

Smoking: Taxing Health and Social Security

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Abstract: While the health risks associated with smoking are well known, the impact on income distributions is not. This paper extends the literature by examining the distributional effects of a behavioral choice, in this case smoking, on net marginal Social Security tax rates (NMSSTR). The results show that smokers, as a result of shorter life expectancies, incur a higher NMSSTR than nonsmokers. In addition, as low-earnings workers have a higher smoking prevalence than high-earnings workers, smoking works to widen the income distribution. This higher tax rate could have implications for both labor supply behavior and Social Security system funding.

JEL classification: H55, I1

Key words: smoking, Social Security, health, taxes, widows, low earnings

The views expressed here are the authors' and not necessarily those of the Federal Reserve Bank of Atlanta or the Federal Reserve System. Any remaining errors are the authors' responsibility.

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Smoking: Taxing Health and Social Security

I. Introduction

Cigarette smoking is the largest single health risk in the United States, accounting for approximately 440,000 deaths each year (USDHHS, 2004a). The financial cost of smoking-attributable health care expenditures and lost productivity has been well documented (CDC, 2003). In general, smokers have higher healthcare expenditures and more sick days than do nonsmokers (Max, 2001). However, the effects of smoking-attributable mortality on income distributions is less well known.

Premature death attributable to smoking may redistribute Social Security income in unanticipated ways that affect behavior and reduce the economic well-being of smokers and their family members (dependent spouses and children) (Rice, 1986). Knowledge of how smoking redistributes both individual and household Social Security benefits and taxes is important not only from the perspectives of informing smoking cessation efforts (Rice, 1986) and evaluating proposals to improve family welfare through reductions in system inequities or promotion of social adequacy, but also from the standpoint of the system's finances. Social Security is financed by a pay-as-you-go payroll tax levied on earnings; thus, if the harmful health effects of smoking reduce individual or household hours of work, there are implications for the system's funding.

Economists employ the comprehensive marginal tax rate to assess the distortionary effect of taxation on labor supply and welfare (Armour & Pitts, 2004). One important component of this comprehensive marginal tax rate in the United States is the Social Security payroll tax, which is assessed on individual earnings up to the annual taxable maximum. In 2002,

approximately 94% of all U.S. workers earned less than the annual taxable maximum of \$84,900, 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), which is defined as the difference between the statutory payroll tax 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

Studies that have used the NMSSTR to examine the distributional effects of Social Security concluded that Social Security benefit and tax rules create NMSSTRs that treat workers differently depending on age, gender, race, dependency status, earnings, insurance status, and income-related life expectancy (e.g., Aaron, 1977; Browning, 1985; Burkhauser & Turner, 1985; Feldstein & Samwick, 1992; Armour & Pitts, 2004). To our knowledge, no study has looked at lifestyle and the harmful health effects of an addictive habit such as smoking on NMSSTR estimation. This study contributes to the literature by examining the distributional effects of smoking-attributable mortality on NMSSTR estimation.

II. Methods

A. Social Security 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 workers taxable

earnings by an indexing factor for each year after 1950 through the indexing year. The indexing year is defined as the year a worker attains age 60. The indexing factor for each year, t , is obtained by dividing average covered worker earnings in the indexing year, $\bar{E}_{60,t}$, by average covered worker earnings at each age, a , in each year, $(\bar{E}_{a,t})$. The AIME for individuals retiring in year t is

$$AIME = \frac{1}{n} \frac{1}{12} \sum_{t \in A} \frac{\bar{E}_{60,t}}{\bar{E}_{a,t}} E_t + \sum_{t \in B} E_t. \quad (1)$$

For individuals attaining age 62 after 1991, the 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 the AIME from an annual to a monthly basis, $1/12$ is used. E_t denotes worker earnings in year t . The set of all years through age 60 that will be counted among the highest 35 or n years of earnings is denoted by A . B denotes the set of years between age 60 and the year prior to retirement that a year of unindexed earnings replaces a year of indexed earnings in the benefit formula.

Once the AIME is determined, the primary insurance amount (PIA), which is the amount of monthly benefits payable at retirement, may be calculated.³ The benefits formula for a covered worker attaining age 62 in 2002 is

$$PIA = (90\% * (AIME \leq \$592)) + (32\% * (\$592 < AIME \leq \$3567)) + (15\% * (AIME > \$3567)). \quad (2)$$

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.⁴

The benefit formula illustrates one fundamental feature of the system: the progressive structure of Social Security. Low-earnings workers are afforded proportionately greater benefits with a marginal replacement rate of 90%, when compared with average-earnings and high-earnings workers whose marginal replacement rates of 32% and 15%, respectively. Because the Social Security benefit formula is structured in a manner that classifies workers into one of three earnings groups, the NMSSTR by sex and age is calculated for a representative worker in each group.

B. Calculation of the NMSSTR

NMSSTRs by sex, age, and earnings classification are calculated under two alternative scenarios: the first scenario uses a common mortality assumption and the second scenario accounts for smoking-attributable mortality in calculating the NMSSTR.

The NMSSTR is $\tilde{T} = T - B_{PV}$. T denotes the OASI statutory rate which is defined as the combined employee-employer legislated rate. The combined employee-employer tax rate was 10.6% in 2002.⁵ This analysis assumes that the tax is paid by the employee.⁶

Primary Beneficiary (Single)

The present value of the change in anticipated future benefits resulting from a \$1 change in earnings is

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

The future benefits that an additional dollar of earnings entitles an individual to at retirement

depend 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 full benefit retirement age, f .⁷ The indexing factor at each age, $(I + g)^{\max(60-a)}$, is estimated assuming that earnings grow at a real rate of 1.1%.⁸ The probability that an individual of sex s and age a in year t will be eligible for benefits at age f in year \tilde{t} ($\tilde{t} = t + f - a$) is denoted by $i_{s, f, \tilde{t}, t}$.⁹ 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 to be dead and is set at 100 in all calculations. The rate at which a worker discounts future benefits, r , is set at 3% in all calculations.¹¹

To illustrate, consider the case of a male who is 55 years old in 2002 and plans to retire at age 66 in 2011. Because he will attain age 62 after 1991, the AIME is based on the highest 35 years of earnings. Earnings through age 60 are indexed to the growth rate in average covered earnings. Assuming that real earnings grow at a rate of 1.1% annually, then $(I + g)^{\max(60-55)} = 1.056$. An additional dollar of earnings at age 55 increases average indexed earnings by $\$(1/35)(1.056) \approx \0.03 .

Assuming that the 55-year-old male is a lifetime average wage earner his marginal replacement rate is 0.32 and an extra dollar of earnings at age 55 would increase the PIA by $\$(0.03)(0.32) \approx \0.0097 . The present value of the change in anticipated future benefits resulting from a one-dollar change in earnings is $0.0097 \sum_{j=66}^{N=100} P_{ft}(j/55)(I + r)^{55-j}$. The discounted sum of survival probabilities for a male age 55 is 7.838. Multiplying 0.076 (0.0097×7.838) by the probability that a 55-year-old male will be eligible for social security benefits at the full benefit retirement age, 0.931, yields an estimate of $B_{PV} \approx 0.0705$. Subtracting 0.0705 from the statutory rate yields 0.0355, or 3.55%.

NMSSTRs for representative low-, average-, and high-earning workers by sex and select ages in 2002 are shown in Table 1. The estimates reveal that males and females at each age face a NMSSTR that is less than the statutory rate. The estimates indicate that the NMSSTR declines with age. The age differential is due to higher conditional survival probabilities and the fact that older workers have a shorter period over which to discount future benefits. Also, low-earnings workers incur the lowest NMSSTR. Given the progressive nature of the benefit formula, this is as expected.

Across earnings classes, females at most ages incur a lower NMSSTR than do males. The estimated NMSSTR for a low-earnings female age 55 is 1.12 percentage points lower than the rate faced by her male counterpart (-10.34% compared with -9.22%). Gender differences in the NMSSTR are approximately 0.4 percentage points for average-earnings individuals and 0.2 percentage points for high-earnings individuals age 55. The gender differential in the NMSSTR is attributable to the longer life expectancy of females. The NMSSTR for a female age 65 with average lifetime earnings is 0.9 percentage points higher than the rate for her male counterpart. Older females incur a higher NMSSTR because they have less of an attachment to the labor force and thus have a lower probability of being fully insured for benefits.¹²

Primary Beneficiary and Dependent Spouse

Women who are married and do not work outside the home or fail to qualify for benefits based on their own earnings histories may qualify for dependent spouse benefits. Thus, the present value of anticipated future benefits also depends on whether a primary beneficiary claims benefits for a dependent spouse.¹³ A dependent spouse is entitled to an additional 50% of the

primary beneficiary's benefit amount at retirement. In addition, if the primary beneficiary dies, the widow is entitled to 100% of the primary beneficiary's benefit.¹⁴ 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 age a with a dependent spouse is shown in Equation 4.

$$\begin{aligned}
 B_{PV} = & \sum_{j=a}^N P_{1,t}(j/a) - P_{1,t}(j+1/a) PIA(j, E_t) \sum_{j=\max(a,60)}^N P_{2,t}(j/a) (1+r)^{a-j} \\
 & + \sum_{j=f}^N P_{1,t}(j/a) PIA(f, w) (1+r)^{a-j} \\
 & + \sum_{j=f}^N 0.5 P_{1,t}(j/a) P_{2,t}(j/a) PIA(f, E_t) (1+r)^{a-j}
 \end{aligned} \tag{4}$$

where, 1 = male, 2 = female, and a dependent female spouse is assumed to be the same age as her husband. The definitions of the other characters are identical to those for a single primary beneficiary.

The first term of Equation 4 denotes the expected value of the widow's benefits conditional on the worker dying at age a . The second term denotes the expected value of the primary beneficiary's retirement benefit conditional on attaining the 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.

Because beneficiaries with a dependent spouse do not pay any additional taxes for the additional benefit, they incur a lower NMSSTR than do singles. The NMSSTR for an average earning male age 55 with a dependent spouse, assuming a discount rate of 3%, is -0.02% (see Table 1). This negative tax rate is a net marginal subsidy and is lower than the rate incurred by female dependent spouses, whose NMSSTR equals the statutory rate of 10.6%.

Smoking-Attributable Mortality

The progressivity of the Social Security benefit formula is based on a common mortality assumption. However, the literature contains evidence that smoking reduces life expectancy (USDHHS 2004a). Life tables published by the National Center for Health Statistics are used to construct and account for differences in life expectancy among current, former, and never smokers in determining NMSSTRs. The approach utilizes the mortality ratios of Thun, Day-Lally, Myers, Calle, Flanders, Zhu et al. (1997) and current and former smoking prevalence estimates for persons age 35-64 made available by the Centers for Disease Control and Prevention for 2002 (CDC, 2004). The method of estimation is described below.

Estimates of the total number of survivors, l_a , by sex, s , and exact age, a , are shown in

Table A.1. 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.

The mortality ratio which is the ratio of one group's death rate to that of the population was used to split the file table into three tables: one for current smokers, one for former smokers, and one for never smokers. The mortality ratio (M) by smoking status (SS) at each age (a)

is $M_{SS,a} = \frac{q_{SS,a}}{q_{T,a}}$. The mortality rate for the total population is $q_{T,a}$, and $q_{SS,a}$ denotes the mortality

rate by smoking status. For example, the mortality rate for current smokers by sex and exact age is calculated as follows: $q_{CS,a} = M_{CS,a} \times q_{T,a}$. For persons age 21 through 35 the mortality ratio for

male and female current and former smokers was assumed to be one. For males age 35 and older

the mortality ratio for current smokers and former smokers were 2.30 and 1.46, respectively. For female current and former smokers age 35 and older the mortality ratios were 1.92 and 1.30, respectively.¹⁵

To determine the number of survivors by smoking class it was initially assumed that 23.2% of men were current smokers and 34.3% were former smokers. For women, it was initially assumed that 18.7% were current smokers and 22.9% were former smokers.¹⁶ Mortality rates by sex for current smokers were subtracted from one and multiplied by the number of current smokers that survived to age $a - 1$ to estimate the number of current smokers by sex surviving to age a . The number of surviving former smokers by sex and age were calculated in a similar manner. The number of never smokers of sex s surviving to age a is estimated by subtracting the number of current plus former smoking survivors from the total number of survivors. The number of survivors at each age in their respective smoking class as shown in Table A.1, is then used to calculate the probability that a person age a will survive to age j . For each smoking class the survival probabilities are in turn used to calculate B_{PV} .

NMSSTRs for single primary beneficiaries that account for smoking-attributable mortality by age, gender, and earnings class are shown in Table 2. As expected, a comparison of the results in Tables 1 and 2 reveals that a smoker's shorter life expectancy increases the NMSSTR at each age. A single male current smoker age 55 with lifetime average earnings faces a net tax rate of 6.51%, which is approximately 3 percentage points higher than the rate estimated under the common mortality assumption (3.55%). The NMSSTR for a single male former smoker age 55 with average lifetime earnings is 4.92%, which is approximately 1.4 percentage points higher than the rate estimated under the common mortality assumption. The

NMSSTR for a single male never smoker age 55 with average lifetime earnings is 1.25%, which is approximately 5.3 percentage points lower than the rate incurred by a 55-year-old current smoker and approximately 3.7 percentage points lower than the rate incurred by a 55-year-old former smoker.

A single female current smoker age 55 with lifetime average earnings faces an NMSSTR of 5.13%, which is approximately 1.4 percentage points lower than the rate estimated for a 55-year-old current smoking male with lifetime average earnings. The gender differential in NMSSTRs for both current and former smokers at each age is larger than the differential estimated under the common mortality assumption. In addition, 65-year-old female current and former smokers now incur a lower NMSSTR than do their male counterparts. These gender differences result from males smoking at higher rates than females and having a higher smoking-attributable mortality risk.

As shown in Table 3, a 55-year-old male current smoker with lifetime average earnings and a dependent spouse who also smokes incurs an NMSSTR of 3.17%, which is more than 3 percentage points higher than the rate estimated under the common mortality assumption (-0.02). In addition, this rate is 1.69 percentage points higher than the rate incurred by a 55-year-old male former smoker with lifetime average earnings and a dependent spouse who formerly smoked (1.48%) and approximately 5.5 percentage points higher than the rate incurred by a 55-year-old never smoker with lifetime average earnings and a dependent spouse who never smoked (-2.49%).

III. RESULTS AND DISCUSSION

As have previous studies, we find that social security treats singles and two-earner couples less equitably than one-earner couples. The results of this study add to previous findings by showing that NMSSTRs also vary by smoking status.¹⁷ The higher tax rates that smokers incur may reduce their labor supply.¹⁸ Given that social security is financed by a payroll tax levied on earnings, any reduction in labor supply will have implications for the system's funding. However, the aggregate effect of smoking on the OASI Trust Fund's finances would depend on how smoking redistributes benefits from smokers to never smokers and the resulting labor supply response to changes in marginal tax rates.

While Social Security has reduced poverty among elderly Americans, young widows are at increased risk of living in poverty because of the premature death of their spouse (Redja 1994; Englehart & Gruber, 2004; Sevak, Weir & Willis, 2004). Many of those individuals who smoke die prematurely. Approximately 536,000 adults in the United States under age 65 died of smoking-attributable illnesses between 1997 and 2001.¹⁹ Widows with no children under age 16 in their care who were married to fully insured workers who died prematurely may be ineligible for Social Security benefits until they attain age 60. Estimates suggest that 15 percent of women aged 54, too young to qualify for Social Security benefits, fall in poverty following the death of their husband (Sevak et al. 2004).²⁰ As a result, it has been suggested that Social Security is failing to live up to one of its' primary goals of providing adequate survivors insurance for older low-earning Americans (Gustman & Steinmeier, 2002). One proposal designed to improve Social Security adequacy is to lower the eligibility age for widows from 60 years to 55 years (Redja, 1994).²¹ In addition to the establishment of private accounts, two of the three plans

proposed by The President's Commission to Strengthen Social Security (2001) recommended an increase in benefits for low-earnings widows and widowers.

Because low-earnings workers are more likely to smoke and smokers are more likely than never smokers to die prematurely, an unintended distributional effect of enacting proposals that would reduce widows' retirement age and/or increase retirement benefits among low-earnings widows' and widowers' would be to redistribute benefits from never smokers to smokers, which would benefit behavior that is detrimental to health. As with life insurance, perhaps this unintended effect could be offset by smokers paying a higher premium, in this case a smoker's insurance tax rate. The revenue generated from a tax levied on current smokers could be added to the OASI trust fund and used to reduce financial hardship currently faced by young widows and widowers' by paying increased benefits and/or benefits at an earlier age. In addition, the higher tax penalty associated with smoking may increase cessation. The aggregate impact of such a change on the various trust fund finances would be a valuable addition to the debates surrounding the system's solvency and ways to reduce poverty among widows.

As in previous studies, these results are limited in that they are based on hypothetical workers; thus the relative importance of various economic assumptions and differences is an empirical question.²² Because analysis with money flows over time may be sensitive to the choice of discount rate, selective results shown in Tables 1 through 3 for workers with average lifetime earnings were re-estimated under alternative discount rate assumptions. As shown in Table 4, a lower discount rate reduces the NMSSTR at each age.²³

Although the calculations presented are complex, they oversimplify the Social Security program in a number of ways. First, we focused on OASI and ignored the DI and HI

components of Social Security. Second, we ignored benefits for dependent children of young widows or widowers. Third, we ignored the possibility of divorce and remarriage. Fourth, the employer portion of the payroll tax is tax exempt, and given the progressive nature of income taxation this disproportionately benefits higher earning individuals. Thus, the NMSSTR for high-earning individuals may be lower than the estimates reported. Fifth, smoking prevalence was held constant across earnings class. Because lower-earning individuals have a higher smoking prevalence than do higher-earning individuals, low-earning individuals' NMSSTRs may be higher than the rates reported, whereas average- and high-earning individuals may have NMSSTRs that are lower than the rates reported.

A final potential limitation to our results is that the mortality risk measures used to account for the mortality difference among current and former smokers are adjusted for sex and age only. Other risk factors such as educational status, diet, and alcohol consumption that are correlated with smoking were unaccounted for in the mortality risk measure that was used. As a consequence, the NMSSTR estimates may overstate the tax penalty associated with smoking (Shoven, Sundberg & Bunker, 1987 and Thun et al., 1997). However, this limitation may not pose too great a problem, because evidence in the literature suggests that when behavioral and demographic factors correlated with smoking were taken into account, the higher mortality risks faced by smokers did not change much (Malarcher, Schulman, Epstein, Thun, Mowery, Pierce et al., 2000; Thun et al., 1997).

IV. CONCLUSIONS

The analyses reveal that smokers will incur higher net marginal tax rates than do never smokers and may reduce their labor supply.²⁴ Any reduction in labor supply among smokers

will have implications for the system's funding. Knowledge of the distributional effects of smoking on Social Security is important not only from the standpoint of the system's funding, but also from the perspective of informing smoking cessation efforts (Rice, 1984). The higher net marginal tax rates can be avoided by never smoking or reduced by quitting smoking. Finally, smoking status should be considered in assessing Social Security legislative proposals designed to reduce system inequities or promote social adequacy in particular, amendments designed to reduce poverty among young widows and widowers. Failure to do so may unintentionally promote behavior that is detrimental to health.

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Table 1
 Net Marginal Social Security Tax Rate Estimates for Single Beneficiaries and Primary Male Beneficiaries with a Dependent Spouse
 by Earnings Classification and Age in 2002.^a

| Age in 2002 | Single Female | | | Single Male | | | Male Beneficiary and Dependent Spouse | | | Uninsured Female |
|----------------|-----------------|---------------------|------------------|-----------------|---------------------|------------------|---------------------------------------|---------------------|------------------|------------------|
| | Low Earnings | Average Earnings | High Earnings | Low Earnings | Average Earnings | High Earnings | Low Earnings | Average Earnings | High Earnings | |
| 35 | -4.68 | 5.17 | 8.05 | -2.11 | 6.08 | 8.48 | -9.75 | 3.37 | 7.21 | 10.6 |
| 45 | -8.24 | 3.90 | 7.46 | -4.94 | 5.07 | 8.01 | -13.54 | 2.02 | 6.58 | 10.6 |
| 55 | -10.34 | 3.15 | 7.11 | -9.22 | 3.55 | 7.30 | -19.26 | -0.02 | 5.62 | 10.6 |
| 65 | -15.33 | 1.38 | 6.28 | -17.86 | 0.48 | 5.86 | -31.37 | -4.32 | 3.60 | 10.6 |

^aWorkers are assumed to retire at the full benefit retirement age. Low-earnings workers expect a marginal replacement rate of 0.9, average-earnings and high-earnings workers expect rates of 0.32 and 0.15, respectively. A real discount rate of 3 percent is assumed. The growth rate in real earnings is set at 1.1 percent.

Table 2
 Net Marginal Social Security Tax Rate Estimates for Single Primary Beneficiaries
 by Sex, Smoking Status, Earnings Classification, and Age in 2002.^a

| Female | Current Smoker | | | Former Smoker | | | Never Smoker | | |
|-------------|----------------|------------------|---------------|---------------|------------------|---------------|--------------|------------------|---------------|
| | Low Earnings | Average Earnings | High Earnings | Low Earnings | Average Earnings | High Earnings | Low Earnings | Average Earnings | High Earnings |
| Age in 2002 | | | | | | | | | |
| 35 | -0.14 | 6.78 | 8.81 | -2.87 | 5.81 | 8.35 | -6.84 | 4.40 | 7.69 |
| 45 | -2.83 | 5.83 | 8.36 | -6.09 | 4.67 | 7.82 | -10.78 | 3.00 | 7.04 |
| 55 | -4.77 | 5.13 | 8.04 | -8.13 | 3.94 | 7.48 | -12.86 | 2.26 | 6.69 |
| 65 | -9.84 | 3.33 | 7.19 | -13.13 | 2.16 | 6.64 | -17.62 | 0.57 | 5.90 |
| | | | | | | | | | |
| Male | Current Smoker | | | Former Smoker | | | Never Smoker | | |
| | Low Earnings | Average Earnings | High Earnings | Low Earnings | Average Earnings | High Earnings | Low Earnings | Average Earnings | High Earnings |
| Age in 2002 | | | | | | | | | |
| 35 | 3.96 | 8.24 | 9.49 | 0.73 | 7.09 | 8.96 | -7.68 | 4.10 | 7.55 |
| 45 | 2.21 | 7.62 | 9.20 | -1.61 | 6.26 | 8.57 | -11.16 | 2.86 | 6.97 |
| 55 | -0.91 | 6.51 | 8.68 | -5.37 | 4.92 | 7.94 | -15.69 | 1.25 | 6.22 |
| 65 | -8.84 | 3.69 | 7.36 | -13.68 | 1.97 | 6.55 | -23.50 | -1.53 | 4.92 |

^aWorkers are assumed to retire at the full benefit retirement age. Low-earnings workers expect a marginal replacement rate of 0.9, average-earnings and high-earnings workers expect rates of 0.32 and 0.15, respectively. A real discount rate of 3 percent is assumed. The growth rate in real earnings is set at 1.1 percent.

Table 3

Net Marginal Social Security Tax Rate Estimates for Male Primary Beneficiaries with a Dependent Spouse
by Earnings Classification, Smoking Status, and Age in 2002.^a

| Low Earner | Primary Beneficiary Current Smoker | | | Primary Beneficiary Former Smoker | | | Primary Beneficiary Never Smoker | | |
|-------------|------------------------------------|---------------|--------------|-----------------------------------|---------------|--------------|----------------------------------|---------------|--------------|
| | Dependent Spouse | | | Dependent Spouse | | | Dependent Spouse | | |
| | Current Smoker | Former Smoker | Never Smoker | Current Smoker | Former Smoker | Never Smoker | Current Smoker | Former Smoker | Never Smoker |
| Age in 2002 | | | | | | | | | |
| 35 | -4.39 | -6.41 | -8.68 | -5.56 | -7.14 | -8.97 | -13.77 | -15.42 | -17.44 |
| 45 | -6.53 | -8.57 | -10.87 | -8.53 | -10.18 | -12.10 | -18.21 | -20.01 | -22.22 |
| 55 | -10.30 | -12.38 | -14.71 | -13.31 | -15.05 | -17.05 | -24.26 | -26.21 | -28.57 |
| 65 | -20.90 | -22.95 | -25.18 | -24.76 | -26.51 | -28.47 | -35.42 | -37.38 | -39.68 |
| | | | | | | | | | |
| Avg. Earner | Primary Beneficiary Current Smoker | | | Primary Beneficiary Former Smoker | | | Primary Beneficiary Never Smoker | | |
| | Dependent Spouse | | | Dependent Spouse | | | Dependent Spouse | | |
| | Current Smoker | Former Smoker | Never Smoker | Current Smoker | Former Smoker | Never Smoker | Current Smoker | Former Smoker | Never Smoker |
| Age in 2002 | | | | | | | | | |
| 35 | 5.27 | 4.55 | 3.75 | 4.86 | 4.29 | 3.64 | 1.94 | 1.35 | 0.63 |
| 45 | 4.51 | 3.78 | 2.97 | 3.80 | 3.21 | 2.53 | 0.36 | -0.28 | -1.07 |
| 55 | 3.17 | 2.43 | 1.60 | 2.10 | 1.48 | 0.77 | -1.80 | -2.49 | -3.33 |
| 65 | -0.60 | -1.33 | -2.12 | -1.97 | -2.59 | -3.29 | -5.76 | -6.46 | -7.28 |
| | | | | | | | | | |
| High Earner | Primary Beneficiary Current Smoker | | | Primary Beneficiary Former Smoker | | | Primary Beneficiary Never Smoker | | |
| | Dependent Spouse | | | Dependent Spouse | | | Dependent Spouse | | |
| | Current Smoker | Former Smoker | Never Smoker | Current Smoker | Former Smoker | Never Smoker | Current Smoker | Former Smoker | Never Smoker |
| Age in 2002 | | | | | | | | | |
| 35 | 8.10 | 7.77 | 7.39 | 7.91 | 7.64 | 7.34 | 6.54 | 6.26 | 5.93 |
| 45 | 7.75 | 7.40 | 7.02 | 7.41 | 7.14 | 6.82 | 5.80 | 5.50 | 5.13 |
| 55 | 7.12 | 6.77 | 6.38 | 6.62 | 6.33 | 5.99 | 4.79 | 4.46 | 4.07 |
| 65 | 5.35 | 5.01 | 4.64 | 4.71 | 4.42 | 4.09 | 2.93 | 2.60 | 2.22 |

^aWorkers are assumed to retire at the full benefit retirement age. Low-earnings workers expect a marginal replacement rate of 0.9, average-earnings and high-earnings workers expect rates of 0.32 and 0.15, respectively. A real discount rate of 3 percent is assumed. The growth rate in real earnings is set at 1.1 percent.

Table 4
 Net Marginal Social Security Tax Rate Estimates for Average Earner Primary Beneficiaries and Dependents
 by Sex, Smoking Status and Age in 2002^a

| Age in 2002 | Primary Beneficiary | | | | | | Smoking Status of Male Primary Beneficiary and Dependent Spouse | | |
|----------------------|---------------------|---------------|--------------|----------------|---------------|--------------|---|---------------------|--------------------|
| | Single Female | | | Single Male | | | Both Current Smokers | Both Former Smokers | Both Never Smokers |
| | Current Smoker | Former Smoker | Never Smoker | Current Smoker | Former Smoker | Never Smoker | | | |
| Discount rate = 2.2% | | | | | | | | | |
| 35 | 5.83 | 4.56 | 2.69 | 7.69 | 6.23 | 2.35 | 5.34 | 4.30 | 0.50 |
| 45 | 5.08 | 3.68 | 1.64 | 7.19 | 5.59 | 1.52 | 4.68 | 3.35 | -0.95 |
| 55 | 4.76 | 3.42 | 1.50 | 6.28 | 4.54 | 0.45 | 3.49 | 1.83 | -2.88 |
| 65 | 3.42 | 2.18 | 0.47 | 3.85 | 2.08 | -1.58 | 0.07 | -1.84 | -6.32 |
| Discount rate = 3.0% | | | | | | | | | |
| 35 | 7.07 | 6.17 | 4.87 | 8.42 | 7.35 | 4.59 | 5.67 | 4.77 | 1.38 |
| 45 | 6.18 | 5.11 | 3.57 | 7.84 | 6.58 | 3.44 | 4.97 | 3.76 | -0.19 |
| 55 | 5.54 | 4.44 | 2.89 | 6.81 | 5.35 | 1.95 | 3.73 | 2.17 | -2.28 |
| 65 | 3.88 | 2.79 | 1.32 | 4.20 | 2.61 | -0.62 | 0.24 | -1.60 | -5.94 |
| Discount rate = 3.7% | | | | | | | | | |
| 35 | 7.87 | 7.21 | 6.25 | 8.90 | 8.09 | 6.02 | 5.90 | 5.09 | 1.96 |
| 45 | 6.95 | 6.10 | 4.89 | 8.30 | 7.28 | 4.77 | 5.18 | 4.06 | 0.34 |
| 55 | 6.13 | 5.20 | 3.90 | 7.22 | 5.95 | 3.06 | 3.92 | 2.43 | -1.83 |
| 65 | 4.25 | 3.28 | 1.97 | 4.49 | 3.04 | 0.13 | 0.38 | -1.42 | -5.63 |

^aWorkers are assumed to retire at the full benefit retirement age. Average-earnings workers expect a marginal replacement rate of 0.32. The growth rate in real earnings is set at 1.1 percent. Estimates account for smoking attributable mortality and taxation of benefits.

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

| Survivors by Smoking Status ^a | | | | | | | | | |
|--|---------------------|-------------------|------------------|-----------------|----------------|---------------------|-------------------|------------------|-----------------|
| Age in 2002 | Total Population | Current Smoker | Former Smoker | Never Smoker | Age in 2002 | Total Population | Current Smoker | Former Smoker | Never Smoker |
| 20 | 98922 | 18538 | 22604 | 57780 | 61 | 90138 | 15614 | 20076 | 54448 |
| 21 | 98877 | 18530 | 22593 | 57754 | 62 | 89374 | 15360 | 19854 | 54159 |
| 22 | 98827 | 18520 | 22582 | 57725 | 63 | 88552 | 15089 | 19617 | 53846 |
| 23 | 98781 | 18512 | 22571 | 57698 | 64 | 87657 | 14796 | 19359 | 53502 |
| 24 | 98736 | 18503 | 22561 | 57672 | 65 | 86680 | 14479 | 19079 | 53122 |
| 25 | 98688 | 18494 | 22550 | 57644 | 66 | 85631 | 14143 | 18779 | 52709 |
| 26 | 98639 | 18485 | 22539 | 57615 | 67 | 84512 | 13788 | 18460 | 52264 |
| 27 | 98589 | 18476 | 22528 | 57586 | 68 | 83281 | 13402 | 18110 | 51768 |
| 28 | 98539 | 18466 | 22516 | 57557 | 69 | 81982 | 13001 | 17743 | 51238 |
| 29 | 98483 | 18456 | 22503 | 57524 | 70 | 80556 | 12567 | 17342 | 50647 |
| 30 | 98424 | 18445 | 22490 | 57489 | 71 | 79026 | 12109 | 16914 | 50004 |
| 31 | 98362 | 18433 | 22476 | 57453 | 72 | 77410 | 11633 | 16464 | 49313 |
| 32 | 98296 | 18421 | 22461 | 57415 | 73 | 75666 | 11130 | 15982 | 48554 |
| 33 | 98225 | 18407 | 22444 | 57373 | 74 | 73802 | 10604 | 15470 | 47729 |
| 34 | 98148 | 18393 | 22427 | 57328 | 75 | 71800 | 10051 | 14924 | 46824 |
| 35 | 98064 | 18363 | 22402 | 57299 | 76 | 69639 | 9470 | 14340 | 45828 |
| 36 | 97970 | 18329 | 22374 | 57267 | 77 | 67366 | 8877 | 13732 | 44757 |
| 37 | 97869 | 18293 | 22344 | 57232 | 78 | 64935 | 8262 | 13088 | 43585 |
| 38 | 97759 | 18253 | 22311 | 57195 | 79 | 62372 | 7636 | 12416 | 42320 |
| 39 | 97640 | 18210 | 22276 | 57153 | 80 | 59621 | 6989 | 11704 | 40928 |
| 40 | 97500 | 18160 | 22234 | 57105 | 81 | 56681 | 6327 | 10954 | 39400 |
| 41 | 97355 | 18109 | 22192 | 57055 | 82 | 53660 | 5680 | 10195 | 37785 |
| 42 | 97194 | 18051 | 22144 | 56999 | 83 | 50324 | 5002 | 9371 | 35951 |
| 43 | 97023 | 17990 | 22093 | 56940 | 84 | 47075 | 4382 | 8585 | 34109 |
| 44 | 96830 | 17921 | 22036 | 56873 | 85 | 43542 | 3751 | 7747 | 32045 |
| 45 | 96627 | 17849 | 21976 | 56802 | 86 | 39919 | 3151 | 6909 | 29859 |
| 46 | 96405 | 17770 | 21910 | 56724 | 87 | 36246 | 2595 | 6083 | 27569 |
| 47 | 96176 | 17689 | 21843 | 56644 | 88 | 32571 | 2090 | 5281 | 25201 |
| 48 | 95928 | 17602 | 21769 | 56557 | 89 | 28943 | 1643 | 4516 | 22784 |
| 49 | 95654 | 17505 | 21689 | 56460 | 90 | 25411 | 1258 | 3800 | 20354 |
| 50 | 95364 | 17403 | 21603 | 56357 | 91 | 22024 | 936 | 3141 | 17947 |
| 51 | 95059 | 17297 | 21513 | 56249 | 92 | 18828 | 675 | 2549 | 15604 |
| 52 | 94724 | 17179 | 21415 | 56130 | 93 | 15862 | 471 | 2027 | 13364 |
| 53 | 94380 | 17060 | 21314 | 56007 | 94 | 13158 | 317 | 1578 | 11264 |
| 54 | 93989 | 16924 | 21199 | 55866 | 95 | 10737 | 205 | 1200 | 9332 |
| 55 | 93572 | 16780 | 21077 | 55716 | 96 | 8613 | 127 | 892 | 7594 |
| 56 | 93095 | 16616 | 20937 | 55542 | 97 | 6785 | 75 | 646 | 6064 |
| 57 | 92629 | 16456 | 20801 | 55372 | 98 | 5245 | 42 | 455 | 4747 |
| 58 | 92084 | 16270 | 20642 | 55172 | 99 | 3977 | 23 | 312 | 3642 |
| 59 | 91491 | 16069 | 20469 | 54953 | 100 | 2954 | 12 | 208 | 2735 |
| 60 | 90826 | 15845 | 20275 | 54706 | | | | | |

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

| Survivors by Smoking Status ^a | | | | | | | | | |
|--|---------------------|-------------------|------------------|-----------------|----------------|---------------------|-------------------|------------------|-----------------|
| Age in 2000 | Total Population | Current Smoker | Former Smoker | Never Smoker | Age in 2000 | Total Population | Current Smoker | Former Smoker | Never Smoker |
| 20 | 98436 | 22778 | 33724 | 41934 | 61 | 83612 | 16028 | 26805 | 40779 |
| 21 | 98299 | 22746 | 33677 | 41875 | 62 | 82483 | 15530 | 26276 | 40677 |
| 22 | 98157 | 22714 | 33629 | 41815 | 63 | 81255 | 14998 | 25705 | 40552 |
| 23 | 98021 | 22682 | 33582 | 41757 | 64 | 79946 | 14442 | 25101 | 40403 |
| 24 | 97882 | 22650 | 33534 | 41698 | 65 | 78556 | 13865 | 24463 | 40228 |
| 25 | 97746 | 22618 | 33488 | 41640 | 66 | 77071 | 13262 | 23788 | 40021 |
| 26 | 97614 | 22588 | 33443 | 41584 | 67 | 75501 | 12641 | 23081 | 39779 |
| 27 | 97479 | 22557 | 33396 | 41526 | 68 | 73809 | 11989 | 22326 | 39494 |
| 28 | 97352 | 22527 | 33353 | 41472 | 69 | 72012 | 11318 | 21532 | 39162 |
| 29 | 97225 | 22498 | 33309 | 41418 | 70 | 70087 | 10622 | 20692 | 38773 |
| 30 | 97091 | 22467 | 33263 | 41361 | 71 | 68039 | 9908 | 19809 | 38322 |
| 31 | 96954 | 22435 | 33216 | 41302 | 72 | 65864 | 9180 | 18884 | 37800 |
| 32 | 96813 | 22403 | 33168 | 41242 | 73 | 63621 | 8461 | 17945 | 37215 |
| 33 | 96678 | 22371 | 33122 | 41185 | 74 | 61202 | 7721 | 16949 | 36532 |
| 34 | 96526 | 22336 | 33070 | 41120 | 75 | 58680 | 6989 | 15930 | 35761 |
| 35 | 96367 | 22251 | 32990 | 41125 | 76 | 56028 | 6262 | 14878 | 34887 |
| 36 | 96196 | 22161 | 32905 | 41131 | 77 | 53251 | 5549 | 13802 | 33901 |
| 37 | 96016 | 22065 | 32815 | 41136 | 78 | 50398 | 4865 | 12722 | 32811 |
| 38 | 95823 | 21963 | 32719 | 41141 | 79 | 47454 | 4211 | 11637 | 31606 |
| 39 | 95610 | 21851 | 32612 | 41147 | 80 | 44370 | 3582 | 10533 | 30255 |
| 40 | 95381 | 21731 | 32498 | 41152 | 81 | 41252 | 3003 | 9452 | 28797 |
| 41 | 95128 | 21598 | 32373 | 41157 | 82 | 38102 | 2475 | 8399 | 27228 |
| 42 | 94859 | 21458 | 32239 | 41163 | 83 | 34798 | 1982 | 7335 | 25481 |
| 43 | 94577 | 21311 | 32099 | 41167 | 84 | 31719 | 1578 | 6388 | 23753 |
| 44 | 94266 | 21150 | 31945 | 41171 | 85 | 28478 | 1207 | 5435 | 21836 |
| 45 | 93929 | 20976 | 31778 | 41175 | 86 | 25296 | 897 | 4548 | 19851 |
| 46 | 93569 | 20791 | 31600 | 41178 | 87 | 22212 | 646 | 3739 | 17828 |
| 47 | 93171 | 20587 | 31404 | 41179 | 88 | 19266 | 449 | 3015 | 15803 |
| 48 | 92755 | 20376 | 31199 | 41180 | 89 | 16494 | 300 | 2381 | 13812 |
| 49 | 92296 | 20144 | 30974 | 41178 | 90 | 13925 | 193 | 1840 | 11893 |
| 50 | 91809 | 19900 | 30735 | 41174 | 91 | 11585 | 118 | 1388 | 10078 |
| 51 | 91286 | 19639 | 30480 | 41167 | 92 | 9490 | 69 | 1022 | 8399 |
| 52 | 90722 | 19360 | 30205 | 41157 | 93 | 7648 | 38 | 732 | 6877 |
| 53 | 90138 | 19073 | 29921 | 41144 | 94 | 6059 | 20 | 510 | 5529 |
| 54 | 89505 | 18765 | 29614 | 41126 | 95 | 4715 | 10 | 345 | 4360 |
| 55 | 88850 | 18449 | 29298 | 41103 | 96 | 3601 | 4 | 226 | 3371 |
| 56 | 88102 | 18092 | 28938 | 41072 | 97 | 2698 | 2 | 143 | 2553 |
| 57 | 87369 | 17746 | 28586 | 41037 | 98 | 1982 | 1 | 88 | 1894 |
| 58 | 86542 | 17360 | 28191 | 40991 | 99 | 1426 | 0 | 52 | 1374 |
| 59 | 85644 | 16945 | 27764 | 40935 | 100 | 1005 | 0 | 29 | 975 |
| 60 | 84637 | 16487 | 27287 | 40863 | | | | | |

^aThis refers to the number of persons by smoking status reaching exact age *a* during the year in the stationary population. Estimates were constructed from life tables published by the National Center for Health Statistics.

NOTES

¹ Estimated from information contained in Table 4.B4 of the U.S. Department of Health and Human Services Annual Statistical Supplement to the Social Security Bulletin, 2004. Available online from the Social Security Administration at <http://www.ssa.gov/policy/docs/statcomps/supplement/2004/4b.pdf> (verified April 19, 2005).

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 (Browning, 1985 and Burkhauser & Turner, 1985).

³ There is a limit to the benefit amount that family members may receive each month. The limit varies, but is generally equal to about 150 to 180 percent of PIA. If the sum of the benefits payable to family members exceeds this limit, their benefits will be reduced. However, any benefits paid to a surviving divorced widow or widower, do not count toward this maximum amount (see U.S. Department of Health and Human Services, 2004).

⁴ The 1977 amendments to the Social Security Act indexed the benefit formula's bend points to the growth rate in average covered earnings. The marginal replacement rates were fixed at 90, 32, and 15 percent, respectively (see U.S. Department of Health and Human Services 2004).

⁵ 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 2002, the combined employee-employer DI and HI rates were 1.8 and 2.9 percent, respectively (see U.S. Department of Health and Human Services 2004).

⁶ Brittain (1972) found that the payroll tax reduced employee earnings by the full amount of the tax.

⁷ 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.

⁸ The economic assumptions used in the calculations are based on the 2005 Social Security Board of Trustees best cost estimates (U.S. Department of Health and Human Services 2005).

⁹ 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 (Social Security Administration 2001). The minimum number of quarters required to be fully insured ranges from six to forty.

¹⁰ Unpublished insurance rate estimates were provided by the Social Security Office of the Actuary. The data contained projections covering the period 2002 by sex and age for the number of fully insured workers as a percentage of the total population.

¹¹ 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 2005 Trustees Report (U.S. Department of Health and Human Services 2005b).

¹² The probability that a male age 65 was fully insured for benefits in the year 2002 was 0.929. In comparison, the

probability that a 65-year-old female was fully insured was 0.741. As before, these estimates are unpublished and were provided by the Social Security Office of the Actuary.

¹³ The Social Security Administration (2001) reports that, of the 21.4 million women age 62 and older in 2000, 8.2 million were entitled to primary benefits only, 5.9 million were dually entitled and 7.4 million were solely entitled to benefits as a dependent spouse and failed to qualify for benefits based on their own earnings history (U.S. Department of Health and Human Services 2001).

¹⁴ Widows and widowers become eligible to receive survivor benefits at age 60. However, children and disability may lower the age of eligibility. A detailed explanation of how these criteria may affect the age that survivors may be first eligible for benefits is contained in the U.S. Department of Health and Human Services Annual Statistical Supplement to the Social Security Bulletin 2002.

¹⁵ Mortality ratios for current and former smokers were obtained from Thun, Day-Lally, Myers et al. (1997).

¹⁶ Smoking prevalence for current and former smokers were obtained from the CDC (CDC, 2004).

¹⁷ It has been suggested that premature deaths attributable to smoking saves Social Security money (Shoven, Sunderberg & Bunker, 1987). One should not infer from these results that because smokers' incur a higher NMSSTR that they pay more than their fair share to Social Security. The reason is that the higher NMSSTR may cause smokers' to reduce their labor supply and thereby reduce social security contributions. In addition, social security disability payments to persons with smoking attributable diseases and payments to dependents and survivors of deceased smokers' will offset reductions in future system liabilities that stem from smoking attributable death.

¹⁸ In addition to reducing hours of work an increase in taxes may decrease labor force participation. Specifically, smoking may lead to a reduction in labor supply through early retirement. According to the Social Security Advisory Council's 1997 report, retirement studies have typically used average life expectancy by age as opposed to predictions based on health status in their analysis. Those smokers in poor health that retire early may be responding to financial incentives that are masked in analyses that use average life expectancies. The report is available at <http://www.ssa.gov/history/reports/adccouncil/tirs1.txt> (verified April 19, 2005).

¹⁹ These estimates are unpublished and were estimated from Smoking-Attributable Mortality Morbidity and Economic Cost (SAMMEC) data maintained by the Office on Smoking and Health, CDC. SAMMEC estimates are available online from CDC at <http://apps.nccd.cdc.gov/sammec/> (verified April 19, 2005).

²⁰ We do not know how many young widows under age 60 are ineligible for benefits because they are currently too young and as a consequence live in poverty. However, we do know that in the year 2000, 45,680 widows received benefits because they had a child under age 16 in their care (see Table 5.F1 of the U.S. Department of Health and Human Services 2001).

²¹ It is unclear why age 55 is recommended. Widows under age 55, whose eligibility is based solely on age, would continue to be ineligible for social security benefits and the system would fail to live up to one of its' main goals of providing adequate retirement security. Additional information on proposals aimed at changing social security survivorship benefits and poverty among widows is available from Anzick and Weaver, 2001.

²² However, this is the best one can do since the real world data are unavailable (Garrett, 1995). Also for a discussion of the usefulness of results based on hypothetical worker data see Leimer, 1995.

²³ The calculations shown in Table 1-3 ignored the personal income tax bracket at which social security retirement benefits will be taxed during retirement. Thus, the estimates shown in Table 4 assumed that social security benefits will be subject to a federal income tax rate of 15 percent. For a single male current smoker age 55, assuming a discount rate of 3%, taxation of benefits increased his NMSSTR by 0.3 percentage points (6.51% vs. 6.81%).

²⁴ The evidence is mixed on the impact of Social Security on labor supply, although the predominant research in this area has focused on the labor supply responses of older workers (Krueger and Meyer 2002).