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MRDRC WP 2021-417

UM19-13

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February 2021

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Acknowledgements

The research reported herein was performed pursuant to a grant from the U.S. Social Security Administration (SSA) funded as part of the Retirement Research Consortium through the University of Michigan Retirement Research Center Award RDR18000002. The opinions and conclusions expressed are solely those of the author(s) and do not represent the opinions or policy of SSA or any agency of the federal government. Neither the United States government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of the contents of this report. Reference herein to any specific commercial product, process or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply endorsement, recommendation or favoring by the United States government or any agency thereof.

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Abstract

Social Security provides retirement benefits to age-eligible workers and their spouses. Benefits are permanently increased if initial receipt is delayed. For benefits paid to spouses, these incentives reflect a complex interaction of the worker's and spouse's earnings histories, benefit claiming decisions, and age difference. We demonstrate that the benefit increment from delaying initial receipt of spousal and survivor benefits is substantial for some households. Past studies find that workers respond to potential increments in their own benefit by delaying labor force exit. Using a nationally representative panel, we investigate whether an additional dollar in expected lifetime benefits paid to the worker directly is treated the same as an additional dollar paid to the worker's spouse from spouse and survivor benefits. We find minimal evidence that workers or their spouses change retirement behavior in a way that is theoretically consistent with spouse and survivor benefit claiming incentives. The lack of responsiveness suggests that incentives to delay claiming for benefits other than the worker's own are not salient in the worker's decision-making. This may reflect the complexity of benefit rules or different preferences concerning benefits paid to others. A parallel analysis using German data, where rules surrounding survivor benefits are simpler, finds that workers respond in a theoretically consistent way, but small sample sizes prevent conclusive results. Our findings suggest models estimating the policy impact of reducing spousal and survivor benefits on female labor supply are likely overstated, and that a greater understanding of survivor benefits may lead to better claiming decisions for couples.

Citation

Knapp, David, Jinkook Lee, Maciej Lis, and Drystan Phillips. 2021. "Public Pension Design and Household Retirement Decisions: A Comparison of the United States and Germany." Ann Arbor, MI. University of Michigan Retirement and Disability Research Center (MRDRC) Working Paper; MRDRC WP 2021-417. https://mrdrc.isr.umich.edu/publications/papers/pdf/wp417.pdf

Authors' acknowledgements

The authors thank Ah Reum Lee for research assistance and Molly Saunders-Scott for helpful comments and feedback. They also acknowledge generous support from Social Security Administration through the Michigan Center for Retirement and Disability Research and the National Institute on Aging (R01 AG030153).

1. Introduction

Social insurance-based public pensions, such as the social security systems in the United States and Germany, were developed to insure financial security for individuals in old age, dependents after death, or disabled individuals.[1] While these plans may be designed to be actuarially fair, differences in generational and gender mortality often mean these public pensions provide financial incentives to continue or stop working. An important role is played by the earliest eligibility age (EEA), which determines the youngest age an individual may begin receiving benefits. Additionally, many pension systems increase monthly payment amounts if an individual delays benefit claiming (i.e., the start of benefit payments). Sometimes, these are framed as penalties for claiming benefits before reaching a specific age. In the United States, both framings exist: a delayed retirement credit that individuals can receive if they start their benefit after "full retirement age" (FRA) and a reduction of benefits if receipt begins prior to the FRA.

Public pensions often provide insurance in case a family's income earner becomes unable to work or dies. These benefits, known as auxiliary benefits, introduce additional financial incentives to shift benefit receipt, depending on a beneficiary's circumstances.

The complexity of a pension system may make its designed incentives less

[1] We compare the U.S. and Germany in this paper given the many similarities between the two systems, including basing benefit levels on earnings histories, having survivor benefits, providing incentives to delay the start of benefits, and similar eligibility ages for earliest and full benefits.

salient to the beneficiaries. Some of these incentives are complex and so may not be broadly understood, limiting most individuals' ability to respond to them. For example, in the U.S., the FRA varies by birth year, as do increases in lifetime monthly payments from delayed benefit start. The complexity is compounded for auxiliary benefits, as variation in FRA by birth year and increases for delayed start differ between retirement benefits paid to a worker and benefits paid to his or her spouse or survivor.

Previous studies have demonstrated that people respond to pension incentives. In this paper, we affirm these findings and analyze whether individuals also respond to the additional incentives implicitly built into auxiliary benefits. We focus on Social Security's spousal and survivor benefits. We examine whether our findings are consistent with these benefits being salient for retirement and benefit-claiming decisions. For example, when considering the gains in lifetime Social Security benefits from continuing to work and delaying the start of benefits, does a worker weigh an additional dollar of expected lifetime income paid to his or her survivor the same as an additional dollar of expected lifetime income paid to themselves? Do we observe a relationship between additional expected lifetime income from survivor benefits and an individual's retirement timing?

Social Security's spousal and survivor benefits of retired or deceased workers amounted to $130 billion (U.S. Social Security Administration 2019), or 3.2% of federal expenditures in 2018 and 14.8% of old-age and survivors insurance expenditures.[2] Since auxiliary benefits come at a substantial cost, it is important for policymakers to

[2] Annual estimates are from author's calculations using December 2018 average monthly benefits as reporting in Tables 5A.1 and 5G.4 of the 2019 Social Security Annual Statistical Supplment (U.S. Social Security Administration 2019).

understand the effectiveness of these benefits and their incentives. A worker's contributions support those benefits regardless of whether the insurance is relevant to them (e.g., the contributions of a single worker who does not benefit from survivor benefits are determined the same way as those of a married worker). It is an open question as to whether workers respond to the retirement incentives created by those auxiliary benefits. If they do not, then there are two possible explanations. First, it could be that workers do not place high value on those benefits. Second, the complexity of the structure of auxiliary benefits may limit their influence on decision-making. As policymakers contemplate future reforms, auxiliary benefits may be a potential area of interest.

To understand the relative impact of auxiliary benefits versus own benefits on retirement timing, we conduct parallel analyses of both the U.S. and Germany using the same methodology and harmonized data sources. The U.S. Social Security system was modeled on the German social insurance system, which was introduced in 1889 (U.S. Social Security Administration 2021). Since then, the German pension system, has undergone a number of revisions. In the current state mandatory pension system, Gesetzliche Rentenversicherung (GRV), individuals accrue credits over their life cycle, and these credits transform into a permanent benefit. There also exist incentives to delay claiming through increases in the per-credit benefit rate. Importantly, as we will discuss later in this paper, the survivor benefit is notably simpler than the U.S. benefit.

In the next section, we provide pertinent institutional details on the U.S. and German mandatory pension schemes, and illustrate how U.S. spousal and survivor benefits can provide sizeable incentives to a worker to either start receiving their benefit

as soon as possible or delay. In the third section, we introduce our data, discuss our sample selection, and present summary statistics about our population. The fourth section presents our economic model and discusses identification and interpretation of our model parameters. The fifth section presents our findings and discusses the model's results. We conclude with a summary of key findings, including policy implications, and note potential paths for future research.

2. Household incentives in public pension design

A. Institutional details for the U.S.

Old Age, Survivor, and Disability Insurance (OASDI), typically referred to as Social Security in the U.S., was established in 1935, expanded in 1939 to include benefits for wives and widows, and gradually expanded through the 1970s to include husbands and widowers. Since a major reform in 1983 to stabilize long-term financing, no substantial reforms have been made.[3] The durability of Social Security's benefit structure has provided reliable expectations about income to generations of households planning their retirement.

We focus on three major benefits of OASDI for our analysis: own retirement benefits, spousal retirement benefits, and survivor retirement benefits. We exclude disability benefits, as well as the range of other auxiliary benefits (e.g., benefits for

[3] Minor reforms included the Senior Citizens' Freedom to Work Act of 2000 that eliminated the Retirement Earnings Test for beneficiaries at or above FRA and the Bipartisan Budget Act of 2015 which eliminated a "file and suspend" strategy for couples. This strategy enabled one member of the couple to file for their benefit at or after FRA but suspend their own payment, allowing their spouse to collect a spousal benefit while simultaneously receiving delayed retirement credits on their own benefit.

worker's children or parents, or workers who happen to be mothers or fathers of children younger than 18), that are not directly aimed at those nearing retirement. We refer to individuals covered by OASDI as workers (including self-employed) and distinguish between high and lower earnings in a couple by referring to the current higher earner as the primary worker and the lower earner as the secondary worker. Throughout this paper, we use the terminology "own" to highlight benefits paid to a worker based on his or her own working history.

In its current form, workers contribute 6.2% of their earned income to OASDI, with employers contributing an equal amount, up to a statutory maximum (set at $142,800 in 2021). Contributions are independent of household circumstance.

Workers are entitled to start receiving their own and spousal old-age benefits at an EEA of 62. EEA for survivor old-age benefits is age 60. The FRA is age 65 for workers born before 1938 and increases by two months every birth year until it reaches 66 for workers born between 1943 and 1954. For workers born after 1954, it increases by two months every birth year until it reaches 67 for workers born after 1959.

An individual's benefit amount is determined by calculating his or her average indexed monthly earnings. That measure is based on his or her best 35 years of earnings, indexed for wage growth over time using the Social Security Administration's average wage index.[4] Earnings up to the two years prior to his or her EEA (i.e., age 60 for own benefits) are indexed to age-60 dollars, while earnings after are not indexed. Average indexed monthly earnings is transformed to a primary insurance amount (PIA) based on a progressive rule; In 2021, the PIA would be 90% of the first $996 of average

[4] Earnings over the taxable maximum do not count toward average indexed monthly earnings.

Mathematically, a worker *i*'s own benefit at time t is determined by the worker's claiming age (ca_i), birth year (byr_i), and a vector of lifetime earnings, $EARN_{it}$, accrued through period t:

$$own.ben_{it}^{US} = own.delay^{US}(ca_i, byr_i) \times pia(EARN_{it}, byr_i) \times cola(t, byr_i) \quad (2.1)$$

where $own.delay^{US}(\cdot)$ reflects adjustments to benefits due to claiming them before or after the FRA and FRA depends on birth year.[6] The next term, $pia(\cdot)$ stands for the function for computing the worker's PIA based on i's life-cycle earnings, indexing earnings before age 60, and accounting for a progressive formula described above for transforming average earnings into the monthly benefit at FRA. The final term in Equation 2.1, $cola(\cdot)$, corresponds to the cost-of-living adjustment for person i in year t as set by the U.S. Social Security Administration. Benefit payments are adjusted annually for cost-of-living based on the U.S. Bureau of Labor Statistics Consumer Price Index for Urban Wage Earners and Clerical Workers. These adjustments are compounded annually from the year an individual reaches the EEA.[7] Combining all of this for a more concrete example, in 2019, an individual whose average indexed monthly earnings was equal to the average wage ($54,100) would have been entitled to an annual benefit at FRA of $24,641.

Equations for the spouse *j*'s spousal benefit ($sp.ben_{ijt}^{US}$) and survivor benefits

[6] See "Worker Claiming Age Reduction Factor" in Table 2.1 for an example, Appendix Table B.1 for reductions in PIA by claiming age relative to FRA and Appendix Table B.2 for FRA by birth year.

[7] So, for an individual claiming at FRA, his or her initial benefit would be approximately equal to the PIA multiplied by the compounded cost-of-living adjustments between age 62 and FRA. It is approximate because Social Security policy requires that for each annual benefit adjustment the benefit is rounded down to the nearest $0.10.

National Center for Health Statistics (2021). We calculate SSW present value at the claiming age back to the survey period, time *t*.

Additional SSW from spousal and survivor benefits ($sp.ssw_{it}^{c}$ and $sur.ssw_{it}^{c}$, respectively) based on the worker's earnings history are more complex because they depend on the interrelationship between the spouse's claiming decisions, the spouse's own benefit entitlement, and the expected survivorship of both. Given its complexity, we detail this computation in Appendix A (Equations A.8 and A.9). We also compute additional SSW from the worker's supplement ($sup.ssw_{it}^{c}$), which is benefits paid to the worker based on his or her spouse's earnings record (appendix Equation A.7).

SSW is a static measure as it captures the present value of lifetime social security benefits at a point in time. As a result, it does not show delayed claiming incentives that lead to greater SSW. Researchers have developed a number of forward-looking measures based on SSW, including a simple one-year accrual, the option value approach, and the peak value approach (PKV) (Gruber and Wise 2004). While an accrual measure captures growth in the benefit from delaying one year, it does not account for further forward-looking incentives two or more years in the future. An option value approach improves on this by computing the difference between the utility of benefit claiming in the current year relative to the utility maximizing point in the future. As Coile and Gruber (2007) note, the calibrated version of the option value approach that does not require structural estimation has the majority of the option value measure variation explained by individual wages, making identification of a retirement incentive harder to argue. The PKV approach of Coile and Gruber (2007) calculates the difference between maximum expected value SSW and SSW accrued to date. We use

the PKV approach in this paper for ease of comparison across benefit types and across countries (all comparison take on a dollar value).

The peak value, pkv_{it}, for the worker's own benefits at time *t* is determined as the difference between the greatest SSW achievable from decisions up to time *t* across all possible claiming ages and the SSW at time *t*:

$$own.pkv_{it}^{c} = \left(\max_{k=[t,T]}\left(own.ssw_{it}^{c}\left(k, ca_j(k)\right)\right)\right) - own.ssw_{it}^{c}(ca_i(t), ca_j(t)) \quad (2.3)$$

Once the peak SSW is achieved, Equation 2.3 takes a value of zero for all future years. Given the complexity of the above calculation, we simplify the spouse's decision for the purposes of computing SSW by assuming that the spouse claims as soon as possible.[9]

Additional SSW from spousal and survivor benefits peaks at different ages. Thus, we cannot use Equation 2.3 to compute the retirement incentives (or disincentives) from spousal and survivor benefits. To maintain consistency with the existing literature, which has focused on the PKV for own benefits, we study the effects of spousal and survivor benefits by looking at the difference between the additional SSW from the spousal benefit at year, *t*, and the own PKV age, *p*:

$$sp.pkv_{it}^{c} = sp.ssw_{it}^{c}(p, ca_j(p)) - sp.ssw_{it}^{c}(ca_i(t), ca_j(t)) \quad (2.4)$$

for the survivor benefit:

$$sur.pkv_{it}^{c} = sur.ssw_{it}^{c}(p, ca_j(p)) - sur.ssw_{it}^{c}(ca_i(t), ca_j(t)) \quad (2.5)$$

[9] This is age 62 for own and spousal benefits or age 60 for survivor benefits. If the spouse is older than 62, we assume the spouse claims immediately. Not fixing the spouse's claiming age leads to a substantial growth in required computations (i.e., instead of computing benefits for all possible ages between 62 and 70 for the primary earner — nine outcomes — we would need to compute up to 9x9=81 outcomes). This represents a lower bound for spousal and survivor SSW, as delaying claiming may lead to increases in spousal and survivor benefits as discussed in Section 2.

and for the worker's supplement:

$$sup.pkv_{it}^{c} = sup.ssw_{it}^{c}\left(p, ca_j(p)\right) - sup.ssw_{it}^{c}\left(ca_i(t), ca_j(t)\right) \quad (2.6)$$

We refer to these as spousal, survivor, and worker's supplement PKVs for ease of exposition, but it is important to remember that they depend on the age of the PKV for a worker's own benefits.

Our measures of spousal, survivor, and worker's supplement PKVs are potentially negative, capturing the ways in which spousal and survivor benefits potentially offset the retirement incentives (disincentives) created by own benefits. An alternative approach would be to create a PKV concept that looked at the PKV for total (own, spousal, and survivor) benefits. However, that approach would not be comparable to the existing literature and would require an assumption about the value a worker places on spousal and survivor benefits relative to his or her own benefits. To the degree that past researchers have included spousal and survivor benefits in their SSW calculation, they have implicitly assumed that these are treated the same as own benefits for the purposes of decision-making. Our findings in this paper suggest that this assumption may not be valid.

For the purposes of the examples and analysis that follow, we assume a real discount factor of one, which is equivalent to a zero real discount rate. In recent years, the real rate of return on a safe asset (e.g., 10-year treasury bill) has been zero or negative. We have also examined higher real rates of return (e.g., 3% real rate of return). A higher real rate of return moves the peak value age earlier. At a zero real rate of return, own benefits peak value age typically occurs at ages 68 to 69 for men. At a 3% real rate of return, peak value age occurs around 64 to 66. Moving the peak value

age earlier on spousal and survivor benefits tends to make future benefits (e.g., survivor benefits) smaller relative to benefits received earlier (e.g., own and spousal benefits), and makes all future benefits smaller relative to current income and assets. In our later analyses, our findings based on a zero percent real rate of return are generally robust to using a 3% real rate of return.

Auxiliary benefits alter incentives to delay claiming

Table 2.2 presents an example of SSW from own benefits and additional spousal and survivor benefits by age for a U.S. household where the husband, age 60 in 2005, receives a $2,000 monthly benefit if he claims at FRA and the wife has no entitlement based on her earnings' history. We assume that additional years of work do not change the best 35 years used in his benefit calculation.[10] His own SSW at age 62 is $338,700 and rises to $376,300 if he delays claiming until age 69, leading his PKV to be $37,600 at age 60 — approximately 11% of his age-62 SSW.[11,12]

Table 2.2 also shows the additional SSW from spousal and survivor benefits paid to the wife based on the husband's earnings. If the husband and wife are the same age, those auxiliary benefits amount to between 55% and 71% of his own benefit, indicating

[10] Relaxing this assumption means that his PIA could grow at up to 2.8% (1/35th) per year if the additional year of work replaces a zero in his earnings history. Making this adjustment will change the values in Table 4.1, but will not alter the general findings.

[11] For women in a similar position, their benefit at age 69 is 17% greater than their age-62 SSW. In the U.S., Social Security's incentives to delay claiming more than offset mortality differences.

[12] This means they are not actuarially neutral with an assumed zero real rate of return. The assumed real rate of return necessary to make the growth rate in the benefit actuarially neutral ranges from 2.2% to 5.1%, and varies by age and gender. Women would require a higher real rate of return for the benefit growth rate from delayed claiming to be actuarially neutral.

substantial additional wealth for this single-income household.

Spousal benefits strongly modify incentives to work longer. Whereas own SSW increases with time, auxiliary benefits for the same-age couple decline, reflecting the loss of spousal benefits for delaying claiming beyond age 62. This results from the constraint that a spouse cannot begin to collect spousal benefits until the husband claims his own benefit. Consequently, the loss of this additional income is not fully replaced by higher benefits from delayed claiming. After age 66, the decline in additional spousal SSW is offset by an increase in additional survivor SSW, because delayed retirement credits are passed on to the survivor.

Table 2.2 parses additional SSW from spousal and survivor benefits. In this case, the SSW from spousal benefits is greatest at age 62. By age 69, spousal benefits have declined by $49,600 (Equation 2.4), erasing the gains in SSW from delayed claiming of own benefits and providing a net SSW decrease from delayed claiming. However, the increase in survivor benefits from delayed claiming to age 69 is $16,500 (Equation 2.5). Combining the own benefit PKV and the difference in additional SSW from spousal and survivor benefits at these ages, the value is only a net increase of $4,600, resulting in a relatively small incentive for this husband to delay claiming until age 69.

In our analysis in Section 4, we use the measures discussed here to address whether incentives from added SSW due to spousal and survivor benefits are related to the decision to continue work by incorporating these measures into a model of labor force exit. The examples in this section illustrate that additional spousal and survivor benefit SSW can provide significant added incentives (or disincentives) to continue work past the EEA, and the value of these incentives depends on the spouses' age differences and differences in benefit entitlement based on their individual earnings histories. Further, spousal and survivor benefits may also incentivize a different decision in terms of retirement timing than incentives based on a worker's own benefit alone.

A worker's benefit payment in the U.S. depends on a complex interaction of own claiming decisions and his or her spouse's claiming decisions. Our aim is to understand whether auxiliary benefits and associated incentives influence retirement decisions. If we find that workers respond more to the value of their own benefit entitlement then to the value of benefits paid to their spouse, then it could indicate that workers place less value on spousal benefits, or it could simply indicate that they do not understand spousal benefits. Looking just at the U.S. would not enable us to understand the role of the system's complexity. To provide a benchmark, we compare results for Germany, where survivor benefits create similar incentives for retirement timing. In Germany, as we discuss next, survivor benefits are largely independent of the survivor's decision, making the benefit calculation, and resulting incentives, easier to understand.

C. Institutional details of Germany

GRV is the mandatory state pension system in Germany. Whereas OASDI

remains funded through current and past contributions, the public pension in Germany shifted to pay-as-you-go in 1959, meaning current contributions pay for the benefits of current beneficiaries. Like OASDI, GRV provides benefits for the elderly, widows, and the disabled. The social security systems of the Federal Republic of Germany (i.e., West Germany) and the German Democratic Republic (i.e., East Germany) were merged in 1992. Since then, a number of reforms have aimed to improve the long-term viability of the system, including the introduction of increases in EEA (1999), FRA (1999, 2007), new benefit adjustments and changes to survivor benefits (2001), and the introduction of contribution and sustainability factors in determining benefit levels (2004).

We focus on two major benefits of GRV: own retirement benefits and survivor retirement benefits.[15] Similar to the U.S., we exclude disability benefits. Spousal benefits similar to those in OASDI do not exist in Germany.[16] GRV also does not have the range of other auxiliary benefits available in OASDI. GRV does offer different benefit eligibility rules for miners, but we do not account for this distinction in our analysis.

Contributions to GRV vary by year. Since 2018, contributions have been 9.3% of wage income (employers provide an equal amount), up to a statutory maximum that

[15] In GRV, there are major and minor survivor benefits. The minor survivor benefits refer to a benefit received in the 24 months following death. Major benefits are persistent benefits received after meeting EEA. When referring to “retirement benefits” in the case of GRV, we are referring to the major survivor benefit.

[16] Since 2001, spouses are permitted to split their pensions, but this is not required and splitting pensions eliminates entitlement to survivor benefits. Additionally, the federal government began offering the Riester pension, a tax-advantaged saving account where the government will make subsidized contributions up to 350 euros per couple per year. These values are substantially smaller compared to GRV old age and survivor benefits.

differs by region (set at 78,000 euros in 2018 in West Germany and 69,600 euros in East Germany). Male workers are entitled to start receiving their own retirement benefits at an EEA of 63 if they reached that age prior to 2018. Male workers with at least 35 years of contributions have a FRA of 65 years if reaching FRA before 2012. FRA is lowered to the EEA for workers with at least 45 years of contributions. Men and women used to have differing eligibility ages, although these differences are legislated to disappear in the next decade. Female workers had an FRA of 60, making the effective EEA also 60 before 2006. The FRA rose by one year annually until it matched the male FRA of 65 in 2010. For survivor benefits, the EEA is 45 for individuals qualifying before 2012. For survivor benefits, the EEA and FRA are the same (i.e., there is no incentive to delay receiving benefits). The FRA and EEA for own and survivor benefits are scheduled to increase through 2029. Appendix Table B.2 details differences in EEA and FRA by birth year and sex.

The GRV monthly benefit amount is straightforward to compute. It is determined by multiplying the pension point value by an individual's accumulated number of pension points. For consistency, we refer to this as the German PIA. Annual pension points are computed based on the ratio of individual earnings (up to the maximum allowable) in that year to the national average earnings of all contributors (differentiated by East and West Germany). An individual can earn up to two pension points per year. In 2020, the pension point value was 33.23 euros for East Germany and 34.19 euros for West Germany. This means that an individual who earned an average wage and worked 40 years would have 40 pension points and be entitled to 16,411 euros a year in West Germany (approx. $19,690 if the conversion rate is $1.2 per euro). For survivor

her benefits before death, then the own benefit reflects 100% PIA plus any credits for delaying retirement past FRA.

The pension point rate is updated annually to account for changes in the average wage, acting as a cost-of-living adjustment. Since 2004, this adjustment also accounts for a contribution factor which reflects changes in the contributions to the fund and a sustainability factor that accounts for shifts in the dependency ratio (the ratio of pensioners to contributors).[17] The goal of these adjustments is to make benefit growth more reflective of changes to GRV's funding base. These changes are generally small. In 2020, the contributory factor was 1 (no adjustment for contributions, since the rate was held steady) and the sustainability factory was 1.0017 since the number of pensioners decreased relative to contributors.

Mathematically, a German worker *i*'s own benefit at time *t*, like a U.S. worker's benefit, is determined by the worker's claiming age, birth year, a vector of lifetime earnings accrued through period t. In Germany, it is also depended on whether they are from East or West Germany:

$$own.ben_{is}^{GR} \quad = \quad ppv(s, East_i) \times own.delay^{GR}(ca_i, byr_i) \times pp(EARN_{is}, East_i) \quad (2.7)$$

where $ppv(\cdot)$ corresponds to the pension point value in year s depending on whether respondent *i* lives in East or West Germany (as indicated by $East_i$), which is updated annually by GRV, based on the average wage growth and sustainability adjustment,

[17] "If the number of pensioners increases faster than the number of contributors, this has a dampening effect on the pension adjustment. In the opposite case, the sustainability factor increases the pension adjustment." (https://www.deutsche-rentenversicherung.de/DRV/DE/Ueber-uns-und-Presse/Presse/Meldungen/2020/200605_bundesrat_rentenanpassung_2020.html)

$own.delay^{GR}(\cdot)$ is the multiplier on the benefit entitlement reflecting changes from claiming own benefits before or after the FRA (see "Worker Claiming Age Reduction Factor" in Table 2.4 for an example, Appendix Table B.1 for reductions in benefit by claim age relative to FRA). Finally, $pp(\cdot)$ reflects the worker *i*'s cumulative pension points based on his lifecycle earnings accrued through period s and accounting whether respondent *i* lives in East or West Germany. Appendix A provides further detail on the computation of German survivor benefits.

Importantly, unlike in the U.S., there is no additional interrelationship of household claiming behavior in GRV beyond those built into the reductions in survivor benefits if the deceased begins receiving benefits before FRA. There is no spousal benefit and a survivor can collect both a survivor benefit based on a deceased's pension points and their own benefit based on their own pension points. A dually entitled survivor (i.e., entitled to their own and a survivor benefit) may have their survivor benefit reduced based on an income test that includes own pension income.

D. Previous literature

Effective retirement ages for men declined while life expectancy improved strongly in many countries in the last quarter of the 20th century. Seminal work of Gruber and Wise (1999), provided comprehensive evidence about the role of pension system incentives in explaining the decline of labor force participation rates concurrent with longer life expectancy . This work compared financial incentives to retire at different ages in Belgium, Canada, France, Germany, Italy, Japan, the Netherlands, Spain, Sweden, the United Kingdom, and the U.S. on the aggregate level. Incentives were measured through replacement rates and the changes in SSW when postponing

retirement age by a year, the so-called implicit tax on work. The subsequent work on similar countries (Gruber and Wise 2004) enforced the previous conclusions with new evidence based on microdata. Their SSW measures combined own pension entitlements and spousal and survivor benefits.

In the past decade, researchers have begun to study survivor pensions and other benefits that do not depend on own earnings history but on the earnings history of spouses or partners, also known as derived pension rights. James (2009) presented an international landscape of survivor pensions while the OECD (2018) updated and broadened this picture through depicting the main features of survivor pensions in the OECD countries. Almost all OECD countries cover survivor risks, but the design and generosity of spousal and survivor benefits differ greatly across countries. Survivor schemes were generally tightened over the last decades.

In the last few years, researchers have studied the couples' financial incentives embedded in derived pension rights and begun to evaluate their role on employment decisions. Coile (2004) demonstrates that a wife's pension incentives (as measured by a spouse's own PKV) influence her husband's work decision, but finds limited evidence of the reverse. Coile (2018) provides an updated picture of the U.S.' financial incentives to retire, including derived pension rights and private pensions. In particular, they show how a spouse's income affects the implicit tax on working longer and argue that women often face different retirement incentives than men. For Belgium, Jousten and Lefebvre (2019) showed that spousal and survivor benefits substantially modify the incentives for retiring, which mainly affect women's employment decisions. For Germany, Börsch-Supan, Rausch and Goll (2020) showed that couples' SSW is larger than the sum of

individuals when the survivor benefit is included.

The role of spousal and survivor benefits on female labor supply has been shown to be particularly important. Nishiyama (2019), who focuses on the redistributive mechanism between singles to couples within pension systems, provides evidence that survivor and spousal benefits reduce female labor market participation by around 1.5% in the U.S. Similarly, Borella, De Nardi, and Yang, (2019) found that eliminating U.S. spousal and survivor benefits would substantially increase married women's labor market participation.

The interaction between employment decisions and derived pension rights has received substantial research interest, catching up with the evidence gathered for own pension benefits and employment decisions. Yet none of the studies to date have questioned whether a worker treats their own benefits the same as spousal and survivor benefits. Implicitly, they assume that workers respond similarly to an additional $1 from their own benefit versus $1 from auxiliary benefits. Our findings are consistent with this not being true.

3. Data and summary statistics

A. Panel data

We use the harmonized data files developed by the Gateway to Global Aging Data (g2aging.org), an NIH-funded data and information portal.[18] These harmonized data files are designed for cross-country analysis using the international family of Health and Retirement Studies. The first of these studies was the U.S.' Health and Retirement Study (HRS), started in 1992 as a nationally-representative panel study of people older than 50 and their spouses. The HRS has been conducted biennially since its start and has added additional cohorts every six years.

Since 2001, a growing number of sister studies have been started around the world, which are purposefully designed to be comparable to the HRS. One such study is the Survey of Health, Ageing and Retirement in Europe (SHARE), which began its first wave in 2004. Like the HRS, SHARE has (1) biennial interviews with respondents and their spouses; (2) a multidisciplinary questionnaire design that elicits a wealth of information about health, retirement, demographics, and other topics; and (3) regular refreshment samples to keep the sample representative of the older population. However, SHARE administered a life-history interview for Wave 3 instead of core interviews. There is a four-year core interview interval between 2007 and 2011.

We use data from the HRS and SHARE to study how retirement claiming decisions of married households in the U.S. and Germany are influenced by the

[18] Gateway to Global Aging Data (2020), produced by the Program on Global Aging, Health & Policy, University of Southern California, with funding from the National Institute on Aging (R01 AG030153)

existence and structure of auxiliary benefits.[19]

B. Sample selection

To ensure common observational periods for HRS and SHARE, we begin our sample in 2004 and follow both biannually through 2016. This corresponds to a maximum of six observations for HRS and five observations for Germany.[20] Since our interest is in married households' retirement incentives, we apply a series of sample restriction noted in Table 3.1.

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[19] The HRS (2020) is sponsored by the National Institute on Aging (grant number NIA U01AG009740) and is conducted by the University of Michigan. The data used in this analysis is partly derived from RAND HRS Longitudinal File 2016 (V2) (2020). This paper also uses data from SHARE Waves 1, 2, 3, 4, 5, 6, 7 and 8 (DOIs: 10.6103/SHARE.w1.710, 10.6103/SHARE.w2.710, 10.6103/SHARE.w3.710, 10.6103/SHARE.w4.710, 10.6103/SHARE.w5.710, 10.6103/SHARE.w6.710, 10.6103/SHARE.w7.711, 10.6103/SHARE.w8cabeta.001), see Börsch-Supan et al. (2013) for methodological details. The SHARE data collection has been funded by the European Commission through FP5 (QLK6-CT-2001-00360), FP6 (SHARE-I3: RII-CT-2006-062193, COMPARE: CIT5-CT-2005-028857, SHARELIFE: CIT4-CT-2006-028812), FP7 (SHARE-PREP: GA N°211909, SHARE-LEAP: GA N°227822, SHARE M4: GA N°261982, DASISH: GA N°283646) and Horizon 2020 (SHARE-DEV3: GA N°676536, SHARE-COHESION: GA N°870628, SERISS: GA N°654221, SSHOC: GA N°823782) and by DG Employment, Social Affairs & Inclusion. Additional funding from the German Ministry of Education and Research, the Max Planck Society for the Advancement of Science, the U.S. National Institute on Aging (U01_AG09740-13S2, P01_AG005842, P01_AG08291, P30_AG12815, R21_AG025169, Y1-AG-4553-01, IAG_BSR06-11, OGHA_04-064, HHSN271201300071C) and from various national funding sources is gratefully acknowledged(see www.share-project.org). Additionally, this paper uses data from the generated Job Episodes Panel (DOI: 10.6103/SHARE.jep.710), see Brugiavini et al. (2019) for methodological details. The Job Episodes Panel release 7.1.0 is based on SHARE Waves 3 and 7 (DOIs: 10.6103/SHARE.w3.710, 10.6103/SHARE.w7.710).

[20] Observations require consecutive interviews in order to determine an exit, meaning that we must observe an individual working in wave *t* and observe whether they are working or not working in *t+1*. Therefore, despite there being seven interviews between 2004 and 2016 for the HRS, we have a maximum of six observations.

following the 2004 survey). This results in 8% reduction in respondents for the U.S. and a 44% reduction in respondents for Germany respectively, a reduction of 6% and 22% of person-year observations. Finally, we drop observations after the first exit from the labor force, since our interest is in the relationship between first exit from the labor force and pension incentives.

Given Germany's large reduction in the sample at the fourth step , in Appendix D, we investigate the characteristics of those households in the U.S. and Germany that respond in 2004 but not in 2006. For Germany, to the degree that our pension measures are associated with active attrition, the pattern suggests that those entitled to greater SSW and with less incentive to delay claiming based on their own benefit are more likely to attrit.

C. Sample summary statistics

Table 3.2 reports characteristics of our married household sample. By virtue of the sample selection, all our sample respondents are married and working in 2004. Both samples have an average age around 54 to 55, with the average Germany man being the same age and the average German woman being 0.5 years younger. In both countries, working men are older than their wives on average, 2.4 years in the U.S. and 2.3 years in Germany. Given this, it is unsurprising that working women tend to be younger than their husbands, but the age gap is larger, 3.1 in the U.S. and 2.8 in Germany. The larger gap for married, working women suggests that, on average, they are married to older husbands than nonworking, married women. Men and women in Germany have longer marriages on average (3.4 to 3.7 years), but spouses are notably less likely to be working, 9% for wives of working men, 8% for husbands of working

women. This suggests a lower prevalence of dual-earner couples in Germany. Part of this difference may reflect the German data's greater spousal nonresponse, which is 19% for wives of working men and 26% for husbands of working women, compared to 2% of either in the HRS.[22]

We see interesting differences across genders and countries in household labor force participation. In the U.S., a working, married woman earns 51% of a working, married man, but the wife of a working man earns 64% of the husband of a working woman. This indicates that the gender wage gap for married households in this age group is smaller for dual-income households and that households depending on the wife to be the sole income earn notably less than households that depend on the husband for the sole income. In Germany, a working, married woman earns 47% of a working, married man, but an employed wife of a working man earns 43% of an employed husband of a working woman. These comparisons do not account for difference in work effort (i.e., German women are more likely to work part-time, leading to lower incomes). Comparing German to U.S. incomes for this age group, we see that working, married men in Germany earn 64% of their U.S. counterparts and working, married women earn 59%.[23] Wives of working husbands in Germany earn 56% of their U.S. counterparts and husbands of working wives earn 83%. This last finding suggests that the fewer German husbands of working wives who are themselves working for pay are positively selected:

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[22] Wave 1 SHARE did not recruit non age-qualifying spouses and started recruiting spouses younger than age 50 from Wave 2 forward.

[23] This comparison is sensitive to the assumed exchange rate. For comparison purposes, we use a $1.24 per euro exchange rate, which is the average rate in 2004 (https://www.macrotrends.net/2548/euro-dollar-exchange-rate-historical-chart). Also note, that incomes reflect self-reported pre-tax amounts.

They tend to earn relatively more than working men overall. Their U.S. counterparts are negatively selected: They tend to earn less than married and working U.S. men.

Reflecting the gender education gap for this birth cohort, a greater proportion of working men holds a college degree than working women, both in the U.S. (38% versus 30%) and Germany (43% versus 34%), and that proportion is higher for both men and women in Germany than the U.S. The proportion of college educated was equivalent for working women and wives of working men, but a smaller proportion of husbands of working women are college educated compared with working men in both U.S. and Germany. For example, in the U.S., 33% of husbands of working women have college degrees compared with 38% of working men. Similarly in Germany, 36% of husbands of working women have college degrees compared with 43% of working men.

Note that a greater proportion of German women hold physically demanding jobs (27%) than German men (19%) or American men (18%) and women (17%). In both countries, working women reported higher survival probabilities than working men, 69% versus 64% in the U.S. and 72.4% versus 69% in Germany. In Germany, missingness is an issue for both the respondent's and spouse's subjective survival probabilities. For German spouses, missingness can stem from not only the spouse not providing the response to survival probability question, but also the spouse not participating in the interview.

Home ownership is much higher in the U.S. than Germany with more than 90% of American workers owning their home and home ownership about 16 to 21 percentage points lower in Germany. With regard to household assets, households with working, married women have about 5% less than households with working, married

men in the U.S.. In Germany, a 10% household asset difference is observed.

In the U.S., SSW for women is 92% of men's SSW, reflecting greater relative earnings for men compared to women – the main determinant of SSW (see Equation 2.1). The comparatively small difference between SSW of U.S, working women and men may reflect the progressivity of the pension benefit and women's longer life expectancy. It also partly reflects our relatively strong assumptions for projecting earnings history based on last observed earnings.[24] In Germany, SSW for women is 75% of men's SSW. The lower relative SSW for women is consistent with lower relative incomes. As discussed in the last section, PKV represents the growth in SSW from delaying benefit claiming to a later age when SSW is maximized. That age varies by gender. As such, the PKV is 9% greater for U.S. women in our sample at baseline and 3% greater for German women. In the U.S., average PKV is 19% to 22% of own SSW, while this ratio is 30% to 40% in Germany. The greater growth from continued work and delayed claiming in Germany reflects that accrual of additional pension points is not limited, so additional years of contributions lead to benefit growth on top of any benefit increments for delayed claiming. The U.S. uses the best 35 years of earnings for computing benefits, limiting the benefit gains from additional years of contribution to only replacing the worst earnings years.

[24] We discuss our approach to predicting earnings histories in Appendix A. We considered a variety of alternative approaches to projected earnings history in lieu of administrative data on earnings history. Alternative approaches considering select-reported years worked can make this difference more pronounced. However, as discussed in Knapp et al. (2019), approaches using self-reported years worked introduce additional, more substantive error than our comparatively simpler approach. Regardless, our results are robust to the alternative approaches discussed in Knapp et al. (2019) that do not use administrative data.

Additional SSW from spousal and survivor benefits depends on the spouses' age difference and the spouse's own benefit entitlement. Working men have greater additional SSW from spousal and survivor benefits, but the difference is likely being driven by working men earning more than working women. For spousal and survivor PKV, the gender differences are substantial. In the U.S., working men have an additional incentive of $28,800 from survivor benefits to continue working to their peak value age, which is 49% of the PKV from their own benefit. The spousal benefit disincentivizes continued work until the peak value age, reducing the net incentive to delay claiming by $16,900, or 29% of the PKV from their own benefit. This net effect from additional spousal and survivor benefits is equivalent to 20% of the PKV from their own benefit, providing the average married, working man a financial incentive to delay claiming. For working women, this is -4%, because the spousal benefit provides a disincentive to work to their own PKV age. The differences reflect working women's husbands being more likely to be eligible for their own benefits than working husbands' wives.

A worker's supplemental SSW tends to be small for working, married men (3% of own SSW) and comparatively larger for working, married women (19% of own SSW). The larger value for women reflects their greater likelihood of receiving these benefits. A similar pattern exists in Germany, except these benefits are comparatively more valuable (53% of own SSW) due in part to lower SSW but larger expected benefits since the survivor benefit can start as early as age 45 in Germany and is additive to own benefits. The reported means mask substantial variation, which can be observed by looking at the standard deviation. The standard deviation in SSW and PKV from spousal

With regard to marital status, we observe that more than 90% of men are married to their original spouse at ages 65 to 66 both in the U.S. and Germany. For women in that age group the rate is 84%. Changes in marriage are driven by a mixture of widowhood and divorce, with widowhood becoming increasingly more important with age. Higher widowhood rates for women are reflective of higher mortality among men than women: About 10% of women at ages 65 to 66 experience widowhood in both countries, and this rate roughly doubles at ages 69 to 70 (not shown).

Similar to what we observed in the first period of observation (Table 3.2), SSW for women is typically around 90% of men's SSW, and both sexes exhibit a similar increase in SSW between ages 60 to 61 and ages 65 to 66. For Germany, own SSW for women is 75% of men's own SSW at ages 60 to 61, and this gap widens with age. In both countries, own PKV declines with age. Additional SSW from spousal benefits decreases slightly with age, and the fraction eligible for men decreases from 78% at ages 60 to 61 to 43% at ages 65 to 66. Less than a quarter of women are eligible for spousal benefits reflecting the comparatively higher incomes of their husbands. PKV from spousal benefits is negative, -$14,000 at ages 60 to 61, reflecting a strong disincentive on average to delay benefit claiming to the peak value age of one's own benefits. This disincentive decreases with age. Survivor SSW increases with age in both countries. For women in both countries, additional SSW from the survivor benefit is comparatively small, and also increases with age. At ages 60 to 61, 91% of married, working men have some additional SSW from the survivor benefit, but this declines with age. That pattern likely reflects that, if his wife continues to work, the value of the survivor benefit is reduced and potentially eliminated as the wife's own benefit

A. Model of labor force exit

We are interested in whether a worker's decision to leave the labor force is associated with SSW and the incentives designed into the pension system. Our outcome measure is exiting the labor force (recall that our sample is restricted to individuals who are in the labor force as of 2004). $Exit_{it}$ is a binary indicator of whether or not individual *i* exits the labor force at period *t*, no matter whether he or she claims pensions. Since our outcome measure is binary, we estimate a probit model.[25] Our specification is:

$$Exit_{it} = \Pr(\beta_0 + \beta_{Own} OWN_{it} + \beta_{Aux} AUX_{it} + \beta_R R_{it} + \beta_H H_{it} + \varepsilon_{it} > 0) \qquad (4.1)$$

OWN_{it} is a vector of *i*'s own SSW and own PKV, as defined in Equations 2.2 and 2.3. AUX_{it} is a vector of *i*'s SSW and PKV from spousal and survivor benefits paid to the *i*'s spouse and the *i*'s supplement (as defined in Equations 2.4 - 2.6 and appendix Equations A.7 - A.9). R_{it} represents a respondent's observable characteristics, including his or her age difference with their spouse, marriage length, self-reported poor health, educational achievement, self-reported probability of living to 75 reported in 2004, whether he or she has retirement plan through his or her employer in 2004 (U.S. only), and whether the job they held in 2004 was physically demanding.[26,27] H_{it} represents a

[25] Alternatively, we could reframe our model of labor force exit in terms of a logit model or a linear probability model, which reflect slightly different assumptions pertaining to the error distribution and the boundedness of the outcome measure. In practice, using these alternative models changes point estimates of the marginal effects of factors but does not meaningfully alter the substantive findings we discuss in this paper.

[26] SHARE did not collect questions on private pension entitlements through current employers.

[27] We also estimated models accounting for whether respondents or their spouse exhibited low cognitive abilities. Low cognition was measured by having a score below 1.5 standard deviations of the mean on immediate and delayed word recall for a particular age, gender, and educational achievement group. In general our measure of low cognition was not a significant

respondent's spouse and household characteristics, including whether the spouse responded to the survey, whether the spouse works for pay, whether the spouse reports poor health, the spouse's educational achievement, whether the spouse has a retirement plan through his or her employer in 2004 (U.S. only), whether the spouse's job in 2004 is physically demanding, the spouse's self-reported probability of living to 75 in 2004, whether the couple owns their home, and the household's assets.

We estimate the model in Equation 4.1 using maximum likelihood. The model is estimated separately by gender and country. Estimation finds the model parameters that best fit the data for the U.S. and Germany discussed in Section 3. The model's parameters include vectors β_{Own}, β_{Aux}, β_R, and β_H that capture coefficients on the respective explanatory factors, and β_0, an intercept that partially captures the average probability of labor force exit independent of other explanatory factors, and σ, the distribution of the unobserved component, ε_{it}.

The model is estimated separately for men and women. Studies have typically found that men and women differ in their willingness to supply labor. As noted earlier, Coile (2004) finds that both men and women respond to their Social Security incentives, but that men are more sensitive to their wives' own pension incentives (i.e., if their wife has a strong incentive to continue working in order to grow their benefit, the husband will continue to work as well).

B. Identification

Our main parameters of interest are those related to SSW and PKV associated

predictor of labor force exit. The exception was working married German women, but its inclusion did not have a substantive effect on the findings described in the next section.

with a worker's own benefits and supplementary benefits they receive based on their spouse's entitlement, and the worker's spousal and survivor benefits paid to his or her spouse. Identification of model parameters requires that the factor of interest determines the parameter value and not a highly correlated factor omitted from the model. A well-identified model parameter can be interpreted as the relationship between the factor and the model's outcome — in our case, initial labor force exit. A well-identified model parameter does not imply causality. Causality additionally requires an experimental design or a convincing argument for why the factor of interest determines the outcome measure, not the other way around.

None of our main parameters of interest are reported as part of the survey, rather they are constructed from harmonized survey responses and institutional details. It is, therefore, difficult to separately identify the relationship between the survey responses and the outcome of interest from the relationship between the constructed measure and the outcome of interest. For example, if pension benefit was a fixed multiplier based on final salary, then the relationship between the constructed pension measure and labor force exit would be equivalent to the relationship between reported final earnings and labor force exit, up to the multiplier. Identification may come indirectly based on policy differences that lead to independent variation in the constructed measure. For example, if the pension multiplier depends on hair color and hair color has no effect on income, then differences in labor force-exit rates for individuals of similar incomes but different hair colors, could reveal the additional incentive to leave the labor force based on a pension entitlement.

Our measure of own SSW and PKV, based on Equation 2.2 and 2.3, depend on

last observed full-time earnings, age, gender (through mortality), and birth year. For the U.S., own SSW and PKV are primarily determined by the first three factors because our sample was born between 1943-1953 and the policy variables contributing to these factors are similar. Since we estimate Equation 4.1 conditional on gender, identification of SSW and PKV are based on differential labor force exit associated with nonlinearities in how pension benefits are computed and the age-based incentives to delay claiming. Using the example in Figure 1, own SSW increases by $4,900 between ages 62 and 63, $9,700 between 63 and 64, but the annual gain by year decreases to $4,500 between 65 and 66, and then increases again $6,680 between 66 and 67.[28] Absent Social Security, we would not expect labor force exit to follow such a pattern. In practice, estimates may be only insignificantly different from zero given that these differences are less than 3% of SSW.

If own SSW includes the worker's supplement (appendix Equation A.7), then additional factors contribute to the own SSW calculation, namely, the spouse's own benefit entitlement and claiming age. As a result, there is significant variation in SSW and PKV in our sample based on factors independent of one's own income and age, in addition to the last observed earnings variations. This additional variation is likely to exist for the low-income earner in a couple, so we expect that estimates of own SSW and PKV to be more clearly identified for women, since they are predominantly the low-income earners in our sample of couples.

Identification for spousal and survivor SSW is clearer cut. As demonstrated in

[28] The difference in gains reflects that the benefit to delay claiming is kinked (5% of PIA before 63, 6.7% between 63 and 66, and 8% after) while the probability of death increases steadily over this age range. This leads to uneven accrual of SSW.

Table 2.2 and 2.3, an individual with a benefit entitlement at FRA of $2,000, which is determined primarily by income, will have very different incentives based on his or her spouse's age and own benefit entitlement at FRA. As our sample differs along these dimensions and the consequences for SSW and PKV are substantial and nonlinear, there exists ample variation in the data to identify these relationships.

C. Interpretation and limitations

Interpretation of the parameters is based on our model choice and the strength of their identification. Since we estimate a Probit model, we compute the average marginal effects of the model's explanatory factors to support the interpretation of our findings. Average marginal effects are computed by simulating the predicted change in labor force participation from incremental changes in the explanatory factor of interest, using the records in the sample and holding the values of all other explanatory factors constant.

If well-identified, the average marginal effect of own SSW in Equation 4.1 represents the change in the probability of labor force exit from an additional $1 of expected lifetime Social Security benefits, holding all other factors constant (e.g., assets, spousal characteristics). Those additional benefits are paid to the respondent. We interpret the average marginal effect of spousal or survivor SSW similarly, except that the benefit is paid to the respondent's spouse while the respondent is alive or dead, respectively. If leisure is a normal good, then greater SSW in any form should increase a worker's incentive to leave the labor force. Further, if workers have perfect information regarding their benefits and value benefits paid to their spouse the same as benefits paid directly to them, then they should value an additional $1 of SSW the same

regardless of source. If true, then the parameter estimates for all SSW measures should be positive and equal. If one is significantly greater than the others, then it suggests the respondent's labor force exit is more responsive to those benefit levels, potentially because the benefit type is more salient or because the respondent values benefits paid to his or her spouse differently than benefits paid directly to them. All of this would be true if SSW was well-identified. Since our measure of own SSW is based on last observed earnings and not the actual earnings history, this means that it cannot be separated from the substitution effect of earnings — that is, greater earnings from continued work increase the opportunity cost of stopping work. Consequently, our estimates of own SSW will be a composite of the income effect from greater SSW and the substitution effect from greater income while working — the net effect of which will be ambiguous.

If well-identified, the average marginal effect of own PKV in Equation 4.1 represents the change in the labor force-exit probability from a possible $1 gain in SSW from delaying benefit claiming to a future peak age, where the gain is based on the respondent's own earnings history and is paid to the respondent. Similar to SSW, the difference for spousal and survivor PKV parameters are when and to whom the benefits are paid. A positive PKV should incentivize delayed claiming. Further, an additional $1 of PKV should have the same effect if workers have perfect information regarding their incentives to delay claiming and value benefits paid to their spouse the same as benefits paid directly to them.

As previously noted, identification of own SSW and PKV may be difficult to identify separately from income and age. In a typical labor supply model, greater income

would be expected to encourage continued labor force participation, and if the value of leisure rises with age, then greater age would be expected to discourage labor force participation. The net impact on our estimates of SSW and PKV would be ambiguous. Therefore, in reporting our results, we focus on the directionality and relative values of the parameter estimates, rather than the magnitude of the point estimates.[29]

5. Findings

In this section, we present the findings from estimating the model in Equation 4.1 for married working men and women in the U.S. and Germany.

A. U.S.

Table 5.1 presents marginal effects for the parameters of interest from the model presented in equation 4.1, where labor force exit is measured as the first post-2004 period that a worker is no longer in the labor force (i.e., working or looking for work). For men and women, Table 5.1 begins by reporting the relationship between labor force exit and the SSW and PKV measures of interest (Model 1), and then adds respondent characteristics, except notably age and earnings (Model 2), then spousal and household

[29] Since our interest is in the relative relationship between own, spousal and survivor SSW and PKV (i.e., are they equal?), the ambiguous influence of income and age on parameter estimates only matters insofar as it disproportionately impacts one type of SSW or PKV over the other for explicable reasons. For example, age may have a greater influence on labor force exit for own SSW relative to survivor SSW if husbands believed that they would live longer on average than life tables would suggest. In this case, it could lead to husband's weighting their own benefit more relative to the survivor benefit. We control for survey questions that may indicate when a respondent's expectations about future payouts might differ from average, including self-reported expections of own and spousal probability of surviving to 75, self-reported health, and difficulty of work, both as independent regressors and interacted with our SSW measures, but find no substantive impact to our findings.

Recall from the previous section that we expect greater SSW to be associated with wealth effects, leading to labor force exit (positive coefficient) and greater PKV to be an incentive to remain in the labor force (negative coefficient). The simplest model, Model 1 highlights that for men and women, own PKV can provide strong incentives to continue work: Every additional $10,000 in PKV is associated with a decreased probability of labor force exit — 2.0 percentage points for men and 0.7 percentage points for women. For comparison, 12.5% of men and 15.3% of women exit the labor force per sample period, suggesting these are sizeable incentives to remain working. For women, consistent with theory, an additional $100,000 in SSW is associated with a 0.6 percentage point greater probability of labor force exit. For men, the relationship is only 0.1 percentage point. Neither is statistically different from zero. The weak SSW relationships reflect our inability to separately identify the income effect of greater SSW from the higher income substitution effect, as discussed in the last section.

Moving across the models, we observe that as respondent, spousal, and household characteristics are added into the model, the marginal PKV estimates are slightly attenuated but remain statistically significant. Our measures appear robust to these potentially confounding factors. We also present results incorporating age for consistency with previous estimates in the literature, but since our constructed measure of PKV is primarily determined by age and SSW, we are unable to separately identify a relationship for PKV independent of age.[30] For men, adding age reduces the relationship with PKV. For women, adding age similarly attenuates the SSW and PKV

[30] A simple regression of our own PKV measure on age and own SSW yields an R-squared of 0.68 for men and 0.73 for women.

marginal effects. Our inability to separately identify age is reflective of strong age effect on SSW and PKV through mortality rates and the age-specific benefit adjustments (penalties and bonuses), as well as our measures' construction. We speculate other authors have had more success including earnings and age because they use administrative earnings data, which leads to variation in earnings history independent of last observed earnings. For the rest of our narrative, we focus on the first three models, recognizing that our SSW measure cannot separately identify the income effect of greater wealth from the substitution effect of higher earnings and that our PKV measure cannot separately identify the incentive to continue working from Social Security benefits from a rising disutility of work with age. We argue that identifying these relationships is unnecessary for our research question. We are trying to establish whether the relationship between own PKV and labor force exit is the same as the relationship between PKV from spousal or survivor benefits and labor force exit. As long as the relationship between aging and labor force exit does not disproportionately affect the valuation of own benefits versus spousal or survivor benefits, then our models excluding age and earnings are sufficient to address whether the incentive to delay claiming from an additional $1 in future own benefits is valued the same as an additional $1 in future auxiliary benefits.

Next we review the relationship between labor force exit and additional SSW and PKV from spousal benefits. Consistent with theory, additional SSW from spousal benefits is positively and significantly associated with labor force exit (7.8 percentage points for men and 23.9 percentage points for women). Adding in respondent, spousal, and household characteristics reduce the marginal effect estimates, although they

remain large and statistically significant for women. The statistically significant relationship for women is surprising. In our sample, it is rare that a spousal benefit would be paid to the husband of a working woman. For spousal PKV, we find a positive relationship with labor force exit for men in the simple model, suggesting that a greater incentive to delay benefit claiming is associated with greater labor force exit. This relationship disappears once we include spousal and household characteristics in the model. For women, the relationship with PKV is significant, but also opposite the expected sign. Combined with the large relationship for SSW and the relative rarity of additional SSW from spousal benefits for working women, we would caution interpreting the spousal SSW and PKV coefficients for women as they may reflect unmodeled factors associated with work among couples where the wife is the dominant earner.

For men, we observe that additional SSW from the survivor benefit is counterintuitively negative and significantly related to labor force exit (4.1 percentage points per an additional $100,000). As with own benefits, this may reflect a stronger substitution effect associated with individuals entitled to these benefits, thereby dominating the income effect from greater SSW. This relationship is robust to accounting for additional respondent, spousal, and household characteristics. Additional PKV from the survivor benefit is, counterintuitively, positively associated with labor force exit (1.0 percentage points per an additional $10,000). This suggests that working, married men who could grow their benefit by delaying claiming are actually more likely to exit the labor force. This relationship is robust to accounting for additional respondent, spousal, and household characteristics, including respondent age. This relationship may reflect that respondents most likely to grow their survivor benefit from

delayed benefit claiming (e.g., a single-income household with a notably older husband) have other, unmodeled factors influencing their decision to leave work. While we do not interpret the coefficient to suggest that incentives to continue delay claiming lead to less work, the significant counterintuitive relationship leads us to conclude that husbands' labor supply decisions are not responding to incentives built into the survivor benefit to delay claiming. Put another way, these incentives are not salient in a husband's work decision.

For women, additional survivor benefit SSW and PKV are negatively associated with labor force exit. As with additional spousal benefit SSW and PKV, it is rare that survivor benefits would be paid to a working woman's husband. Similarly, we caution against interpreting the survivor SSW and PKV coefficients as they may be reflecting unmodeled factors.

Finally, we consider the role of additional SSW and PKV from the worker's supplement, focusing on married, working women, as they are the most likely to benefit from these supplements. Supplemental SSW from a worker's spouse encourages labor force exit, and the relationship is statistically significant. Supplemental PKV, counterintuitively, is positively associated with labor force exit. As with the positive relationship estimated between survivor PKV and a husband's labor force exit, we conclude the significant counterintuitive relationship indicates that wives' labor supply decisions are not responding to incentives to alter their claiming decision timing.

Our findings in Table 5.1 have presented a surprising mix of counterintuitive results for additional SSW and PKV from auxiliary benefits. Spousal and survivor benefits paid to the spouse have incentives that should alter a worker's decision to

continue working and delay benefit claiming. We find no indication that men, for whom the incentives generally apply, are responsive to them. For the PKV from spousal and survivor benefits, the relationship operates in a counterintuitive direction. Supplemental benefits paid to the worker based on the spouse's entitlement disincentivize work by reducing gains to a worker's own benefit from additional work. For women, for whom they generally apply, we find that the relationship is also not consistent with theory. Taken as a whole, our results suggest a limited relationship between incentives for claiming built into spousal and survivor benefits and continued work. This contrasts with findings (both here and in the literature more broadly) that workers are responsive to incentives driven by their own benefit. Our interpretation is that incentives to delay claiming from auxiliary benefits are comparatively less salient than incentives to delay claiming from a worker's own benefit. Next, we re-estimate our model with harmonized German data to explore whether survivor benefits and incentives to delay claiming are associated with retirement decisions in a policy settings where eligibility and benefit rules are simpler.

B. Germany

As with the U.S., Table 5.2 presents marginal effects for the parameters of interest from the model presented in Equation 4.1, where labor force exit is measured as the first post-2004 period that a worker is no longer in the labor force (i.e., working or looking for work). For men and women, Table 5.2 begins by reporting the relationship between labor force exit and the SSW and PKV measures of interest (Model 1), and then adds respondent characteristics except age and earnings (Model 2), then spousal

exit (negative coefficient). The simplest model, Model 1, highlights that for men and women, own PKV can provide strong incentives to continue work: Every additional 10,000 euros in PKV is associated with a decreased probability of labor force exit, 2.9 percentage points for men and 2.1 percentage points for women. For women, consistent with theory, an additional 100,000 euros in SSW is associated with a 2.9 percentage point greater probability of labor force exit, and for men the relationship is only 4.2 percentage points.

Moving across the models, we observe that as respondent, spousal, and household characteristics are added into the model, the marginal PKV estimates are attenuated but remain negative and statistically significant for men. As with the U.S., we also present results incorporating age for consistency with previous estimates in the literature, but emphasize our constructed PKV measure is primarily determined by age and SSW, so we are unable to separately identify a relationship for PKV independent of age. For men, adding age eliminates the statistically significant relationship with PKV. For women, the relationship for both SSW and PKV is weakened by the inclusion of spousal and household characteristics.

Survivor benefits paid to the spouse have incentives that should encourage a worker to continue working and delay benefit claiming. Focusing on men, for whom these benefits are substantial (see Table 3.2 and 3.3), we estimate an insignificant, positive relationship. For the survivor benefit PKV, the relationship is negative but not statistically different from zero or the estimated relationship between own PKV and labor force exit. Supplemental benefits paid to the worker based on the spouse's entitlement disincentivize work by reducing gains to a worker's own benefit from additional work.

For women, for whom they generally apply, we find that the relationship is positive (inconsistent with theory) and not significantly different from zero.

Comparing labor force responses from incentives to delay benefit claiming in the U.S. to Germany (using Model 3 in Tables 5.1 and 5.2), we find that own PKV for working men is associated with labor force exit. This is consistent with past work focusing on the retirement responsiveness of men to Social Security benefits (Börsch-Supan et al. 2004; Coile and Gruber 2007). For married, working women the relationship appears to be smaller and is statistically insignificant for Germany, although that may reflect the substantially smaller sample size in SHARE. For married, working men in the U.S., survivor PKV is counterintuitively associated with greater labor force exit: It is both significantly different from zero and the estimated response from own PKV. In Germany, the relationship is consistent with theory, but not statistically different from zero or the estimated response from own PKV. The finding suggests that incentives associated with the survivor benefit in the U.S. are not salient, but the same cannot be conclusively said for Germany. We note that for Germany, the results are consistent with theory, just not statistically significant due, in part, to a small sample size. Regarding supplemental benefit PKV, the estimates in the U.S. and Germany are both positively associated with labor force exit for married, working women, a counterintuitive result. In the U.S., the counterintuitive estimate is both significantly different from zero and the estimated response from own PKV. In Germany, the estimate is not statistically different from either. This suggests that incentives to delay claiming are not salient in the U.S. and inconclusive in Germany.

6. Conclusions

We find that incentives to alter benefit claiming timing built into auxiliary U.S. Social Security benefits, such as spousal and survivor benefits, are unrelated to labor supply decisions. This finding is consistent with recent survey evidence from an online representative panel of American households that suggests that knowledge of eligibility rules for these benefits is low (Carman and Hung 2018). A U.S. worker's benefit payment depends on a complex interaction of own claiming decisions and his or her spouse's claiming decisions. The lack of responsiveness may reflect the complexity of benefit rules or that benefits paid to a worker's spouse are not salient in the worker's decision-making.

To provide a benchmark, we examine Germany where survivor benefits create similar incentives for retirement timing. German survivor benefits are largely independent of the survivor's decision, making the benefit calculation and resulting incentives easier to understand. Given the small sample size, the German analysis is inconclusive. However, the findings are consistent with survivor benefits influencing married, working men's labor supply decisions.

Our findings have implications for Social Security policy. When created by the 1939 Social Security amendments, spousal and survivor benefits were intended to provide "life-time family security instead of only individual old age security to the workers in insured occupations" (Roosevelt 1939). A lack of policy salience may be desirable in old-age insurance if the incentives encourage early labor market exit. The design of U.S. spousal benefits is an example. A spouse cannot collect her spousal benefits until the worker claims his benefit. This design theoretically promotes early

claiming for households eligible for this benefit. Early claiming encourages these households to take lower lifetime monthly benefits, placing them at greater risk of financial insecurity in retirement, particularly in widowhood. Alternatively, the design of survivor benefits rewards delayed benefit claiming through increases in the monthly benefit. These incentives a designed to encourage working longer. We find married workers do not respond to the incentives associated with spousal and survivor benefits even if doing so would enhance their retirement security. Additional education and outreach may increase couples' understanding of how individual claiming decisions influence each person's benefits while alive and in widowhood.

Our findings also have implications for analyses of retirement benefits' potential impact on households' retirement decisions. Recent studies evaluating the potential impact of reducing or eliminating spousal or survivor benefits (Knapp 2014; Borella et al. 2019; Nishiyama 2019) using structural models of household decision-making assume that potential income sources are treated equally. In the context of own, spousal, and survivor retirement benefits, our findings suggest that this is not true. If spousal and survivor benefits are not salient, then the predictions by many structural models are unlikely to be valid. Our findings suggest caution when interpreting model predictions of labor supply responses from potential changes to own and auxiliary benefit policy. Future research into benefits' salience may reveal certain types of couples where these benefits are influential.

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Appendix A. Technical details of social security wealth estimates

To estimate SSW and the PKV, we must first estimate earnings histories and then use these histories to estimate potential future benefits if the individual continues to work.

Estimation of earnings

Pension benefits depend on earnings over the life cycle. To estimate potential pension benefits, life-cycle earnings need to be known or estimated. Earnings histories are not collected as part of the HRS (for the U.S.) or SHARE (for Germany). The HRS has an administrative data linkage that includes earnings histories for respondents who consent to having their records matched. SHARE does not collect earnings histories but does collect work histories, and final earnings in each employment spell. Comparing the use of actual earnings histories reported in Social Security administrative earnings data leads to a simple approach of projecting life-cycle earnings histories based on last observed earnings. Knapp et al. (2019) find that the simple approach captures the majority of the variation associated with incentives to delay benefit claiming and performs similarly to an approach that accounts for work history. Following their approach, we predict life-'cycle earning trajectories based on major labor force surveys in each country and use last observed full-time earnings to estimate life-cycle earnings for each respondent and their spouse.[31]

[31] A consequence of using this approach is that own pension benefit levels are determined by final earnings, so we cannot identify the relationship between labor force exit and own SSW separately from the relationship between labor force exit and final earnings.

Computation of U.S. pension benefit

We compute the U.S. own pension benefit based on the following formula:

$$own.ben_{is}^{US} \quad = \quad cola(s, byr_i) \times own.delay^{US}(ca_i, byr_i) \times pia(EARN_{is}, byr_i) \quad \text{(A.1)}$$

where $cola(\cdot)$ corresponds to the cost-of-living adjustment for person i in year s as set by the U.S. Social Security Administration, $own.delay^{US}(\cdot)$ reflects benefit adjustments due to claiming them before or after the FRA (see Table 2.1 for an example). Finally, $pia(\cdot)$ stands for the function for computing the worker's PIA based on i's lifecycle earnings, $EARN_{is}$, accrued through period s and accounting for a progressive formula, depending on i's birth year, for transforming average earnings into the monthly benefit at FRA.

Spouse *i*'s spousal benefits based on worker *j*'s earnings history are computed using the following equation:

$$sp.ben_{ijs}^{US} \quad = \quad \begin{cases} cola(s, byr_j) \times sp.delay^{US}(ca_i, byr_i) \times 0.5 \times pia(EARN_{js}, byr_j) & \text{, if } j \text{ claimed} \\ & (ca_j + byr_j \geq s) \\ 0 & \text{, otherwise} \end{cases} \quad \text{(A.2)}$$

Spouse *i*'s survivor benefits based on worker *j*'s earnings history are computed using the following equation:

$$sur.ben_{ijs}^{US} \quad = \quad \begin{cases} cola(s, byr_j) \times sur.delay^{US}(ca_i, byr_i) \times pia(EARN_{js}, byr_j) & \text{, if } j \text{ never claimed} \\ cola(s, byr_j) \times \max\{sur.delay^{US}(ca_i, byr_i) & \text{, if } j \text{ claimed} \\ \quad \times own.delay^{US}(ca_j, byr_j), 0.715\} \times pia(EARN_{js}, byr_j) & \\ 0 & \text{, otherwise} \end{cases} \quad \text{(A.3)}$$

Computation of German pension benefit

Similarly, we compute pension benefits in Germany based on the following formula:

$$own.ben_{is}^{GR} \quad = \quad ppv(s, East_i) \times own.delay^{GR}(ca_i, byr_i) \times pp(EARN_{is}, East_i) \quad \text{(A.4)}$$

where $ppv(\cdot)$ corresponds to the pension point valuation in year s depending on whether respondent *i* lives in East or West Germany (as indicated by $East_i$), which is updated annually by GRV, $own.delay^{GR}(\cdot)$ is the multiplier on the benefit entitlement reflecting changes from claiming own benefits before or after the FRA (see Table 2.2 for an example). Finally, $pp(\cdot)$ reflects the worker *i*'s cumulative pension points based on his life-cycle earnings accrued through period s and accounting whether respondent *i* lives in East or West Germany.

Germany does not offer spousal benefits like those in the U.S.[32] However, spouse *j*'s survivor benefits based on worker *i*'s earnings history are computed using the following equation:

$$sur.ben_{ijs}^{GR} = \begin{cases} ppv(s, East_i) \times 0.55 \times pp\left(EARN_{js}, byr_j\right) & \text{, if } j \text{ never claimed} \\ ppv(s, East_i) \times 0.55 \times own.delay^{GR}\left(ca_j, byr_j\right) \times pia\left(AIME_{js}, byr_j\right) & \text{, if } j \text{ claimed} \\ 0 & \text{, otherwise} \end{cases} \quad \text{(A.5)}$$

The survivor benefit is income tested, meaning it is reduced based on other income the survivor receives. The income test includes own pension income. To compute the reduction amount, net income must be computed first. If income is from own pension benefits, net income is 87% of the own benefit received (86% for survivors married before 2002). From net income, excess net income is determined by differencing net income from an exempt amount (equal to 26.4 times the current year's pension point value). The reduction in the spousal benefit is then computed as 40% of the excess net income.

[32] As mentioned in section 2, an exception is pension splitting, which we do not incorporate into our analysis.

Computation of social security wealth and peak value

Own pension benefit ($own.ben_{it}^{c}$) of an individual *i* depends on claiming age, the individual's earnings history up to time *t* and the benefit formula in country *c*. Own SSW ($own.ssw_{it}^{c}$) is a measure of the expected present discounted value of all future own pension benefits. Thus:

$$own.ssw_{it}^{c}(ca_i) \quad = \quad \frac{\beta^{ca_i - t}}{\inf(ca_i,t)} \times \Pr(i \text{ s.t. } ca_i) \times \sum_{s=ca_i}^{T} \left(\frac{\beta^{s-ca_i}}{\inf(s,ca_i)}\right) \times own.ben_{is}^{c} \times \Pr(i \text{ s.t. } s \mid i \text{ s.t. } ca_i) \qquad \text{(A.6)}$$

where β is a real discount factor, $\inf(t_2, t_1)$ is the cumulative inflation between t_1 and future period t_2. $\Pr(i \text{ s.t. } s \mid i \text{ s.t. } ca_i)$ represents the probability of individual i surviving to (s.t.), a future period *s* conditional on his or her survival to claiming age ca_i. Survival probabilities are age- and gender-specific and are based on predictions from the Human Mortality Database (2021). We calculate the present value of SSW at the claiming age back to the survey period, time *t*.

SSW in equation A.6 may misrepresent i's incentives if *i* is eligible for auxiliary benefits based on his or her spouse's contribution history because being eligible for spousal benefits might reduce or eliminate own benefits (e.g., if the spouse is older or has greater lifetime earnings). Accounting for i's potential spousal and survivor benefits yield a modified version of Equation A.6 that reflects individual i and spouse j's probability of joint survival, the age of *j*'s death (da_j), and whether *j* has not claimed her benefit prior to her death (i.e., $ca_j \leq da_j$). Once eligible for benefits, i is eligible for his own pension benefit and potentially a spousal supplement (*sp.ben*) if his own pension is low enough and his spouse, *j*, is alive. In the United States, after *j*'s death, *i* is eligible for a survivor benefit instead of the spousal benefit. In Germany, the survivor benefit is independent of one's own benefit entitlement. Accounting for spousal and survivor

benefits for *i* based on *j*'s benefit entitlement leads to an expanded formula for *i*'s own SSW that accounts for the interactions of own and spousal benefits (sp.int) and own and survivor benefits (sur.int):

$$
\begin{aligned}
\widetilde{own.ssw}_{it}^{c}(ca_i, ca_j) \quad = \quad & \frac{\beta^{ca_i - t}}{\inf(ca_i, t)} \times \Pr(i \,\&\, j \text{ s.t. } ca_i) \times \sum_{s=ca_i}^{T} \left(\frac{\beta^{s-ca_i}}{\inf(s, ca_i)}\right) \\
& \times \Big\{ \text{sp. int}\big(own.ben_{is}^{c}, sp.ben_{ijs}^{c}\big) \times \Pr(i \,\&\, j \text{ s.t. } s \mid i \,\&\, j \text{ s.t. } ca_i) \\
& \quad + \text{sur. int}\big(own.ben_{is}^{c}, sur.ben_{ijs}^{c}(j \text{ claimed})\big) \\
& \qquad \times \Pr(\text{only } i \text{ s.t. } s \mid i \,\&\, j \text{ s.t. } ca_i) \times \Pr(ca_j \le da_j \mid i \,\&\, j \text{ s.t. } ca_i) \\
& \quad + \text{sur. int}\big(own.ben_{is}^{c}, sur.ben_{ijs}^{c}(j \text{ never claimed})\big) \\
& \qquad \times \Pr(\text{only } i \text{ s.t. } s \mid i \,\&\, j \text{ s.t. } ca_i) \times \big(1 - \Pr(ca_j \le da_j \mid i \,\&\, j \text{ s.t. } ca_i)\big) \Big\} \\
& + \frac{\beta^{ca_i - t}}{\inf(ca_i, t)} \times \Pr(\text{only } i \text{ s.t. } ca_i) \times \sum_{s=ca_i}^{T} \left(\frac{\beta^{s-ca_i}}{\inf(s, ca_i)}\right) \\
& \times \Big\{ \text{sur. int}\big(own.ben_{is}^{c}, sur.ben_{ijs}^{c}(j \text{ claimed})\big) \\
& \qquad \times \Pr(\text{only } i \text{ s.t. } s \mid \text{only } i \text{ s.t. } ca_i) \times \Pr(ca_j \le da_j \mid \text{only } i \text{ s.t. } ca_i) \\
& \quad + \text{sur. int}\big(own.ben_{is}^{c}, sur.ben_{ijs}^{c}(j \text{ never claimed}\big) \\
& \qquad \times \Pr(\text{only } i \text{ s.t. } s \mid \text{only } i \text{ s.t. } ca_i) \times \big(1 - \Pr(ca_j \le da_j \mid \text{only } i \text{ s.t. } ca_i)\big) \Big\}
\end{aligned}
$$

(A.6)

where

$$
\text{sp. int}\big(own.ben_{is}^{c}, sp.ben_{ijs}^{c}\big) = \begin{cases} \max\big(own.ben_{is}^{c}, sp.ben_{ijs}^{c}\big) & \text{if c=U.S.} \\ own.ben_{is}^{c} & \text{if c = Germany} \end{cases}
$$

$$
\text{sur. int}\big(own.ben_{is}^{c}, sur.ben_{ijs}^{c}(j \text{ claim})\big) = \begin{cases} \max\big(own.ben_{is}^{c}, sur.ben_{ijs}^{c}(j \text{ claim})\big) & \text{if c=U.S.} \\ own.ben_{is}^{c} + sur.ben_{ijs}^{c}(j \text{ claim}) & \text{if c = Germany} \end{cases}
$$

We compute the SSW associated with the worker's supplement (i.e., the additional benefit he receives based on spousal and survivor benefits he is paid based on his spouse's earnings history) as the difference between Equations A.6 and A.6':

$$
sup.ssw_{it}^{c}(ca_i, ca_j) \quad = \quad \widetilde{own.ssw}_{it}^{c}(ca_i, ca_j) - own.ssw_{it}^{c}(ca_i) \qquad \text{(A.7)}
$$

We compute additional SSW from spousal benefits based on individual *i*'s earnings history that are paid to spouse *j*. SSW of individual *i*'s spousal benefit at time *t* if benefits start at claim age (ca_i) reflects the additional benefits received by spouse *j* based on individual *i*'s pension record while *i* is alive. The spousal benefit also depends

on the spouse's benefit claiming behavior and the spouse's own benefit based on his or her earnings. Additional SSW from spouse benefits is computed as:

$$\begin{aligned} sp.ssw_{it}^{US}(ca_i, ca_j) \quad = \quad & \frac{\beta^{ca_i - t}}{\inf(ca_i, t)} \times \Pr(i \,\&\, j \text{ s.t. } ca_i) \times \sum_{s=ca_i}^{T} \left(\frac{\beta^{s-ca_i}}{\inf(s, ca_i)}\right) \\ & \times \max\left(sp.ben_{jis}^{US} - \; own.ben_{js}^{US}, 0\right) \times \Pr(i \,\&\, j \text{ s.t. } s \mid i \,\&\, j \text{ s.t. } ca_i) \end{aligned} \tag{A.8}$$

We also compute SSW from individual *i*'s survivor pension benefit based on claim age ca_i. SSW of individual *i*'s survivor benefit reflects the additional benefits received by spouse *j* based on individual *i*'s pension record if individual *i* has died but spouse *j* is still alive. The survivor benefit also depends on the spouse's benefit claiming behavior and, in the U.S., the spouse's own benefit based on his or her own earnings. Additional SSW from survivor benefit is computed using the following equation accounting for the country specific rules for the interactions of own and survivor benefits (sur.add):

$$\begin{aligned} sur.ssw_{it}^{c}(ca_i, ca_j) \quad = \quad & \frac{\beta^{ca_i - t}}{\inf(ca_i, t)} \times \Pr(i \,\&\, j \text{ s.t. } ca_i) \times \sum_{s=ca_i}^{T} \left(\frac{\beta^{s-ca_i}}{\inf(s, ca_i)}\right) \\ & \times \Big\{\text{sur.add}\left(own.ben_{js}^{c}, sur.ben_{jis}^{c}(i \text{ claimed})\right) \\ & \quad \times \Pr(\text{only } j \text{ s.t. } s \mid i \,\&\, j \text{ s.t. } ca_i) \times \Pr(ca_i \le da_i \mid i \,\&\, j \text{ s.t. } ca_i) \\ & \quad + \text{sur.add}\left(own.ben_{js}^{c}, sur.ben_{jis}^{c}(i \text{ never claimed})\right) \\ & \quad \times \Pr(\text{only } j \text{ s.t. } s \mid i \,\&\, j \text{ s.t. } ca_i) \times (1 - \Pr(ca_i \le da_i \mid i \,\&\, j \text{ s.t. } ca_i))\Big\} \\ & + \frac{\beta^{ca_i - t}}{\inf(ca_i, t)} \times \Pr(\text{only } j \text{ s.t. } ca_i) \times \sum_{s=ca_i}^{T} \left(\frac{\beta^{s-ca_i}}{\inf(s, ca_i)}\right) \\ & \times \Big\{\text{sur.add}\left(own.ben_{js}^{c}, sur.ben_{jis}^{c}(i \text{ claimed})\right) \\ & \quad \times \Pr(\text{only } j \text{ s.t. } s \mid \text{only } j \text{ s.t. } ca_i) \times \Pr(ca_i \le da_i \mid \text{only } j \text{ s.t. } ca_i) \\ & \quad + \text{sur.add}\left(own.ben_{js}^{c}, sur.ben_{jis}^{c}(i \text{ never claimed})\right) \\ & \quad \times \Pr(\text{only } j \text{ s.t. } s \mid \text{only } j \text{ s.t. } ca_i) \times (1 - \Pr(ca_i \le da_i \mid \text{only } j \text{ s.t. } ca_i))\Big\} \end{aligned} \tag{A.9}$$

where

$$\text{sur.add}\left(own.ben_{js}^{c}, sur.ben_{jis}^{c}(i \text{ claim})\right) = \begin{cases} \max\left(sur.ben_{jis}^{c}(i \text{ claim}) \text{-} own.ben_{js}^{c}, 0\right) & \text{if c=U.S.} \\ sur.ben_{jis}^{c}(i \text{ claim}) & \text{if c = Germany} \end{cases}$$

college degree								
Self-reported prob. of living to 75		-0.001	0.002	0.001		-0.001	-0.004***	-0.004***
		(0.001)	(0.002)	(0.002)		(0.001)	(0.001)	(0.001)
Missing self-reported prob. of living to 75		0.251***	0.446***	0.315**		-	-	-
		(0.073)	(0.146)	(0.147)				
Lived in East Germany in 1990		0.018	0.035	0.035		-0.034	-0.046	-0.037
		(0.036)	(0.036)	(0.038)		(0.044)	(0.044)	(0.044)
Job in 2004 is physically demanding		0.017	0.008	-0.004		0.007	-0.028	-0.017
		(0.047)	(0.046)	(0.045)		(0.036)	(0.036)	(0.034)
Spouse did not respond to survey (indicator)			-0.088	-0.096			-0.079	-0.021
			(0.076)	(0.069)			(0.056)	(0.059)
Spouse works for pay			-0.140***	-0.112***			-0.089**	-0.036
			(0.045)	(0.042)			(0.043)	(0.044)
Spouse reports poor health			0.062	0.077			-0.106	-0.090
			(0.091)	(0.086)			(0.072)	(0.073)
Spouse education: At least a college degree			0.009	0.028			0.122***	0.113***
			(0.037)	(0.036)			(0.035)	(0.035)
Spouse self-reported prob. of living to 75			-0.003	-0.002			0.006***	0.006***
			(0.002)	(0.002)			(0.002)	(0.002)
Missing spouse self-rpt. prob. of living to 75			-0.146	-0.071			0.469***	0.437***
			(0.141)	(0.143)			(0.123)	(0.121)
Spouse's job in 2004 is physically demanding			0.072	0.043			0.045	0.026
			(0.046)	(0.044)			(0.056)	(0.056)
Couple own's home			0.078**	0.083**			0.028	0.036
			(0.038)	(0.035)			(0.041)	(0.046)
Household assets ($100,000)			-0.013**	-0.015***			-0.001	-0.005
			(0.006)	(0.005)			(0.003)	(0.005)

Appendix D. Attrition analysis

Table D.1 analyzes the sample's attrition between survey waves starting in 2004 and 2006 relative to the most expansive specification chosen in Section 5. A statistically positive relationship means that the explanatory factor is associated continued participation in the survey. We omit those who die between survey waves from this analysis.[33] First, we consider how our explanatory factors of interest, SSW and PKV, are related to attrition, and then we consider the relationship between our other explanatory factors and attrition.

In the U.S., own SSW and PKV are not associated with attrition. However, some of the auxiliary benefit measures are related — namely spouse's SSW and PKV and worker's supplement PKV (men only) are associated with greater survey attrition between the 2004 and 2006 surveys, while greater survivor SSW (men only) is associated with greater survey continuation. In contrast to the U.S., own SSW for German men is associated with greater attrition and a greater PKV is associated with less attrition. For German women, greater supplemental SSW and PKV are associated with greater attrition. For Germany, to the degree that our pension measures are associated with attrition, the pattern suggests that those entitled to greater SSW and who have less incentive to delay claiming based on their own benefit are more likely to attrit.

In Germany, we find that married, working men who attrit between 2004 and 2006 are more likely to report being in poor health, living in West Germany prior to

[33] This corresponds to 10 men and eight women in the HRS and none in SHARE.

Couple own's home	-0.014	0.017	0.070	0.120**
	(0.027)	(0.022)	(0.065)	(0.060)
Household assets ($100,000)	-0.001**	-0.001	0.012*	0.001
	(0.000)	(0.000)	(0.006)	(0.003)
Household assets missing (indicator)	-	-	-0.087	-0.558**
			(0.173)	(0.250)
Age	0.010***	0.006***	0.028*	0.005
	(0.003)	(0.002)	(0.015)	(0.015)
Observations	1,484	1,456	326	317

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. (omit - X) means that X observations were dropped because they were perfectly associated with the outcome.