An Evaluation of Social Security Reforms: Policy Substitution and Redistributive Consequences[*]

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March 12, 2026

Abstract

This study evaluates the effects of Social Security (SS) reforms, incorporating its interactions with Disability Insurance (DI). The 1983 Social Security Amendments, by raising the full retirement age and increasing early claiming penalties, made DI relatively more generous compared to early SS claiming. We provide empirical evidence that this shift in relative generosity induced individuals to substitute from early SS claiming to DI enrollment. To quantify its implications, we estimate a life-cycle model and find that the DI program significantly mitigates the reform's regressive fiscal and welfare impacts, particularly for individuals in poor health, by serving as a critical safety net.

JEL Codes: H55, J26, I18, I38
Keywords: Social Security, disability insurance, retirement, policy interaction, redistribution

[*]We are grateful to Yongsung Chang, Steven Durlauf, Karen Kopecky, Hamish Low, Svetlana Pashchenko, and participants at ASSA KWEN Workshop, KER International Conference, Brownbag Seminar at GSU, Midwest Macro, and I85 Macroeconomics Workshop for their valuable comments. Any errors are our own.

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1 Introduction

As the population is aging in most developed countries, policymakers and researchers are increasingly focused on improving the fiscal sustainability of the public old-age pension programs. The United States (US) is no exception, leading to the introduction of the 1983 Amendments to Social Security (SS), the government-run public old-age pension program formally known as the Old–Age and Survivors Insurance (OASI). These amendments included a gradual increase in the full (normal) retirement age (FRA), the age at which individuals become eligible to receive 100% of their retirement benefits. Additionally, the reform adjusted benefit schedules to discourage early claiming of benefits and encourage delayed claiming of benefits. Although there are active discussions on the effects of the reform, there is limited understanding of how these reforms may interact with other social insurance programs that may complement or substitute for OASI.

In this paper, we provide a unified framework to jointly study OASI and Disability Insurance (DI), two major social insurance programs for households approaching retirement phase in the US. The OASI program is one of the largest components of the federal budget, accounting for about a quarter of the total. In 2022, 29% of individuals aged 62 claimed SS benefits and 61% claimed benefits before reaching their FRA of 66. Although the DI program aims to provide income insurance for the entire working-age population with work disabilities and does not specifically target older workers, it supports a significant share of individuals nearing retirement: approximately 17% of workers aged 60 to 66 benefits from the program.[1] As such, these two programs are crucial in shaping individuals' transition to retirement.

Given the overlap in the beneficiary population, the Social Security reforms—such as the 1983 Amendments—can affect the claiming behaviors for both the retirement benefits and DI. Specifically, the 1983 Amendment implicitly increases the relative generosity of the DI program because workers can receive DI benefits until FRA, which effectively extends the duration of DI benefits. Furthermore, unlike SS benefits, DI benefits are not subject to early retirement penalties, providing greater incentives to utilize DI rather than claiming SS benefits early. Importantly, such an impact of these incentive changes may vary depending on worker characteristics. In particular, both DI participation and early SS claiming are more common among workers with low education and poor health. Consequently, an increased early claiming penalty may induce larger behavioral responses from

[1] Although the Social Security Administration's Medical-Vocational Guidelines relax eligibility standards for applicants over age 55, this design accounts for the reduced vocational adaptability of older workers rather than an explicit policy objective to provide early retirement benefits. See Code of Federal Regulation § 404.1563(e) for more details.

these workers, especially those who are marginally attached to the labor market due to health reasons, leading to potential redistributive effects.

Our goal in this paper is to evaluate the 1983 Social Security reform, focusing on the potential interactions between SS and DI.[2] Specifically, we address the following three questions: How does the reform impact individuals' utilization of the DI program? What are the effects of the reform when accounting for behavioral responses? And finally, how does the presence of the DI program shape the overall impact of the reform? Specifically, we examine the extent to which the DI program mediates the redistributive effects of the reform on fiscal outcomes (measured as changes in the present value of net benefits) and welfare across individuals of different health statuses. We answer these questions by empirically analyzing DI program utilization behaviors among birth cohorts impacted by the 1983 Amendment and by evaluating the reform's consequences within a structural life-cycle model.

We use the Health and Retirement Study (HRS) data to conduct a cohort-level analysis exploiting the 1983 Amendment. The reform raised the FRA for the 1943-1954 ("young") birth cohorts to 66, up from 65 for the 1931-1937 ("old") cohorts. Further, when the young cohort claims SS benefits at the Early Eligibility Age (EEA) of 62—the youngest age at which he can claim SS benefits—his benefit is reduced by 25%, compared to a 20% for the old cohort.[3] We first document whether the DI and early SS claiming behaviors differ between these two cohorts and quantify the impact of changes in the early SS claiming penalty on these patterns.

Across these two cohorts, we observe varying patterns in DI and SS benefit receipts between the EEA and FRA. In this age range, individuals can claim SS at reduced benefits (since he is older than EEA) or receive DI benefits (since he is younger than FRA). We observe that while the share of individuals receiving either SS or DI benefits is similar across cohorts at each age, the composition of benefits differs. Among the old cohort, about 6% of individuals aged between 62 and 64 receive DI, whereas among the young cohort, the share is around 12%. The discrepancy is more pronounced among high school dropouts than among those with college education.

[2] In 1984, Social Security Disability Benefits Reform Act was enacted that effectively relaxed the screening criterion for the DI program. This policy was applied to all cohorts, although younger cohorts may have been impacted more than older cohorts. We address the potential impact of the DI reform in the empirical analysis by controlling for birth cohort effects as well as the linear trends; and in the quantitative analysis, by conducting counterfactual analyses accounting for the relevant DI program change that impacted the young cohort.

[3] The FRA increases by two months for each birth year for cohorts 1938-1942. The early claiming penalties and delayed retirement credits are also impacted that differ across cohorts, which we detail in Section 2.3. For simplicity, we compare two birth cohorts, 1931-37 and 1943-1954, within which each cohort has the same FRA.

To further evaluate the extent to which the retirement policy reform impacts the behaviors of those nearing retirement, we link the HRS with the restricted Social Security Earnings Records. This linked data allows us to calculate the present values (PV) of DI and claiming SS benefits at age 62 for all individuals at each age leading up to 62. We then construct the percent difference between present values of DI and early SS claiming. This relative DI generosity variable (PVDR) measures the financial trade-offs individuals face, which was impacted by the 1983 Amendments (increased for the young cohort). Our analysis suggests that the relative DI generosity has a statistically significant positive association with DI receipt status. In particular, individuals with a 8 percentage point (pp) higher relative DI generosity (the difference in the medians across two cohorts) are about 11pp more likely to receive DI than claim SS early.

Our empirical evidence indicates that the SS reform may have spillover effects into the DI program, with redistributive fiscal and welfare implications that have yet to be comprehensively explored in the literature. We analyze these consequences using a dynamic life-cycle model that accounts for workers' behavioral responses and the trade-offs inherent in the post-reform environment. The model incorporates workers of heterogeneous education statuses who face disability and labor market risks. Importantly, they make labor supply, DI application, and SS claiming decisions, and we model key policy features, including the distinct benefit calculation formula for SS and DI programs and risks associated with DI application process. We calibrate the model to match the key empirical features of the old cohort, including the age distribution of the Social Security claimants, the share DI recipients by age, and the heterogeneity in outcomes by education statuses.

The calibrated model is then used to conduct several counterfactual analyses. First, we simulate the "young" cohort facing differential SS policies. We observe a decrease in the share of individuals claiming SS at 62, alongside an increase in DI claims, with effects more pronounced among the lower-educated. The simulated model replicates our empirical findings, showing that the PVDR is positively associated with a higher likelihood of receiving DI over early claiming of SS benefits, thereby validating our quantitative framework. We then evaluate the reform's impact by health status—good, fair, and poor—in later working ages.[4] The fiscal effect is measured as the PV of net benefits (PVNB), comprising DI and SS benefits net of taxes, received from ages 50 until death. We evaluate the PVs at age 50 to precisely capture the impact of policy reforms during the life stages when these policies matter the most. We find that the increase in PVNB is higher for individuals with fair and poor health than those with good health. Regarding welfare that we

[4]The 'health' status defined here is different from 'disability' status. Unlike disability status, which evolves annually, our health status represents an individual's overall health capacity between ages 50 and 64. We use this measure to capture a more robust, long-term measure of individual health near retirement.

also evaluate age 50, while the reform results in a welfare loss, the cost is smaller for poor health individuals.

Second, we simulate the reform under two alternative DI environments, one without DI and one with a higher acceptance probability, to examine how DI shapes these fiscal and welfare effects. In the No-DI economy, the poor health individuals are the ones whose PVNB increases the least, unlike in the benchmark economy. That is, DI plays a crucial role in mitigating the reform's otherwise regressive fiscal impact with respect to health statuses. Further, the benchmark DI program reduces the welfare costs by approximately 14% relative to the no-DI economy, with a 37% reduction for those in poor health. Lastly, we examine a more stringent SS reform, the elimination of early SS benefit claiming. This policy significantly increases the DI share, creating a large offsetting effect between decreased SS benefits and increased DI benefits. These results further highlight the significant spillover effects of SS tightening on DI program, and its implications across workers of different health groups.

Overall, our findings underscore that SS and DI function as a deeply integrated system. Ignoring these cross-program spillovers leads to an overestimation of fiscal gains and an underestimation of the vital role DI plays in protecting vulnerable workers near retirement.

Related Literature. Our paper contributes to the vast literature studying public old-age pension and DI.

Recent empirical studies utilizing administrative data have examined the effects of public pension reforms across European countries. For example, Lalive et al. (2023), Rabate et al. (2024), and Geyer et al. (2020) estimate the effects of increased FRA in Switzerland, Netherlands, and Germany, respectively. Notably, Geyer et al. (2020) document evidence of program substitution, specifically into unemployment and other transfer programs within households, which aligns with our observed substitution into DI. Andersen et al. (2021), provides further relevant findings, showing that a Norwegian early retirement incentive change increased working hours of high-wage earners, thereby increasing inequality. Additionally, studies have explored the effects of transitioning from defined contribution to notional defined benefit pension systems in Sweden (e.g., Kolsrud et al., 2024) and Poland (e.g., French et al., 2026). French et al. (2026) highlight dynamic employment responses to pension reform. This aligns with our focus on individuals making dynamic policy and labor market decisions in response to the US Social Security reform.

There are also a substantial body of research using structural models to evaluate the program including French (2005), French and Jones (2011), Imrohoroglu and Kitao (2012), Yang (2013), Kitao (2014b), Dotsey et al. (2015), Jones and Li (2023), Pashchenko and Porapakkarm (2023), and Bairoliya and McKiernan (2023). As summarized in French and Jones (2017), the interaction between health and retirement decisions, influenced by policy environments, is well-established. These papers often incorporate health and medical expenditure risks the elderly face to better understand their retirement behaviors and evaluate the effects of policies. Collectively, previous literature documents a range of public pension reform effects—policy substitutions and dynamic responses at the individual level; and its distributional consequences—which are consistent with the mechanisms and outcomes that we aim to capture in this work. Our work extends the literature by providing coherent empirical and structural analyses of SS reforms, in combination with DI, a policy that individuals may substitute into.

Studies on DI have extensively examined its effects on labor supply, consumption, and mortality, among others (see e.g., Bound and Burkhauser, 1999 for a summary of the literature, and Maestas et al., 2013; French and Song, 2014; Autor et al., 2019; and Gelber et al., 2023). Further, recent structural analysis, including Low and Pistaferri (2015), Kim and Rhee (2022), Hosseini et al. (2025), and Aizawa et al. (2025), focus on DI policy design and its macroeconomic effects, particularly on working-age individuals. We complement this literature by analyzing how DI influences worker decisions near retirement.

Among the few studies that investigate the interaction between SS and DI, as we do, are Duggan et al. (2007), Coe and Haverstick (2010), Li (2018), and Laun et al. (2019). Our work extends these studies in several dimensions. First, we build upon the cohort-based policy variation utilized by Duggan et al. (2007). While their study focuses on average outcomes across cohorts, our use of the Social Security Earnings Records linked to the HRS enables us to measure these effects while accounting for micro-level heterogeneity. This approach is similar to that of Coe and Haverstick (2010) and Li and Maestas (2008), but the availability of recent data provides a more complete understanding of the behaviors of the cohorts under study. Second, our work advances the structural literature of Li (2018) and Laun et al. (2019) by explicitly bridging empirical evidence with structural modeling. We conduct the empirical analysis that measure how the relative generosity of DI impacts worker decisions; we then use these empirical findings to validate our quantitative framework.

Finally, our model provides a nuanced evaluation of the distributional consequences of Social Security reform in the presence of DI. While Kitao (2014b) analyzes the long-run general equilibrium effects of these reforms, we focus on the redistributive fiscal and welfare impacts on the specific cohorts directly affected by the 1983 Amendments. By incorporating the granular interplay between education and health statuses, our work quantifies the disaggregated effects across individuals with heterogeneous profiles. This approach allows us to demonstrate how DI serves as a critical social safety net that mitigates the regressive impact of Social Security tightening, particularly for individuals in poor health. Ultimately, by highlighting micro-level heterogeneity during the pre-retirement period, our analysis provides a more detailed understanding of the welfare costs borne by the most vulnerable populations, a dimension often obscured in aggregate general equilibrium modeling.

The rest of the paper is organized as follows. We summarize the institutional background in Section 2 and present our empirical analysis in Section 3. We describe the model environment and the calibration strategy in Sections 4 and 5 respectively, and conduct quantitative analyses in Section 6 before we conclude in Section 7.

2 Institutional Background

In the US, the Social Security Administration (SSA) administers the federal Old-Age, Survivors, and Disability Insurance (OASDI) program. The OASDI program provides benefits for retired workers, survivors and individuals with disabilities. In 2022, the program provided payments to 66.0 million people—57.2 million individuals received old-age and survivors insurance and 8.8 million people received disability insurance—with its total cost at 5.2% of GDP ($1.2 trillion dollars). The program is funded by payroll taxes on wage and salary earnings with contributions from both employers and employees. In 2024, the OASDI tax rate is 12.4%, up to a maximum earnings of $168,600.

Within the broader OASDI program, we distinguish between the DI and OASI and refer to OASI as SS program. In the next, we discuss institutional details of each program, outline the key components of policy changes, and summarize the resulting discrepancies in policy environments across cohorts, which we utilize for our empirical analyses.

2.1 Disability Insurance

DI program is aimed at helping working-age individuals who are unable to work due to disabilities. To be insured, a worker needs to accumulate enough "credits," where one credit is awarded for a certain amount of earnings ($1,730 in 2024) for a maximum of four credits per year.[5] The Social Security Act defines disability as an "inability to engage in any substantial gainful activity by reason of any medically determinable physical or mental impairment which can be expected to result in death or which has lasted or can be expected

[5]The number of credits required to be insured depends on the individual's age at the onset of disability. For example, if a disability begins at age 42, five years of work are required, whereas nine years are required if the disability begins at age 58.

to last for a continuous period of not less than 12 months."[6] In 2024, the substantial gainful activity (SGA) amount was $1,550 per month for non-blind individuals. A worker who is disabled and has the number of credits necessary to be insured sends his application to the Disability Determination Services. The decision for benefits are determined following evaluation of the individual's ability to work, the severity of condition, the type of impairments, and the ability of the individual to continue his past work or do other type of work. Once the application is submitted, it takes around six to eight months for an initial decision, five months before the first benefit is paid, and 24 months to become eligible for Medicare benefits.[7] The DI benefits may be terminated if upon a review by an examiner, the beneficiary is deemed no longer disabled, or he dies. Otherwise, when he reaches a full-retirement age, the benefit automatically changes to retirement benefits.

The DI benefits are calculated based on each workers' average indexed monthly earnings (AIME). AIME is determined as the average earnings (indexed to reflect wage levels in each year) over the computation years. For DI, the years with the highest indexed earnings between the age of 22 and the disability onset are used, excluding a maximum of five years of earnings.[8] Given the AIME, the primary insurance amounts (PIA) is determined as 90% replacement of the AIME up to the first bend point, 32% replacement between first and the second bend points, and 15% replacement beyond the second bend points, with a maximum benefit amount.[9]

2.2 Old-Age and Survivors Insurance

Individuals who have worked and paid Social Security taxes for 10 years (40 credits) or more become eligible for SS benefits upon reaching age 62. Similar to DI, the size of the retirement benefit is determined by AIME. However, unlike the AIME for DI, which is based on earnings prior to disability onset, the AIME for SS is calculated as the average of the highest 35 years of indexed earnings over the workers' career. Thus, if a worker worked for 30 years, then five years of earnings are recorded as zero in calculating his AIME for SS. The PIA is then determined following the same formula as in DI.

There are two additional adjustments to the actual benefit amount that retirees receive.

[6] See Section 223(d)(1) of the SSA for further details. A separate definition applies to those who are blind.

[7] If the individual is denied the benefits, he is allowed to appeal the decision. For a detailed discussion of the DI appeal process, see French and Song (2014).

[8] The number of "drop-out" years is calculated as the minimum of 5 and one-fifth of the elapsed years, represented as $\min\{5, 0.2 \times (\text{disability onset age} - 22)\}$. According to this formula, the number of drop-out years is five for anyone who develops a disability on or after age 47.

[9] The two bend points of the 2024 monthly benefit formula are $1,174 and $7,078, and the maximum benefit amount is $3,822.

First, the benefit amount depends on the age at which the benefits are claimed. Workers receive the PIA as their benefits if they claim SS at FRA. Monthly benefit payments are reduced if claimed prior to FRA and increased if deferred, up to age 70. The FRA and the specific penalty (credit) from early (delayed) claims depend on the beneficiary's year of birth; we provide a detailed discussion of these cohort-specific policies in Section 2.3. Second, the retirement earnings test (RET) reduces benefits for those with earnings above a certain threshold.[10] For instance, the RET deducts $1 from retirement benefits for every $2 of labor income above the annual limit if the beneficiary claims SS before reaching their FRA. These withheld benefits are given back to beneficiaries once they reach their FRA.

2.3 Legislative Reforms and Policy Environments Across Cohorts

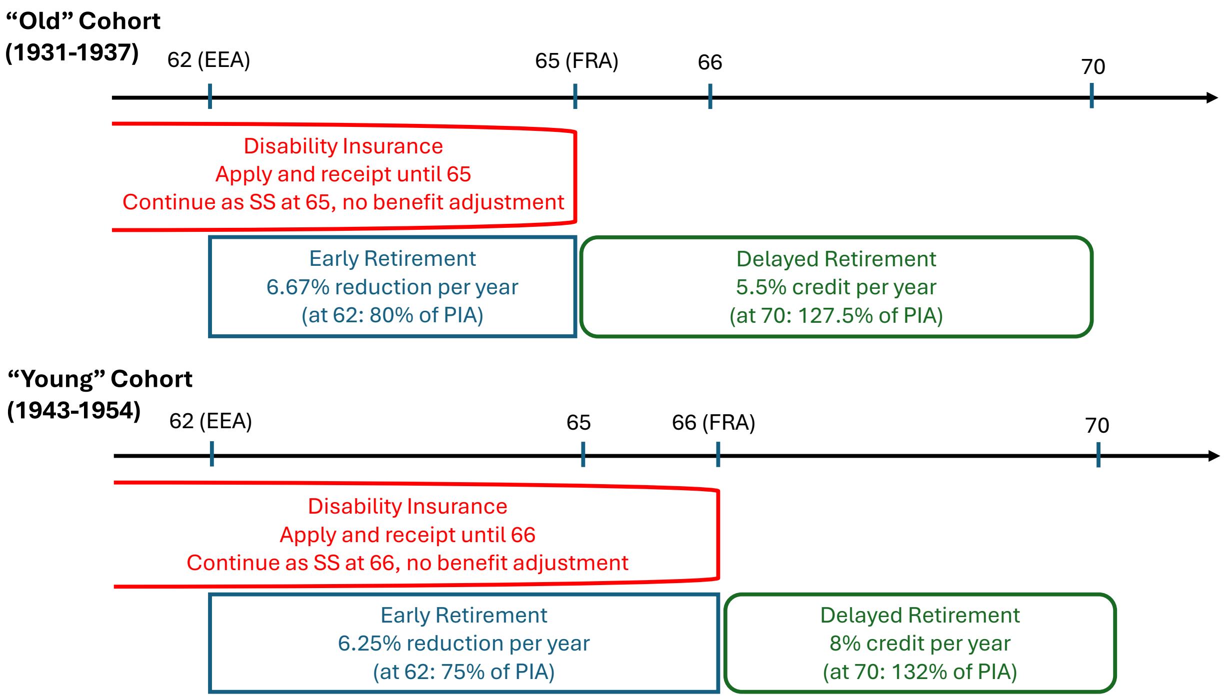
Social Security Amendments of 1983. In April 1983, the Social Security Amendments of 1983 was signed into law to restore the program's financial stability. Among the changes were increases in FRA, enhancements to the early retirement penalty, and adjustments to the delayed retirement credit. First, the FRA is 65 for workers born in 1937 or earlier. Then, it rises incrementally for subsequent cohorts by two months per birth year, reaching 66 for those born between 1943 and 1954, and eventually increasing to 67 for those born 1960 or later. Secondly, the early retirement penalty for those born in 1937 or earlier is 6.67% per year; consequently, claiming benefits at EEA of 62 results in a 20% reduction. In contrast, the 1943-1954 birth cohorts face a steeper penalty, resulting in a 25% reduction if benefits are claimed at 62. Lastly, among those who claim benefits after the FRA, there is a credit to their benefits. These credits gradually increased from 4.5% per year for 1929-1930 birth cohorts with a maximum of 22.5% at age 70, to 8% per year for 1943 and later cohorts with a maximum of 32% at age 70.[11] Combined, these policy adjustments are aimed at incentivizing longer working years.

Social Security Disability Benefits Reform Act of 1984. In 1984, the Social Security Disability Benefits Reform Act mandated a "medical improvement standard" that required the SSA to prove the a recipient's condition had improved before terminating benefits. Further, the Act effectively made it easier to receive DI benefits for non-severe conditions. The reform did not alter DI benefit schedule and was applied uniformly for all individuals.

[10] For details on the implementation of the RET, see Social Security Administration (2026). Regarding behavioral responses, Gruber and Orszag (2004), among others, examines how the earnings test affects the labor supply decisions of workers near the FRA.

[11] It increases 0.5% per year for every two-year birth cohorts, e.g., 5% for 1931-1932 cohorts and 5.5% for 1933-1934 cohorts.

Figure 1: Disability Insurance and Social Security Options by Cohorts



Summary of Policy Environments across Cohorts. In the next section, we analyze the behaviors of two cohorts—those born between 1931 and 1937 whom we denote as the “old” cohort, and those born between 1943 and 1954, the “young” cohort. We select these two cohorts because they face a discrete difference in the FRA (65 vs. 66) and differential early claiming penalties (20% vs. 25% at age 62). Additionally, the availability of recent data enables us to track their DI and SS benefit claiming behaviors through the FRA of the youngest birth cohort.

Figure 1 summarizes the DI and SS policy environments faced by these two cohorts. The DI option is available until the worker reaches the FRA. As discussed, the early claiming of the Social Security benefits is available at age 62 (EEA), at differential penalty rates across cohorts. Additionally, the delayed claiming of SS benefits is rewarded differentially across cohorts, with the maximum reward at age 70.[12]

Overall, the retirement reform increased the relative attractiveness of DI for the young cohort for several reasons. First, note that the PIA of DI may be higher than that of SS benefits, especially among workers with (potentially) shorter years of work history. This is because when a worker with less than 35 years of experience receives DI, his AIME is

[12]There are differences in early and delayed retirement benefit adjustments within our two cohort groups (“young” and “old”); in such cases, we use simple averages. The exactly policy parameters for each birth year are summarized at https://www.ssa.gov/oact/ProgData/ar_drc.html.

not penalized as much as it is for retirement benefits, due to differences in computation years between DI and SS. Secondly, the PIA effect is amplified by higher FRA and a larger early claiming penalty. As noted, DI benefits are automatically transferred to retirement benefits at FRA without adjustments in their benefit amounts. Therefore, a higher FRA implies longer expected duration of DI receipt. Further, a higher early retirement penalty increases the relative generosity of the DI. These factors collectively enhance the relative value of disability benefits, potentially inducing higher DI utilization among the young cohort.

It is also worthwhile to note the timing of the 1984 reform relative to each cohort's life cycle. In 1984, the old cohort was aged between 47 and 53, while the young cohort was aged between 30 and 41; consequently, the young cohort was exposed to relaxed screening criteria for a longer portion of their working lives. However, because our analysis focuses on the ages at which DI and retirement incentives most directly interact, in the empirical analysis, we restrict our attention to individuals who start receiving DI after the age of 50. This restriction implies that the majority of the old cohort, like the young cohort, were subject to the same post-1984 DI screening criteria at the time of their disability shocks.[13]

3 Empirical Motivation

Our goal in this section is to empirically examine whether there is a connection between the change in retirement benefit schemes and the utilization of DI. Specifically, we investigate whether more stringent retirement policies (e.g., higher penalty from early retirement) are associated with higher utilization of DI (substitute early retirement with DI). We do so by leveraging the policy reform described in Section 2.3 that resulted in differential policy environments across cohorts. We first describe the datasets used for the analyses, present the behaviors of individuals near retirement by cohort, and conduct econometric analyses to measure the effects of changes in SS benefits on DI utilization and early retirement decisions of workers.

[13]Nevertheless, as there is suggestive evidence of a long-term trend toward more relaxed DI screening (Autor and Duggan, 2006), we include both cohort dummies and linear trends in our empirical analysis to account for these potential confounding effects. Furthermore, our quantitative analysis includes a counterfactual scenario with a higher DI acceptance probability for the young cohort. This allows us to further examine the potential impact of the changing institutional environment.

3.1 Data

Our main data source for empirical analysis is the HRS, linked with the administrative data from the SSA. The HRS data is a biennial longitudinal dataset representing individuals aged 51 or older. We combine the publicly available HRS data for years 1992 to 2020, which contains detailed demographic and health information, with restricted SSA datasets. Specifically, we use the Cross-Year Benefits data and the Cross-Year Summary Earnings data to further investigate and understand the factors determining workers' labor market, DI, and SS receipt statuses.

The HRS is suitable for our analysis as we analyze behaviors of individuals near retirement. Further, as the HRS started in 1992, we can utilize a long panel dimension to gather information over individuals' lives. Of particular interest are the health and work disability statuses, important determinants for DI and retirement decisions. Although DI benefit decisions are based on whether a worker has a work disability, there is a large spectrum in severity of such disabilities or health statuses. Thus, capturing health statuses of individuals at finer levels is crucial. To do so, we utilize two measures in our analysis. First is the work disability variable, a binary variable indicating whether an individual has a work disability or not. The second is "frailty index" that is constructed using the number of health conditions (e.g., specific diagnosis like diabetes and restrictions in activities of daily living) an individual has, which was shown to be a good measure of health status (see, e.g., Mitnitski et al., 2002). We use the index constructed by Hosseini et al. (2022), which is an unweighted average of the sum of health conditions (one if you have a condition, zero otherwise) that does not include the binary work disability variable. In addition to disability and health-related variables, we also utilize other individual-level characteristics such as education and marital statuses.

We combine the HRS with the Cross-Year Benefits data from the SSA. In this dataset, we observe benefits participation (DI and SS), the benefit starting month and year, and the benefit amounts. These are important outcome (e.g., whether one receives benefits) and explanatory (e.g, how benefit amounts impact the decision to claim SS benefits) variables for our analyses. A limitation, however, is that the benefit amount is available only for those who are receiving DI or SS, which makes it difficult to fully understand how the reform impacted behaviors. We address this shortcoming by further utilizing the Cross-Year Summary Earnings data. The Cross-Year Summary Earnings data from the SSA provides earnings records of the HRS respondents for those who have provided permission to match their SSA records with HRS data. For those who consent to provide earnings record, we have annual earnings data for years from 1951 to 2020. Earnings are recorded to zero for those who have no reported earnings; earnings below $49.99 were recorded as "N" to preserve confidentiality; and earnings above $50 are rounded to the nearest $100. We use this data to construct the potential (hypothetical) PIAs for each individual at a given age, providing us with a measure that captures the financial values of receiving DI or SS. We explain in detail how we use this data to construct a variable measuring the relative generosity of DI compared to claiming SS early in Section 3.3, with more detailed descriptions of the datasets relegated to the Appendix A.

We restrict our sample to males, as female employment rates among the studied birth cohorts are significantly lower than those of males (unlike females in recent birth cohorts), which may confound the analyses.[14] We also drop individuals who started receiving DI before 50 as we are interested in DI utilization decisions near retirement.

3.2 Stylized Facts

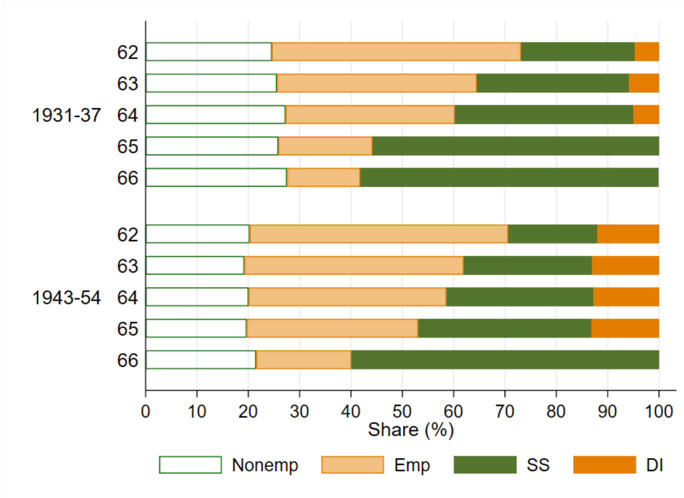
In this section, we examine whether there are any behavioral differences across the "old" and "young" cohorts as defined in Section 2.3, who face differential SS benefit schedules. Figure 2 plots the share of workers by their labor market and benefit receipt statuses, for ages between the EEA (62) and FRA (65 for old cohort and 66 for young cohort) within each cohort; and Figure 3 presents the same statistics by three education groups, high school dropouts (HSD), high school graduates (HSG), and those with some college education or more (COL). We focus on behaviors between EEA and FRA, since that corresponds to the age range in which individuals can utilize either DI (since it is before the FRA) or claim SS benefits (since one can start receiving SS benefits at EEA). For example, the first bar in Figure 2 represents the share of individuals who are employed, unemployed, receiving SS benefits, or receiving DI benefits at age 62, among the old cohort.[15]

We make two observations from these plots. First, as shown in Figure 2, there is a growing share of individuals receiving any benefits (DI or SS) as they approach their FRA, and this is common in both cohorts. However, the composition of benefits differ across cohorts. Among 62-year-old individuals, 5% of those in the old cohort receives DI and 23% receives

[14]This sample restriction follows the standard approach in the literature. For instance, French (2005) uses male observations from the PSID to study the role of pension and health on labor supply decisions, and Low and Pistaferri (2015) use a similar sample to analyze the effects of DI. By focusing on males, we abstract from spousal claiming strategies and joint labor supply decisions. For research that explicitly focuses on household interactions, see, e.g., Nishiyama (2019) or Borella et al. (2023).

[15]These categories are not necessarily mutually exclusive as those who receive DI and SS can also work. For a clear illustration, we categorize employed and unemployed among those not receiving any benefits. Practically, DI recipients earning more than the Substantial Gainful Activity ($1,550 per month in 2024) lose their benefits. Thus, in our data, the share of DI recipients who also work is small at around 10%, while the share of employed individuals among SS recipients is higher and varies across ages. In Appendix A.3, we provide further statistics distinguish employment statuses of SS recipients. We find that the qualitative patterns across cohorts are robust to using more disaggregated categories.

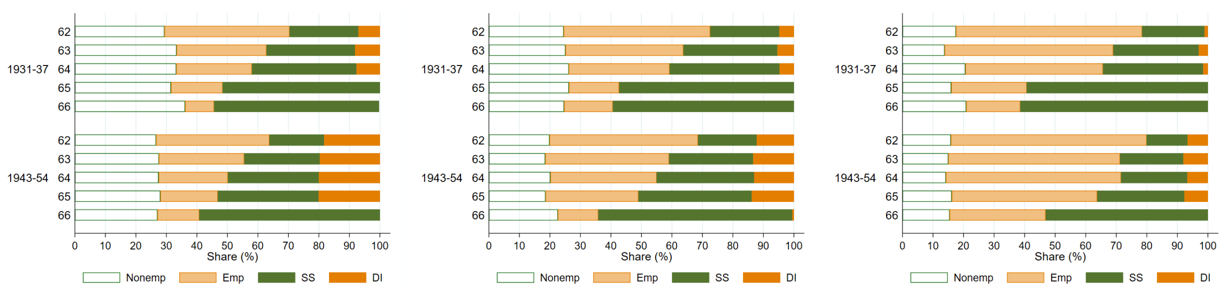
Figure 2: Share of Workers by Labor Market, SS, and DI Status, by Cohort



Note: Figure 2 shows the share of males by labor market and benefit statuses between ages 62 and 66, using the restricted HRS dataset.

Figure 3: Share of Workers by Labor Market, SS, and DI Status, by Education and Cohort

(a): High School Dropouts (b): High School Graduates (c): Some College



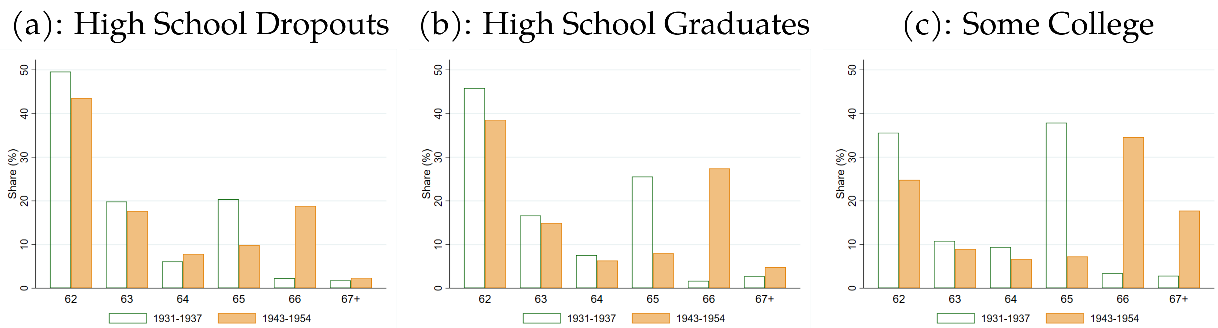
Note: Figure 3 shows the share of males between ages 62 and 66 by their labor market and benefit statuses across education groups, using the restricted HRS dataset.

SS, whereas 12% of those in the young cohort receives DI and 18% receives SS.[16] Thus, we see substantial compositional differences in benefit types across cohorts. Note that at the FRA, DI benefits automatically become SS benefits, and therefore DI shares are no longer relevant. Second, in Figure 3, we see a large heterogeneity in these shares across education groups. Less-educated workers (HSD or HSG) are more likely to receive DI benefits and retire early than their more educated counterparts (COL) who are more attached to the labor market as shown by high share of employed workers. Further, the difference in DI shares across cohorts is more pronounced among the less-educated, implying that

[16]It is important to note, however, that this does not necessarily imply that individuals work longer. Recent papers (e.g., Deshpande et al., 2024) have found that while younger cohorts delay SS claiming until their FRA, the retirement age (as measured by labor supply) is sticky at 65.

less-educated workers may be more responsive to SS benefit changes with regards to DI utilization.

Figure 4: Distribution of SS Claiming Age by Education and Cohort



Note: Figure 4 illustrates the distribution of SS benefit claiming age by education and cohort from the restricted HRS dataset.

Focusing on SS claiming behaviors, Figure 4 compares SS claiming age distribution of young and old cohorts. It represents the share of individuals claiming SS benefits at each age by education and cohort. As is well-known in the literature, there are two modes in the distribution—one at EEA and another at FRA—and there are large differences in retirement behaviors across education groups. Less (highly)-educated individuals are more likely to choose early (delayed) claiming of SS. Further, we see a lower early claiming share and a higher delayed claiming share among the young cohort.

Overall, the discrepancies in DI recipiency rates across cohorts that we document may be primarily driven by worker behaviors. However, it is also possible that DI program changes impacted such heterogeneity. As discussed in Section 2.3, the Disability Benefits Reform Act was implemented in 1984, which broadened the definition of disability and provided more flexibility in DI acceptance decisions. In our sample, 1934 birth cohorts were 50 years old when the Act was implemented, suggesting that all cohorts, with the exception of 1931-1933 birth cohorts, were subject to the same DI policy. Importantly, this reform did not impact DI benefits formula, which we use in Section 3.3 to understand behavioral differences across cohorts.

Although there have been no major institutional reforms in the DI program since 1984, it is still possible that the DI screening process might have still changed. For example, Autor and Duggan (2006) report a significant increase in the applicants going through the appeals process: in 1986, 54% of applicants denied at the initial appeal stage appealed to administrative law judges, whereas the share rose to 83% in 1997. Similarly, von Wachter et al. (2011) use SSA administrative data to document an increase in the annual allowance rate at the Disability Determination Services (DDS) level between 1992 and 1999. These observations suggest that the discrepancy in DI beneficiary shares across cohorts may have also been partly impacted by changes in DI screening policies, even in the absence of new legislation.

In the following section, we further explore the role of SS reform in DI utilization, after controlling for various cohort and time effects. Specifically, we measure to what extent changes in retirement benefit policies that increased the generosity of DI relative to early retirement are associated with the observed patterns in DI utilization across cohorts.

3.3 Descriptive Evidence

We aim to further investigate the relationship between the policy change and the observed behavioral differences across cohorts documented in Section 3.2. Our goal is to compare the expected present values (PV) of DI and SS benefits to measure the economic incentives of opting in to these programs and relate them to worker outcomes, the approach initially suggested by Duggan et al. (2007) and also used by Li and Maestas (2008) and Coe and Haverstick (2010). Our analysis leverages the detailed micro-level panel data to construct individual-level incentives to analyze individual-level outcomes, in contrast to Duggan et al. (2007) who use average economic incentives and outcomes across cohorts. Additionally, as our data spans 1992 to 2020, we can observe the decisions of the young (birth years 1943-1954) cohort until up to between ages 66 (1954 birth cohort) and 77 (1943 birth cohort).[17]

To conduct our analysis, we first calculate hypothetical AIME and PIA at the individual level utilizing Social Security earnings records merged with the HRS, and compute the present values of receiving DI (PVDI) and claiming SS benefits at EEA (PVSS). We then use these values to construct a measure of relative generosity of DI to understand its effects on individual behaviors.

Constructing the Present Values of DI and SS Benefits. The present values of DI and SS benefits capture the economic values of enrolling in these programs. In the Cross-Benefits data, the benefit amounts (PIA) are only available for those who start receiving benefits and only in the person's first year of benefit receipt. Our goal is to construct the PIA and subsequently, the present values of enrolling in policies for *each individual at each age* to understand its role in worker decisions.

[17] Li and Maestas (2008) and Coe and Haverstick (2010) use individual-earnings records from the HRS from 1992 through 2006 and 2008 respectively to construct the values of DI and SS. Thus, the samples in these studies are limited to those born in years 1935-1941 and 1935-1943. Both studies find increases in DI application probabilities in response to the rise in FRA.

Using the earnings history from the Cross-Year Summary Earnings data, we calculate AIME for DI and AIME for SS for each individual at each age. As discussed in Section 2, the computation year of DI may be lower than that of SS, thus the AIME depends on the type of benefit. We then use the AIME for each policy to construct the corresponding PIA, which is determined as a piece-wise linear function of the AIME. We describe the detailed construction process of the AIME and PIA in Appendix A.2, where we also confirm the validity of our measure of PIA using the observed PIA variables (available only for a small subsample of individuals in the data).[18]

Given the calculated hypothetical PIA's for DI and SS, the expected present value of DI benefit of individual i at age a is defined as

$$\mathrm{PVDI}_{i,y,a} = \sum_{t=a}^{T} \sigma_{y,a,t} \cdot \frac{\widehat{\mathrm{PIA}}_{i,a}^{\mathrm{DI}}}{(1+r)^{t-a}}, \qquad (1)$$

where $\sigma_{y,a,t}$ is the survival probability between age a and t of cohort y from the life table from the SSA, and $\widehat{\mathrm{PIA}}_{i,a}^{\mathrm{DI}}$ is the PIA of DI at age a based on his earnings record. Future benefits are discounted with an interest rate r of 3% and the maximum age T is set at 95.[19]

As described in Section 2.3, whereas DI benefit formula has not changed across cohorts, the SS benefits vary by the individual's birth year. In particular, we are interested in the expected present value of claiming SS benefit at age 62, the EEA. We focus on benefits at age 62, because the early claiming penalty differs across cohorts due to policy change. Further, since 62 is the earliest age at which workers can claim benefits, individuals considering DI may also consider the option to claim SS at age 62, representing the differential trade-offs individuals face by their birth years. The present value of claiming SS benefits at age 62 for an individual i of cohort y at age $a \leq 62$ is expressed as

$$\mathrm{PVSS}_{i,y,a} = \left(\frac{\sigma_{y,a,62}}{(1+r)^{62-a}} \right) \cdot \left(\sum_{t=62}^{T} \sigma_{y,62,t} \cdot \frac{\delta_y \cdot \widehat{\mathrm{PIA}}_{i,62}^{\mathrm{SS}}}{(1+r)^{t-62}} \right), \qquad (2)$$

where δ_y is the early claim reduction rate for cohort y. Since the EEA is 62, the expected present value of SS benefits at age a reflects the waiting period between age a and 62, taking

[18]Specifically, we run the regression of observed PIA on our hypothetical PIA by benefit types—SS at FRA, early SS, and DI beneficiaries. The coefficients on hypothetical PIA are 0.96, 0.70, and 0.91 with R^2 ranging between 0.83 and 0.93. The coefficient on early claimants reflects early claiming penalty of around 30%, consistent with the SS policy specifics described in Section 2.2. Overall, this confirms that our constructed PIA is a reliable measure of the benefit amounts that a worker would have received, if he were to enroll in these programs.

[19]In addition to monthly benefits, DI beneficiaries become eligible for Medicare after a two-year waiting period, which provides substantial monetary value (Autor and Duggan, 2006). Therefore, our PVDI measure can be considered as a lower bound.

into account both the interest rate r and survival probability between age a and 62, $\sigma_{y,a,62}$.

Relative Generosity of DI. Now, we construct the relative DI generosity as

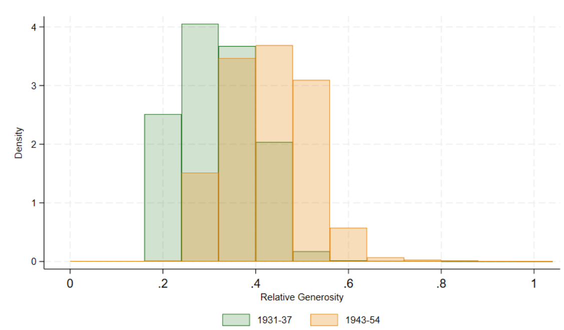
$$\mathrm{PVDR}_{i,y,a} \equiv \frac{\mathrm{PVDI}_{i,y,a} - \mathrm{PVSS}_{i,y,a}}{\mathrm{PVSS}_{i,y,a}}, \tag{3}$$

which represents the relative difference between the PV of receiving DI (PVDI) and the PV of claiming SS benefits at age 62 (PVSS), for an individual of current age a of cohort y, as a share of PVSS.[20] Table 1 illustrates the summary statistics of relative DI generosity by cohort at age 62 (top panel) and for those between ages 60 and 62 (bottom panel). There is a substantial heterogeneity in the relative DI generosity across cohorts: the average (median) relative DI generosity of the old cohort is 0.25 (0.24) and that of the young cohort is 0.35 (0.32) at age 62. The average PVDR at age 62 is smaller than that of ages 60-62, because individuals can start receiving SS at EEA (so there is no waiting period for SS claiming).[21] In Figure 5, we plot the distribution of relative DI generosities across cohorts for those aged 60-62, where we see a shift in the distribution of PVDR across cohorts. This across-cohort heterogeneity provides us with the variation we can exploit to study individual behaviors.

Table 1: Relative DI Generosity

		Birth Years	
		1931-37	1943-54
At 62	Mean	0.25	0.35
	Median	0.24	0.32
	St. Dev	0.07	0.18
Ages 60-62	Mean	0.30	0.44
	Median	0.31	0.42
	St. Dev	0.14	0.20

Figure 5: Relative DI Generosity Distribution by Cohort



Note: Table 1 documents the average, median, and standard deviation of PVDR at age 62 and age 60-62, as defined in Equation (3), by cohort. Figure 5 shows the corresponding distribution of PVDR for 60-62-year-olds across cohorts.

Relative Generosity of DI and Early Claiming of Social Security. By exploiting policy-driven variations in PVDR, we analyze the relationship between relative DI generosity and

[20]Further details regarding the construction of these variables are summarized in Appendix A.1.

[21]While the raw differences between PVDI and PVSS vary across education, when normalized by PVSS as in Equation (3), the average relative DI generosities are similar across education.

early SS claiming to investigate the extent to which DI and early SS claiming are substitutes. We estimate the following linear probability model in a sample of individuals who receive DI or claim SS early, using two measures of early SS claiming: (i) claiming at EEA (62); and (ii) claiming between the EEA and one year before the FRA (64 for the old cohort and 65 for the young cohort):

$$y_i = \beta_0 + \beta_c \cdot \text{Cohort}_i + \beta_t \cdot t + \beta_X \cdot X_i + \gamma \cdot \text{PVDR}_{i,62} + \varepsilon_i. \quad (4)$$

Specifically, the outcome variable is recorded as one if he receives DI and zero if he claims SS early (either at the EEA or anytime before the FRA). Our coefficient of interest is γ which captures the effect of PVDR on a worker's DI receipt status. Therefore, a positive coefficient implies that those with high relative DI generosity may be substituting out of early SS and towards DI. We use PVDR at age 62 to more accurately capture the exact trade-off at EEA. We add cohort dummy variable, Cohort_i; a linear trend, t; and individual-level characteristics in X_i that include education, marital status, and health statuses, as controls. To control for health, we use the average frailty index and work limitation around EEA (between 61 and 63). We use averages over several ages because health-related variables are not reported every year and this approach allows us to increase the sample size. The cohort dummies and linear trend capture the potential differences in the DI program faced by individuals at different years and ages, and the steady increase in the enrollment in DI programs documented in Autor and Duggan (2006).[22]

In Table 2 are the results from the two outcome variables. Under both the narrow (SS at age 62, first two columns in Table 2) and broad (SS before FRA, last two columns in Table 2) definitions of early claiming, we observe that highly educated individuals are less likely to receive DI benefits, but the effect diminishes after controlling for frailty index and work limitation. Under both specifications, those with a high frailty index (indicating more health conditions) or a work disability are more likely to receive DI. Across specifications, we see that relative generosity of DI has a significantly positive impact on DI receipt of individuals even after controlling for health statuses. That is, those whose financial incentives from DI are high opt out of claiming SS early and are more likely to enroll in DI, a suggestive evidence of substitutability between DI and early SS claiming. In the sample of DI recipients and those claiming SS at 62, 16% of the old cohort receives DI and 32% of the young cohort receives DI. Quantitatively, an increase in the PVDR at age 62 from 0.24 (median of old cohort in Table 1) to 0.32 (median of the young cohort) is associated with

[22] We use the observation at age 62 for this analysis (so age dummies are not necessary). It is also possible to conduct the analysis at varying ages of an individual (e.g., the first observation of each individual) and add age dummies. The results are robust to such choices.

Table 2: Relative DI Generosity and DI Receipt (versus Early SS Claiming)

	DI Status versus			
	SS Claiming at 62		SS Claiming before FRA	
High school graduates	-0.085***	-0.030	-0.058***	-0.013
	(0.027)	(0.020)	(0.020)	(0.015)
Some college	-0.151***	-0.024	-0.108***	0.001
	(0.031)	(0.026)	(0.022)	(0.019)
Relative DI generosity at 62	2.301***	1.356***	2.261***	1.361***
	(0.431)	(0.304)	(0.363)	(0.255)
Frailty		0.624***		0.575***
		(0.079)		(0.063)
Work Limitation		0.472***		0.406***
		(0.025)		(0.255)
R^2	0.084	0.486	0.066	0.431
Observations	1,471	1,314	2,200	1,950

Note: Table 2 documents regression coefficients from estimating Equation (4) on sample of individuals who either receive DI or retire early. The two outcome variables are constructed as one if the individual receives DI and zero if he claim SS at 62 (the first two columns) or if he claim SS before FRA (the last two columns). Frailty and work limitation are averages between the ages of 61 and 63. Robust standard errors are in parentheses. $*p < 0.10; **p < 0.05; ***p < 0.01$

around 11pp increase in DI receipt probability, around 67% of the difference in behaviors.[23] In Appendix A, we also estimate a Logit model and find similar effects of PVDR.

3.4 Taking Stock

We document heterogeneity in DI and SS claiming behavior across cohorts in Section 3.2 and show evidence that these behaviors may be associated with the SS reform in Section 3.3. Specifically, our empirical analyses suggest that the SS reform has shifted individuals from early SS toward DI. When the value of DI program is relatively higher than alternatives like the early SS claiming, individuals experiencing a disability shock before the retirement age are more inclined to choose DI, a decision consistent with dynamic optimization.[24] Thus, while the empirical analysis in this section provides suggestive evidence of the behavioral response of forward-looking individuals and highlights its economic sig-

[23] Coile et al. (2015) documents that the expansion of the VA's Disability Compensation Program coincides with a decline in Veterans' labor force participation. To address potential compositional changes driven by the increase in Vietnam war veterans among the later cohort, we re-estimate Equation (4) excluding observations with veterans status. Our results remain robust to this sample selection criterion.

[24] These further imply that workers may opt for DI with milder or less verifiable health conditions. Indeed, we observe a higher prevalence of reported psychiatric condition, which is associated with larger labor disincentive effects according to Maestas et al. (2013), among DI recipients in the young cohort compared to the old cohort, reinforcing the idea that the SS reform-driven changes in financial incentives may impact DI utilization.

nificance for evaluating SS reform, it is limited in its ability to capture the full dynamic impact of the policy change. To quantitatively evaluate these dynamic trade-offs, we develop a structural model in the following section.

4 The Model

We construct a stochastic life-cycle model of labor supply, consumption and savings, DI application, and SS claiming, with agents facing disability and labor market risks. The model builds upon a life-cycle model with endogenous DI application (e.g., Low and Pistaferri, 2015; Kim and Rhee, 2022) by incorporating SS policies and endogenous retirement and SS claiming decisions (e.g., Jones and Li, 2023; Pashchenko and Porapakkarm, 2023).

4.1 The Model Environment

4.1.1 Demographics, Endowments, and Preferences

Time is discrete, and a model period is a year. Each individual of a given education status s (high school dropouts, high school graduates, or some college), starts his life at age 25 ($j = 25$), works at most 45 years (mandatory retirement at age 70, $j^R = 70$), and can live at most 70 periods (maximum age $J = 95$). The conditional survival probability depends on his age j, education s, and disability status h, where h is either non-disabled (ND), moderately disabled (MD) or severely disabled (SD). We denote the survival probability from age j to age $j+1$ as $\delta^h_{s,j} \in (0,1)$ with $\delta^h_{s,J} = 0$, and specify the transition of h as an age and education-specific Markov chain denoted by $\pi^{ab}_{s,j} = \Pr\left(h_{j+1} = b \middle| h_j = a\right)$.[25] We model three education statuses in light of the empirical observations in Section 3.2, which further allows us to evaluate redistributive consequences of SS reforms in our counterfactual analyses.[26] Additionally, modeling three disability categories (relative to two) is essential as it allows us to capture the behavior of individuals who are at the margin of DI application and/or SS benefit claiming.[27]

[25]Empirically, we combine the frailty index and the binary measure of work disability to discretize the disability status of workers. See Section 5 for details.

[26]Previous papers, e.g., Jones and Li (2023), have also shown the importance of accounting for education-dependence in factors such as mortality for evaluating SS reforms.

[27]We assume that the disability process is first-order Markov, a commonly used assumption in the literature (e.g., French, 2005; Kitao, 2014a). A recent paper (De Nardi et al., 2025) captures both the short- and long-run dynamics of health by allowing for history-dependence of health shocks. Although the rich modeling would be preferable, we adopt a simpler disability transition technology for tractability. Accounting for the rich dynamics could impact the degree of heterogeneity in the labor market responses to the DI program across disability statuses.

An individual maximizes his expected lifetime utility with a discount factor of β. His periodic utility is determined by the amount of consumption c and leisure l. We use the following specification, similar to, e.g., French (2005) and French and Jones (2011):

$$u(c,l) = \frac{\left(c^{\kappa} \cdot l^{1-\kappa}\right)^{1-\gamma}}{1-\gamma}, \text{ where } l = 0.3 + \frac{1-0.3}{1+\exp\left(\theta\left(s,h,P_j\right)\right)} \tag{5}$$

The parameter κ determines the weight on consumption, and γ impacts the degree of risk aversion. The amount of leisure available to an individual l is normalized to one with a minimum value of 0.3 (for, e.g., sleep). The function $\theta\left(s,h,P_j\right)$ incorporates the time costs of worker's disability and employment statuses $P_j \in \{0,1\}$. We allow for employment costs to depend on his education, disability status, and age, and parameterize this time cost $\theta\left(s,h,P_j\right)$ in Section 5.2. Additionally, he derives warm-glow utility from leaving bequests b, specified as $\phi(b) = \phi_1 \cdot (1 + b/\phi_2)^{1-\gamma}$, following De Nardi (2004). Parameters ϕ_1 and ϕ_2 represent the intensity and curvature of bequest utility, respectively.

A working-age individual ($j < 70$) decides whether to work or not, subject to labor market risks. He receives a job offer with probability $\chi^1_{s,j,h}$ if he was employed in the previous period, and $\chi^0_{s,j,h}$ if he was not (either unemployed, applying for DI, or was a DI recipient), reflecting labor market frictions. These job offer probabilities as well as wage offers $w^h_{s,j}$ vary by his education, age, and disability status. Upon receiving a productivity shock ν that follows an AR(1) process, the worker makes a labor supply decision. Although there is an extensive margin choice for labor supply, we abstract from the intensive margin decision of individuals and exogenously set the hours worked as disability and age-dependent λ^h_j. Thus, the labor income is $y^h_{s,j} \equiv \left(w^h_{s,j} \cdot \nu\right) \cdot \lambda^h_j$ if an individual works ($P = 1$). Importantly, individuals younger than FRA j^F who are moderately or severely disabled can also decide whether to apply for DI benefits that incurs disutility ζ_s. Once the individual reaches EEA j^E, he can claim SS benefits, and the mandatory retirement age (MRA) j^R is 70. Lastly, all agents have access to risk-free bonds with a time-invariant interest rate r, and face borrowing constraints.

4.1.2 Medical Expenditures and Health Insurance

An individual is subject to medical expenditure risks m whose process depend on worker's age and labor market statuses. We assume that employed workers have access to health insurance consistent with the employer-sponsored health insurance system in the US. They pay insurance premium p_E (constant across all workers) and have a coinsurance rate of $q_E(m) < 1$ that may depend on the size of the medical expenditure. Thus, an employed individual's out-of-pocket expenditure is $oop_E(m) \equiv p_E + q_E(m) \cdot m$. For simplicity, we assume that unemployed individuals and DI beneficiaries not yet qualified for Medicare benefits do not have access to insurance. However, we empirically capture other sources of insurance the uninsured workers have, through, e.g., spousal or public insurance, by allowing for their out-of-pocket expenditures to be $q_U(m) < 1$ share of total medical expenditures. Thus, an unemployed individual's out-of-expenditure is $oop_U(m) \equiv q_U(m) \cdot m$. Lastly, qualified DI beneficiaries and individuals aged 65 or older receive Medicare benefits, a public health insurance program with a premium of p_M and a coinsurance rate $q_M(m) < 1$ and thus out-of-pocket expenditure $oop_M(m) \equiv p_M + q_M(m) \cdot m$.

4.1.3 Government Policies

The government policies are modeled based on our discussion in Section 2, and policy options at each age by cohort follow the description in Figure 1.

Disability Insurance. The government runs the DI program for working-age individuals. Agents can apply for the DI program if they are moderately or severely disabled which incurs utility cost; however, this does not guarantee receipt of DI benefits. The application process is successful with probability $\pi^{DI,h}$ that differs across disability status, and the accepted workers receive DI benefits $DI(\omega_{DI})$ that replace the recipient's foregone labor income proportional to their previous earnings history ω_{DI}. Further, DI recipients become eligible for Medicare after they receive DI benefits for 24 months. To capture this institutional feature, we assume that DI recipients receive Medicare benefits with probability π^M with an expected waiting period of two years. The beneficiary may receive a reassessment of disability status with probability π^{RE}. If the individual is not deemed eligible to receive DI (i.e., he is non-disabled) upon reassessment, his benefit will be terminated. Individuals can apply for DI up to FRA, j^F. Once a DI recipient reaches FRA, his benefit automatically becomes SS benefits, without adjustments in the benefit amounts.

Social Security. SS benefits differ across cohorts due to the 1983 Amendments. Here, we briefly describe the general structure of SS, and specify the policy parameters across cohorts in the next section. Individuals can claim SS benefits between the EEA, j^E, and the MRA, j^R. We consider the claiming decision as irreversible, and thus collecting SS benefits is an absorbing state. An individual's benefit size is determined by his past earnings summarized by ω_{SS} and the age at which the individual claims the benefits. If an individual claims benefits at FRA j^F, his benefits are equal to the primary insurance amount that depend on ω_{SS}, $\text{PIA}(\omega_{SS})$. If he claims benefits before (after) reaching j^F, the benefits are reduced (increased). We assume that all individuals stop working and receive SS benefits by the MRA, j^R, at the latest.

Individuals are allowed to work while receiving SS benefits. However, those who earn labor income before reaching the FRA are subject to the RET. Specifically, if earnings exceed the threshold $y_{RET,1}$, SS benefits are reduced by $1 for every $2 earned above that limit. Beyond higher threshold $y_{RET,2}$, benefits are reduced by $1 for every $3.[28]

AIME Updating and DI and SS Benefits AIME summarizes an individual's earnings history that determines DI and SS benefits. As discussed in our policy specifics, the AIME for DI may not be the same as the AIME for SS, due to computation year differences across policies. For computational tractability, instead of tracking the entire earnings history, we approximate an individual's AIME for SS using the average earnings as in French (2005). Further, we use the AIME for SS to construct the AIME for DI.

We denote the AIME for SS as ω. This state variable ω is updated as the average earnings until age 60, and then it is updated only if the new earnings exceed the previous average after age 60. That is,

$$\omega' = \begin{cases} \omega + \dfrac{\min\{y, \bar{y}_{ss}\}}{35}, & j < 60 \\ \omega + \dfrac{1}{35}\max\{0, \min\{y, \bar{y}_{ss}\} - \omega\} & j \geq 60, \end{cases} \tag{6}$$

where $\bar{y}_{ss}$ is the income limit subject to SS contribution. For those who do not work, zero is used to update the state variable. We then separately construct ω_{DI} using ω, accounting for earnings history up to disability onset age. We translate ω into total earnings until age j and divide it by the number of working years until age j. That is,

$$\omega_{DI} = \frac{35 \cdot \omega}{\text{computation year}_j}, \tag{7}$$

where the computation year is defined as the years worked between age 22 and the onset of disability after subtracting the dropout year.[29]

Using the respective AIME for SS and DI, the annual primary insurance amount (PIA)

[28]Note that the RET underwent a reform in 2000. Previously, the earnings test also applied to individuals older than the FRA, but this feature was removed in 2000. Since our benchmark cohort (birth years 1931-1937) was aged between 64 and 70 in 2000, we use the post-reform RET policy. Additionally, while the withheld benefits are added back to benefits after reaching the FRA, we capture this clause indirectly through a continuous updating of AIME described in Equation (6).

[29]DI applicants typically have shorter earnings records up until the onset of their disability. Consequently, the AIME for DI recipients is calculated after dropping a number of low-earnings records to better reflect their average lifetime earnings. For more details about the 1-for-5 rule, see https://secure.ssa.gov/poms.nsf/lnx/0300605230.

is calculated as

$$\text{PIA}(\omega) = \begin{cases} 0.90 \times \omega & \text{if } \omega < b_1 \\ 0.90 \times b_1 + 0.32 \times (\omega - b_1) & \text{if } b_1 \leq \omega < b_2 \\ 0.90 \times b_1 + 0.32 \times (b_2 - b_1) + 0.15 \times (\omega - b_2) & \text{if } \omega \geq b_2, \end{cases} \tag{8}$$

where the replacement rate starts at 90% but drops to 32% and 15% for AIME above bend points b_1 and b_2. Thus, DI benefit $DI(\omega_{DI})$ is equal to $\text{PIA}(\omega_{DI})$. And the SS benefits $SS(\omega)$ for those at claiming age j is $\text{PIA}(\omega) \cdot \psi_j$, where ψ_j reflects the early claiming penalties and delayed claiming credits.

Other Social Insurance Programs and Taxes Unemployed workers receive unemployment insurance (UI) benefits proportional to their labor market income $UI(y)$. Other welfare programs (e.g., the Supplemental Nutrition Assistance Program) are captured by a consumption floor of amount $\underline{c}_f$. These government programs are funded by labor income tax $\tau_y(y)$, capital income tax τ_k, Social Security tax τ_{ss}, and Medicare tax τ_{med}, which we collectively denote as τ.

4.1.4 Timing of Events

At the beginning of each period, death shocks occur and disability status is updated for survived agents. Based on disability status, DI application results are released for previous applicants, and reassessments results are determined for randomly selected current DI enrollees. Subsequently, job-offer and productivity shocks arrive, and individuals make labor supply decisions. At this stage, working-age individuals younger than FRA with moderate and severe disabilities can also consider applying for DI. Furthermore, individuals between the ages of j^E and j^R can also consider claiming SS benefits, regardless of their disability statuses. Then, individuals receive income (e.g., government benefits and labor income) and make consumption and savings decisions.

4.2 Individual Problems

An individual's life cycle can be characterized into four phases depending on their eligible social insurance programs: (i) young working-age with DI eligibility ($j < j^E$); (ii) older working-age with both DI and early SS claim options ($j^E \leq j < j^F$); (iii) age after full retirement with delayed SS claiming option ($j^F \leq j < j^R$); and (iv) retirement phase after mandatory retirement, the latest age that workers claim SS ($j \geq j^R$). For each phase, we formulate the value function at the beginning of the consumption-savings stage, suppressing education-dependence for notational simplicity. The state variables are age j, asset a, health h, AIME ω,medical expenditure m, and labor productivity ν. For expositional purpose, we let $x \equiv (j, a, \omega, m, \nu)$ denote all state variables except health status h, as choice sets for individuals (e.g., DI application availability) explicitly depend on his health status. For all workers, the AIME ω' evolves following Equation (6), AIME for DI given ω is determined as in Equation (7), and the government's welfare program ensures that the worker is able to consume at least the amount of the consumption floor so that $tr = \max\left\{\underline{c}_f - c, 0\right\}$. Given these common constraints for all workers, we now lay out value functions in each age group, specifically highlighting the trade-offs each worker faces.

4.2.1 Workers Aged $j < j^E$ (EEA): Work or Apply for DI?

Workers in the labor market. Workers who are currently employed ($P = 1$) or unemployed ($P = 0$) solve the following problem:

$$
\begin{aligned}
V^P(x,h) \;=\; & \max_{c,a'\geq 0} u(c+tr,l) + \beta\delta_j^h \pi_j^{h,ND}\left[\ \chi_{h'}^P \mathbb{E} \max_{P\in\{0,1\}} V^P(x',ND) + \left(1-\chi_{h'}^P\right)\mathbb{E}V^0(x',ND)\ \right] \qquad (9)\\
& + \beta\delta_j^h \sum_{h'\in\{MD,SD\}} \pi_j^{h,h'} \left[\begin{array}{l} \chi_{j+1,h'}^P\ \ \mathbb{E}\max\left\{\max\limits_{P\in\{0,1\}} V^P(x',h'), V^A(x',h')\right\} \\ +\left(1-\chi_{j+1,h'}^P\right)\mathbb{E}\max\left\{\ V^U(x',h'), V^A(x',h')\ \right\}\end{array}\right] \qquad (10)\\
& + \beta\left(1-\delta_j^h\right)\phi\left(a'\right)
\end{aligned}
$$

with the budget constraint for employed workers being

$$
c + a' = \tilde{y} - oop_E(m) + (1+\tilde{r})\,a \qquad (11)
$$

and that for unemployed workers,

$$
c + a' = UI(y) - oop_U(m) + (1+\tilde{r})\,a. \qquad (12)
$$

The periodic utility is drawn from consumption and leisure, where the amount of leisure l depends on disability and employment statuses. In the next period, if he survives (with probability δ_j^h) and turns out to be non-disabled ($\pi_j^{h,h'=ND}$), there are two possibilities (line (9)): he may receive a job offer with probability $\chi_{j+1,h'}^P$ or he is left unemployed with probability $1-\chi_{j+1,h'}^P$. Note that the job offer arrival rates χ depends on his age and disability status in the next period and labor market status in the current period to capture the impacts of labor market attachment on future labor market opportunities.[30] When the individual receives the offer and productivity shock, he makes the labor market participation decision, with its value $\mathbb{E}\max_{P\in\{0,1\}} V^P(x',h')$, where expectations (here and in problems to follow) are taken with respect to medical expenditure and labor productivity shocks. For a worker who becomes moderately or severely disabled, his choice set expands as he can also choose to apply for the DI program (line (10)). Lastly, there is a warm-glow utility from bequests when he is deceased.

As seen in the budget constraints (Equations (11) and (12)), expenditures include consumption c, savings a', and employment-dependent out-of-pocket expenditures. The total resources for the employed are from after-tax labor income $\tilde{y} \equiv y - \tau_y(y)$ and after-tax capital income $(1+\tilde{r})a$. The before-tax labor earnings are $y \equiv w_j^h \nu \lambda_j^h$, where ν is the productivity shock and λ_j^h is the hours worked. Additionally, $\tilde{r} \equiv (1-\tau_k)r$ denotes the after-tax rate of return of capital. An unemployed worker's income source is unemployment insurance $UI(y)$, instead of after-tax labor earnings.

DI applicants. Moderately and severely disabled workers, i.e., those with $h \in \{MD, SD\}$ have an option to apply for DI benefits.[31] Their value reads

$$\begin{aligned} V^A(x,h) &= \max_{c,a'\geq 0} u(c+tr,l) - \zeta \\ &+\beta\delta_j^h \sum_{h'} \pi_{j+1}^{hh'} \left[\begin{array}{c} \pi^{DI,h} V^{D,i_M=0}(x',h') + \\ \left(1-\pi^{DI,h}\right) \left[\begin{array}{c} \chi_{j+1,h'}^0 \mathbb{E} \max_{P\in\{0,1\}} V^P(x',h') \\ +\left(1-\chi_{j+1,h'}^0\right) \mathbb{E} V^0(x',h') \end{array} \right] \end{array} \right] + \beta\left(1-\delta_j^h\right)\phi(a') \\ s.t. \quad & c + a' = oop_E(m) + (1+\tilde{r})a. \end{aligned} \tag{13}$$

The applicant incurs disutility ζ and forgoes his labor income in the current period, but he has access to health insurance, in accordance with COBRA continuation coverage. In the next period, if successful (with probability $\pi^{DI,h}$), the worker becomes a DI recipient without Medicare denoted by value $V^{D,i_M=0}$. If not successful, he becomes unemployed, unless he is given the opportunity to enter the labor market.

DI beneficiaries with ($i_M = 1$) and without Medicare ($i_M = 0$). The value of being a DI beneficiary depends on whether he receives Medicare benefits ($i_M = 1$) or not ($i_M = 0$).

[30] We use two age groups for arrival rates, those younger than the FRA and those older than the FRA, as a way to capture reentry cost among the old in a similar manner as in French and Jones (2011).

[31] We do not allow non-disabled workers to apply; however, it may be that endogenously, it is not in their best interest to do so. In some sense, our notion of disability (from the PSID at least) may extend beyond those who actually receive DI.

Their values are

$$V^{D,i_M}(x,h) = \max_{c,a'\geq 0} u(c+tr,l)$$

$$+\beta\delta_j^h\left(\left(1-\pi^{RE}\right)+\pi^{RE}\sum_{h'=MD,SD}\pi_{j+1}^{hh'}\right)\ \mathbb{E}V^{D,i_M}(x',h') \tag{14}$$

$$+\beta\delta_j^h\pi^{RE}\ \ \pi_{j+1}^{h,ND}\left[\begin{array}{c}\chi_{j+1,ND}^{0}\mathbb{E}\max_{P\in\{0,1\}}V^P(x',ND)\\+\left(1-\chi_{j+1,ND}^{0}\right)\mathbb{E}V^0(x',ND)\end{array}\right]+\beta\left(1-\delta_j^h\right)\phi\left(a'\right) \tag{15}$$

$$s.t.\qquad c+a'=DI(\omega_{DI})-(i_M\cdot oop_M(m)+(1-i_M)\cdot oop_U(m))+(1+\tilde{r})a. \tag{16}$$

In the following period, if the worker is not reassessed or is reassessed and he is moderately or severely disabled, he remains a DI recipient with expected value $\mathbb{E}V^{D,i_M}(x',h')$ (line (14)). The expected value additionally incorporates Medicare acceptance probability π^M in addition to medical expenditure and productivity shocks. If the beneficiary does not pass the reassessment (i.e., he is non-disabled when reassessed), his benefits are terminated (line (15)). Then, he either receives a job offer with probability $\chi_{j+1,ND}^{D}$ (since those whose DI is terminated are non-disabled) or becomes unemployed. As DI beneficiaries only leave the program upon failing the reassessment, non-disabled workers may continue receiving DI benefits. Whether the beneficiary receives Medicare impacts his medical expenditures through the budget constraint (line (16)).

4.2.2 Workers Aged j^F(FRA) $\leq j < j^R$(MRA): Claim SS Benefits?

We have discussed the working-age individual's problem with DI option. We now describe the decision process of an individual in age between j^F and j^R who has the option to claim SS. Then we will return to the case for age between j^E and j^R with both DI and SS options. DI benefits of previous DI recipients are automatically converted into SS at age j^F. We assume that they do not re-enter the labor market, thus their value function is equivalent to the value function in retirement phase where agents make only consumption and savings decision. For non-DI beneficiaries, they make two choices, SS claiming and labor supply.

Claimed SS benefits. Once SS claiming decision is made, then the agent cannot revoke his decision. Thus, his value function becomes a life-cycle model with labor supply, consumption, and savings decisions, with the two distinctions being that now they have additional income from SS benefits and access to Medicare. Thus, for individuals receiving

SS, the value function is given as

$$
\begin{aligned}
V^{S,P}(x,h) &= \max_{c,a'\geq 0} u(c+tr,l) \\
&\quad +\beta\delta_j^h \sum_{h'} \pi_j^{h,h'} \left[\begin{array}{c} \chi_{j+1,h'}^P \mathbb{E} \max\limits_{P\in\{0,1\}} V^{S,P}(x',h') \\ +\left(1-\chi_{j+1,h'}^P\right) \mathbb{E}V^{S,0}(x',h') \end{array} \right] + \beta\left(1-\delta_j^h\right)\phi(a') \\
s.t. \quad & c+a' = SS(\omega)+\tilde{y}\cdot\mathbb{I}_{P=1}+UI(y)\cdot\mathbb{I}_{P=0}-oop_M(m)+(1+\tilde{r})a.
\end{aligned} \tag{17}
$$

Did not claim SS benefits yet. Individuals without SS can determine their benefit status after the labor market uncertainty resolves. Since the individual passed the FRA for DI application, his option is limited to either claiming the benefits this period or delaying it. The value function of individuals with postponed SS claim, $V^{PS,P}$ with $P \in \{0,1\}$ is

$$
\begin{aligned}
V^{PS,P}(x,h) &= \max_{c,a'\geq 0} u(c+tr,l) \qquad (18) \\
&\quad +\beta\delta_j^h \sum_{h'} \pi_j^{h,h'} \left[\begin{array}{c} \chi_{h'}^P \mathbb{E} \max \left\{ \max\limits_{P\in\{0,1\}} \left\{ V^{S,P}(x',h'), V^{PS,P}(x',h') \right\} \right\} \\ +\left(1-\chi_{h'}^P\right) \mathbb{E} \max\left\{ V^{PS,0}(x',h'), V^{S,0}(x',h') \right\} \end{array} \right] + \beta\left(1-\delta_j^h\right)\phi(a') \\
s.t. \quad & c+a' = \tilde{y}\cdot\mathbb{I}_{P=1}+UI(y)\cdot\mathbb{I}_{P=0}-oop_M(m)+(1+\tilde{r})a. \qquad (19)
\end{aligned}
$$

These agents weigh the benefits of claiming SS in the next period, $V^{S,P}(x',h')$, or postponing it, $V^{PS,P}(x',h')$, incorporating the SS benefit adjustments by claiming age.

4.2.3 Workers Aged j^E (ERA) $\leq j < j^F$ (FRA): Apply for DI or Claim SS Benefits?

Relative to individuals past the FRA, these individuals have an additional option, as they can also apply for DI benefits like those in the working age ($j < j^E$), further expanding the choice set beyond those older than FRA we described in the previous section. For brevity, we discuss their choices in the main text and relegate the problem specifications to Appendix B.

Claimed SS benefits. If the individual claimed benefits, he can still work, but cannot apply for DI. Thus, his decision problem is the same as Equation (17), except for the fact that his benefits are reduced to reflect the early claiming penalty and the RET. Additionally, because he is not yet eligible for Medicare, the out-of-pocket medical expenditures in their budget constraint are determined based on his labor market status.

Did not claimed SS benefits yet. If the individual has not yet claimed benefits, he can still apply for DI if his disability status is *MD* or *SD*. Thus, the value function is a combination of

Equations (9) and (18), as he can make labor supply choices in conjunction with whether or not to claim SS, and whether to apply for DI.

DI beneficiaries. For simplicity, we assume that once an individual is past the age of j^E, he continues receiving DI (does not get reassessed) until the benefit gets transferred to SS (without any cuts in benefits) at age j^F. Therefore, the only choices are consumption and savings with the budget constraint in Equation (16).

DI applicants. DI applicants in this age range incorporate the possibility of claiming SS benefits if he is not accepted to DI, with the budget constraint specified in Equation (13).

4.2.4 Workers Aged $j \geq J^R$: Retired

Once retired, the individual receives SS benefits and makes optimal consumption and saving decisions:

$$\begin{aligned} V^R(x,h) &= \max_{c,a'\geq 0} u(c+tr,l) + \beta\delta_j^h \mathbb{E} V^R(x',h') + \beta\left(1-\delta_j^h\right)\phi(a') \\ s.t. &\quad c + a' = SS(\omega) - oop_M(m) + (1+\tilde{r})a. \end{aligned}$$

Overall, our model specifies the distinct choice sets individuals face due to DI and SS policy features, making it a suitable laboratory for quantifying the effects of the SS reform. We now discuss how we map the model to data.

5 Calibration

We describe how we map our model to the data to evaluate SS reforms in the presence of DI. We calibrate the model to 1931-1937 cohorts, utilizing additional data sets—Panel Study of Income Dynamics (PSID), Medical Expenditure Panel Survey (MEPS), and Current Population Survey (CPS)—which complement the HRS data as they include samples across all ages. We first document the parameters calibrated outside the model, describe the within-model calibration process, and discuss the model's performance on the targeted moments.

5.1 Exogenously Calibrated Parameters

We set the parameter γ in the utility function exogenously at 7.5 as in Jones and Li (2023). This parameter, along with κ, the consumption weight on utility that we calibrate within the model determines the relative risk aversion. The annual return of the risk-free bonds r is set at 3%.

Disability statuses. We classify disability status (h) into three categories, non-disabled (ND), moderately disabled (MD) and severely disabled (SD), based on a binary measure of work disability status and the frailty index that we describe in Section 3.1. The frailty index complements the work disability status by also capturing the worker's general health statuses, and is useful as it can be constructed from the three data sources that we are using, HRS, PSID, and MEPS, as documented in Hosseini et al. (2022).

We define a worker to be ND if he does not have a work disability and his frailty is in the lower 90% of the frailty distribution. Specifically, we use the 90th-percentile of the frailty distribution among individuals aged 25 and 67 from the PSID, the main dataset for the calibration of parameters for working-age individuals (e.g., wage and disability status transitions). He is SD if he has a work disability and his frailty is in the top 10% of the frailty distribution, and all others are defined to be MD. Using this definition, the shares of workers classified as ND, MD, and SD are 72%, 15% and 13%, respectively, among those aged between 50 and 67.

Disability status in the model impacts the worker's (i) survival probability; (ii) evolution of disability status; (iii) medical expenditures; earnings through (iv) hours worked and (v) wage offer profiles; (vi) job offer arrival rates; and (vii) time costs. We exogenously calibrate parameters (i) through (v), and calibrate (vi) and (vii) endogenously within the model, which we discuss in Section 5.2. Parameters (i) through (vii) except for (iii) and (iv) are also education-dependent to capture the substantial heterogeneity in health and labor market outcomes across education status of workers.

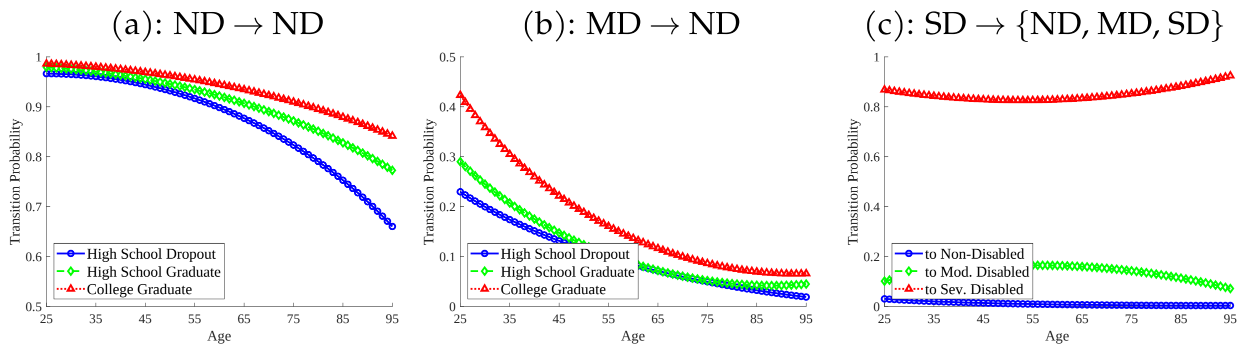
We now describe the external calibration processes of these parameters. In the main text, we focus on the key features of model parameters, relegating detailed descriptions to Appendix C.

Survival probability and disability evolution. First, following the strategy of Attanasio et al. (2011), we estimate conditional survival probabilities by disability and education statuses using the life table from the SSA and micro-level data from the PSID. The estimated survival probabilities and the procedure are documented in Appendix C.

Second, the disability status in the model evolves stochastically and depends on worker's age, education, and current disability status.[32] Utilizing the panel dimension of PSID, we

[32] A recent work by De Nardi et al. (2025) estimates a second-order Markov process to capture history dependence in health. While we adopt a first-order process for computational tractability given our large

Figure 6: Disability Transitions



estimate a multinomial logit model to predict the future disability status, and fit these moments to a quadratic function of age to produce smooth transitions over the life cycle. In Figure 6, we plot selected disability transitions. Figures 6(a) and 6(b) are probabilities of transitioning to non-disabled, from non-disabled and moderately-disabled, respectively, by education. These figures show the education- and age-dependence in disability transitions. Figure 6(c) shows probabilities of transitioning to three disability statuses for severely disabled workers, where, due to sample size issues, we do not model education-dependence. The estimated transitions illustrate persistence in disability statuses, which is more pronounced for severely disabled workers.

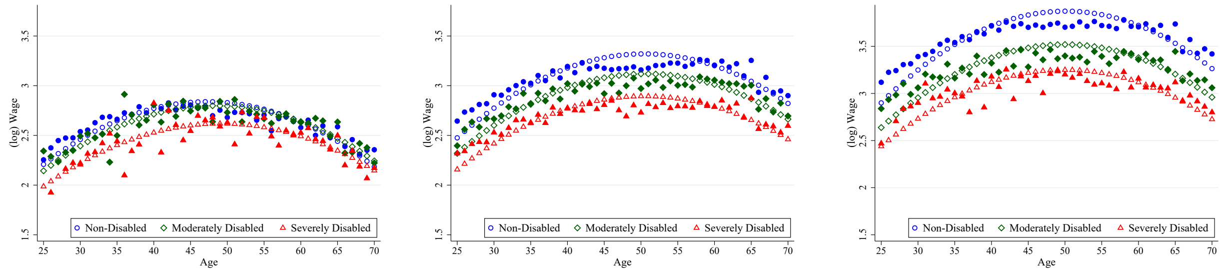
Wage offer profiles and hours worked. We estimate hourly wage offer profiles externally, using a two-step estimation procedure of Heckman (1979). To control for selection into employment, we follow the approach by Low and Pistaferri (2015), where we utilize the cross-state variations in social insurance and welfare programs to construct an instrumental variable for the employment regression. The estimated wage offer profiles are presented in Figure 7 with the detailed estimation procedures reported in Appendix C. Each plot in Figure 7 shows life-cycle profiles by education and disability statuses. Conditional on working, we assume that individuals work for a fixed number of hours. For each age and disability status, we construct working hours as the average working hours among the employed with more than 700 hours per year.

Medical expenditures and health insurance. Medical expenditure risks differ by age and disability status. We use medical expenditures from MEPS to construct these variables. Similar to Attanasio et al. (2011), we use three medical expenditure bins representing the average total expenditures in the 1st–50th percentile, 51st–90th percentile, and 91th–99th

state space, we enrich the analysis by employing three distinct disability statuses (*ND*, *MD*, and *SD*) rather than the standard binary measure, which is crucial for capturing behavioral responses at the margin.

Figure 7: Wage Offer Profiles by Education

(a): High School Dropouts (b): High School Graduates (c): Some College



percentile by age and disability status. We then utilize the total amount paid by self to construct coinsurance rate—amount paid by self divided by total medical expenditures—for the insured (employed) who are younger than 65 ($q_E = 0.30$) and for those older than 65 and DI beneficiaries who are covered by Medicare ($q_M = 0.24$). Further, to capture other sources of insurance not directly captured in our model (e.g., spousal health insurance or public insurance programs) for the uninsured individuals, we construct a similar ratio to obtain $q_U = 0.68$. The out-of-pocket medical expenditures by age, health, and insurance (employment) statuses are then constructed as $oop_i(m) \equiv p_i + q_i \cdot m$, for $i \in \{E, U, M\}$ where health insurance premium for the employed and Medicare enrollees, $p_E = \$1,530$ and $p_M = \$1,740$, are taken from those reported in Kaiser Family Foundation.[33,34]

Government policies. We describe policy parameters for DI and SS, as well as other welfare programs and taxes relevant for individual decisions.

Disability Insurance. Four parameters fully describe the DI program: application success probability π^{DI}, the probability of qualifying for Medicare benefits π^M, reassessment probability π^{RE}, and benefit schedule as a function of previous earnings $DI(\omega)$.

The DI receipt probabilities are set at 15% for moderately disabled workers and 35% for severely disabled workers, similar in ranges to those estimated in Low and Pistaferri (2015).[35] The Medicare receipt probability is set at 50% to capture the delay of two years

[33]The premium for the employed p_E is the average annual single premium per employee for employer-based health insurance. We use the average employee contribution in 2021 from KFF (constructed from the MEPS Insurance Component, a survey of establishments) to capture the out-of-pocket expenditures on the worker-side. The Medicare premium p_M is an annual average of Medicare Part B.

[34]We do not explicitly model nursing home expenditures in the current analysis, despite their known importance as a major source of financial risk for the elderly (e.g., De Nardi et al., 2016; Kopecky and Koreshkova, 2014; Braun et al., 2017). However, our structural framework is sufficiently flexible to integrate these costs as an extension of the medical expenditure process.

[35]Low and Pistaferri (2015) estimates DI allowance rates of 0.17 (moderate limitation) and 0.33 (severe limitation) for those younger than 45, and 0.18 (moderate) and 0.63 (severe) for those older than 45, using high school graduates. Our sample includes individuals with college education.

before qualifying for the benefits. Further, the reassessment probability is set at 6%, similar to that used by Low and Pistaferri (2015). Lastly, the DI payments are determined by the PIA formula (in 2020 dollars, annually) in Equation (8), with AIME for DI described in Equation (7).

Social Security. The PIA in Equation (8) also determines SS payments, with ω in Equation (6). As discussed in Section 2.3, SS benefits are reduced (increased) by 6.7% (5.5%) per year of claiming age from the FRA for the old cohort. Additionally, the two threshold income levels for the RET, $y_{RET,1}$ and $y_{RET,2}$ are \$15.6K and \$36.4K corresponding to values expressed in 2020 dollars.

Unemployment insurance, welfare programs, and taxes. UI benefits are paid to unemployed workers. With about a 45% replacement rate that pays up to six months, the overall yearly replacement rate is set at 23% of the worker's annual income. We set the consumption floor $\underline{c}_f$ at \$4.7K to capture other unmodeled government's welfare programs.[36] Labor income tax is progressive, with after-tax income expressed as $\tau_{y,0} \cdot \left(\bar{y}^{1-\tau_{y,1}}\right)$ following Holter et al. (2019). Parameters $\tau_{y,0} = 0.818$ and $\tau_{y,1} = 0.111$ represent level and curvature of the tax function where $\bar{y}$ is income expressed as a multiple of average income.[37] The capital income tax rate is set to $\tau_k = 0.36$. The Social Security tax rate is $\tau_{ss} = 0.106$, levied on labor earnings up to a maximum taxable limit of y_{ss} of \$103K. Finally, the Medicare tax rate is $\tau_M = 0.029$, levied on all labor earnings without a cap.

We summarize the values of all exogenously calibrated parameters in Table 3.

5.2 Endogenously Calibrated Parameters

We calibrate the remaining parameters, those governing preferences and labor market opportunities, within the model. In doing so, we parameterize the time cost of disability and work $\theta_{s,h,j}$ as the following:

$$\theta_{s,h,j} = \theta_0(h) + \mathbb{I}_{P_j=1} \cdot \left(\theta_1(s,h) + \mathbb{I}_{j\geq 51} \cdot \theta_2(s,h) \cdot \left\{\exp\left(\frac{1}{19} \cdot (j-50) - 1\right)\right\}\right). \tag{20}$$

The parameter $\theta_0(h)$ captures the time costs of disability, where we normalize the time cost of the non-disabled. Time costs of work depend on $\theta_1(s,h)$ and $\theta_2(s,h)$: the former cap-

[36] This is within the range used in the literature: the annual consumption floor is set at \$4,000 (2009 dollar) in Kitao (2014a) and estimated at \$3,593 (2013 dollar) in De Nardi et al. (2025).

[37] We use the average income of \$47K and confirm that the endogenously generated average income from the model is similar in magnitude (in the calibrated model, it is \$49K) to avoid having to solve for a fixed point.

Table 3: Parameters Calibrated Outside the Model

Parameter	Description	Values	Parameter	Description	Values
Demographics, Preferences, Technology			*Policy: UI, Welfare, Tax*		
$\delta_{s,j}^{h}$	Survival rates	Fig. A2	b	UI replacement rate	0.23
γ	Risk preference	7.5	$\underline{c}_f$	Consumption floor	\$4.7K
r	Interest rate	0.03	$\tau_{y,0}$, $\tau_{y,1}$	Labor income tax	0.818; 0.111
			τ_k	Capital income tax	0.36
Health and Medical Expenditures			τ_M	Medicare tax	0.029
$\pi_{s,j}^{h,h'}$	Health transition	Fig. A3	τ_{SS}; y_{SS}	SS tax, max earnings	0.106; \$103K
$oop(m)$	OOP expenditures	Fig. A5	*Policy: Social Security and Disability Insurance*		
			$b_1; b_2$	PIA bend points	\$8.6K; \$52K
Wage and Hours			$\pi^{DI,\{MD;SD\}}$	DI receipt prob.	0.15; 0.35
$w_{s,j}^{h}$	Wage process	Fig. 7	π^{M}; π^{RE}	Medicare; re-exam. prob.	0.5; 0.06
$\rho_v; \sigma_v$	Productivity shock	0.95; 0.15	ψ_j	SS benefit penalty; credit	6.7%; 5.5%
λ_j^h	Hours	Fig. A4	$y_{RET,1}$; $y_{RET,2}$	RET thresholds	\$15.6K; \$36.4K

tures the education- and disutility-dependent time cost of work, and the latter represents additional time costs of work for those older than 51, where $\theta_2(s,h)$ controls the slope with respect to age.[38] These parameters help match the employment patterns over the life cycle, along with the job offer arrival rates. As we use the male sample, the employment rates of non-disabled working-age individuals are high for all education groups. To reflect this feature, we set the offer arrival rates of the employed, younger than 65, $\chi_{s,ND,j<65}^{P=1}$ at 0.985. Additionally, we allow the job offer arrival rates $\chi_{j,s,h}^{P}$ to differ after reaching 65. This assumption is similar to those in French and Jones (2011) and Paschchenko and Porapakkarm (2023), where individuals near retirement age face re-entry time costs. In specifying the job offer arrival rates, we use two education groups, combining HSD and HSG to ensure that we have enough empirical and simulated data points in the data and in the model.[39] Table 4 summarizes all parameters calibrated within the model. In addition to the aforementioned parameters, it also includes preference parameters, β (discount factor), κ (weight on consumption), ϕ_1, ϕ_2 (bequest motives), and ψ_s (DI application cost).

Our target moments (data sources) are: (i) employment rates by age, education, and disability (PSID); (ii) employment to employment and non-employment to employment transition rates by education (CPS); (iii) share of individuals who claim SS at 62, 65, and after 65 by education, and share of those who work while receiving SS (HRS); (iv) DI share

[38] The constant 1/19 is used so that at age 69, time cost is $\theta_1(s,h) + \theta_2(s,h)$. While the functional forms differ, similar age-dependent preference specifications have been used in, e.g., French and Jones (2011) and Jones and Li (2023).

[39] We use CPS to construct transition rates by education to utilize its larger sample size compared to PSID. Although the CPS includes a disability variable, it lacks the health condition variables required to construct a frailty index, necessary to categorize individuals into disability groups in our model. Thus, we are unable to generate a reliable set of target transition rates by disability status, and therefore only use only education-specific moments as empirical targets.

among 50-54 and DI share by education among 60-64 (HRS); (v) average wealth among 55-59 and 60-64, and 25th to 75th wealth ratio for 65-69 (PSID); and (vi) average consumption by education and disability (PSID).[40] These constitute a total of 41 parameters chosen to match 428 moments. We use simulated methods of moments, minimizing the unweighted sum of percent deviations of the model moments from the data moments. While these moments jointly determine the parameters, certain parameters are more tightly linked to specific moments. For example, while $\theta_1(s,h)$ and $\chi^P_{j<65,s}$ control employment and job transition rate levels and their heterogeneity during working-age, $\theta_2(s,h)$ and $\chi^P_{j\geq 65,s,h}$ help match the corresponding patterns beyond ages 50 and 65. These parameters also govern DI shares as they represent the trade-offs faced by individuals who are moderately or severely disabled. Further, the consumption and wealth moments guide consumption weight and bequest parameters κ, ϕ_1, and ϕ_2.

5.3 Calibration Results and Model Performance

We discuss calibration results and selected model fit on key moments in this section. In Table 4 and Figure 8, we report calibration results and plot the calibrated leisure by education and disability statuses. The calibrated discount factor is 0.831, within the ranges

Table 4: Calibrated Parameters and Values

Parameters		Description (number)	Values
Preferences	β	discount factor	0.832
	κ	weight on consumption	0.441
	ϕ_1	bequest intensity	-4.026
	ϕ_2	bequest curvature	\$562K
	ζ_s	utility cost of DI app. by educ. (3)	0.144; 0.074; 0.004
Time costs from disability and work			
of disability	$\theta_0(h)$	normalized for $h = ND$ (2)	-2.154; -2.154
of work	$\theta_1(s,h)$	by educ. (3)×disability (3)	Figure 8
	$\theta_2(s,h)$	age grad., by educ. (3)×disab. (3)	
Job offer arrival rates of previously employed			
age<65	$\chi^{P=1}_{s,MD/SD}$	by education (2)	0.926; 0.955
age≥65	$\chi^{P=1}_{s,ND}$	by education (2)	0.758; 0.845
	$\chi^{P=1}_{s,MD/SD}$	by education (2)	0.722; 0.803
Job offer arrival rates of previously non-employed			
age<65	$\chi^{P=0}_{s,ND}$	by education (2)	0.197; 0.207
	$\chi^{P=0}_{s,MD/SD}$	by education (2)	0.140; 0.198
age≥65	$\chi^{P=0}_{s,ND}$	by education (2)	0.169; 0.207
	$\chi^{P=0}_{s,MD/SD}$	by education (2)	0.159; 0.190

[40] We describe our moments and their construction process in Appendix C.

estimated in studies incorporating retirement choices, e.g., Lockwood (2018). The weight on consumption κ is 0.441, implying along with the predetermined γ of 7.5, the relative risk aversion of around 3.2.

From Equations (5) and (20), the estimated time costs of disability yields leisure endowment of 0.93 for both moderately and severely disabled workers, with a normalized leisure of one for non-disabled workers. Similarly, in Figure 8, we plot leisure of employed workers by education and disability statuses over the life-cycle. We note that leisure costs of work differ across education and disability, and increase in age with varying gradients. These time costs, along with the job offer arrival rates match employment patterns from the empirical data, as we present in Figure 9. In particular, the drop in the employment rates beyond 50 until 65 are generated from the changes in time cost. After 65, changes in the job offer arrival rates also impact the employment rates.

Figure 8: Leisure of Employed by Disability Status

(a): High School Dropouts (b): High School Graduates (c): Some College

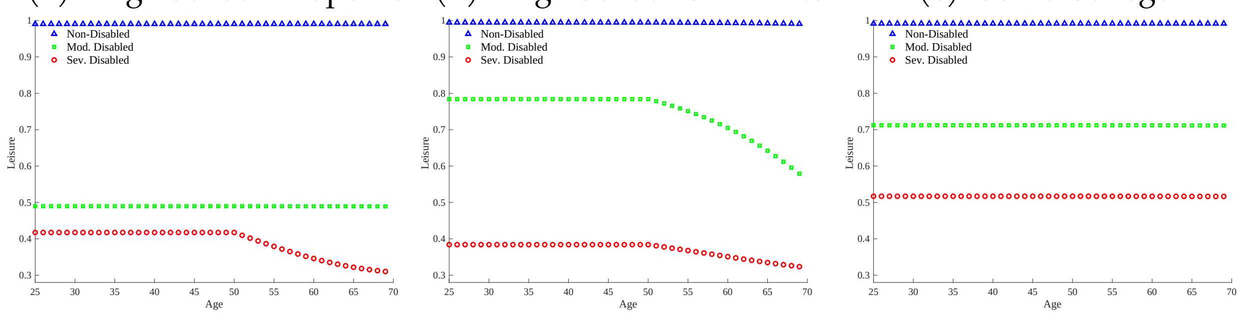
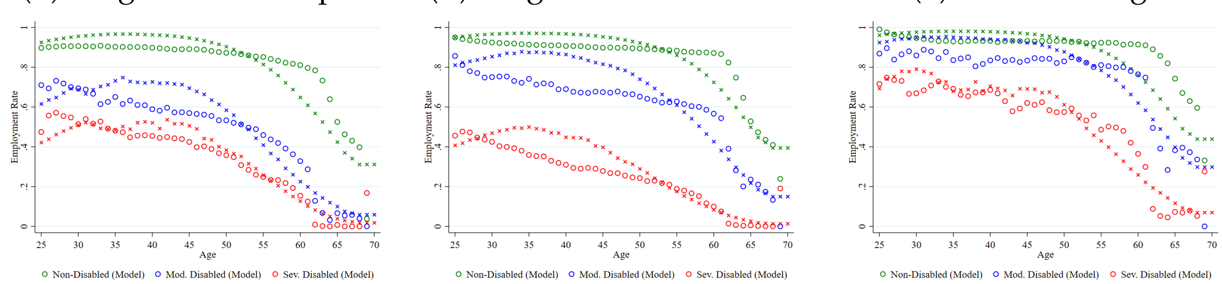


Figure 9: Employment Over the Life Cycle (Data vs. Model)

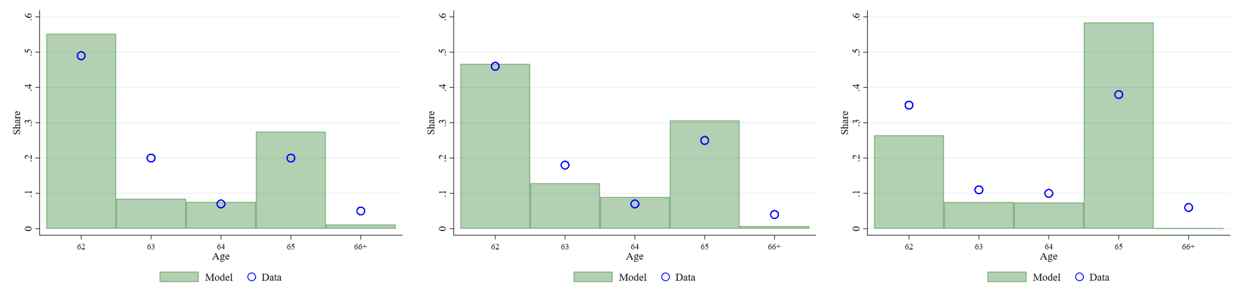
(a): High School Dropouts (b): High School Graduates (c): Some College



Lastly, we present the model fits for SS and DI decisions. In Figure 10, we show the SS claiming age distribution in the data and in the model by education. The model is able to generate the early claiming share and matches the qualitative patterns in SS claiming behaviors across education statuses. Additionally, the model predicted DI share among

Figure 10: Social Security Claiming Age Distribution (Data vs. Model)

(a): High School Dropout (b): High School Graduates (c): Some College



50-54-year-olds are 0.04, close to 0.03 in data. The education-specific shares among 60-64-year-olds in the model (data) are 0.13 (0.09), 0.04 (0.05), and 0.02 (0.02) for HSD, HSG, and COL respectively. Overall, while the model produces a higher DI share for HSD than in the data, the patterns of heterogeneity across education statuses are well-captured. A discussion of the remaining moments and the model fit is provided in Appendix C.

6 Counterfactual Analyses

In this section, we use the calibrated model to investigate how SS reform interacts with DI and to quantify the resulting effects. To that effort, we first simulate young cohort in our model and validate whether the model replicates the empirical findings in Section 3.3. We then evaluate the redistributive fiscal and welfare effects of the reform. Further, to analyze the interaction between SS and DI, we conduct the SS reform analysis in an economy without DI and in an economy, where the acceptance rate into DI increases for the young cohort. Lastly, we consider a more stringent SS reform of an elimination of early SS claiming option.

6.1 Simulating the "Young" Cohort

We simulate the model for the "young" cohort. Specifically, we apply their SS policy specifics—FRA, early/delayed claiming penalty/credits, PIA, and RET parameters—along with the corresponding survival and wage processes.[41] Using the simulated data, we ana-

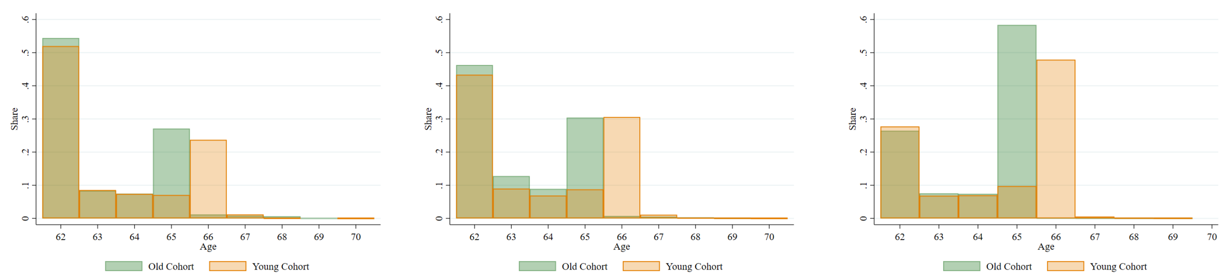
[41] The FRA and early (delayed) claiming penalty (credits) for the young cohort are detailed in Section 2.3. The PIA bend points and the RET cutoff amounts are updated each year to reflect CPI as detailed in https://www.ssa.gov/oact/cola/bendpoints.html and https://www.ssa.gov/OACT/COLA/rtea.html. Specifically, we use 2010 parameter values expressed in 2020 dollars. These SS policy and worker-level pa-

lyze the behaviors of the young cohort, specifically focusing on their DI utilization and SS claiming decisions. Then, we conduct the analysis as in Section 3.3 to validate whether the model is able to capture the empirical findings that relate relative generosity of DI with early SS claiming behavior. We then analyze the fiscal and welfare effects on the young cohort.

How do DI utilization and SS claiming decisions differ across cohorts? In Figure 11, we plot SS claiming age distributions for the old and young cohorts by education. Consistent with the data, there are two peaks in SS claiming age distribution: one at the EEA and another at the FRA. Furthermore, a higher share of individuals with lower education claim SS benefits early. In the old cohort, 54% of HSD claims SS benefits at 62, whereas the shares are 46% and 26% among HSG and COL. When the SS policy is reformed to penalize early SS claiming at steeper rates, these shares decrease by 2.4pp for the HSD and 3.0pp for the HSG.

Figure 11: Social Security Claiming Age Distribution by Cohort

(a): High School Dropouts (b): High School Graduates (c): Some College

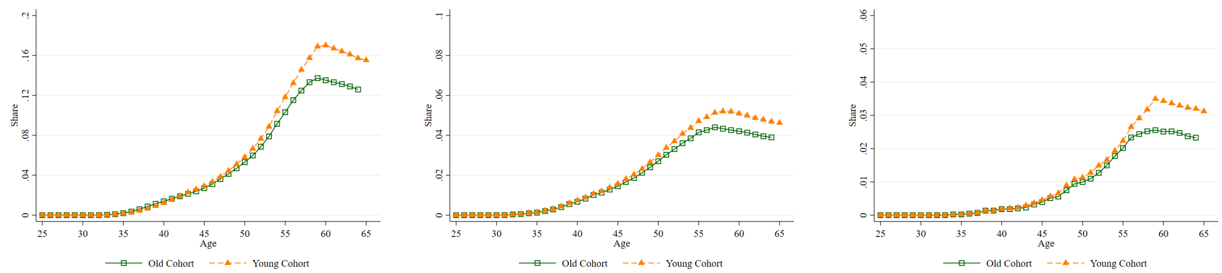


As SS claiming age distribution shifts, we observe that DI shares increase among the young cohort: The average DI receipt share among those aged between 50 and FRA increases from 6.7% to 7.7%. As shown in Figure 12, the DI share increases are observed across all education groups. Among 62-year-old individuals, 14.4% of HSD in the old cohort receives DI, whereas 16.7% in the young cohort receives DI; the shares for HSG are 6.1% (old) and 6.6% (young); and for COL, 2.2% (old) and 3.8% (young). Documented in Section 3, the DI share among 62-year-olds in the young cohort is about 7pp higher than in the old cohort. The simulated model therefore generates about 33% (2.2pp) of the observed cohort differences from the data.

rameters for the young cohort are detailed in and Appendix C.

Figure 12: Share of DI Recipients by Cohort

(a): High School Dropouts (b): High School Graduates (c): Some College



In the simulated data, we zoom in on behaviors of individuals who claimed SS benefits early (before the FRA) as an old cohort, but no longer do so as a young cohort. Among these 62-65-year-old individuals, 33% become DI beneficiaries. The education composition among these DI beneficiaries are skewed towards lower-educated individuals: 54% are HSD, 40% are HSG, with a remaining 6%, COL. These show that individuals in the model utilize DI when SS policies become less generous towards early benefit claimants.

Does the model-constructed PVDR impact these behaviors? Given the behavioral patterns of the young cohort, we conduct the empirical analysis detailed in Section 3.3 using our simulated data. This analysis tests whether the model can capture the extent to which the relative generosity of DI explains the young cohort's propensity to shift from early SS claiming to DI.

In Figure 13, we present the model-generated PVDR distribution among 60-62-year-old individuals, analogous to the data-generated plot in Figure 5. As summarized in the top rows in Table 5, the average PVDR at age 62 by cohort in the model is similar to those in the data reported in Section 3.3, both in magnitudes and differences. In the lower part of Table 5, we report the education and PVDR coefficients from running an analogous regression (4) using simulated data, controlling for disability status between 61 and 63.[42] The model generated coefficient on PVDR is around 1.6, close to the empirical coefficient of approximately 1.4. Thus, the model not only matches the qualitative patterns in DI and SS claiming behaviors, but also accurately quantifies the marginal responsiveness of individuals to substitute early SS claiming with DI in response to financial incentives.

What are the fiscal and welfare effects of the reform? Having demonstrated the model's ability to capture the behavioral response to the SS policy change consistent with the em-

[42]Our results are robust to using either the aggregate disability measure (sum of disability statuses) between 61 and 63 or a dummy variable derived from it.

Figure 13: PVDR Distribution, Model

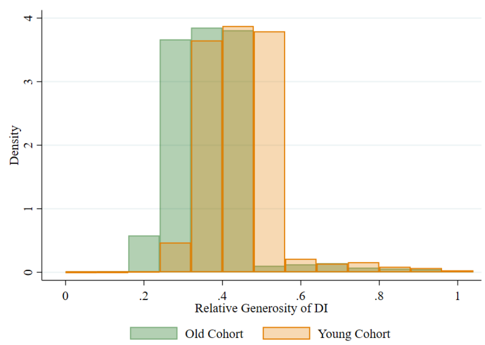


Table 5: DI and PVDR, Model

	Empirical	Model
Avg. PVDR at 62, Old	0.249	0.250
Avg. PVDR at 62, Young	0.347	0.332
(a) DI versus SS at 62		
HSG	-0.030	-0.092***
COL	-0.024	-0.068***
PVDR	1.356***	1.585***
(b) DI versus SS before FRA		
HSG	-0.013	-0.069***
COL	0.001	-0.055***
PVDR	1.361***	1.553***

Note: Figure 13 plots the PVDR distribution among 60-62-year-olds from the model. Table 5 presents coefficients from running Equation (4). Control variables include dummy variables for cohort and education. Additionally, to control for disability status, we construct the aggregate disability measure (sum of disability statuses) between 61 and 63 and use a dummy variable (a total of nine categories, 3 disability status per age) derived from it.

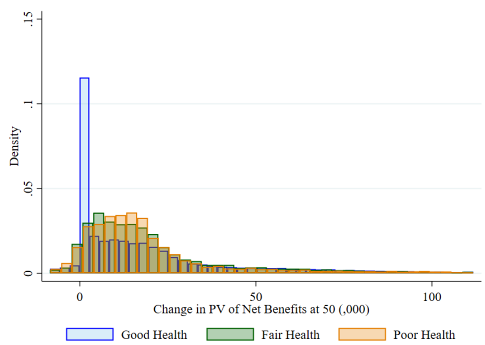
pirical analysis in Section 3.3, we now examine the effects of the reform from our simulated data.

We evaluate the fiscal and welfare effects of the reform on individuals at age 50, which approximates the age where the increased likelihood of health shocks makes the trade-off between early SS claiming and DI enrollment substantially more relevant for workers. Moreover, given DI's role as a social insurance program against health risks, we focus on analyzing the redistributive effects across health statuses. To achieve this, we categorize individuals into three "health" types based on their disability status between ages 50 and 64, older working ages relevant to the SS and DI claiming margins in our analysis. Specifically, we construct health status by counting the number of years in which an individual is either moderately or severely disabled between ages 50 and 64. Individuals with less than five such years are defined as having "good health," those with five to ten years are classified as having "fair health," and those with more than ten years are classified as having "poor health." The composition of workers in the good, fair, and poor health groups is 46%, 27%, and 27%, respectively.[43] We choose to use this health status measure utilizing multi-year disability statuses, rather than relying on annually measured disability status, as it yields a robust indicator of health that is more meaningful for analyzing the distributional effects of the reform.

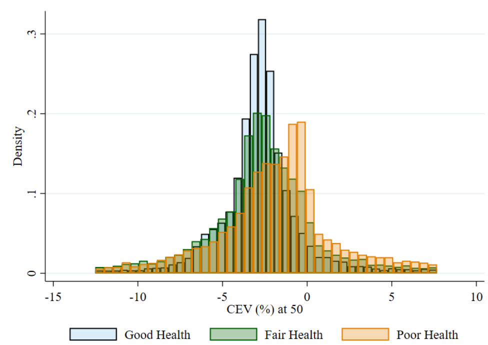
[43]Using an alternative criterion that incorporates the intensity of disability status, e.g., by distinguishing between years with a moderate or severe disability, does not significantly alter the resulting categorization.

Figure 14: Fiscal and Welfare Effects by Health Status

(a): Changes in PV of Net Benefits



(b): CEV



(c): Summary

	Avg.
Δ PV	18.9
Good	17.9
Fair	20.6
Poor	19.6
CEV	-2.53
Good	-2.77
Fair	-2.67
Poor	-1.85

Note: Figure 14(a) plots the distribution of changes in PV of net benefits (DI and SS benefits net of taxes) expressed in thousands of dollars at age 50; and Figure 14(b) plots the distribution of CEV at age 50. We drop the bottom and top 5% of the distribution. The averages are summarized in Table (c).

For each individual in the simulated data, we construct the present value (PV) of DI and SS benefits net of taxes, that the individual receives from ages 50 until death, evaluated at age 50. We then calculate the difference in this PV of net benefits (PVNB) across cohorts; that is, we compare the PVNB an individual receives when simulated under the old cohort's environment with that under the young cohort's environment. The distribution of this change in PVNB calculated at age 50 is plotted in Figure 14(a) by health status with their corresponding averages summarized in the 14(c). We note that the average change in the PVNB is higher among fair and poor health individuals compared to those in the good health group. In the distribution, we observe a large mass of good health individuals for whom the change in PVNB is negligible. On the other hand, most fair and poor health individuals experienced an increase in PVNB when simulated as young cohort. These changes are primarily driven by the differential change in DI benefits. Specifically, the changes in the PV of DI benefits received by fair and poor health individuals are around \$1.9K and \$6.5K, respectively, relative to \$0.2K for good health individuals. Thus, by the measure we consider, the effects on PVNB at age 50, the reform is fiscally progressive with respect to health status.

Now we evaluate the welfare effects of the reform by calculating the consumption equivalent variation (CEV) at age 50. Following De Nardi et al. (2025), we construct a CEV measure to quantify welfare effects. We compare an individual's utility under the baseline policy to his utility in a counterfactual scenario where he faces the SS reform, holding all else constant. Specifically, we calculate the percent change in consumption required for an individual in the baseline environment to be indifferent to living in the reform environment. We evaluate the CEV at age 50 that captures the welfare effects during the older years, more reflective of the target population of DI and SS policies. In Figure 14(b) is the CEV distribution and in 14(c), the averages across health types. On average, the CEV is negative, implying welfare cost for individuals living as a young cohort.[44] The welfare cost is higher for those of good health than it is for the poor health on average, and it is also evident from the distribution in Figure 14(b). Notably, there is a large overlap in the CEV distribution between good and fair health individuals, with the distribution shifted to the right for the poor health individuals. Similar to the redistributive fiscal effects, the welfare effects are also progressive with respect to health statuses.

6.2 DI and SS Reform

In the benchmark policy environment, we find that the SS reform experienced by the young cohort had progressive fiscal and welfare effects with respect to health statuses. In this section, we investigate the role of DI in shaping these outcomes through two counterfactual analyses. First, we simulate the SS reform in an economy without a DI program, comparing the effects on old and young cohorts. Second, we simulate an economy where the SS reform is accompanied by a more lenient DI policy. We model this by increasing the DI acceptance probability by 20%, which captures the potential unmodeled shifts in screening stringency over time.[45] We then compare the reform effects relative to old cohorts in our benchmark economy. To focus the main text on fiscal and welfare implications, we report detailed DI and SS behavioral statistics for the counterfactual economies in Appendix D.

In the first counterfactual, the change in the share claiming SS at 62 is negligible. On the other hand, in the second experiment, the DI share at age 62 rises from 6.3% to 11.6%, mirroring the empirical patterns of DI shares among the young cohort documented in Section 3.2. This increase is more pronounced among the HSD individuals, rising from 13% to 24%. Concurrently, the aggregate share claiming SS at age 62 declines by 5pp from 46% to 41%; this decline is sharpest among HSD individuals, from 54% to 46%. These results indicate significant substitution from early SS claiming to DI when the DI policy becomes more lenient.

In Table 6, we document the fiscal and welfare effects across health statuses for the no-

[44] We report unweighted averages within health groups. This approach abstracts from mortality-driven inequality, as the utilitarian criterion focuses on the welfare of living agents only (see Jang et al., 2024).

[45] The acceptance probabilities increase from 15% to 18% for moderately disabled workers and 35% to 42% for severely disabled workers. This experiment may be interpreted as capturing both the effects of the 1984 DI reform and a secular increase in DI acceptance probabilities (e.g., Autor and Duggan, 2006). Although these changes impacted all individuals, young cohort has been exposed to these policy environments more (longer) than the old cohort.

Table 6: Effects of Social Security Reform across DI environments

	Benchmark	No-DI	Lenient-DI
Changes in (,000)	18.9	16.7 (-2.2)	22.8 (+3.9)
Good health	17.9	16.9 (-1.0)	20.2 (+2.3)
Fair health	20.6	18.4 (-2.2)	25.1 (+4.5)
Poor health	19.6	14.9 (-5.0)	27.4 (+7.8)
CEV (%)	-2.53	-2.88 (-0.35)	-2.22 (+0.31)
Good health	-2.77	-2.93 (-0.16)	-2.55 (+0.22)
Fair health	-2.67	-3.00 (-0.33)	-2.47 (+0.20)
Poor health	-1.85	-2.54 (-0.69)	-1.21 (+0.64)

Note: Table 6 documents the changes in the PV of net benefits and the CEV at age 50 across cohorts. The "Benchmark" refers to the results under the benchmark environment, also reported in Figure 14. The "No-DI" refers to the effects comparing the old and young cohorts' outcomes both in the no-DI economy. The "Lenient-DI" compares outcome of the benchmark old cohort with the young cohort facing the SS reform and a concurrent, 20% increase in DI acceptance probability. As in the benchmark analyses, we report averages after dropping the bottom and top 5% of the distribution. The numbers in parentheses represent the difference relative to the benchmark.

DI and lenient-DI economies, alongside the benchmark results. In the no-DI economy, the average change in PVNB from the reform is 12% lower compared to the benchmark, due to the absence of the additional social insurance program. More notably, the heterogeneity across health statuses shifts significantly: the PVNB change in the no-DI economy is higher among good health individuals than for poor health individuals, unlike in the benchmark economy. This implies that the DI program in the benchmark economy plays a crucial role in mitigating the reform's regressive fiscal impact on vulnerable populations.

These fiscal shifts underscore the insurance value provided by the DI program. In the absence of DI, the welfare cost of the SS reform rises because older individuals face a more stringent SS program without a safety net against health shocks. Our estimates quantify that the benchmark DI program reduces the welfare costs of the reform by approximately 14% (comparing 2.88 to 2.53) relative to the no-DI economy. This protection is most valuable to those with the highest risk; individuals in poor health see their welfare costs drop 37% when moving from no-DI to the benchmark economy.

In the lenient-DI economy, the SS reform tends to benefit the poor health regarding both PVNB and welfare costs, making the reform effects much more progressive with respect to health status. This outcome is driven by the generous DI policy, which disproportionately shields individuals with poor health from the costs of reform compared to those in good health.

6.3 Elimination of Early SS Claiming

Now, we examine a more stringent SS reform: the elimination of early SS benefit claiming.[46] This policy mirrors systems currently in place in the United Kingdom and Denmark. For instance, the UK State Pension and Denmark's public pension (*Folkepension*), analogous to SS in the US, do not offer an option to claim benefits prior to their statutory retirement ages of 66 and 67, respectively.

Table 7: Effects of Eliminating Early Claiming of SS Benefits

	Changes in PV (,000)			CEV
		SS Benefits	DI Benefits	
All	+3.61	-5.11	+4.12	-5.67
Good health	+5.18	-0.95	+0.30	-5.82
Fair health	-0.16	-9.98	+5.88	-6.18
Poor health	+3.58	-11.49	+13.34	-4.73

Note: Table 7 compares outcome of the benchmark old cohort with the young cohort facing no option to claim SS early (all other SS policy changes are equivalent to the benchmark reform, e.g., FRA for the young cohort is 66). As in the benchmark analyses, we report averages after dropping the bottom and top 5% of the distribution.

Table 7 summarizes the effects of this reform, with behavioral details relegated to Appendix D. Under this scenario, the PVNB increases by 3.61, an increase that is 80% smaller than that in the benchmark reform (18.9). Decomposing this change into SS and DI benefits reveal substantial differences. While the PV of SS benefits decreases, a large share of this decline is offset by an increase in DI benefits. This effect is particularly heterogeneous across health statuses, as individuals in poor health largely recoup lost SS benefits through DI. Indeed, at age 62, 13% of the young cohort in this counterfactual economy receives DI, with the share reaching 27% among HSD. The corresponding CEV reflects this heterogeneity. Interestingly, the fair health group incurs the highest welfare cost. Compared to the poor health group, they have less insurance from DI due to stricter DI eligibility; yet compared to the good health group, they face inferior labor market opportunities. This experiment further highlights the significant spillover effects of SS tightening, and its implications across workers of different health groups.

[46] Specifically, we keep all components of the SS reform modeled for the young cohort in the benchmark economy (e.g., FRA, delayed claiming credits), with the only exception being no choice of claiming benefits before the FRA (66).

7 Conclusion

This paper studies the effects of Social Security reforms, accounting for its interaction with Disability Insurance. Utilizing the Social Security Amendments of 1983, we document and measure behavioral differences across cohorts facing differential retirement ages and penalties for early SS benefit claiming. In particular, we find suggestive evidence of individuals substituting early SS claiming with DI, when the relative generosity of DI, measured by the percent difference in the present value of receiving DI versus claiming SS benefits early, increases due to policy change. We develop and calibrate a quantitative life-cycle model that captures these endogenous DI and SS claiming decisions. Our quantitative model, which successfully replicates key empirical patterns, suggests that DI plays an important role in shaping the fiscal and welfare effects of the SS reform. In particular, the DI program significantly mitigates the reform's regressive effects and lowers welfare costs, particularly for individuals with poor health.

Our findings have important implications for policy design, particularly as the US Social Security Trust Fund is facing imminent depletion. We highlight the necessity of jointly evaluating the aggregate and redistributive consequences of SS and DI. Specifically, any changes in the SS benefit structure may induce stronger financial incentives for individuals at the margin to apply for DI benefits. While this substitution may impose additional fiscal constraints, it also acts as a critical insurance mechanism that is highly valuable for vulnerable individuals. Therefore, optimal policy responses should account for these reidistributive effects to balance the fiscal goals and welfare outcomes across the population.

References

Aizawa, N., S. Kim, and S. Rhee (2025). Labour market screening and the design of social insurance: An equilibrium analysis of the labour market for the disabled. *Review of Economic Studies 92*, 1–39.

Andersen, A. G., S. Markussen, and K. Roed (2021). Pension reform and the efficiency-equity trade-off: Impacts of removing an early retirement subsidy. *Labour Economics 72*.

Attanasio, O., S. Kitao, and G. L. Violante (2011). *Demography and the Economy*, Chapter Financing Medicare: A General Equilibrium Analysis, pp. 333–366. University of Chicago Press.

Autor, D., A. Kostøl, M. Mogstad, and B. Setzler (2019, July). Disability benefits, consumption insurance, and household labor supply. *American Economic Review 109*(7), 2613–2654.

Autor, D. H. and M. G. Duggan (2006). The growth in the social security disability rolls: A fiscal crisis unfolding. *Journal of Economic Perspectives 20*(3), 71–96.

Bairoliya, N. and K. McKiernan (2023). Revisiting retirement and social security claiming decisions. *Working Paper*.

Borella, M., M. De Nardi, and F. Yang (2023, January). Are marriage-related taxes and social security benefits holding back female labor supply? *Review of Economic Studies 90*(1), 102–131.

Bound, J. and R. V. Burkhauser (1999). *Handbook of Labor Economics*, Volume 3C, Chapter Economic Analysis of Transfer Programs Targeted on People with Disabilities, pp. 3417–3528. Amsterdam: Elsevier Science.

Braun, R. A., K. Kopecky, and T. Koreshkova (2017). Old, sick, alone and poor: A welfare analysis of old-age social insurance programs. *The Review of Economic Studies 84*, 580–612.

Coe, N. B. and K. Haverstick (2010). Measuring the spillover to disability insurance due to the rise in the full retirement age. *Boston College CRR working paper* (2010-21).

Coile, C., M. Duggan, and A. Guo (2015). Veterans' labor force participation: What role does the va's disability compensation program play? *American Economic Review: Papers & Proceedings 105*(5), 131–136.

De Nardi, M. (2004). Wealth inequality and intergenerational links. *Review of Economic Studies 71*, 743–768.

De Nardi, M., E. French, and J. B. Jones (2016, November). Medicaid insurance in old age. *American Economic Review 106*(11), 3480–3520.

De Nardi, M., S. Pashchenko, and P. Porapakkarm (2025). The lifetime costs of bad health. *Review of Economic Studies*.

Deshpande, M., I. Fadlon, and C. Gray (2024, March). How sticky is retirement behavior in the u.s.? *The Review of Economics and Statistics 106*(2), 370–383.

Dotsey, M., W. Li, and F. Yang (2015). Home production and social security reform. *European Economic Review 73*, 131–150.

Duggan, M., P. Singleton, and J. Song (2007). Aching to retire? the rise in the full retirement age and its impact on the social security disability rolls. *Journal of Public Economics 91*, 1327–1350.

French, E. (2005). The effects of health, wealth, and wages on labour supply and retirement behaviour. *Review of Economic Studies 72*, 395–427.

French, E. and J. B. Jones (2011, May). The effects of health insurance and self-insurance on retirement behavior. *Econometrica 79*(3), 693–732.

French, E. and J. B. Jones (2017). Health, health insurance, and retirement: A survey. *Annual Review of Economics 9*, 338–409.

French, E., A. Lindner, C. O'Dea, and T. Zawisza (2026). Labor supply and the pension contribution-benefit link. *The Review of Economic Studies*.

French, E. and J. Song (2014, May). The effect of disability insurance receipt on labor supply. *American Economic Journal: Policy 6*(2), 291–337.

Gelber, A., T. Moore, Z. Pei, and A. Strand (2023). Disability insurance income saves lives. *Journal of Political Economy 131*(11).

Geyer, J., P. Haan, A. Hammerschmid, and M. Peters (2020). Labor market and distributional effects of an increase in the retirement age. *Labour Economics 65*.

Gruber, J. and P. Orszag (2004, December). Does the social security earnings test affect labor supply and benefits receipt? *National Tax Journal 56*(4), 755–773.

Heckman, J. J. (1979, January). Sample selection bias as a specification error. *Econometrica 47*(1), 153–161.

Holter, H., D. Krueger, and S. Stepanchuk (2019). How does tax progressivity and household heterogeneity affect laffer curves? *Quantitative Economics 10*, 1317–1356.

Hosseini, R., K. Kopecky, and K. Zhao (2022). The evolution of health over the life cycle. *Review of Economic Dynamics 45*, 237–263.

Hosseini, R., K. Kopecky, and K. Zhao (2025). How important is health inequality for lifetime earnings inequality? *The Review of Economic Studies*.

Imrohoroglu, S. and S. Kitao (2012). Social security reforms: Benefit claiming, labor force participation, and long-run sustainability. *American Economic Journal: Macroeconomics 4*, 96–127.

Jang, Y., S. Pashchenko, and P. Porapakkarm (2024). Mortality regressivity and pension design. *Working paper*.

Jones, J. B. and Y. Li (2023). Social security reform with heterogeneous mortality. *Review of Economic Dynamics 48*, 320–344.

Kim, S. and S. Rhee (2022, October). Understanding the aggregate effects of disability insurance. *Review of Economic Dynamics 46*, 328–364.

Kitao, S. (2014a). A life-cycle model of unemployment and disability insurance. *Journal of Monetary Economics 68*, 1–18.

Kitao, S. (2014b). Sustainable social security: Four options. *Review of Economic Dynamics 17*(4), 756–779.

Kolsrud, J., C. Landais, D. Reck, and J. Spinnewijn (2024). Retirement consumption and pension design. *American Economic Review 114*(1), 89–133.

Kopecky, K. and T. Koreshkova (2014). The impact of medical and nursing home expenses on savings. *American Economic Journal: Macroeconomics 6*(3), 29–72.

Krusell, P., T. Mukoyama, R. Rogerson, and A. Sahin (2017, November). Gross worker flows over the business cycle. *American Economic Review 107*(11), 3447–34476.

Lalive, R., A. Magesan, and S. Staubli (2023). How social security reform affects retirement and pension claiming. *American Economic Journal: Economic Policy 15*(3), 115–150.

Laun, T., S. Markussen, T. C. Vigtel, and J. Wallenius (2019). Health, longevity and pension reform. *Journal of Economic Dynamics and Control 103*, 123–157.

Li, X. and N. Maestas (2008). Does the rise in the full retirement age encouraege disability benefit applications? evidence from the health and retirement study. *University of Michigan Retirement Research Center Working Paper 2008-198*.

Li, Y. (2018). Paradoxical effects of increasing the normal retirement age: A prospective evaluation. *European Economic Review 101*, 512–527.

Lockwood, L. (2018). Incidental bequests and the choice to self-insure late life risks. *American Economic Review 108*(9), 2513–2550.

Low, H. and L. Pistaferri (2015, October). Disability insurance and the dynamics of the incentive-insurance tradeoff. *American Economic Review 105*(10), 2986–3029.

Maestas, N., K. J. Mullen, and A. Strand (2013). Does disability insurance receipt discourage work? Using examiner assignment to estimate causal effects of SSDI receipt. *American Economic Review 103*(5), 1797–1829.

Mitnitski, A. B., J. E. Graham, A. J. Mogilner, and K. Rockwood (2002). Frailty, fitness and late-life mortality in relation to chronological and biological age. *BMC Geriatrics 2*(1).

Nishiyama, S. (2019, January). The joint labor supply decision of married couples and the u.s. social security pension system. *Review of Economic Dynamics 31*, 277–304.

Pashchenko, S. and P. Porapakkarm (2023, February). Accounting for social security claim behavior. *International Economic Review 65*(1), 505–545.

Rabate, S., E. Jongen, and T. Atav (2024, Feb). Increasing the retirement age: Policy effects and underlying mechanisms. *American Economic Journal: Economic Policy 16*(1), 259–291.

Social Security Administration (2026, January). How work affects your benefits.

von Wachter, T., J. Song, and J. Manchester (2011). Trends in employment and earnings of allowed and rejected applicants to the social disability insurance program. *American Economic Review 101*(7), 3308–29.

Yang, F. (2013). Social security reform with impure intergenerational altruism. *Journal of Economic Dynamics and Control 37*, 52–67.

Appendix

A Supplemental Details on Empirical Analysis

A.1 Data: Health and Retirement Study

The Health and Retirement Study (HRS) is a biennial longitudinal dataset representing older American households starting from year 1992. As of year 2024, the raw datafiles for waves 1 to 15 are publicly available and downloadable from the HRS webpage. Our main analysis is based on the RAND HRS datafile that covers waves 1 to 15. We focus on males born in years 1931-1937 ("old" cohort) and those born in years 1943-1954 ("young" cohort), whose FRA is 65 and 66 respectively (Those born in 1938-1942 experience a two-month increase in FRA for each birth year).

Table A1: Number of HRS Respondents by Cohort

	Birth year	Male	Female	Total		Birth year	Male	Female	Total
Old cohort	1931	402	460	862	Young cohort	1943	254	389	643
	1932	434	461	895		1944	220	352	572
	1933	381	440	821		1945	220	310	530
	1934	453	489	942		1946	279	348	627
	1935	461	463	924		1947	251	373	624
	1936	443	484	927		1948	321	436	757
	1937	467	534	1,001		1949	345	459	804
Partially affected	1938	470	530	1,000		1950	367	465	832
	1939	510	531	1,041		1951	341	429	770
	1940	478	560	1,038		1952	408	485	893
	1941	500	555	1,055		1953	392	439	831
	1942	274	435	709		1954	365	476	841

We supplement the publicly available data with the restricted variables from the Social Security Administration (SSA) to construct the expected present-value of benefit amounts. The SSA-merged data is available for individuals who provide consent. For those who consent to provide earnings record, we have annual earnings data for years from 1951 to 2020. Earnings are recorded to zero for those who have no reported earnings. Earnings below \$49.99 were recorded to N to preserve confidentiality. Earnings above \$50 are rounded to the nearest \$100. Additionally, the data provides benefit types (e.g., retired worker, disabled worker, aged spouse), benefit starting month and year, as well as benefit amounts. As benefit amounts are only available for beneficiaries, we use earnings records to impute the individual's potential benefit amounts. We additionally utilize the reported benefit amounts to confirm whether our imputation is reliable. We describe these steps in Section A.2.

A.2 Construction of Hypothetical Primary Insurance Amount

We follow the process provided by SSA for constructing Average Indexed Monthly Earnings (AIME), the average lifetime earnings measured around the time of your retirement, and Primary Insurance Amount (PIA), the monthly amount of insurance benefits depending on his lifetime earnings.

PIA for Social Security. We merge the publicly available HRS dataset with the SSA's restricted nominal earnings dataset for years from 1951 to 2020. For older cohort born in years 1931, it means their earnings records between age 20 and 88 are available. For later cohort born in years 1954, their earnings record is available until age 66. For each matched respondent, we keep their earnings records between age 21 to their full retirement age to compute thier AIME.

To construct the AIME, we first convert the nominal earnings across different years into real term using the Average Wage Index (AWI), which measures the national wage level over time. For retirement benefits, indexing is based on the year a respondent turns age 60. For example, if a respondent turned 60 in year 2020, his earnings in year $t < 2020$ is converted into 2020 US dollars using the ratio $\frac{AWI_{2020}}{AWI_t}$. For earnings after age 60, the indexing factor is 1.After indexing the nominal earnings in basis year, we compute the AIME based on the maximum 35 years of indexed earnings. For those who have less than 35 years with positive earnings, zero will be substituted instead. Then, the total sum of these 35 observations of annual earnings is divided by 420 ($= 35 \times 12$) to obtain the AIME.

Once the AIME is calculated, we compute the PIA using a progressive piece-wise linear formula. The replacement rate is 90% up to the first bend point, 32% between the first and second bend points, and 15% beyond the second bend point. These bend points vary over time, and determined by the year the respondent turns 62. Given the PIA, we then apply several adjustments to the final benefit amount. First, benefits are reduced for early retirees. Second, the Retirement Earnings Test (RET) may cause the actual benefits received to differ from the PIA for beneficiaries between age 62 and the FRA. Specifically, SSA withholds $1 in benefits for every $2 or $3 of earnings in excess of exempt amounts. Earnings in or after the month you reach the FRA do not count toward the retirement test.

PIA for Disability Insurance. Compared to SS benefits that have earnings record until claiming age, DI applicants have shorter earnings records until the onset of their disability. Therefore, PIA for DI recipients is calculated after dropping a number of low earnings records[A1] in calculating their average lifetime earnings. More specifically, out of elapsed

[A1] For more details about the 1-for-5 rule, see https://secure.ssa.gov/poms.nsf/lnx/0300605230.

years from age 22 to the disability onset, we decide the number of dropout earnings using the following formula:

$$\text{Dropout year} = \min\{5, \min\{62, 0.2 \times (\text{Disability Onset Age-22})\}\}.$$

Thus, the dropout year is capped at five for recipients whose onset of disability occurs after age 47. For those who are younger, their dropout year is less than five years. Then numerator for AIME is calculated based on the total of earnings record during the computation year, which is defined as the number of years between age 22 and the disability onset age after subtracting the dropout year. The denominator for AIME will be the computation year times 12.

Validating our measure of PIA. To confirm the reliability of our constructed PIA, we compare this hypothetical PIA with actual PIA reported in the dataset, where the latter is only available for a subset of individuals receiving benefits. In particular, we run the following regression by program type and claiming age:

$$\text{PIA}_{i,t} = \alpha + \beta \cdot \widehat{\text{PIA}}_{i,t} + \varepsilon_{i,t},$$

where $\text{PIA}_{i,t}$ is the actual PIA for those available and $\widehat{\text{PIA}}_{i,t}$ is the calculated PIA of individual i based on his earnings up to age t. Table A2 shows that the relationship between the calculated PIA and observed PIA among the SS beneficiaries who claimed at FRA is close to one, while the early claimants exhibit a reduction of about 30%, consistent with the benefit schedules for SS described in Section 2.2. Furthermore, we find that the relationship between the observed PIA and calculated PIA for DI beneficiaries exhibits a significantly high correlation, aligning with the institutional features of DI discussed in 2.1. Therefore, we conclude that our measure of PIA which determines the relative generosity of DI that we explain below, reliably captures individual-level incentives between the two programs.

Table A2: Relation between the Observed and Calculated PIA

	SS Beneficiaries		DI Beneficiaries
	FRA Claim	Early Claim	
β	0.959	0.703	0.911
	(0.011)	(0.010)	(0.020)
R^2	0.927	0.877	0.828
Observations	559	667	431

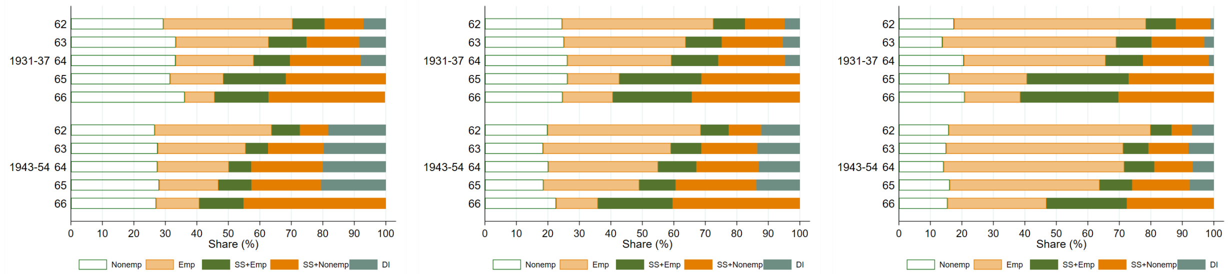
Note: Table A2 documents the coefficients of regression between the observed and calculated PIA, which is constructed based on individual-level earnings history from the SSA administration data.

A.3 Additional Empirical Results

Worker Compositions by Cohort Complementing worker composition statistics in Section 3.2, we plot workers by five statuses—not employed, employed, employed with SS benefits, not employed with SS benefits, and DI recipients. We observe that even with more disaggregated status categories, young cohort's benefit compositions differ from those of the old cohort.

Figure A1: Share of Workers by Five Statuses, by Education and Cohort

(a): High School Dropouts (b): High School Graduates (c): Some College



Note: Figure A1 shows the share of individuals by their statuses, by education group using the restricted HRS dataset.

Relative DI Generosity and Early Claiming of Social Security, Logit Model. We estimate Equation (4) using a logistic model and report the estimated coefficients in Table A3. Similar to findings in the linear probability model, the coefficient on PVDR is statistically significant even after controlling for health statuses. The implied marginal effect implies that an increase in the PVDR at 62 from 0.24 (old cohort's median) to 0.32 (young cohort's median) is associated with a 11pp increase in claiming SS at age 62. The magnitude is similar to benchmark estimate.

B Individual Problems between EEA and FRA

We specify worker problems for those between the ages of j^E, the EEA and j^F, the FRA. These individuals have three choice sets: whether to work, apply for DI or claim Social Security benefits. As discussed in the main text, their choice sets are combination of those in the working age ($j < j^E$) and those past FRA ($j > j^F$). We specify the value functions of those who have not yet claimed SS benefits and DI applicants, which are omitted from main text.

Table A3: Relative DI Generosity and DI Receipt (versus Early SS Claiming), Logit Model

	DI Status versus			
	SS Claiming at 62		SS Claiming before FRA	
High school graduates	-0.486***	-0.376*	-0.433***	-0.199
	(0.148)	(0.219)	(0.138)	(0.200)
Some college	-0.969***	-0.465	-0.940***	-0.248
	(0.205)	(0.289)	(0.194)	(0.265)
Relative DI generosity at 62	14.046***	15.501***	15.516***	16.075***
	(2.798)	(4.176)	(2.679)	(3.947)
Frailty		3.957***		3.819***
		(0.757)		(0.672)
Work Limitation		3.702***		3.865***
		(0.301)		(0.295)
R^2	0.080	0.482	0.073	0.475
Observations	1,471	1,314	2,200	1,950

Note: Table A3 documents regression coefficients from estimating Equation (4) using a logit model on sample of individuals who either receive DI or retire early. The two outcome variables are constructed as one if the individual receives DI and zero if he claim SS at 62 (the first two columns) or if he claim SS before FRA (the last two columns). Frailty and work limitation are averages between the ages of 61 and 63. Robust standard errors are in parentheses. $*p < 0.10; **p < 0.05; ***p < 0.01$

Claimed SS benefits. If the individual claimed benefits, he can still work, but cannot apply for DI. Thus, his decision problem is the same as Equation (17), except for the fact that his benefits are reduced according to the RET policy (thus, benefits are $SS(\omega, y)$), and that he is not eligible for Medicare. Therefore, the out-of-pocket medical expenditures in their budget constraint are determined based on their labor market status.

$$
\begin{aligned}
V^{S,P}(x,h) \quad &= \quad \max_{c,a' \geq 0} u(c + tr, l) + \beta \delta_j^h \sum_{h'} \pi_j^{h,h'} \left[\begin{array}{c} \chi_{h'}^P \mathbb{E} \max_{l \in \{0,1\}} V^{SP}(x', h') \\ + \left(1 - \chi_{h'}^P\right) \mathbb{E} V^{S,0}(x', h') \end{array} \right] + \beta \left(1 - \delta_j^h\right) \phi(a') \\
s.t. \qquad & c + a' = SS(\omega, y) + (\tilde{y} - oop_E(m)) \cdot \mathbb{I}_{P=1} + (UI(y) - oop_U(m)) \mathbb{I}_{P=0} + (1 + \tilde{r}) a.
\end{aligned}
$$

Did not claimed SS benefits yet. If the individual has not yet claimed benefits, he can still apply for DI if his disability status is *MD* or *SD*. Thus, the value function reads

$$
\begin{aligned}
V^{E,P}(x,h) \quad = \quad & \max_{c,a'\geq 0} u(c+tr,l)+\beta\delta_j^h\pi_j^{h,ND}\left[\ \chi_{h'}^P\mathbb{E}\max_{l\in\{0,1\}}V^l(x',ND)+\left(1-\chi_{h'}^P\right)\mathbb{E}V^0(x',ND)\ \right] \\
& +\beta\delta_j^h\sum_{h'\in\{MD,SD\}}\pi_j^{h,h'}\left[\begin{array}{c}\chi_{h'}^l\ \ \mathbb{E}\max\left\{\max\limits_{l\in\{0,1\}}V^{E,P}(x',h'),\ \max\limits_{l\in\{0,1\}}V^{S,P}(x',h'),V^A(x',h')\right\} \\ +\left(1-\chi_{h'}^P\right)\mathbb{E}\max\left\{V^{E,0}(x',h'),V^{S,0}(x',h'),V^A(x',h')\right\}\end{array}\right] \\
& +\beta\left(1-\delta_j^h\right)\phi(a') \\
s.t. \qquad & c+a'=(\tilde{y}-oop_E(m))\cdot\mathbb{I}_{P=1}+(UI(y)-oop_U(m))\,\mathbb{I}_{P=0}+(1+\tilde{r})\,a.
\end{aligned}
$$

The problem is a combination of Equations (9) and (18), as he can make labor supply choices in conjunction with whether or not to claim SS, and whether to apply for DI.

DI beneficiaries. For simplicity, we assume that once an individual is past the age of j^E, he continues receiving DI (does not get reassessed) until the benefit gets transferred to SS (without any cuts in benefits) at age j^F. Therefore, the only choices are consumption and savings, and the budget constraint is equivalent to the one faced by DI beneficiaries in the working age, Equation (16).

$$
\begin{aligned}
V^{E,D,i_M}(x,h) \quad = \quad & \max_{c,a'\geq 0} u(c+tr,0)+\beta\delta_j^h\ \ \mathbb{E}V^{E,D,i_M}(x',h')\ \ +\beta\left(1-\delta_j^h\right)\phi(b) \\
s.t. \qquad & c+a'=DI(\omega_{DI})-(i_M\cdot oop_M(m)+(1-i_M)\cdot oop_U(m))+(1+\tilde{r})\,a
\end{aligned}
$$

DI applicants. The problem of DI applicants reads as the following that also incorporates the possibility of claiming SS benefits in the next period:

$$
\begin{aligned}
V^{E,A}(x_A) \quad = \quad & \max_{c,a'\geq 0} u(c+tr,\kappa)-\zeta \\
& +\beta\delta_j^h\sum_{h'}\pi_{j+1}^{hh'}\left[\begin{array}{c}\pi^{DI,h}V^{D,i_M=0}(x',h') \\ +\left(1-\pi^{DI,h'}\right)\left[\begin{array}{c}\chi_{h'}^A\mathbb{E}\max\left\{\max\limits_{l\in\{0,1\}}V^{E,l}(x',h'),\ \max\limits_{l\in\{0,1\}}V^{S,l}(x',h')\right\} \\ +\left(1-\chi_{h'}^A\right)\mathbb{E}\max\left\{\ V^{E,0}(x',h'),V^{S,0}(x',h')\ \right\}\end{array}\right]\end{array}\right] \\
& +\beta\left(1-\delta_j^h\right)\phi(a') \\
s.t. \qquad & c+a'=(1+\tilde{r})\,a-oop_E(m).
\end{aligned}
$$

The budget constraint is the same as that of the applicants in the working age, Equation (13).

C Data, Moments, and Calibration Descriptions

C.1 Data

We complement the HRS data with three additional data sources—Panel Study of Income Dynamics (PSID), Medical Expenditure Panel Survey (MEPS), and Current Population Survey (CPS)—for calibration. The main dataset for calibration is PSID. We use the PSID to calibrate parameters exogenously and to construct moments for endogenously calibrated parameters. Exogenously calibrated parameters include survival probabilities, disability transition probabilities, wage offers, and hours worked. Moments for within-model calibration include employment rates, wealth, and consumption moments. We need these empirical moments by education and/or disability statuses over the life-cycle, for which the PSID is the uniquely suited among publicly available datasets.

We use the PSID data for years 2003 through 2017, and restrict sample to male (consistent with the HRS) older than 24 (consistent with model life-cycle). We define employed as those with hourly wage higher than $4. We drop those missing education, frailty, or disability statuses with a remaining sample size of 23,393, among which 19,986 are employed. As described in the main text, we use the frailty index constructed by Hosseini et al. (2022) to construct disability status used in our calibration and quantitative analysis. Table A4 presents the summary statistics of key variables among those aged between 25 and 70 from the PSID for all and by disability status. As can be seen, healthier individuals tend to be younger, more educated, and have better labor market outcomes.

Table A4: Summary Statistics by Disability Status from PSID

	All	Non-Disabled	Mod. Disabled	Sev. Disabled
Age	44.10	42.59	49.02	53.08
Frailty	0.10	0.07	0.18	0.33
Work disability (binary)	0.14	0.0	0.55	1.0
High school dropout	0.08	0.07	0.13	0.16
High school graduate	0.58	0.57	0.63	0.67
Some college	0.34	0.37	0.23	0.16
Employment	0.80	0.88	0.59	0.22
Earnings of employed	$63.9K	$66.4K	$49.3K	$30.9K

We also use the MEPS to construct medical expenditure profiles over the life-cycle. While the PSID collects medical expenditures at the family level, the MEPS reports individual-level expenditures, which can be more readily mapped to individual disability status. We use the same sample restrictions used for the PSID to construct these medical expenditure profiles, which we detail below. Finally, following Krusell et al. (2017), we use the

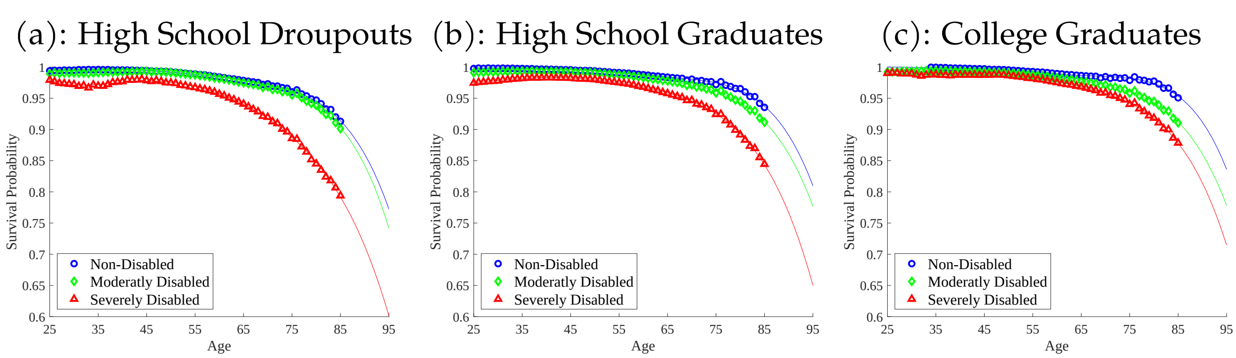
CPS from 1978 to 2012 to construct the labor market transition rates used as moments in within-model calibration. For this analysis, we aggregate HSD and HSG into a single 'non-college' category.

C.2 Exogenously Calibrated Parameters and Values

The exogenously calibrated parameters include: (i) survival probabilities, (ii) disability transition probabilities, (iii) wage offers and hours worked, and (iv) medical expenditures. We use the PSID for (i)-(iii) and the MEPS for (iv). Below, we describe their construction processes, which broadly follow Pashchenko and Porapakkarm (2023). Whenever applicable, we control for cohorts using 5-year birth cohort dummies with the exception of the oldest (1930 and before) and the youngest (1985 and later) cohorts in the data, as well as the "old" (1931-1937) and "young" (1943-1954) cohorts as defined in our empirical analyses.

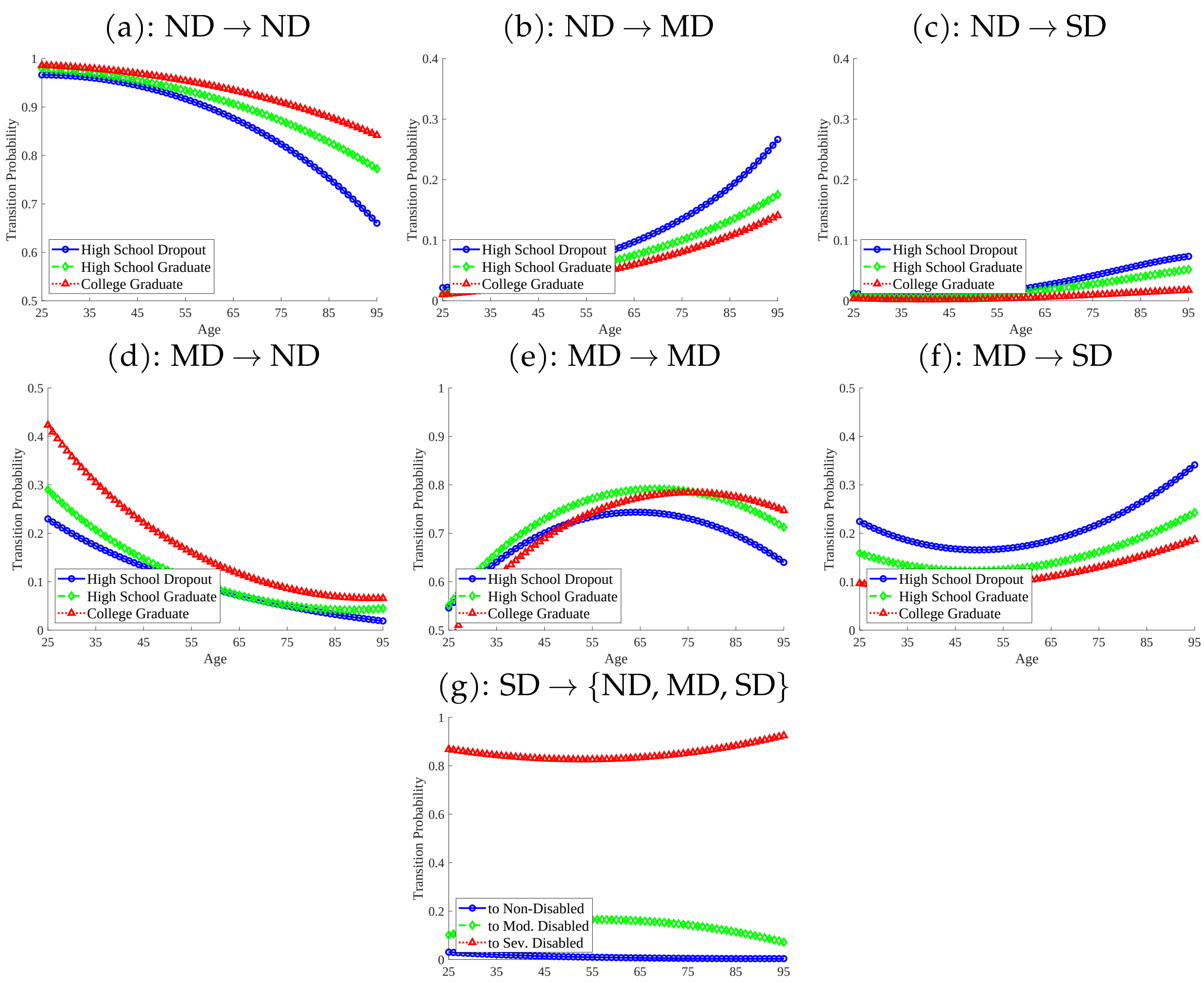
Survival probabilities. Survival probabilities over the life-cycle differ by education and disability status. Following Attanasio et al. (2011), we estimate conditional survival probabilities by education and disability status, using the Cohort Life Tables from the SSA (for the 1934 cohort) and micro-level data from the PSID. Specifically, from the PSID, we estimate a probit model of death with cohort dummies, disability interacted with education dummies, age (quadratic), race, schooling (in years), marital status, and region. We then construct the predicted values for the old and young cohorts, and obtain disability and education-specific survival premia to be consistent with life tables. These are then smoothed out by fitting polynomials in age, and extrapolated for individuals older than 85. Figure A2 plots the survival probabilities by education for the old cohort.

Figure A2: Survival Probability by Education



Disability transition probabilities. Disability transition probabilities follow a first-order Markov process and are calibrated using the panel dimension of the PSID data. We allow for education-dependence for the non-disabled and moderately-disabled individuals. Due to sample size issues, transition probabilities of severely disabled individuals do not depend on education. Similar to the calibration of the survival probabilities, we estimate a multinomial logit model with future disability status as the dependent variable. We then predict disability transitions, which are fitted to polynomials in age, extrapolated beyond age 85. Figure A3 plots the calibrated life-cycle disability transition probabilities (which we assume to be the same across cohorts).

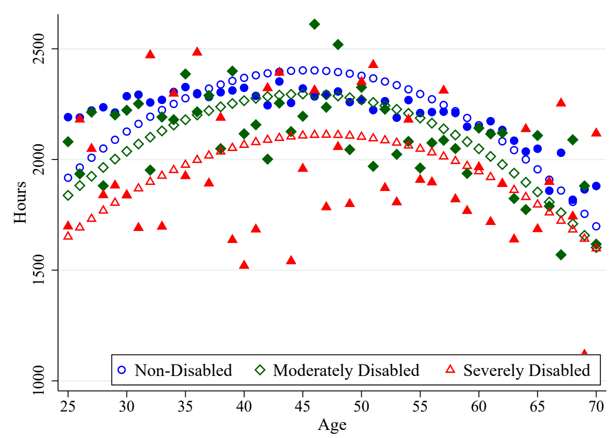
Figure A3: Disability Transition Probabilities



Wage offers and hours worked. We estimate the wage offer profiles following Heckman (1979) to control for selection into employment, where we use welfare benefits as an instrument in employment equation. Following Low and Pistaferri (2015), we construct transfers—Earned Income Tax Credit, unemployment insurance, Supplemental Nutrition Assistance Program, and Aid to Families with Dependent Children (subsequently, Temporary Assistance for Needy Families)—of a representative earner, utilizing their variations across state and year. These are used in the selection equation, in addition to cohort dummies, disability dummies, age (quadratic), race, years of schooling, marital status, and region. In the second stage, we regress log hourly wage on individual characteristics and disability interacted with education dummies. Their predicted values for the old cohort are then smoothed out by fitting polynomials in age, which are plotted in Figure 7.

Conditional on employment (which we assume to be more than 700 hours), hours worked do not vary much across education statuses. We thus use the average hours over the life-cycle, fitted to polynomials in age by disability as shown in Figure (A4).

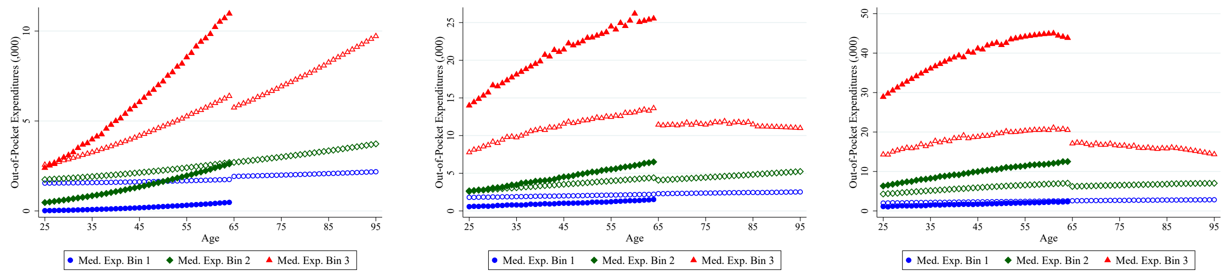
Figure A4: Hours of Employed Workers



Medical expenditures. The out-of-pocket expenditure profiles constructed using procedures described in Section 5.1 are plotted in Figure A5: hollow markers are for the uninsured (unemployed) and filled markers are for the insured (employed), with those older than 65 are universally covered by Medicare.

Figure A5: Out-of-Pocket Medical Expenditures by Disability Status

(a): Non-Disabled (b): Moderately Disabled (c): Severely Disabled



C.3 Moments for Calibration, Calibrated Parameters, and Model Fit

Table A5 summarizes the moments used in calibration and the model fit.

Table A5: Moments and Model Fit

	Data	Model	Source	N
Labor Market				
Emp. by age / educ. / disab.	see Figure 9		PSID	396
Avg. EE transition by two educ.	0.92, 0.96	0.96, 0.98	CPS	2
Avg. NE transition by two educ.	0.30, 0.41	0.13, 0.20	CPS	2
Social Security and Disability Insurance				
SS claiming at 62 by educ.	0.50, 0.46, 0.35	0.54, 0.46, 0.26	HRS	3
SS claiming at 65 by educ.	0.20, 0.25, 0.38	0.27, 0.30, 0.60	HRS	3
SS claiming at 66+ by educ.	0.05, 0.04, 0.06	0.03, 0.02, 0.00	HRS	3
Emp. share among SS by educ., 62-69	0.34, 0.40, 0.47	0.11, 0.17, 0.34	HRS	3
DI share, 50-54	0.03	0.04	HRS	1
DI share by education, 60-64	0.09, 0.05, 0.02	0.13, 0.04, 0.02	HRS	3
Wealth and Consumption				
Avg. wealth, 55-59 and 60-64	$62K, $92K	$133K, $152K	PSID	2
Wealth ratio, 25th-to-75th perc., 65-69	0.11	0.22	PSID	1
Avg. cons. of HSD by disab.	$13K, $13K, $12K	$18K, $16K, $13K	PSID	3
Avg. cons. of HSG by disab.	$19K, $18K, $16K	$26K, $21K, $18K	PSID	3
Avg. cons. of COL by disab.	$28K, $28K, $24K	$43K, $36K, $32K	PSID	3
Total				428

Following the analogous procedure used in constructing the exogenously calibrated parameters, we obtain the employment rate targets from running a Probit model and smoothing the predicted values using age polynomials. The SS and DI moments are from the restricted HRS data set that we used and described in Section 3 and Appendix A. Wealth and consumption moments are from the PSID, where we control for household size using an equivalence scale that assigns 0.3 to each child and 0.5 to each additional adult. We drop those at the lowest and highest 1% in the sample, run the regression (as in other parameters and moments), and use the cohort-specific predicted values to generate the average moments by age group, education, and disability status. The model is able to broadly capture the key empirical observations.

In Table A6, we document values of $\theta_1(s,h)$ and $\theta_2(s,h)$ that determine time costs of work and age-gradient beyond 50. These values underlie the leisure endowment by age, education, and disability in Figure 8, constructed from Equations (20) and (5).

Table A6: Time Costs of Work and Disability Parameters

	ND	MD	SD		ND	MD	SD
$\theta_1(s,h)$: time cost of work				$\theta_2(s,h)$: age-gradient beyond 50			
HSD	0.72	3.14	3.76	HSD	0.00	0.00	1.52
HSG	0.176	1.35	4.15	HSG	0.28	0.71	0.80
COL	0.59	1.79	2.95	COL	0.00	0.00	0.00

D Supplemental Details on Quantitative Analysis

D.1 Cohort-Specific Parameters

In simulating the young cohort in Section 6.1, we use cohort-specific worker-level parameters and policy parameters. Specifically, we use the same procedures as described in Section C.2 to construct survival probabilities and wage offer processes for the young cohort. For survival probabilities, we use the survival probabilities of the 1949 birth cohort in Cohort Life Tables. The estimated survival probabilities and wage processes are presented in Figures A6 and A7.

For Social Security policy parameters, we transform values in 2010 to 2020 dollars. The corresponding values for SS tax max earnings; the two bend points for PIA; and the two RET thresholds are, \$127K; \$10.8K, \$65.3K; and \$17.1K, \$45.6K. The annual early claiming penalty is 6.25%, resulting in a 25% lower PIA if one claims benefits at 62 instead of at the FRA of 66. Analogously, one receives an 8% per year delayed retirement credit for each year past the FRA, resulting in a maximum credit of 32% if benefits are claimed at age 70.

Figure A7: Wage Offer Profiles by Education of the Young Cohort

(a): High School Dropouts (b): High School Graduates (c): Some College

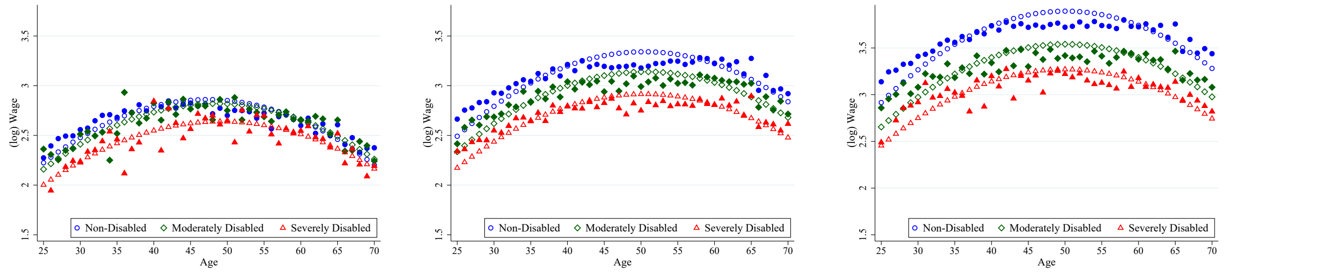
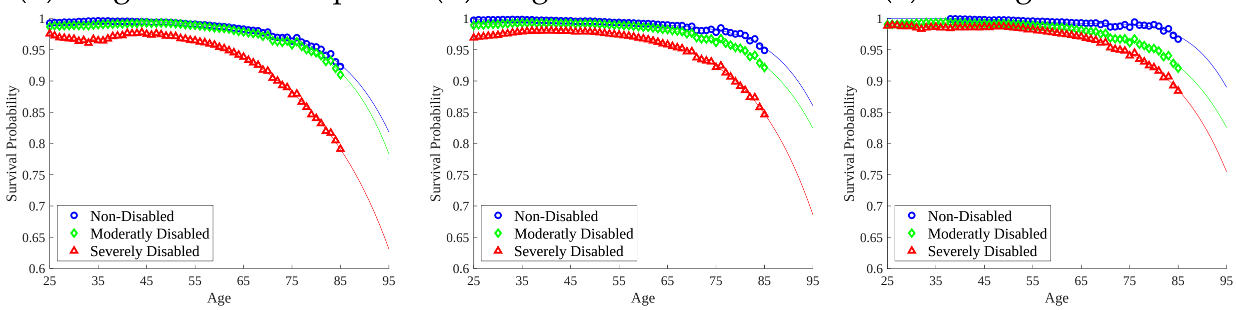


Figure A6: Survival Probability by Education of the Young Cohort

(a): High School Droupouts (b): High School Graduates (c): College Graduates



D.2 Additional Results on Counterfactual Analyses

In Tables A7 and A8 we document DI shares at age 62 and shares claiming SS at age 62, respectively, across different counterfactual economies. The changes on DI shares across counterfactual economies vary greatly across education. In particular, a relaxation of the DI program or an elimination of early SS significantly widens the DI share gap across education. At the same time, Table A8 shows that the early SS claiming share decreases significantly, implying a large substitution patterns between early SS claiming and DI.

D.3 Welfare Analysis

We consider the allocation of the old cohort as the benchmark and construct the utility of an individual of age τ who lives until T_i as $U^0_{i,\tau} = \sum_{t=\tau}^{T_i} \beta^{t-\tau} u\left(c^0_{i,t}, l^0_{i,t}\right) + \beta^{T_i-\tau} \phi\left(b^0_i\right)$, where b^0_i denotes bequest. Similarly, given the same health and mortality outcomes, the lifetime utility of the same individual facing environments of the young cohort is $U^1_{i,\tau} = \sum_{t=\tau}^{T_i} \beta^{t-\tau} u\left(c^1_{i,t}, l^1_{i,t}\right) + \beta^{T_i-\tau} \phi\left(b^1_i\right)$. We measure the welfare costs of the reform using the consumption-equivalent variation (CEV) and solve the required additional consumption

Table A7: DI Shares at Age 62 across Counterfactual Economies

	Benchmark-DI		No-DI		Lenient-DI	No Early SS
	Old	Young	Old	Young	Young	Young
All	0.063	0.077	-	-	0.116	0.127
HSD	0.131	0.164	-	-	0.244	0.272
HSG	0.040	0.049	-	-	0.074	0.079
COL	0.025	0.033	-	-	0.045	0.050

Note: Table A7 reports DI shares at age 62. Lenient DI refers to an economy with young cohort's SS policies and 20% higher DI acceptance rates. No Early SS refers to young cohort's SS policies but with no option to claim SS before FRA.

Table A8: Share Claiming SS at Age 62 across Counterfactual Economies

	Benchmark-DI		No-DI		Lenient-DI	No Early SS
	Old	Young	Old	Young	Young	Young
All	0.462	0.438	0.509	0.495	0.408	-
HSD	0.544	0.520	0.648	0.648	0.455	-
HSG	0.463	0.433	0.490	0.467	0.415	-
COL	0.264	0.278	0.279	0.297	0.270	-

Note: Table A8 reports share claiming SS at age 62. Lenient DI refers to an economy with young cohort's SS policies and 20% higher DI acceptance rates. No Early SS refers to young cohort's SS policies but with no option to claim SS before FRA.

that equates utility across the two policies:

$$\sum_{t=\tau}^{T_i} \beta^{t-\tau} u\left((1+\lambda)\, c_{i,t}^0, l_{i,t}^0\right) + \beta^{T_i-\tau}\phi\left(b_i^0\right) \quad = \quad \sum_{t=\tau}^{T_i} \beta^{t-\tau} u\left(c_{i,t}^1, l_{i,t}^1\right) + \beta^{T_i-\tau}\phi\left(b_i^1\right).$$

Given the functional form assumptions,

$$\begin{aligned} & \sum_{t=\tau}^{T_i} \beta^{t-\tau} \frac{\left((1+\lambda_{i,\tau})\, c_{i,t}^0\right)^{\kappa(1-\gamma)} \left(l_{i,t}^0\right)^{(1-\kappa)(1-\gamma)}}{1-\gamma} + \beta^{T_i-\tau}\phi\left(b_i^0\right) \\ = \quad & (1+\lambda_{i,\tau})^{\kappa(1-\gamma)} \sum_{t=1}^{T_i} \beta^{t-\tau} \frac{\left(c_{i,t}^0\right)^{\kappa(1-\gamma)} \left(l_{i,t}^0\right)^{(1-\kappa)(1-\gamma)}}{1-\gamma} + \beta^{T_i-\tau}\phi\left(b_i^0\right) \\ = \quad & \sum_{t=\tau}^{T_i} \beta^{t-\tau} \frac{\left(c_{i,t}^1\right)^{\kappa(1-\gamma)} \left(l_{i,t}^1\right)^{(1-\kappa)(1-\gamma)}}{1-\gamma} + \beta^{T_i-\tau}\phi\left(b_i^1\right). \end{aligned}$$

Denoting the utility from consumption and leisure as U_τ^x, the CEV of an individual i at age τ can be obtained as the following:

$$\lambda_{i,\tau} \quad = \quad \left\{ \frac{U_{i,\tau}^1 + \beta^{T_i-\tau}\left(\phi\left(b_i^1\right) - \phi\left(b_i^0\right)\right)}{U_{i,\tau}^0} \right\}^{\frac{1}{\kappa(1-\gamma)}} - 1.$$