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How Will COVID-19 Excess Mortality Affect Social Security Benefit Payouts?

Abstract

We project the impact of excess mortality during the COVID-19 pandemic on future Social Security Old-Age and Survivors Insurance (OASI) payouts. The magnitude of the reduction in future payouts will depend not only on the magnitude of excess mortality by age, but also on the underlying life expectancies of those who fell victim. The impact will be smaller if excess COVID-19 mortality was concentrated among those who were already frail. It will also be offset by survivor benefit payouts to spouses of COVID-19 victims. We calculate the overall reduction in future Social Security net benefit payouts to be small. The fundamental reason is that excess mortality did not lead to a substantial reduction in life-years lost. A simple model implemented as a starting point suggests average life-years lost of about one month during 2020. We also undertake a careful projection of benefit payouts given COVID-19 mortality through late 2021 versus a counterfactual of pre-COVID-19 mortality, using several data sources. For individuals 55 and older who are nationally representative of the 2015 noninstitutionalized population, we project a reduction in net benefit payouts of $131 billion in present value, or 0.5% of benefits payable to that group in the absence of COVID.-19 This is a slight underestimate because of the following factors omitted from our calculations: excess mortality of those who were younger than 55 and of those who were institutionalized. Our analysis suggests that the major impact of the pandemic on the OASI trust fund operated through labor markets rather than excess mortality.

Citation

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1. Introduction

The consequences of the COVID-19 pandemic have been widespread and devastating. Government social insurance programs played a critical role in alleviating the unusual magnitude of suffering. Social Security, for example, provided benefits to those forced to retire or widowed earlier than expected.[1] In fact, Social Security is one of our most important social insurance programs, by virtue of its size and unique breadth in insuring against a range of factors associated with unexpected earnings loss and insufficient savings.[2] The flip side of its function as an automatic stabilizer is that increased transfers during aggregate downturns, as well as decreased payroll taxes (which during the pandemic, experienced an unprecedented dip), harm the long-run finances of Social Security, which of course are a cause for concern. However, among the many unusual aspects of the COVID-19 shock, its defining feature — the death toll caused by both COVID-19 and the resulting crisis of care in the medical system — stands out for having the opposite effect on the long-run finances of Social Security as the usual downturn does.

In this paper, we project the impact of excess mortality during the COVID-19 pandemic on Social Security Old Age and Survivors Insurance (OASI) payouts. We

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[1] Social Security also insured those affected by the pandemic in subtler ways (albeit imperfectly). For example because people who suffered an earnings loss (whether because of a temporary layoff or long COVID-19 symptoms) can expect to get a higher Social Security replacement rate, because of the progressivity of the benefit formula, than they otherwise would have.

[2] While Social Security and Medicare are roughly the same size, Social Security implicitly insures a wide range of risks associated with outliving one's savings in old age, including not only the risk of living longer than expected, but also the risk of mid-life disability and earnings losses, earlier-than-expected widowhood, rate-of-return shocks, and others.

consider the impact of the large jump in all-causes mortality, observed through September 2021, as the virus not only infected many people but overwhelmed the entire medical system. The resulting long-run reductions in benefits paid out and payroll taxes paid in due to excess COVID-19 mortality will take time to unfurl, as compared to the more immediate and drastic labor market effects on the OASI trust fund from the pandemic and its associated shutdowns. The magnitude of the reduction will obviously depend on the magnitude of excess mortality, and the ages at which it occurs, as benefits that would have been paid out to individuals who died as a result of the COVID-19 pandemic will not be. However, the magnitude of forgone benefit payments will also depend critically on underlying life expectancy of those who fell victim to the pandemic. The impact will be smaller than naïve projections suggest if excess COVID-19 mortality was concentrated among those who were already frail.[3] Also, the reduction in payouts to retired workers will be offset by rising payouts to surviving spouses of COVID-19 victims, a reflection of the program's social insurance function.

Several features of COVID-19 excess mortality are important to account for when considering its influence on trust fund payouts. First, medical data show that COVID-19 mortality rates are higher at older ages but are highest among those with pre-existing health conditions. Probably, then, those who died from COVID-19 are disproportionally likely to have died relatively soon from other causes. Second, COVID-19 mortality is elevated among men, which will ultimately increase survivor claims. Third, excess

[3] We omit some factors that need to be considered in future research. We do not estimate the long-run consequences of long COVID-19 or foregone medical care due to the health care crisis on Social Security Disability Insurance (SSDI) or Social Security benefit payouts; long-term mortality consequences of the recession; or the impact of excess COVID-19 deaths operating through reduced SSDI payouts.

mortality due to COVID-19 is concentrated at lower socioeconomic levels, so those who die would have received relatively lower benefits on average.

We calculate the resulting overall reduction in future Social Security benefit payouts to be relatively small. The fundamental reason is that excess mortality, as shocking as it was, did not lead to a substantial reduction in life-years lost in the population as a whole, contrary to what some of the analysis at the time suggested.[4] For example, we construct a simple spreadsheet model using Center for Disease Control (CDC) estimates of 2020 excess mortality by age group, implicitly assuming that excess mortality was proportional to all-causes mortality. This approach recognizes that those who died due to the pandemic in 2020 were, on average, relatively vulnerable, even though other evidence indicates that those with comorbidities were even more likely to die than implied by this initial assumption, which would lead to an overstatement of life-years lost. This baseline analysis suggests that average years of life lost in 2020 was 0.17 of a month at age 20 (which is about 0.02% of their remaining life expectancy), rising to 0.34 of a month at age 50 (0.09% of remaining life expectancy) and 1.37 months at age 95 (3.9% of remaining life expectancy).[5] These numbers are of the same magnitude as those obtained by Barreto-Parra et al. (2022) and, to put them in further context, the reduction in life expectancy was a little less

[4] A National Vital Statistics Rapid Release report gained considerable attention for reporting a substantial decrease in life expectancy in 2021 compared to 2019 (Arias et al. 2022). The report calculates period mortality, assuming that individuals continue to have 2021 mortality at every age of their life. Period mortality tables are useful for highlighting short term changes in mortality but are a poor guide to understanding life-years lost because they assume those changes are permanent.

[5] COVID-19 mortality was about 20% higher in 2021 than in 2020 (Ahmad et al. 2022).

overall than the long-run annual average of about one month's gain in average life expectancy at birth. These small reductions in average life-years lost will lead to analogously small reductions in trust fund payouts.

In addition to the simple spreadsheet model, we undertake a careful projection of benefit payouts given COVID-19 mortality through late 2021 versus a counterfactual of pre-COVID-19 mortality. We undertake our analysis by using the Health and Retirement Study (HRS) to observe the relationship between socioeconomic status, illness, and non-COVID-19 mortality; the Current Population Survey (CPS-ASEC) to project counterfactual mortality if COVID-19 had not happened, based on the estimated HRS model;[6] and then the CPS-ASEC merged with administrative data on death in order to infer excess COVID-19 mortality. After that, we use the CPS-ASEC merged with administrative data in order to project changes in benefit payouts and payroll taxes as a result of COVID-19 excess mortality. In projecting benefits, we incorporate models from our earlier analysis (Dushi et al. 2021a, 2021b) of claiming ages, mortality, and retired-worker, spousal, and survivor benefits.

We focus on projections of the impact of COVID-19 mortality for people who were 51 and older in the 2015 CPS-ASEC, and hence 55 and older when the pandemic began. This is governed by limitations in the data, resulting in two factors that are not included in our calculations, both of which are small in relation to what we do include.[7] First, the reduction in net benefits will be a little higher because of deaths of individuals

[6] This is the Annual Statistical Supplement of the Current Population Survey, also known as the March CPS. We explain more about our data choices later.

[7] The reason for this age frame is that our methodology relies on use of the HRS, which samples individuals aged 51 and over, along with their spouse of any age.

younger than 55. However, for this group, excess COVID-19 mortality was even smaller, generating an extremely small value of life-years lost in our spreadsheet calculations. Additionally for them, taxes not received will offset a greater share of the more distant benefit not paid. Second, the reduction in net benefit payouts will also be a little higher because of deaths to institutionalized individuals who are not represented in the 2015 CPS-ASEC sample. They experienced relatively high mortality but, already having low life expectancy (of at most three years, based on our calculations using the 2010 HRS), this generated a small value of life-years lost and less than $10 billion of forgone benefits, and perhaps as low as $3 billion. Lastly, in future research we plan to add additional years of the CPS-ASEC to our current calculations in order to expand our sample size.

Based on this analysis of COVID-19 mortality, we project that the expected present value (EPV) of benefit payouts not paid net of payroll taxes not received will be $86 billion for individuals who are unmarried. Those individuals have an EPV of benefits that is considerably lower than average, and this reduces net benefit payouts to single individuals by only 0.8%. For married couples, we project a decline in expected net benefit payouts of $78 billion, an even lower reduction at 0.6%, than for single individuals. The resulting increase in survivor benefit payouts offsets 45% of the reduction — pointing to the important protective effect of survivor benefits in insuring against the premature death of a spouse. Overall, our analysis suggests that the major impact of the pandemic on the OASI trust fund operated through labor markets rather than excess mortality.[8] We project a reduction in benefit payouts to individuals 55 and older who are nationally representative of the 2015 noninstitutionalized population (adjusted for deaths 2015 through 2019) of $131 billion, or 0.5% of benefits payable to that group in the absence of COVID-19.[9]

2. Background

We focus on the defining aspect of the COVID-19 pandemic, the death toll caused by both COVID-19 and the resulting crisis of care in the medical system. We do not consider some of the other effects of the pandemic and its associated shutdown that influenced the trust fund more immediately. Most notably, the sharp contraction of the labor force, whether voluntary (by those who feared exposure to the virus) or involuntary (as a result of mass layoffs), resulted in an unprecedented drop in payroll tax revenue. The subsequent protracted and uneven return to employment gradually restored this source of trust fund revenue, though possibly with shifts in the composition of work (for example, involving both hours and compensation) that affect revenue. Longer-term labor market consequences resulting from the prevalence of long COVID-19, along with the pandemic-induced declines in immigration and fertility, will have knock-on effects that also bear study.

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[8] This paper thus fits in a broader research agenda that documents ways in which unequal mortality across socioeconomic status is undermining redistribution through Social Security (Dushi et al. 2022, 2023).

[9] Moreover, the distributional consequences across socioeconomic groups of COVID-19 excess mortality that operate through the Social Security system are analogously small, because the overall impact on benefit payouts is small.

COVID-19 deaths were, of course, not randomly distributed within the population, as the literature review in Wettstein et al. (2022) makes clear. Therefore, it is important to consider the correlations between characteristics associated with COVID-19 mortality, on the one hand, and the expected present value of Social Security benefits of those who died, on the other. Some groups of people had greater exposure to COVID-19 — for example, Black and Hispanic individuals in the early months of the pandemic (Hooper et al. 2020, Sarkar et al. 2021) — and some, conditional on exposure, suffered graver consequences. In particular, COVID-19 was more dangerous, among those who contracted it, for those with certain preexisting health conditions and for older individuals (Imam 2020; Harrison et al. 2020; Ssentingo et al. 2020; Bhaskaran et al. 2021). The Centers for Disease Control (CDC 2022) noted seven chronic health conditions associated with elevated risk from COVID-19: cancer, cerebrovascular disease, diabetes, heart disease, kidney disease, lung disease, and obesity.

The groups most at risk of dying from COVID-19 had higher mortality even in the absence of COVID-19, with the exception of Hispanics. As Wettstein et al. (2022) note, mortality has been higher among Black than white Americans, rises with age, and is higher among individuals with a large range of health problems that lead to increased risk of COVID-19 mortality.

COVID-19 mortality is the result of two occurrences: first, becoming infected, and second, succumbing to that infection. The well-documented fact that COVID-19 mortality was higher among those with pre-existing health conditions, among Black than white Americans, and increased with age, is consistent with the hypothesis that the risk of succumbing to COVID-19 infection is proportional to all-cause mortality. But, the risk of infection may vary across groups, depending on the extent to which they can practice social distancing. The risk may be higher among the institutionalized, and lower among the retired who remain in their own homes, those whose occupation permitted them to work from home, or those who do not live in overcrowded housing. If the risk of infection is greater for low socioeconomic status individuals, it is possible that the ratio of COVID-19 to baseline mortality may be higher for such individuals.

Of course, vaccination provides strong protection against severe infection. The vaccination of the U.S. population started in Winter 2021, and we will therefore observe the effects of the initial roll-out of vaccination in the 2021 data. In this initial period, vaccination access varies to some extent by socioeconomic status, exacerbating some of the socioeconomic differentials referred to above.

Much prior research constructs period life table estimates of the impact of COVID-19, showing mortality rates at all ages in a given year. Demographers often construct period mortality tables, showing mortality rates at all ages in a given year. Period life tables provide a snapshot of current mortality and are used to calculate life expectancy on the assumption that an individual faced the age-specific mortality observed that year for the rest of their lives.[10] Yet, period life tables overstate the impact of COVID-19 on life-expectancy and life years lost and estimates based on this research will dramatically overstate the impact on Social Security finances. Calculations based on period life tables implicitly assume that individuals will face the 2020 risk of dying from COVID-19 throughout their lives. For example, Andrasfay and Goldman

[10] In contrast, a cohort life table assumes an individual faces a mortality risk that changes over time.

(2021) estimate national life expectancy loss during 2020 of 1.13 years overall, 2.10 years for Blacks, and 3.05 years for Hispanics. A more reasonable assumption is to assume that vaccination and both individual and herd immunity will reduce COVID-19 excess mortality over time, perhaps to negligible levels. To be credible, an estimate of life years for the purposes of understanding Social Security finances must make defensible assumptions about excess mortality in future years.

The simple spreadsheet model for 2020 that we begin our analysis with, below, assumes that excess mortality is zero after the end of 2020 and that all individuals at each age have the same baseline mortality and risk of dying from COVID-19. Going forward, of course, one might reasonably assume that later COVID-19 mortality draws similarly from the same groups but shrinks as immunity levels rise. Yet, the baseline assumption may overstate the impact of 2020 mortality if, even within each age group, mortality risk varies and COVID-19 mortality is proportional to subgroup baseline mortality. In that case, COVID-19 deaths will be concentrated among those within each age group who had shorter remaining life expectancy, and our model will overstate life-years lost.

Estimates must also make assumptions about the relationship between COVID-19 mortality and remaining life expectancy, assuming that individuals who die of COVID-19 have population average mortality for their age and gender will overstate life years lost. Wettstein et al. (2022) show that individuals dying of COVID-19 were in considerably worse than average health for their age and gender. Barreto-Parra et al. (2022) control for such differences and estimate average life expectancy lost through September 30, 2021, at 10.6 days (12.0 days for men; 9.1 days for women). This estimate is a similar order of magnitude to that obtained from our simple spreadsheet model. Thus, it suggests that almost all of the overstatement of life years lost obtained when using period life tables (as in Andrasfay and Goldman 2021) results from the implicit assumption that individuals face COVID-19 excess mortality for the remainder of their lives, not from the assumption that COVID-19 mortality is uncorrelated with baseline health status.

If those who die from COVID-19 had higher-than-average mortality risk pre-COVID-19, then those who survive must have lower than average mortality risk. However, two papers — Wettstein et al. (2022) and Cairns et al. (2020) — conclude that the effect on average life expectancy of survivors was very small. We hypothesize that the number of people who died was not sufficiently large to reduce average life expectancy of the far larger number of survivors.

3. Baseline mortality calculations

We begin by constructing a simple spreadsheet model of life-years lost during the pandemic. This provides a baseline to understand why excess mortality during the pandemic did not lead to a substantial reduction in life-years lost in the population as a whole. After presenting this model, we will undertake a careful projection of the impact of excess COVID-19 mortality on benefit payouts.

3.1 Baseline assumptions

Our goal is to calculate the expected present value of retired worker, spousal, and survivor benefits of current and future retirees, given under two sets of assumptions: first, projecting mortality accounting for COVID-19 deaths through

September 2021, and second, assuming that the COVID-19 pandemic never happened.[11] The difference represents the reduction in obligations resulting from COVID-19 excess mortality. Our modeling takes account of the facts that 1) all-cause mortality, and not just deaths caused by COVID-19, jumped during the pandemic, 2) spouses of retired workers who die may switch from receiving a retired-worker to a survivors benefit, and 3) individuals who die as a result of COVID-19 may have shorter life expectancies than the average for people of their age and gender.

Our projections depend on the extent to which those who died during the pandemic would have died sooner than average counterfactually. We begin with the assumption that COVID-19-related excess mortality was proportional to all-cause mortality. If so, the relatively rare COVID-19-related deaths among the young would result in a loss of many years of life, simply because mortality rates at young ages are so low; the loss in life-years will be lower to the extent that those who were sicker at any given age had a higher percentage increase in their likelihood of dying.[12] In comparison, deaths among the old would be far more common, but each death would result in a loss of far fewer years of life — and notably, fewer than if COVID-19 mortality at each age was essentially random.

The epidemiological evidence shows that COVID-19 mortality varies with age, health status, race, gender, and socioeconomic status, in ways that are correlated with all-cause mortality (Sanzenbacher et al. 2017, Wettstein et al. 2022). Thus, the

[11] The end date for considering excess COVID-19 deaths arises because of lags in deaths being fully recorded in the National Death Index.

[12] Under the proportional mortality assumption, everyone would have an equal increase in their likelihood of dying.

assumption that COVID-19 excess mortality is proportional to all-cause mortality is a reasonable starting point. We begin by constructing a simple spreadsheet model that uses COVID-19 death rates by age in 2020 and invokes the assumption of proportional mortality within age group. This spreadsheet model sets a baseline by demonstrating that the COVID-19 pandemic resulted in the loss of about a week of life among the young and a month of life among the old — which is of relatively small consequence for the OASI trust fund.

We then move away from this starting point by observing, among individuals in several years of the CPS-ASEC, who died during the pandemic according to the National Death Index, and whether those individuals are likely to have higher comorbidities, based on their socioeconomic status and how socioeconomic status is related to comorbidities in the HRS.[13]

3.2 Spreadsheet model of 2020 mortality

The National Center for Health Statistics Data Brief (Murphy et al. 2021) reports the increase in death rates per 100,000 in 2020 by 10-year age intervals. This shows that excess mortality in 2020 was broadly proportional to baseline mortality. For example, at ages 15 to 24, the increase was 20.8%, which is not that different than the increase of 15.0% at ages 85-plus.

We use these increases in excess mortality as follows. We begin with cohort life tables, which express the number of remaining life-years by age. Then, we simply multiply baseline mortality as predicted by cohort life tables by the COVID-19-induced

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[13] While we can also determine who died in the HRS, the sample is considerably smaller, making it difficult to gain sufficient precision in this analysis.

increase in mortality during 2020 to calculate the percentage reduction in average life-years by age. Baseline pre-COVID-19 mortality was of course much higher at older ages, and thus COVID-19 excess mortality, which was very low at younger ages, increased rapidly with age. Under our current simplifying assumption that all individuals of the same age and gender have the same percentage increase in their mortality during the pandemic, younger individuals dying as a direct or indirect result of COVID-19 lost many life years, and many more than those dying at older ages.[14]

This approach suggests that average years of life lost in 2020 increases from 0.17 of a month at age 20 (accounting for 0.02% of remaining life years at that age) to 0.34 of a month at age 50 (or 0.09% of remaining life years) to 1.37 months at age 95 (or 3.9% of remaining life years), as shown in Figure 1. The calculations are based only on excess mortality through December 31, 2020, since they rely on 2020 data; and since COVID-19 deaths were somewhat higher in 2021, these baseline results would somewhat understate the impact on life years lost.[15] On the other hand, if excess mortality at each age was higher among those with shorter remaining life expectancy, then average years of life lost would be less. To put these numbers in context, historical

[14] Other possible assumptions are that those who were in poorer health had a greater percentage increase in their likelihood of dying, in which case life-years lost would be lower at all ages; or that those who were in better health had a greater percentage increase, in which case life-years lost would be higher at all ages. The evidence indicates the former, as argued in Wettstein et al 2021; similarly, the Medicare Trustees (2023, p.3) noted that those who died from COVID-19 had much higher Medicare spending in earlier years than those who did not. In any case, we do not have reliable population-wide information on mortality within subgroups, for example white, female, high school dropouts.

[15] Official COVID-19 deaths were about 350,000 in 2020 and 415,000 in 2021 (2020 Final Death Statistics: COVID-19 as an Underlying Cause of Death vs. Contributing Cause (cdc.gov), Provisional Mortality Data — United States, 2021 | MMWR (cdc.gov)).

increases in period life expectancy at birth have been about one month per year over recent decades (though with large fluctuations), so the loss due to COVID-19 in 2020 amount to a little less than one year's average gain. These small reductions in average life-years lost will lead to analogously small reductions in trust fund payouts.

4. Formal methodology

While the spreadsheet model illustrates why excess COVID-19 mortality did not lead to a substantial reduction in life-years lost, we implement a formal analysis to project changes in benefit payouts. To do this, we project counterfactual mortality for a large sample of individuals observed before the pandemic; we observe mortality during the pandemic for the same individuals; and we project benefit payouts in both scenarios.

Our formal analysis makes use of Current Population Survey data from the CPS-ASEC linked to Social Security administrative data on benefits, earnings, and deaths, as well as data from the Health and Retirement Study. We cannot rely on administrative data alone for several reasons, including that it is impossible to know who died during the pandemic who would not have died otherwise. The administrative data also lack health, socioeconomic, and marital status information that would allow us to infer excess deaths and the resulting forgone taxes and benefits. The CPS has the advantage of a large sample size and contains information on marital and socioeconomic status, and when linked to death information from the administrative records, allows us to see which CPS-ASEC individuals from several previous surveys died during the COVID-19 pandemic. We include participants in the 2015 CPS, and in future work we will add additional, more recent years of the CPS.

The linkage to other administrative data enables several things. We can observe benefit entitlement, as well as lifetime earnings as a measure of socioeconomic status. Also, it allows us to identify marriages that ended by death between the date of the interview and 2020, though it does not permit us to identify people who married or divorced between the date of the CPS interview and the beginning of the pandemic. In any case, our analysis of HRS data shows that the incidence of marriage and divorce in old age is relatively low.

Although the CPS contains information on marital and socioeconomic status, it lacks the detailed information on health status needed to model mortality in the absence of COVID-19 (CDC 2019) and includes only the noninstitutionalized, so we do not see individuals who live in a nursing home. We therefore use HRS data to estimate socioeconomic correlates of diseases that influence mortality. The HRS is a nationally representative panel data set of individuals who were ages 51 to 61 on entry to the study, with new birth cohorts added every six years beginning in 1992. The absence of individuals younger than 51 in 2015 (age 55 when we begin our analysis) is not a significant limitation as the COVID-19 death rate among individuals younger than 51 has been extremely low.[16]

Specifically, we estimate a multivariate probit model where the six dependent variables take the value one if an HRS respondent reports having high blood pressure,

[16] The effect on our net benefit calculations of focusing only on those 55 and older when the pandemic began is ambiguous. Excess mortality at younger ages was extremely low, as our calculations above showed. Both taxes not received in the near future and benefits not paid in the distant future of those who died due to COVID-19 would affect our calculations, though even those amounts are likely to be lower than average for the population of that age because deaths at younger ages occur disproportionally among people with high comorbidities.

diabetes, cancer, or lung disease, or has suffered a stroke, zero otherwise, separately for men and women in 10-year age groups, 50 to 80 and a group aged 80 and older. All these diseases are associated with elevated mortality in normal times and elevated risk of dying from COVID-19, and they are well-measured in the HRS. The multivariate model accounts for the correlation between the outcomes — for example, that an individual who has diabetes is also more likely to suffer from heart disease, etc. Explanatory variables, also found in the CPS-ASEC, include whether self-reported health is poor, race (Black versus non-Black), ethnicity (non-Black Hispanic versus others), education (less than high school, high school or some college, and college graduate), age, birth year, marital status (a base case of married and indicator variables taking the value one if never married, partnered, divorced, or widowed), and residence in a nursing home. For men and women younger than 65, we also include indicator variables for Social Security Disability Insurance (SSDI) recipiency and whether the individual is currently working for pay.

We make random draws from the multivariate standard normal distribution with correlations based on the multivariate probit model and assign disease status to CPS participants based on these draws and their socioeconomic characteristics. The goal is not to accurately predict the disease status of each individual in the CPS but to capture the relationship between the burden of disease and socioeconomic status. Since we use the model estimates for forecasting purposes, we do not focus on the values of particular point estimates.

Our next step is to estimate a mortality model using HRS data separately for men and women. We estimate a Gompertz survival model, a parametric demography model commonly used to analyze mortality (Dushi et al. 2021, 2024). The model relies on the empirical regularity first reported by Gompertz (1825) that the annual percentage increase in mortality varies little with age, up to quite advanced ages. So, even though a worker who claims at age 70 may have, for example, the biological age and hence mortality risk of a 62-year-old, we might expect that the age-related *increase* in mortality risk does not vary with claiming age. The Gompertz model is a two-parameter distribution with a hazard that takes the form:

$$h(t) = e^{\lambda} e^{\gamma t} \qquad (1)$$

The parameter λ captures individual characteristics X_{1i} that affect baseline mortality at some arbitrary age:

$$\lambda_i = e^{X_{1i}\beta_1} \qquad (2)$$

and similarly the parameter γ captures individual characteristics X_{2i} that affect the exponential growth rate of mortality at subsequent ages t:

$$\gamma_i = e^{X_{2i}\beta_2}\, t$$

Our data are right censored because not all deaths are observed.

Our explanatory variables include the six diseases referred to above (high blood pressure, diabetes, cancer, lung disease, stroke), race, ethnicity, education, number of activity of daily living limitations, residence in a nursing home, self-reported health status (excellent or very good, good or fair, and poor), and a linear trend for birth year. Our tabulations indicate that the percentage impact of disease on mortality is much greater at younger than at older ages. At younger ages, an individual without underlying diseases is extremely unlikely to die and almost all mortality occurs among individuals with several underlying diseases. At older ages, most individuals have at least one underlying disease, but the percentage impact on mortality of additional diseases is far less. We considered estimating a model with time varying covariates. However, this is difficult to implement when the data are heavily censored. Instead, we estimated models in which mortality depended on health and socioeconomic status at baseline ages 50 to 51 onward in two-year increments. For individuals younger than 65, in addition to the variables mentioned above, we also include SSDI recipiency and indicator variables for labor force participation and current earnings quartile.

We use the output of the Gompertz model to compute counterfactual annual survival probabilities, if COVID-19 had not occurred, for each of the individuals in the CPS sample. As there is a sample size numbering about 75,000, each with different health and socioeconomic characteristics, calculating survival probabilities for each individual is computationally infeasible. Instead, for each two-year age group we calculate a matrix of 21*21*20*50 survival probabilities for 21 different values of h(t) for husband and for wife, 20 age differences between husband and wife, and 50 years, from 2020 to 2070, by which almost all CPS households 50 and older will have died. We assign couples to their closest grid point.

The next step is to use the annual survival probabilities that we estimate to calculate the expected present value of lifetime Social Security retired worker, spousal, and survivor benefits. For single individuals and higher earners within married couples who have already claimed their retired worker benefit, the expected present value of that benefit depends solely on the current benefit amount and their annual survival probabilities. For lower earners within married couples who are in receipt of a spousal benefit, the expected present value of that benefit depends on both spouses' annual survival probabilities because the benefit is payable while both spouses are alive. For lower earners within married couples who anticipate receiving a survivor benefit following the death of their spouse, the expected present value of their survivor benefit depends on both spouses' annual survival probabilities (because it is payable conditional on the lower earning spouse being alive and the higher earning spouse dead), the higher earning spouse's PIA (benefits payable at their full retirement age), the age at which the higher earning spouse claimed their retired worker benefit, and the higher earning spouse's birth year (because these two data points determine the extent to which the survivor benefit will be increased or decreased based on the age at which the higher earning spouse claimed their retired worker benefit). The special case is workers who are in receipt of Social Security Disability Insurance (SSDI) and who are automatically transferred from SSDI to retired worker benefit on attaining their full retirement age. We assume that workers in receipt of SSDI continue to remain in receipt of that benefit until their FRA and do not return to the workforce.

For couples who have not yet claimed benefits, we need to impute a claiming age. Claiming ages are correlated with earnings (Dushi et al. 2021) and marital status (Dushi et al. 2024) and have trended upwards over time. We impute claiming ages separately by gender by estimating a regression model based on race, age, education, earnings quartile, and marital status.

The benefits of workers who have not yet retired depends not only on past, but also on future earnings. One approach, adopted in the literature on defined benefit pension wealth (as in Ghilarducci et al. 2022) is to project earnings to retirement, calculate benefits based on those earnings, and prorate to past and future service.

Unlike defined benefit pensions, Social Security requires employee contributions, and an adjustment would be required for projected contributions. We adopt a simpler approach, namely to calculate the expected present value of future benefits earned on contributions paid on earnings to date, which avoids making possibly tenuous assumptions about the path of future earnings.

5. Data

Our main sample consists of respondents in the March Current Population Survey (CPS-ASEC), merged with their Social Security administrative records. This allows us to obtain information on their earnings history, benefit types and amounts, benefit claiming age, and birth and death dates, so that we can make projections about future Social Security benefits paid out and taxes received, derived from several data files: the Master Beneficiary Record (MBR), Summary Earnings File (MEF), Payment History Update System (PHUS), and Numident. Because the CPS-ASEC lacks rich information about health and well-being, which is important for projecting mortality, we estimate an auxiliary mortality model using Health and Retirement Study (HRS) data.

In this section, we describe our CPS-ASEC sample, since it forms the basis for our analysis of COVID-19 and counterfactual mortality and of benefit payouts. We select individuals from the 2015 CPS-ASEC participants who were 51 and older in 2015, and their spouse of any age (matching the age frame of the HRS).[17] All demographic

[17] Importantly, the CPS is representative of only the noninstitutionalized population, so we cannot implement our methodology for those in nursing homes, who had high excess mortality during the pandemic. After presenting our calculations of foregone benefit payouts for the CPS-ASEC population due to COVID-19 excess mortality, we present some additional back-

information of our sample, such as gender, race/ethnicity, education, marital status, and health status, come from the CPS. The variables of interest derived from administrative records include date of birth, date of death, OASI claiming age, amount of benefits received in 2020 or 2021, earnings history (used to calculate the AIME and PIA at age 62), and AIME quartiles.[18] We use this information as inputs in calculation of the impact of mortality on trust fund payouts, separately for singles (whose death ends benefit flows) and couples (for whom, in the event of one spouse's death, the other spouse's benefits may change).

The overall CPS sample for this analysis is 52,016 observations, comprising 24,772 singles and 27,244 couples. Table 1 provides demographic characteristics of the sample, separately for singles and married and also separately for those (based on the methodology above) whom we impute to have died from COVID-19. Compared to couples, singles are more likely to be people of color, with lower levels of education, in fair or poor health, ages 55 to 64, to be in lower AIME quartiles, and less likely to be receiving benefits in January 2020. For both singles and couples, compared to the respective overall samples, those who died from COVID-19 are older, have lower levels of education, are more likely to report being in fair or poor health, less likely to have earnings in 2020, and more likely to receive benefits in January 2020, be an SSDI recipient, and be in the lowest AIME quartiles.

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of-the-envelope calculations to show that the impact on benefit payments forgone for this group was likely quite small, since their overall loss of average life years was small.

[18] For each couple, the spouse's information from administrative data sources is assigned manually to the other respective spouse.

6. Results

6.1 Multivariate probit model of correlates of disease

We estimate multivariate probit models using data from the HRS to predict comorbidities of CPS-ASEC participants. We estimate these models for HRS participants separately by age group and gender and report multivariate probit marginal effects for a subset of the sample, focusing on men and women ages 50 to 59 and age 80 plus in Table 2. A positive coefficient signifies that the characteristic is associated with an increased probability of an individual reporting they suffer from a disease and a negative coefficient is associated with a reduced probability.

For both men and women and at all ages, including the subsamples reported in Table 2, self-reported poor health is associated with an elevated risk of an individual reporting that they suffer from each of the diseases we consider. Black men are more likely to report suffering from high blood pressure, diabetes, and stroke, but less likely to report lung disease, heart disease, or cancer. Non-black Hispanic men are more likely to report diabetes, but substantially less likely to report suffering from the other five diseases. Currently working for pay is associated with lower incidence of all six diseases, although the coefficients are not always statistically significant. Focusing on men ages 50 to 59, we obtained a counterintuitive result that higher levels of educational attainment are associated with a higher self-reported risk of suffering most diseases, the exception being lung disease.[19] We estimated a model without covariates

[19] We have ascertained that much the same result emerges in simple cross-tabulations in the HRS. A key reason may be that many diseases do not present symptoms at those relatively

and obtained the expected result that higher levels of educational attainment are associated with lower levels of self-reported disease, so our result flows from other characteristics — SSDI recipiency, self-reported health, and working for pay — that are correlated with both educational attainment and self-reported disease status. Among women ages 50 to 59, a college level of educational attainment is associated with a higher self-reported probability of suffering only from high blood pressure and cancer. The relationship between marital status and all six diseases is mixed.

Importantly, the correlations among the error terms estimated for each condition are largely positive and significant. In other words, conditioning on our explanatory variables, individuals suffering from one disease are more likely to suffer other diseases, so that a univariate probit model that treated the risks as independent would understate the extent of comorbidities and thus the extent to which a subset of the population faced much higher-than-average mortality risk.

The incidence of each of the diseases increases with age. Socioeconomic patterns are similar at older ages, although the magnitude of the marginal effects generally declines with age, reflecting a narrowing of socioeconomic morbidity differentials. Among women, patterns are similar with the exception of marital status, where divorced and widowed women are more likely to report lung disease, heart disease, and stroke.

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young ages. In that case, diagnosis may depend on access to and use of preventative care, which itself rises with socioeconomic status.

6.2 Gompertz mortality model

After estimating the comorbidity models in the HRS, we estimate Gompertz mortality models to determine the relationship between subsequent mortality and the comorbidities observed in the HRS, along with other covariates also observed for our CPS-ASEC sample. We estimate Gompertz models separately by age group and report estimates starting from baselines of ages 58 to 60 and 78 to 80 (Table 3). When multiplied by 100, the coefficients approximately equal the percentage change in mortality at all ages associated suffering from a particular disease or having a particular socioeconomic status at baseline. In the following discussion, we report the resulting percentage changes, not the coefficients.

For the baseline age-60 sample, lung disease, diabetes, cancer, heart disease, and stroke are all associated with large ((38% to 103%) increases in mortality.[20] High blood pressure is associated with a much smaller (10.7%) and borderline significant increase in mortality. Even after controlling for all the above diseases, individuals who report being in fair or poor health have a 64% higher mortality rate, suggesting that individuals possess further information about their health status and that this information is predictive of mortality. Relative to married individuals, widowed, separated or divorced, and never married individuals all have substantially and significantly higher mortality (43%, 49%, and 29%, respectively). Conditional on working, being in the highest quartile of earners is associated with significantly lower mortality. College level

[20] For example, the coefficient on having had cancer is 0.709 for people aged 58 to 60. The resulting increase in mortality associated with this diagnosis is exp(0.709)-1 = 103%. Analogous calculations yield the other percentage changes in mortality that we highlight in this paragraph.

education is also associated with 28% lower mortality. Perhaps surprisingly, the mortality of Black individuals is not significantly different from the remainder of the population, possibly reflecting the extensive controls, while Hispanic individuals have significantly lower mortality. SSDI recipiency is associated with 31% higher mortality. Women have mortality rates 45% lower than those of men, a larger disparity than in population life tables, but reflecting gender disparities in other covariates. Importantly, at 9.1%, the annual age-related increase in mortality closely matches that in SSA life tables.[21]

Patterns are similar for the model estimated from a baseline of age 80. The coefficients for the various categories of marital status are smaller and no longer statistically significant relative to a baseline of being currently married. The mortality rates of married and single individuals may still differ if single individuals suffer a greater burden of disease. The coefficients for the diseases that we consider are all statistically significant, but diabetes, cancer, and stroke have significantly smaller effects at age 80 than at age 60, perhaps because by age 80, frailty becomes a more significant cause of death, relative to chronic disease. At 13.2%, the annual age-related increase in mortality is higher after age 80 than after age 60, consistent with rectangularization of mortality — the survival curve taking on the shape of a rectangle, with mortality increasing rapidly with age from a low base, and with most deaths occurring in a limited range at very old ages.

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[21] Period life tables from the Trustee's Report appear at Actuarial Life Table (ssa.gov)

6.3 Imputing disease to the CPS sample

We impute disease to the CPS sample using estimated coefficients and correlations across diseases from our multivariate probit model. Table 4 reports the imputed burden of disease at ages 50 to 60 and 80+ for men and women by race. Black people face a higher self-reported burden of disease, while Hispanic people face a lower burden. At ages 50 to 60, women are more likely to have experienced high blood pressure, diabetes, cancer, or lung disease, while men are more likely to have experienced heart disease or stroke. By ages 80+, men have largely caught up in experiencing these conditions. Disparities in these conditions will result in disparities in life expectancy, in the expected present value of Social Security benefits, and in COVID-19 mortality.

We use imputed disease burden and other observables, combined with our Gompertz model estimates from the HRS, to impute non-COVID-19 mortality to the CPS-ASEC sample. Table 5 reports imputed life expectancy at age 62 at the outset of 2020 by demographic and socioeconomic status. Our projections suggest that this is a relatively long-lived sample overall, likely because the CPS-ASEC in 2015 did not include institutionalized individuals. Yet, comparisons among groups yield the expected relationships; women have substantially longer life expectancy than men, as do those in very good health or with fewer imputed diseases, and those who are married.

6.4 Benefit calculations

Using CPS data weighted so that it is representative of the U.S. population, we calculate the expected present value (EPV) of obligations under present law to individuals 55 and older as of January 2020.[22] We subtract the EPV of future employer and employee Social Security contributions.

We observe deaths that occurred up to 30 September 2021, after which the mortality records are currently incomplete. After imputing which deaths were due to excess mortality during the pandemic, the impact of pandemic deaths on the trust fund has three components: 1) Social Security taxes will no longer be paid by the deceased individual and their employer, 2) Social Security retired-worker, spousal, or survivor benefits will no longer be paid to the deceased individual, and 3) survivor benefits will be paid to surviving spouse as a result of the COVID-19-related death.

All of these calculations rely on imputations of behavior for those CPS-ASEC individuals who have not yet claimed Social Security when they are observed in the SSA administrative records. For multiple reasons, however, the imputations are not very consequential.[23] For individuals who have claimed Social Security, we impute claiming-age behavior of surviving spouses who have not yet claimed Social Security in the event of the individual's death. For individuals who have not yet claimed Social Security, we also impute claiming ages of initial Social Security benefits, for individuals who first claim as retired workers, spouses, or survivors. And, for individuals who are still working

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[22] In doing so, we are treating COVID-19 excess mortality from March 2020 on as happening in January 2020. This timing assumption slightly overestimates the impact of COVID-19 excess mortality on the trust fund.

[23] The imputations involve relatively young individuals for whom excess COVID-19 mortality was low, and therefore they do not have a consequential impact on our calculations of benefits that will not be paid because of COVID-19. Moreover, claiming ages, whether actual or imputed, do not have first-order effects on the EPV of lifetime benefits, And lastly, individuals who continue to work at these older ages have better health and thus lower COVID-19 excess mortality on average, which if anything leads us to slightly overestimate the impacts on forgone benefit payouts and payroll tax revenues as a result of these imputations.

in 2020 and are younger than 62, we further impute their earnings for year 2021 as the average of the last five years and then assume a 3% annual increase until age-62 retirement. We apply the same 3% rate to adjust the average wage, FICA maximum tax, and PIA bend points for future years. For all calculations related to AIME and PIA, we use values observed up to age 62 (so as not to incorporate uneven work histories for those who continue in the labor force), and we impute PIA and AIME at age 62 using our earnings projections for younger respondents.

The first column of each panel of Table 6 reports the expected present value (EPV) of benefits payable to different groups of individuals 55 and older at their observed or projected claiming ages, and changes as a result of excess COVID-19 mortality. The second column shows the same for the EPV of employer and employee FICA taxes paid to the anticipated claiming age, and among this older group, most of whom have already claimed, future taxes reduce the liability only slightly. The third column shows the liability net of taxes. All values are discounted at a 3% interest rate to January 1, 2020.[24]

The first row shows the gross liability, tax, and net liability as of January 1, 2020, assuming no pandemic. The second row shows the effect of COVID-19 excess mortality through September 2021, reporting the EPV of benefits no longer payable, taxes no longer receivable, and the net reduction in payouts. The third row shows the position after eliminating excess COVID-19 mortality.

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[24] The 3% rate is a standard long-run assumption in the academic literature used, for example, to discount annuities (Friedberg and Webb 2022). Though it slightly exceeds the real interest rate of 2.8% assumed in the 2023 Trustees Report (U.S. Social Security Administration 2023). It also reflects a return to the interest rate environment of historic norms.

For unmarried individuals in the middle panel, COVID-19 reduced the EPV of benefit payouts net of taxes by $86 billion. This consists of reduced benefits of $87 billion and reduced payroll taxes of $1 billion. Within the over-55 population we study, unmarried individuals who we infer died because of the pandemic were much older than average (80.0 years, compared with 69.1 years overall), and thus more likely to be receiving benefits in January 2020, but also much closer to the end of benefit receipt. Although 1.3% of the unmarried in this age group died due to excess COVID-19 mortality, the reduction in aggregate benefits was only 0.8%.

The third panel reports analogous results for couples. Benefit payouts include retired-worker, spousal, and survivor benefits projected to be payable under different scenarios, and an additional row shows the cost of new survivor benefit claims resulting from the death of a higher-earning spouse. Prior to the survivor benefit offset, the net benefit reduction was $78 billion, even smaller in percentage terms than for the unmarried, at 0.6%, although 0.8% of individuals in married couples died. Survivor benefits reduced the saving by about 45% to $45 billion.

Therefore, we project a reduction in benefit payouts to individuals 55 and older who are representative of the 2015 CPS-ASEC sample of $131 billion, or 0.5% of benefits payable to that group in the absence of COVID-19. We note three factors that are not included in our calculations, each of which will lower net benefit payouts further, but by relatively small amounts in relation to what we do include. First, the reduction in net benefit payouts will be a little higher because of deaths to individuals younger than 55. However, for this group, excess COVID-19 mortality was even smaller, generating an extremely small value of life-years lost in our earlier spreadsheet calculations.

Additionally for them, taxes not received will offset a greater share of the more distant benefits not paid. Second, the reduction in net benefit payouts will be somewhat higher due to continued high excess mortality after our period of analysis. According to the 2023 Trustees Report (U.S. Social Security Administration 2023), excess mortality due to COVID-19 is projected to be 18% higher than average in 2021 (which we capture through September) and 12% higher in 2022, while returning almost to average levels in 2023.

Third, the reduction in net benefit payouts will be a little higher because of deaths to institutionalized individuals who are not represented in the 2015 CPS-ASEC sample. They experienced relatively high mortality, with about 133,000 COVID-19 deaths occurring in nursing homes as of August 2021 (Cronin and Evans 2022). An analysis of institutionalized individuals in the 2010 HRS (almost all of whom died by the 2018 wave) indicates three years of life expectancy in this group. Supposing that COVID-19 excess mortality affected those with the most comorbidities, we might assume an average loss of two life-years for this group. Assuming further a round number of monthly Social Security benefits of $1,000 (and that few deaths in this group would generate a survivor benefit, as many are already widows), then the gain to the trust fund of benefit payments forgone by this group might be $3 billion — a small amount relative to our projections above.

7. Conclusions

We project the impact of excess mortality observed through September 2021 during the COVID-19 pandemic on Social Security payouts. The magnitude of forgone benefit payments will depend critically on underlying life expectancy of those who fell victim to the pandemic. The impact will be smaller than naïve projections suggest if excess COVID-19 mortality was concentrated among those who were already frail. The reduction in payouts will be offset by rising payouts to surviving spouses of COVID-19 victims, a reflection of the program's social insurance function. It will also be offset by a reduction in contributions that would have been received among those who would have had additional labor market earnings.

We calculate the resulting overall reduction in future Social Security benefit payouts net of contributions to be relatively small. The fundamental reason is that excess mortality did not lead to a substantial reduction in life-years lost in the population as a whole. Simple calculations suggest an overall loss in average life-years during 2020 of about one month, which will lead to analogously small reductions in trust fund payouts.

We undertake a careful projection of benefit payouts net of contributions, given COVID-19 mortality through late 2021 versus a counterfactual of pre-COVID-19 mortality, using several survey and administrative data sources. Three factors not included in our calculations — deaths of individuals younger than 55, continued excess mortality which remained high for at least another year, and deaths of individuals who were institutionalized — will be small in relation to what we do include. We project that expected benefit payouts net of payroll taxes, made to individuals 55 and older who are nationally representative of the 2015 noninstitutionalized population, will fall by $164 billion, or 0.7% of benefits payable to that group in the absence of COVID-19.

Additional factors affecting the Social Security OASI trust fund need to be considered in future research. These include the consequences of long COVID-19 and of forgone medical care due to the shortage of health care provision during the first part of the pandemic; long-term mortality consequences of the recession; and the impact of excess COVID-19 deaths on benefits paid out by Social Security Disability Insurance.

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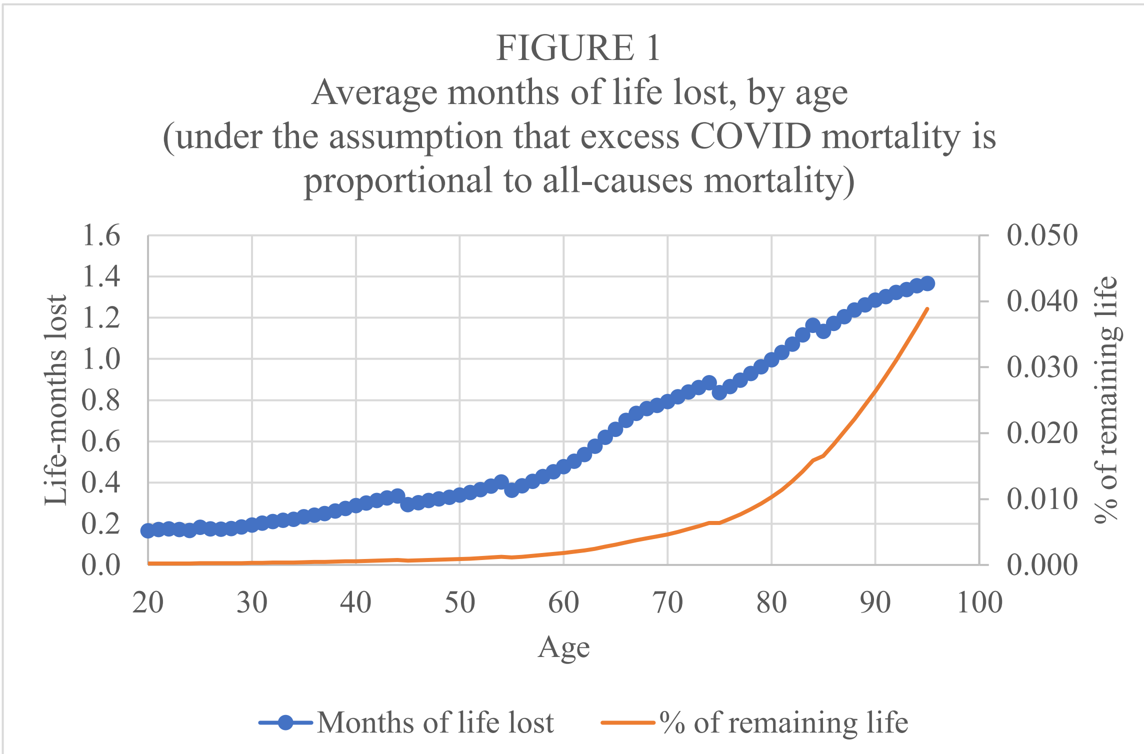
Figures and tables

Figure 1: Average months of life lost, by age (under the assumption that excess COVID-19 is proportional to all-causes mortality



Note: Source, authors calculations based on National Center for Health Statistics Data Brief (Murphy 2021).

Table 1: Demographic characteristics of samples for the gross liability and tax reduction due to COVID-19 deaths

	Singles	Couples
	All	**All**
Race/ethnicity		
% Black	14.8	6.7
% Hispanic	11.0	8.9
Educational attainment		
Less than high school	14.4	9.5
High school/some college	59.2	56.2
College	26.4	34.2
In poor/fair health	24.2	17.3
SSDI recipient	7.6	2.7
With positive earnings (%)	33.6	34.7
Mean earnings in 2020 ($)	18,022	18,486
Receiving benefits in January 2020 (%)	50.5	56.1
Mean benefit amount received in January 2020 ($)	1,170	1,190
Mean of projected benefits for non-recipients ($)	1,528	1,547
Mean expected present value (EPV) of benefits or tax (if died)	247,752	283,140
Mean age in 2020	69.1	69.0
% by age category in 2020		
55-64	42.1	34.4
65-74	30.1	41.1
75-84	16.7	19.5
85+	11.2	5.0
AIME quartile		
First (lowest)	24.0	22.2
Second	26.3	22.0
Third	25.7	26.4
Fourth (highest)	24.0	29.4
Number of observations	24,772	27,244

Source: March 2015 CPS data matched with SSA restricted data. Estimates are weighted using CPS person weight.

Table 2: Multivariate probit disease model estimated on Health and Retirement Study sample

	Men				Women			
	Age 50-60		Age 80 and older		Age 50-60		Age 80 and older	
	Coef	Std err	Coef	Std err	Coef	Std err	Coef	Std er
				High blood pressure (1)				
Black	0.353	0.031	0.356	0.048	0.627	0.026	0.328	0.037
Non-Black Hispanic	-0.138	0.037	0.089	0.058	-0.016	0.033	-0.049	0.046
High school or some college	0.159	0.034	0.049	0.032	0.005	0.031	-0.143	0.025
College graduate	0.072	0.039	0.027	0.039	-0.221	0.037	-0.208	0.038
Age	0.058	0.005	0.021	0.004	0.045	0.004	0.034	0.003
Birth year - 1950	0.015	0.002	0.044	0.002	0.012	0.002	0.033	0.002
Work for pay	-0.070	0.033			-0.009	0.025		
Never married	-0.128	0.048	0.208	0.104	0.156	0.046	0.013	0.076
Divorced	0.040	0.033	0.068	0.069	0.002	0.027	0.001	0.050
Widowed	0.002	0.090	0.099	0.031	0.142	0.039	0.098	0.026
Fair or poor health	0.473	0.031	0.255	0.028	0.472	0.027	0.242	0.023
Nursing home	0.187	0.036			0.175	0.030		
SSDI recipient	0.226	0.052			0.059	0.046		
Constant	-3.726	0.278	-0.549	0.319	-3.010	0.250	-1.536	0.232
				Diabetes (2)				
Black	0.289	0.035	0.149	0.053	0.316	0.031	0.348	0.036
Non-Black Hispanic	0.324	0.044	0.237	0.062	0.243	0.037	0.384	0.046
High school or some college	0.132	0.041	0.029	0.037	-0.050	0.035	-0.104	0.029
College graduate	0.087	0.048	-0.217	0.046	-0.138	0.044	-0.222	0.045
Age	0.048	0.006	0.011	0.005	0.056	0.006	0.006	0.004
Birth year - 1950	0.015	0.002	0.033	0.002	0.023	0.002	0.032	0.002
Work for pay	-0.041	0.040			-0.038	0.030		
Never married	-0.226	0.056	0.080	0.118	0.035	0.054	0.128	0.084
Divorced	-0.106	0.042	-0.061	0.076	0.006	0.032	-0.083	0.058
Widowed	0.003	0.106	-0.084	0.035	0.015	0.046	0.079	0.031
Fair or poor health	0.638	0.035	0.259	0.031	0.626	0.031	0.354	0.026
Nursing home	0.140	0.043			0.175	0.035		
SSDI recipient	0.223	0.055			0.100	0.049		
Constant	-4.067	0.346	-0.885	0.379	-4.529	0.317	-0.767	0.278

				Cancer (3)				
Black	-0.157	0.058	0.054	0.052	-0.235	0.036	-0.275	0.040
Non-Black Hispanic	-0.298	0.073	-0.382	0.064	-0.208	0.052	-0.425	0.056
High school or some college	0.253	0.070	0.037	0.035	0.162	0.046	0.085	0.029
College graduate	0.306	0.079	0.110	0.042	0.196	0.053	0.226	0.041
Age	0.055	0.009	0.019	0.004	0.030	0.006	0.018	0.003
Birth year - 1950	0.007	0.003	0.022	0.002	0.008	0.002	0.019	0.002
Work for pay	-0.009	0.054			-0.146	0.033		
Never married	-0.252	0.098	-0.159	0.118	0.011	0.066	-0.006	0.082
Divorced	0.049	0.060	-0.109	0.070	0.097	0.035	-0.063	0.055
Widowed	0.371	0.118	-0.002	0.033	-0.152	0.059	0.015	0.029
Fair or poor health	0.374	0.054	0.231	0.029	0.263	0.037	0.263	0.025
Nursing home	0.259	0.061			0.038	0.039		
SSDI recipient	0.090	0.074			0.108	0.055		
Constant	-5.138	0.505	-1.709	0.347	-3.190	0.347	-2.034	0.263
				Lung disease (4)				
Black	-0.396	0.053	-0.269	0.062	-0.393	0.043	-0.464	0.053
Non-Black Hispanic	-0.363	0.084	-0.441	0.081	-0.588	0.068	-0.313	0.063
High school or some college	-0.069	0.056	-0.024	0.041	-0.091	0.045	-0.080	0.033
College graduate	-0.394	0.073	-0.271	0.053	-0.357	0.060	-0.061	0.051
Age	0.024	0.009	-0.006	0.006	0.029	0.007	0.010	0.004
Birth year - 1950	0.007	0.003	0.011	0.003	0.024	0.003	0.022	0.002
Work for pay	-0.049	0.063			-0.192	0.038		
Never married	-0.035	0.079	-0.271	0.164	0.127	0.073	0.030	0.098
Divorced	0.068	0.060	-0.074	0.083	0.150	0.041	0.230	0.063
Widowed	0.388	0.150	0.042	0.039	0.203	0.056	0.144	0.036
Fair or poor health	0.572	0.049	0.558	0.035	0.599	0.040	0.476	0.029
Nursing home	0.355	0.059			0.374	0.041		
SSDI recipient	0.343	0.066			0.216	0.054		
Constant	-3.200	0.528	-0.484	0.427	-3.240	0.397	-1.787	0.316
				Heart disease (5)				
Black	-0.167	0.040	-0.505	0.048	0.145	0.034	-0.163	0.034
Non-Black Hispanic	-0.346	0.053	-0.687	0.060	-0.367	0.049	-0.514	0.048
High school or some college	0.144	0.044	-0.022	0.032	0.015	0.038	-0.016	0.025
College graduate	0.130	0.051	-0.122	0.039	-0.131	0.050	-0.175	0.039
Age	0.044	0.007	0.032	0.004	0.039	0.006	0.029	0.003

Birth year - 1950	0.001	0.002	0.021	0.002	0.013	0.002	0.008	0.002
Work for pay	-0.082	0.041			-0.073	0.035		
Never married	-0.311	0.066	-0.396	0.110	-0.227	0.055	-0.063	0.078
Divorced	-0.115	0.042	-0.232	0.069	-0.141	0.036	0.231	0.049
Widowed	-0.012	0.099	-0.037	0.031	-0.046	0.052	0.114	0.027
Fair or poor health	0.524	0.035	0.505	0.028	0.515	0.035	0.581	0.022
Nursing home	0.442	0.042			0.372	0.037		
SSDI recipient	0.147	0.055			0.148	0.049		
Constant	-3.827	0.373	-2.282	0.320	-3.674	0.355	-2.852	0.234
				Stroke (6)				
Black	0.257	0.051	-0.083	0.055	0.180	0.043	-0.035	0.039
Non-Black Hispanic	-0.125	0.075	-0.376	0.077	-0.202	0.075	-0.455	0.058
High school or some college	0.060	0.066	-0.031	0.037	-0.075	0.054	-0.002	0.030
College graduate	0.010	0.082	-0.068	0.046	-0.184	0.076	-0.093	0.046
Age	0.029	0.010	0.025	0.005	0.022	0.009	0.029	0.003
Birth year - 1950	-0.003	0.004	0.012	0.002	0.012	0.003	0.001	0.002
Work for pay	-0.324	0.055			-0.136	0.049		
Never married	0.035	0.077	-0.151	0.133	-0.140	0.072	-0.127	0.092
Divorced	-0.050	0.057	0.021	0.080	0.105	0.048	0.131	0.058
Widowed	-0.023	0.131	-0.061	0.035	0.062	0.069	-0.010	0.032
Fair or poor health	0.520	0.054	0.335	0.032	0.459	0.049	0.396	0.026
Nursing home	0.322	0.060			0.330	0.057		
SSDI recipient	0.251	0.066			0.166	0.059		
Constant	-3.625	0.575	-2.795	0.372	-3.293	0.497	-3.595	0.262
Rho (estimated correlation of error term for each of diseases 1-6)								
Rho 2,1	0.320	0.015	0.169	0.018	0.367	0.014	0.239	0.015
Rho 3,1	0.007	0.024	0.061	0.017	0.042	0.017	-0.032	0.014
Rho 4,1	0.073	0.025	-0.019	0.020	0.047	0.020	0.026	0.018
Rho 5,1	0.243	0.016	0.169	0.016	0.212	0.016	0.200	0.013
Rho 6,1	0.257	0.026	0.202	0.018	0.183	0.024	0.133	0.015
Rho 3,2	-0.020	0.026	0.053	0.018	0.038	0.019	0.011	0.016
Rho 4,2	0.030	0.028	-0.075	0.021	0.000	0.021	0.037	0.018
Rho 5,2	0.130	0.019	0.072	0.017	0.137	0.018	0.177	0.014
Rho 6,2	0.108	0.029	0.054	0.019	0.061	0.025	0.081	0.017
Rho 4,3	0.004	0.030	0.059	0.021	0.084	0.022	0.040	0.018
Rho 5,3	-0.019	0.023	-0.026	0.017	0.039	0.020	0.027	0.014
Rho 6,3	0.003	0.037	-0.003	0.019	0.104	0.028	-0.026	0.016
Rho 5,4	0.092	0.022	0.094	0.019	0.143	0.022	0.181	0.015
Rho 6,4	0.072	0.033	0.043	0.022	0.148	0.030	0.042	0.018

Rho 6,5	0.292	0.026	0.132	0.018	0.208	0.027	0.182	0.015

Source: Authors' calculations, based on the Health and Retirement Study.

Notes: Sample sizes age 50 to 60 men, 21,604, women 28,159, age 80 and older, men 11,356, women 17,984. Variables with missing coefficient estimates were dropped to due colinearity.

Table 3: Gompertz mortality model estimated

on Health and Retirement Study sample

	Age 58-60		Age 78-80	
	Coefficient	**Standard error**	**Coefficient**	**Standard error**
Female	-0.603	0.066	-0.335	0.036
Black	0.003	0.064	-0.029	0.054
Non-Black Hispanic	-0.472	0.096	-0.039	0.069
Education				
High school/some college	-0.100	0.061	-0.019	0.039
College and above	-0.330	0.091	-0.124	0.055
Marital status at baseline (age 60 or age 80)				
Widowed	0.355	0.088	0.057	0.038
Separated/Divorced	0.400	0.064	0.135	0.074
Single	0.251	0.127	0.107	0.112
Diseases at baseline				
High blood pressure	0.102	0.054	0.140	0.035
Lung disease	0.555	0.075	0.557	0.049
Diabetes	0.694	0.058	0.271	0.041
Cancer	0.709	0.070	0.263	0.040
Heart Disease	0.322	0.061	0.273	0.036
Stroke	0.471	0.083	0.294	0.047
Earnings at baseline				
Second Quartile	0.007	0.114		
Third Quartile	-0.126	0.115		
Fourth Quartile	-0.379	0.125		
Other characteristics at baseline				
Fair or poor health	0.493	0.059	0.417	0.036
Working for pay, male	-0.251	0.115		
Working for pay, female	-0.184	0.103		
SSDI Recipient	0.272	0.076		
Birth year relative to baseline of	-0.044	0.006	-0.023	0.004
Constant	-4.845	0.102		
Gamma	0.087	0.005	0.124	0.004

Source: Authors' calculations

Notes: The probability of death at a given age equals the exponent of the sum of the constant plus gamma multiplied by the number of years from a baseline of age 60 or age 80. The year trend is calculated relative to a baseline of 1940. The age-60 sample comprises 10,580 individuals of whom 1,680 died during the observation period. The age-80 sample comprises 8,703 individuals of whom 5,327 died during the observation period.

Table 4: Imputed prevalence of disease by socioeconomic status

in the CPS sample

	High blood pressure	Diabetes	Cancer	Lung Disease	Heart disease	Stroke
Men, ages 50-60						
Black	0.510	0.171	0.025	0.026	0.060	0.058
Hispanic	0.291	0.172	0.008	0.023	0.045	0.010
Other	0.394	0.119	0.033	0.033	0.092	0.022
Women, ages 50-60						
Black	0.558	0.206	0.059	0.049	0.136	0.051
Hispanic	0.320	0.177	0.060	0.025	0.036	0.010
Other	0.364	0.116	0.087	0.073	0.090	0.032
Men, ages 80 plus						
Black	0.846	0.332	0.321	0.086	0.343	0.155
Hispanic	0.739	0.413	0.172	0.093	0.296	0.145
Other	0.713	0.285	0.303	0.123	0.465	0.162
Women, ages 80 plus						
Black	0.840	0.338	0.143	0.091	0.329	0.160
Hispanic	0.702	0.411	0.155	0.063	0.195	0.045
Other	0.730	0.231	0.216	0.135	0.324	0.134

Note: imputations based on estimates from Table 1, weighted using CPS person weight.

Table 5: Life expectancy at age 62 of CPS sample

	Men	**Women**
Race/ethnicity		
Black	21.90	25.26
Hispanic	27.60	29.19
Other	24.90	27.60
Marital status		
Married/partnered	26.22	29.39
Separated/divorced	21.56	24.46
Widowed	21.03	24.45
Never married	23.29	25.58
Educational attainment		
Less than high school	23.36	24.40
High school/some college	23.57	26.87
College	28.21	30.23
Health Status		
Poor/Fair	15.76	20.02
Good/Very good/Excellent	26.97	29.59
Burden of disease		
Zero diseases	28.69	31.05
One or two diseases	24.92	27.51
Three or more diseases	13.81	15.61

Source: Authors' calculations using CPS data and estimates from Gompertz mortality model. Estimates are weighted using CPS person weights.

Table 6: Impact on the trust fund of COVID-19 excess mortality at ages 55 and older through September 2021

	All		
	Gross liability	EPV of future contributions	Net liability
Expected Present Value (EPV) as of Jan 2020	24,628,193,394,688	654,868,054,016	23,973,325,340,672
Reduction as a result of respondent deaths	165,508,022,272	1,376,805,808	164,131,216,464
Offset as a result of new survivor benefits	33,416,742,400	0	33,416,742,400
Net reduction in EPV due to Covid (row 2 – row 3)	132,091,279,872	1,376,805,808	130,714,474,064

	Singles		
	Gross liability	EPV of future contributions	Net liability
EPV as of January 2020	10,813,062,512,640	344,298,979,328	10,468,763,533,312
Reduction as a result of respondent deaths	87,199,580,160	1,133,302,656	86,066,277,504
Offset as a result of new survivor benefits	0	0	0
Net reduction in EPV due to Covid (row 2 – row 3)	87,199,580,160	1,133,302,656	86,066,277,504
	Couples		
	Gross liability	EPV of future contributions	Net liability
EPV as of January 2020	13,815,130,882,048	310,569,074,688	13,504,561,807,360
Reduction as a result of respondent deaths	78,308,442,112	243,503,152	78,064,938,960
Offset as a result of new survivor benefits	33,416,742,400	0	33,416,742,400
Net reduction in EPV due to Covid (row 2 – row 3)	44,891,699,712	243,503,152	44,648,196,560

Note: Authors' calculations.