ESSAYS ON INTRAGENERATIONAL AND INTERGENERATIONAL INEQUALITIES IN THE SOCIAL SECURITY PROGRAM AND THEIR IMPLICATIONS

By

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CHAPTER I

INTRODUCTION

In 1935 President Franklin Roosevelt signed the Social Security Act. This act introduced a broad social insurance program in the United States, which followed the introduction of similar programs in Europe (Germany in 1883, Great Britain in 1911). The official name of Social Security is the Federal Old-Age, Survivors, and Disability Insurance (OASDI) program. The name refers to the main three components of Social Security, but there are other welfare and insurance programs within Social Security.

The program has been successful as the living standards of the elderly improved considerably since its creation. The poverty rate among people aged 65 and older dropped from roughly 50% in the 1930s to less than 10% in the 2000s. Currently the poverty rate among senior citizens is less than the poverty rate among working adults. The elderly are no longer dependent on their children; they own their housing, and retirement years have become “a period of enjoyment and creative experience and a reward for a lifetime of labor” (Costa 1998, 27). One third of all beneficiaries receive at least 90% of their income and two-thirds receive at least half of their income from Social Security (Costa 1998).

There are many issues for discussion regarding Social Security’s effects on the economic activity of the population and the economic performance of the country in general. Economists have been studying how Social Security affects the labor supply decision, savings, economic growth, fiscal policy, and so forth. The objective of this dissertation is to study some of the equity issues associated with Social Security.

There are two main types of inequality within Social Security: intragenerational and intergenerational inequalities. Regarding intragenerational inequality, we examine how black workers fare relative to white workers within the same age cohort. We do it by estimating the effective net tax rate for these two racial groups. Shorter life expectancy of black workers means that their life in retirement is shorter; therefore they draw less in social security retirement benefits than white workers in the same age and income group, which in turn means that they face a higher effective Social Security tax rate. There are several reasons for this exercise. First, the differences in net tax rates may differentially affect labor force participation or the distribution of labor among families of different racial and age groups. Second, the progressivity of the benefit schedule may be eliminated when differential mortality is accounted for across different income groups among black workers. Third, Social Security may contribute to the wealth gap among racial groups.

Regarding intergenerational inequality, we are convinced that people are not treated the same over time. The normal retirement age has been 65 for many years. Although according to 1983 amendments the retirement age is set to increase to 67 by 2027, it is not growing at the same rate as life expectancy. The main components of the program have been unchanged for decades. This means that future generations will be drawing benefits for longer periods than earlier generations while they contribute to the program roughly for the same period of time. Our aim is to show that imposing a simple intergenerational fairness principle may secure long term financial stability of the Social

Security program. We also demonstrate that if this kind of policy were adopted early in the past, then the amendments of 1983 aimed at restoring the long term fiscal soundness would not have been necessary.

All incidents of inequity in our study stem from disparities in life expectancy across demographic groups. Black workers have always had higher mortality rates than their white counterparts. According to the literature this gap narrowed in the first half of the 20th century, but it was stable in the second half of the last century. Levine et al. (2001) show that if one uses data from 1933 until 1999 to project future white-black mortality and life expectancy ratios, then the gap tends to close. But if one observes only the 1954-1999 period, then extrapolation of these ratios shows that the gap is stable until 2063. However, studies that incorporate data from the 2000s show the black-white life expectancy disparity closed a little, but experts do not expect the gap to be eliminated in the foreseeable future (Harper et al. 2007). At the same time, life expectancy has grown steadily for all race and sex groups over time, and growth is expected to continue, which produces inequality in the services of Social Security across generations.

The Social Security program has grown into a huge program. In 2008 51 million people received benefits of $615.3 billion (21% of federal spending), and 162 million people paid payroll taxes totaling $672 billion (25% of federal receipts). Because Social Security pays so many benefits to so many people, politicians are very cautious about tampering with it. Nevertheless, the reform of the Social Security program has propelled discussion among politicians and scholars over the last decade because the Social Security program is projected to become financially unsustainable in the future (2009

Annual Report of the Social Security Board of Trustees; 2004 Long Term Analysis of the Congressional Budget Office).

The reasons behind the long term deficit of Social Security are both demographic and economic. Fertility and mortality rates have declined steadily in the United States; this pattern is common among many developed countries in the world. The downward trend in fertility has been observed since the beginning of the 20th century. There was only one period of sharp increase in birth rates in the United States, and this occurred after World War II and lasted for about 20 years. That period is known as "the baby boom." Seventy six million babies were born during this period; the fertility rate reached 3.77 in 1957 compared to 2.1 in 1930. The reasons for the baby boom are clear. There was great optimism after World War II, families were moving to the suburbs, and incomes were rising rapidly, not the least because the United States came out of World War II as the main producer of most manufactured goods. Baby-boomers became the largest generation in American history. This generation had a substantial impact on American economic history. In the 1950s, baby boomers brought rapid growth in demand for housing and expenditures on schools. In the 1960s, this generation brought more spending on higher education. In the 1970s, they produced growth in the labor force (Weaver 1982). From now and into the future, baby boomers will put considerable pressure on Social Security's budget as they move into retirement.

Another characteristic demographic trend is the decline in mortality rates. In 1935 when Social Security was established the overall life expectancy was 61 years. More than half of Americans would not live to 65 to collect their Social Security benefits. In 2009, the life expectancy for males is more than 75 years, while that of females is above 80 years. Data on life expectancy at retirement are shown in Figures 1.1 and 1.2 for men and women respectively. Numbers beyond 2009 are projected by the Board of Trustees and presented under three different future cost scenarios (intermediate, low, high). Different cost scenarios correspond to different assumptions underlying the projection procedures (fertility, immigration, long-term productivity growth, unemployment, and so forth) with intermediate being the best-guess scenario. In 1935 newly retired men could expect to receive benefits for 12 years on average, while retired women could expect to receive benefits for 13 years. Currently we expect men to receive benefits for 17 years and women to receive them for 19 years on average. Benefits paid have gone up by more than 40% since 1935. From this source of social security alone, the cost of old age insurance has increased by 40% per retiree since 1940.

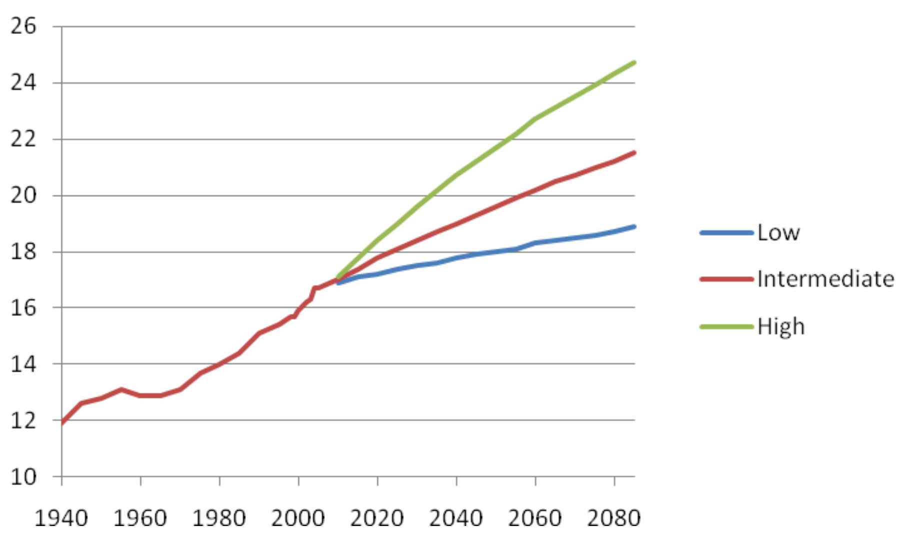

Figure 1.1: Life Expectancy of the Male Population at Age 65

Notes: Based on the 2009 Annual Report of the Board of Trustees. Before 2009 the Intermediate scenario represents historical data.

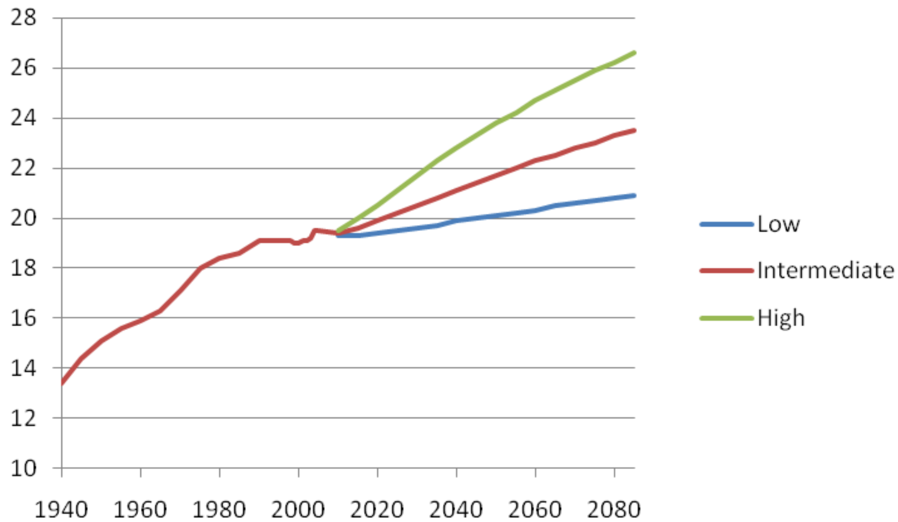

Figure 1.2: Life Expectancy of the Female Population at Age 65

Notes: Based on the 2009 Annual Report of the Board of Trustees. Before 2009 the Intermediate scenario represents historical data.

Since Social Security is a pay-as-you-go system, these demographic tendencies lead to a decline in the number of taxpaying workers per Social Security beneficiary. In 1950, 16 working people paid benefits for a single retired person. In 1960, only five workers were paying benefits of a retired worker. By 2010, this number dropped below three. In 2030, the number of workers supporting benefits of a retiree is projected to be two, and this ratio is expected beyond 2030 if current demographic trends continue (Gramlich 2003, 28).

Theoretically it is possible that productivity growth will be high enough so that affordable benefits can continue without raising the payroll taxes of workers. But the data show that since World War II productivity has been declining. Right after the war productivity and real wages grew rapidly for a number of reasons. First, the United States came out of the war with its industrial base unharmed, while other industrial countries were suffering from the war's destructions. Second, natural resources were relatively cheap. As a result, real wage growth rate was on average 2% until the 1970s. In the 1970s, the United States started to experience productivity slowdown as the above factors reversed. Real annual wage growth dropped to 1% and has remained at this level since then. There is nothing to suggest that productivity growth rate will change significantly in the near future.

Since the conception of Social Security in 1935, in most fiscal years contributions into the program exceeded the expenditures from it. These surpluses accumulated in the Social Security Trust Fund. This trust fund is invested in special government bonds, and it earns interest on these bonds. According to the 2009 Annual Report of the Board of Trustees, the annual surplus will continue until 2017 under the "intermediate cost" scenario.

Figure 1.3 shows the projected surplus/deficit in the annual budget until 2018 and Figure 1.4 shows the projected size of the Social Security Trust Fund until 2080 under three different cost scenarios (intermediate, low, and high). According to the Board of Trustee's projections the Trust Fund will be exhausted by 2035 under the "best-guess" scenario.

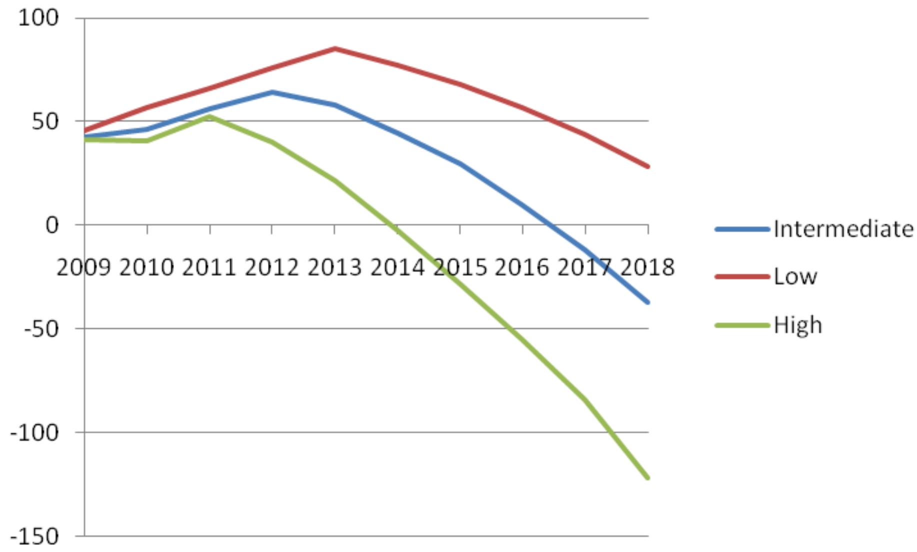

Figure 1.3: Projected Social Security Budget

Notes: Based on the 2009 Annual Report of the Board of Trustees.

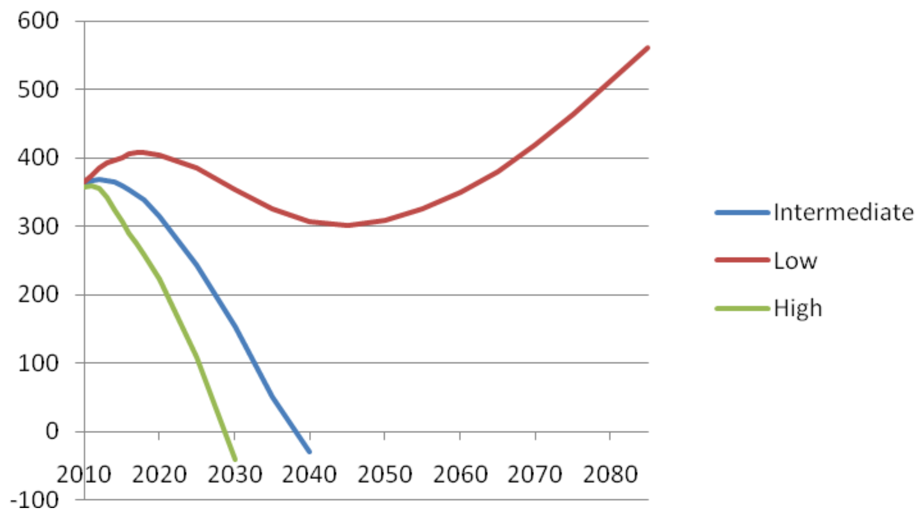

Figure 1.4: Projected Social Security Trust Fund (Billions of Dollars)

Notes: Based on the 2009 Annual Report of the Board of Trustees.

This dissertation contains two essays. In the first essay, we calculate the net marginal Social Security tax rate for different racial and income groups. The net marginal Social Security tax rate (NMSSTR) is the difference between the Social Security tax rate and the present value of future benefits to which an additional dollar of income entitles an individual. The disparity in NMSSTR across racial groups is caused by differences in mortality rates. In our calculations we incorporate variation across racial and income groups. We find that the progressivity of the benefit schedule of Social Security is affected by differences in life expectancy. We discuss what differences in the marginal return on Social Security imply in terms of optimal tax theory and the likely effects of differences in the NMSSTR on labor force participation and income inequality.

Social Security is a pay-as-you-go system and generates intergenerational transfers of income between workers and retirees. At current regulations and demographic tendencies, Social Security produces inequality in services across future generations. According to Rawls' theory of justice (1971, 1975, 1999), a just social contract is one to which we would agree if we did not know in advance where we ourselves would end up within the rules. In this regard, those cohorts who do not live long and are aware that their lives will be short would object to the state in which all contribute the same amount of resources but receive benefits according to how long they live. In the second essay, we show that, at the fixed normal retirement age and ever increasing life expectancy, Social Security is bound to bring gains for younger generations that are not produced by economic growth. This essay describes fairness concerns related to the services Social Security provides across cohorts. We suggest a policy that imposes a level of equality in returns to Social Security by age cohort. Our proposition is that the normal retirement age should be determined for every age cohort so that expected benefits relative to contributions are the same for all age cohorts. Our objective is to search for an initial level of benefits to contributions ratio that would make the expected balance of Social Security positive in the long term.

There are a number of arguments in favor of using retirement age to impose intergenerational equality in Social Security. First, the demographic trends are more robust and can be projected with greater accuracy than economic or financial indicators. Second, the demographic trend is one of the main causes of the long term imbalance in Social Security. Finally, the fixed retirement age and rising life expectancy undermine the original purpose of Social Security, namely old-age insurance. We conduct stochastic projections of the balance of Social Security under the proposed retirement scheme.

We also calculate the retirement age and estimate the balance in the Social Security Trust Fund for the period 1957 – 2005. We show that under a fair retirement scheme, Social Security could be kept in sound financial condition throughout its history. Our results show that the amendments of 1983 would be unnecessary if the retirement age was set for each age cohort based on its life expectancy at retirement.

Our results are timely and contribute to the current debate over social security policy reforms. The 1983 amendments were necessary for the fiscal viability of the system, but were not sufficient. We offer a reasonable and fair policy that will restore fiscal health to the social security system in the future.

CHAPTER II

NET MARGINAL SOCIAL SECURITY TAX RATE BY RACIAL AND INCOME GROUPS

2.1. Introduction

The objective of this essay is to calculate the Net Marginal Social Security Tax Rate (NMSSTR) for different racial and age groups following Feldstein and Samwick (1992). NMSSTR is the difference between the social security tax and the present value of future benefits to which an additional dollar of income entitles an individual. Only individual and survivor retirement benefits are taken into account in calculating these net marginal tax rates, and disability is ignored. It is difficult to obtain a credible measure of the probability of somebody becoming disabled over his or her lifetime. On the other hand, the expected value of individual and survivor retirement benefits can be estimated based on each demographic group's mortality rates. Following Feldstein and Samwick's methodology, we estimate the net marginal tax rate of a particular group by subtracting the present value of future benefits, weighted by survival and discount rates, from the statutory Social Security tax rate. We calculate NMSSTR for different age, sex and racial groups. Armour and Pitts (2004) extend this basic procedure by adding the probability of a particular individual being eligible for Social Security benefits, which depends on the number of years the individual makes payments to Social Security and differential mortality rates for different income groups.

There are several incentives to conduct a study like this. One of them is related to the progressivity of the Social Security program. Progressivity is a feature that almost all modern tax systems possess. The rationale is to make the tax burden more equitable: wealthier people can afford to pay higher taxes than poorer people. But in reality, seemingly progressive or non-regressive tax schedules can impose regressive *effective* marginal tax rates. The most common example is the sales tax. It can become regressive because low income people spend most of their earnings. The structure of Social Security benefits is progressive, i.e. low income workers have higher marginal replacement rates; a larger share of their average lifetime earnings is paid back as retirement benefits. However, if the mortality difference between low income and other workers is high enough, then effectively the benefit schedule may be regressive because low income workers may not live long enough to collect those benefits.

Another incentive to conduct a study like this is the labor incentive effect of any income tax. Different demographic groups may have different labor elasticities; for example, married women have greater labor supply elasticities than single men or women or married men (Hausman 1985). This fact makes it interesting to study whether the tax and benefits of the Social Security program create distortionary effects on the incentives to work for different groups. Optimal tax theory suggests that efficiency is achieved only if the effective marginal tax rate is inversely proportional to the compensated wage elasticity of labor supply. There have been a number of empirical studies providing evidence of higher labor supply elasticities for younger workers and workers from minority groups (Silberberg 1985; Juhn et al. 1991). A high NMSSTR for young black workers implies that the social security tax imposes distorting incentives for this group.

Other studies (Grogger 1995, 1997) have found that younger workers, especially young black workers, are more responsive to the difference in returns in the legal and illegal economies. Therefore, a low return from Social Security for young black workers may contribute to their participation in illegal activities or encourage them to work in the informal sector. We are not trying to explain the effects of the Social Security tax on labor force participation decisions of different racial and age groups, but we believe that noticeable differences in effective net marginal tax rate across racial groups suggest that the Social Security program has explanatory power in these decisions because the net marginal Social Security tax rate is virtually a rate of return on Social Security from an additional dollar of earnings.

One other proposition that makes calculating NMSSTR for different racial groups interesting is that Social Security may be contributing to the wealth gap between white and black workers who have otherwise similar characteristics.

Our purpose is to estimate the net marginal tax rate for different racial groups. Previous studies have looked at differences by sex and age (Feldstein and Samwick 1992; Armour and Pitts 2004). Surprisingly, we have not found any study in the literature that estimates the effective tax rate at the margin for different racial groups, although it is known that mortality rates and life expectancies differ by race. Our research fills this gap in the literature. There has been research on lifetime returns of Social Security to minorities (Liebman 2001; Duggan et al. 1993), but it is interesting to estimate the net marginal tax rate by race for the reasons mentioned above.

2.2. Methodology and Literature

Gordon (1983), Browning (1985), and Burkhauser and Turner (1985) are among the early literature on the effective marginal rate that incorporated the subsequent benefits to which a worker was entitled upon retirement. Feldstein and Samwick (1992) extend their methodology with sex specific mortality rates and estimate net marginal social security tax rates separately for males and females in three different income groups. They find that the marginal tax rate decreases with age, since a randomly selected older person has a better chance of living until retirement than a younger person. Another reason is that the discount factor of future benefits is smaller for older people. Feldstein and Samwick find that women face a noticeably lower net marginal tax rate thanks to their higher life expectancy. The finding that the younger population faces a higher net marginal tax rate implies that social security may be imposing incentive distortions on labor supply decisions, discouraging younger people from working more hours. Feldstein and Samwick suggest that one of the solutions to this problem could be to increase the weight placed on earlier years' income in calculation of the Average Indexed Monthly Earnings (AIME), which is the base for determining monthly social security benefits. With regard to the sex gap, they believe it could be consistent with efficiency considerations. Since labor supply elasticities are higher for women than men, the optimal tax must be lower for women.

Armour and Pitts (2002) suggest that the assumption that any worker would be fully insured by the time she is retired could be relaxed. An individual is eligible for social security benefits only if she is fully insured. Although the majority of workers become fully insured after 10 years of work, women have a lower probability of being insured due to their shorter work histories. Armour and Pitts incorporate the probability of an individual of certain sex and age being fully insured by retirement into the net marginal tax rates. They also account for the fact that mortality rates can differ not only by age and sex, but also by income group. Similar to Feldstein and Samwick, they find that net marginal tax rates decline with age and are higher for males than for the same age females. The lower insurance probability for females reduces the sex differential. Accounting for mortality differentials across income groups does not remove the progressivity of the benefits schedule, but it does reduce it.

Social security benefits are based on average lifetime earnings of a retired worker. The measure of average lifetime earnings used to determine social security benefits is called the Average Indexed Monthly Earnings (*AIME*). We assume that individuals start working at 21 and retire at the normal retirement age. Earnings of a worker through age 60 are indexed by an indexing factor, which is equal to the ratio of population average earnings in the year an individual attains age 60 to population average earnings in each year. Thus a worker who earns 1% of the national average throughout his life will have *AIME* equal to 1% of the national average at age 60. One other feature needs to be taken into account. All employees have an option to drop up to five years of their lowest years of earnings to reduce the effect of those years when an employee is unemployed or allocating time to raising children. Because only earnings up to the age of 60 are indexed, the number of years on which *AIME* is based is 35. *AIME* for an individual retiring at age 66 is:

$$AIME = \frac{1}{35}\frac{1}{12}\left(\sum_{t\in A}\frac{\overline{E}_T}{\overline{E}_t}E_t\right) \tag{1}$$

where $\overline{E}_t$ and $\overline{E}_T$ are average earnings and *T* is the year when an individual attains 60. E_t is an individual's actual earning in year *t*. *A* denotes the set of all years through age 60 that are counted into the best 35. We assume that the best 35 will occur at ages 26 through 60. That means that the lowest earnings occur in the earliest five years.

Once *AIME* is determined, the Primary Insurance Amount (*PIA*) -- monthly benefits payable -- is calculated. In 2009 the *PIA* was based on the formula below:

$$PIA= \qquad (2)$$

$$90\%(AIME<\$744)+32\%(\$744<AIME<\$4483)+15\%(\$4483<AIME)$$

The Net Marginal Social Security Tax Rate, $\tilde{T}$, is the difference between the statutory rate, *T*, which is defined as the combined employee-employer legislated rate, and the present value of the change in expected future benefits, B_{PV}. So $\tilde{T}=T-B_{PV}$. In 2009 the combined employee-employer tax rate was 12.4 percent. Half of the tax technically is paid by the company and half is paid by the employee. But it has been found that employees' wages are reduced by the full amount of the payroll tax (Brittain 1972). Therefore our estimations assume that the tax incidence falls fully on labor.

The present value of the change in expected future benefits resulting from a one-dollar increase in earnings is:

$$B_{PV}=\frac{1}{35}\frac{\partial PIA}{\partial AIME}\left(1+g\right)^{\max(60-a,0)}\sum_{j=66}^{100}P\left(j|a\right)\left(1+\delta\right)^{a-j} \qquad (3)$$

where $\frac{\partial PIA}{\partial AIME}$ is the marginal replacement rate, *g* is the growth rate of average worker earnings, *a* is the age of an individual, $P_{s,r}\left(j|a\right)$ is the probability of an individual of sex *s* and race *r* surviving from age *a* to age *j*, and δ is the discount rate. We assume that everybody is dead by the age of 101. We also ignore the income tax on social security benefits. There are two further assumptions we need to make. We assume that the real average wage growth rate is 1% and the discount rate is 3%. We take these assumptions on recommendations from the 2000 Social Security Board of Trustees Report.

The marginal replacement rate $\frac{\partial PIA}{\partial AIME}$ depends on which income category a worker falls into according to benefit formula "bend points". If a worker's current average monthly earnings is below the first "bend point" ($744 in 2009), then her marginal replacement rate is 90%. We call this category of employee low income workers. Similarly, if the average worker's lifetime average earnings is between $744 and $4483 per month and their marginal replacement rate is 32%, we call this category middle income workers. High income employees average monthly earnings indexed up to 2009 are above $4483 and below $8900, and their additional dollar of earnings is replaced at 15%. Workers with higher average earnings greater than $8900 per month neither pay Social Security tax nor receive extra benefits at the margin.

We calculated net marginal tax rates based on life tables for the year of 2004 published in 2007; this is the last life table available from the Department of Health and Human Services. These life tables contain information on the number of survivors by sex, age and race for every 100,000 newborns. The probability of an individual of sex *s* surviving from age *a* to age *j* is $P_s(j|a) = \frac{l_j}{l_a}$, where l_j and l_a are the numbers of survivors aged *j* and *a* respectively. The life tables do not account for differential mortality rates across different income groups. We estimate life tables that account for differential mortality using mortality ratios. The mortality ratio is the ratio of one group's death rate to that of the population. Life tables for certain demographic groups present estimates of mortality ratios for different age and income groups. The mortality ratio for low income workers is $M = \frac{q_{L,a}}{q_{T,a}}$, where $q_{L,a}$ and $q_{T,a}$ are mortality rates (number of deaths per 1000 population) for low income workers and the total population. The mortality rate for low income workers is $q_{L,a} = M \cdot q_{T,a}$ given the mortality rate for the total population. Mortality rates by sex and age for low income workers are subtracted from one and multiplied by the number of low income persons that survived to age a to estimate the number of low income persons by sex and race surviving to age $a+1$. The number of average/high income persons of sex s and race r surviving to age a is estimated by subtracting the number of low income survivors from the total number of survivors. The number of survivors at each age in their respective income classes is then used to calculate the probability that a person aged a will survive to age j. For each income class the survival probabilities are in turn used to calculate B_{PV}. Mortality ratios, M, for low income males and females aged 20-64 are 1.73 and 1.15 respectively. Those for low income males and females aged 65 and higher are 1.5 and 1.7 respectively (Armour and Pitts 2004; Duleep 1995).

For example, consider a white female aged 50 in 2004, who is a lifetime average earner and will retire in 2016 at age 66, which is the normal retirement age based on 1983 Amendments. Suppose in 2004 she receives a one dollar increase in her income. Assuming real average earnings grow at a rate of one percent, her extra dollar of earnings is indexed by $(1+g)^{\max(60-a,0)}$=1.1 (earnings are indexed through age 60). So her average indexed annual earnings increase by $\frac{1}{35}\cdot 1.1 = 0.0314$. Since she is an average earner and her marginal replacement rate is 0.32, then her PIA would increase by 0.32·0.0314=0.01. The present value of the change in expected future benefits from a one-dollar increase in earnings is $0.01\sum_{j=66}^{100} P_f(j|50)(1+r)^{50-j}$. Assuming the discount rate is three percent, the discounted sum of survival probabilities times the increase in monthly benefits for a white female aged 50 is 0.083777. Subtracting B_{PV} from the statutory rate, we receive $\tilde{T}$ = 0.0402 or 4.02 percent. Note the year that the one dollar increase in an individual's income occurs may not be included in her best 35 years and not affect her *AIME*. In that case the marginal tax rate is the full 12.4%, because this dollar does not affect the individual's benefits. We assume the years of highest earnings are when an individual is 25 to 60 years old.

The calculation of the marginal tax rate for a worker with a dependent spouse is more complicated. We consider the scenario of a male worker with a spouse who is two years younger than him. The rules of Social Security are such that the dependent spouse can draw benefits both when her husband is alive and dead. If the husband is alive and retired, then the wife can receive benefits equal to half of her husband's benefits. In other words, the benefits paid to a male worker increase by 50% if both he and his wife are alive when he retires. If the male worker dies at any point in time, his wife will draw his benefits as long as she is older than 60. This applies to our case because the rules actually say she can draw starting the year her husband turns 62. So in order to calculate the increase in benefits paid to a male worker with a dependent spouse we need to add three different streams of benefits: one that is paid to him if he was not married, 50% of that amount if he and his wife are both alive and retired, and his benefits if he died and his wife is alive and older than 60. If we denote the age of the husband as *a* and the age of the wife as *a* – 2, then the formula for the increase in total benefits for a married male worker is:

$$B_{PV} = \sum_{i=a}^{100} \left[P_m(i|a) - P_m(i+1|a)\right] \frac{1}{35}\frac{\partial PIA}{\partial AIME}(1+g)^{\max(60-a,0)} \sum_{j=\max(62,i)}^{100} P_f(j|a-2)(1+\delta)^{a-j} + \sum_{j=66}^{100} P_m(j|a)(1+\delta)^{a-j} \frac{1}{35}\frac{\partial PIA}{\partial AIME}(1+g)^{\max(60-a,0)} + \sum_{j=66}^{100} \frac{1}{2}\frac{1}{35}\frac{\partial PIA}{\partial AIME}(1+g)^{\max(60-a,0)} P_m(j+2|a) P_f(j|a-2)(1+\delta)^{a-j} \quad (4)$$

The first term shows how much the present value of benefits would change if they were paid to his wife as a survivor. $P_m(i|a) - P_m(i+1|a)$ is the probability of the male worker dying at age *i*. Since $P_m(i|a)$ is the probability that a worker at age *a* survives to age *i*, then the difference in the two survival probabilities is the probability of death in between. Then in the same term there follows the change in the amount of benefits weighted by the discounted probability of survival of the wife after the age of 60 or the age of death of the husband, whichever is later. The whole product has to be summed over all ages of death of the husband.

The second term is simple. It is the same as if the male worker was single or if his wife drew benefits based on her own earnings. It measures the increase in the present value of the benefits that he will draw for himself.

The third term is the change in benefits that the wife would draw if both were alive and retired. The multiplier ½ shows it is half of what her husband draws in benefits.

Then there is the change in benefits weighted by the probabilities of survival of both spouses.

We consider the example of an average lifetime black male earner of age 45 and his wife of age 43 in 2004. The probability of the husband dying at the age of 45 is 0.07. His extra dollar of earnings in the current year is indexed by $(1+g)^{\max(60-a,0)}$ = 1.16. So his average indexed annual earnings increase by $\frac{1}{35}\cdot 1.16 = 0.0332$. Since he is an average earner and his marginal replacement rate is 0.32, then her PIA would increase by 0.32·0.0332=0.011. The discounted sum of survival probabilities of his wife is 6.05. If the husband dies at the age of 45, the present value of benefits for the wife will increase by 0.064. Multiplying by the probability of death of the husband gives us 0.0045. If we aggregate over all years of possible death, we obtain 0.078 or 7.80%. This means that an additional dollar of earnings of the husband in the current year increases the wife's benefits as a survivor by 7.8%. The second term in (4) is similar to the case of benefits of a worker who is single or does not have a dependent spouse. Those benefits increase by 5.15% ; we can simply look it up in the table for workers without dependents. The third term, the case when both spouses are alive and retired, is equal to 1.9%. The calculation of the third term is similar to the previous one, except we weight the benefits by the probabilities of survival of both spouses and divide the benefits in half. Adding all three terms we receive B_{PV} = 0.1298. Subtracting B_{PV} from the statutory rate, we have $\tilde{T}$ = -.0058 or -0.58%.

One of the objectives of this study is to see what the effective tax rate across racial and sex groups implies in terms of optimal tax theory. We expect to find that current demographic tendencies and Social Security stipulations impose efficiency and welfare distortions. We can speculate on what effect the net marginal tax rate may have on life cycle work, consumption and savings patterns, based on a common literature and theoretical framework.

2.3. Results

In Table 2.1 and Table 2.2 we have the first set of estimates of NMSSTR. Table 2.1 shows the results for the white population that do not account for mortality differentials across income groups; Table 2.2 has similar results for the black population. Even if there is disparity in life expectancy, we can see that the benefit structure of Social Security is highly progressive, i.e. higher income groups face higher net marginal tax rates. Most age groups in the low income group have net positive returns from the Social Security program. The reason is that low income individuals enjoy high replacement rates; a low income worker contributes 12.4% of her marginal income to Social Security and receives 90% of it in benefits after retirement. The probability of death and the discount rate close this otherwise big gap between revenues and costs. But what stands out is that the poorest black males up to the age of 40 do not get positive marginal returns from Social Security. The other demographic groups that face net positive marginal tax rates are the youngest white males and youngest black females. The main reason why the youngest black males in the low income category get negative marginal tax rates is because their mortality rate is very high. In fact, a working age black male is almost twice as likely to die in any given year as a similar white male. Only after age 60 does the disparity in mortality start to fall. Note that in this analysis we assumed that everybody is fully insured. But the eligibility for full insurance depends on both the number of years of covered employment and income earned in those years. Normally most workers get full insurance status with ten years of covered employment, but it may take longer for part-time workers and low wage earners; low income younger blacks are more likely to be

Table 2.1
Net Marginal Social Security Tax Estimates by Sex, Age and Income Classification in 2004: White Population, Not Accounting for Differential Mortality by Income

	Total Population			Male			Female		
Age	Low Income	Average Income	High Income	Low Income	Average Income	High Income	Low Income	Average Income	High Income
25	-2.15	6.07	8.47	-0.79	6.55	8.70	-3.43	5.61	8.26
30	-3.53	5.58	8.25	-2.04	6.11	8.49	-4.91	5.08	8.01
35	-5.06	5.03	7.99	-3.43	5.61	8.26	-6.57	4.50	7.74
40	-6.79	4.42	7.70	-5.02	5.05	8.00	-8.42	3.84	7.43
45	-8.78	3.71	7.37	-6.85	4.39	7.69	-10.54	3.09	7.08
50	-11.10	2.89	6.98	-9.03	3.62	7.33	-12.96	2.22	6.67
55	-13.85	1.91	6.52	-11.65	2.69	6.89	-15.81	1.21	6.20
60	-17.30	0.68	5.95	-15.00	1.50	6.33	-19.29	-0.03	5.62
61	-18.38	0.30	5.77	-16.04	1.13	6.16	-20.39	-0.42	5.44
62	-19.54	-0.12	5.58	-17.17	0.73	5.97	-21.56	-0.83	5.24
63	-20.76	-0.55	5.37	-18.37	0.30	5.77	-22.79	-1.27	5.03
64	-22.08	-1.02	5.15	-19.67	-0.16	5.55	-24.11	-1.74	4.82
65	-23.49	-1.52	4.92	-21.07	-0.66	5.32	-25.51	-2.24	4.58

Table 2.2
Net Marginal Social Security Tax Estimates by Sex, Age and Income Classification in 2004: Black Population, Not Accounting for Differential Mortality by Income

	Total Population			Male			Female		
Age	Low Income	Average Income	High Income	Low Income	Average Income	High Income	Low Income	Average Income	High Income
25	2.17	8.76	10.69	3.91	9.38	10.98	0.63	8.21	10.44
30	1.02	8.35	10.50	2.92	9.03	10.82	-0.64	7.76	10.23
35	-0.27	7.89	10.29	1.80	8.63	10.63	-2.08	7.25	9.99
40	-1.76	7.36	10.04	0.51	8.17	10.42	-3.73	6.67	9.71
45	-3.53	6.73	9.74	-1.04	7.62	10.16	-5.67	5.98	9.39
50	-5.71	5.96	9.38	-3.01	6.92	9.83	-7.98	5.15	9.00
55	-8.46	4.98	8.92	-5.58	6.01	9.40	-10.83	4.14	8.53
60	-12.10	3.69	8.32	-9.10	4.76	8.82	-14.46	2.85	7.92
61	-13.22	3.29	8.13	-10.19	4.37	8.63	-15.60	2.44	7.73
62	-14.42	2.87	7.93	-11.36	3.95	8.44	-16.79	2.02	7.54
63	-15.72	2.40	7.71	-12.64	3.50	8.23	-18.07	1.56	7.32
64	-17.12	1.90	7.48	-14.03	3.00	7.99	-19.47	1.07	7.09
65	-18.63	1.37	7.23	-15.54	2.47	7.74	-20.94	0.54	6.84

part time and low wage earners. In reality the effective marginal tax rate may be even higher than what these estimates show.

For all older groups, people face lower net marginal social security taxes because they have higher conditional probabilities of reaching retirement than younger people. Because they have fewer remaining working years, the discount factor is also smaller for older people. As Feldstein and Samwick (1992) noted, large negative marginal tax rates in later years of life will create distortions towards greater labor supply in later years, because they effectively subsidize labor in those years. We do include in our estimates anyone who is younger than 25 years old. It is most likely that for the youngest workers the net marginal tax rate will be equal to the statutory rate of 12.4%, since most workers have their lowest earnings in their earliest years and must drop the first five years of earnings from the AIME calculation. Therefore, the incentive distortions must be more pronounced than our results suggest. We find that the difference in the net marginal tax rate across age groups is more noticeable for low income groups because their relatively greater rate of return is discounted for this group. Women in all income, age and racial groups bear a lower NMSSTR than men due to their longer life expectancy. Lower net marginal taxes for low wage workers and female workers are consistent with efficiency considerations because these categories of workers have been found to have higher labor supply elasticities than other workers (Juhn et al. 1991; Killingsworth 1983).

The difference in the net marginal social security tax between same age whites and blacks also increases during most of their working lifetime. The disparity only starts to close after age 55 when the difference in life expectancy begins to shrink. A low income black male aged 25 faces a 2.89 percentage lower net return on Social Security than his white counterpart. This difference rises until it reaches 4.28 for 55 year olds. The racial disparity in net marginal tax between average and high income workers is much narrower, but follows the same pattern. The disparity among females is smaller because of the smaller gap in life expectancy between white females and black females.

Table 2.2 presents the estimates of the NMSSTR for the white population which takes into consideration differential mortality between income groups. As expected new estimates show greater net marginal tax rates for the low income group as they have lower life expectancy than other groups. The difference is rather noticeable and steadily increasing for older workers; it starts at 2.88 percentage points for 25 year old males and reaches 4.74 for 64 year olds. The presence of this variation is explained by the fact that low income workers have higher than average (on which earlier estimates are based) mortality rates, and this difference becomes larger as people grow older. On the other hand, workers with average and high income bear lower net marginal tax rates since they live longer than an average individual. But the difference is not as big as in the case of low income workers; workers with higher income receive lower benefits relative to their average lifetime income.

With regard to female workers, we can see that the variation in earlier years is smaller in absolute terms but greater in later years. This is because the adverse effect of low income on mortality of females is relatively smaller in their younger ages and becomes greater in their older ages.

In Table 2.3 we present similar estimates for black workers. We observe a similar pattern, and the difference between the common mortality net marginal rate and the differential mortality net marginal tax rate is greater for blacks than for whites. Differential mortality slightly reduces the progressivity of the net marginal social security tax. The benefit structure of Social Security is highly progressive, and the gap in life expectancy across different income groups cannot remove this feature.

Table 2.3
Net Marginal Social Security Tax Estimates by Sex, Age and Income in 2004:
White Population, Accounting for Differential Mortality by Income

	Total Population			Male			Female		
Age	Low Income	Average Income	High Income	Low Income	Average Income	High Income	Low Income	Average Income	High Income
25	2.53	7.61	10.16	3.95	8.09	10.38	0.94	7.18	9.95
30	1.43	7.10	9.92	2.98	7.62	10.16	-0.28	6.63	9.70
35	0.20	6.53	9.65	1.90	7.10	9.92	-1.63	6.02	9.41
40	-1.22	5.89	9.35	0.63	6.51	9.64	-3.16	5.33	9.09
45	-2.88	5.16	9.00	-0.88	5.84	9.32	-4.91	4.55	8.72
50	-4.90	4.31	8.61	-2.75	5.04	8.95	-6.93	3.65	8.30
55	-7.41	3.32	8.14	-5.12	4.10	8.51	-9.31	2.60	7.81
60	-10.77	2.10	7.57	-8.39	2.92	7.96	-12.27	1.32	7.20
61	-11.82	1.71	7.39	-9.40	2.55	7.78	-13.20	0.91	7.01
62	-12.97	1.30	7.20	-10.53	2.15	7.60	-14.20	0.48	6.81
63	-14.20	0.87	7.00	-11.75	1.73	7.40	-15.25	0.03	6.60
64	-15.56	0.41	6.78	-13.10	1.28	7.19	-16.38	-0.46	6.37
65	-16.96	-0.09	6.55	-14.49	0.78	6.95	-17.76	-0.95	6.14

Table 2.4 displays the NMSSTR for black workers taking differential mortality into account. The gap in the marginal return from Social Security follows the pattern similar to the case with a common mortality rate. For example, the difference in the net marginal tax rate between white male workers and black male workers starts at 3.09 percentage for 25 year olds and peaks at 4.76 percent for 55 year olds; the difference falls slightly as the disparity in life expectancy narrows.

Table 2.4
Net Marginal Social Security Tax Estimates by Sex, Age and Income Classification in 2004: Black Population, Accounting for Differential Mortality by Income

	Total Population			Male			Female		
Age	Low Income	Average Income	High Income	Low Income	Average Income	High Income	Low Income	Average Income	High Income
25	5.42	8.48	10.56	7.04	9.10	10.86	3.80	7.93	10.31
30	4.59	8.04	10.36	6.36	8.73	10.68	2.84	7.46	10.08
35	3.64	7.56	10.13	5.59	8.31	10.48	1.73	6.92	9.83
40	2.51	7.00	9.87	4.66	7.82	10.25	0.43	6.30	9.54
45	1.11	6.34	9.56	3.50	7.25	9.98	-1.16	5.59	9.21
50	-0.71	5.55	9.19	1.91	6.53	9.65	-3.16	4.75	8.81
55	-3.20	4.57	8.73	-0.36	5.61	9.22	-5.76	3.73	8.33
60	-6.78	3.29	8.13	-3.81	4.38	8.64	-9.35	2.45	7.74
61	-7.90	2.90	7.95	-4.89	4.00	8.46	-10.46	2.05	7.55
62	-9.09	2.48	7.75	-6.06	3.59	8.27	-11.65	1.63	7.35
63	-10.43	2.03	7.54	-7.40	3.15	8.06	-12.96	1.18	7.14
64	-11.92	1.54	7.31	-8.88	2.66	7.84	-14.41	0.69	6.91
65	-13.42	1.01	7.06	-10.39	2.14	7.59	-15.88	0.17	6.67

Finally, we turn to Table 2.5, which presents net marginal tax rates for a male with a dependent spouse. We already showed how the effective marginal tax rate for a black male aged 45 with a dependent spouse is equal to -0.58%. The components of the marginal benefits that an additional dollar of income to which this worker is entitled are: benefits that he is expected to collect himself which increase by 5.15%, benefits that his wife is expected to collect when he dies which increase by 5.92%, and the benefits his wife will collect if they are both alive which rise by 1.9%. It is interesting that the benefits he is expected to receive himself are lower than what his wife as a survivor would collect when he dies. It shows how a large disparity in life expectancy between black males and black females is reflected in the benefit components. For comparison, the increase in benefits for a white male aged 45 with a dependent spouse is split as: 6.56% for himself, 2.13% for his wife when they are both alive, and 5.7% in survivor benefits. Again the fact that a sizeable share of future benefits is for a survivor is the reflection of the greater likelihood of the male spouse dying first, but the sex difference in mortality is lower among white workers than among black workers

Table 2.5

Net Marginal Social Security Tax for a Married Employee With a Dependent Spouse: White and Black Populations, Accounting for Differential Mortality by Income

White

Age	Male without dependent spouse	Female without dependent spouse	Male with dependent spouse	Female dependent spouse
25	8.09	7.18	1.12	12.4
35	7.10	6.02	0.55	12.4
45	5.84	4.55	-1.27	12.4
55	4.10	2.60	-3.81	12.4
60	2.92	1.32	-5.37	12.4

Black

Age	Male without dependent spouse	Female without dependent spouse	Male with dependent spouse	Female dependent spouse
25	9.10	7.93	1.44	12.4
35	8.31	6.92	1.10	12.4
45	7.25	5.59	-0.58	12.4
55	5.61	3.73	-3.09	12.4
60	4.38	2.45	-4.74	12.4

The last column in Table 2.5 is for dependent female spouses. A spouse is dependent if she is non-working or she is working but her earnings are much lower than her husband's earnings so that she qualifies for benefits as a dependent. Her net marginal tax rate is 12.4% or the full statutory rate because her additional earnings do not affect her benefits.

There are households where each spouse draws benefits based on his and her own earnings, but even in those households, the lower earning spouse is entitled to the higher earning spouse's benefits if the latter dies first. The marginal tax rate for the primary earner in cases like this can be calculated similar to those with a dependent spouse. We do not include the portion of benefits that are received by the secondary earner when both spouses are alive. The increase in benefits for a married 45 year old black male is, therefore, the sum of 5.15% and 5.92%, and for his white counterpart it is the sum of 6.56% and 5.7%.

Based on our findings, we conclude that unequal marginal tax rates may distort the labor supply decisions of married and unmarried workers. In families where the husband earns more than the wife, the husband is encouraged to work more, while the wife is encouraged to work less. These effects are larger for black families than for white families.

2.4. Implications

Race is frequently brought into the debate over Social Security reform. Many support the claim that the return to Social Security for blacks is lower than for whites due to the lower life expectancy of the former group. But none of these claims are based on the return at the margin rather than the total return on investment. Two frequently cited empirical papers that support this claim (Beach and Davis 1998; Panis and Lillard 1996) use a similar methodology. They consider paid taxes as a series of investments. The Social Security rate of return is the rate of return on payroll taxes that would buy an annuity upon retirement equal to the Social Security benefits. This yield is the difference between benefits payments and the amounts paid through payroll taxes. In other words, they simulate the representative individual and estimate the rate of return this representative type can expect to receive. Beach and Davis find that young low income workers will receive only a 1.23 percent rate of return on payroll taxes, while black low earners actually face a negative rate of return. Their study implies that if these workers were permitted to convert the payroll taxes into safe market investments, they would be considerably better off upon retirement. Panis and Lillard also note that lower rates of return for black workers imply that they subsidize the retirement of white workers. We found that black workers bear noticeably greater net marginal taxes than white workers, with the difference ranging from 2.52 to 4.22 percentage points. This implies that Social Security does not close the wealth gap between workers of different races but otherwise with similar characteristics. On the contrary, it contributes to it. The lower return on Social Security for younger workers could also imply that it affects the decision by young men to pursue activities in the informal or illegal economies. Grogger (1997) found that young workers were very sensitive to the difference in returns in formal and informal sectors.

The advocates of the Social Security system (Diamond and Orszag 2004; Liebman 2005) believe that the black population in general benefits more. Because the benefit schedule is highly progressive and a greater share of the black population is low income, then black workers enjoy a higher replacement rate than white workers. They also claim that black households receive more disability and survivors' benefits. The Social Security Administration provides the following figures. While black workers account for 11 percent of the labor force, they comprise 18 percent of workers receiving disability benefits. Although black children comprise about 16 percent of all children in the United States, they make up 24 percent receiving survivor benefits.

The benefit structure of Social Security made it highly progressive. Accounting for differential mortality rates reduces somewhat this feature of the Social Security program, but it cannot totally remove it.

The implications of the effective marginal tax rate on labor supply are based on the assumption that workers see the link between the tax they pay on additional earnings today and the benefits to which these tax payments entitle them when they retire. Unfortunately, we could not find any literature that studies how Social Security benefits affect working hours. Liebman et al. (2008, 1) write, “To our knowledge, no papers have examined whether the effective Social Security tax rate affects labor supply as measured by hours or earnings”. But there is considerable literature that studies how Social Security influences the retirement decision. Again, most of this literature does not look at tax and benefit rates at the margin, but instead considers the overall wealth effect of Social Security (Diamond and Gruber 1999; Coile and Gruber 2000). Liebman et al. (2006) propose a methodology that uses the rule of 35 years highest earnings to examine how the earnings in the year which is being replaced by the current year’s earnings affect workers’ decision to retire. They hypothesize that the higher the earnings that are being replaced in the formula for AIME, because they are lower than the current year’s earnings, the more likely is the worker to retire. Since the change in AIME is directly related to marginal benefits, this test relates the marginal benefits, hence the effective tax rate, to labor supply. Using data for workers aged 50 and older from the Health and Retirement Study, a longitudinal survey, Liebman et al. find empirical evidence that higher annual earnings in the year replaced in the AIME formula increase the retirement hazard. Again their paper studies the retirement decision instead of hours worked, but they are looking at the effect of Social Security at the margin rather than its overall wealth effect. It supports our assumption at least to some degree that workers see the link between the tax rate and additional benefits.

2.5. Conclusion

In this essay, we estimated the net marginal Social Security tax rate across age, sex and racial groups. The effective marginal tax rate depends on earnings, mortality rates, and marital status. There is literature that conducts similar exercises for age and sex groups. We contribute to this literature by accounting for differences by race. We find that the Social Security tax and benefits schedules which are designed to be progressive preserve this feature when differential mortality is accounted not only across racial groups, but also income groups. Predictably, different mortality rates across income groups reduce the progressivity of Social Security. We showed that the effective marginal Social Security tax rate was higher for black workers compared to white workers. It is clear that Social Security contributes to the wealth gap between workers of different races but who are similar otherwise. There also is a literature that argues that the black population in general benefits more when children and disabilities are taken into account. Unequal marginal tax rates across age cohorts and racial groups impose distortionary effects on labor supply of different categories of workers, based on the assumption that workers see the link between the tax they pay today and the future benefits to which they are entitled.

CHAPTER III

NORMAL RETIREMENT AGE UNDER EQUALITY OF SOCIAL SECURITY ACROSS AGE COHORTS

3.1. Introduction

The first widely available federal assistance to the disabled and dependents in the United States started with the Union army pension program in 1862. At the beginning it was a modest benefits program covering only severely injured soldiers and their dependents, but over time the program increased benefits and expanded coverage so that any veteran who served in the Civil War could claim benefits due to either age or disability. By the beginning of the 20th century, social reformers started to discuss the possibility of transforming the veterans' pension into a general old-age pension program. In 1909 American sociologist Charles Henderson wrote: "The nation and the states have already declared it to be our duty to shelter the aged and wounded soldier, why should the victims of the 'army of labor' be neglected?" (Henderson 1909, 308). But the transformation of the Union army pension into a federal old-age pension program did not materialize. Instead state, not federal, old-age pension programs were adopted in the 1920s. The Great Depression severely affected the operation of these programs; the number of pensioners increased, and the cost of benefits rose sharply. The ability of most states to finance their programs weakened dramatically. Under these circumstances, Congress considered the possibility of federal participation (Weaver 1982).

In 1935 Congress passed the Social Security Act. When Social Security was first created it resembled a private insurance program. It was more like a government administered annuity system. First, Old Age Insurance was designed to be actuarially fair. The benefits were determined by the cumulative wage history of a worker rather than the average wage. If a worker died before reaching the age of 65, he or she would receive a “money back guarantee” which was equal to the worker’s contributions plus interest. Second, the program covered only workers in industry and commerce excluding agricultural workers, government workers, and the self-employed. There were also some features attributed to a transfer program -- for example, a slightly progressive benefits formula favoring lower income workers. In this setup the program would be fair across generations because each generation’s benefits would be determined by their own contributions. In fact, it would feature intergenerational equity and individual equity.

In 1939, before Social Security paid its first benefits, major amendments were adopted. Social Security was transformed into a pay-as-you-go system. As a result, workers who retired in the early stages of Social Security received very high returns on their tax payments. Most of these retirees received more benefits than what their contributions could finance. This is an early example of intergenerational inequality in Social Security and is attributed to the pay-as-you-go system and, thus, cannot be completely avoided. Right now workers spend their entire working lives under the system. The program has matured, and it is in the “steady state” when different age cohorts are treated equally. But the ever increasing life expectancy and the stipulations in Social Security that are unchanged for decades result in a new type of intergenerational inequality. If the retirement age stays constant, then younger generations draw more benefits than older generations while all generations contribute over the same working lifetime.

In this essay we propose a fairness principle that imposes equality across age cohorts. According to this principle, discrepancy in returns to Social Security cannot by produced by differences in life expectancy between cohorts but only by differences in real wages. A simple solution to the principle can be achieved by assigning an individual normal retirement age to each cohort.

This essay has two empirical exercises. In the first exercise, we propose a solution to the intergenerational equality principle and solve for the normal retirement age for all cohorts retiring during 2005-2080. In order to do it, we need to project future fertility and mortality rates and the age distribution of the population over the period. Based on the retirement schedule for future cohorts and projected future economic and financial variables, we forecast the balance of the trust fund. The objective is to impose a rule that achieves equality and long term balance in Social Security. In the second part, we solve for the retirement age schedule for past cohorts and simulate the trust fund for 1957-2005. We want to show that if this rule was adopted early, the concerns over the long term stability of the program would not arise in 1983.

3.2. Literature survey

Discussions over Social Security's long term financial stability intensified over the last decade. Both politicians and academicians examined the causes of financial instability of the system and developed policy reforms. Peter Diamond is among the most prominent economists who have studied these issues and proposed potential solutions.

His book published in 2004, *Saving Social Security: A Balanced Approach* co-authored with Peter Orszag, is the summary of their study of Social Security. It has been widely cited and reviewed by other economists. Diamond and Orszag list three main causes of Social Security's long term deficit: increasing life expectancy, increasing earnings' inequality, and "the legacy debt."

Life expectancy at age 65 has increased significantly since Social Security was founded. It has risen by four years for men and five years for women, and the current trend is expected to continue in the near future. Diamond and Orszag believe that any financial pressure on Social Security from increased life expectancy and healthier seniors would not be offset by increased work. First, according to empirical studies, a longer life expectancy is not associated with a proportional increase in years of work. Second, Social Security is structured in an actuarially fair way; postponed retirement translates into higher benefits, and total expected payments are kept the same irrespective of retirement age after the full retirement age. Diamond and Orszag indicate that the 1983 reforms were designed to restore actuarial balance only for the next 75 years. But life expectancy has increased since then, and financing difficulties are again on the horizon.

The second factor responsible for the Social Security deficit according to Diamond and Orszag is the increase in earnings inequality. The maximum taxable base is automatically set to increase at the rate of average wage growth; the share of the population subject to Social Security tax and eligible for benefits remains roughly constant. The share of aggregate earnings not subject to tax has been steadily increasing because earnings growth at the top of the income distribution has been more rapid than the growth of average earnings. If the earnings distribution was more equal, a larger share of earnings would be subject to tax. Therefore, according to Diamond and Orszag, the taxable maximum base must grow not only in line with average wage growth but also with aggregate earnings growth.

The third influence outlined by Diamond and Orszag comes from the past; Social Security carries the burden of earlier beneficiaries. Almost all earlier cohorts or beneficiaries received more benefits than were financed with their own contributions plus interest. They argue that Social Security would be in substantially better shape if past generations had received only what they had contributed. Once actuarial balance is restored this legacy debt should not be a factor anymore, but Diamond and Orszag are concerned about equity issues here and suggest that reforms must distribute this burden as evenly as possible across future generations.

Any solution to the Social Security deficit problem involves increasing receipts and/or reducing benefits. In our study we use the cohort-based retirement age as the main instrument for meeting financial balance and fairness requirements. The primary concern of Diamond and Orszag's work is the practical feasibility of their suggestions rather than their fundamental fairness. Therefore their approach is to use the most available instruments to distribute the actuarial deficit in an even and feasible way across cohorts and income groups. They do not change the retirement age because they believe that raising the retirement age is equivalent to raising taxes and cutting benefits. They suggest that benefits and tax rates should be recalculated regularly as life expectancy grows the way benefits and wages subject to tax regularly change with inflation and wage growth. This is not equivalent to defining the retirement age for every cohort because the benefit and eligibility rules are the same for all. The main difference between their policy and what we suggest in this study is that they are mainly concerned with the long term balance of Social Security and how to distribute the burden evenly across generations. We are suggesting rules that would equate Social Security services across cohorts first, and then we pick a starting point that makes financial stability likely. Diamond and Orzsag's rules are predetermined and fixed for long periods of time which means that if vital and economic rates are different from what is anticipated now then their policy is bound to produce inequality across generations again. Our policy adjusts the rules according to the prevailing expected rates at every point in time and therefore preserves equality in the future.

Retirement means permanent withdrawal from the labor force. Since the beginning of the last century the living standards of retired workers and factors that determine the decision to retire, such as loss of productivity, health status, preferences, have changed considerably. At the beginning of the twentieth century labor productivity was significantly lower at the retirement age than at younger ages. Today productivity also declines with age, but there is no evidence that it declines sharply at any particular age. Many studies show that productivity deteriorates gradually (Kotlikoff 1988; Kotlikoff and Wise 1987). The retirement age of 65 came to the United States from the German social insurance program initiated by Bismarck in 1889, but no data show a discrete decrease in mental or physical abilities at that age. Before Social Security, some state pension programs in the United States used 70 as the retirement age. It was only with the introduction of Social Security that the age of 65 became the main retirement age. The existence of this retirement age is mostly likely explained by economic considerations and custom rather than a sharp decrease in health and productivity.

In the early twentieth century it was commonly believed that older men were pushed out of the labor force not only by declining health but also by drastic technological change (Lynd and Lynd 1929). The common perception was that older workers could not operate new machinery, and therefore modern industries were reluctant to employ them. When in 1937 Supreme Court Justice Benjamin Cardozo upheld the Social Security Act in Helvering vs. Davis, he said that the number of persons aged 65 and over who are "unable to take care of themselves is growing at a threatening pace. More and more of our population is becoming urban and industrial instead of rural and agricultural."[1] Similarly, the US Committee on Economic Security in 1935 supported the Social Security Act on the basis that a worker's "advanced age or invalidity renders him incapable of an effective part in productive enterprise."[2] However, Costa (1998) showed that labor force participation declined for both rural and urban people since 1880. The advances in technology could not explain the common trend for rural and urban populations. She argued that retired farmers often left their farms; the statistics showing that older people living on a farm were more likely to be employed than other people of the same age could not support the technological explanation of growing unemployment among the elderly.

More recent studies conclude that the increase in retirement came about because more workers could afford it. Haber and Gratton (1994) studied how the assets of the elderly grew over the twentieth century. Using Consumer Expenditure Surveys of 1880-90 and 1917-19, they showed that summing median savings between ages 25 and 65 generated assets of $1,745 in 1880-90 and $3,015 in 1917-19 (both in 1917 dollars). They

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1 www.historycentral.com/Documents/Helvering.html
2 www.socialsecurity.gov/history/reports/ces/cesbookc7.html, page 137.

also studied how much annuity the elderly could buy on reaching 65. They found that by using their assets, only 20% of men aged 65 could purchase a ten-year annuity of $231 per year in 1870, while about 50% of all men aged 65 could buy a ten-year annuity of $616 per year by 1920.

There are other indications that living standards of the elderly improved substantially over the last century. The number of retired workers living in households headed by their adult children or other relatives declined considerably. In 1880 46% of retired men were living with children, but only 22% of retired men lived with children in 1940 and 5% in 1990. The greater portion of this decline occurred by 1940. The same tendency is displayed by the trend in home ownership. In the beginning of the twentieth century, a working person was twice as likely to own a home as a retired worker. By 1990, this discrepancy virtually disappeared meaning that over the century the elderly managed to approach the home ownership level of those who are still in the labor force.

The demand for recreational goods and activities rose considerably over the last century. The main factors were the increase in income, the greater number of goods to choose from, and lower prices (Costa 1998). Costa found that the income elasticity of recreational expenditures (vacations, excursions, meals and alcohol away from home, and so forth) is the same for the elderly and the young working group. In fact, she argued that the elderly benefited most from this trend of more accessible recreational goods for two reasons. First, most modern entertainment activities are less physically demanding. Second, the tax rules are such that the pension system makes saving for retirement less costly compared to other savings. In addition, retired workers have both the time and income to spend on recreation while leisure is more costly for younger workers.

Miron and Weil (1997) study the creation of Social Security and discuss the roles of political and economic factors in the design of the program. They state that because of today's lower labor force participation, higher life expectancy, and better health, current Social Security undermines its original purpose, which was insurance against old age. Miron and Weil note that in 1930 labor force participation for men aged 65 and over was 58%. In addition to high labor force participation (by today's standards), life expectancy was much lower in the 1930s. The probability of a 40-year-old man reaching retirement at age 65 was only 0.61. High labor force participation combined with high mortality meant that few people would actually experience a "retirement." After World War II, labor force participation of elderly men steadily declined from 45% to 21% during 1950-1990, but there was a slight increase in labor force participation in this age group beginning in 2000. Even though labor force participation was lower than in the early 20th century, the economic status of the elderly improved. The poverty rate among people 65 and older was 12.2 % in 1993 compared to 15.1 % for the whole population. In 1935 about half of the elderly population was poor. Prior to Social Security, most retired workers were physically unable to work. At present the link between retirement and disability is greatly weakened. Miron and Weil point out that, in 1941, 3% of men who began receiving Social Security at age 65 said that they retired because they preferred leisure to work. By 1982 this figure had risen to 48%. Thus health became less important to the labor force decisions of the elderly over the course of the 20th century.

In 1935 the Social Security program was founded and designed to meet the financial risks of old age. Social Security was originally designed as a form of insurance against income loss due to age. The designers of the program stressed that it was a form of "social insurance," and one aim of the program was to reduce uncertainty in income. However, in the early years of the program not everyone claimed retirement income from Social Security. Over time, however, claims on Social Security became the norm. Therefore the role Social Security plays in the economy has changed substantially. For the founders of the program retirement was a hazard and unusual at that time: many workers never lived to age 65, and many who did kept working. By the end of the century healthy retirement became commonplace. What started as an insurance program, which supported people in unlikely circumstances as they reached old age, instead became a transfer program from which most people would benefit at some point in their lifetime. Today, individuals are retiring not because they are unable to work, but because they want to enjoy leisure. Retirement is no longer primarily protection against employment risk in an industrialized economy; retirement is a time of enjoyment and a reward for many years of labor. Among men who began collecting Social Security benefits at 65 in 1941, only 3% said they retired because they preferred leisure to work, while in 1982 this figure was 48%. In the 1960s, people aged 65 or older were twice as likely to be poor compared to the rest of population. Today, the elderly are less likely to live below the poverty line than people of working age (Hurd 1994).

Even today after having developed into a much broader welfare program, retired workers comprise two-thirds of Social Security beneficiaries and account for more than 75% of benefit payments. Since the 1930s the demographic structure in the US has seen a steady increase in the relative number of elderly people and their life expectancy; these trends were driven by advances in living standards and health care. This tendency has challenged Social Security's long term financial condition. In 1983 the unsoundness of the system was addressed by the National Commission on Social Security Reform, and the 75 year actuarial balance was restored. In 1996 the Advisory Council again found the program in imbalance over the 75 year period and submitted recommendations to eliminate the deficit. In both cases adjustment of the normal retirement age according to life expectancy was given secondary significance. Because demographic dynamics are the primary reason for the financial shortfall, we believe that the age distribution of the population and life expectancy must be crucial determinants of the program's parameters, which is not the case at present. In 1935, when the Social Security system was established, a 20-year old expected that she would spend 12% of her lifetime in retirement if she reached retirement age. It turned out this person would spend 22% of her lifetime in retirement, and part of this retirement would be spent in recreational activities. If these improvements in life expectancy continue, then a 20-year old today will spend a third of her lifetime in retirement.

This literature review indicates that Social Security has grown into a generous program, and it will continue to transfer increasing amount of benefits to future generations. This is one of the reasons why we propose to impose equality across generations by increasing the normal retirement age for every cohort that lives longer, while keeping the early retirement option at 62. In our study, we simulate the past and future dynamics of the Social Security trust fund in order to test our proposed cohort specific retirement age scheme. The approach of many independent authors and Social Security Administration experts is to use deterministic demographic and economic projections to forecast the Social Security trust fund balance. The methodology behind demographic projections assumes that within a certain group the propensity to bear children, die, and migrate stays constant. Statistics confirm that these are reasonable assumptions if demographic groups are correctly chosen. These deterministic projections forecast a trajectory for each population quantity but carry quite a large degree of uncertainty. Lee and Tuljapurkar (1998) offer an alternative approach to improve upon the problem of uncertainty in deterministic forecasts. They suggest using stochastic time series models to project the probability distribution of any population quantity. The balance of the Social Security trust fund is also assumed to be a probability distribution which allows one to estimate the probability of solvency. Lee, Anderson and Tuljapurkar (2003) evaluate several plans for achieving long-term solvency by increasing payroll taxes, raising the normal retirement age, or investing some portion of the fund in the stock market. They estimate that an immediate 2% increase in the payroll tax (from 12.4% to 14.4%) produces a positive expected fund balance until 2078. An increase in the retirement age from 67 to 69 by 2024 keeps the expected fund balance positive until 2047.

3.3. Methodology

Our methodology sets the expected return – or the ratio of benefits to payroll tax payments -- on Social Security across age cohorts. Since Social Security was conceived as insurance against the risk of old age, this is equivalent to making the insurance premium rate equal for different age cohorts. If we assume that income grows at the same rate for all individuals, then the return on Social Security depends only on the age of death distribution. We propose to set the normal retirement age for a cohort such that the life expectancy at retirement relative to the age of retirement is the same for all cohorts. The important note to make here is that the life expectancy in question is measured exactly at the retirement of every cohort but *not* at some fixed date or age such as at birth or at age 65. To see the difference, consider the following example. Suppose there are only two cohorts with 100 people in each. Let all individuals die at age 75 in the first cohort and all die at age 80 in the second cohort. These two cohorts are identical in cohort size and differ only by life expectancy or the first moment of the age of death distribution. If we fix the retirement age for the first group at 65 years, then the second cohort must retire at 69.3 years so that the ratio of years in retirement to working years would the same for both cohorts. Now suppose that half of the individuals in the second cohort die at age 60 and the other half dies at age 90. In this case, the two cohorts are the same except for the second moment of the age of death distribution. Again, if the retirement age is fixed at 65 years for the first cohort, then the second cohort must retire at 80 to achieve parity in the ratio of retirement to working years. In other words, life expectancy at birth, or any other fixed age, cannot be a determinant of the retirement age.

Given the current year's normal retirement age, we solve for the retirement age of every cohort in future years which equates Social Security service across cohorts. For this solution procedure we need to forecast future life tables and develop a numeric search algorithm. The methodology for forecasting life tables is described below. The numeric search algorithm is fairly elaborate if the retirement age is a continuous variable. Since we determine the retirement age in years and months, e.g. 68 years and 2 months of age, the algorithm is relatively simple. The algorithm searches for a retirement age for every cohort such that the ratio of the number of months in retirement over the number of working months (working years expressed in months) is the same as that for the previous cohort. Having pinned down the normal retirement age for every future cohort, we forecast the size of the Social Security trust fund. The starting normal retirement age, the one that is applied in the current year, is set at different levels. Eventually we attempt to find the retirement age that maintains the long term solvency of Social Security.

There are several reasons why we focus on the retirement age in the pursuit of Social Security equality. First, grounding the policy on demographic variables seems sensible as they are less volatile and more predictable compared to economic variables. Moreover, current demographic trends are arguably the main source of fiscal pressure on Social Security. Second, the Social Security program departed from its original purpose as insurance against the risk of income loss in old age, and a higher normal retirement age is needed to move it towards the original goal of the program.

In order to forecast the dynamics of the Social Security fund under the policy we have in mind, we employ stochastic time-series models proposed by Lee and Carter (1992) and Lee and Tuljapurkar (1994) to project the age distributions of the population and economic variables. These models are an improvement over the standard method of using high, medium and low scenarios. The latter approach assumes correlations among fertility, mortality and other vital rates. There is no a satisfactory explanation for why certain correlations should remain for a long period of time. Second, the high-medium-low approach does not assess the degree of uncertainty in the forecasts. In this regard, stochastic forecasts of population and economic variables (Lee-Carter and Lee-Tuljapurkar) have some advantages. Because stochastic models treat most variables as stochastic processes, this approach imposes weaker assumptions about the future dynamics of variables and also provides a credible confidence interval for every forecast. But long forecast horizons far exceed the intended use of these models. As the horizon expands, probability distributions widen and devalue forecasts in these stochastic models. Nonetheless, the relative simplicity of the approach makes it an appropriate research tool for our study.

The dynamics of the Social Security trust fund are generated by the following variables:

t - time in years;

B(t) - balance of the Trust Fund in year t;

r(t) - real interest rate in year t;

T(s,a,t)- matrix of per-capita taxes paid in year t in Social Security by sex, age;

D(s,a,t)- matrix of disability benefits paid in year t in Social Security by sex, age;

S(s, t) - retirement benefits per capita received in year t from Social

Security by sex;

O(s, t) - number of retired workers by sex;

a - administrative cost of the system as a fixed fraction of benefits paid;

p(t) - rate of growth of real wages in year *t*;

I(t) - real interest earned in year *t*;

T(t) - total taxes collected by the system in year *t*;

H(t) - total benefits paid in year *t*;

N(a,s,t)- matrix of the number of individuals in year t by sex, age;

K(t) - aggregate rate of taxation of retirement and disability benefits.

The dynamics of the system are presented by the following equation:

$$B(t+1) = B(t) + I(t) + T(a,s,t)\cdot N(a,s,t) - H(t) - a\cdot H(t) + K(t)\cdot H(t) \qquad (5)$$

Total benefits, $H(t) = D(a,s,t)\cdot N(a,s,t) + S(s,t)\cdot R(s,t)$, are the sum of two products: total disability benefits and total retirement benefits. $T(a,s,t)\cdot N(a,s,t)$ is the product of tax payments and the population distribution by age and sex. It is equal to the total payment into Social Security per year. $I(t)$ is interest earned and is equal to $r(t)\cdot B(t)$.

We need to update the following variables for every year beyond the base year of 2005:

- *N(a,s,t)* (population by age, sex)
- *T(s,a,t)* (age-sex specific average tax payment schedule)
- *D(s,a,t)* (age-sex specific average disability benefit schedule)
- *S(s,t)* (sex specific average retirement benefit)

- *O(s,t)* (sex specific number of retired workers)
- *r(t)* (real interest rate)
- *p(t)* (wage growth rate)

We update the tax schedules *T*(*s*,*a*,*t*) and benefits schedule *D(s,a,t)* by the projected real wage growth for every year. The average retirement payment *S(s,t)* is updated based on the wage growth rate in the year when the retiring cohort was 60 years old because benefits are not indexed after the age of 60. The number of retired workers *O(s,t)* depends on the current normal retirement age and the population age and sex distribution. We assume that everybody retires at the normal retirement age. Although this assumption simplifies the setup, we do not think it is as a strong assumption as it appears because Social Security benefits are adjusted for early retirement so that actuarially it is the same as normal retirement.

Economic forecasts are generated with AR(1) with constrained long run means. Standard AR does not fit long term forecasts. Long term forecasts in these models may lead to implausible levels of the economic variables. Instead we use AR with a long term mean value. In our model r_t is the real annual effective interest rate at time *t;* if *g* is the long run average interest (set at 3%), then:

$$r_t = g + \rho(r_{t-1} - g) + \mu_t \tag{6}$$

Wage or productivity growth rate is modeled similarly. It is also constrained to the long term mean, *h*, which we set at 1.1%. The wage model is:

$$w_t = h + \theta(w_{t-1} - h) + \nu_t \tag{7}$$

The dynamics of population by the age-sex matrix, *N(a,s,t)*, are generated by recursion: $\mathbf{n}_t = \mathbf{X}_t \mathbf{n}_{t-1} + \mathbf{I}_t$

where **X** is a Leslie population projection matrix, **n** is a vector containing population numbers by age, and I is net immigration. Entries into the population matrix come from the projected fertility, mortality and net migration rates. In this analysis, we bring fertility and mortality rates in as stochastic variables while net migration is fixed at the future levels assumed by the Social Security Administration. Mortality for both sexes and fertility are fitted by similar models. The model of mortality is specified as:

$$\ln[m(x,t)] = a_x + k_t b_x + \varepsilon_{x,t} \tag{8}$$

where a_x and b_x are age-specific constants and k_t is a time specific index of the general level of mortality. Both constants a_x and b_x and past values of the mortality index k_t are estimated. This model is underdetermined because there are no given regressors on the right hand side. On the right side of the equation we have only parameters to be estimated and the unknown index k_t. In order to overcome the issue of identification, we need to normalize the parameters. Suppose vectors a, b and k are a solution. For any scalar *c*, it must be true that a – b*c*, b, k + *c* are also a solution. Similarly a, b*c*, k/c are again a solution. Therefore, k is closed under the linear transformation, b is closed under multiplication, and a is closed under addition. Therefore we normalize b_x to sum to one and k_t to sum to zero, which implies that a_x are simply the averages over time and a_x are the averages of $\ln(m_{x,t})$ over time. Even normalized parameters cannot be estimated using OLS; instead we use the singular value decomposition (SVD) method to find a least squares solution. This technique is available in STATA. Projected mortality and fertility rates provide a Leslie matrix which is a matrix of survival rates for different age groups that can be used recursively to project population growth given the current age distribution. That is what we do to forecast population starting with year 2005's population.

All the models above are estimated based on historical values over the past 50 year series. Fortunately, data availability has not been a significant issue so far. Benefits and Social Security trust fund data are reported in the Social Security Administration's *Annual Statistical Supplement*. Productivity rates, age distribution of the population, and taxable income (from which Social Security taxes are derived) are provided by the Census Bureau and the Bureau of Labor Statistics.

3.4. Results

The estimates of the Lee-Carter mortality and fertility models give us the projection of age and sex distributions of the population until 2080. Economic models provide us with indexes for upgrading tax and benefit payments each year. The results of the estimation of these models are given in Tables 3.1-3.4.

Table 3.1
Single Value Decomposition Estimates of the Fertility Model

Age	c_x	d_x
15	0.0084	0.0031
16	0.0174	0.0045
17	0.043	0.0004
18	0.064	0.0079
19	0.087	0.031
20	0.1059	0.049
21	0.1123	0.0609
22	0.114	0.0734
23	0.1142	0.0809
24	0.1144	0.0822
25	0.1147	0.0781
26	0.1153	0.069
27	0.1156	0.0577
28	0.1145	0.0494
29	0.1118	0.041
30	0.1061	0.0367
31	0.101	0.028
32	0.0917	0.0252
33	0.0812	0.0232
34	0.0701	0.0259
35	0.0599	0.0262
36	0.0515	0.026
37	0.0411	0.0264
38	0.0316	0.0269
39	0.0252	0.0257
40	0.019	0.0239
41	0.014	0.023
42	0.009	0.0151
43	0.0057	0.0117
44	0.0032	0.009
45	0.0018	0.0064
46	0.0007	0.0045
47	0.0001	0.0028
48	0	0.0015
49	0	0.0008
50	0	0.0004

Table 3.2
Single Value Decomposition Estimates of the Mortality Equation

Year	K_x	Year	K_x
2000	-15.06	2041	-30.03
2001	-15.43	2042	-30.40
2002	-15.79	2043	-30.76
2003	-16.16	2044	-31.13
2004	-16.52	2045	-31.49
2005	-16.89	2046	-31.86
2006	-17.25	2047	-32.22
2007	-17.62	2048	-32.59
2008	-17.98	2049	-32.95
2009	-18.35	2050	-33.32
2010	-18.71	2051	-33.68
2011	-19.08	2052	-34.05
2012	-19.44	2053	-34.41
2013	-19.81	2054	-34.78
2014	-20.18	2055	-35.14
2015	-20.54	2056	-35.51
2016	-20.91	2057	-35.87
2017	-21.27	2058	-36.24
2018	-21.64	2059	-36.61
2019	-22.00	2060	-36.97
2020	-22.37	2061	-37.34
2021	-22.73	2062	-37.70
2022	-23.10	2063	-38.07
2023	-23.46	2064	-38.43
2024	-23.83	2065	-38.80
2025	-24.19	2066	-39.16
2026	-24.56	2067	-39.53
2027	-24.92	2068	-39.89
2028	-25.29	2069	-40.26
2029	-25.65	2070	-40.62
2030	-26.02	2071	-40.99
2031	-26.38	2072	-41.35
2032	-26.75	2073	-41.72
2033	-27.11	2074	-42.08
2034	-27.48	2075	-42.45
2035	-27.84	2076	-42.81
2036	-28.21	2077	-43.18
2037	-28.57	2078	-43.54
2038	-28.94	2079	-43.91
2039	-29.30	2080	-44.27
2040	-29.67		

Age	a_x	b_x	Age	a_x	b_x	Age	a_x	b_x
0	-3.64	0.09	40	-5.70	0.03	80	-2.34	0.04
1	-5.19	0.19	41	-5.62	0.04	81	-2.26	0.04
2	-6.18	0.13	42	-5.53	0.04	82	-2.17	0.04
3	-6.88	0.09	43	-5.43	0.04	83	-2.09	0.04
4	-7.35	0.06	44	-5.34	0.04	84	-2.00	0.04
5	-7.64	0.05	45	-5.25	0.04	85	-1.92	0.04
6	-7.80	0.05	46	-5.15	0.05	86	-1.85	0.04
7	-7.84	0.05	47	-5.06	0.05	87	-1.78	0.04
8	-7.82	0.06	48	-4.97	0.05	88	-1.71	0.04
9	-7.73	0.08	49	-4.88	0.05	89	-1.64	0.04
10	-7.62	0.10	50	-4.79	0.05	90	-1.57	0.04
11	-7.49	0.11	51	-4.71	0.05	91	-1.51	0.04
12	-7.35	0.10	52	-4.62	0.05	92	-1.44	0.04
13	-7.21	0.08	53	-4.54	0.04	93	-1.37	0.04
14	-7.07	0.05	54	-4.46	0.04	94	-1.31	0.04
15	-6.95	0.04	55	-4.39	0.04	95	-1.24	0.04
16	-6.84	0.03	56	-4.31	0.04	96	-1.16	0.04
17	-6.75	0.02	57	-4.24	0.04	97	-1.08	0.04
18	-6.67	0.02	58	-4.17	0.04	98	-1.00	0.04
19	-6.61	0.02	59	-4.09	0.04	99	-0.90	0.04
20	-6.56	0.03	60	-4.02	0.03	100	-0.81	0.04
21	-6.51	0.03	61	-3.95	0.03	101	-0.72	0.04
22	-6.48	0.03	62	-3.88	0.03	102	-0.64	0.04
23	-6.46	0.03	63	-3.81	0.03	103	-0.54	0.04
24	-6.44	0.03	64	-3.73	0.03	104	-0.46	0.04
25	-6.42	0.03	65	-3.66	0.03	105	-0.40	0.04
26	-6.40	0.03	66	-3.58	0.03	106	-0.37	0.04
27	-6.39	0.03	67	-3.50	0.03	107	-0.35	0.04
28	-6.37	0.03	68	-3.42	0.03	108	-0.31	0.04
29	-6.34	0.02	69	-3.34	0.03	109	-0.26	0.04
30	-6.31	0.02	70	-3.26	0.03			
31	-6.28	0.02	71	-3.17	0.03			
32	-6.24	0.02	72	-3.08	0.03			
33	-6.19	0.02	73	-2.99	0.03			
34	-6.14	0.02	74	-2.90	0.03			
35	-6.08	0.02	75	-2.80	0.03			
36	-6.02	0.02	76	-2.71	0.03			
37	-5.95	0.02	77	-2.62	0.04			
38	-5.87	0.03	78	-2.53	0.04			
39	-5.79	0.03	79	-2.43	0.04			

Table 3.3
Population Forecast

Year	Population	Year	Population
2005	296576820	2043	415368601
2006	299381851	2044	418780149
2007	302204639	2045	422211522
2008	305046273	2046	425665560
2009	307906080	2047	429145145
2010	310785252	2048	432650477
2011	313683246	2049	436186481
2012	316601522	2050	439753795
2013	319539519	2051	443357199
2014	322498370	2052	446996298
2015	325478083	2053	450673401
2016	328477226	2054	454396197
2017	331496777	2055	458166274
2018	334535509	2056	461985208
2019	337594016	2057	465841151
2020	340670509	2058	469756664
2021	343765555	2059	473730507
2022	346877857	2060	477762039
2023	350007761	2061	481854398
2024	353153583	2062	486008333
2025	356315279	2063	490223207
2026	359491101	2064	494501668
2027	362681606	2065	498842355
2028	365885101	2066	503253649
2029	369102030	2067	507729590
2030	372330622	2068	512276296
2031	375571246	2069	516894573
2032	378821884	2070	521579982
2033	382083970	2071	526340714
2034	385356237	2072	531176742
2035	388640065	2073	536085059
2036	391935077	2074	541065957
2037	395242369	2075	546121461
2038	398561480	2076	551262380
2039	401894236	2077	556479727
2040	405239131	2078	561770489
2041	408599590	2079	567129811
2042	411975231	2080	572551841

Table 3.4
Normal Retirement Age 2005 - 2080 (Starting NRA = 66)

		NRA				NRA	
Year	**DOB**	**Years**	**months**	**Year**	**DOB**	**Years**	**Months**
2005	1939	66	0	2044	1974	70	7
2006	1940	66	1	2045	1975	70	8
2007	1941	66	3	2046	1976	70	9
2008	1942	66	4	2047	1977	70	11
2009	1943	66	5	2048	1978	71	0
2010	1944	66	7	2049	1978	71	0
2011	1945	66	8	2050	1979	71	3
2012	1946	66	10	2051	1980	71	5
2013	1947	66	11	2052	1981	71	6
2014	1948	67	0	2053	1982	71	7
2015	1948	67	0	2054	1983	71	9
2016	1949	67	3	2055	1984	71	10
2017	1950	67	4	2056	1985	72	0
2018	1951	67	6	2057	1985	72	0
2019	1952	67	7	2058	1986	72	3
2020	1953	67	9	2059	1987	72	4
2021	1954	67	10	2060	1988	72	5
2022	1955	67	11	2061	1989	72	7
2023	1956	68	1	2062	1990	72	8
2024	1956	68	1	2063	1991	72	10
2025	1957	68	4	2064	1992	72	11
2026	1958	68	5	2065	1993	73	0
2027	1959	68	6	2066	1993	73	0
2028	1960	68	8	2067	1994	73	3
2029	1961	68	9	2068	1995	73	4
2030	1962	68	11	2069	1996	73	6
2031	1963	69	0	2070	1997	73	7
2032	1963	69	0	2071	1998	73	9
2033	1964	69	3	2072	1999	73	10
2034	1965	69	4	2073	2000	73	11
2035	1966	69	6	2074	2001	74	1
2036	1967	69	7	2075	2001	74	1
2037	1968	69	9	2076	2002	74	3
2038	1969	69	10	2077	2003	74	5
2039	1970	69	11	2078	2004	74	6
2040	1971	70	1	2079	2005	74	7
2041	1971	70	1	2080	2006	74	9
2042	1972	70	4				
2043	1973	70	5				

Notes: DOB = date of birth   NRA = normal retirement age

We solved for all future normal retirement ages based on a starting normal retirement age of 65, 66, or 67 years. The results for the normal retirement age projection are presented in Table 3.4. Given the future normal retirement age for every year, the indicators of economic performance, and population age and sex distributions, we projected the dynamics of the Social Security trust fund for these three starting normal retirement ages (Figure 3.1). Our projection shows that if the retirement age of 66 is set today and the proposed retirement scheme is followed, Social Security is expected to be solvent over the 75 year horizon. The retirement age in 2080 under this scheme is expected to be 74 years and 4 months with life expectancy at that age to be over 20 years. In 2005 the retirement age was 66 years and the life expectancy at the retirement was 18 years. This is the main result we were looking for. The normal retirement age of 66 years is projected to keep the long term balance of Social Security sound if the retirement scheme which imposes the intergenerational fairness principle is adopted.

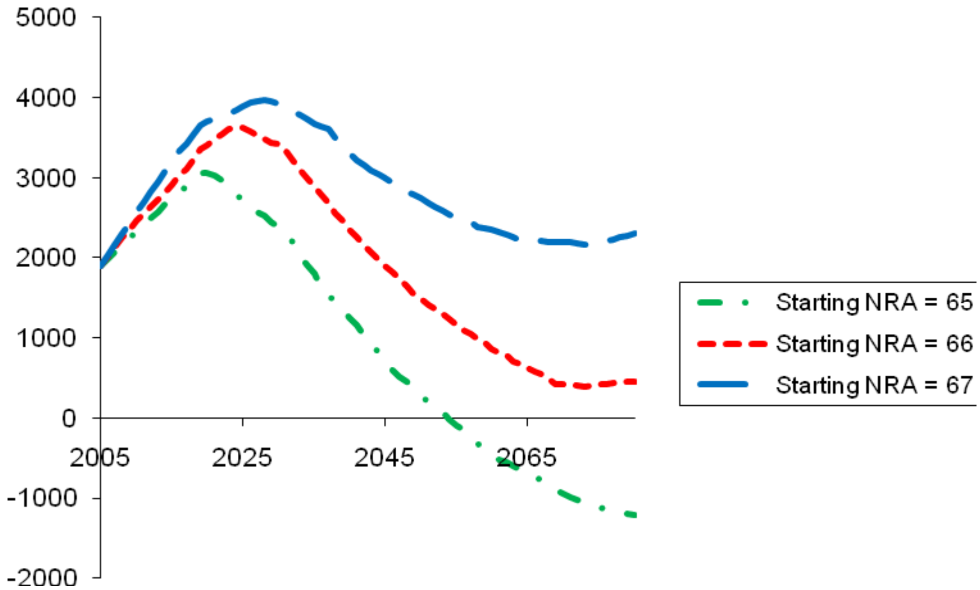

Figure 3.1: Projection of Social Security Trust Fund under Intergeneration Equality for 2005-2080

The last exercise we conducted for this study was to construct the 95 confidence interval for our projected Social Security trust fund dynamics (Figure 3.2). Our economic variables are modeled as stochastic variables, so we generated 500 different trajectories for interest rate and wage growth rate simulating the error terms. That in turn gave 500 alternative dynamics of the Social Security trust fund or, in other words, the distribution of the future value of the fund. With 66 years as the starting normal retirement age, Social Security has a 58% chance of solvency by 2080.

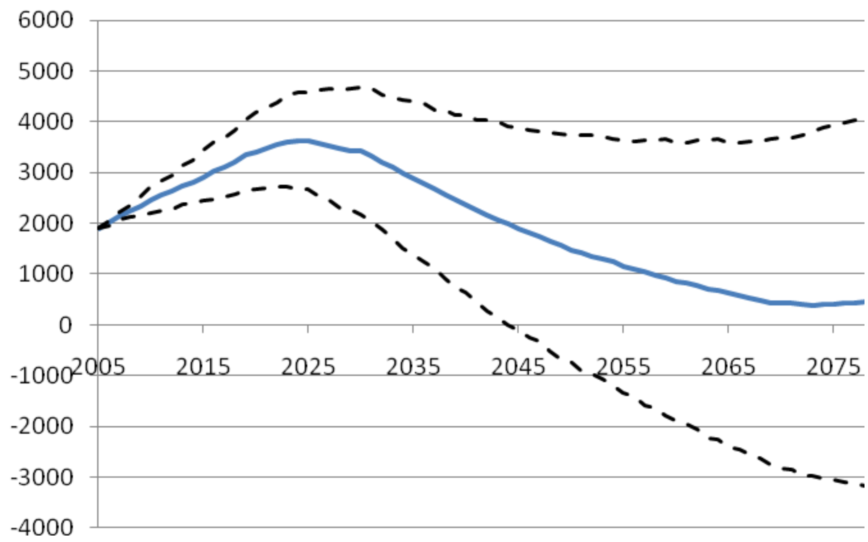

Figure 3.2: 95% Confidence Interval for Social Security Trust Fund (Starting NRA = 66)

We simulate the dynamics of the Social Security trust fund using the demographic data and the program's provisions since 1935 (Figure 3.3). Effectively we project the fund's past balance using historical data. We assume that the retirement age does not affect other payments from the fund such as disability and payments to dependents.

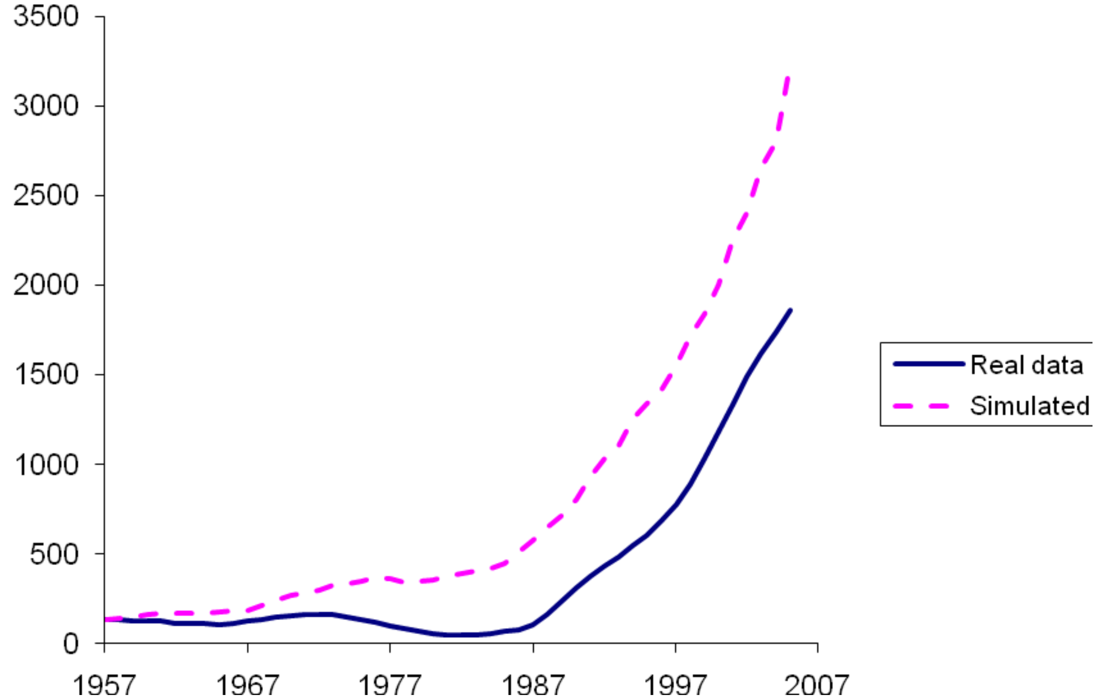

Figure 3.3: Simulation of Social Security Trust Fund under Intergeneration Equality for 1957-2005

We conduct this type of exercise because merely restoring 75 year actuarial balance will not provide long term financial soundness of the Social Security program. Preserving the current structure of Social Security's benefits and revenue rules would result in fiscal imbalance as time passes and the projection period shifts into the future. This is because it is highly likely that trends in mortality and fertility will continue beyond the projection period. If, in fact, life expectancy of retirees continues to rise and/or fertility continues to decline in the distant future, then the cost of Social Security will always grow at a higher rate than its revenue. Therefore, the reform of Social Security should change the rules so that the growth rate of costs and the growth rate of income remain similar over time and fiscal imbalance does not reoccur. Establishing a mechanism to automatically adjust the rules of Social Security in accordance with demographic trends would address this issue. Under the automatic adjustment approach changes should be made to the payroll tax rate, Social Security benefits, the normal retirement age or some combination of these three on an annual or periodic basis to keep the system in actuarial balance. There are already automated adjustments in place that index benefits to changes in prices. We suggest indexation that takes into account future demographic changes in order to automatically remove strain on the fiscal status of the program.

Automatic adjustment mechanisms aimed at preserving long term financial soundness of the pension fund have already been adopted by a number of industrialized countries, including Sweden, France and Canada. In Sweden, social security benefits are annually indexed not only by the CPI but also by the balance ratio. The balance ratio is the ratio of the present value of contributions over the present value of liabilities. No matter what kind of risk may affect the fiscal status of the pension fund, if expected liabilities are greater than expected contributions, then the growth rate of pension benefits slows down by the balance ratio. If, on the contrary, future contributions exceed future liabilities, then benefits grow faster until the balance between assets and liabilities is reached.

The second part of our empirical exercise has two stages. First, we solve for normal retirement ages from 1957 to 2005. The numerical search algorithm finds a retirement age for every cohort over this period such that the ratio of the expected time in retirement to the number of working years at the time a worker retires is constant for every cohort. It satisfies our fairness principle that differences in benefits drawn should be based only on wages and not other characteristics of cohorts. Second, we simulate the size of the Social Security trust fund assuming our scheme is imposed in 1957. The methodology is simple. The total amount of benefits is the sum of old age and disability benefits. Disability benefits remain the same. But old age benefits are recalculated based on the new retirement age, the population's age distribution and the average benefit per retired worker. Assuming that the birthdays of different income level earners are uniformly distributed over a year, we multiply the average benefit by the estimated number of retired workers under the new retirement age. Similarly, additional tax payments to Social Security by people older than 65 and below the retirement age are estimated. The number of people in this category is calculated based on the age distribution, the retirement age and the assumption that birthdays are uniformly distributed and multiplied by the prevailing payroll tax rate and average wage in this age category.

There have been numerous amendments to Social Security since its conception in 1935. Therefore the exercise that we are suggesting may bring a question of whether it is a reasonable assumption that this policy of adjusted retirement age can be combined with all others because we are assuming that all figures remain at historical levels. We think it is a legitimate assumption. First of all, most amendments until 1980 were envisioned or at least anticipated by the Social Security planners. Most tax increase and employee coverage changes that did occur until 1983 were specified in the 1935 and 1939 acts. Second, even those changes that were not originally planned, for example the rise in taxable ceilings from 1966 to 1976, did not occur because of concerns of long term financial stability but rather were the result of the unplanned expansion of the program. Therefore we can use the historical data as it is without making any adjustments.

The projected retirement age schedule is given in Table 3.5. Starting with age 65 in 1957, the normal retirement age would become 68 years and 6 months in 2005. The result of such a policy is that the balance in the Social Security trust fund is projected to be $3,235 billion in 2005 instead of the actual balance of $1,857 billion. The difference is $1,377 billion which is higher than the present value of the future deficit of the program under current trends and regulations. In the previous chapter we found that setting the normal retirement at 66 in 2005 and then adjusting it accordingly would keep Social Security solvent in the long term. This means that adopting this policy in 1957 would keep the Social Security in positive balance over the 75-year projection period.

In 1983, the Greenspan Commission on Social Security Reform recommended amendments that would provide additional funds in the amount of $168 billion over the years 1983-1989 to cover the short term imbalance. Our estimates show that the trust fund would have $357 billion more in 1983 under our adjusted retirement age policy; therefore these measures would not have been necessary if our policy had been adopted.

Table 3.5
Normal Retirement Age 1957-2005 Under Intergenerational Equality

		NRA				NRA	
Year	**DOB**	**Years**	**Months**	**Year**	**DOB**	**Years**	**Months**
1957	1892	65	0	1982	1915	66	9
1958	1893	65	1	1983	1916	66	10
1959	1894	65	2	1984	1917	66	11
1960	1895	65	3	1985	1918	67	0
1961	1896	65	4	1986	1919	67	1
1962	1896	65	4	1987	1920	67	2
1963	1897	65	5	1988	1921	67	2
1964	1898	65	6	1989	1922	67	3
1965	1899	65	7	1990	1923	67	4
1966	1900	65	8	1991	1924	67	5
1967	1901	65	8	1992	1925	67	6
1968	1901	65	9	1993	1926	67	7
1969	1902	65	10	1994	1927	67	8
1970	1903	65	11	1995	1928	67	9
1971	1904	66	0	1996	1929	67	10
1972	1905	66	1	1997	1930	67	11
1973	1906	66	2	1998	1931	68	11
1974	1907	66	2	1999	1932	68	0
1975	1908	66	3	2000	1933	68	1
1976	1909	66	4	2001	1934	68	2
1977	1910	66	5	2002	1935	68	3
1978	1911	66	6	2003	1936	68	4
1979	1912	66	7	2004	1937	68	5
1980	1913	66	7	2005	1938	68	6
1981	1914	66	8				

Notes: DOB = date of birth   NRA = normal retirement age

3.5. Conclusion.

In this essay we proposed a fairness principle for Social Security's treatment of workers over time and a simple solution that would achieve this intergenerational equality. There were several reasons we chose the retirement age as the means of imposing the fairness principle. First, trends in demographic variables are more stable than those in economic variables, and therefore their forecasts are more accurate. Second, the living standards of the elderly, their health status, and life expectancy have improved considerably since 1935 when Social Security was conceived. This means that at present Social Security does not function as old-age insurance for a large share of the retired population, but rather as transfer of money once they reach retirement. Therefore a higher normal retirement age for each cohort living longer with an option of early retirement at 62 for everybody is consistent with the purpose of old-age insurance. Finally, the demographic trends are the primary cause of the long term imbalance in Social Security.

Based on our solution to the requirement that only differences in wages can cause inequality across generations, we solved for the retirement age for all age cohorts in periods 1957-2005 and 2005-2080. That allowed us to simulate the dynamics of the trust fund for those periods under our policy. We find that if the intergenerational equality was imposed in 1957 at the level of returns in that year, the concerns over financial stability of Social Security would not arise. Both in 1983 and 2005 the present value of the future deficit of the program would be less than the additional means accumulated due to the imposed equality. We also find that setting the normal retirement age at 66 in 2005 and adjusting it for all future cohorts keeps Social Security in balance over the 75 year horizon.

We do not elaborate on political feasibility of our policy; this is probably the main difference between our results and those of other studies on Social Security reform, and it is the main weakness of our study. At the same time, because we are not concerned with feasibility, we can base our approach on fairness attributes of Social Security.

Appendix

Real Interest Rate and Average Wage Growth ARIMA models' estimates

$$r_t = 3.00 + \underset{(0.364)}{0.801} (r_{t-1} + \underset{(4.28\ )}{3.00}) + \mu_t \qquad R^2 = 0.15$$

$$w_t = 1.10 + \underset{(0.262)}{0.596} (w_{t-1} - \underset{(1.56)}{1.10}) + \nu_t \qquad R^2 = 0.47$$

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