.47	136.26	135.78	-1.21 (0.76)	-1.7** (0.76)
Women					
Market Work	6	7.18	7.36	1.18*** (0.47)	1.36*** (0.45)
Nonmarket Work	25.33	23.14	23.63	-2.19*** (0.45)	-1.7*** (0.44)
Leisure	132.42	133.2	133.19	0.77 (0.58)	0.77 (0.55)

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

4.1 Trends in Market Work

Working hours have been extensively studied by researchers, and existing trends have already been documented. For example, [McGrattan and Rogerson \(2004\)](#) integrated public microdata series samples from the decennial census surveys and the American Community Survey to document a decline in market work for men and an increase for women since the late 1960s. About elderly, they found that average hours worked per worker reduced 52 percent for laborers aged 65-74 years. [Aguilar and Hurst \(2007\)](#) tracked similar trends for both sexes by merging different surveys of time use between 1965 and 2003. The author found that core market work hours for males have fallen by 6.6 hours per week,

but have increased by 3.8 hours per week for women. Additionally, [Aguiar et al. \(2021\)](#) utilized CPS data to show that the trend of market work is decreasing for both men and women from 2000 to 2017. They document that market hours declined for younger men aged 21-30 by 10.9% and 2.2% for the same age younger women. However, these studies focused mainly on the working-age population and excluded the elderly from their samples. While [Yu \(2024\)](#), [Tomaz et al. \(2023\)](#), and [Goldin and Katz \(2016\)](#) documented increase in labor force participation rate of older labor, they did not discuss an increasing trend in working hours of this group. Using PSID data set, [Yu \(2024\)](#) only showed that working hours for newer cohorts are higher than older ones and did not study the trend. Following the literature, we found it worthwhile to include the elderly in our analysis and compare this often-neglected group to the extensively studied working-age population. After restricting the primary sample to observations of individuals older than 60, we witnessed a contrasting trend. Figure ?? compares market working hours for full sample of individuals aged equal or younger than 60 to all elderly individuals older than 60, as well as for elderly men and women specifically. It illustrates while market hours for younger age group is relatively stable, they faced some fluctuations mainly driven by business cycles including great recession of 2008 and COVID recession. On the other hand, elderly keep working longer on a stable uptrend across the last two decades.

As a robustness analysis, we repeat this experiment with a data set from Current Population Survey (CPS). In this survey, respondents question about how many hours they worked last week. We downloaded Annual Social and Economic Supplement (ASEC) data from IPUMS-CPS. We used "AHRSWORKT" variable which implies hours worked last week and corresponding weights of "ASECWT". Although data only rely on recalled working hours of individuals, it supports increasing trend for elderly labor hours but at different level of hours. According to the full sample of this data set, people aged older than 60 worked about 34 hours a week on average in 2003-05 while they are working around 36 hours in most recent years of 2021-23. Figure 6 in Appendix validates the results found from CPS data.

4.2 Trends in Nonmarket Work

We categorized home production, shopping, caregiving, and etc as nonmarket works. Detailed categories of tasks are provided in the appendix. As figure ?? implies, while non-market working is decreasing significantly for younger age group (≤ 60 years old) since the early of 2000s, senior people behave differently in terms of gender. Women lowered their nonmarket assignments by 1.7 hours (7 percent) between 2003 to 2023. They used to

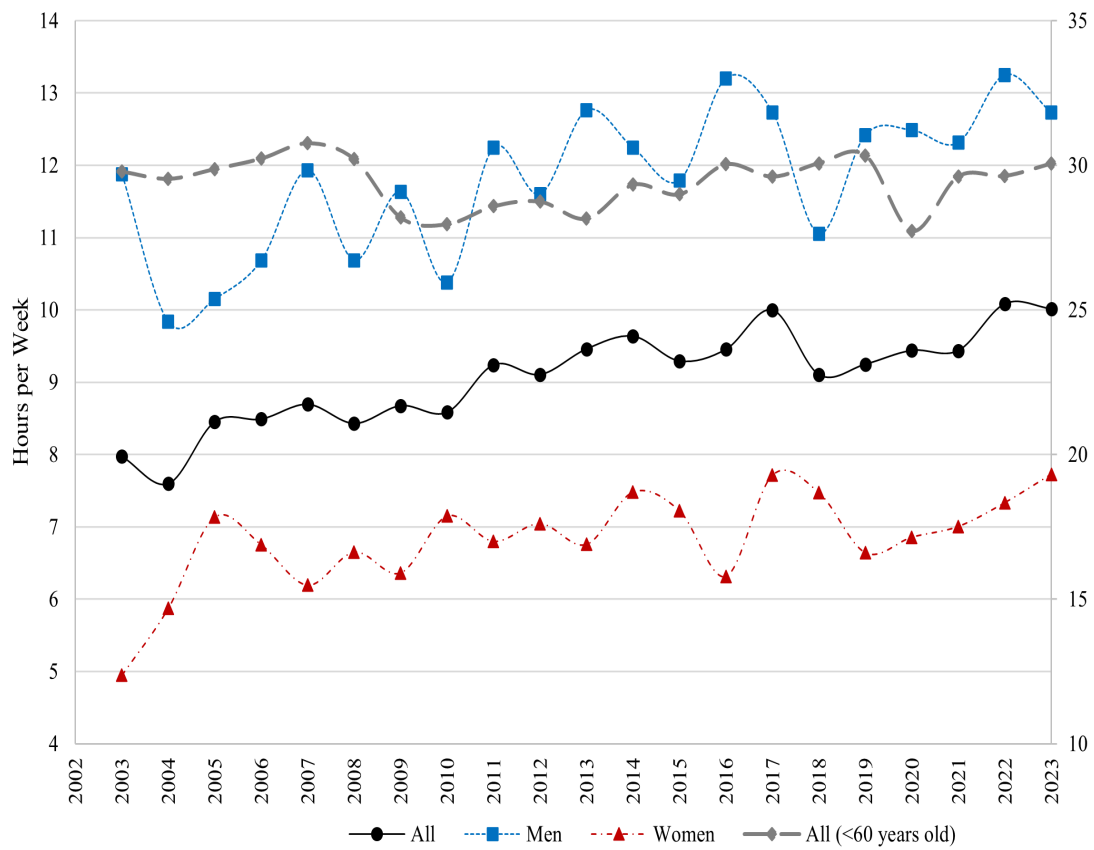


Figure 1: Market Working Hours of Elderly (ATUS)

work for 25.33 hours per week as nonmarket work in 2003-05, but they decreased it to 23.6 hours by 2021-23. On the other hand, men in recent time are not statistically different than their peers in the early of 2000s. To have a deeper insight into this category of time use, we segregate home production and shopping from nonmarket work. While both males and females spent lower time for shopping by 0.6 (12%) and 1 (16%) hours, respectively, they are different in terms of core housework. In contrast to women that spent less time for home production, men do more home production by 1.7 hours (20 percent) per week compared to 2003-05

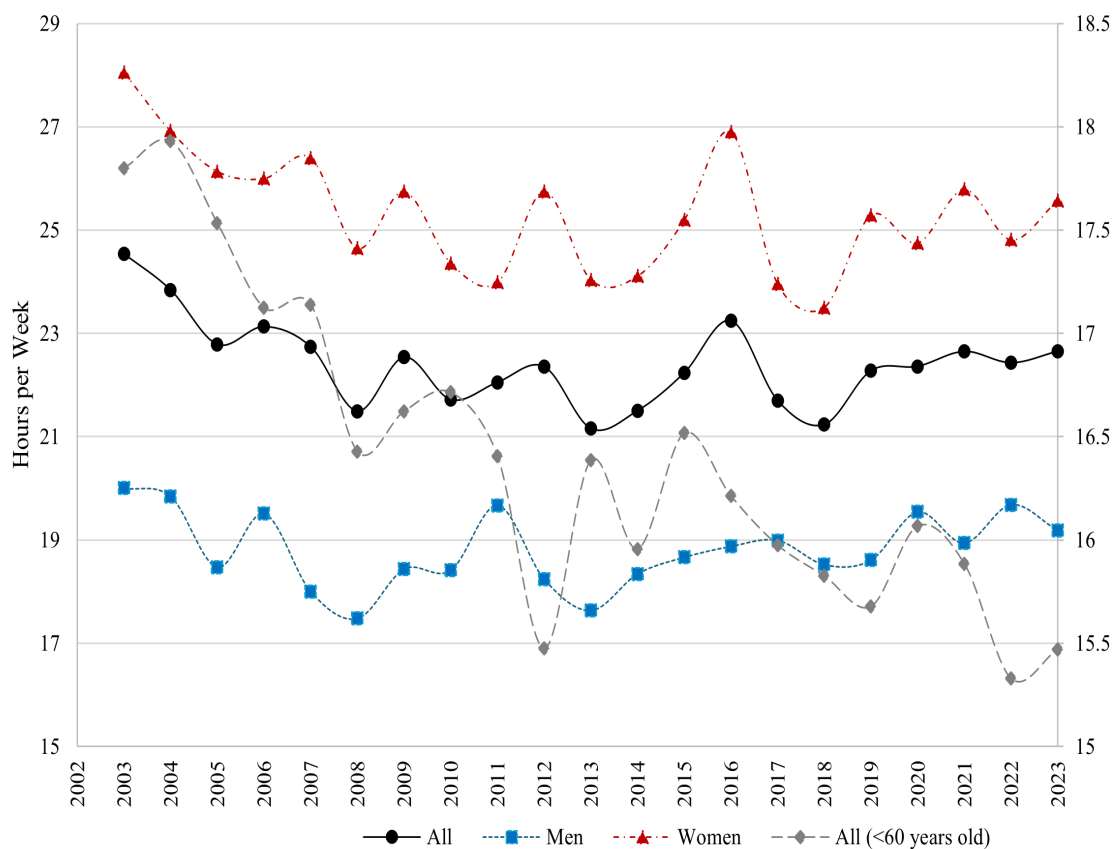


Figure 2: Nonmarket Working hours of elderly

4.3 Trends in Leisure

Although definition of leisure can be subjective due to personal preferences, [Aguilar and Hurst \(2007\)](#) found that average time spending on leisure is following a long term increasing trend. [Aguilar et al. \(2021\)](#) documents that leisure time for men aged 31 to 55 years old has increased by 0.6 hours per week in 2017 since 2004 and 1.3 hours for women of the same age group. Figure ?? also confirm the same trend for a full sample of individuals

Table 2: Time Use for Home Production by Elderly above 60 years old

Time Use Category	Average of 2003-2005 (I)	Average of 2016-2018 (II)	Average of 2021-2023 (III)	Difference (II) vs. (I) (IV)	Difference (III) vs. (I) (V)
Full Sample					
Core Housework	5.43	4.7	5.15	-0.73 *** (0.17)	-0.28 (0.17)
Preparing meals	4.82	4.82	5.32	-0.01 (0.13)	0.5 *** (0.12)
Obtaining Goods and Services	5.55	5.18	4.7	-0.38** (0.16)	-0.85 *** (0.16)
Home and Car Maintenance	1.86	1.85	1.78	-0.01 (0.14)	-0.07 (0.13)
Men					
Core Housework	1.66	2.02	2.37	0.36 *** (0.15)	0.71 *** (0.16)
Preparing meals	2.42	3.01	3.43	0.59 *** (0.14)	1.02 *** (0.15)
Obtaining Goods and Services	5.01	4.52	4.39	-0.49** (0.23)	-0.62 *** (0.25)
Home and Car Maintenance	3.05	3.12	2.89	0.07 (0.27)	-0.16 (0.24)
Women					
Core Housework	8.34	6.94	7.52	-1.4 *** (0.27)	-0.82 *** (0.27)
Preparing meals	6.69	6.33	6.93	-0.36* (0.19)	0.25 (0.18)
Obtaining Goods and Services	5.97	5.72	4.96	-0.25 (0.22)	-1.01 *** (0.20)
Home and Car Maintenance	0.93	0.79	0.84	-0.14 (0.12)	-0.09 (0.11)

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

younger than 60 in ATUS data. It is a matter of discussion that what kind of activities are considered as leisure. For example, gardening or mowing could be considered as home production for a person, but it is a leisure for the other person. We categorized eating, sleeping, personal care, watching TV, socializing, reading, doing exercise, gardening, caring pet, and etc as leisure activities. The detailed list is provided in the appendix. According to the table 1 and in contrast to the current documented trend by literature, leisure time does not follow a noticeable uptrend for the full sample of individuals older than 60. Although, time spent on leisure increased by 0.11 hours per week, we witness heterogeneity in data. Older males experienced lower leisure by 1.26 hours per week, whereas the same age group females enjoyed about 1 hour more of their leisure time in a week. Although some estimations are not statistically significant, table 6 support this fact that men in both age subsamples have lower leisure time while women increased their spending time on leisure. Having a deeper look at can shed lights on aged people time allocation behavior. Both men and women significantly watch TV more by 4.35 hours (15.4%) and 2.91 hours (12%), respectively. They also spent lower time for eating by 1.35 hours (12%) and 0.94 hours (9.5%) for men and women. We included activities such as hosting or attending gatherings with friends and family, dating, participating in social events, civic or religious affairs as socializing.

5 Market Work Profile

As we previously discussed, market working hours of elderly have been increasing since the beginning of 2000s; however, the underlying factors have not been studied. [Tomaz et al. \(2023\)](#) found that compositional changes in US population, such as education, health, and spouse employment can explain one-third of increase in LFPR of labors aged 62-66 years. Following their approach, in this section, we investigate the primary forces that have contributed to this rising trend. First, by a naive analysis, we found that the average share of working males in 2021-2023 has increased by 5 percentage points from 28 percent in 2003-2005 to 33 percent. This average of participation in market work for women is 19 percent with 5 pp increase in the same period of time. Although the average of market working hours has not increased meaningfully, higher participation rate in working can explain significant rise in average of market works for both men and women. Furthermore, we see no changes in the share of part-time workers; on the other hand, the share of full-time laborers has elevated by 6 and 4 pp for men and women, respectively. Meanwhile, market working hours for full-time men and part-time women workers have not changed since 2003, while the drop in allocated time to market by full-time female and part-time male

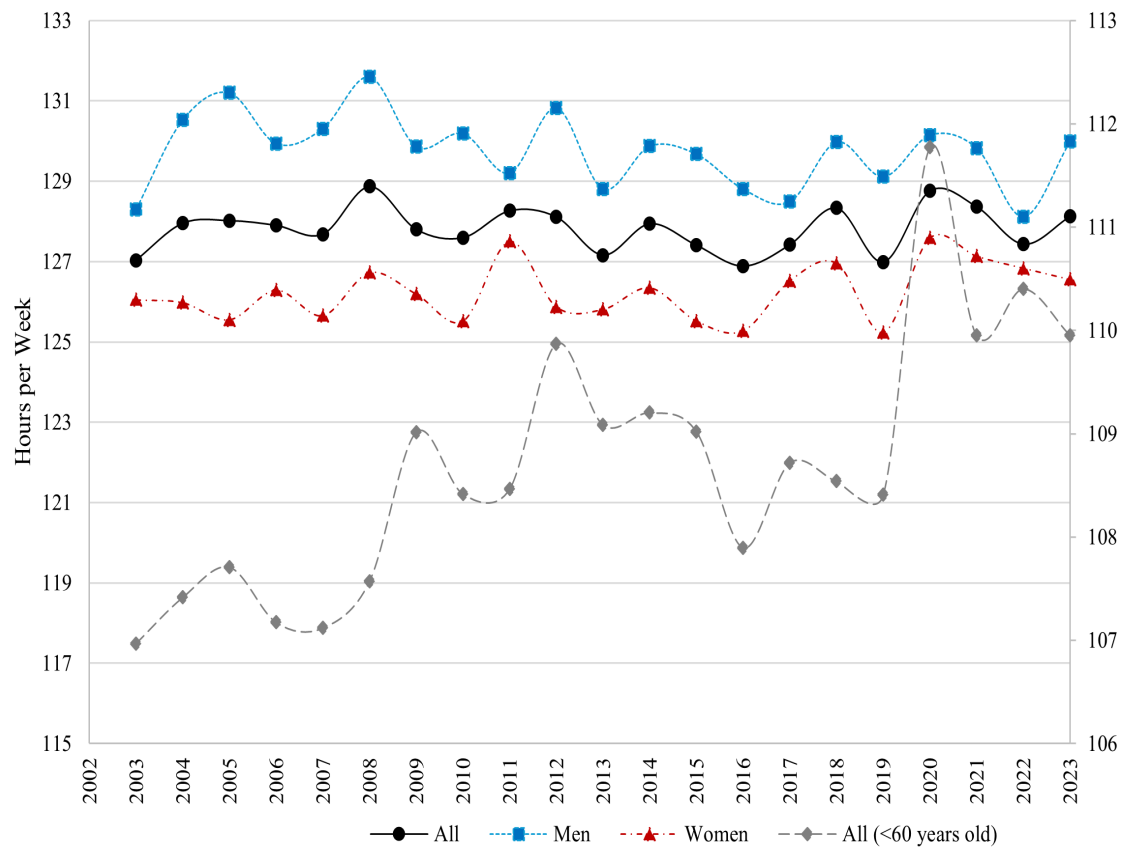


Figure 3: Leisure hours of elderly

laborers is not statistically significant. We also assess the impact of demographic variables of individuals such as education, race, spouse employment, health, and marital status. We tracked significant variations in both changes in share of people with these characteristics in population and changes in their market work hours. Table 4 for men and 5 for women show changes in allocating time of elderly to market work, nonmarket work, and leisure conditioned on a particular characteristic individually. According to the finding in those tables, share of people with college degree has increased by 13 pp for men and 20 pp for women, whereas working hours has not changed significantly on average of 2021-2023 compared to average of 2003-2005. Although share of men without college degree dropped by 13 pp, their market work increased by 3.82 hours. In the meantime, undereducated women did not change their market work in the same period of time. By analyzing marital status of men, we witnessed that both groups of married and not-married men have raised their market work meaningfully to reach 13.2 from 11.72 and 11.88 hours from 7.82 hours in the early of 2000s, respectively. The same trend was observed for women, their market hours is 7 and 7.82 hours for married and not-married. However, the share of married interviewers declined by 7 for men and 3 percentage point for women from average of 2003-05 in the US population. Spouse employment is the other influential factor in working hours for the elderly. This partition has increased by 1 pp for men and 5 pp for women when market work decreased by 2.66 hours for women and increased by 2.71 hours for men. However, average working hours for males whose spouse participate in labor market is almost three times compared to men with none-working wife (24.3 v.s. 9.04 hours) and the similar trend for women (12.5 v.s. 4.7 hours). Undoubtedly, health condition affects all daily activities of elderly including market work. Healthy men laborer work 14.6 hours while unhealthy individuals only work on average 6.8 hours in 2021-23. These numbers are 7.6 for healthy and 3.68 hours for unhealthy women. On the other hand, share of people who claimed healthy increased by 8 pp for men and 7 pp for women. More details about health status data in ATUS is provided in Appendix section. Considering all these findings, rise in market work of senior workers can be due to behavioral changes in birth cohorts or changes in demographic characteristics of US population. Thus, conduction a birth cohort analysis can shed light to these mixture of factors.

5.1 Role of Cohorts

It has been well studied that people are born in different cohorts participate in labor market differently when they reach the same age. [Goldin and Mitchell \(2017\)](#) found that cohorts of women born in the 1950s participated in the labor market more compared to

their peers born in the 1940s and 1940s. [Tomaz et al. \(2023\)](#), by studying men and women aged 62 to 66 from the 1934 cohort to 1953, document that behavioral differences, including education, health, and spouse's participation, account for 8 pp of the rise in LFPR of senior workers. [Yu \(2024\)](#) divided data from CPS into two cohorts of born in 1930s and 1950s to explore the impact of changes in social security rules on older labors. Social security rules have changed gradually to keep individuals in retirement age longer in labor market. One major change throughout the last two decades is extension of NRA ¹ for receiving full retirement benefits. According to SSA, we segregate data to five cohorts: individuals born in 1920-37, 1938-42, 1943-48, 1949-54, and 1955-59 and 1960 or later with average NRA of 65, 65 and 6 months, 66, and 66 and 6 months, and 67, respectively. ² Cohort of 1920-1937 is considered as the base cohort. To analyze mentioned factors in a pool, we specify a regression model to regress market work hours allocated by individual i at time t on a series of dummies to capture them in their birth year cohort with respect to their life cycle profile, business cycle fluctuations, and controls for demography. Before running our regression model and as tables 4 and 5 suggest, we investigate the effects of shifts in the proportion of the working population and full-time workers.

5.2 Role of Full-time Worker

To identify the implications of the higher rate of contribution in the job market and being a full-time worker, we utilize the same method in [Tomaz et al. \(2023\)](#) but for working and full-time share in population instead of LFPR. In this specification, we regress two dummy variables of working ($working=1$) and full-time working ($fulltime=1$) to specify if cohorts behave differently in working or full-time working respect to life cycle, business cycle, race, college degree, spouse employment, health, and disability status. In equation 1, $j \in 1, 2$ that $j = 1$ denotes dummy for working and $j = 2$ for full-time working, Age_{it} represents a vector of 21 one-year dummies for age from 61 to 80 and a single group of 85 years old, $Cohort_{it}$ stands for a vector of six 5-year birth dummies, and UR_t is unemployment rate to capture business cycle effects. Moreover, X_{it} accounts for demographic characteristics including dummy variables of college degree ($having\ college\ degree=1$), spouse employment status ($spouse\ working=1$), health ($healthy=1$), race ($black=1$), and disability status ($disabled=1$). ϵ_{it} captures the error terms which are clustered at individual level. Finally, time, t , is considered on monthly basis. This model enables us

¹The age at which beneficiaries are eligible for full benefits without any age-related reduction, also called full retirement age (FRA), it ranges from 65 to 67 depending on the worker's year of birth.

²See Social Security Advisory Board, [Administration \(2024\)](#) for more information.

$$Share_{it}^j = \beta_0 + \beta_{cohort}Cohort_{it} + \beta_{age}Age_{it} + \beta_{ur}UR_t + \mathbf{X}'\beta + \epsilon_{it} \quad (1)$$

According to the results in table 8, spouse employment and health have the largest effect on working and full time working of seniors. For example, employed wife increases share of working men by 20 pp and full-time working by 14 pp. Because health data is not collected for all individuals in all period of time, we investigate the effect of health in another regression experiment shown in columns 3 and 7 for men and 4 and 8 for women in table 8. Although data size has shrunk considerably, the impact of college degree and spouse employment do not disappear. Share of working males and full-time workers are 10 and 7 pp higher among healthy people compared to unhealthy. These shares are higher, respectively, by 8 and 4 pp for women. Calculated coefficients in table 8 suggest that after controlling for demographic characteristics, share of later cohorts of 1955-1959 and born after 1960 are higher in working and full-time worker population. For instance, participate rate of men born in 1955-59 is 6 pp higher in market work and 10 pp more in full-time working regardless of their health status. These findings indicate a correlation between older adults' average market work and the growth in the share of full-time workers. Thus, we add dummy variable of full-time working to specification 2 to explore if cohorts behave differently respect to the the selected control variables. Results for below regression model is provided in table 9.

$$\tau_{it}^{market} = \beta_0 + \beta_{cohort}Cohort_{it} + \beta_{full}FullTime_{it} + \beta_{age}Age_{it} + \beta_{ur}UR_t + \mathbf{X}'\beta + \epsilon_{it} \quad (2)$$

In this specification, τ_{it}^{market} represents market work hours by individual i in period t , and $FullTime_{it}$ captures if they are full-time worker. Coefficients in table 9 can be interpreted to indicate that race, full-time employment, college degree, and spouse employment all influence market working hours, but birth-year cohorts have no discernible effect. Therefore, rather than a shift in the tendency to work longer hours, we can infer that the upward trend in senior laborers' market work is primarily due to their higher involvement in the labor market and full-time employment. Our findings are supported by other studies (i.e. [Goldin and Mitchell \(2017\)](#), [Tomaz et al. \(2023\)](#), and [Yu \(2024\)](#))

6 Conclusion

7 Appendix

7.1 Health Data

Although surveying general health of interviewers is not main purpose of ATUS, they collect this data in marginal modules of "The ATUS Eating and Health (EH) Module" and "The ATUS Well-Being (WB) Module". These modules are designed to elicit data about special topics by adding more questions to the regular survey. EH module is only available for 2006 to 2008, 2014 to 2016, and 2022. WB module was collected in 2010, 2012, 2013, and 2021. Thus, data for general health of individuals can be extracted only for these years from these two modules. We downloaded these modules from IPUM and merged them with initial data from BLS. Variable "GENHEALTH" record the general assessment of interviewers about their health that is categorized in excellent, very good, good, fair, and poor. Figure 4 illustrates health distribution of interviewers in ATUS for two time cross sections of 2006-07 and 2021-22. It implies general health level of population has shifted toward excellence. Then, we define a healthy (healthy=1) person if they reported excellent, very good, or good and unhealthy (healthy=0) if fair or poor. [Tomaz et al. \(2023\)](#) studied the impact of health on LFPR and they found that consistent increase in LFPR centered around healthy people while unhealthy old labors reduced their participation. However, we find a contradictory evidence about working hours. Although not statistically significant, market work for healthy and unhealthy men has increased in average of 2021 to 2022 compared to the average of 2006 and 2007. Surprisingly, unhealthy labeled men have increased their market work by 1.16 hours (20%) and nonmarket by 2.3 hours (18%) while they supplied these works by giving up 3.16 hours of their leisure time. The same pattern is found among women but they sacrifice their leisure less due to lower nonmarket work compared to the average of 2006-07. Our results supports finding in [Yu \(2024\)](#) that argue unhealthy people increased older-age labor force participation rate by 8.2%.

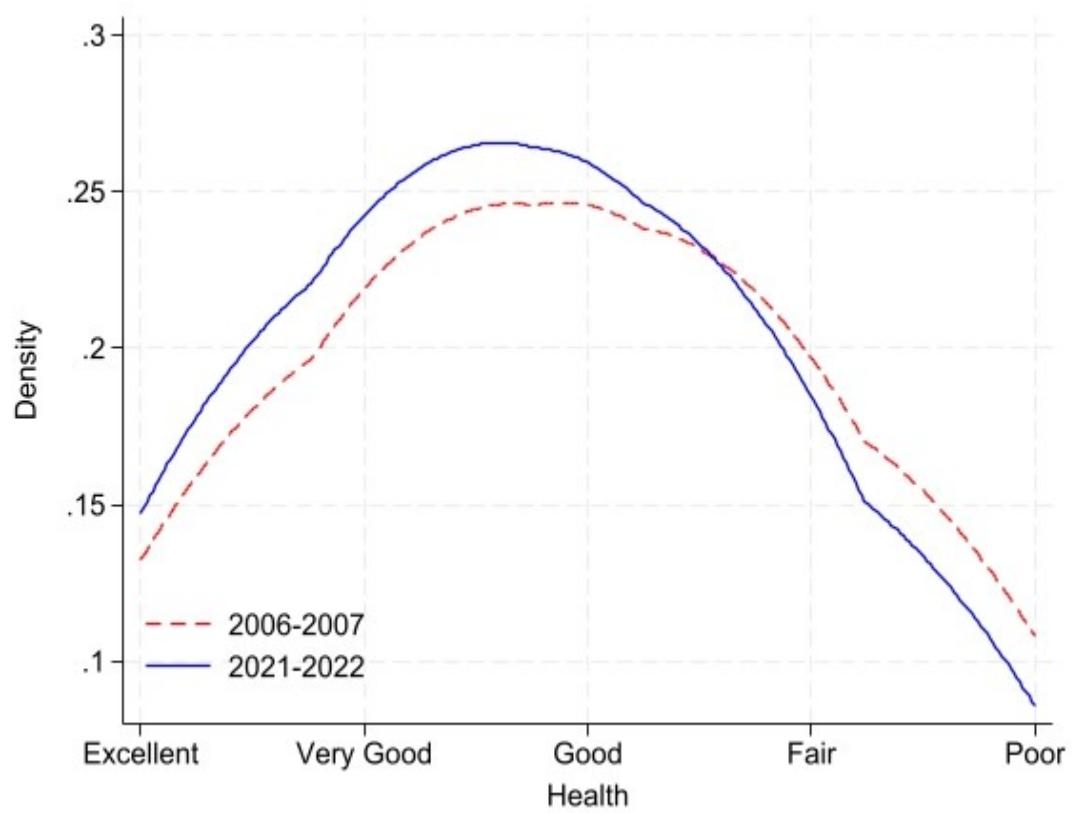


Figure 4: Health density distribution of elderly in ATUS.

Table 3: Time Use by Elderly above 60 years old by health condition

Time Use Category	Average of 2006-2007 (I)	Average of 2015-2016 (II)	Average of 2021-2022 (III)	Difference (II) vs. (I) (IV)	Difference (III) vs. (I) (V)
Men					
Healthy					
Market Work	14.00	13.81	14.61	-0.19 (1.29)	0.61 (1.34)
Non Market Work	16.29	16.28	16.23	-0.01 (0.78)	-0.06 (0.77)
Leisure	133.86	134.65	133.68	0.78 (1.3)	-0.18 (1.34)
Unhealthy					
Market Work	5.63	7.33	6.79	1.7 (1.45)	1.16 (1.55)
Non Market Work	12.62	13.57	14.92	0.95 (1.17)	2.3* (1.32)
Leisure	145.00	143.38	141.83	-1.62 (1.86)	-3.16 (1.99)
Women					
Healthy					
Market Work	8.16	7.96	7.64	-0.2 (0.77)	-0.52 (0.76)
Non Market Work	25.87	25.29	24.24	-0.58 (0.7)	-1.63** (0.71)
Leisure	130.23	131.04	132.61	0.81 (0.85)	2.38*** (0.87)
Unhealthy					
Market Work	2.53	2.31	3.69	-0.22 (0.67)	1.16* (0.79)
Non Market Work	21.74	20.82	21.31	-0.92 (1.23)	-0.43 (1.24)
Leisure	138.07	137.97	137.52	-0.1 (1.42)	-0.55 (1.46)

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 4: Compositional changes of Male population

	Share in Sample		Market Work		Nonmarket Work		Leisure	
	Average	Difference (%)	Average	Difference (SD)	Average	Difference (SD)	Average	Difference (SD)
Working	28	5	37.14	0.87(1.42)	12	1.52**(0.73)	116.11	-2.27*(1.27)
Full Time	18	6	45.34	-0.15(1.8)	11.33	0.9(0.9)	109.06	-0.72(1.57)
Part Time	10	0	23.19	-1.98(1.78)	13.15	3.4 *** (1.22)	128.11	-1.4(1.81)
Self Employed	9	0	37.66	-4.36*(2.41)	10.77	4.38 *** (1.43)	117.11	-1.05(2.3)
Government Employee	4	1	34.27	2.31(3.81)	18.68	-3.72*(2.18)	112.93	1.15(3.47)
Private Employee	16	5	37.52	2.77(1.93)	11.12	1.4(0.91)	116.3	-3.44**(1.67)
Family Business	14	-1	29.5	-0.24(2.07)	12.95	0.96(1.16)	121.5	-0.09(1.97)
Non Family Business	86	1	7.63	2.74 *** (0.58)	16.18	0.07(0.44)	139.99	-2.13 *** (0.66)
College	43	13	13.65	-0.4(0.88)	17.22	-0.4(0.57)	133.11	0.85(0.91)
No College	57	-13	8.34	3.82 *** (0.8)	14.63	0.24(0.6)	140.73	-2.66 *** (0.91)
Married	74	-7	11.57	1.64** (0.76)	16.08	0.41(0.53)	136.21	-1.19(0.82)
Not Married	26	7	7.82	4.38 *** (0.93)	14.79	0.16(0.64)	141.11	-4.1 *** (1.05)
Black	8	4	6.2	4.77 *** (1.76)	12.92	1.1(1.26)	144.06	-4.44** (2.04)
Spouse Employed	28	1	21.59	2.71(1.78)	15.79	-0.93(0.97)	127.06	-1.03(1.67)
Spouse Not Employed	54	-5	7.74	1.3* (0.74)	16.19	0.75(0.63)	139.77	-1.21(0.88)
Live in Metro Area	75	7	10.41	2.88 *** (0.69)	15.81	0.07(0.47)	137.72	-2.44 *** (0.74)
Live in Nonmetro Area	25	-8	11.26	-0.91(1.14)	15.52	0.56(0.89)	136.67	1.56(1.32)
Healthy	69	8	14	0.61(0.98)	16.3	-0.06(0.63)	133.86	-0.18(1.02)
Not Healthy	31	-8	5.63	1.16(1.14)	12.62	2.3** (0.95)	145	-3.16** (1.46)

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Compositional changes of Female population

	Share in Sample		Market Work		Nonmarket Work		Leisure	
	Average	Difference (%)	Average	Difference (SD)	Average	Difference (SD)	Average	Difference (SD)
Working	19	5	30.69	-0.09(1.3)	21.43	-1.45*(0.78)	113.33	1.15(1.13)
Full Time	10	4	41.89	-2.6(1.94)	18.62	-0.93(1.11)	105.35	2.71*(1.6)
Part Time	10	0	19.57	-0.67(1.39)	24.23	-1.16(1.09)	121.26	1.87(1.42)
Self Employed	3	0	27.96	-1.59(3.05)	22.61	0.43(2.04)	113.75	1.69(2.81)
Government Employee	3	1	32.92	-1.49(3.27)	19.39	0.63(1.93)	113.63	0.59(2.75)
Private Employee	13	3	30.82	0.58(1.59)	21.56	-2.27**(0.94)	113.24	1.03(1.38)
Family Business	10	0	16.59	-0.33(1.68)	26.22	-1.24(1.29)	121.69	1.43(1.72)
Non Family Business	90	0	4.89	1.5*** (0.37)	25.24	-1.75*** (0.39)	133.55	0.74(0.49)
College	32	20	8.08	0.77(0.64)	25.35	-1.63*** (0.57)	130.09	1.06(0.74)
No College	68	-20	5	0.69(0.45)	25.32	-1.8*** (0.52)	133.55	1.93*** (0.63)
Married	49	3	6.77	0.23(0.61)	28.62	-2.28*** (0.62)	128.46	2.22*** (0.75)
Not Married	51	-3	5.38	2.44*** (0.47)	22.18	-1.51*** (0.45)	136.07	-0.23(0.6)
Black	10	4	4.9	4.28*** (1.1)	21.05	-1.49(1.05)	136.59	-0.9(1.45)
Spouse Employed	25	5	15.22	-2.66*(1.55)	27.66	-1.57(1.21)	121.38	2.92*(1.56)
Spouse Not Employed	37	1	3.94	0.81(0.57)	29	-2.77*** (0.71)	130.79	2.65*** (0.84)
Live in Metro Area	75	9	6.04	1.4*** (0.43)	24.86	-1.67*** (0.42)	132.77	0.67(0.54)
Live in Nonmetro Area	25	-9	5.87	1.26*(0.75)	26.72	-1.11(0.83)	131.41	0.72(1.02)
Healthy	71	7	8.16	-0.52(0.59)	25.87	-1.63*** (0.56)	130.23	2.38*** (0.71)
Not Healthy	29	-7	2.53	1.16** (0.58)	21.74	-0.43(0.95)	138.07	-0.55(1.14)

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

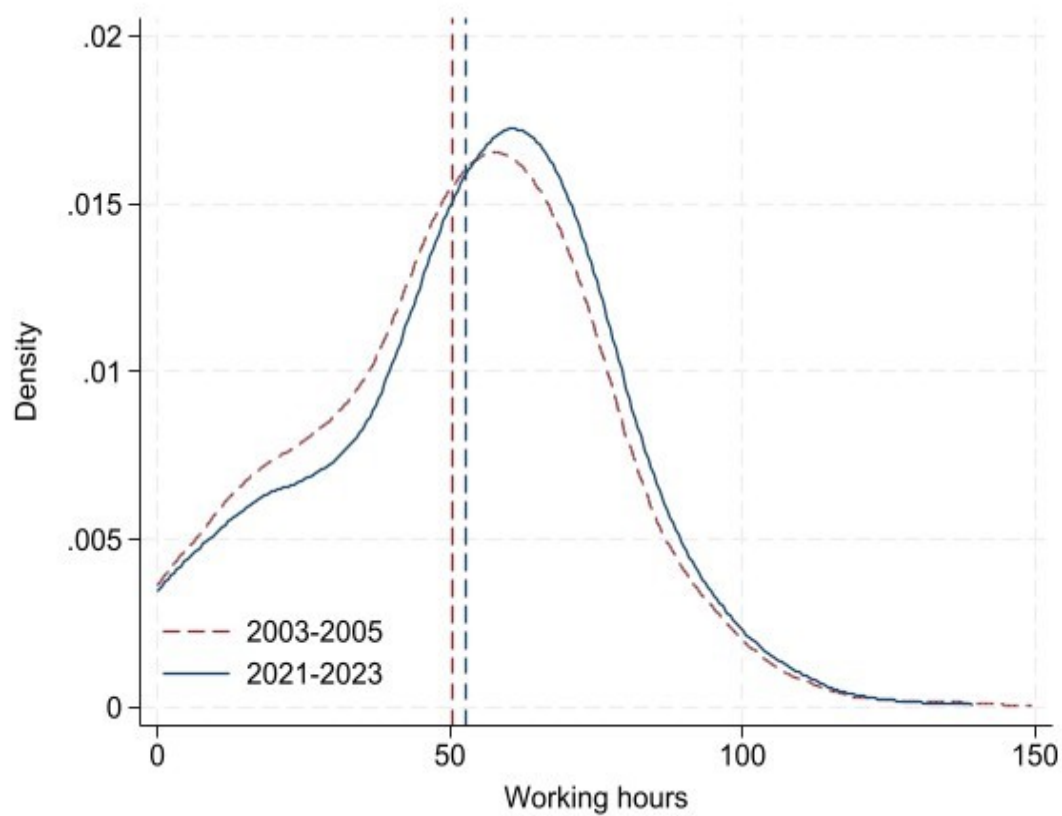


Figure 5: Market working hours density distribution for individuals who are not retired. A subsample for nonretirees who do not reported zero market work on the interview day.

Table 6: Time Use by Elderly above 60 years old for different age groups

Time Use Category	Average of 2003-2005 (I)	Average of 2016-2018 (II)	Average of 2021-2023 (III)	Difference (II) vs. (I) (IV)	Difference (III) vs. (I) (V)
Men					
Age 61-67					
Market Work	18.63	21.51	22.31	2.88** (1.37)	3.68*** (1.41)
Non Market Work	15.98	15.12	15.18	-0.86 (0.79)	-0.8 (0.8)
Leisure	129.63	128.39	127.09	-1.24 (1.33)	-2.54* (1.36)
Age >67					
Market Work	5.45	5.87	6.36	0.42 (0.65)	0.91 (0.62)
Non Market Work	15.58	16.21	16.47	0.62 (0.6)	0.89 (0.58)
Leisure	142.51	141.76	141.6	-0.75 (0.85)	-0.91 (0.81)
Women					
Age 61-67					
Market Work	13.14	13.79	14.25	0.65 (1.08)	1.11 (1.03)
Non Market Work	26.85	23.82	22.71	-3.03*** (0.76)	-4.13*** (0.75)
Leisure	124.51	126.03	127.03	1.52 (1.04)	2.52*** (1.02)
Age >67					
Market Work	2.32	3.04	3.23	0.72** (0.35)	0.91*** (0.34)
Non Market Work	24.55	22.71	24.18	-1.84*** (0.56)	-0.37 (0.54)
Leisure	136.51	137.68	136.89	1.17* (0.65)	0.38 (0.61)

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 7: Time Use For Leisure by Elderly above 60 years old

Time Use Category	Average of 2003-2005 (I)	Average of 2016-2018 (II)	Average of 2021-2023 (III)	Difference (II) vs. (I) (IV)	Difference (III) vs. (I) (V)
Full Sample					
Sleeping	61.57	61.95	63.14	0.38 (0.26)	1.58 *** (0.25)
TV Watching	25.84	29.2	29.51	3.36 *** (0.41)	3.67 *** (0.41)
Eating	10.42	9.14	9.32	-1.28 *** (0.13)	-1.10 *** (0.13)
Socializing	11.53	10.70	9.95	-0.83 *** (0.21)	-1.58 *** (0.21)
Reading	7.1	4.98	4.34	-2.12 *** (0.18)	-2.76 *** (0.16)
Other Leisure	12.06	13.11	13.22	1.05 *** (0.25)	1.16 *** (0.24)
Men					
Sleeping	61.5	61.46	62.61	-0.04 (0.40)	1.10 *** (0.40)
TV Watching	28.22	32.28	32.57	4.06 *** (0.68)	4.35 *** (0.68)
Eating	11.18	9.59	9.83	-1.59 *** (0.20)	-1.35 *** (0.21)
Socializing	10.16	9.16	7.99	-1.01 *** (0.33)	-2.18 *** (0.30)
Reading	6.53	4.4	3.76	-2.13 *** (0.26)	-2.78 *** (0.24)
Other Leisure	13.62	13.75	14.28	0.13 (0.43)	0.66 (0.42)
Women					
Sleeping	61.61	62.35	63.6	0.74 ** (0.34)	1.99 *** (0.32)
TV Watching	23.99	26.62	26.91	2.63 *** (0.49)	2.91 *** (0.48)
Eating	9.82	8.76	8.89	-1.06 *** (0.16)	-0.94 *** (0.15)
Socializing	12.59	12	11.62	-0.59 ** (0.28)	-0.96 *** (0.29)
Reading	7.54	5.47	4.84	-2.07 *** (0.24)	-2.7 *** (0.22)
Other Leisure	10.85	12.58	12.31	1.73 *** (0.28)	1.46 *** (0.26)

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

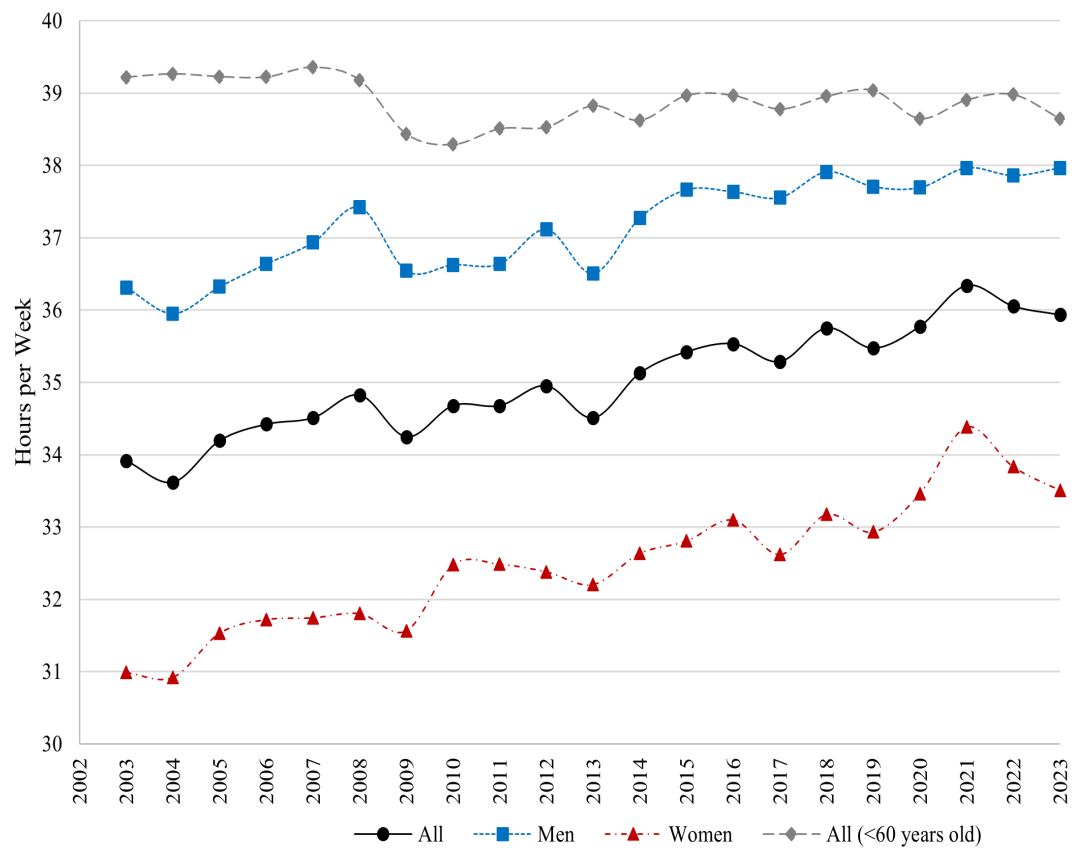


Figure 6: Market Working hours of elderly (CPS)

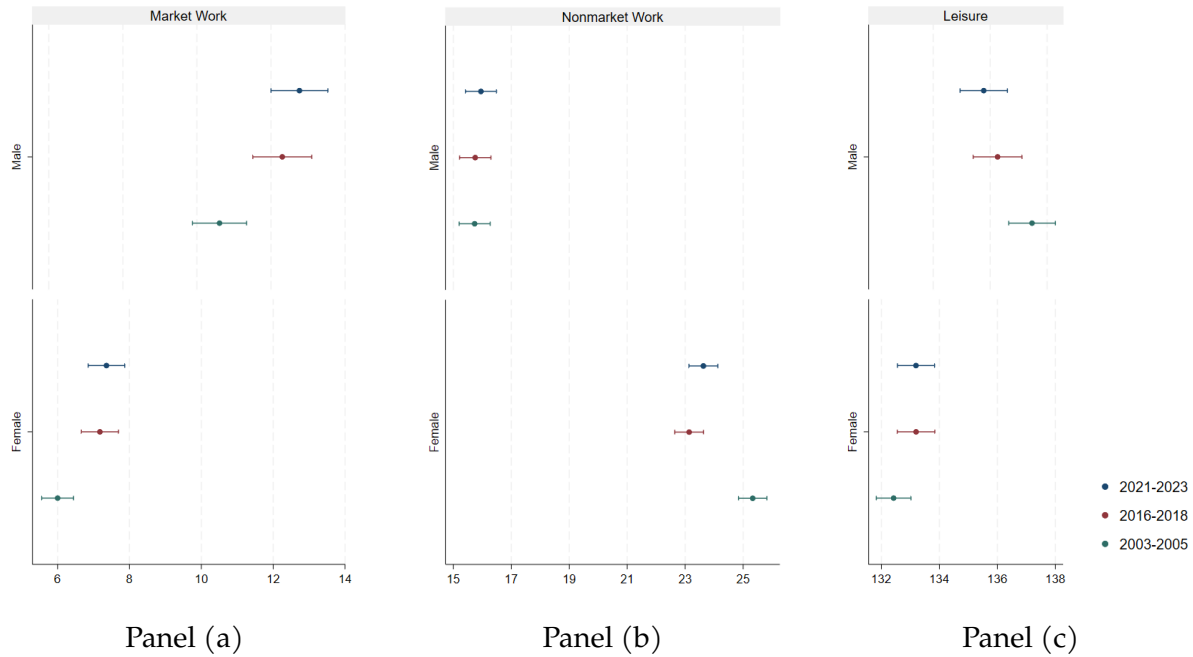


Figure 7: Average time used for market work (panel (a)), non-market work (panel (b)), and leisure (panel (c)) by gender for three time periods of 2003-05, 2016-18, and 2021-23. Time spent is expressed in hours per week. 95% confidence intervals are depicted.

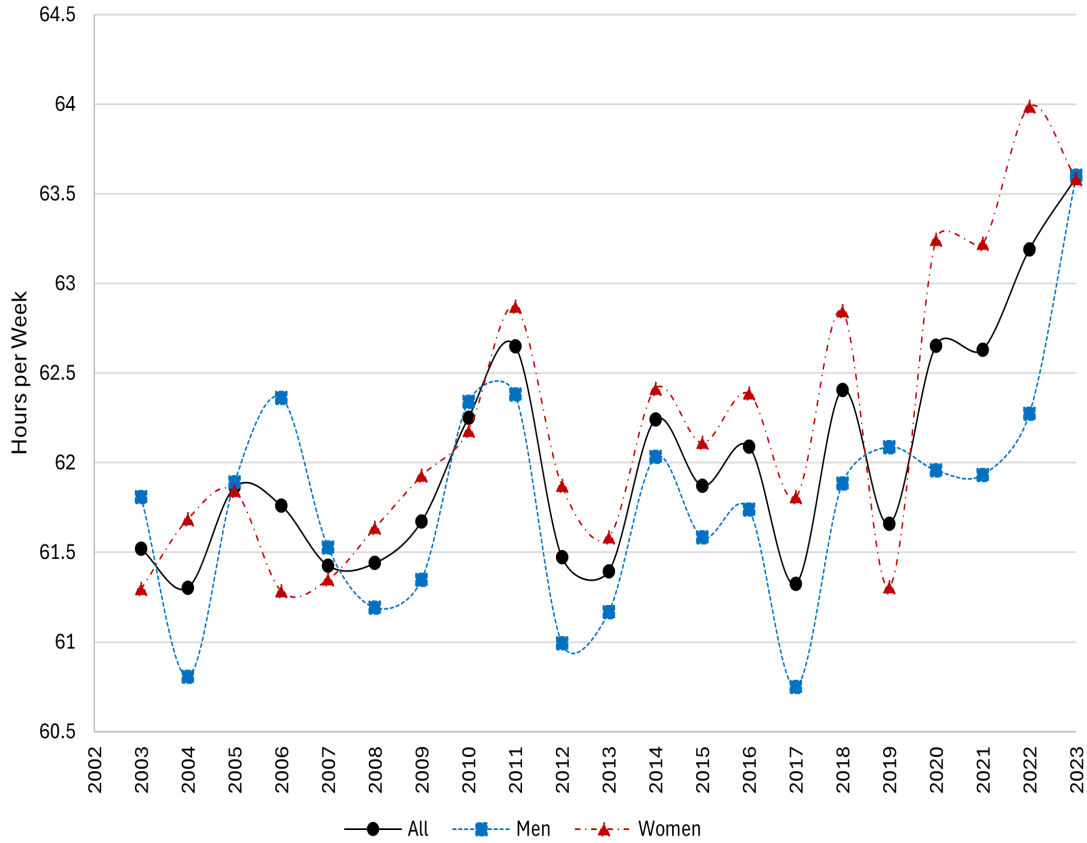


Figure 8: Sleeping hours of elderly

have kept increasing their attachment to the labor force rising trend our goal is to understand the key driving forces behind the observed changes in hours of work. The increase, 2.7 hours per week, is 7 percent of average hours of market work.

Compared with early 2000s, employees working local, state, and federal government increased by 1 percent, and in case of private employers, this share raised by 5 percent for men and 3 percent for women. For self employed people, we did not find any changes in their share in population but a significant drop in their working hours by 4.36 hours for men and 1.59 for women. Thus, this item has a negative impact on total market work of older workers. Higher tendency of living in cities is another influential factor in working more in labor market. Men living in cities work 2.88 hours more in recent years compared to their peers in 2000s. This factor is intensified when we witness higher share of living in cities in men's population by 8 percent and 7 percent for women's.

Yu (2024) developed a structural model to explain the impact of three main changes in social security rules including normal retirement age (NRA)³, delayed retirement credits

³The age at which beneficiaries are eligible for full benefits without any age-related reduction, also called

Table 8: Share of Working and Full Time Labor

	Working				Full Time Working			
	(1) Men	(2) women	(3) Men	(4) women	(5) Men	(6) Women	(7) Men	(8) Women
Year of Birth Cohort								
1938-1942	-0.00 (0.01)	0.01 (0.01)	-0.02 (0.02)	-0.02 (0.02)	-0.01 (0.01)	-0.01 (0.01)	-0.02 (0.02)	-0.00 (0.01)
1943-1948	-0.00 (0.01)	0.04*** (0.01)	-0.04** (0.02)	0.00 (0.02)	-0.01 (0.01)	0.01 (0.01)	-0.05*** (0.02)	0.02 (0.02)
1949-1954	0.01 (0.01)	0.02* (0.01)	-0.03 (0.02)	-0.03 (0.02)	0.03** (0.01)	0.00 (0.01)	-0.00 (0.02)	-0.01 (0.02)
1955-1959	0.06*** (0.02)	0.04** (0.02)	0.05* (0.03)	0.01 (0.03)	0.10*** (0.02)	0.04*** (0.01)	0.07*** (0.03)	0.03 (0.02)
>=1960	0.05* (0.03)	0.00 (0.03)	-0.03 (0.04)	0.03 (0.04)	0.10*** (0.02)	0.00 (0.02)	0.03 (0.04)	0.07** (0.03)
College	0.05*** (0.01)	0.04*** (0.01)	0.04*** (0.01)	0.03*** (0.01)	0.03*** (0.01)	0.02*** (0.01)	0.04*** (0.01)	0.02* (0.01)
Spouse Employed	0.20*** (0.01)	0.21*** (0.01)	0.18*** (0.01)	0.21*** (0.01)	0.14*** (0.01)	0.11*** (0.01)	0.13*** (0.01)	0.11*** (0.01)
Race	-0.04*** (0.01)	0.01 (0.01)	-0.06*** (0.02)	-0.00 (0.02)	-0.01 (0.01)	0.02* (0.01)	-0.01 (0.02)	-0.00 (0.02)
Health			0.10*** (0.01)	0.08*** (0.01)			0.07*** (0.01)	0.04*** (0.01)
Constant	0.60*** (0.02)	0.41*** (0.02)	0.58*** (0.04)	0.38*** (0.04)	0.48*** (0.02)	0.30*** (0.02)	0.49*** (0.03)	0.27*** (0.03)
Age Dummies	✓	✓	✓	✓	✓	✓	✓	✓
Business Cycle	✓	✓	✓	✓	✓	✓	✓	✓
Disabled	✓	✓	✓	✓	✓	✓	✓	✓
Health			✓	✓			✓	✓
R-Squared	0.23	0.21	0.23	0.22	0.23	0.17	0.23	0.18
Observations	16244	14265	7404	6640	16244	14265	7404	6640

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 9: Market Work Regression Results

	Market Work Hours			
	(1) Men	(2) Women	(3) Men	(4) Women
Year of Birth Cohort				
1938-1942	-0.20 (0.51)	0.18 (0.44)	-0.47 (0.82)	-0.07 (0.70)
1943-1948	0.31 (0.51)	0.45 (0.45)	0.18 (0.86)	0.27 (0.74)
1949-1954	-0.42 (0.61)	-0.33 (0.52)	-0.75 (1.01)	0.13 (0.84)
1955-1959	-0.75 (0.76)	-0.74 (0.63)	0.06 (1.33)	-2.01* (1.08)
>=1960	-0.63 (1.26)	-2.14** (1.04)	-0.13 (2.01)	-5.10*** (1.62)
College	0.99*** (0.30)	0.23 (0.26)	0.61 (0.45)	0.26 (0.38)
Spouse Employed	2.14*** (0.35)	1.83*** (0.30)	2.85*** (0.52)	2.64*** (0.44)
Full Time	39.51*** (0.40)	34.88*** (0.41)	39.54*** (0.59)	33.37*** (0.59)
Race	-1.69*** (0.53)	-0.08 (0.48)	-2.49*** (0.78)	-0.34 (0.73)
Health			0.74 (0.55)	0.51 (0.49)
Constant	7.01*** (1.07)	6.68*** (0.91)	6.18*** (1.77)	5.45*** (1.49)
Age Dummies	✓	✓	✓	✓
Business Cycle	✓	✓	✓	✓
Disabled	✓	✓	✓	✓
Health			✓	✓
R-Squared	0.47	0.42	0.48	0.41
Observations	16244	14265	7404	6640

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

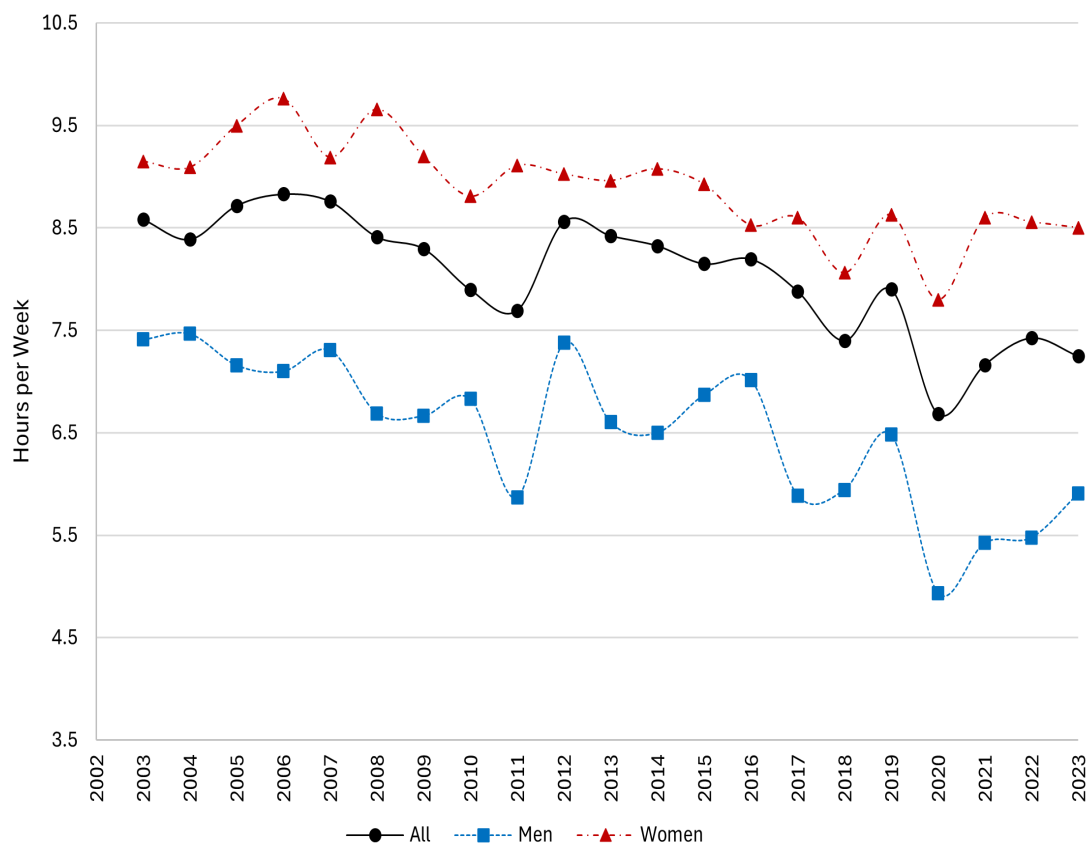


Figure 9: Socializing hours of elderly

(DRC)⁴, and retirement earnings test (RET)⁵ on senior worker's labor supply. However, since RET was eliminated in the beginning of 2000 and ATUS data has been collected since 2003, changes in RET cannot be the driver of rising working hours for the elderly. To test if NRA could explain longer working hours, we segregated observations in two age groups of 61 to 67 and older than 67 years old. Table ... in appendix shows that market work increased by 3.68 hours per week for males aged 61 to 67 and 0.91 hours for older group while females work 1.11 hours and 0.91 hours more, respectively. Additionally, to find the differences among cohorts, we experiment the impact of birth year on market work in the section....

full retirement age (FRA), it ranges from 65 to 67 depending on the worker's year of birth.

⁴Retirement benefits increase by a specific percentage, DRC, as per year that a worker holds off applying for benefits beyond the Normal Retirement Age (NRA). To extend the labor supply, social security administration (SSA) increased DRC gradually to 8 percent for the latest cohort.

⁵The rule mandating that retirement benefits be withheld from recipients under the NRA if their wages exceed specific exempt amounts

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