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Abstract

This paper compares the relative strengths of working longer vs. saving more in terms of increasing a household's affordable, sustainable standard of living in retirement. Both stylized households and actual households from the Health and Retirement Study are examined. We assume that workers commence Social Security benefits when they retire. The basic result is that delaying retirement by 3-6 months has the same impact on the retirement standard of living as saving an additional one-percentage point of labor earnings for 30 years. The relative power of saving more is even lower if the decision to increase saving is made later in the work life. For instance, increasing retirement saving by one percentage point ten years before retirement has the same impact on the sustainable retirement standard of living as working a single month longer. The calculations of the relative power of working longer and saving more are done for a wide range of realized rates of returns on saving, for households with different income levels, and for singles as well as married couples. The results are quite invariant to these circumstances.

JEL codes: H55, D14, J26

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1. Introduction

One of the biggest financial challenges people face is allocating lifetime resources in such a way as to support a satisfactory and sustainable standard of living in retirement. Households can explicitly or implicitly establish a plan at a relatively early age, but there is a great deal of uncertainty about important factors such as future wage growth, asset returns, life expectancies, annuity prices and Social Security benefit formulas at the time of retirement. The key decisions to make include when to start saving for retirement, what percentage of earnings to contribute to employer-based tax deferred saving accounts, what asset returns and expenses to assume, and at what age to retire. As time passes and some of this uncertainty is resolved, households should reassess their strategy for providing resources for retirement. For example, households today may wish to re-optimize retirement strategy in light of persistently low real interest rates and wage growth. In a standard life cycle model with uncertainty, households continually reassess and reoptimize as new information is revealed. In reality, households facing constraints on their time and attention could reexamine their plan at periodic intervals, such as every ten years.

In this paper, we examine how households that are close to retirement could reassess retirement plans. Rather than specifying a full-blown life cycle model, we examine the marginal impact of saving and retirement choices on sustainable retirement consumption. This framework allows us to see how each of these margins influences retirement consumption, thereby defining the tradeoffs that households face. The optimal choice with respect to these tradeoffs will of course depend on household preferences. But spelling out the tradeoffs can provide practical guidance for individuals and financial planners. We calculate the impact of working longer on retirement consumption and compare it to the impact of saving more or switching to assets with lower expense ratios. We examine this issue for both stylized households and actual households from the Health and Retirement Study (HRS), a nationally representative panel of older adults. Our key insight is that some decisions, such as how much to save in retirement accounts going forward, become less powerful at older ages in changing the affordable retirement standard of living. Saving an additional one percent of earnings, for instance, would affect the retirement standard of living much more at age 36 than at age 56. Similarly, the impact of choosing cost-efficient assets – something financial planners frequently emphasize to increase retirement resources – diminishes with age since there are fewer years to enjoy the benefit of a lower cost portfolio. In contrast, changes to planned retirement and Social Security claiming dates continue to have the same impact on retirement living standards as a person ages.

We define the maximum sustainable standard of living in retirement as the maximum annuity that can be obtained from both private retirement savings and Social Security. We assume that retirement accumulations are used to purchase an inflation-indexed joint survivor life annuity with 100% of the monthly benefit continuing for the survivor. Annuitizing wealth guarantees that the benefits are indeed sustainable and protected from both inflation and the risk of outliving retirement resources, and is generally optimal in the life cycle framework (see Yaari 1965; Mitchell et al. 1999). It also facilitates our analysis by ensuring that the annuity benefits from 401(k) and similar plans are comparable to Social Security benefits for primary earners, where the benefits are paid out as a second-to-die inflation-indexed annuity. We assume that workers claim Social Security upon retirement, and therefore workers who extend their careers postpone the commencement of Social Security to their new retirement age. Claiming Social Security upon retirement is not necessarily optimal. In fact, most primary earners benefit from delaying Social Security to age 70 regardless of retirement age[2], and using private retirement assets to finance a

[2] See, e.g., Meyer and Reichenstein (2010); Munnell and Soto (2005); Sass, Sun, and Webb (2007, 2013); Coile et al. (2002); Mahaney and Carlson (2007); Shoven and Slavov (2014a, b).

delay of Social Security is superior to annuitizing them (Bronshtein et al. 2017). However, claiming Social Security upon retirement matches actual behavior of most Americans and appears to be a social norm (Shoven, Slavov, and Wise 2017). We further assume that individuals who continue to work continue to contribute to their employer's defined contribution plan. We show that postponing retirement impacts the sustainable standard of living in retirement for several reasons: (1) commencing Social Security at a later age results in higher monthly benefits, (2) working longer involves additional contributions to retirement accounts, (3) delayed withdrawals from retirement accounts results in additional compounding of previous account balances, and (4) delayed annuity purchase results in lower annuity prices (that is, a given amount of wealth will convert to a larger monthly annuity payment).

The stylized analysis and the empirical results from the HRS lead to the same conclusion. Working longer is a powerful method to increase retirement standard of living and has a substantially larger impact on retirement consumption than other alternatives, particularly in mid- and late-career circumstances. For individuals who are 30 years away from retirement, extending work for six months or less has the same impact as increasing annual retirement contributions by one percentage point. For near retirees, increasing retirement contributions has even less relative strength. In those cases, a one-percentage point increase in the contribution rate may be equivalent to postponing retirement by a single month. While the optimal choice depends on household preferences, including the disutility of work, these are the tradeoffs. Our analysis provides valuable information to households as they consider the levers that they have at their disposal to increase their retirement standard of living.

2. Analysis of Stylized Households

The traditional economic approach to modeling saving and retirement decisions is based on the life cycle model. In a standard life cycle model, households aim to smooth consumption over the lifetime by saving during working years and drawing down on savings during retirement years (Friedman 1957; Modigliani 1966). Life cycle models can incorporate uncertainty in a range of outcomes, such as wages, asset returns, and health. Some studies have introduced endogenous retirement into the life cycle model by having the marginal cost of effort increase or the marginal value of leisure decrease with age (e.g., Gustman and Steinmeier 1986; Blau 2008). Some studies have explored the implications of various policy changes, such as an increase in the pension eligibility age on retirement (Haan and Prowse 2014). A few papers have used the life cycle framework to examine the impact of the actuarial adjustment for delaying Social Security on consumption and retirement behavior (e.g., Gustman and Steinmeier 2008; 2015). For example, Gustman and Steinmeier (2008) predict that changes to Social Security rules between 1992 and 2004, including the increase in the delayed retirement credit, increased the male labor force participation rate.

While the standard life cycle model provides the theoretical framework for our approach, we focus directly on the marginal impact that adjusting saving and retirement decisions has on the maximum sustainable consumption in retirement. This allows us to examine the tradeoffs that households approaching retirement face. Like Gustman and Steinmeier (2008; 2015), we show that the recent, more generous rules for delaying Social Security play a large role in the returns to working longer relative to saving more, although other factors matter too.

We begin by analyzing stylized workers who have smoothly growing wages and constant asset returns, and who participate in the labor force without interruption. The advantage of examining stylized workers is that the underlying arithmetic relationships between saving, wealth accumulation, and annuitization are readily transparent. Analyzing such individuals will give us guidance on what to expect from real households with more complicated financial lives. We start with an equation for the evolution of wealth in a defined contribution retirement plan as a function of previous contributions and returns:

$$W_T = \sum_{t=1}^{T-1} \left\{ C_t \prod_{i=t+1}^{T} (1 + r_i) \right\} + C_T$$

In this equation, W_T is wealth at time T, C_t is annual contribution made at time t, and r_t is the return over the period $(t-1, t)$. The above equation has the household starting retirement saving at time 0 and shows wealth accumulation as a function of time T. The equation assumes that contributions take place at the end of each year of work, so that the final contribution does not earn any asset returns. This annual version of the accumulation equation is sufficiently accurate for our stylized examples, but it should be clear that a monthly version with monthly asset returns would be simple to implement.

In our stylized examples, we assume that workers earn the same real wage, ω, in each period of life. We further assume that there is no economy-wide wage growth. Social Security benefits are based on Average Indexed Monthly Earnings (AIME), calculated as the average of the highest 35 years of earnings, indexed for economy-wide wage growth and divided by 12 to convert to a monthly amount. Workers who claim at full retirement age (FRA) receive a monthly benefit (called the primary insurance amount, or PIA) equal to 90 percent of the first \$885 of AIME, 32 percent of any AIME between \$885 and \$5,336, and 15 percent of any remaining AIME.[3] Our

[3] These PIA "bend points" are in effect for 2017. In general, bend points are indexed to average age growth. To calculate AIME, wages are indexed to the year in which the worker turns 62 (with any additional years of earnings counting at their nominal value), and PIA is based on the bend points in effect during the year in which the worker

assumption of zero real wage growth, both for the individual worker and economy-wide, implies that AIME is equal to the monthly equivalent of ω. For our stylized worker, we assume that the ratio of PIA to AIME is equal to 0.42. That value is roughly in line with the ratio for a worker who earns the economy-wide average wage in each year of his or her career.[4] Due to the progressivity of the PIA formula, the ratio of PIA to AIME declines with AIME. This fact will become relevant later when we consider workers with different levels of earnings.

At the time of retirement, the household annuitizes the accumulated wealth and commences Social Security benefits. We define the retirement replacement ratio as the sum of the annuity payments and Social Security benefits divided by pre-retirement income. Specifically, the retirement replacement ratio, if retirement occurs at time T, is:

$$\rho_T = \frac{A_T \cdot W_T + S_T}{\omega}$$

where A_T is the annual annuity conversion factor relevant at time T, S_T is the annual Social Security benefit at time T, and ω is the annual wage. The annuity conversion factor, A_T, converts retirement wealth into the annualized inflation-indexed life annuity benefit. Recent quotes for annuity factors for same-age married couples and single men and women are shown in Figure 1.

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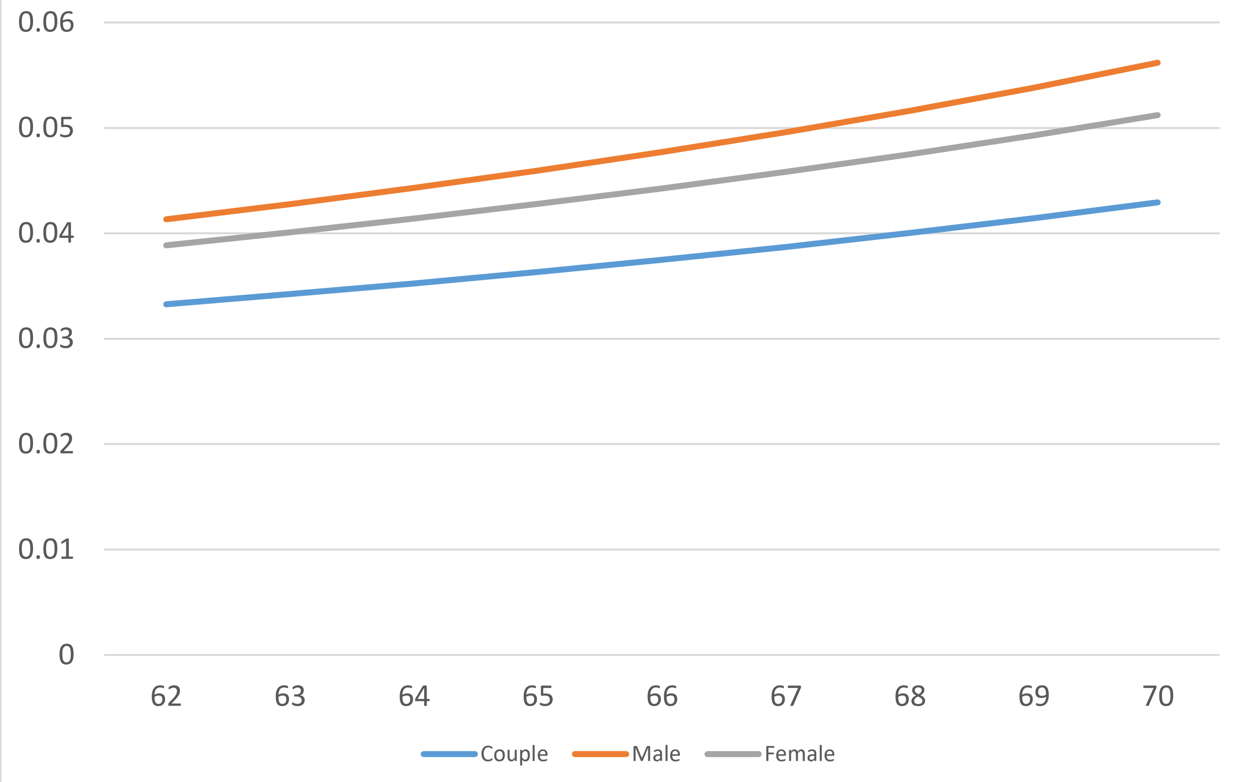
turns 62. PIA is indexed for price inflation after age 62. For our stylized example, since we have assumed zero wage growth, we are simply using the bend points for 2017.

[4] See Table V.C7 of the Social Security Trustees Report for 2013, at https://www.ssa.gov/oact/tr/2013/V_C_prog.html#997444. This table reports the ratio of PIA to career-average indexed earnings (similar to AIME) for individuals whose career-average earnings are equal to the economy-wide wage index. The average of these ratios for workers reaching full retirement age in 2013, 2015, and 2020 is roughly 42 percent. The Trustees Reports stopped reporting these ratios in 2014.

Figure 1: Annuity Conversion Factors for Same-Age Couples, Single Women and Single Men



Source: Conversion factors are based on CPI-adjusted single life and 100% Joint and Survivor annuity quotes for from Immediate Annuities retrieved on August 9th, 2017, and authors' calculations.

The lowest curve shows the annuity conversion factors for same-age married couples and the highest curve shows the factors for single men. These quotes reflect several important realities. First, increasing sustainable lifetime standard of living is very expensive. At age 62, the conversion factor for couples is .033267, which means that an additional $100,000 of retirement wealth would raise the annual inflation-adjusted standard of living by just $3,327 per year. These quotes implicitly take into account the current low real interest rates and the anticipated mortality of today's retirement age individuals.

Financial planners often use replacement ratios like the one above to summarize a household's goal for a sustainable retirement living standard. These ratios are a rule of thumb deriving from the life cycle framework. Scholz and Seshadri (2009) show that optimal replacement rates derived from a life cycle model vary greatly by household; for example, a couple with children should target a lower replacement rate than a couple without children as the former can reduce child care expenses during retirement. In addition, there has been some debate regarding the appropriate denominator.[5] Numerous alternatives are possible, such as final salary, real average salary over the lifetime, AIME, or real average salary over the 5 years prior to retirement. The optimal replacement ratio can vary greatly depending on the choice of denominator. In our stylized examples, since we assume zero wage growth both economy wide and for the individual, all these denominator choices are equivalent. Moreover, we do not take a stand on the optimal replacement ratio. Instead, we examine how changes in saving and retirement decisions affect retirement living standards at the margin. Using replacement ratios to summarize retirement living standards simplifies the presentation of our stylized examples. However, even with wage growth, our results would be insensitive to the choice of denominator or to other factors that influence the optimal replacement rate. As long as the replacement ratio denominator is held constant, the growth rate in the replacement ratio will be equal to the growth rate in retirement income.

Next, we list our base case assumptions, summarized in Table 1. We start by looking at the primary earner in a same-age couple, who chooses to start saving at age 36. This is $t = 0$ in the wealth accumulation equation. Their employer offers to match 50% of employee contributions to a 401(k) plan, up to 6 percent of salary. The worker assumes that he or she will have this plan or an identical plan available to them for their entire career. The worker's initial plan is to work until

[5] See Biggs (2008, 2016) for further discussion.

age 66, then retire, annuitize any 401(k) account balances, and commence Social Security benefits. The worker intends to take advantage of the employer's match offer and contribute 6 percent to the retirement plan, with the employer matching with an additional 3 percent. In addition to zero wage growth, we assume a constant return on assets (zero percent in the base case, though we consider alternatives). Our assumptions about wage growth and asset returns are not far out of line with recent experience. Real median wages have been quite stagnant for several decades and safe, real asset returns such as interest rates on Treasury Inflation Protected Securities (TIPS) have been roughly zero for the past nine years.

Table 1: Baseline Assumptions

Assumption	Value
Constant real wage	ω
Contributions are 9% of salary (e.g. 6% employee / 3% employer)	$C_t = 0.9 \cdot \omega$
Constant real returns, r, assumed to be zero	$r_1 = r_2 = .. = r_T = r = 0$
30 year saving horizon, starting at age 36 and retirement age 66	$T = 30$
PIA is 42% of AIME (equal to constant wage)	$S_T/\omega = 0.42$
Annuity conversion factor at age 66	$A_T = .03748125$
Annuity conversion factor at age 67	$A_T = .03871467$

With these assumptions, we have the following base case replacement ratio:

$$\rho_T = \frac{A_T \cdot W_T}{\omega} + \frac{S_T}{\omega} = \frac{A_T \cdot 30 \cdot .09\omega}{\omega} + \frac{S_T}{\omega} = .1011994 + .42 = .5211994$$

Despite 30 years of saving 9 percent of earnings, the annuitized 401(k) balance accounts for only 19.4 percent of retirement income with Social Security accounting for the remainder. This fact alone highlights the incredible value of Social Security benefits for primary earners.

2.1 Working an Additional Year at Age 66.

If our stylized primary earner delays retirement by one year to age 67, there are four main impacts on retirement income:

1. The annuity is cheaper (i.e., each dollar of savings will convert to a larger annuity payment) - the new conversion factor would increase to $A_{T+1} = .03871467$.
2. Wealth increases by the return on assets (initially ignored since asset returns are assumed to be zero).
3. Wealth increases by the additional retirement contribution, $W_{T+1} = W_T + C_T$.
4. The Social Security monthly benefit increases by 8% over and above inflation.

The replacement ratio at age 67 is then:

$$\rho_{T+1} = \frac{A_{T+1} \cdot W_{T+1}}{\omega} + \frac{S_{T+1}}{\omega} = \frac{A_{T+1} \cdot 31 \cdot .09\omega}{\omega} + \frac{1.08 \cdot S_T}{\omega} = .1080139 + .4536 = .561614$$

By working one year longer, the replacement rate has increased from around 52.1 percent to 56.2 percent. Recall that as long as the denominator used in the replacement rate is held constant, the growth in the replacement rate is mathematically equal to the growth in retirement income, so we can conclude that by working one year longer retirement income has increased by 7.75 percent. This increase is a weighted average of the 8 percent increase in real Social Security benefits and the 6.73 percent increase in the real value of the annuity payment obtained from the 401(k) balance at retirement. The weights are based on the share of each of the elements in the replacement ratio at the initial planned retirement age (about 81% and 19%, respectively). Even with zero percent returns, the annuity payment still increases due to the additional contributions for one year and due to the fact that annuities are cheaper at 67 than at 66. This example emphasizes that the returns to working longer can be quite high even when asset returns are low.

We now discuss the relative importance of each of the four impacts on retirement income listed above. We do this by showing the increase in retirement income attributable to each factor. In our example the overall replacement rate increased by 4.04 percentage points. This overall impact on the replacement ratio can be decomposed as follows:

$$\rho_{T+1} - \rho_T = \frac{1}{\omega}[(A_{T+1} - A_T) \cdot W_T + A_{T+1} \cdot W_T \cdot r + A_{T+1} \cdot C_{T+1} + (S_{T+1} - S_T)]$$

Therefore, the share of the increase attributed to each impact is then:

Total increase	Cheaper Annuity	Return on Wealth	Additional Contributions	Social Security
$\frac{\rho_{T+1} - \rho_T}{\rho_{T+1} - \rho_T}$	$\frac{(A_{T+1} - A_T) \cdot W_T/\omega}{\rho_{T+1} - \rho_T}$	$\frac{A_{T+1} \cdot r \cdot (W_T/\omega)}{\rho_{T+1} - \rho_T}$	$\frac{A_{T+1} \cdot C_{T+1}/\omega}{\rho_{T+1} - \rho_T}$	$\frac{S_{T+1}/\omega - S_T/\omega}{\rho_{T+1} - \rho_T}$
100%	8.2%	0%	8.6%	83.1%

This decomposition shows that 83 percent of the impact of delaying retirement comes from additional Social Security benefits. The increase from Social Security can be further subdivided into two components. One component reflects an actuarial adjustment to the payout associated with delaying the onset of the benefit In the retail market, this actuarial adjustment is 3.3% since the ratio of A_{67} to A_{66} is 1.033. However, the Social Security payout increases by 8% not 3.3%. The additional 4.7% reflects the generous nature of the benefit increase. The rest of the growth comes from the roughly even impacts of the cheaper annuity and the additional contribution.

In the next subsection we look at how the returns to working longer change with respect to changes in the baseline assumptions. First, we consider the returns to working longer when real asset returns are positive (easing the assumption that $r = 0$). Second, we compute the returns to working longer at different baseline retirement ages (easing the assumption that baseline age is

66). Third, we calculate the returns to working more than one year longer. Fourth, we consider the impact of working longer for different wage levels. Last, we estimate the returns for singles.

2.2 Role of Real Investment Returns

We consider real investment returns ranging from 0% to 8%. The second column of Table 2 reports the growth in retirement income relative to the baseline as a result of one additional year of work. The results suggest that the relative impact of working longer is fairly insensitive to asset returns; one additional year of work raises retirement income by roughly 8 percent for real returns of 0-3% and then the income increase gradually rises to about 10 percent in the case of 8% compounded real returns.

Table 2 - Returns to Working Longer by Real Investment Returns

		Shares in the Retirement Income Growth			
Investment Returns	Retirement Income Growth (%)	Cheaper Annuity	Return on Wealth	Additional Contribution	Social Security
0%	7.75%	8.2%	0.0%	8.6%	83.1%
1%	7.85%	9.2%	2.9%	8.3%	79.7%
2%	7.98%	10.1%	6.4%	7.8%	75.7%
3%	8.15%	11.2%	10.5%	7.4%	71.0%
4%	8.39%	12.2%	15.3%	6.8%	65.7%
5%	8.70%	13.2%	20.7%	6.2%	60.0%
6%	9.09%	14.1%	26.5%	5.6%	53.9%
7%	9.56%	14.9%	32.6%	4.9%	47.6%
8%	10.13%	15.5%	38.9%	4.3%	41.4%

In the last four columns of Table 2 we present the share of the increased retirement income attributable to each of the four impacts described above. The growth rate of the Social Security benefit is constant across the investment returns but its share in total retirement income growth decreases from 83% as asset returns increase. Similarly, the effect of the additional contribution is constant across the investment returns, so that its share in the total increase diminishes as returns increase. However, the impact of the additional return on existing wealth and the cheaper annuity are larger at higher investment return rates. Therefore, their share in the total retirement income increases. However, even when asset returns are very high (7-8%), the impact of Social Security still dominates the increase in retirement income.

Throughout, we assume that annuity prices are invariant to asset returns. That is, we use the same annuity factors, based on current conditions, in all calculations regardless of asset returns. It is possible that higher investment returns may be associated with higher discount rates and therefore lower annuity prices. However, high investment returns do not necessarily imply low annuity prices. Annuity prices are mainly based on risk-free interest rates. Over the last several years, investment returns have been high while safe interest rates (such as those on inflation-indexed government bonds) have remained low, a discrepancy that may be attributable to a higher risk premium. Alternatively, the higher investment returns we have considered in this section can be thought of as ex-post returns on potentially risky investments.

2.3 Varying Age and Length of Extension

So far, we have been looking at the power of working to 67 vs. a base case of retiring at 66. But many people retire well before age 66. So, how powerful is working an extra year at age 62 or 63? And what is the impact of delaying retirement by longer than one year? To estimate the returns to working longer at different ages and for different work extension lengths, we return to our baseline case: a primary earner in a same-age married couple who started at age 36 to contribute 9 percent of salary to a defined contribution retirement plan. Asset returns and wage growth are equal to zero. There are two key differences in this exercise compared to our base case.

First, the number of years of saving changes. Clearly, retiring before age 66 means fewer years of accumulated saving (relative to our base case) and retiring after age 66 means greater years of accumulated savings (relative to our base case). Second, the Social Security benefit changes since Social Security pays 100% of PIA for those claiming benefits at the full retirement age (which is 66 for those born between 1943 and 1954) but substantially lower benefits for those claiming earlier and substantially higher for those claiming after their full retirement age.[6]

The first column of Table 3 presents the percent increase in retirement income resulting from working one year longer and delaying the claiming of Social Security by one year for primary earners of age 62 through 69. By age 70 Social Security benefits no longer grow through delay, and the returns to working longer are much lower. There are a few notable results. First, as a result of the peculiar structure of the Social Security benefits, returns to working longer are non-linear. Delaying from age 62 to 63 increases retirement income by 6.7%. Returns are the highest for those aged 63 (about 8%), lower for those aged 64 and 65, and increase again to 7.75% for those aged 66. The rest of Table 3 displays the percentage increase in retirement income for those choosing to delay by two through eight years, up to age 70. The returns are relative to the age displayed in the first column of Table 3. For example, delaying by 4 years at age 64 (i.e., through age 68) increases retirement income by 33.04 percent.

[6] For those born between 1943 and 1954, the Social Security monthly benefit is reduced by 5/9ths of one percent of PIA for each month between 1 and 36 months prior to full retirement age that the benefit is claimed, and 5/12ths of one percent of PIA for each additional month prior to full retirement age that the benefit is claimed. For example, claiming at age 62 will reduce the Social Security benefit to be 75% of PIA, claiming at age 63 will reduce the benefit to 80% of PIA, and so on. For claims after full retirement age, the monthly benefit increases by 2/3rds of one percent of PIA per month of delay up to 48 months. For example, delaying to age 70 increases the benefit to 132 percent of PIA.

Table 3: Returns to Working Longer by Age and Length of Extension

Base	Number of Working Years Extensions							
Age	1 year	2 years	3 years	4 years	5 years	6 years	7 years	8 years
62	6.70%	15.27%	23.92%	32.67%	42.96%	53.36%	63.89%	74.57%
63	8.03%	16.13%	24.34%	33.98%	43.73%	53.60%	63.60%	
64	7.50%	15.10%	24.02%	33.04%	42.18%	51.44%		
65	7.07%	15.36%	23.76%	32.26%	40.88%			
66	7.75%	15.59%	23.53%	31.58%				
67	7.28%	14.64%	22.11%					
68	6.87%	13.83%						
69	6.51%							

The results are unequivocal. Primary earners of ages 62 to 69 can substantially increase their retirement standard of living by working longer. The longer work can be sustained, the higher the retirement standard of living. For example, retiring at 66 instead of 62 increases retirement living standard by about one-third. As we will show in the Section 3, no reasonable amount of additional saving could impact the retirement standard of living so significantly.

2.4 Returns to Working Longer by Different Earnings Levels

The previous analysis assumed a stylized worker with roughly average earnings (which translated into a PIA to AIME ratio of 42 percent). However, as we noted earlier, the PIA formula is progressive, so the ratio of PIA to AIME falls as AIME rises. For the following exercise, we consider five different levels of the PIA to AIME ratio, as shown in the first column of Table 4. These PIA to AIME ratios translate into the annualized AIME levels shown in the second column of Table 4. If we continue to assume zero wage growth, both economy-wide and for individual workers, then this annualized AIME is equal to the wage earned in each year of work.[7] We then

[7] In reality, AIME may not translate one-for-one into annual earnings, as AIME is based on the top 35 years of indexed earnings. For example, a person with a short career and high annual earnings may have the same AIME as a

calculate the returns to working one year longer for the five earning levels. We continue to assume a primary earner in a couple aged 66, saving 9% of salary for 30 years with zero percent real asset returns.

In the third column of Table 4 we present the returns to working longer in terms of percentage increase in retirement income. These results indicate that the returns to working longer – expressed as the percentage increase in retirement income – are about the same across the income levels (about 7.75%, as our baseline results). However, the impact of working longer on the replacement rate varies significantly across the different wage levels. A growth rate of 8% has roughly three times the impact on the replacement rate assuming a base replacement rate of 75% compared to a base replacement rate of 25%.

The second result observed in the table is that the returns to working longer decrease as earnings increase. A decomposition of the four impacts (not presented) reveals that the first three impacts – cheaper annuity, returns to wealth and additional contribution – are constant across wage levels. However, the Social Security impact changes. As the Social Security share of final retirement income increases, the weight on the Social Security impact increases. Thus, an 8% growth in the Social Security benefit has a higher weight for workers at the lower wage levels, translating into higher returns to working an additional year.

Table 4 - Returns to Working Longer by Income Level

PIA/AIME	AIME (annual wage)	Income Retirement Growth (%)
70%	16,212	7.84%
60%	21,996	7.82%
50%	34,224	7.79%
40%	68,184	7.74%
30%	113,628	7.68%

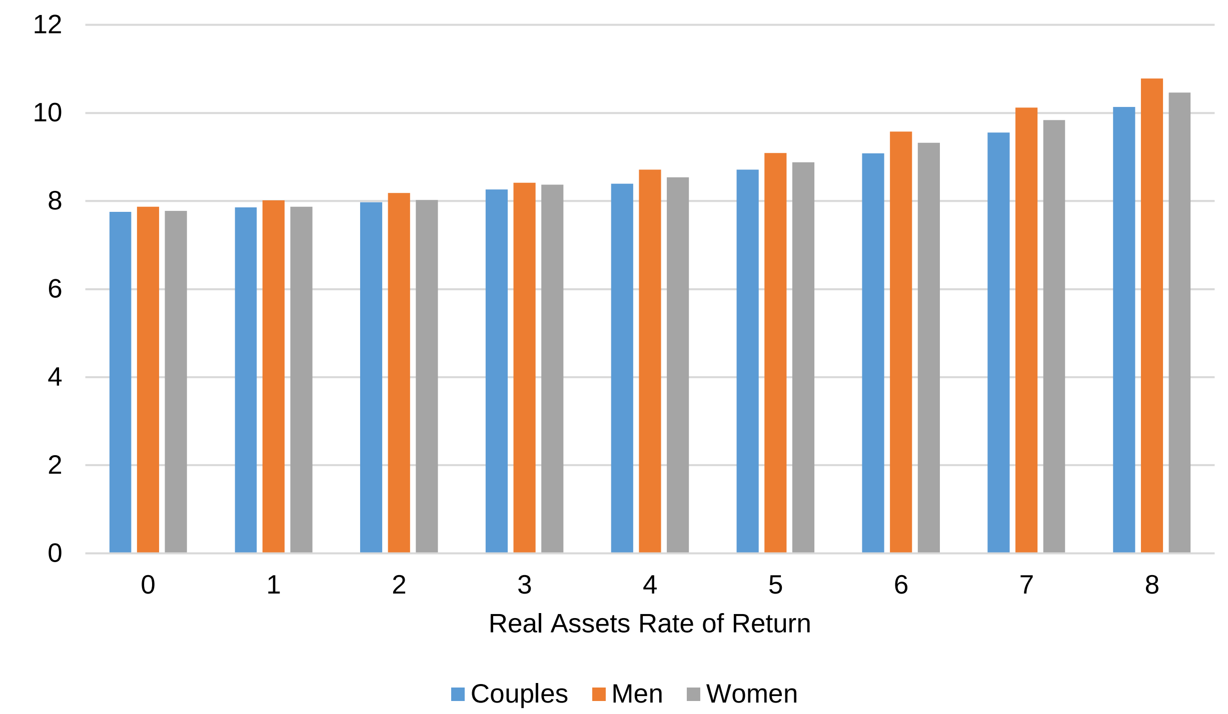
person with a long career and low annual earnings. In our stylized examples, individuals are assumed to work full careers.

2.5 Single Individuals

All of the above analysis was for the primary earner of a couple. In that case, Social Security benefits are paid in the form of a second-to-die annuity, and we assume private retirement wealth is converted into the same form. We now address how working longer impacts retirement living standard for single individuals. While the increase in Social Security is the same as our base case, the annuity factors are different. For singles, the analysis is identical for men and women except that retail annuities are cheaper for men due to their shorter life expectancy. (For married primary earners, the gender of the primary earner did not matter. A 100 percent joint and survivor annuity is priced based on one male and one female lifetime.) Of course, annuities are cheaper for both single men and women compared to primary earners, since primary earners buy a second-to-die annuity and singles buy single life annuities.

The returns to working one additional year at age 66 for single males, single females, and married primary earners are shown in Figure 2. We illustrate in this graph how the returns increase as we ease the assumption of zero rate of returns on assets. Returns are slightly higher for single males, and to a lesser degree for single females, compared to married primary earners. These small differences are driven by the impact of working longer on annuity prices (resulting from delaying the annuity purchase by one year). It is important to note, however, that these figures represent the increase in *annual* retirement income rather than *lifetime* retirement income. The increase in *lifetime* retirement income is always greater for married couples compared to singles, as the higher income is paid out as a second-to-die annuity rather than a single life annuity (see e.g., Shoven and Slavov 2014a,b).

Figure 2: Percentage Increase in Retirement Income from One Additional Year of Work at age 66 by Marital Status and Real Asset Rate of Return



3 Working Longer vs. Alternative Strategies

3.1 Alternative Strategy: Save One Percent More of Earnings

An alternative way to boost retirement living standards is to save more. Suppose that our stylized primary earner saves 1 percent more of wages starting at age 36. That is, they move from a 6 percent to a 7 percent personal contribution rate, with a 3 percent employer contribution, for a total retirement saving rate of 10 percent. If the higher contribution rate were applied for the entire 30 years (maintaining the assumption of zero real asset returns and wage growth during those 30 years), then the replacement rate would rise to .53244 from the base case of .521194, translating into a 2.16% percent increase in retirement income.[8]

Recall from Section 2.1 that working one year longer increased retirement income by 7.75%. Delaying retirement by one year is roughly 3.5 times as impactful as saving an additional 1 percent of wages for 30 years. To put it another way, working just over 3 months longer would have the same impact as a 1 percentage point increase in the contribution rate for 30 years. In what follows we compare various alternatives that would increase retirement income to the working longer alternative. For all these cases, we state the number of additional working months required to have an equal impact on retirement income. The message resulting from this comparison is clear. Working longer is very powerful compared to the other alternatives. This result holds for all reasonable investment returns and ages considered.

3.2 Role of Real Investment Returns

In Section 2.2 we considered the effect of various asset returns on returns to working one year longer. In Table 5 below we demonstrate how the returns to saving 1% more of wages for 30 years change with respect to the real asset returns.[9] As expected, saving has a larger impact on retirement income when real asset returns are higher. However, the returns to saving more are much smaller than the returns to working one year longer shown in Table 2. For low asset returns, working 3-4 months longer increases retirement income about the same as increasing the contribution rate by 1 percentage point more for 30 years. At high asset return levels, working

[8] Recall that since we are keeping the denominator in the replacement rate calculation constant, the growth in the replacement rate is equal to the growth in retirement income.
[9] As in section 2.2, we assume annuity prices do not change as investment returns increase.

around half a year longer has the same impact as increasing the contribution rate by 1 percentage point.

Table 5 - Returns to Saving 1% More of Earnings by Real Investment Returns

Investment Returns	Retirement Income Growth (%)	Number of additional months of work equal to 1% additional saving for 30 years
0%	2.16%	3.3
1%	2.43%	3.7
2%	2.73%	4.1
3%	3.07%	4.5
4%	3.45%	4.9
5%	3.87%	5.3
6%	4.32%	5.7
7%	4.79%	6.0
8%	5.29%	6.3

3.3 Role of Start Age

Now, let us look at different start ages for saving 1% more of wages. The base case is still a contribution rate of 9 percent starting at age 36. We examine three alternatives (increasing the contribution rate by 1 percentage point at ages 36, 46 and 56) and compare the impact of these three scenarios with never increasing the contribution rate but working one year longer. Table 6 contains the results for two investment returns, zero and five percent.

Table 6 - Returns to Saving 1% More of Earnings, by Age Initiated

Age	Investment Returns	Retirement Income Growth (%)	Number of additional months of work equal to 1% additional saving for 30 years
36	0%	2.16%	3.3
36	5%	3.87%	5.3
46	0%	1.54%	2.4
46	5%	2.33%	3.2
56	0%	0.83%	1.3
56	5%	1.02%	1.4

The table shows that as the number of additional saving years decreases, the impact of the asset return assumption diminishes. That is, the impact of a 5% real asset return has a much smaller effect relative to a zero percent return when the contribution rate is increased for only 10 years. Second, as reflected in the last column, at age 56, the power of saving one percent more of income is equivalent to working just one additional month (regardless of the return environment considered). That is, the older the individual, the greater the relative impact of working longer compared to increasing the saving rate.

3.4 Role of Earnings Levels

As we have shown in Section 2.4, the impact of working longer on the growth rate in retirement income is insensitive to income levels. In this section, we examine the impact of saving an additional 1% on different income groups' retirement living standards. In Table 7 we present the returns to saving more for different income levels (as indicated by PIA/AIME ratios, which correspond to annual earnings under the zero-wage growth assumption).

Table 7 - Saving More or Working Longer by Income Level

Annualized AIME (Wage)	PIA/AIME (Replacement Rate)	Months of work to equal 1% additional saving for: 30 Years	20 Years	10 Years
$16,212	70%	2.1	1.4	0.7
$21,996	60%	2.5	1.6	0.8
$34,224	50%	2.9	1.9	1.0
$68,184	40%	3.5	2.3	1.2
$113,628	30%	4.4	2.9	1.5

In terms of replacement rate, we see that Social Security is highly progressive. At a wage rate of $16,000, Social Security replaces 70% of income, whereas the replacement rate at $113,000 is only 30%. When Social Security replaces a larger fraction of income, working longer is relatively more impactful than saving more. For example, compare a high wage worker to a low wage worker each considering whether to save for 30 years or work longer. The lower wage worker need only work 2.1 months to equal the benefit of 30 years of saving, whereas the higher wage worker has to work more than twice as long, 4.4 months, to receive a comparable benefit. The impact of saving more falls precipitously if saving occurs for fewer years. In this case, a low wage worker saving more for 10 years need only work about 3 weeks to garner a comparable benefit.

Consider this information in a more realistic setting. Suppose a high wage worker is 46 years old and is deciding between saving an additional 10% of salary for the next 20 years or working longer. The alternative to saving an extra 10% for 20 years is to plan on working an extra 29 months.[10] For the low wage worker, the decision would be between saving an additional 10% for 20 years, or working an extra 14 months. If the low wage worker were 56, then the decision would be between saving an additional 10% for 10 years or working a mere 7 months longer. The disutility of work would have to be very high for low wage workers to consider saving more rather than working longer.

3.5 Understanding the Results: Saving More vs. Working Longer

Clearly working one year longer is much more powerful than saving one percentage point more for 30 years. But, why is working longer so much more powerful? The income and saving that results from one more year of work is only a small part of the story. Our calculations show that working longer is only powerful if accompanied by deferring the commencement of Social

[10] Since the Social Security benefit growth varies over different ages, the calculation is not exact for horizons that extend beyond 12 months.

Security and the annuitization of the accumulated 401(k) balance. Recall that in our base case, working one additional year to 67 – and simultaneously and deferring Social Security and the annuitization of defined contribution balances – increased the sustainable real standard of living for the couple's retirement by 7.75 percent. That is a very big impact.

Now, consider another scenario, where the primary earner commences Social Security at 66, annuitizes his or her retirement assets at the same time, and then decides to work for another year while making a 9 percent contribution to the company's 401(k) plan. This is a case of working longer with no deferrals at all, and the the sustainable standard of living would increase by only 0.67%.

This calculation illustrates that working longer only has a powerful impact on retirement income if it facilitates delay of Social Security claiming and annuitization. Of course, Social Security and annuitization can both be delayed without working longer. Alternatively, Social Security can be delayed and 401(k) assets used to finance living expenses during the delay period. But given the presence of liquidity constraints and the strong social norm of claiming Social Security upon retirement, it is plausible that delaying retirement can facilitate delays in both claiming Social Security and tapping into 401(k) wealth.

3.6 Alternative Strategy: Use More Cost-Efficient Portfolios

One of the key services provided by financial planners is helping clients reduce portfolio costs. Lower portfolio costs translate into higher net asset returns and higher retirement income. In our last exercise, we compare the impact of reducing portfolio management costs to the impact of working longer. Overall, our results in this section suggest that the gains from choosing more cost-efficient portfolios are relatively small compared to the gains from working longer. Thus, financial planners may have more of an impact on clients' retirement living standards by helping them time their retirement (and Social Security claiming) optimally than by helping them choose cost-efficient portfolios.

We return to the case of the primary earner in a couple who started contributing 9% of earnings to a 401(k) at age 36, and planned to retire and collect Social Security at 66. The rates of returns that have been used in the analysis up to now should be interpreted as net returns to investors. We now look at the impact of increasing those returns by 60 basis points (0.6%), which may be achieved by investing in lower cost mutual funds. Specifically, 60 basis points is roughly the average difference between the expense charges of active and passive mutual funds, but it is also possible to find active funds that are 60 basis points cheaper than some of the alternatives. (There is little to no evidence that the more expensive funds have greater gross returns.)

Table 8 shows the impact of reducing portfolio costs at different levels of net investment returns. Comparing these results to those in Tables 2 and 5, we can see that improving returns by 60 basis points for 30 years has about the same impact as saving one percentage point more for the same duration. Both of these strategies have a much smaller impact than working an additional year. The last column in Table 8 shows that to replicate the impact of cost efficient investments on retirement income, a primary earner would need to work just under 3 months more in the low real asset return environment and around 6 months more in a high return environment. Finally, if one could use a two-pronged approach of reducing portfolio management costs by 60 basis points *and* saving an additional 1% of earnings (both maintained for 30 years), the impact on retirement income would be equivalent to that of working one year longer if asset returns are high. If this combined strategy were implemented at age 56, just ten years before retirement, then the impact on retirement income for an average earner would be equivalent to working three to four months more.

Table 8 - Returns to Reducing Portfolio Costs

Original Net Investment Returns	Income Retirement Growth (%)	Number of additional months of work equal to 60 bp reduction in expense ratio for 30 years
0%	1.79%	2.8
1%	2.09%	3.2
2%	2.45%	3.7
3%	2.85%	4.2
4%	3.30%	4.7
5%	3.81%	5.3
6%	4.36%	5.8
7%	4.95%	6.2
8%	5.57%	6.6

3.7 The Marginal Incentive to Work

Throughout this paper, we have reported the benefit of working longer in terms of its impact on retirement income. Here, we explore the benefit of working longer as a fraction of final wage. We return to our base case, with zero wage growth and zero asset returns, in which a 66-year-old primary earner is considering whether to continue working until age 67. If retirement occurs at age 66, retirement income is $\rho_{66} \cdot \omega$, where ρ_{66} is the replacement rate as defined in Section 2. If retirement occurs at age 67, retirement income is $\rho_{67} \cdot \omega$.

The increase in income can be decomposed into three factors. Mathematically, the decomposition is as follows:

$$\rho_{67} \cdot \omega - \rho_{66} \cdot \omega = .09 \cdot \omega \cdot A_{67} + \rho_{66} \cdot \omega \cdot A_{67} + X \cdot A_{67}$$

The left-hand side is the difference in income. Part of this increase in income stems from the fact that the extra year of work resulted in an additional 9% of salary contribution to savings. This is the first part of the right-hand side of the equation. A second part of the increase in income results from simply purchasing the annuity later. We capture this aspect by calculating how much additional lifetime income at 67 could be purchased using the retirement income that would have been received between 66 and 67.[11] Even after correcting for these two factors that increase income, the income at age 67 is still higher due to the higher Social Security benefit. We let X in the equation represent the amount of additional wealth that would generate the same increase in income as working longer, after controlling for the increase in saving and the lower annuity price. Solving for X, yields:

$$X = \left[\frac{\rho_{67} - \rho_{66}}{A_{67}} - .09 - \rho_{66}\right]\omega$$

If we use the values in our baseline case, we get

$$X = \left[\frac{0.5616 - 0.5212}{0.0387} - .09 - 0.5212\right]\omega = .4327\omega$$

Working an additional year results in an income increase far beyond what we would expect from additional saving and delaying the annuity purchase. The value of this difference is 43.27% of final salary in our baseline case. The root cause of this difference is the generosity of the Social Security formula. In fact, people could capture a large fraction of the benefit for delaying retirement by simply delaying taking Social Security. However, since people seem to closely tie taking Social Security with the stoppage of work, claiming this increase in practice would likely involve working longer.

[11] We assume income at 67 without work would be $\rho_{66}\cdot\omega\cdot(1+A_{67})$, reflecting using retirement income that would have been received at age 66 to purchase more lifetime income at 67. Alternatively, we could assume income at 67 is $\rho_{66}\cdot\omega\cdot A_{67}/A_{66}$, which represents buying income at 67 using the implicit resources available at 66. While the differences are small, we prefer to use first method because it is feasible for individuals and reflects a conservative estimate of the work incentive.

4 Empirical Evidence from the Health and Retirement Study

We examine the returns from working longer for actual individuals using data from the Health and Retirement Study (HRS), a panel survey intended to be representative of the U.S. population aged 50 and older. The survey began in 1992 and has been conducted every other year since then, with additional cohorts added periodically to keep the sample representative of the target population. For couple households, information is available for both spouses. The public use HRS data includes information on basic demographics, as well as defined contribution balances. The HRS further asks respondents for permission to access their Social Security earnings data. Thus, we can merge the public use data with full earnings records derived from administrative Social Security data.[12] The earnings records allow us to identify the primary earner in each couple and calculate the impact of an additional year of earnings on Social Security benefits.

We begin by calculating Average Indexed Monthly Earnings (AIME) for each respondent with a linked earnings history and eligible for Social Security from 1985 to 2017 (18,444 individuals).[13] Individuals with less than 10 years of earnings history are not eligible for retirement benefits, so they are excluded from the data (this reduces the sample to 16,555 individuals). We then drop all married secondary earners (reducing the sample to 11,579 individuals), thereby restricting attention to singles and married primary earners. We further restrict the data to those working for pay[14] and are 61 or 62 in waves 10,11 or 12 (reducing the sample to 971 individuals). We choose to focus on this age group since most individuals retire and claim Social Security at or before their full retirement age (Goda et al., 2017). Finally, we remove one percent of observations

[12] Most of the variables used in our analysis come from the RAND version of the HRS (version P) except for the earnings history variables, which come from the restricted HRS data.

[13] To estimate the AIME we merge the Social Security Index factors based on the respondent's year of birth and earnings year to calculate the indexed earnings. Then we calculate the average indexed-earnings for the highest 35 years of earnings.

[14] Having r10work r11work or r12work (whichever variable corresponds to the wave in which they are 61 or 62) equal to 1 in the RAND dataset.

with the highest percent change in their AIME if they work one additional year, which is a proxy for the disparity between their earnings history and their self-reported last income. Our final sample includes 962 people, and we calculate the Primary Insurance Amount (PIA) for each of them.[15]

Out of the 962 people in our sample, 60 percent are married primary earners, 72 percent of whom are male. Of the singles in our analysis, 34 percent are male. In Table 9 we present basic summary statistics for our sample. Average earnings for those aged 61-62 is $53,800, slightly higher than the average income in the population aged 55-64, which is $52,350.[16] Since we drop married secondary earners, it is not surprising that the average (and median) income in our sample is higher. The average PIA of our sample is about $1,600, above the national average PIA calculated based on the average monthly benefit for those receiving benefits at age 62.[17] Finally, the majority of individuals in the data do not have a significant balance in their defined contribution plan; however, some have large balances, resulting in a median ($7,650) that is well below the mean ($107,284). In Appendix A we provide histograms of income and defined contribution balances at individual and household levels.

[15] To estimate the PIA, we apply the bend points in the PIA formula based on the respondent's Social Security eligibility year (the year he or she turned 62).

[16] Source: United States Census Bureau, Historical Income Tables: People, Table P-10. Age--People (Both Sexes Combined--All Races) by Median and Mean Income: 1974 to 2015

[17] The average monthly benefit for those claiming benefits at age 62 was $1,045 as of December 2015, corresponding to a PIA of $1,393. Source: Annual Statistical Supplement, 2016, Table 5.A1.1: "Number and average monthly benefit for retired workers, by age and sex, December 2015"
https://www.ssa.gov/policy/docs/statcomps/supplement/2016/5a.html#table5.a1.1

Table 9 - Descriptive Statistics

	Mean	Std. Div.	Median
Married	60%	-	-
Male	72%	-	-
Age difference between primary and spouse	2.4	6.4	2
Single	40%	-	-
Male	34%	-	-
Individual income at age 61/62	$53,801	$59,437	$40,000
Individual PIA	$1,625	$621	$1,640
Household income at age 61/62	$95,638	$113,260	$65,200
Individual Defined Contribution Balance at age 61/62	$81,905	$525,152	$1000
Household Defined Contribution Balance at age 61/62	$107,284	$556,898	$7,650

Note: [1] Positive value indicates primary older than spouse.
Source: Health and Retirement Study, Waves 10-12.

Next, we construct annuity factors to convert respondents' wealth to annuity income. Rather than obtain annuity quotes for each gender and age combination in the sample, we estimate annuity prices by first calculating actuarially fair prices using real risk-free interest rates as of August 9th, 2017, and mortality rates as provided by the IRS.[18] We then compare these actuarially fair prices to quotes we retrieved from Immediate Annuities on August 9th, 2017 for various combinations of age, gender, and marital status. The ratio between the actuarially fair price and the quote obtained is the money's worth ratio (MWR). For a large range of the quotes we retrieved, the MWR was about 0.84, so we use this factor to transform the actuarially fair prices to market prices. These prices are then merged to the HRS data based on the age and gender of the individual and (if married) spouse. We also merge in the annuity prices that individuals would receive if they

[18] Source: Updated Static Mortality Tables for Defined Benefit Pension Plans for 2017; https://www.irs.gov/pub/irs-drop/n-16-50.pdf

were to start the annuity one year, three years, and eight years later (corresponding to retiring at age 63, 65 and 70).

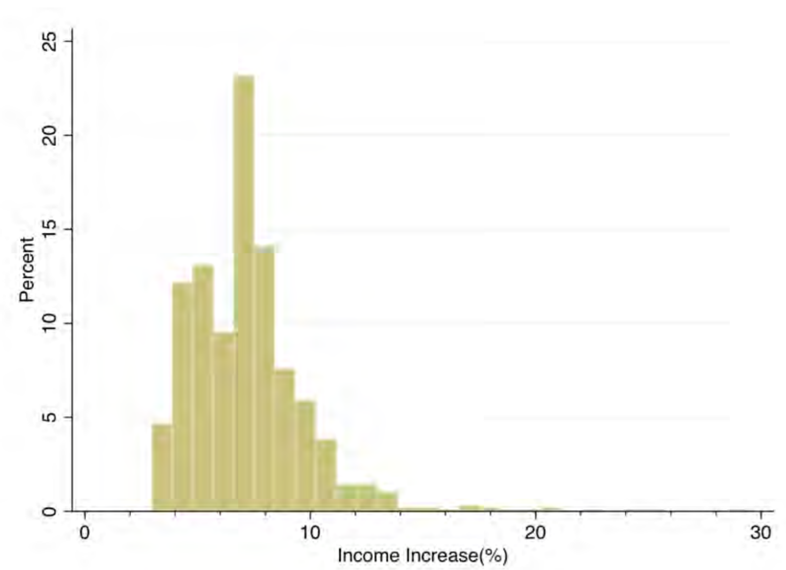
To calculate the returns to working longer we must make several assumptions. First, we assume that regardless of the retirement choice of the primary earner, the spouse will retire at age 62 and receive 75% of their Social Security benefits. Holding the secondary earner's retirement and claiming age constant ensures that the increase in retirement income is entirely driven by the primary's retirement choice. The specific age at which the spouse claims Social Security and retires would not change the results substantially; we just need it to be constant across the scenarios compared. Second, we assume future wage growth is zero, so that the wage in future years of work is the same as the wage at age 61/62. Third, we allow for the additional year to count towards one of the wages included in the AIME calculation; that is, if the last wage earned is among the top 35 years of indexed earnings it will increase the individual's AIME. Fourth, we assume real asset returns are 0%, and that the defined contribution saving rate during additional years of work is equal to 9% of annual salary. Fifth, as in the stylized examples, we assume claiming Social Security and retirement are simultaneous. Sixth, we assume people annuitize their defined contribution balance when they retire.[19] Finally, we ignore potential income from defined benefit pensions.

With the assumptions we have made, we can compute the returns to working longer for each individual. Since the returns will differ across people based on individual factors, we plot in Figures 3 through 8 the distributions of the returns to working longer and consider how these vary based on individual characteristics and assumptions made.

[19] The initial defined contribution balance is the sum of the current balance in plans 1 through 4 (variable names R`w'DCBAL1- R`w'DCBAL4, where `w' indicates the wave number. We used the latest available balance we have in the data. For many individuals since is the balance prior to age 61/62.

In Figure 3 we plot the distribution of returns to working longer for our full sample. Returns vary from about 3% to double-digit returns. The mean and median are 7.4% and 6.9%, respectively, not much higher than the 6.7% returns found in Table 3 for a 62 year old stylized worker.

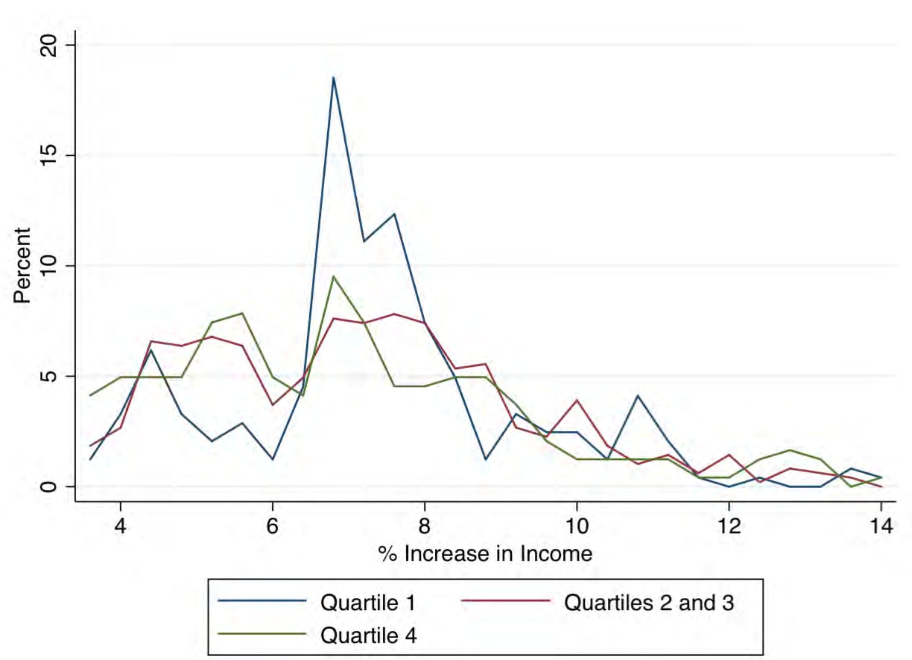
Figure 3: Returns to Working One Year Longer



Note: Returns are calculated for all primary earners in the HRS data aged 61/62 in waves 10, 11 or 12. Calculations assume returns on wealth are equal to zero and a 9 percent contribution rate.

Figure 4 below presents the distribution of the returns to working longer based on income quartiles, corresponding to the analysis of stylized workers at different income levels in Section 2.4. The only difference is that our stylized workers were assumed to be 66, while the empirical analysis is done for individuals aged 62. The figure shows that returns tend to be more disperse for higher income households relative to lower income households. While the mean return for all income groups is about the same, the majority of households at the lowest income quartile receive returns around 6-8% returns, while middle and top income quartile households' returns are more spread out.

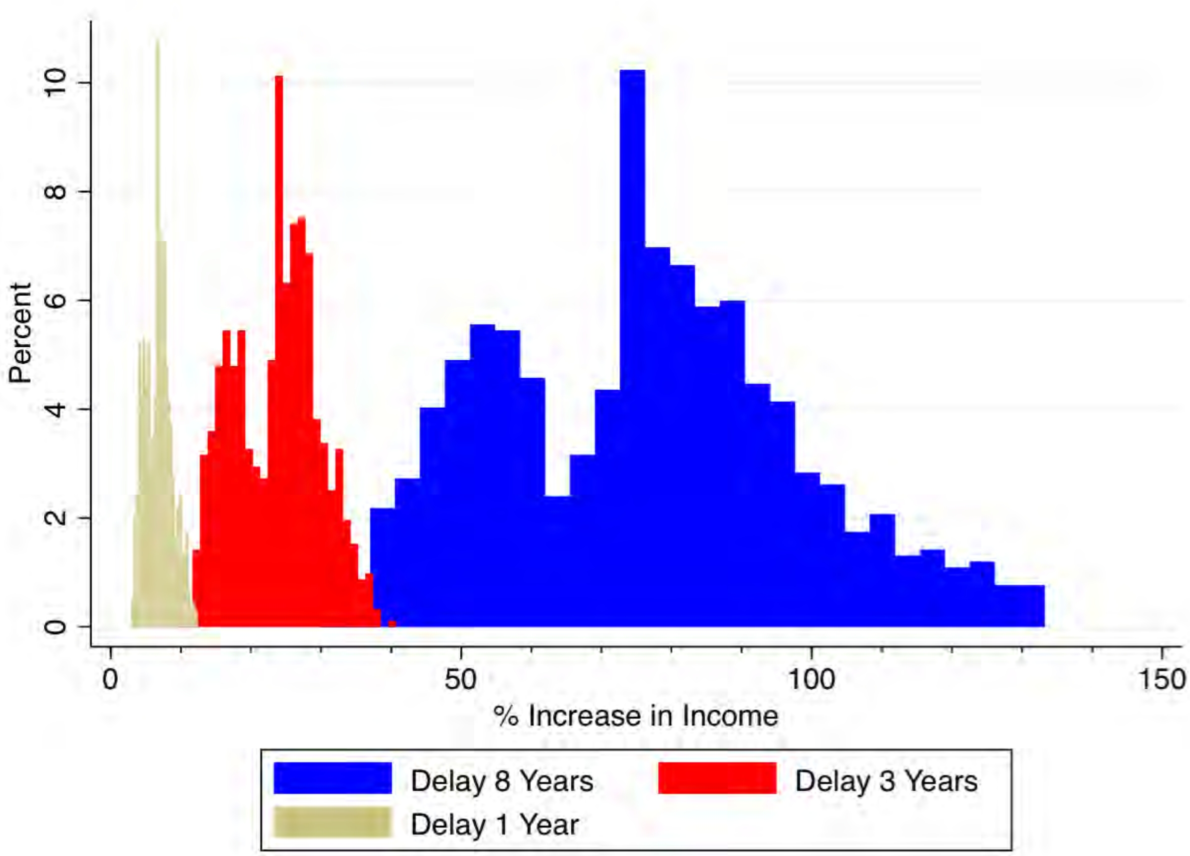
Figure 4: Returns to Working One Year Longer by Income Quartiles



Note: Returns are calculated for all primary earners in the HRS data aged 61/62 in waves 10, 11 or 12. Calculations assume returns on wealth are equal to zero and a 9 percent contribution rate. We exclude in the graph returns below 3% and above 14% to focus attention on the majority of the return distribution.

Figure 5 illustrates the impact of working for an additional three or eight years (as opposed to one year). Unsurprisingly, working eight years longer has a much larger impact on retirement living standards than working one year longer. The figure suggests that working eight additional years will increase retirement income by at least 40% and above 100% for some individuals. There is a large mass of people gaining just below 80%, which corresponds well with our stylized example in Table 3.

Figure 5: Returns to Working Longer by Duration of Extension



Note: Returns are calculated for all primary earners in the HRS data aged 61/62 in waves 10, 11 or 12. Calculations assume returns on wealth are equal to zero and a 9 percent contribution rate.

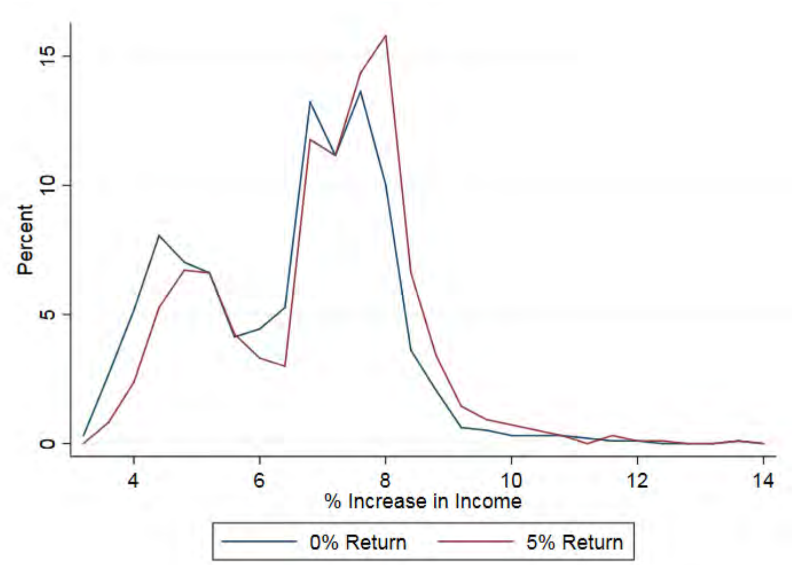
Who gains the most from working eight additional years? To answer that question, Table 10 presents the means of a number of variables for the full sample as well as those in the top 5 percent of the returns distribution. Those with higher returns are less likely to be married. They also have shorter working histories (less than 35 on average), so part of the return from working longer likely comes from the impact of the additional year's salary on AIME. But the biggest difference between the full sample and those at the top of the returns distribution is the average defined contribution balance at age 62. The average DC balance of the top 5 percent is a fifth of the average DC balance of the full sample. When low-balance individuals save 9% of their annual wage during additional years of work (where their final annual wage is about the same in the two groups), they more than triple their savings. With the change in annuity prices due to age they more than quadruple their annuity income.

Table 10 – Characteristics of Full Sample versus Highest-Return Individuals

	Full sample	Top 95 percentile
No. of Observations	962	171
% Married	60%	39%
% Male	57%	40%
Annuity Price at 62	$29.1	$28.2
Annuity Price at 70	$22.5	$21.8
Years Worked	39	33
Last Household Income	$95,638	$91,531
AIME at 62	$3,745	$2,615
AIME at 70	$4,186	$3,556
DC Balance at 62	$107,284	$19,015
DC Balance at 70	$140,424	$65,020
% Change from Delay	*31%*	*242%*
Annuity Monthly Value at 62	$303	$54
Annuity Monthly Value at 70	$517	$245
% Change from Delay	*70%*	*355%*
Monthly Household SS Income at 62	$1,521	$958
Monthly Household SS Income at 70	$2,585	$2,066
% Change from Delay	*70%*	*110%*
Average % Income Change from Delay	81%	128%

Next, we consider the impact of changing the real asset return assumption. In Table 2 we saw that when real asset returns increase, the gains to working longer increase as well, although the impact was small. Figure 6 reflects the same conclusion for our sample. The figure presents the distribution of returns to working an additional year for individuals at age 62 assuming zero and five percent asset returns. The distributions are fairly similar at all asset returns with a slight shift to the right as the asset returns rate increases.

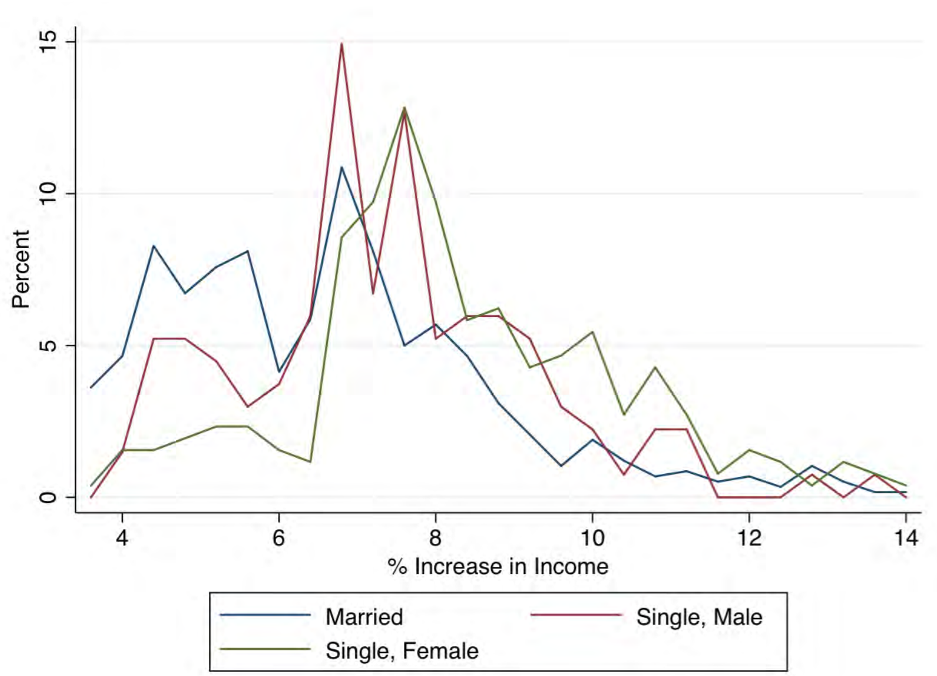
Figure 6: Returns to Working One Year Longer by Real Asset Return Environment



Note: Returns are calculated for all primary earners in the HRS data aged 61/62 in waves 10, 11 or 12. Calculations assume a 9 percent contribution rate. We exclude in the graph returns below 3% and above 14% to focus attention on the majority of the return distribution.

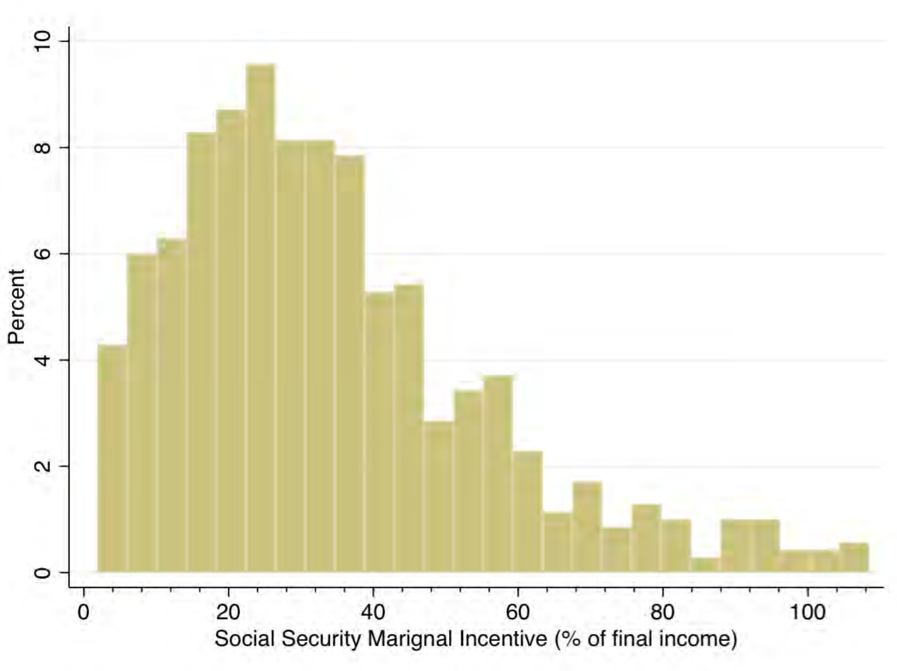
In Figure 7 we consider the impact of marital status and gender on the returns to working longer. Our stylized examples presented in Figure 2 indicated that returns are highest for single males and lowest for couples. The main driver of this result is the change in annuity price from delaying an additional year. As expected, the distribution of returns for couples lies slightly to the left of the distributions for singles. However, in contrast to the stylized examples, single females seem to have larger returns. This might occur because single women in the data have lower incomes on average than single men, while our stylized examples assumed the same income for both genders.

Figure 7: Returns to Working One Year Longer by Marital Status and Gender



Note: Returns are calculated for all primary earners in the HRS data aged 61/62 in waves 10, 11 or 12. Calculations assume returns on wealth are equal to zero and a 9 percent contribution rate.

Figure 8: Marginal Incentive to Work an Additional Year



Note: Returns are calculated for all primary earners in the HRS data aged 61/62 in waves 10, 11 or 12. Calculations assume returns on wealth are equal to zero and a 9 percent contribution rate. Graph includes observations from the 5th to the 90th percentiles so that each bin includes at least 10 people, in accordance with the restricted HRS data use requirements.

Figure 8 shows the marginal incentive to work, as described in Section 3.6, for our HRS sample. The median primary earner would receive the equivalent of an extra 29.9% of final year salary if they were to work an additional year. The 25th and 75th percentiles of this distribution are 18.3% and 44.4% of final salary, respectively. These results suggest that the Social Security formula provides a sizeable incentive to delay the onset of Social Security and work longer if the claiming and retirement decisions are tied together. Understanding this incentive provides valuable information for workers considering options to boost retirement living standards.

5. Conclusion.

Our primary conclusion is that working longer is relatively powerful compared to saving more for most people. Our initial base case stylized primary earner illustrates why that is the case. Recall, the base case was someone who started saving for retirement at age 36, who contributed a total of 9 percent of earnings to a 401(k) plan, who experienced 0 percent real wage growth and 0 percent real investment returns during their career, and who retired and commenced Social Security at age 66. Sustainable income in retirement was composed primarily of Social Security (81 percent), with a smaller proportion coming from the annuitized 401(k) balance (19 percent). By working longer and deferring the commencement of Social Security, the primary earner could increase both the Social Security monthly benefit and the annuitized monthly income. That is, working longer affects both components of retirement income. On the other hand, by saving more, the primary earner could only increase the annuitized 401(k) balance, which makes up only 19 percent of retirement income. For instance, by saving 10 percent rather than 9 percent for the entire 30 years, the affordable 401(k) annuity increases by 11.11%, but that increase applies to only 19 percent of retirement income. Therefore, it is not surprising that only 3 months of additional work generates the same increase in retirement income as 30 years of saving an additional one percentage point of earnings. When we look at different rates of return on assets, different ages of retirement and at singles vs. married primary earners, the general result remains that working 3 to 6 extra months has an equivalent impact on the affordable sustainable standard of living as saving one percentage point more for 30 years. Increases in saving that start later in life have a proportionately smaller impact, increasing the power of working longer for individuals who are reoptimizing close to retirement.

Our empirical results are understandably nosier than our stylized results, but at the same time very consistent with them. They reflect that for most people, Social Security supplies a large fraction of retirement income. Deferring retirement increases all sources of retirement income, whereas saving more only increases the relatively small contribution of annuitized defined contribution balances. The saving adjustment required to achieve a particular increase in retirement income is larger the later in the career that the adjustment takes place. In other words, saving more gets less powerful as the career progresses, but deferring retirement remains equally powerful.

Obviously, the choice of whether to work longer, save more, or adjust the retirement standard of living depends on individuals' preferences. However, by laying out the tradeoffs, we hope that this paper helps people plan for their retirement and helps them reoptimize their retirement plans in the face of changing circumstances. Not everyone has control over their retirement date, but certainly many people do. We have shown that career length is a powerful determinant of the standard of living in retirement. Roughly speaking, deferring retirement by one year allows for an 8 percent higher standard of living for a couple and the subsequent survivor. The effect compounds for two, three, and four-year work extensions. The impact of working longer relative to saving more increases as individuals get closer to retirement. Thus, working longer may be a much more attractive option than saving more for people who are reoptimizing their retirement plans ten or so years before retirement.

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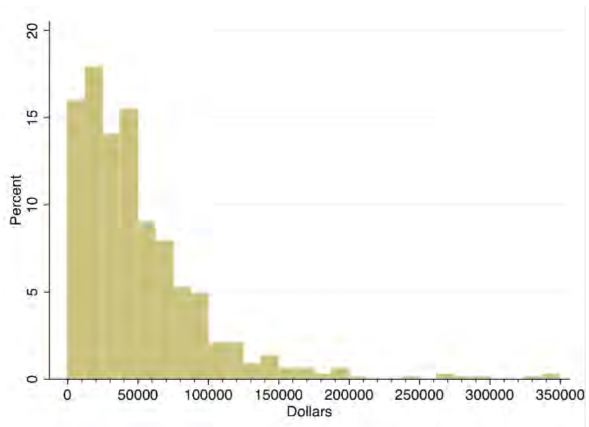
Appendix

A.1 Individual and Household Income

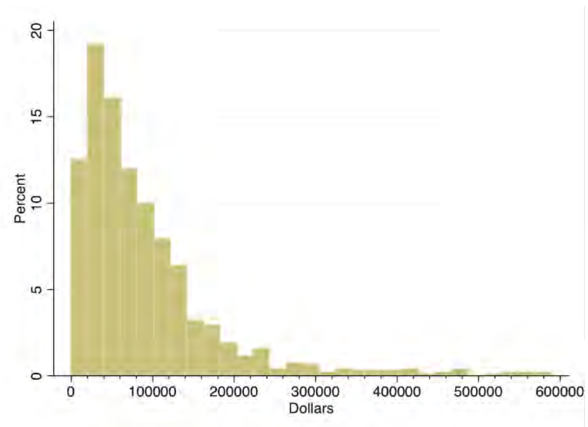
The following figures illustrates the distribution of individual and household income for the people in our sample.

Figure A1: Individual and Household Income Distribution when Individual is of Age 61/62

Primary Income at age 61/62



Household Income when Primary is at age 61/62



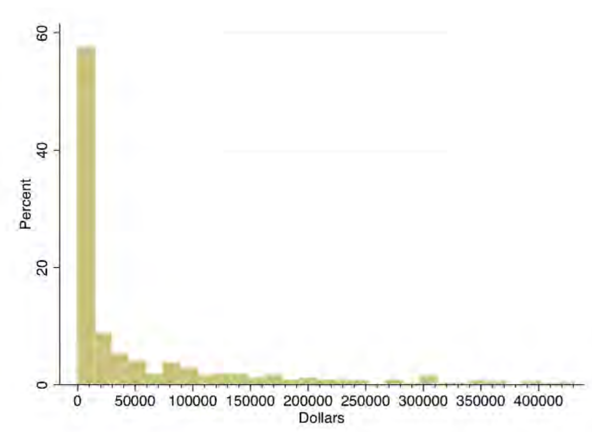
Source: Health and Retirement Study, Waves 10-12.

A.2 Defined Contribution Balances

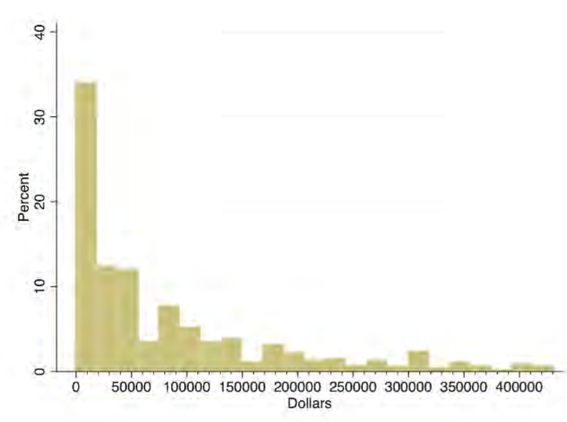
The following figures illustrate the distribution of household defined contribution balances both including and excluding zero balances. The graph on the left indicates that, zero balances are very common, comprising almost 60% of the balances in our sample. The graph on the right illustrates that even when zero balances are removed, the distribution of balances is skewed to the left, with most balances below $50,000. This indicates that for most households, Social Security is likely the main source of income during retirement. (Note that our analysis ignores any defined benefit income.)

Figure A2: Household Defined Contribution Balance Distribution when Primary is of Age 61/62

Household DC Balance When Primary is 61/62



Household DC Balance When Primary is 61/62, Zeros Removed



Source: Health and Retirement Study, Waves 10-12.

A.3 Career Length

Figure A.3 illustrates the distribution of career lengths in our sample. The majority of individuals have a career length of 35 years or more, suggesting that additional years of work will have at most a small impact on AIME.

Figure A3: Distribution of Career Lengths, as of Age 61/62