Understanding the Increase in Spending on DI and SSI

Jeffrey B. Liebman*
Harvard University and NBER
January 2014

Abstract

The share of working age Americans receiving disability insurance benefits has increased substantially in recent years. Some experts attribute this increase primarily to more lenient eligibility criteria and to labor market changes that have increased the incentive for low-wage workers to apply for benefits. Other experts suggest that the aging of baby boomers into prime disability-benefit-receiving ages and the increased labor force participation of women can explain most of the increase. In order to distinguish among these perspectives, this paper decomposes the increase in spending on Disability Insurance (DI) into the share attributable to different factors and conducts simulations of the DI caseload under counterfactual scenarios in which various combinations of these factors are held constant. There are five main findings. First, while the share of the working age population receiving benefits has risen substantially in recent decades, average benefits relative to GDP have fallen. The net effect is that spending on DI and SSI benefits increased by only 0.20% of GDP between the late 1970s and the years immediately preceding the 2007-2009 recession. Second, for men DI spending as a share of GDP was at approximately the same level in 2007 as it was in the late 1970s. Incidence levels fell in the late 1970s and early 1980s and partially rebounded in the late 1980s, but male incidence has been flat since 1991. Measured from 1985, the rise in the beneficiary-to-population ratio among men is attributable to a combination of population aging, a decline in mortality, and an increase in incidence. Measured from 1991, nearly all of the rise is attributable to population aging and a decline in mortality. Third, spending on DI benefits for women has increased by almost 0.15% of GDP over the past 30 years. Almost all of the increase is the result of population aging, an increase in fraction of women with earnings sufficient for them to be covered by DI, and a significant increase in the incidence of DI receipt, with female incidence now approximately equal to male incidence. Fourth, there has been a significant decline in incidence related to impairments from circulatory and neoplasm conditions. This has been offset by increased incidence related to musculoskeletal and mental conditions. Absent the rise in the incidence of musculoskeletal and mental conditions, the number of beneficiaries today would be 21 percent lower. It is unclear to what extent the rising incidence of musculoskeletal and mental conditions reflects more lenient eligibility criteria and increased incentives for low-wage workers to claim benefits versus a reclassification of circulatory cases as musculoskeletal/mental cases. Fifth, incidence rates adjusted for age and the national unemployment rate have been flat for men since 1991 and have exhibited only a slight upward trend for women. Because this constancy has resulted from large underlying changes that have happened to balance each other out, it would not be surprising to see incidence either rise or fall going forward.

*Contact information: jeffrey_liebman@harvard.edu. This research was supported by the U.S. Social Security Administration through grant #DRC12000002-01-00 to the National Bureau of Economic Research as part of the SSA Disability Research Consortium. The findings and conclusions expressed are solely those of the author(s) and do not represent the views of SSA, any agency of the Federal Government, or the NBER.

I. Introduction

Overall spending on Disability Insurance (DI) and Supplemental Security Income (SSI) disability benefits increased from 0.74 percent of GDP in the late 1970s to 0.94 percent of GDP in the years immediately preceding the 2007-2009 recession.[1] During this period, the percent of individuals between the ages of 20 and 64 who were receiving DI benefits rose from 2.2 percent to 3.6 percent.

Some experts have interpreted this increase as evidence of a program that is out of control and in need of significant reform. Autor and Duggan (2006) describe the growth in the disability insurance rolls as "a fiscal crisis unfolding," report that "abuse [has] reached unsustainable levels," and conclude that "the DI screening process is effectively broken." In their view, changes in program rules enacted in 1984 made it easier for applicants to receive benefits for hard-to-verify impairments like back pain and depression. In conjunction with labor market developments that increased the incentive for low-wage workers to apply for benefits, these new program rules led to an increase in disability receipt. Murray (2013) blames the rise in disability receipt on "an increase in Americans for whom the founding virtue of industriousness is not a big deal anymore."

Other experts attribute most of the increase in beneficiaries and spending to baby boomers reaching their peak disability-claiming years and to increased labor force participation by women (Reno, 2011). Under this interpretation, spending on disability insurance is unlikely to rise further.[2] Indeed, both the Social Security Administration actuaries and the Congressional

[1] Spending on disability insurance benefits is highly cyclical (Autor and Duggan, 2003). Thus, spending rose by a further 0.2 percent of GDP during the recent recession. Cutler, Meara, and Richards-Shubik (2012) find that the recession-induced increase in DI claiming was similar to that in prior recessions. It is likely that the availability of extended unemployment insurance benefits in the recent recession prevented some DI claiming (Rutledge, 2011).

[2] Goss (2011) reports that "the number of workers per DI beneficiary is expected to be relatively stable in the future ... A one-time change to offset the drop in birth rate is all that is needed to sustain the DI program for the foreseeable future."

Budget Office predict that spending on DI will fall as a share of GDP in the coming decade as baby boomers convert from DI benefits to retirement benefits and are replaced in the peak disability-receiving ages by smaller cohorts.

The goal of this paper is to make sense of these two competing interpretations of the increase in disability insurance spending and receipt as well as to evaluate the implications of this analysis for future spending levels. The methodology is fairly simple. I build separate models for men and women of disability receipt at single years of age. A simple transition equation relates the number of beneficiaries of a given age in a given year to the number of beneficiaries who were one year younger in the prior year, the age distribution of the population, the insured rate, the incidence rate (disaggregated by impairment), the death rate, and the recovery rate. By simulating the model under counterfactual scenarios, it is possible to answer questions such as "how many disability beneficiaries would there be today if the age distribution of the population had remained the same as in 1985 for the entire 1985 to 2007 period." These simulations make it possible to decompose the actual increase in beneficiaries into the portion attributable to different factors.

The paper has six main findings. First, while the share of the working age population receiving benefits has risen substantially in recent decades, average benefits relative to GDP have fallen. The net effect is that spending on DI and SSI benefits increased by only 0.20% of GDP between the late 1970s and the years immediately preceding the 2007-2009 recession.

Second, for men DI spending as a share of GDP was at approximately the same level in 2007 as it was in the late 1970s. Incidence levels (adjusted for age and the business cycle) fell in the late 1970s and early 1980s and partially rebounded in the late 1980s, but male incidence has been flat since 1991. Measured from 1985, about 55 percent of the increase in the beneficiary-to-population ratio among men is attributable primarily to population aging and a decline in mortality, while 45 percent is the result of the post-1984 rebound in incidence. Measured from 1991, two-thirds of the rise in the beneficiary-to-population ratio is attributable to population aging and the remainder to a decline in mortality.

Third, spending on DI benefits for women has increased by almost 0.15% of GDP over the past 30 years. While the majority of the increase in the beneficiary-to-population ratio among women is the result of population aging and an increase in fraction of women with sufficient earnings to be covered by DI, there has also been a significant increase in the incidence of DI receipt among women, and female incidence is now only slightly below male incidence. Combining men and women and measuring from 1985, about 29 percent of the increase in the beneficiary-to-population ratio is attributable to population aging, 22 percent to increased eligibility (mostly among women), 10 percent to declining mortality rates, and 42 percent to rising incidence. Measuring from 1991, about 34 percent of the increase in the beneficiary-to-population ratio is attributable to population aging, 31 percent to increased eligibility, 16 percent to declining mortality rates, and 23 percent to rising incidence.

Fourth, SSI spending on adults has increased only slightly -- from 0.17% of GDP to 0.20% of GDP -- over the past 30 years. In addition, the 1990 Supreme Court Zebley decision extending disability benefits to children, increased SSI spending by another 0.03% of GDP.

Fifth, there has been a significant decline in incidence related to impairments from circulatory and neoplasm conditions. This decline has been offset by increased incidence related to musculoskeletal and mental conditions. Absent the rise in the incidence of musculoskeletal and mental conditions, the number of beneficiaries in 2007 would have been 21 percent lower. It is unclear to what extent the rising incidence of musculoskeletal and mental conditions reflects more lenient eligibility criteria and increased incentives for low-wage workers to claim benefits versus a reclassification of circulatory cases as musculoskeletal/mental cases.

Sixth, incidence rates adjusted for age and the national unemployment rate have been flat for men since 1992 and have exhibited only a modest upward trend for women. Because this constancy has resulted from large underlying changes in the incidence of particular impairments that have happened to balance each other out, it would not be surprising to see incidence either rise or fall going forward.

Looking forward, there are three main risks to the projections from OACT and CBO that spending on DI will fall as a share of GDP in the coming decade. First, the projections assume that female incidence rates will level off now that they have converged with male rates. If instead female incidence rates continue to rise at the same rate as in recent decades, spending would be higher. Second, over the past 25 years the increased incidence of claims associated with musculoskeletal and mental impairments has been offset by a decline in claims associated with circulatory conditions. If, going forward, musculoskeletal and mental impairments were to continue to rise without an offsetting decline in other conditions, spending could rise. Third, little is known about how social norms about disability receipt are formed. If the historically high rate of disability insurance receipt reduces the stigma associated with applying for benefits, greater than expected incidence rates could occur going forward. On the other hand, if concerns about the fiscal implications of a large disability insurance beneficiary population lead to greater scrutiny of the program, stigma associated with receipt could rise and future incidence rates could fall.

The rest of this paper is organized as follows. Section two presents basic trends on spending levels and benefit receipt over time, explains the paper's modeling methodology and data sources, and discusses some of the demographic factors and changes to program rules that are responsible for the trends. Section three presents results about DI spending for men. Section four presents results for DI spending for women. Section five presents alternative projections for future spending levels. Section six concludes.

2. Spending Trends, Demographic Trends, and Decomposition Methodology

Figure 1 shows spending on DI and SSI disability insurance benefits as a percent of GDP from 1975 to 2010. DI benefits for men were 0.4 percent of GDP in the late 1970s and were similarly 0.4 percent of GDP in the years leading up to the recent recession. In between, spending fluctuated with the business cycle. In addition, spending fell during the 1980s and rose during the 1990s.

Among women, spending increased from 0.14 percent of GDP in the late 1970s to 0.27 percent of GDP in 2007, with spending as a share of GDP increasing steadily from 1989 onward. SSI spending on adults rose from 0.17 percent of GDP in the late 1970s to 0.20 percent of GDP in 1991 and has remained at approximately 0.2 percent of GDP since then. The 1990 Supreme Court Zebley decision extending disability benefits to additional children increased SSI spending by about 0.03 percent of GDP. Overall spending on SSI and DI disability benefits increased by 0.2 percent of GDP between the late 1970s and the years preceding the 2007-2009 recession.

Over the same period during which these increases in disability insurance spending were occurring, major demographic changes were happening as well. As the baby boomers moved through the work force, they first increased the number of young workers, who are less likely to be disabled, and then in recent years have swelled the number of worker in their late 50s and early 60s, who are most likely to be receiving disability benefits. The baby boom is such a well known phenomenon that its quantitative significance can get overlooked. The top panel of Figure 2 shows the number of Americans of each age in 1980 and 2010. In 1980 there were approximately 23 million individuals between the ages of 50 and 59. By 2010 there were a little over 42 million. That figure also shows that the cohorts behind the baby boomers are somewhat smaller, partially explaining why OACT and CBO are predicting declining spending on DI over the coming decade.

The bottom panel of Figure 2 shows the percentage of people at each age receiving DI benefits. Americans who are between the ages of fifty and sixty-four are four times more likely than those between the ages of twenty and forty-nine to be receiving disability insurance benefits.

Figure 3 shows that as the baby boomers moved through the workforce, the average age of new DI beneficiaries initially fell, because there was a surge in younger workers, and then rose as the baby boomers reached older ages. This population-age-structure induced variation in the average age of new beneficiaries has swamped the age-adjusted pattern. The age-adjusted pattern of new awards shows that the average age fell significantly from 1975 to 1990, but has fluctuated around a relatively stable trend since 1990.

The other big demographic change occurring over this time period is the increase in the fraction of women with significant labor market experience. To be eligible for disability benefits a worker generally needs to have worked in five of the past 10 years.[3] Figure 4 shows that the fraction of women ages 50 to 64 insured by DI rose from 46 percent to 72 percent between 1980 and 2007 – an increase of 57 percent.

---

[3] More specifically, to be eligible for disability benefits, a worker generally needs to have earned 40 work credits, 20 of which need to be earned in the last 10 years ending with the year the worker become disabled. In 2013, workers receive one credit for each $1160 of annual earnings with a maximum of four credits earned in any calendar year. The credit requirements are reduced for workers who become disabled at younger ages.

The aim of this paper is to distinguish between these major demographic trends and the other factors, including changes in program rules, program implementation, and economic conditions that have affected disability insurance caseloads. In doing so, it is helpful to begin by decomposing spending as a share of GDP into the component related to average benefit levels ($\overline{Benefits}$) and the component related to the number of beneficiaries, and to scale both by the size of the working age population ($WAPop$).

$$\frac{Spending_t}{GDP_t} = \frac{\overline{Benefits}_t}{GDP_t} x\ Recipients_t$$

$$= \frac{\overline{Benefits}_t}{GDP_t / WAPop_t} x\ \frac{Recipients_t}{WAPop_t}$$

This decomposition reveals that relatively stable spending relative to GDP can be the result of large offsetting changes in the level of benefits and number of beneficiaries. Table 1 shows that for males, whose DI spending was 0.4 percent of GDP in both the late 1970s and late 2000s, average benefits relative to per worker GDP fell by 26 percent (and average benefits relative to GDP fell by 47 percent), while recipients per working age individual increased by an offsetting 39 percent.[4] For females, average benefits relative to per worker GDP fell by 21 percent (and average benefits relative to GDP fell by 42 percent), while recipients per working age individual increased by 159 percent. Figure 5 shows these trends. For SSI adults, the 0.03% of GDP increase in spending is the result of a 32% decline in average benefits relative to per worker GDP and an increase in recipients per working age person of 77 percent.

The decline in average benefits relative to GDP is the result of a decline in the worker compensation share of GDP, an increase in health benefits as a share of compensation (and a

[4]Note that this balances to essentially no change since 1.39 x 0.74 ≈ 1.0.

decline in the share of earnings), and a decline in the ratio of covered earnings to total earnings resulting from a rise in inequality.

Much of the rest of the paper analyzes changes over time in the ratio of DI recipients to the working age population. To do this, I build a simple model of the number of people of age *a* who are receiving benefits ("in current payment") in year t. The number of people in current payment (ICP) increases with new awards and declines with terminations. New awards are the product of the incidence rate and the number of exposed individuals (the insured population minus those already receiving benefits). Terminations come through death or recovery.[5] In the model, *a* represents single years of age from 20 to 64. Men and women are analyzed separately.[6]

$$ICP_{at} = ICP_{(a-1)(t-1)} + new\ awards_{at} - terminations_{at} \quad (1)$$

$$new\ awards_{at} = incidence_{at}((population_{at} * pct\ insured_{at}) - ICP_{(a-1)(t-1)} - \tfrac{1}{2} * new\ awards_{at}) \quad (2)$$

$$terminations_{at} = (death\ rate_{at} + recovery\ rate_{at}) * (ICP_{(a-1)(t-1)} + \tfrac{1}{2} * new\ awards_{at}) \quad (3)$$

The model can be used to examine counterfactual scenarios in which one or more parameters are held constant at historical average levels so as to analyze the share of the change over time that can be attributed to changes in the age distribution of the population, the insured rate, the incidence rate, the death rate, and the recovery rate.

The data for the model come from the SSA Office of the Chief Actuary (OACT). The raw data contain all of the elements in equations (1), (2), and (3) aggregated to five year age ranges. We interpolate linearly between the midpoints of the age ranges to produce data at the level of individual years of age. Figure 6 shows separately for males and females the actual

[5] At the Social Security full benefit age terminations can also occur from individuals transitioning to retirement benefits.

[6] The terms adding and subtracting one-half of new awards are an approximation that adjusts the beginning of year exposed population to reflect the average exposed population during the year.

number of DI recipients and the predicted number based upon starting with the 1980 level of recipients and then running equations (1) through (3) forward in time to produce beneficiaries in subsequent years. The actual and predicted levels are indistinguishable demonstrating that the model successfully captures the evolution of the number of individuals in current payment over time.

3. Understanding the Increase in Male Disability Insurance Beneficiaries

Overall, the ratio of male DI beneficiaries to the male working age population (ages 20 to 64) increased from 2.5 percent to 4.1 percent between 1985 and 2007. This section of the paper analyzes the factors responsible for this increase.[7]

Determinants of Caseloads

Figure 7 shows four of the key determinants of disability caseloads: incidence rates, recovery rates, death rates, and insured rates. Each panel displays both the actual rate and an age-adjusted rate that holds the population age structure constant at its 1980 level.[8]

The top left panel shows the incidence rate. Four patterns are evident. First, incidence rates are highly cyclical (Autor and Duggan, 2003), rising sharply in response to the 1990-1991, 2001, and 2007-2009 recessions. Second, incidence plummeted after the late 1970s and early 1980s reforms that tightened eligibility and increased the number of continuing disability reviews (CDRs), before rebounding after 1982 and particularly after the 1984 legislation that

---

[7] The paper focuses on the ratio of beneficiaries to the working age population rather than on the absolute number of beneficiaries because overall population growth is the main driver of the increase in beneficiary levels.

[8] $(Age\ adjusted\ population)_{i,t} = (fraction\ of\ population)_{i,1980} \times (total\ population)_t$

$$Age\ adjusted\ rate\ in\ year\ t = \frac{\sum_{i=15}^{64}\left((age\ adjusted\ population)_{i,t} \times (rate)_{i,t}\right)}{\sum_{i=15}^{64}(age\ adjusted\ population)_{i,t}}$$

reformed eligibility rules and standards for CDRs. Third, since 1985 there appears to be an upward trend in the actual incidence rate. Fourth, the post-1985 upward trend is much less apparent in the age-adjusted incidence rate, but it is hard to visually isolate the trend given the large business cycle-related fluctuations that are occurring throughout this period.

The top panel of Figure 8 examines the age-adjusted incidence rate in more detail, showing separate rates for age groups 20 to 34, 35 to 49, and 50 to 64 and holding the single-year-of-age distribution constant within each age group. There does not appear to be much, if any, upward trend in the age-adjusted incidence rate for the highest incidence 50 to 64 year-old group. There appears to be slight upward trends in the lower incidence younger age groups. But it is hard to draw a conclusion from these figures because the business cycle effects remain pronounced.

The bottom panel of Figure 8 presents age and unemployment-rate-adjusted incidence rates for the three age groups. These are calculated by regressing the age-adjusted incidence rates for each of the three age groups on the national unemployment rate and then calculating the unemployment adjusted incidence as:

$$Unemployment\ adjusted\ incidence_{g,t} = Age\ adjusted\ incidence_{g,t} + \hat{\beta}_{unemp}(\overline{U} - U_t) + \hat{\beta}_{unemp\_lag1}(\overline{U_{lag1}} - U_{t-1})$$

where $\hat{\beta}_{unemp}$ is the estimated coefficient from regressing the age-adjusted incidence on the national unemployment rate, $\overline{U}$ is the mean unemployment rate over the 1985 to 2009 sample period (5.8), and U_t is the actual unemployment rate in year *t*.[9] In effect, this equation is replacing each year's actual age adjusted incidence rate with the age adjusted rate that would

[9] The regressions also include two-part splines to model the time-trend in incidence as described in further detail below. The qualitative pattern for men are similar if the spline terms are omitted. For women, leaving out the time trend terms causes the sign of the impact of unemployment on incidence to be negative since incidence was lower in the high unemployment years of the 1980s than in the lower unemployment years that followed.

have prevailed if the unemployment rate had been at its mean value over the sample period. The 1985 to 2009 sample period was chosen to match the time period in the analysis of the Social Security Technical Advisory Panel (2010). The unemployment-adjusted series reveals a much more pronounced increase in male incidence in the years following the 1984 legislation – a pattern that was obscured in the top panel of Figure 8 by the high unemployment rates of the 1980s. This unemployment-adjusted series also reveals that incidence rates have been steady for all three age groups of men since the early 1990s.[10]

This pattern is demonstrated more rigorously in Table 2, which displays coefficients from regressing the age-adjusted incidence rate on the unemployment rate and a time trend. Columns (1), (4), and (7) contain the results published in the report of the Social Security Technical Panel on Assumptions and Methods (2011) and show that if a linear time trend is fitted to the entire 1985 to 2009 time period, there is an upward trend in male incidence. This result led the Technical Panel to recommend that the Actuaries assume a rising incidence rate in the future. Columns (2), (5), and (7) show that we are able to closely replicate the point estimates of the Technical Panel with our data, though, for reasons that are not clear, our estimates have larger p-values. However, when a two-part spline is fitted to the data, with the slope allowed to vary between the 1985-1992 and 1992-2009 periods, the results suggest that there has been no upward trend in male incidence for any of the three age groups since 1992. The sum of the two time coefficients is very close to zero for all three groups. There does not appear to be any upward trend in age- and unemployment- adjusted male DI incidence over the past twenty years, which suggest that the difference in views between the Technical Panel and the OASDI Trustees about future incidence rates is largely a disagreement about how much weight to place on the 1985-1992 period relative to the more recent period.[11]

Returning to Figure 7, the top right panel shows recovery rates. There are two main patterns in this figure. First, there were large increases in recovery rates in the early 1980s, when an increase in continuing disability reviews removed many beneficiaries from the roles, and in 1997, after Congress passed a law removing alcohol and drug additions as eligible conditions. Second, for most of the post-1984 period, recovery rates have fluctuated in a narrow range around 1.3 percent.

The bottom left panel of Figure 7 shows mortality rates. Mortality rates among DI recipients have been falling at what appears to be a remarkably steady linear rate, with two exceptions. In the aftermath of removing many individuals from the roles in the early 1980s, death rates rose sharply. This is evidence that those who were removed from the roles were, on average, healthier than those who remained on the roles – which is to be expected since those who were removed were found to lack impairments severe enough to justify eligibility. In addition, there was a sharp drop in death rates in the mid-1990s. It is less clear what explains this drop. It is possible that those removed from the roles because their impairments involved addictions had higher than average mortality. It is also possible that the new beneficiaries who began claiming in the aftermath of the 1991 recession were, on average, healthier than those already on the program.

The steady drop in mortality rates raises the question of whether the program is becoming more lenient, providing benefits to people whose health situation is less severe. However, it is also possible that medical advances have improved the lifespan of people with a given level of

[11] Appendix Table 1 shows that the evidence that male incidence rates have been flat since the early 1990s is not sensitive to the particular year – 1990, 1991, or 1992 – that is used as the spline kink point.

impairment and functioning. One way to explore these two alternative interpretations is to compare mortality rates of DI recipients with those of the broader population.   The left panel of Figure 9 shows that mortality rates for the entire male working-age population are much lower than those of DI recipients, and, while they have fallen, the absolute decrease in mortality rates is much lower than for DI recipients. The right panel uses two different scales for the two populations and shows that in percentage terms, mortality has fallen by a similar amount for all males and for DI recipient males. Interestingly, the overall male population also had a sharp decline in mortality in the mid 1990s. As noted by the Technical Panel, it would be helpful to analyze mortality rates by impairment to determine how much of the decline in mortality among DI recipients is the result of within-impairment improvements is mortality and how much is because of the changing composition of impairments.

The bottom right panel of figure 7 shows that from 1980 to 2000 the portion of males with sufficient earnings to be insured for DI benefits was fairly steady at about 83 percent. In the past decade, however, the coverage rate has fallen.

What Accounts for the Increase in the Beneficiary Ratio Among Men?

In order to determine how the four factors discussed above as well as population aging contributed to the rise in the ratio of DI beneficiaries to the working age population, I next perform a set of counterfactual simulations that ask how the DI beneficiary ratio would have evolved if various of the factors had remained constant at the values from some base year. There is some subjectivity involved in choosing which year to treat as the base year for each factor. It is not possible to choose a single year like 1985 as the base year for all of the factors because some of them were out of equilibrium or exhibited extreme values immediately after the 1984 reforms.[12] Below, I explain the rationale behind each of my choices. The choice of time period matters as well, as different factors were more important in different time periods. In this analysis, I present decompositions both for the 1985-2007 period and for the 1991-2007 period.

Figure 10 shows the results of the simulations for the 1985-2007 period. The dark line shows the actual evolution of the DI beneficiary ratio, rising from 2.46% to 3.93% between 1985 and 2007. The next line holds the population age-distribution constant at its 1985 values (chosen because it is the initial year of the simulations). Absent the aging of the baby boomers, the DI beneficiary ratio in 2007 would have been only 3.45%. The next line shows that additionally holding the male insured rate constant at its 1984 level (chosen because it is approximately the average level in the 1985-2000 period) has little impact on the DI beneficiary level. It falls a bit further to 3.40%.

Holding mortality rates constant at their 1982 level (on top of holding all of the earlier factors constant) has a fairly large effect – reducing the simulated 2010 DI beneficiary rate to 3.21%. The 1982 rate was chosen because it avoids the spike in mortality that followed the removal of beneficiaries in the early 1980s and provides for a base year that is on the longer-term trend line. Additionally holding recovery rates at their 2001 level has only a small further impact on the simulated 2007 DI beneficiary rate, reducing it to 3.28%. 1989 was chosen because it is approximately the average recovery rate for the 1985-2007 period,

Choosing a base year for incidence involves more subjectivity. I chose the average of the 1985 and 1986 incidence rates, adjusted for unemployment, in order to reflect a post-1984 legislation starting point that preceded the late 1980s bounce-back in incidence rates. With incidence held at this average rate, the simulated 2007 DI beneficiary rate falls to 2.74%. Note

[12] Holding the factors constant means holding the entire vector of age specific values for that factor constant at the values from the particular year.

that even with all of the various factors held constant, the simulated DI beneficiary ratio rises somewhat from its 1985 value of 2.45%. The reason for this is that the DI system was not at a steady state equilibrium in 1985. Because so many people were removed from the roles in the early 1980s and because incidence rates were so low in 1982, a rebound in the DI beneficiary ratio would have occurred even absent population aging, reduced mortality, or a post-1985 increase in incidence.

For the simulations that start in 1991 rather than 1985, I change only the incidence base year. I set it at its 1989 level, adjusted for unemployment, so as to be using the earliest year that appears to be part of the stable incidence pattern of the past 25 years. Appendix Figure 1 shows the results from this alternative simulation.

The first column of Table 3 summarizes the simulation results for men by showing the percentage of the distance from the true 2007 beneficiary ratio of 3.93% to the simulated ratio of 2.74% with all of the factors held constant that is attributable to each factor. For men over the 1985-2007 period, population aging is responsible for 40 percent of the increase in the DI beneficiary ratio. Falling death rates is responsible for 16 percent. The recovery rate being lower than the base value is responsible for -6 percent. The insured rate is responsible for a negligible 4 percent. Actual incidence being above the 1985-1986 unemployment-adjusted level is responsible for 45 percent.

Because all of the increase in incidence for men appears to have occurred prior to 1991, the simulations that start in 1991 produce a quite different pattern of results (column 2). Population aging is responsible for 67 percent of the increase in the DI beneficiary ratio between 1991 and 2007. Falling death rates are responsible for 34 percent. The other three factors, including the incidence rate, have only a negligible effect.

Analysis of a Falling Incidence Baseline

The stability of the overall male incidence rate in the post 1991 period masks large changes in the incidence of different impairments. Figure 11 shows male incidence by primary diagnosis code for the five largest impairment categories. These categories account for 80 of all new awards. The incidence of circulatory and neoplasm related benefit awards has been falling while the incidence of musculoskeletal and, to a lesser extent, mental conditions has been rising. Given the overall health improvements that have occurred over the 1985 to 2010 time period, as suggested by the reduction in mortality and the reduction in the incidence of benefit claims for circulatory and neoplasm conditions, the fact that overall male incidence has been flat rather than declining could be evidence of increased leniency in benefit award decisions. To investigate this, I construct a declining incidence baseline in which the incidence of circulatory, neoplasm, nervous system, and other awards follow their true values, while the incidence of musculoskeletal and mental awards is held constant at their 1985 levels. Under this counterfactual scenario, the male beneficiary ratio is 14 percent lower than the actual 2007 beneficiary ratio.

It is also possible that some or all of the decline in claims for circulatory and neoplasm conditions was the result of individuals who would have been eligible for benefits under those categories instead claiming benefits under the musculoskeletal and mental impairment categories. Under this interpretation, the 1984 reforms did not increase leniency, they simply shifted conventions around which conditions people claimed. Some evidence that impaired individuals often have multiple options for which diagnosis to claim benefits under comes from research in the aftermath of the 1996 legislation making claims based on drug and alcohol addiction ineligible. Stapleton et al (1999) found that nearly one-third of those removed after this legislative change were able to re-establish eligibility under another condition.

4. Understanding the Increase in Female Disability Insurance Beneficiaries

Overall, the ratio of female DI beneficiaries to the female working age population increased from 1.20 percent to 3.47 percent between 1985 and 2007. This section of the paper analyzes the factors responsible for this increase, using the same methodology that was used for males in section 3.

Determinants of Caseloads

Figure 12 shows female incidence rates, recovery rates, death rates, and insured rates. The top left panel shows the incidence rate. As in the similar figure for men, there is a decline in incidence in the late 1970s and early 1980s and an increase, particularly around the time of the 1990-1991 recession. However, unlike for men, the female incidence rate does not come down in the mid 1990s, possibly because there was an underlying upward trend for females offsetting the impact of the business cycle recovery or because of interactions with 1990s-era welfare reforms.

Figure 13 displays incidence rates adjusted for age and unemployment. As with men, most of the increase in adjusted incidence for the older, high-incidence age groups occurred prior to 1992, This visual impression is confirmed in the bottom panel of Table 2 where the coefficient on "time (post-spline)" offsets most of the magnitude of the “time” coefficient among older women. For the younger two age categories, there remains an upward trend in incidence in the post-1992 period, but it is approximately one-third as large as the time-trend pre-1992 and approximately one-half as large as the trend for the full period emphasized in the Technical Panel report. Appendix Table 1 shows that there is no upward trend in incidence for older women after 1996, and no upward trend among younger women after 2001.

Returning to Figure 12, the top right panel shows recovery rates. The large increase in recovery rates in the early 1980s is similar to the pattern for men. The 1997 spike after the legislation removing alcohol and drug addictions as eligible conditions is much smaller for women than for men. Overall recovery rates are somewhat lower for women than for men, averaging 11.39 per 1,000 disabled rather than 13.22 over the 1985 to 2007 time period.

The bottom left panel of Figure 12 shows mortality rates. Although death rates are approximately 1 percentage point lower for women than for men, the downward trend over the past 35 years has been similar. The bottom right panel of Figure 13 shows that the insured rate for women has increased from 47 percent in 1975 to 73 percent today as more women have participated in the labor force.

What Accounts for the Increase in the Beneficiary Ratio Among Women?

In order to determine how the four factors discussed above as well as population aging contributed to the rise in the ratio of DI beneficiaries to the working age population among women, I next perform a set of counterfactual simulations that ask how the DI beneficiary ratio would have evolved if various of the factors had remained constant at the values from some base year. The base years used for each factor are the same as they were for men.

Figure 14 shows the results of simulations holding constant various of the factors for the 1985-2007 period --- analogous to Figure 10 for men. The dark line shows the actual evolution of the DI beneficiary ratio, rising from 1.20% to 3.47% between 1985 and 2007. The next line holds the population age-distribution constant at its 1985 values (chosen because it is the initial year of the simulations). Absent the aging of the baby boomers, the DI beneficiary ratio in 2010 would have been only 3.02%. The next line shows that additionally holding the female insured rate constant at its 1984 level has a very large impact on the beneficiary rate -- lowering it to 2.36%

Holding mortality rates constant at their 1982 level (on top of holding all of the earlier factors constant) has a smaller impact than for men, because female mortality is lower; it reduces the simulated 2007 DI beneficiary rate to 2.21%. Additionally holding recovery rates at their 1989 level has no further impact on the simulated 2010 DI beneficiary rate, raising it very slightly to 2.22%. Finally, holding incidence at its 1985-1986, unemployment-adjusted, average reduces the simulated beneficiary rate to 1.41%.

The third column of table 3 summarizes these results for the 1985-2007 time period by showing the percentage of the distance from the true 2007 beneficiary ratio of 3.47% to the simulated ratio of 1.41% with all of the factors held constant that is attributable to each factor. For women, population aging is responsible for 22 percent of the increase in the DI beneficiary ratio. Rising insured rates is responsible for 32 percent. Falling death rates is responsible for 7 percent. The recovery rate being lower than the base value is responsible for -1 percent. Incidence being above the 1996 level is responsible for 39 percent. Column 4 shows that the pattern for the 1991-2007 period is similar.

Trends in Impairments for Females

Figure 15 shows the trends in the incidence of different qualifying conditions for women. The increase in musculoskeletal impairments for women aged 50-64 was very similar to that for men of the same age range– from approximately 2 per thousand in the mid 1980s to almost 5 per thousand in 2010. Like men, women had a decline in cardiovascular conditions. But while the percentage reduction in cardiovascular conditions between 1985 and 2010 was similar for men and women (39% vs. 35%), the initial level was much lower for women. Thus, the decline in cardiovascular claims offset only 20 percent of the increase in musculoskeletal claims for women, whereas it offset 51 percent among men.

5. Projecting Future Spending Levels

Section 2 showed that disability insurance spending relative to GDP can be decomposed into average benefits relative to GDP per working age individual and the beneficiary to working-age-population ratio. Projecting how benefits relative to GDP per worker will evolve in coming decades is challenging. It requires a view of the extent to which trends such as rising income inequality, a declining labor share of output, and the increase in health benefits as a share of total worker compensation will persist. It is possible to make plausible arguments on both sides of each of these. Take inequality for example. Ellwood (2001) observes that the fastest growing demographic groups in the U.S. are those that have traditionally achieved low levels of education -- suggesting that low-skilled workers will increase as a share of the U.S. workforce and inequality could continue to rise. On the other hand, Goldin and Katz (2008) show that in previous eras in which the returns to education widened, there was a large increase in educational attainment – an economic force that could increase the relative supply of high-skilled workers and narrow the gap in wages between those with higher-skill and those with lower-skill.

The simulation model built for this paper is directly applicable to examining the potential future evolution of the second term in the benefit to GDP decomposition – the recipient to population ratio. In particular, by inputting assumed values for sex and age specific population and for incidence, recovery, mortality, and coverage rates it is possible to simulate future levels of the recipient to population ratio.

Figure 16 shows projections of the beneficiary to working age population levels for the 2010 to 2030 period under various scenarios. In the top panel, the solid line is the SSA Office of the Actuary projection taken from the 2013 OASDI Trustees' Report. The darkest dashed line show projections under our base case scenario. This scenario holds incidence rates for all men and older women at their 2007 levels consistent with the evidence in table 2 that these incidence rates have been constant for the past 20 years. For women under 50, incidence is assumed to continue to rise at the same rate estimated for the post 1992 period. In addition, it holds recovery rates at 2003 levels for women and 2004 for men, consistent with historical averages. The projections assume that mortality continues to decline on the same linear trend that was exhibited in figures 9 and 12, and assumes hold male percentage insured constant at 2011 levels. For women under 30, coverage is held constant at 2011 levels. Between age 30 and 60 coverage rates are assumed to rise in line with the increase in labor force participation that these cohorts exhibited at earlier ages. The model projections are done separately for men and women and are then combined in the figure. Under this base case scenario the beneficiary to working age population ratio rises from 4.3 in 2010 to 5.15 in 2030. The model's 2030 projection is some what higher than the SSA Office of the Actuary projection of 5.0 for that year. The time path between 2010 and 2030 is different from the SSA projections. The OACT projection explicitly considers short-term patterns such as a possible decline in applications as the economy continues its recovery from the 2007-2009 recession, since the stock of potential applicants is now lower because of the surge in applications during the recession. This paper's model does not address these short-term considerations.

In addition to the base case projections, we also investigate three higher-incidence scenarios. In the first scenario, the incidence of claims for musculoskeletal conditions continues to rise at the same rate as it has since 1985, but there is no further decline in cardiovascular or neoplasm incidence. Under this scenario, the beneficiary to working age population ratio reaches 5.44%. in 2010. In the second scenario, female incidence grows for all females at their post-1992 rate. Under this scenario, the beneficiary to working age population ratio reaches 5.24%. Finally, if female incidence were to grow at the average rate for the entire 1985-2009 period, the ratio would rise to 5.41%. It is worth emphasizing that under this scenario, the female incidence surpasses male incidence in 2018 and by 2030 is 1 percentage point above male incidence. This would be inconsistent with an interpretation in which the rise in female incidence over the past three decades was primarily driven by women becoming more like men in their labor force participation – an interpretation that underlies the actuaries' projections that the female incidence rate is essentially converging to the male rate.

6. Conclusion

This paper finds that between half and two-thirds of the increase in the Disability Insurance beneficiary to working age population over the past three decades was the result of population aging and increased labor force participation of women, with the exact magnitude depending on the time period of analysis. After the sharp fall in DI incidence rates in the late 1970s and early 1980s, there was a significant rebound in the late 1980s, and this rebound was responsible for most of the rest of the increase in the beneficiary ratio. Adjusted for the age distribution of the population and the unemployment rate, incidence rates have been flat for men since the early

1990s. Rates for older women have been flat since 1996, and rates for younger women have not risen since 2001.

References

Autor, David H. and Mark G. Duggan (2003). The Rise in the Disability Rolls and the Decline in Unemployment. *Quarterly Journal of Economics*, 118: 157 - 206.

Autor, David H. and Mark G. Duggan (2006). The Growth in the Social Security Disability Rolls: A Fiscal Crisis Unfolding. *Journal of Economic Perspectives*, 20: 71-96.

Cutler, David M., Ellen Meara, and Seth Richards-Shubik (2012). Unemployment and Disability: Evidence from the Great Recession. NBER Retirement Research Center Paper NB 12-12.

Ellwood, David T. (2001). The Sputtering Labor Force of the 21st Century. Can Social Policy Help? In Alan Kruger and Robert Solow (eds) The Roaring Nineties: Can Full Employment be Sustained? Russell Sage Foundation, New York.

Executive Office of the President and Council of Economic Advisors (2013). Appendix B in Economic Report of the President.

Goldin, Claudia and Lawrence F. Katz 2008. Inequality across the Twentieth Century. In The Race between Education and Technology. Harvard University Press.

Goss, Steve (2011). Securing the Future of the Social Security Disability Insurance Program. Testimony before the House Committee on Ways and Means, Subcommittee on Social Security.

Murray, Charles (2013). Industriousness. In *Coming Apart: The State of White America 1960-2010*. Random House, New York.

Reno, Virginia P. (2011). Securing the Future of the Social Security Disability Insurance Program. Testimony before the House Committee on Ways and Means, Subcommittee on Social Security.

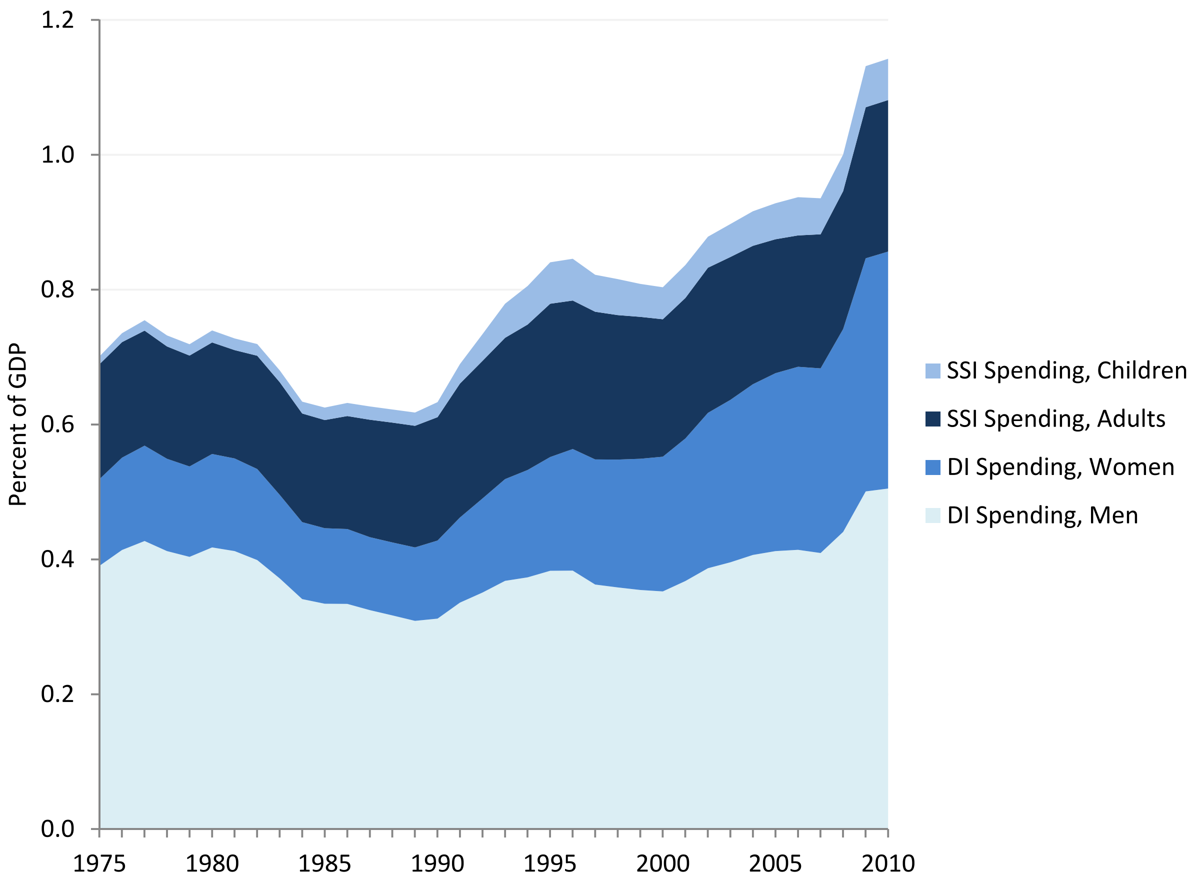
Rutledge, Matthew S. (2011). The Impact of Unemployment Extensions on Disability Insurance Application and Allowance Rates. Center for Retirement Research at Boston College Working Paper 2011-17.

Social Security Administration (1998 - 2013). Tables in Annual Statistical Supplement to the Social Security Bulletin.

Stapleton, David C., Michael E. Fishman, Gina A. Livermore, and David Wittenburg (1999). Policy Evaluation of the Overall Effects of Welfare Reform on SSA Programs. Final Report for The Social Security Administration, Contract 0600-98-27331.

Figure 1

Spending on Disability Insurance Benefits
(Percent of GDP)

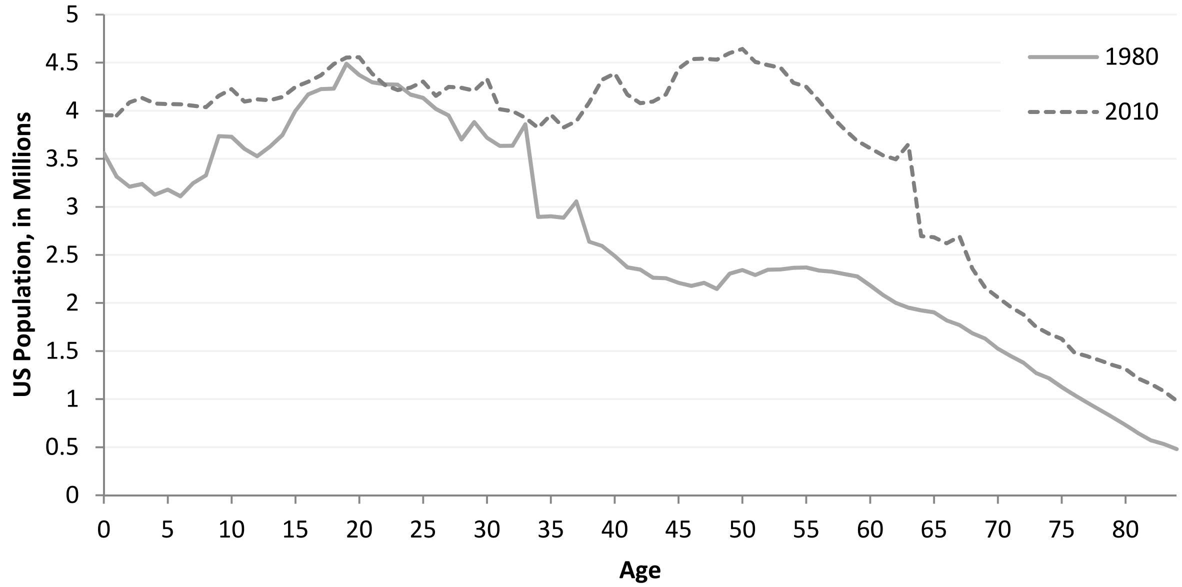


Source: Annual Statistical Report on the Social Security Disability Program (2011); Annual Statistical Supplement (2012, Table 7.A5; 2013, Table 4.A2); 2013 Economic Report of the President ; and Author's Calculations.

Allocation between males and females is based on December data from each year. Benefits for spouses and dependents are allocated between the sexes in proportion to worker benefits. Male-female split in DI benefits is interpolated between 1975 and 1980 and between 1980 and 1985.

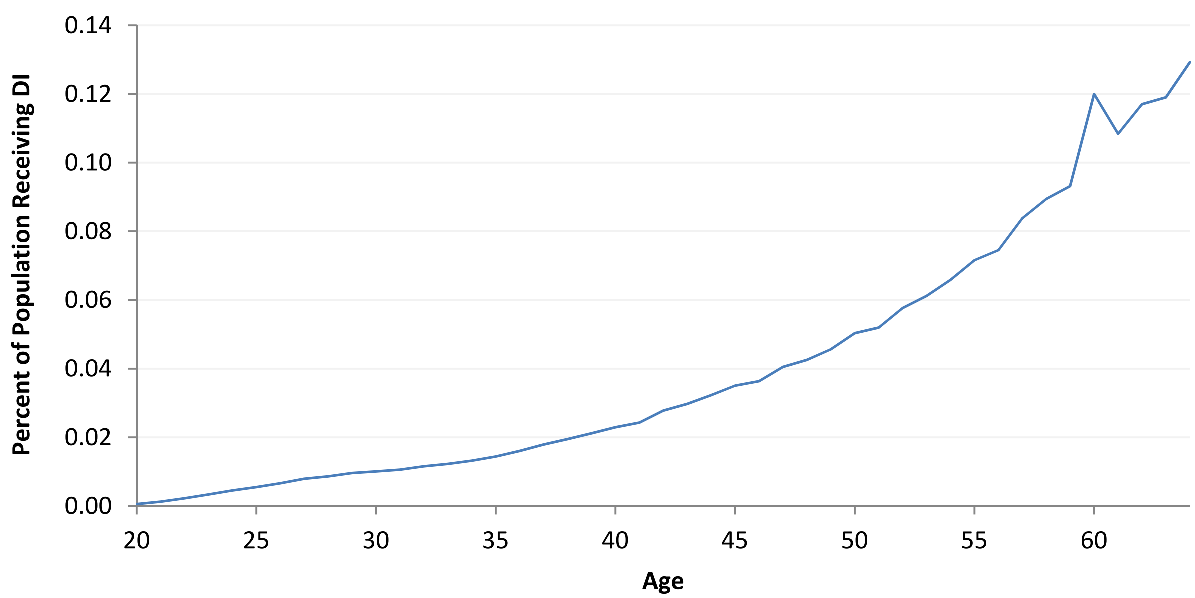
Figure 2

US Population
(By Age, 1980 and 2010)



Source: US Census Intercensal Population Estimates (accessed via NBER.org) and author's calculations.

Percentage of Population Receiving DI
(By Age, 2006)

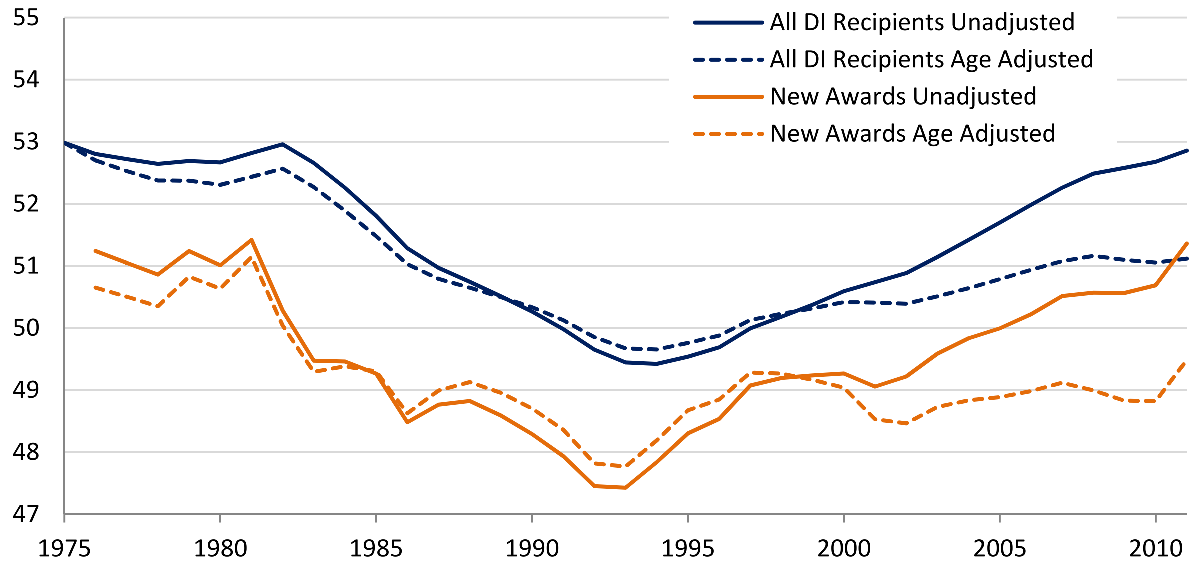


Source: SSA OACT; US Census Intercensal Population Estimates (accessed via NBER.org); and author's calculations.

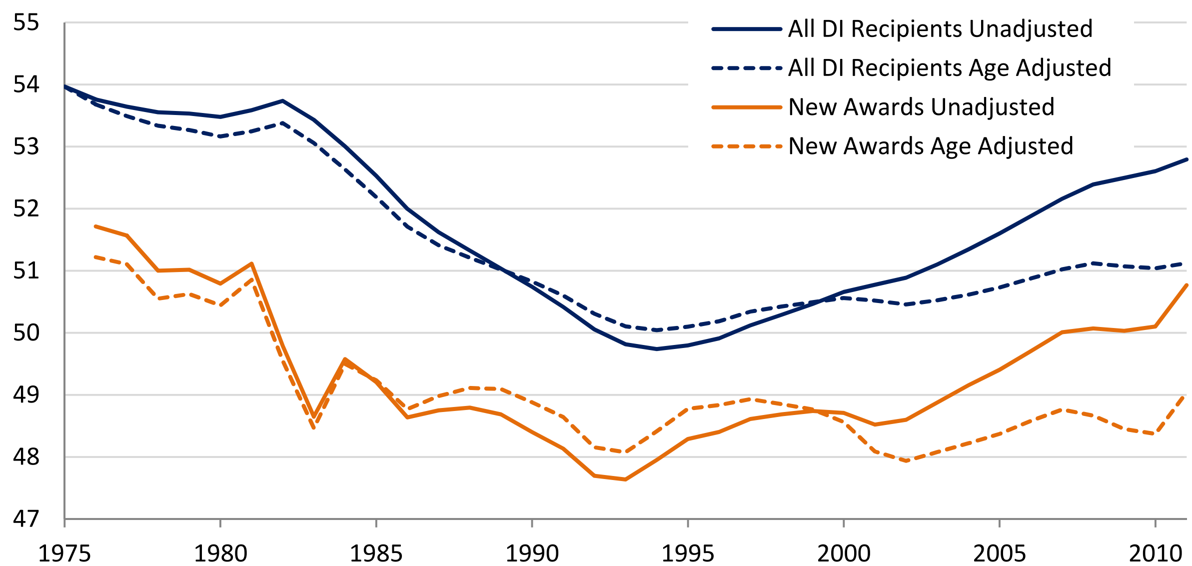
Figure 3

Mean Age of Disability Insurance Recipiency
(New Awardees and All Recipients, Men and Women)

Mean Age, Men



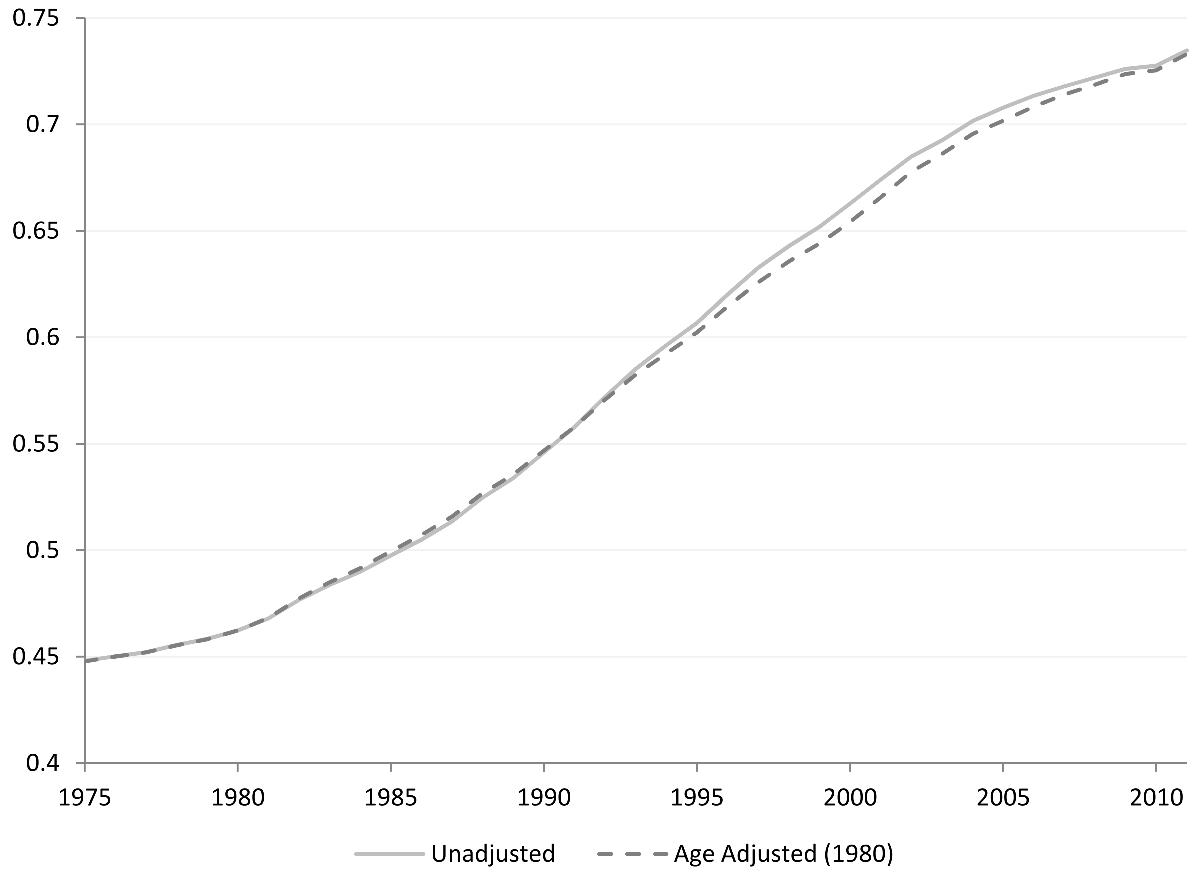
Mean Age, Women



Source: SSA OACT and Author's Calculations.
Note: Age adjusted to hold population distribution constant at 1980 levels.

Figure 4

Percent of the Population Insured
(Women, Ages 50-64)



Source: SSA OACT and Author's Calculations.

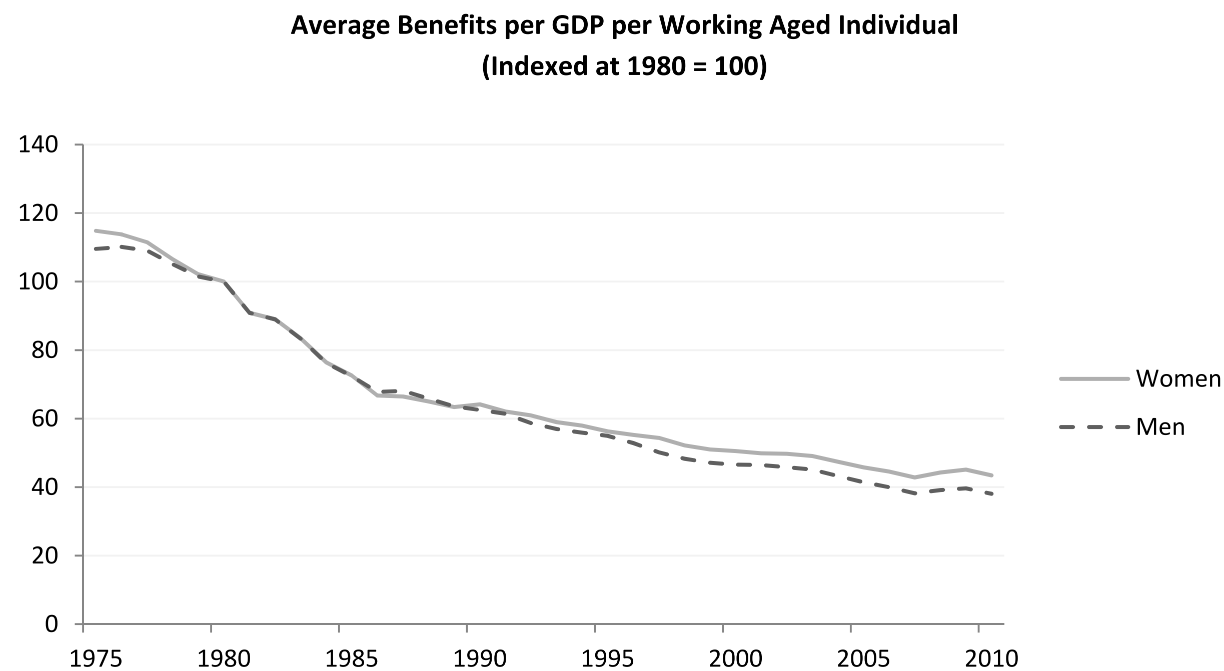
Note: "Age-adjusted" holds population distribution constant at 1980 levels.

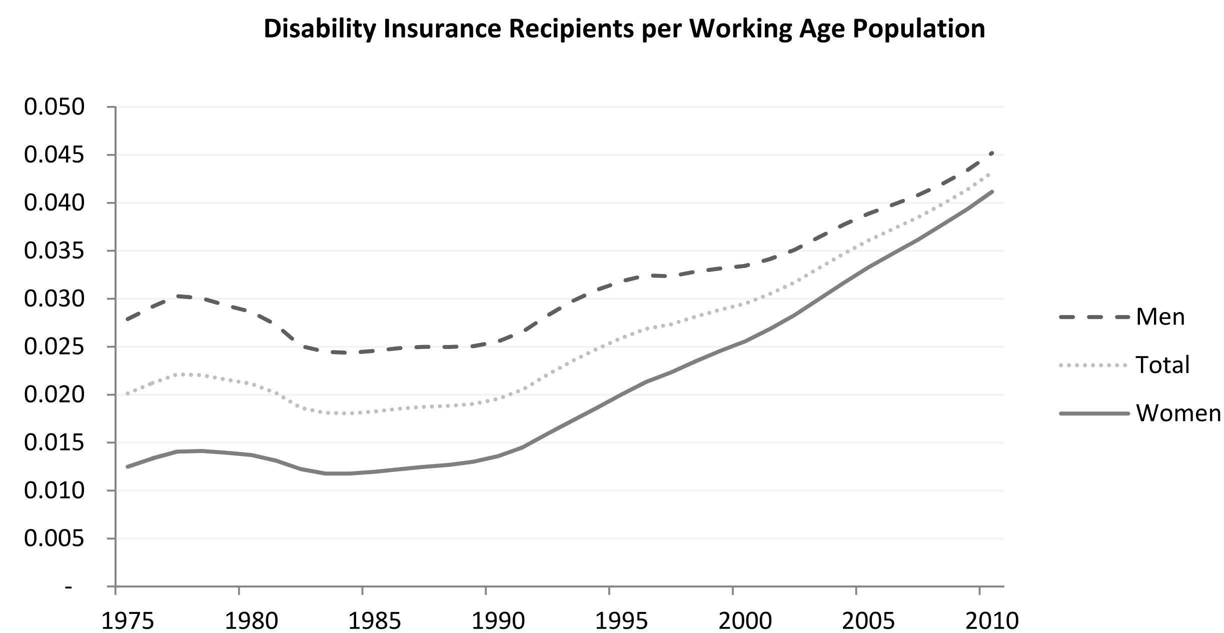
$$(Age\ adjusted\ population)_{i,t} = (fraction\ of\ population)_{i,1980} \times (total\ population)_t$$

$$Age\ adjusted\ percent\ insured\ in\ year\ t = \frac{\sum_{i=50}^{64}\left((age\ adjusted\ female\ population)_{i,t} \times (percent\ insured)_{i,t}\right)}{\sum_{i=50}^{64}(age\ adjusted\ female\ population)_{i,t}}$$

Figure 5

Decomposition of DI Spending Relative to GDP

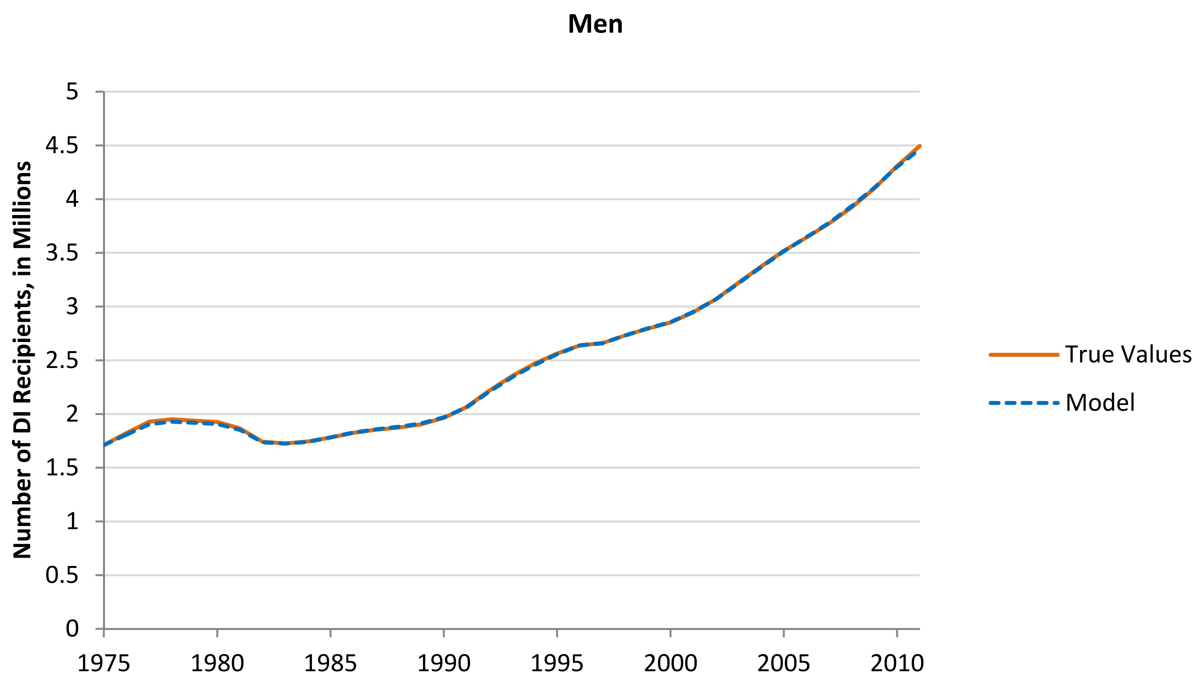


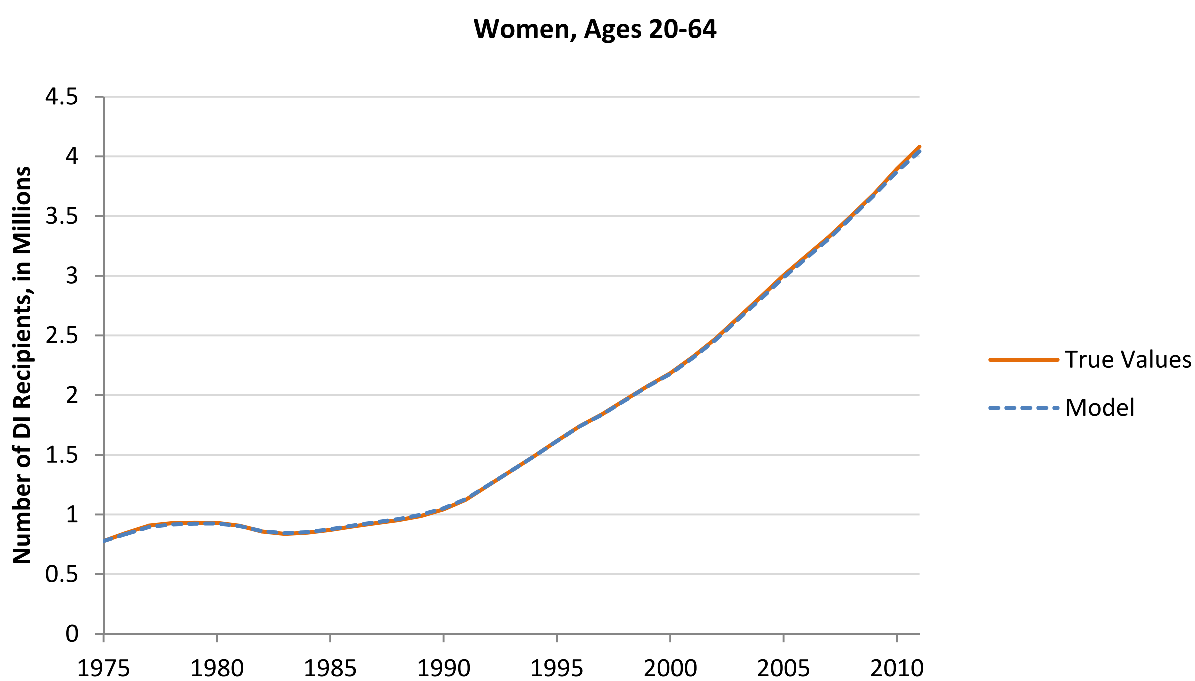


Source: SSA OACT; 2013 Economic Report of the President; and Author's Calculations.

Figure 6

Model Fit: True Values v. Modeled Predictions

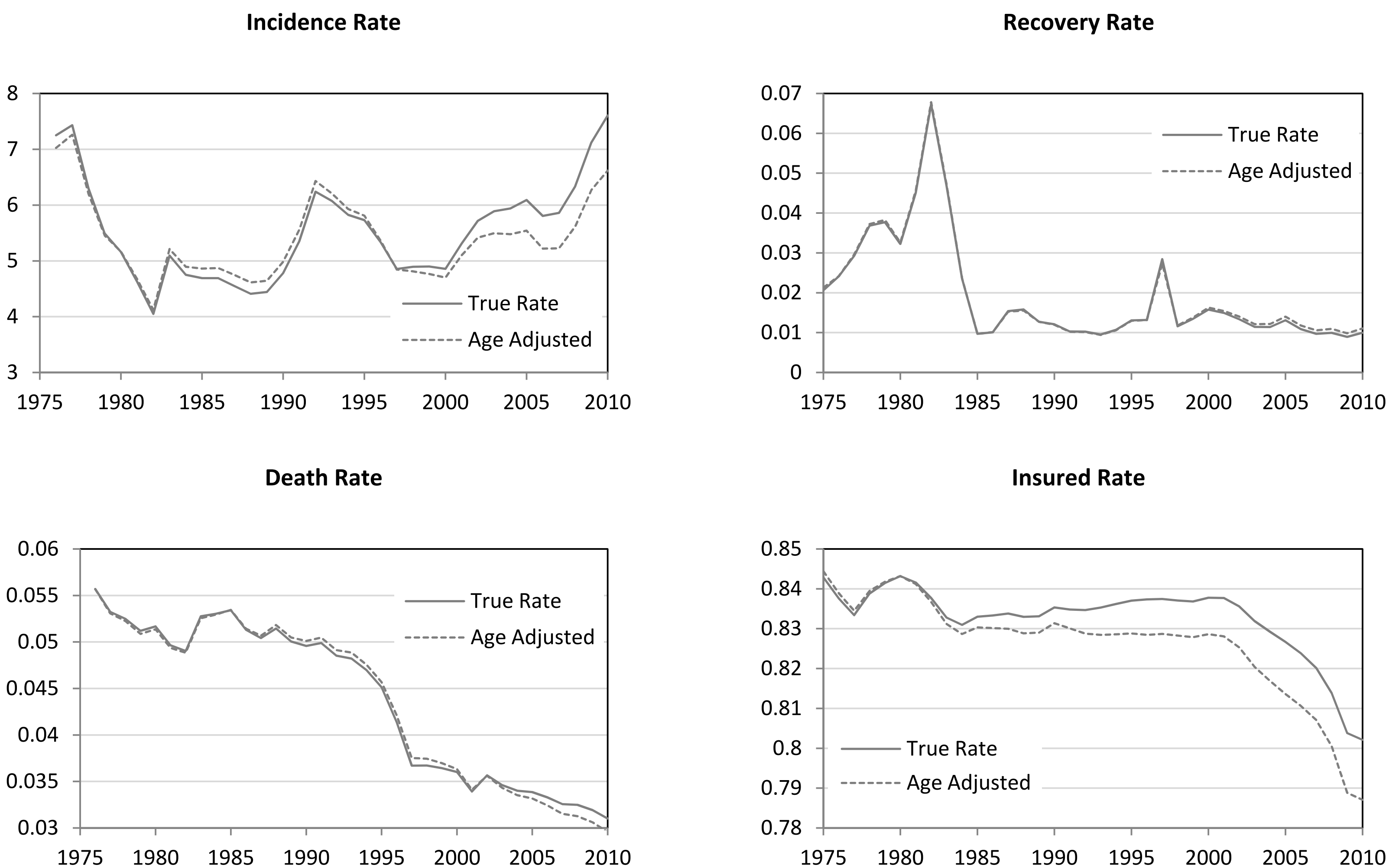




Source: SSA OACT and Author's Calculations.

Figure 7

Model Parameters (Men, Ages 20-64)

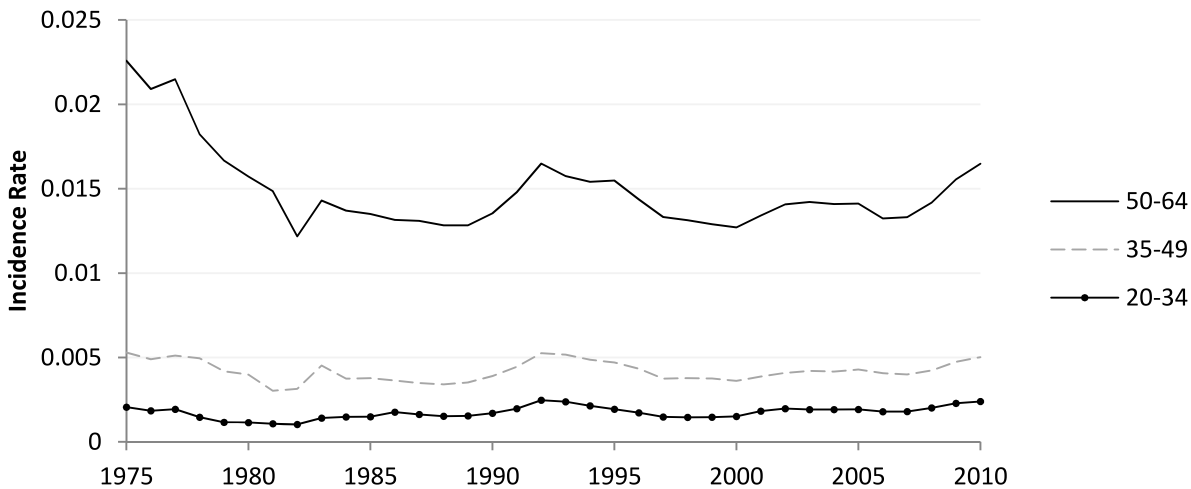


Source: SSA OACT and Author's Calculations.

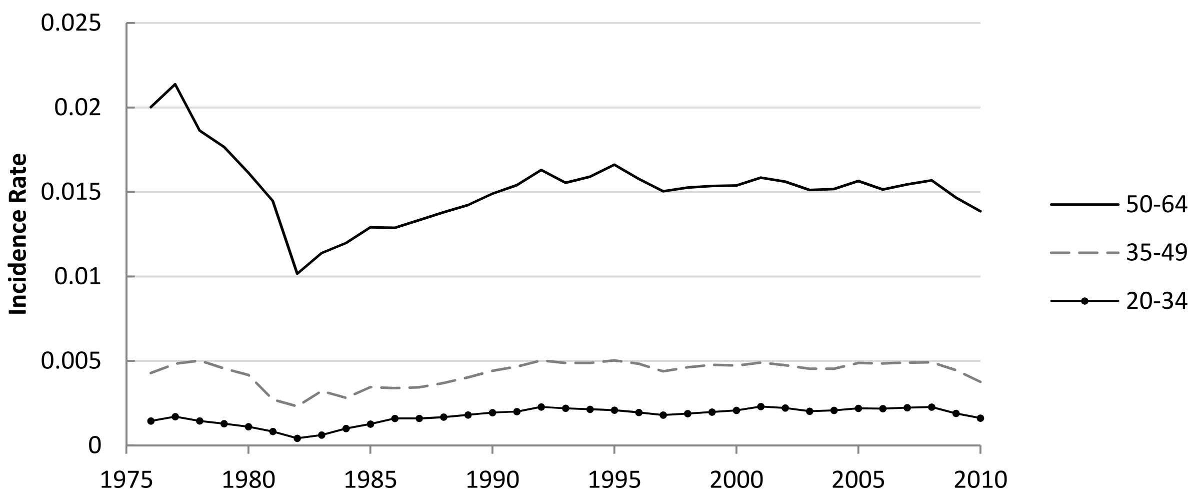
Note: Age Adjustment holds population distribution constant at 1980 levels. See Figure 4 for a note on the age adjustment equation.

Figure 8

Incidence Rates by Age Groups, Men
Age Adjusted[1] with 1980 as Base



Incidence Rates by Age Groups, Men
Age and Unemployment Adjusted[2]



Source: SSA OACT and Author's Calculations.

---

[1] Note: Age Adjustment holds population distribution constant at 1980 levels within 15 year buckets. See Figure 4 for a note on the age adjustment procedure.

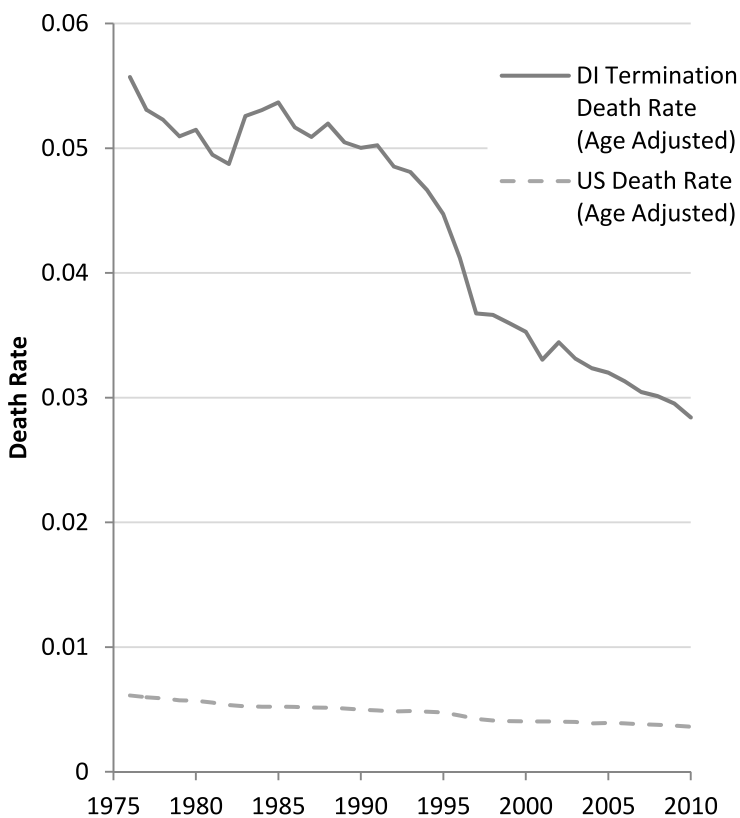
[2] Note: To adjust incidence for unemployment, we regress incidence (averaged over 15 year age buckets) on unemployment, unemployment lagged one year, time, and a time coefficient that is zero before 1992. We then use the equation below to find adjusted incidence, where $\overline{\mathrm{U}}$ is mean unemployment from 1976 – 2010 and $\overline{\mathrm{U}_{\mathrm{lag1}}}$ is the mean unemployment rate lagged by one year over the same period:

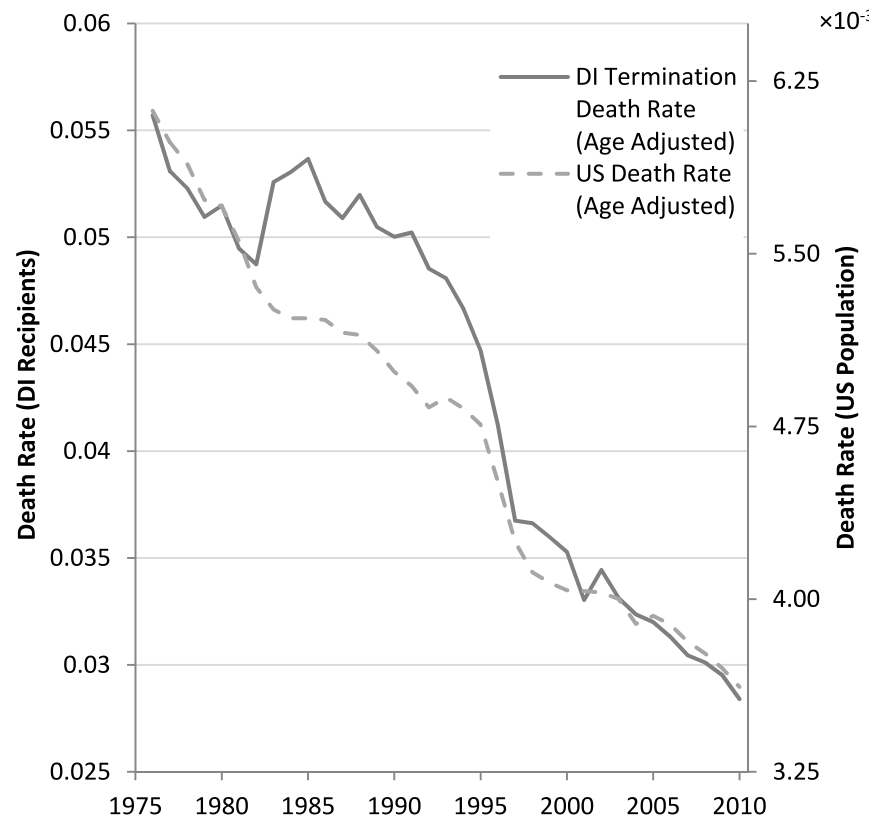
$$Unemployment\ adjusted\ incidence_{g,t} = Age\ adjusted\ incidence_{g,t} + \hat{\beta}_{unemp}(\overline{U} - U_t) + \hat{\beta}_{unemp\_lag1}(\overline{U_{lag1}} - U_{t-1})$$

Figure 9

Age Adjusted Death Rate, DI Recipients v. US Population

Males, Ages 20-64 (2 Different Scales)





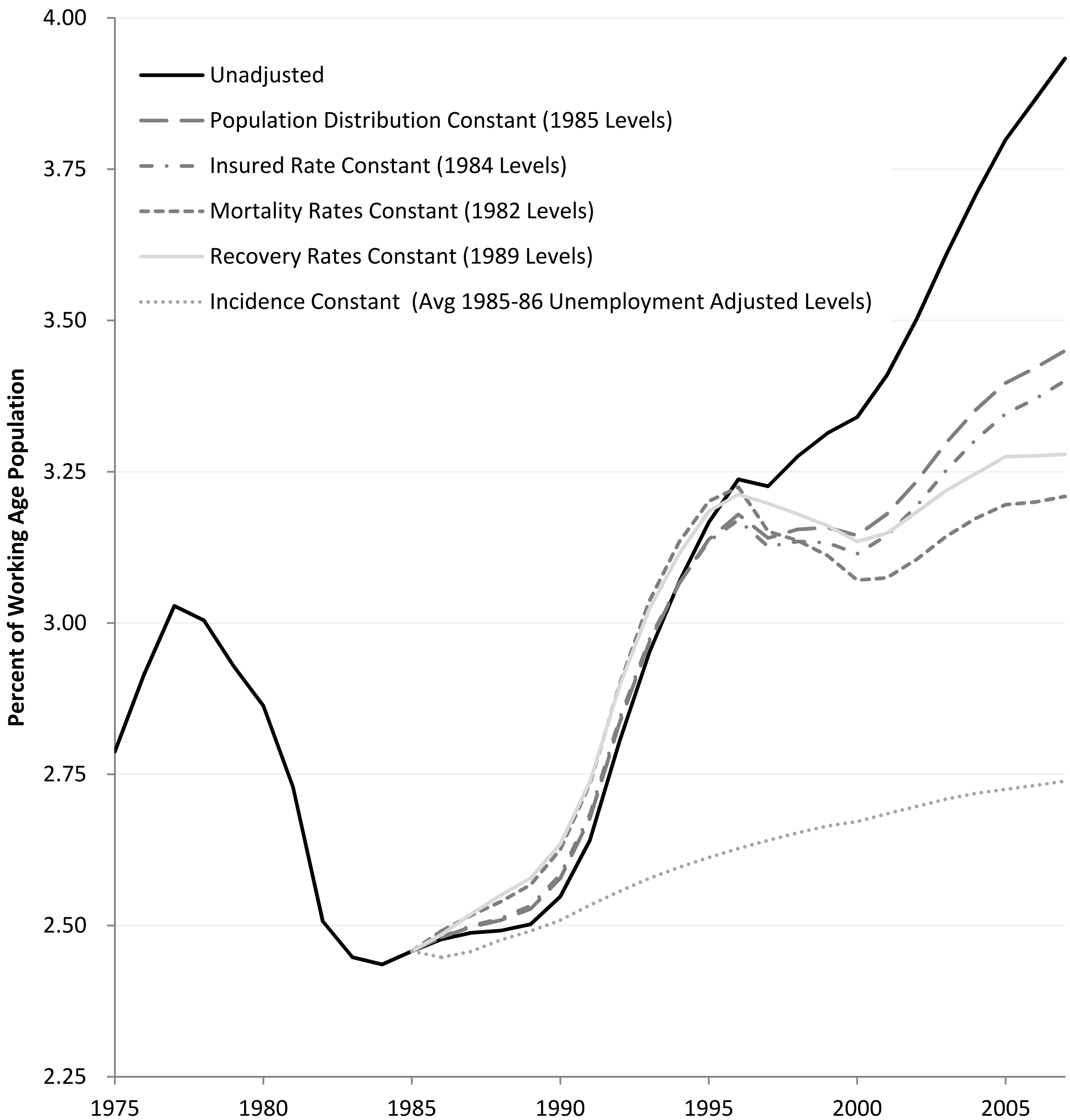
Source: SSA OACT; The Human Mortality Database; and Author's Calculations.

Note: Age adjustment holds population distribution constant at 1980 levels. See Figure 4 for a note on the age adjustment procedure.

Figure 10

Impact of various factors on the percentage of the working age population receiving DI, 1985-2007

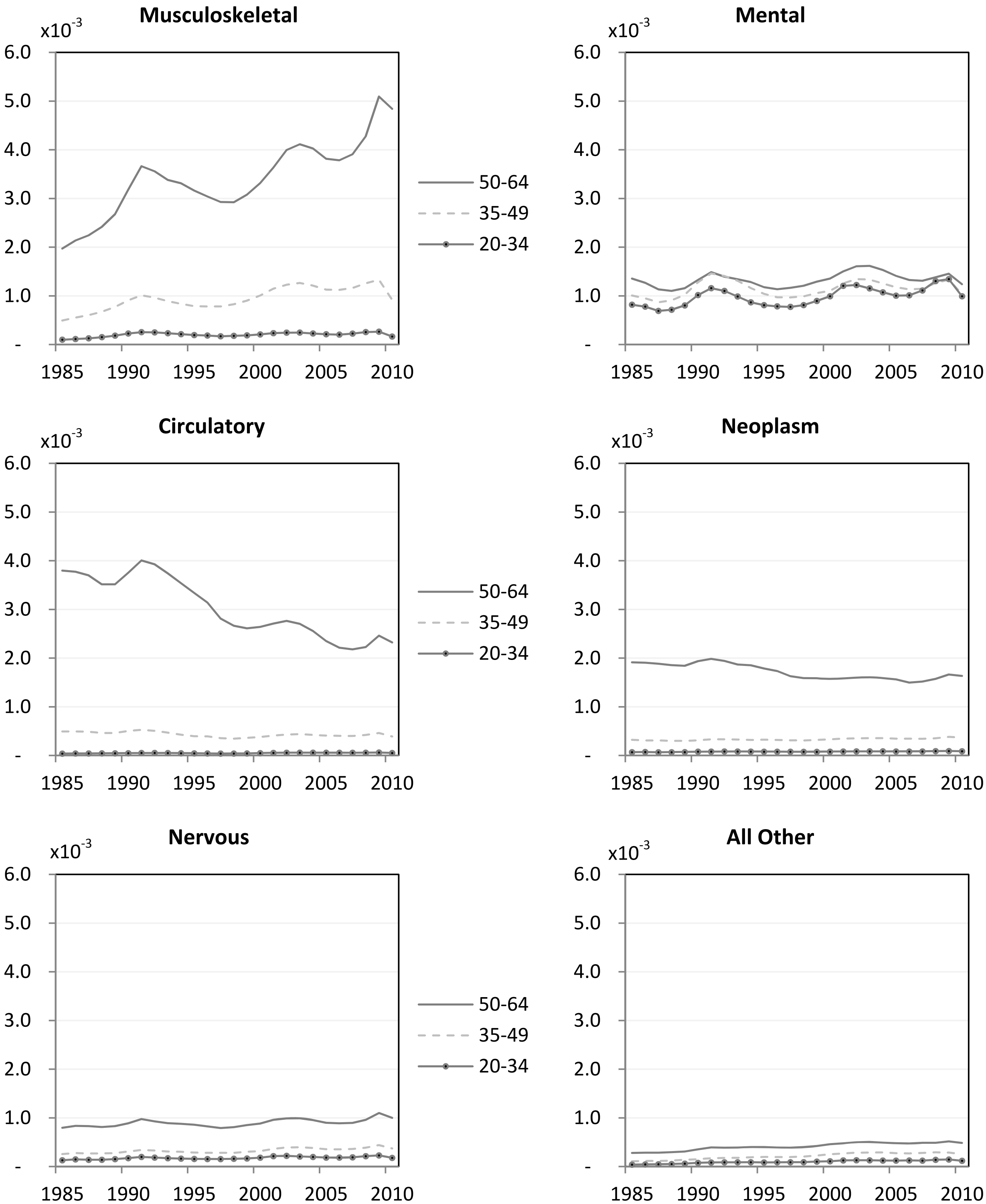
Men Receiving DI, Ages 15-64



Source: SSA OACT and Author's Calculations.

Figure 11

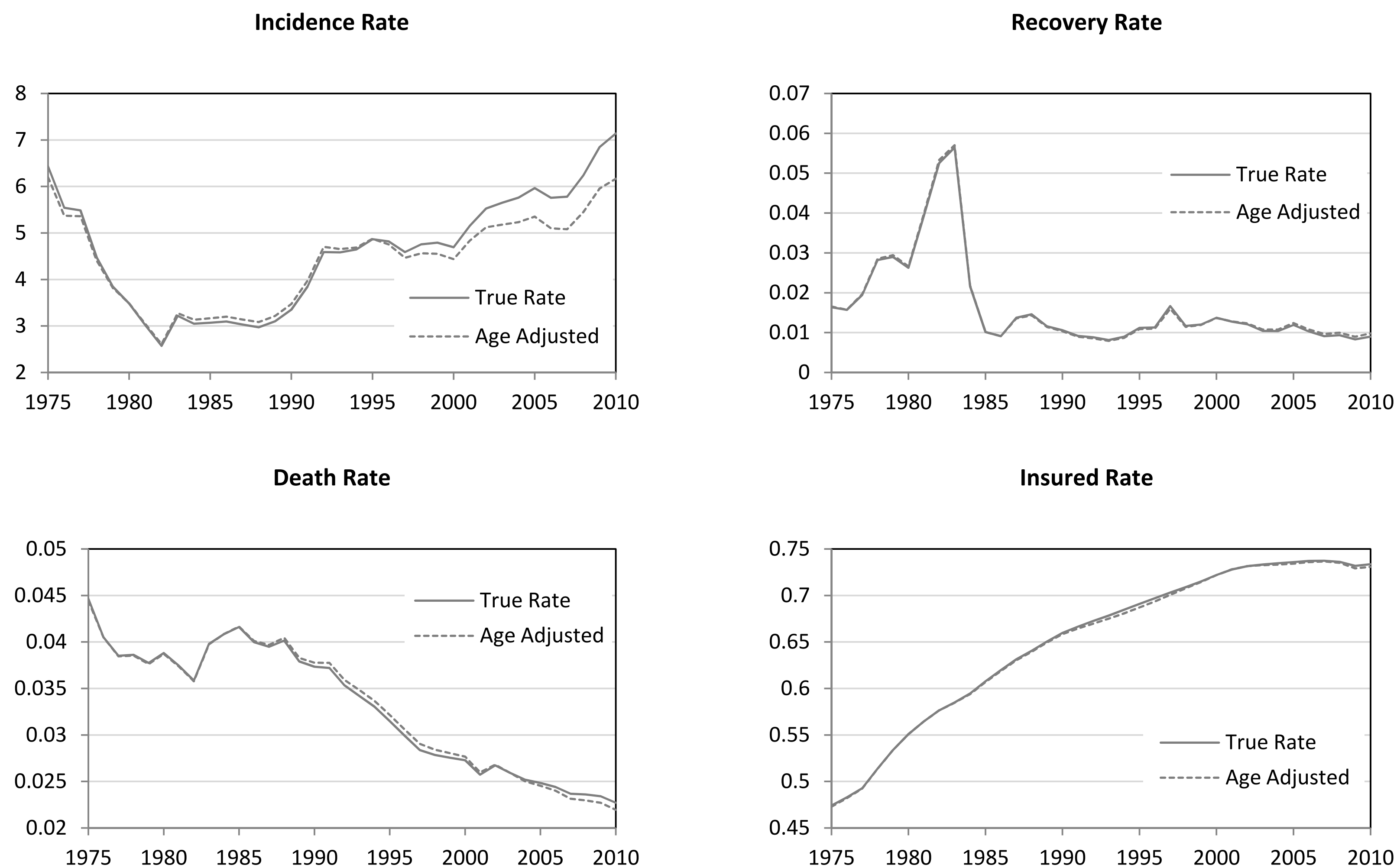
Age Adjusted Incidence Rate by Condition, Men



Source: SSA OACT and Author's Calculations.
Note: Age Adjusted to hold population distribution constant at 1985 levels.

Figure 12

Model Parameters (Women, Ages 20-64)

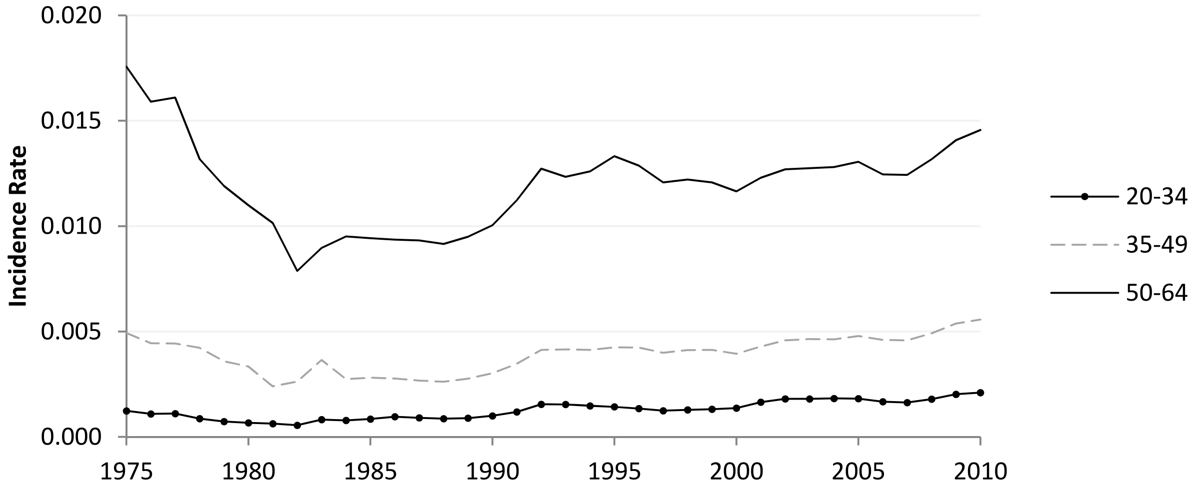


Source: SSA OACT and Author’s Calculations.

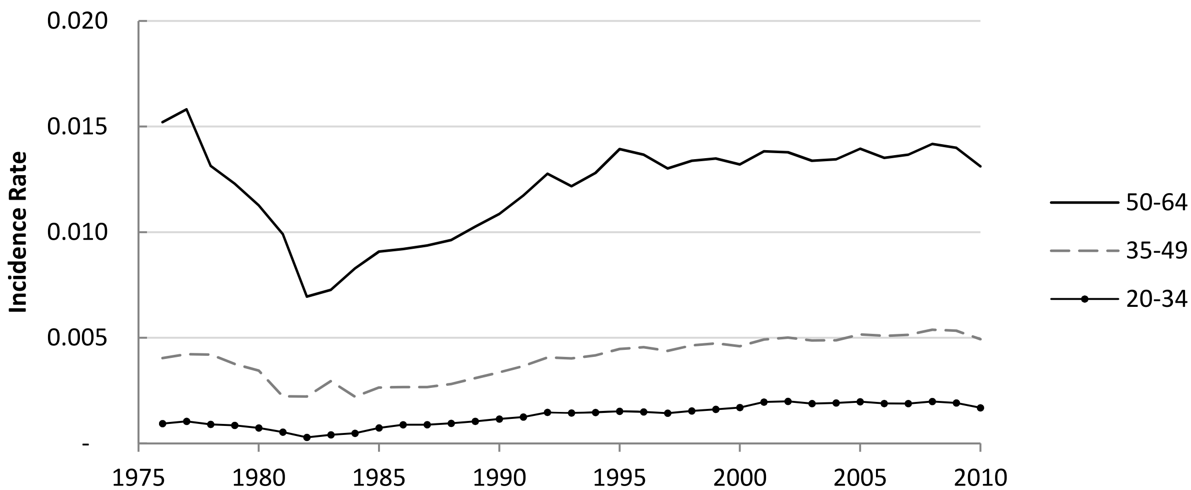
Note: Age Adjustment holds population distribution constant at 1980 levels. See Figure 4 for a note on the age adjustment procedure.

Figure 13

Incidence Rates by Age Groups, Women
Age Adjusted[3] with 1980 as Base



Incidence Rates by Age Groups, Women;
Unemployment Adjusted[4] with No Time Trend



Source: SSA OACT and Author's Calculations.

---

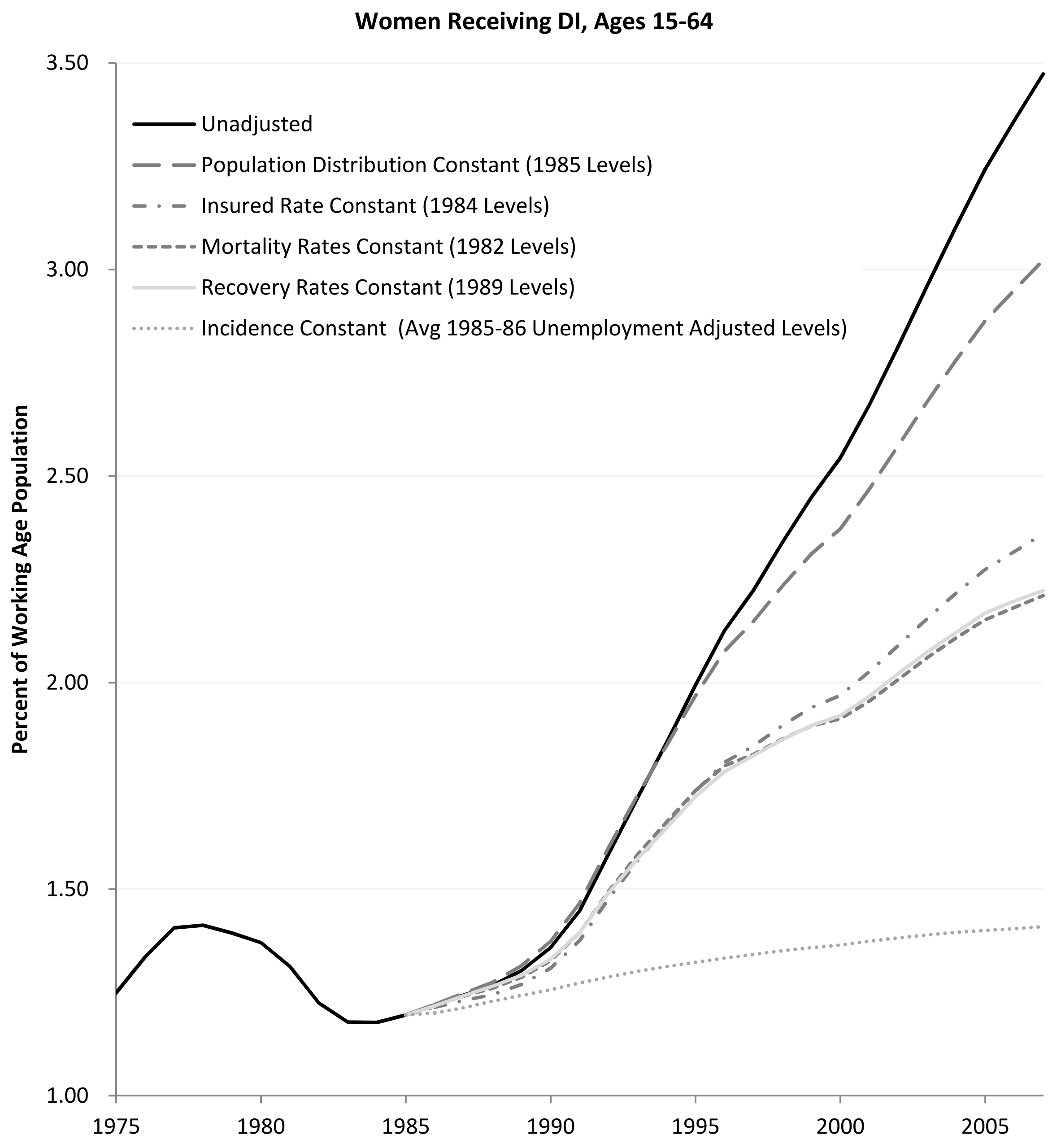
[3] Note: Age Adjustment holds population distribution constant at 1980 levels within 15 year buckets. See Figure 4 for a note on the age adjustment procedure.

[4]Note: To adjust incidence for unemployment, we regress incidence (averaged over 15 year age buckets) on unemployment, unemployment lagged one year, time, and a time coefficient that is zero before 1992. We then use the equation below to find adjusted incidence, where $\overline{\mathrm{U}}$ is mean unemployment from 1976 – 2010 and $\overline{\mathrm{U}_{\mathrm{lag1}}}$ is the mean unemployment rate lagged by one year over the same period:

$$Unemployment\ adjusted\ incidence_{g,t} = Age\ adjusted\ incidence_{g,t} + \hat{\beta}_{unemp}(\overline{U} - U_t) + \hat{\beta}_{unemp\_lag1}(\overline{U_{lag1}} - U_{t-1})$$

Figure 14

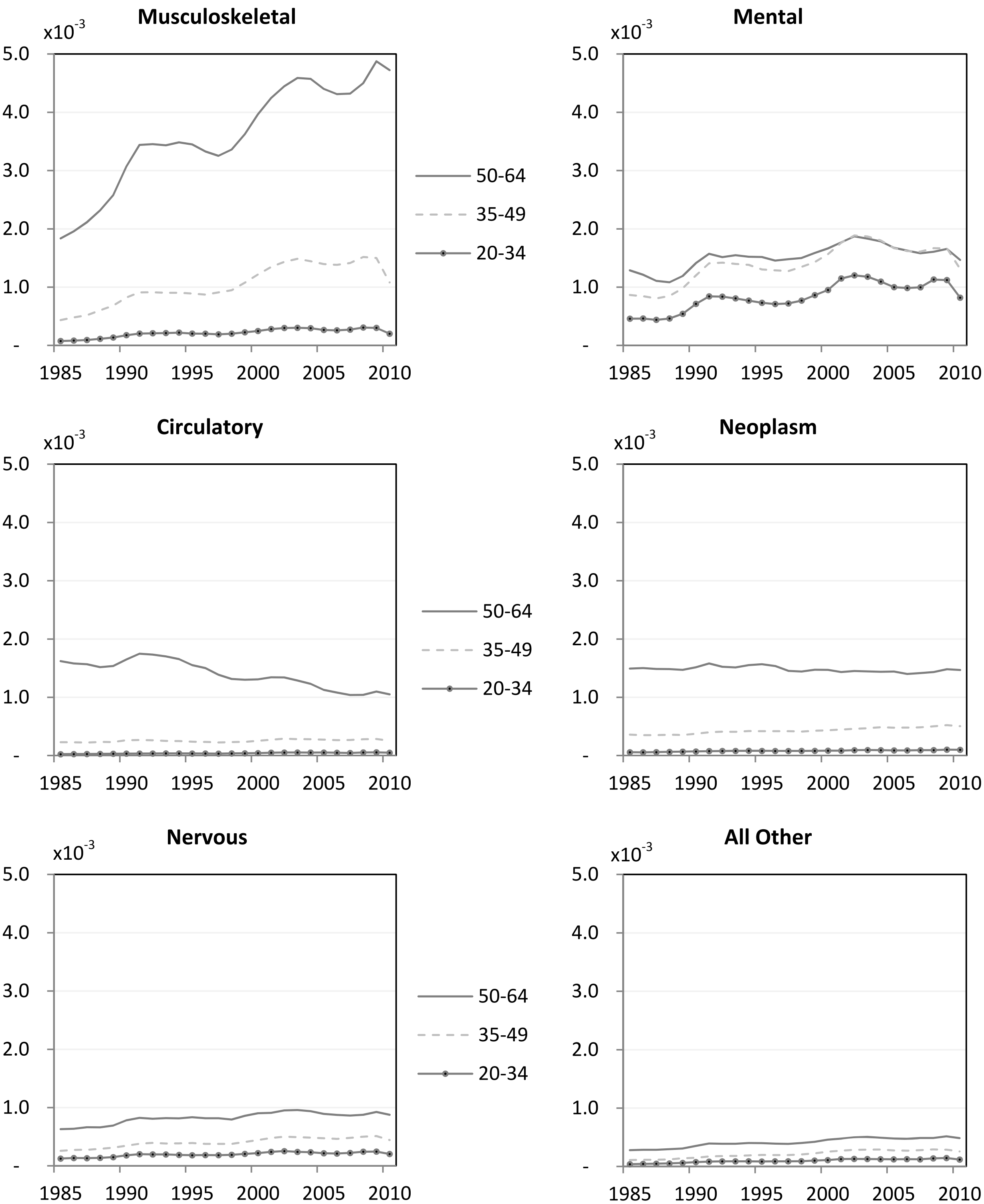
Impact of various factors on the percentage of the working age population receiving DI, 1985-2007



Source: SSA OACT and Author's Calculations.

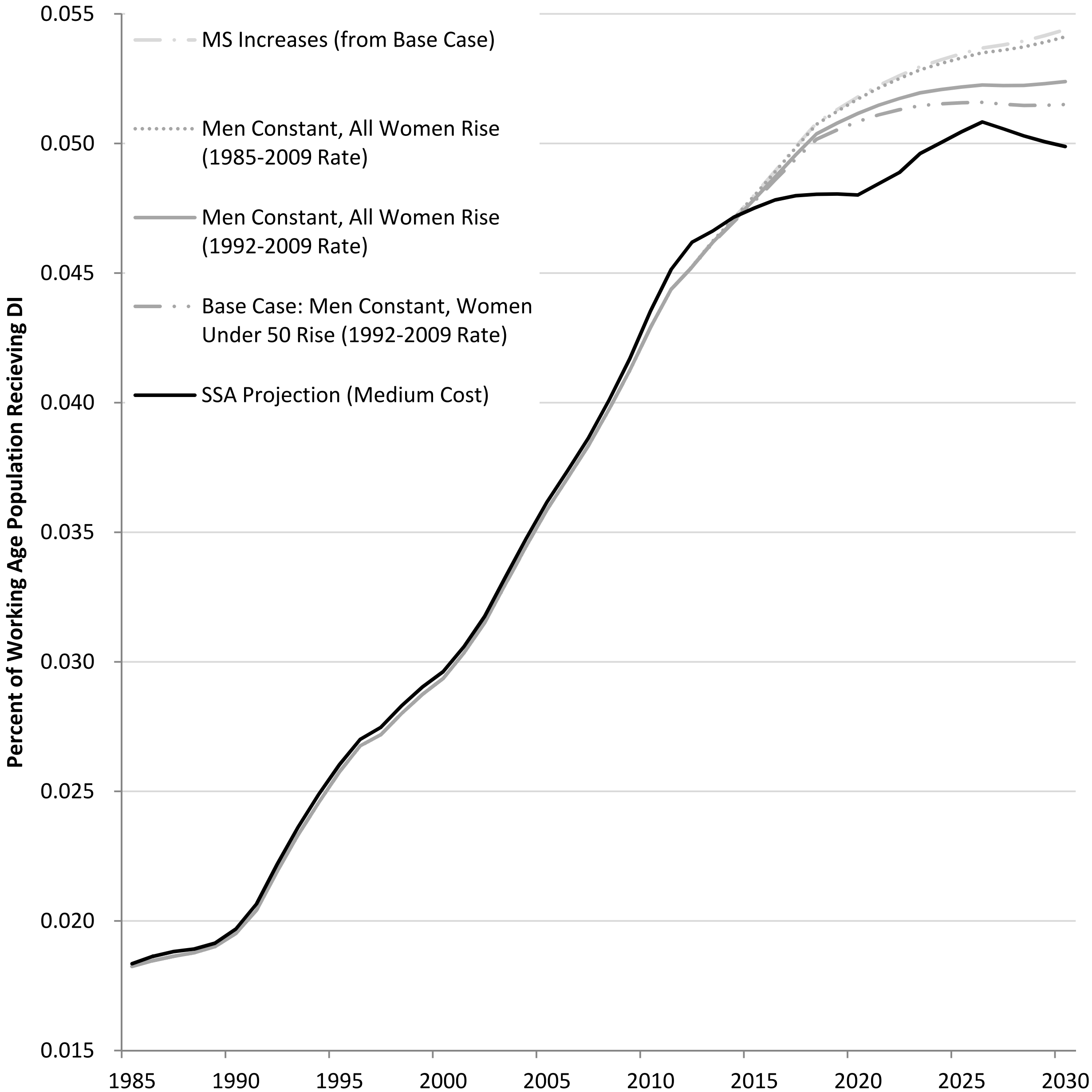
Figure 15

Age Adjusted Incidence Rate by Condition, Women



Source: SSA OACT and Author's Calculations.
Note: Age Adjusted to hold population distribution constant at 1985 levels.

Figure 16
Total DI Recipients per Working Age Population, Projections



Source: SSA OACT and Author's Calculations.

Table 1

Decomposition of Spending as a Share of GDP

	Total Benefits Spending / GDP[1]			Recipients / WAP			Avg Annual Benefits / GDP / WAP		
	1979	**2007**	**Change**	**1979**	**2007**	**Change**	**1979**	**2007**	**Change**
	(1)	(2)	(2)/(1)	(3)	(4)	(4)/(3)	(5)	(6)	(6)/(5)
Male DI Beneficiaries	0.404	0.410	1.01	0.0293	0.0408	1.39	0.128	0.094	0.74
Female DI Beneficiaries	0.134	0.274	2.04	0.0139	0.0362	2.59	0.089	0.071	0.79
Disabled SSI Beneficiaries	0.182	0.252	1.39	0.0166	0.0330	1.99	0.110	0.076	0.70
Disabled SSI Adults	0.165	0.199	1.21	0.0152	0.0269	1.77	0.108	0.074	0.68
Disabled SSI Children	0.017	0.053	3.14	0.0013	0.0061	4.56	0.127	0.088	0.69

1. Expressed in units 10^-2

Note: WAP is Working Age Population

Addendum

	Avg. Annual Benefits / GDP[2]		
	1979	**2007**	**Change**
	(7)	(8)	(8)/(7)
Male DI Beneficiaries	1.93	1.02	0.53
Female DI Beneficiaries	1.33	0.77	0.58
Disabled SSI Beneficiaries	0.83	0.41	0.50
Disabled SSI Adults	0.82	0.40	0.49
Disabled SSI Children	0.96	0.47	0.50

2. Expressed in units 10^-9

Source: SSA OACT; 2012 Economic Report of the President; and Author’s Calculations.

Table 2

Regression Results: Incidence on Unemployment and Time

Men

1985-2009		**50-64**			**35-49**			**20-34**	
	Panel[1]	**Linear**	**Spline**	**Panel[1]**	**Linear**	**Spline**	**Panel[1]**	**Linear**	**Spline**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Unemployment		0.426	0.529		0.140	0.188		0.131	0.150
Unemployment, lagged one year		0.397	0.448		0.239	0.262		0.088	0.970
Time	0.063	0.061	0.482	0.042	0.041	0.238	0.022	0.021	0.101
Time (post-1992)			-0.527			-0.247			-0.099
Constant		-112.00	-950.93		-79.82	-473.05		-41.86	-199.86
P-value (time)	0.018	0.075	0.000	0.003	0.015	0.000	0.001	0.011	0.000
P-value (time, post-1992)			0.000			0.000			0.000

Note: 1992 was used at the spline knot year
[1]2011 Technical Panel on Assumptions and Methods

Women

1985-2009		**50-64**			**35-49**			**20-34**	
	Panel[1]	**Linear**	**Spline**	**Panel[1]**	**Linear**	**Spline**	**Panel[1]**	**Linear**	**Spline**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Unemployment		0.066	0.168		0.061	0.091		0.045	0.056
Unemployment, lagged one year		0.320	0.371		0.146	0.162		0.076	0.082
Time	0.193	0.193	0.611	0.114	0.115	0.240	0.051	0.051	0.096
Time (post-1992)			-0.523			-0.157			-0.057
Constant		-374.61	-1207.22		-225.97	-475.47		-100.26	-191.05
P-value (time)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P-value (time, post-1992)			0.000			0.000			0.001

Note: 1992 was used at the spline knot year
[1]2011 Technical Panel on Assumptions and Methods

Source: SSA OACT; 2011 Technical Panel on Assumptions and Methods; and Author's Calculations.

Table 3

Decomposition of various factors' impact on the percentage of the working age population receiving DI

	Men		**Women**		**Total**	
Incidence Rate Adjustment:	**1985**	**1991**	**1985**	**1991**	**1985**	**1991**
	(1)	(2)	(3)	(4)	(5)	(6)
Population Distribution Constant	0.40	0.67	0.22	0.22	0.29	0.34
Insured Rate Constant	0.04	0.09	0.32	0.39	0.22	0.31
Death Rate Constant	0.16	0.34	0.07	0.09	0.10	0.16
Recovery Rate Constant	(0.06)	(0.12)	(0.01)	(0.01)	(0.03)	(0.04)
Incidence Rate Constant	0.45	0.02	0.39	0.31	0.42	0.23

Source: SSA OACT and Author's Calculations.

Appendix Table 1

Regression Results: Incidence on Unemployment and Time (1985 – 2009)

Men

	50-64			35-49			20-34		
Spline Knot Year:	**1990**	**1991**	**1992**	**1990**	**1991**	**1992**	**1990**	**1991**	**1992**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Unemployment	0.457	0.474	0.529	0.155	0.162	0.188	0.137	0.140	0.150
Unemployment, lagged one year	0.629	0.563	0.448	0.348	0.317	0.263	0.135	0.120	0.097
Time	0.676	0.570	0.482	0.329	0.280	0.238	0.146	0.120	0.101
Time (post-1992)	-0.677	-0.591	-0.527	-0.317	-0.278	-0.247	-0.137	-0.115	-0.099
Constant	-1336.602	-1124.991	-950.928	-653.594	-556.197	-473.049	-290.033	-238.643	-199.863
P-value (time)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P-value (time, post-spline)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Women

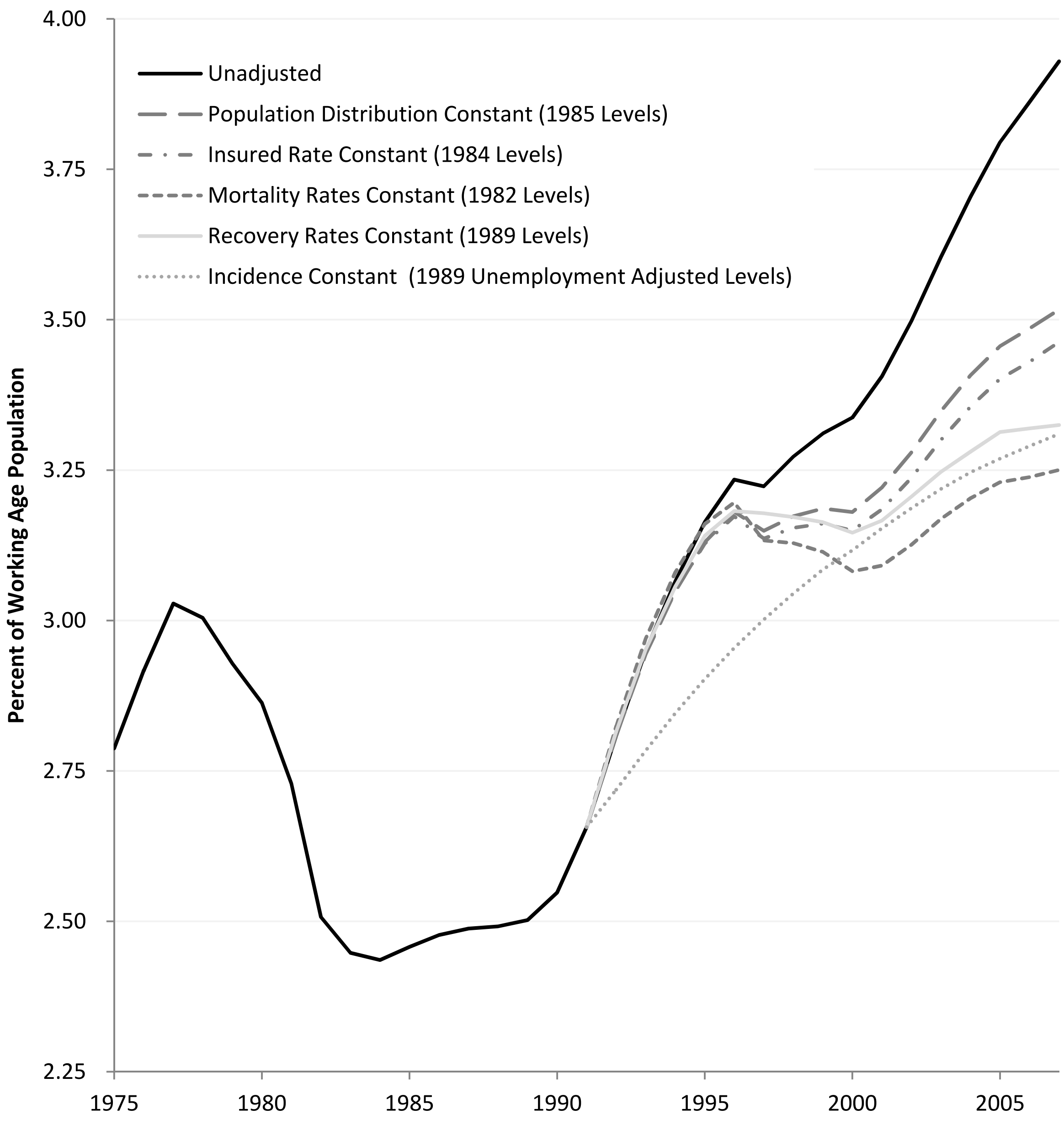
	50-64			35-49			20-34		
Spline Knot Year:	**1992**	**1996**	**2001**	**1992**	**1996**	**2001**	**1992**	**1996**	**2001**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Unemployment	0.168	0.379	0.386	0.091	0.156	0.165	0.056	0.074	0.093
Unemployment, lagged one year	0.371	0.301	0.427	0.162	0.141	0.181	0.082	0.074	0.092
Time	0.611	0.465	0.342	0.240	0.198	0.163	0.096	0.076	0.073
Time (post-1992)	-0.523	-0.469	-0.481	-0.157	-0.143	-0.157	-0.057	-0.043	-0.073
Constant	-1207.222	-917.979	-675.070	-475.471	-391.834	-323.876	-191.049	-150.663	-145.707
P-value (time)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
P-value (time, post-spline)	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.003	0.000

Source: SSA OACT; 2011 Technical Panel on Assumptions and Methods; and Author’s Calculations.

Appendix Figure 1

Impact of various factors on the percentage of the working age population receiving DI, 1991-2007

Men Receiving DI, Ages 15-64

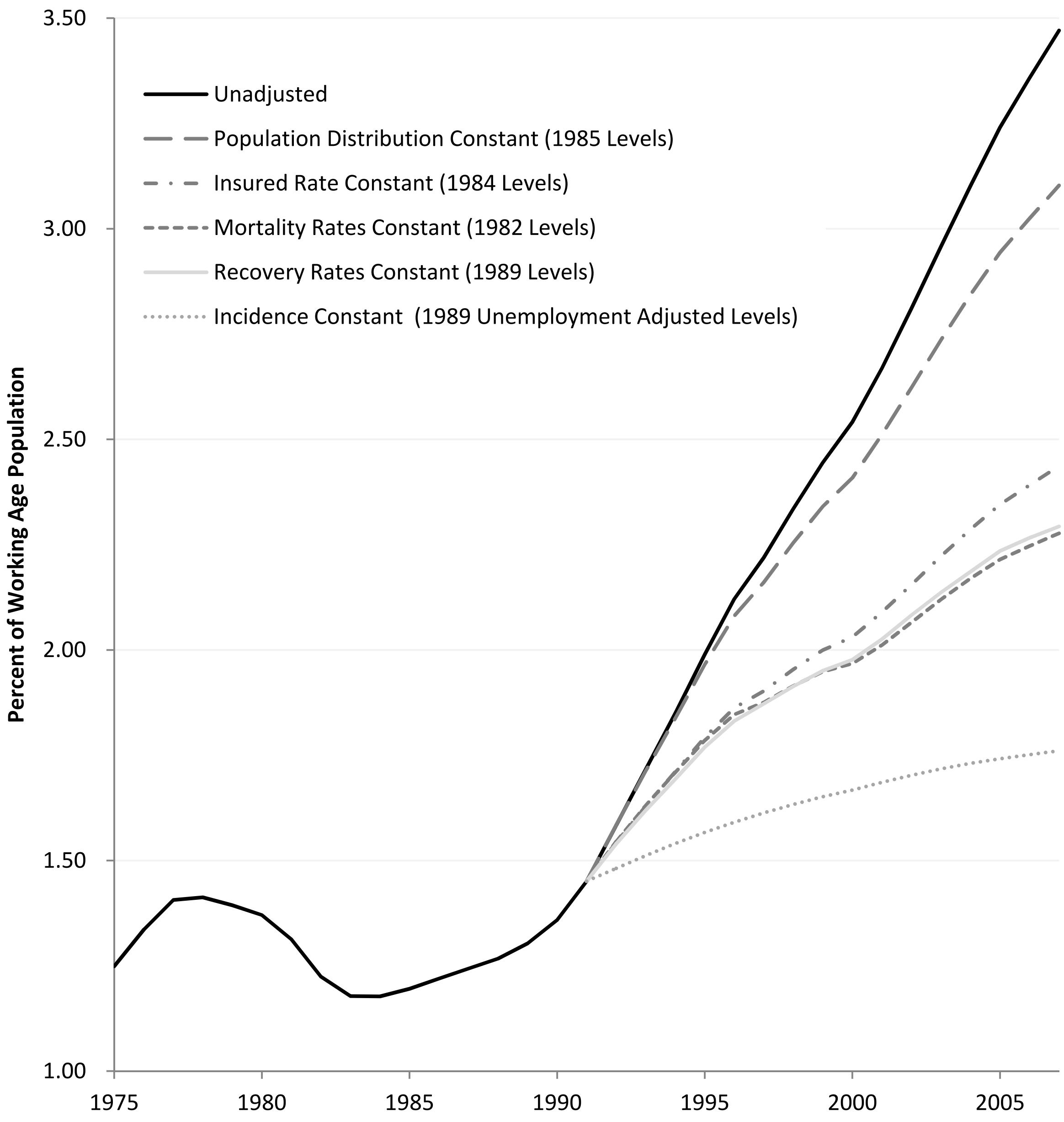


Source: SSA OACT and Author's Calculations.

Appendix Figure 2

Impact of various factors on the percentage of the working age population receiving DI, 1991-2007

Women Receiving DI, Ages 15-64



Source: SSA OACT and Author's Calculations.