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Abstract: This paper extends the literature on net marginal tax rates created by the Social Security program by including variations in both the probability of being eligible to receive benefits and income-related life expectancy. The previous literature has found that women incur a lower net marginal tax rate because they have longer life expectancies. The results presented in this paper indicate that including variations in eligibility for benefits partially reverses this result by increasing net marginal Social Security tax rates for older women. In addition, the existing literature has shown that low-income households pay lower net marginal tax rates because the benefit formula is progressive. Including variations in life expectancy reduces, but does not eliminate, this result. This implies that differential mortality increases the net marginal Social Security tax rates incurred by low-income households. These results are important from a policy standpoint given the gender differences in poverty among the population over age sixty-five and the current debate on the future of the Social Security system.

JEL classification: H2, J26, I30

Key words: Social Security, poverty, tax rates

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I. Introduction

The comprehensive marginal tax rate is used by economists to assess the distortionary effect of taxation on labor supply and welfare. One important component of the marginal tax rate is the social security payroll tax, which in the United States is assessed on individual wages up to the annual taxable maximum, which was $76,200 in 2000. In 2001, approximately 94 percent of all workers earned less than the annual taxable maximum, thus incurring an Old Age Survivors Insurance (OASI) social security payroll tax at the margin.[1] For these individuals, social security is a benefit tax where an extra dollar of earnings may increase their future benefits at retirement. Therefore, the net marginal social security tax rate (NMSSTR), defined as the difference between the statutory rate and the present value of the stream of future benefits to which an additional dollar of earnings entitles the covered worker, should be used in calculating the marginal tax rate for the purpose of assessing the effect of taxation on labor supply and welfare.[2]

Previous studies that calculated the NMSSTR, including Browning (1985) and Feldstein and Samwick (1992), find that the system favors women, as they face a lower NMSSTR at each age.[3] This tax differential is attributed to the longer life expectancies that women enjoy. Feldstein and Samwick conclude that this differential is one of the system's most desirable traits because of empirical evidence that suggests female labor supply is more elastic than male labor supply.[4] Note, the lower female net tax rate is deemed desirable because it reduces the deadweight loss or welfare cost associated with taxation.[5]

However, these papers ignore a number of factors that determine NMSSTR, with one of the most important being benefit eligibility. Previous studies that calculated NMSSTR assumed that workers are fully insured, that is, are eligible for benefits based on their earnings history. The rationale for such an assumption is that most workers qualify for social security benefits after 10 years of work. However, older women may have less of an attachment to the labor force, thus their shorter work histories may not be sufficient to qualify them for benefits based on their own account. Lingg (1994) estimates that of the 18.4 million women aged 65 and older in 1993, 6.5 million were entitled to primary benefits, 4.8 million were dually entitled and 7.1 million were entitled to benefits as a dependent spouse. Lingg (1994) states that the earnings history for the 7.1 million dependent spouses failed to qualify them for benefits based on their own account. In addition, Ferber (1993) contends that the social security systems future treatment of women will, in part, depend on whether their earnings histories qualify them for primary benefits. Therefore, one goal of this paper is to compare the NMSSTR obtained using social security eligibility requirements to the NMSSTR obtained under the full insurance assumption to determine if a lower net tax rate persists for older aged females relative to older aged males.

A second objective of this paper is to account for differential mortality by income group along with social security eligibility requirements in NMSSTR calculation. This is important because the social security benefit formula is generally viewed as progressive, with low-income individuals afforded proportionately greater benefits. However, including mortality differences among income groups may reduce this progressivity. This will disproportionately affect women, as Nichols et al.(2001) report that 315,346 women (48.4%) and 80,160 men (10%) retiring in 1999 had earnings histories that would characterize them as low income workers.[6]

The structure of this paper is as follows: section two describes the procedure used to determine retiree benefits; section three describes the calculation of NMSSTR under three scenarios, scenario one assumes that individuals are fully insured, scenario two incorporates social security eligibility requirements in NMSSTR calculation, and scenario three incorporates differential mortality and social security eligibility requirements in calculating NMSSTR; a discussion is presented in section four, with conclusions contained in section five.

II. Benefit Determination

The social security benefits to which a covered worker is entitled at retirement depends on lifetime earnings. Average indexed monthly earnings (AIME) is the measure of lifetime earnings on which benefits are based. Earnings are indexed by multiplying the worker's taxable earnings by an indexing factor for each year after 1950 through the indexing year. The indexing year is defined as the second year before a worker attains age 62. The indexing factor for each year (t) is obtained by dividing average covered worker earnings in the indexing year (the year an individual attains age 60), $\bar{E}_{60,t}$,by average covered worker earnings at each age (a) in each year, ($\bar{E}_{a,t}$). AIME for individuals retiring at the full benefit retirement age, *f*, is

(1) $$AIME = \frac{1}{n}\frac{1}{12}\sum_{t=1}^{n-q}\frac{\bar{E}_{60,t}}{\bar{E}_{a,t}}E_t + \sum_{t=60}^{t=f-1}E_t.$$

For individuals attaining age 62 after 1991, AIME is based on the highest 35 years of earnings. However, for each year a worker is born before 1929, the number of years, *n*, in the computation period is reduced by one. To convert AIME from an annual to a monthly basis, 1/12 is used. $\frac{\bar{E}_{60,t}}{\bar{E}_{a,t}}$ denotes the indexing factor for each year. E_t denotes worker earnings in year *t*. Finally $\sum_{t=60}^{t=f-1}E_t$, denotes the number of years between age 60 and the year prior to retirement, $f-1$, that a year of unindexed earnings replaces a year of indexed earnings in the benefit formula.

Once AIME is determined, the primary insurance amount (PIA), which is the amount of monthly benefits payable at retirement, may be calculated. The benefits formula for a covered worker attaining age 62 in 2000 is

$$PIA = (90\%(\$531)) + (32\%(\$2671)) + (15\%(>\$3202)) \tag{2}$$

The PIA is composed of two parts: the bend points and the marginal replacement rates. The bend points are the dollar amounts defining the AIME bracket in the benefit formula. The marginal replacement rate is the applicable percentage used to determine the PIA.[7]

The benefit formula illustrates one fundamental feature of the system: the progressive structure of social security. Low-wage workers are afforded proportionately greater benefits with a marginal replacement rate of 90 percent, in comparison to average-wage and high-wage earners with marginal replacement rates of 32 and 15 percent, respectively. Because the social security benefit formula is structured in a manner that classifies workers into one of three income groups, the NMSSTR by sex and age are calculated for a representative worker in each of these three income groups.

III. Calculation of the NMSSTR

Net marginal social security tax rates by sex, age, and income classification are calculated under three alternative scenarios: the first scenario assumes that individuals are fully insured; the second scenario incorporates social security eligibility requirements in determining NMSSTR; and the final scenario accounts for differential mortality by income groups as well as social security eligibility requirements in calculating NMSSTR.

Full Insurance

To qualify for social security benefits, an individual must be fully insured. The measure used to determine whether a worker is eligible for retirement benefits is quarters of coverage. Under current legislation, a worker is fully insured if he obtains one quarter of coverage for each year after 1950 (or age 21, if later) and before the year one dies, becomes disabled or attains age 62. The minimum number of quarters required to be fully insured ranges from six to forty. A worker earned one quarter of coverage for every $780 earnings in 2000.[8] The maximum number of quarters that may be earned in any given year is four.

Previous studies that estimate NMSSTR have assumed that workers are fully insured. The rationale for such an assumption is that most workers are fully insured after 10 years of work. Under this assumption the net marginal social security tax rate is $\tilde{T} = T - B_{PV}$. T denotes the OASI statutory rate which is defined as the combined employee-employer legislated rate. This analysis assumes that the tax is paid by the employee.[9] The combined employee-employer tax rate was 10.6 percent in 2000.[10]

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

$$B_{PV} = \frac{1}{n}\frac{\partial PIA}{\partial AIME}(1+g)^{\max(60-a)}\sum_{j=f}^{N} P_{s,t}(j|a)(1+r)^{a-j}. \quad (3)$$

The future benefits that an additional dollar of earnings entitles an individual at retirement depends on the marginal replacement rate, $\frac{\partial PIA}{\partial AIME}$, and the age, a, at which the individual plans to retire. Workers are assumed to retire at the normal retirement age, 65.[11] The indexing factor at each age,

$(1+g)^{\max(60-a)}$, is estimated assuming that earnings grow at a real rate of one percent.[12] The probability of an individual of sex *s*, surviving from age *a* to age *j*, is denoted by $P_{s,t}(j\,|\,a)$. *N* is the age at which all persons are assumed dead and is set at 100 in all calculations. The rate at which a worker discounts future benefits, *r*, is set at 3 percent in all calculations.[13]

To illustrate, consider the case of a female who is 55 years old in 1995 and plans to retire at age 66 in 2011. Since she will attain age 62 after 1991, AIME is based on the highest 35 years of earnings. Earnings through age 60 are indexed to the growth rate in average covered wages. Assuming real earnings grow at a rate of one percent annually then $(1+g)^{\max(60-55)} = 1.051$. An additional dollar of earnings at age 55 increases average indexed earnings (AIE) by \$(1/35)(1.051)= \$0.03.

Assuming that the 55 year old female is a lifetime average earner then her marginal replacement is 0.32 and an extra dollar of earnings at age 55 would increase PIA by \$(0.03)(0.32) = \$0.0096. The present value of the change in anticipated future benefits resulting from a one-dollar change in earnings is $0.0096 \sum_{j=66}^{N=100} P_{f,t}(j\,|\,55)\,(1+r)^{55-j}$. The discounted sum of survival probabilities for a female age 55 is 9.26 and thus $B_{pv} = 0.089$. Subtracting 0.089 from the statutory rate yields 0.017 or 1.7 percent.

Net marginal social security tax rates for representative low-, average-, and high-income earners by sex and selected ages in 2000 are shown in Table 1. The estimates reveal that males and females at each age face a net marginal social security tax rate that is less than the statutory rate. Low-wage earners incur the lowest NMSSTR. Given the progressive nature of the benefit formula, this is as expected. Also, the estimates indicate that the NMSSTR declines with age. The age differential is due to higher conditional survival probabilities and because older workers have a shorter period over which to discount future benefits.

Across income classes, females face a lower NMSSTR than males at each age. The estimated NMSSTR for a low-income female aged 55 is approximately 5.36 percentage points lower than the rate faced by her male counterpart (-14.42 percent compared to -9.06 percent). Gender differences in NMSSTR are 1.91 percentage points for average-income individuals and 0.89 percentage points for high-income individuals aged 55. The gender differential in NMSSTR is attributable to the longer life expectancy of females.

Social Security Eligibility Requirements

While most workers qualify for social security benefits after 10 years of work, older women may have had less of an attachment to the labor force and, as a result, their shorter work histories may not be sufficient to qualify them for benefits based on their own account. If this is accurate then one would expect older males, on average, to have a higher probability of being insured than older females. Therefore, gender differences in insurance rates will increase the NMSSTR incurred by females at each age relative to males.

Unpublished data furnished by the Social Security Office of the Actuary are used to calculate insurance rates for individuals by sex and exact age. The data contained projections covering the period 2000 by sex and age for the number of fully insured workers as a percentage of the total population. Insurance rate probabilities by sex and age are shown in Table 2. At each age, males have a higher probability of being insured for social security benefits than females. This differential is suggestive of the fact that older females have shorter work histories compared to their male counterparts; as a result, they are less likely to qualify for benefits.

To account for insurance rate requirements in NMSSTR calculation, Equation 3 is rewritten as follows:

$$B_{PV} = \frac{1}{n} \frac{\partial PIA}{\partial AIME} (1+g)^{\max(60-a)} \, i_{s,f,\check{t},t} \sum_{j=f}^{N} P_{s,t}(j|a)(1+r)^{a-j}, \quad (4)$$

where $i_{s,f,\check{t},t}$ denotes the probability that an individual of sex s and age a in year t will be eligible for benefits at age f in year $\check{t}$ ($\check{t} = t+f-a$).

NMSSTR, by age, sex and income class, which account for social security eligibility are also shown in Table 2. As before, NMSSTR at each age are less than the statutory rate, low-income workers face the lowest tax rates and the tax rates fall with age.

A comparison of the tax rates in Tables 1 and 2 reveals that including insurance probabilities in determining the actuarial present value of anticipated future benefits has the largest effect on low-income females. A low-income female aged 55 faces a net tax rate of -9.47 percent, which is 4.95 percentage points higher than the estimate obtained under the assumption that a low-income female aged 55 was fully insured. The NMSSTR for a low-income female aged 65 is -14.71 percent, which is approximately 9.5 percentage points higher than the estimate obtained under the assumption of full insurance. The NMSSTR incurred by average-income and high-income females at each age is higher than the rates obtained under the assumption that individuals are fully insured.

These gender differences in NMSSTR indicate that when eligibility is accounted for in determining net tax rates, older females face a higher NMSSTR than males. Among low-income females, the gender differential ranges from 0.18 percentage points at age 62 to 1.5 percentage points at age 65. Similarly, males aged 62-65 in both the medium-income and high-income groupings faced lower NMSSTR than their female counterparts.

Differential Mortality and Social Security Eligibility Requirements.

The progressivity of the social security benefit formula is based on a common mortality assumption. However, there is evidence in the literature to suggest that socioeconomic factors such as weight, eating habits, education and income influence life expectancy. Indeed, Duleep (1995) found an inverse relationship between income and mortality among U.S. adults. Therefore, one might anticipate low-income worker's shorter life expectancies to offset the progressive nature of the benefit formula and, thus, increase their NMSSTR. Given gender differences in mortality, one would expect that the largest change in tax rates would occur among low-income males. Life Tables published by the Social Security Office of the Actuary are used to construct and account for differences in life expectancy by income in determining NMSSTR. The method of estimation is described in Appendix A.

NMSSTR that account for differential mortality by age, sex, income class, benefit eligibility are shown in Table 3. As expected, a comparison of the results in Tables 2 and 3 reveals that low-income worker’s shorter life expectancy increases their NMSSTR at each age. A low-income female aged 55 faces a net tax rate of -5.59 percent, which is 3.88 percentage points higher than the estimate obtained under the scenario that accounted for social security benefit eligibility. In contrast, including differential mortality reduces the NMSSTR for both average-income and high-income persons at each age.

IV. Discussion

One caveat of this research is that the results are based on hypothetical representative workers, thus the relative importance of various economic assumptions and differences is an empirical question. However, this is the best one can do since the real world data are unavailable (Garrett, 1995). Notwithstanding, analysis with money flows over several decades is prone to be very sensitive to the choice of discount rate. Thus, the results shown in Table 4 for an average wage worker (PIA to AIME ratio of 0.32) were re-estimated under alternative discount rate assumptions.[14] As shown in Table 4, a lower discount rate reduces NMSSTR at each age.

In addition, the calculations shown in Tables 1-3 ignore the personal income tax bracket at which social security retirement benefits will be taxed during retirement. Thus, the estimates shown in Table 4 assume that social security benefits will be subject to a federal income tax rate of 15 percent. For a female aged 55, assuming a discount rate of 3%, taxation of benefits increased her NMSSTR by 0.57 percentage points (3.69 percent compared to 3.12 percent).

The estimates presented in Tables 1-3 were for single earners. However, the present value of anticipated future benefits also depends on whether a beneficiary claims benefits for a dependent spouse. A dependent spouse is entitled to an additional 50 percent of the primary beneficiaries benefit amount at retirement. In addition, if the primary beneficiary dies, the dependent is entitled to 100 percent of the primary beneficiaries benefit. The formula for calculating the benefits for a worker, aged *a*, with a dependent spouse is shown in Appendix B. Since beneficiaries with a dependent spouse do not pay any additional taxes for the additional benefit, they incur a lower NMSSTR than singles (see Table 4). The NMSSTR for an average wage male aged 55 with a dependent spouse, assuming a discount rate of 3 percent, is -0.85 percent, (see Table 4). This rate is lower than the rate incurred by female dependent spouses, whose NMSSTR equals the statutory rate of 10.6 percent. In effect, female dependent spouses who do not quality for benefits based on their own account, but pay social security taxes, purchase redundant retirement insurance.

The estimates presented in Tables 1-4 reveal NMSSTR falls with age. The decrease in NMSSTR with age may lead to intertemporal substitution of labor supply as workers work more in later years and less in earlier years. However, whether variation in NMSSTR rates by age are relevant to worker decisions depends on whether they understand the link between future social security benefits and current labor supply decisions. Even if workers are unaware of this link, the higher rates that older aged females incur relative to males when the probability of insurance was accounted for is undesirable because it implies a greater excess burden. This is exacerbated to the extent that the elasticity of labor supply is greater for female employees than for males (Feldstein and Samwick,1992).

Although the calculations presented are complex they oversimplify the social security program in a number of ways. First, we ignore benefits for dependent children of young widows or widowers. Second, we ignore the possibility of divorce and remarriage. Finally, another potential limitation to our results is that the employer portion of the payroll tax is tax-exempt. Given the progressive nature of income taxation this disproportionately benefits higher income individuals. Thus, the NMSSTR for high-income individuals may be lower than the estimates reported.

V. Conclusion

The analysis reveals how social security tax rules create NMSSTR that treat workers differently based on age, gender, race, marital status, income, insurance status and life expectancy. This research contributes to the literature on effective marginal tax rates by accounting for social security benefit eligibility and income-specific mortality rates in net marginal social security tax rates calculation. Including eligibility requirements in the NMSSTR calculation increases the net tax rate incurred by older aged females. To reduce the excess burden of taxation would require reducing marginal tax rates for older aged women. In addition, the results indicate that differential mortality by income group reduces the benefits formulas progressivity which, in turn, increases the net tax rates incurred by low-income primary beneficiaries. This is important from a policy standpoint since it may, in part, explain why women aged 65 and older are twice as likely as elderly men to live in poverty (Levine et al.,1999).

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Table 1

Net Marginal Social Security Tax Rate Estimates for Primary Beneficiaries by Sex, Income Classification, and Age in 2000[a]

	Male			Female		
Age in 2000	Low Income	Average Income	High Income	Low Income	Average Income	High Income
25	0.88	7.15	8.98	-2.61	5.90	8.40
35	-1.50	6.30	8.58	-5.59	4.84	7.90
45	-4.67	5.17	8.06	-9.36	3.50	7.27
55	-9.06	3.61	7.32	-14.42	1.70	6.43
60	-12.26	2.47	6.79	-17.86	0.48	5.86
61	-13.26	2.12	6.62	-18.96	0.09	5.67
62	-14.34	1.73	6.44	-20.12	-0.32	5.48
63	-15.51	1.32	6.25	-21.36	-0.77	5.27
64	-16.78	0.87	6.04	-22.69	-1.24	5.05
65	-18.16	0.37	5.81	-24.12	-1.74	4.81

[a]Workers are assumed to retire at the full benefit retirement age. Low-income workers expect a marginal replacement rate of 0.9, average-income and high-income workers expect rates of 0.32 and 0.15, respectively. A real discount rate of 3 percent is assumed. The growth rate in real wages is set at 1 percent.

Table 2

Net Marginal Social Security Tax Rate Estimates for Primary Beneficiaries
Accounting for Social Security Benefit Eligibility by Sex,
Income Classification, and Exact Age in 2000.

	Male				Female			
Age in 2000	Insurance Rate	Low Income	Average Income	High Income	Insurance Rate	Low Income	Average Income	High Income
25	92.9	1.57	7.39	9.10	89.3	-1.19	6.41	8.63
35	94.7	-0.86	6.53	8.69	91.0	-4.13	5.36	8.14
45	94.0	-3.75	5.50	8.21	90.0	-7.36	4.21	7.61
55	92.6	-7.61	4.13	7.57	80.2	-9.47	3.47	7.26
60	92.2	-10.48	3.11	7.09	75.7	-10.94	2.94	7.01
61	92.4	-11.45	2.76	6.93	75.2	-11.63	2.70	6.90
62	92.6	-12.50	2.39	6.75	74.6	-12.32	2.45	6.78
63	92.8	-13.63	1.99	6.56	74.0	-13.05	2.19	6.66
64	93.0	-14.86	1.55	6.36	73.5	-13.87	1.90	6.52
65	93.2	-16.21	1.07	6.13	72.9	-14.71	1.60	6.38

[a]Workers are assumed to retire at the full benefit retirement age. Low-income workers expect a marginal replacement rate of 0.9, average-income and high-income workers expect rates of 0.32 and 0.15, respectively. A real discount rate of 3 percent is assumed The growth rate in real wages is set at 1 percent.

Table 3
Net Marginal Social Security Tax Rate Estimates for Primary Beneficiaries Accounting for Social Security Benefit Eligibility and Differential Mortality by Sex, Income Classification and Exact Age in 2000.[a]

	Male			Female		
Age in 2000	Low Income	Average Income	High Income	Low Income	Average Income	High Income
25	4.33	7.15	8.98	1.15	6.20	8.54
35	2.50	6.24	8.55	-1.21	5.10	8.02
45	0.18	5.17	8.05	-3.83	3.90	7.46
55	-3.18	3.78	7.40	-5.59	3.12	7.10
60	-5.99	2.77	6.93	-6.87	2.58	6.84
61	-6.92	2.42	6.77	-7.44	2.33	6.72
62	-7.96	2.05	6.59	-8.03	2.08	6.60
63	-9.10	1.66	6.41	-8.66	1.81	6.48
64	-10.38	1.23	6.21	-9.36	1.51	6.34
65	-11.71	0.75	5.98	-10.22	1.22	6.20

[a]Workers are assumed to retire at the full benefit retirement age. Low-income workers expect a marginal replacement rate of 0.9, average-income and high-income workers expect rates of 0.32 and 0.15, respectively. A real discount rate of 3 percent is assumed. The growth rate in real wages is set at 1 percent.

Table 4
Net Marginal Social Security Tax Rate Estimates for Primary Beneficiaries and Dependents by Sex, Income Classification, and Exact Age in 2000[a]

Age in 2000	Male Average Income	Female Average Income	Male with Dependent Spouse	Female Dependent Spouse
Discount rate = 2.2%				
25	5.91	4.55	-1.09	10.6
35	5.12	3.61	-1.47	10.6
45	4.29	2.72	-1.79	10.6
55	3.26	2.46	-2.53	10.6
65	0.81	1.15	-4.41	10.6
Discount rate = 3%				
25	7.16	6.53	1.38	10.6
35	6.34	5.51	1.15	10.6
45	5.26	4.40	0.40	10.6
55	3.78	3.69	-0.85	10.6
65	0.82	1.92	-3.40	10.6
Discount rate = 3.7%				
25	8.13	7.71	3.32	10.6
35	7.33	6.73	2.89	10.6
45	6.21	5.56	1.94	10.6
55	4.60	4.58	0.41	10.6
65	1.40	2.51	-2.61	10.6

[a]Workers are assumed to retire at the full benefit retirement age. Average-income workers expect a marginal replacement rate of 0.32. The growth rate in real wages is set at 1 percent. Estimates account for benefit eligibility, differential mortality and taxation of benefits.

Appendix A

Estimates of the number of survivors, l_a, by sex, s, and exact age, a are shown in Tables A.1 and A.2. The probability of an individual of sex s, surviving from age a to age j, is $P_s(j|a) = \frac{l_j}{l_a}$. The mortality rate at each age is calculated by subtracting survival probabilities at each age from 1.

To determine mortality rates by income it is initially assumed that 20 percent of the male and female surviving population aged 20 are low-income workers. Mortality ratios, that is, the ratio of one group's death rate to that of the population, are used to split the file table into two tables; one for low-income and one for both average-income and high-income workers.[15] The mortality ratios for low-income males and females aged 22,..,64 are 1.73 and 1.15, respectively. For low-income males and females aged 65,..,94 the mortality ratios are 1.5 and 1.7 respectively.[16] The mortality ratio for low-income workers is $M = \frac{q_{L,a}}{q_{T,a}}$, where $q_{T,a}$ and $q_{L,a}$ denotes mortality rates for the total population and low-income workers, respectively. Solving the mortality rate for the low-income individuals is straightforward, with $q_{L,a} = M \times q_{T,a}$.

Mortality rates by sex and age for low-income persons are subtracted from 1 and multiplied by the number of low-income persons that survived to age *a-1* to estimate the number of low-income persons by sex, surviving to age *a*. The number of average/high-income persons of sex *s* 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}.

Table A.1
Life Tables Used in NMSSTR Estimation, Females

Survivors by Income Classification[a]							
AGE in 2000	Population	Low Income	Other Income	AGE in 2000	Population	Low Income	Other Income
25	98671	19727	78944	63	88487	17403	71084
26	98616	19714	78902	64	87504	17181	70323
27	98560	19701	78859	65	86431	16823	69608
28	98499	19687	78812	66	85262	16436	68826
29	98434	19672	78762	67	83995	16021	67974
30	98362	19656	78706	68	82633	15579	67054
31	98283	19638	78645	69	81183	15114	66069
32	98198	19618	78580	70	79649	14629	65020
33	98106	19597	78509	71	78022	14121	63901
34	98011	19575	78436	72	76296	13590	62706
35	97913	19553	78360	73	74470	13037	61433
36	97812	19529	78283	74	72546	12464	60082
37	97706	19505	78201	75	70520	11872	58648
38	97597	19480	78117	76	68381	11260	57121
39	97484	19454	78030	77	66118	10627	55491
40	97365	19427	77938	78	63731	9975	53756
41	97241	19398	77843	79	61223	9307	51916
42	97110	19368	77742	80	58593	8628	49965
43	96971	19336	77635	81	55833	7937	47896
44	96821	19302	77519	82	52932	7236	45696
45	96659	19265	77394	83	49894	6530	43364
46	96484	19225	77259	84	46723	5824	40899
47	96293	19181	77112	85	43430	5126	38304
48	96083	19133	76950	86	40032	4445	35587
49	95849	19079	76770	87	36550	3787	32763
50	95589	19020	76569	88	33015	3165	29850
51	95298	18953	76345	89	29465	2586	26879
52	94974	18879	76095	90	25946	2061	23885
53	94617	18797	75820	91	22510	1597	20913
54	94225	18708	75517	92	19211	1199	18012
55	93797	18610	75187	93	16103	869	15234
56	93330	18504	74826	94	13234	606	12628
57	92819	18387	74432	95	10645	404	10241
58	92257	18259	73998	96	8374	258	8116
59	91638	18118	73520	97	6440	157	6283
60	90957	17963	72994	98	4841	90	4751
61	90207	17793	72414	99	3557	50	3507
62	89386	17607	71779	100	2558	26	2532

[a]This refers to the number of females by income classification reaching exact age *a* during the year in the stationary population. Estimates were constructed from life tables published by the Social Security Office of the Actuary.

Table A.1
Life Tables Used in NMSSTR Estimation, Males

Survivors by Income Classification[a]							
AGE in 2000	Population	Low Income	Other Income	AGE in 2000	Population	Low Income	Other Income
25	97672	19430	78242	63	78893	13414	65479
26	97498	19370	78128	64	77494	13002	64492
27	97313	19306	78007	65	75968	12618	63350
28	97117	19239	77878	66	74303	12203	62100
29	96910	19168	77742	67	72499	11759	60740
30	96692	19093	77599	68	70565	11289	59276
31	96462	19015	77447	69	68515	10797	57718
32	96220	18932	77288	70	66356	10286	56070
33	95967	18846	77121	71	64088	9759	54329
34	95704	18757	76947	72	61703	9214	52489
35	95432	18665	76767	73	59195	8652	50543
36	95152	18570	76582	74	56559	8074	48485
37	94862	18472	76390	75	53795	7483	46312
38	94561	18371	76190	76	50909	6880	44029
39	94244	18264	75980	77	47917	6274	41643
40	93909	18152	75757	78	44838	5669	39169
41	93552	18032	75520	79	41699	5074	36625
42	93174	17906	75268	80	38522	4494	34028
43	92783	17776	75007	81	35331	3936	31395
44	92391	17646	74745	82	32149	3404	28745
45	92004	17518	74486	83	29003	2904	26099
46	91623	17393	74230	84	25923	2442	23481
47	91242	17268	73974	85	22937	2020	20917
48	90849	17139	73710	86	20074	1642	18432
49	90427	17001	73426	87	17364	1309	16055
50	89964	16851	73113	88	14830	1023	13807
51	89454	16686	72768	89	12495	781	11714
52	88895	16505	72390	90	10375	582	9793
53	88287	16310	71977	91	8480	423	8057
54	87630	16100	71530	92	6816	298	6518
55	86923	15875	71048	93	5382	204	5178
56	86161	15634	70527	94	4169	135	4034
57	85335	15375	69960	95	3164	86	3078
58	84444	15097	69347	96	2352	53	2299
59	83488	14802	68686	97	1711	31	1680
60	82461	14487	67974	98	1218	18	1200
61	81361	14152	67209	99	848	10	838
62	80176	13796	66380	100	577	5	572

[a]This refers to the number of males by income classification reaching exact age *a* during the year in the stationary population. Estimates were constructed from life tables published by the Social Security Office of the Actuary.

Appendix B

The formula, obtained from Feldstein and Samwick (1992), for calculating the present value of the change in anticipated future benefits resulting from a one-dollar change in earnings for a male worker, aged *a,* with a dependent spouse is as follows:

(A.1)

$$B_{PV} = \sum_{j=a}^{N} P_{m,t}(j|a) - P_{m,t}(j+1|a) PIA(j,E_{t,}) \sum_{j=\max(a,60)}^{N} P_{f,t}(j|a)(1+r)^{a-j} + \sum_{j=f}^{N} P_{m,t}(j|a) PIA(f,w)(1+r)^{a-j} + \sum_{j=f}^{N} P_{m,t}(j|a) P_{f,t}(j|a) PIA(f,E_t)(1+r)^{a-j}$$

where,

m = male, f=female and dependent souses are assumed to be the same age as their husband.

The definitions of the other characters are identical to those defined in the text.

The first term of Equation A.1 denotes the expected value of widows benefits conditional on the worker dying at age *a*. The second term denotes the expected value of the man's retirement benefit conditional on him attaining his full benefit retirement age, *f*. The third term denotes the expected value of the dependent spouse's benefit conditional on both parties reaching the full benefit retirement age.

Endnotes

1. http://www.ssa.gov/statistics/fast_facts/2002/ff2002.html (Verified December 5, 2002).

2. While many of the researchers recognize the link between the payroll tax paid on an additional dollar of earnings and anticipated future benefits, their analysis typically calculates the comprehensive marginal tax rate using the social security statutory rate and as a consequence their results are overstated.

3. Also, Burkhuaser and Turner (1985) recognize that the net payroll tax levied on an additional dollar of earnings is not constant across workers but depends on a number of factors including one's current age, planned retirement age, martial status and life expectancy.

4. Killingsworth (1983) reviews the empirical results from a number of labor supply studies and finds evidence that supports this theory

5. Browning (1975) was among the first to recognize that the social security system's social adequacy objective resulted in significant welfare costs. Hausman (1981) analyzed the allocative effects of taxation and found that a 10 percent tax cut would increase a wife's labor supply by 52 hours per year and reduce the excess burden of taxation by 10.6 percent. Similarly, he found that a 10 percent tax cut would increase the husband's labor supply by 22.5 hours per year and lead to a significant reduction in deadweight loss.

6. The numbers of men (80,160) and women (315,136) classified as low income workers were estimated by combining the Nichols et al. (2001) percentages with information on the number of persons initially awarded retiree benefits by age and gender in 1999 as shown in Table 6.B1 of the Annual Statistical Supplement to the Social Security Bulletin (2000)

7. The 1977 amendments to the Social Security Act indexed the benefit formula's bend points to the growth rate in average covered wages. The marginal replacement rates were fixed at 90, 32 and 15 percent, respectively.

8. The dollar amount of earnings required to attain one quarter of coverage has changed with amendments to the Social Security Act. Following the 1977 amendments, the dollar amount defining one quarter of coverage was indexed to the growth rate in average covered wages.

9. Britain (1972) found that the payroll tax reduced employee wages by the full amount of the tax.

10. The tax rate ignores the disability insurance (DI) and health insurance (HI) contribution rates. Including both rates increases the net marginal social security tax rate by the statutory amount. In 2000, the combined employee-employer DI and HI rates were 1.8 and 2.9 percent, respectively.

11. The formula in Equation 3 estimates the actuarial present value of anticipated future benefits relative to some benchmark retirement age. The age chosen here, *f*, is defined as the full benefit retirement age. This corresponds to the age at which an individual is first eligible for retirement benefits without actuarial adjustment. Following legislation implemented in the 1983 amendments to the Social Security Act, the full benefit retirement age, currently 65, is scheduled to increase 2 months each year beginning in the year 2000. Between 2005 and 2016 the full benefit retirement age will remain at 66. In 2017, the full benefit retirement age is scheduled to increase 2 months per annum and will be fixed at age 67 for those attaining age 62 after the year 2022. The retirement age for workers with a full benefit retirement age in terms of years and months is rounded to the next full year in all calculations.

12. The economic assumptions used in the calculations are based on the 2000 Social Security Board of Trustees best cost estimates.

13. A rate of 3 percent was chosen to approximate an individual's rate of time preference. As before, this rate chosen was based on recommendations contained in the 2000 Trustees Report.

14. The discount rates chosen were 3.7 percent and 2.2 percent and were based on the 2001 Social Security Board of Trustees low- and high-cost economic assumptions.

15. A mortality ratio greater than one indicates that the number of deaths in a cohort exceeds the number of deaths one would anticipate solely on the basis of sex and age.

16. The rate for low-income males aged 22,..,65 was constructed by Duleep (1989). The other rates were constructed by Kitagawa and Hauser (1973).