Social Security, the Government Budget and National Savings

Peter Diamond

March 24, 2003

Abstract[1]

In the 1983 Social Security reform, Congress chose to build a substantial trust fund, with principal and interest both to be used for later benefits. That is, Congress chose payroll tax rates higher than pay-as-you-go levels while the baby-boomers were in the labor force in order to have payroll tax rates lower than pay-as-you-go while the baby-boomers were retired. The impact on national capital of these higher payroll taxes, with the implied trust fund buildup, has been controversial. The impact depends on the response of the rest of the government budget as well as the responses of individuals to these government actions. It also depends on the effects of future tax changes as well as initial tax changes. This paper explores a simple overlapping generations model distinguishing two types in each cohort - life-cycle savers and nonsavers, and allowing an income tax change to offset a fraction of the additional revenue from any payroll tax change.

Even if the unified budget is always balanced, the trust fund buildup increases national capital initially when payroll taxpayers have a lower propensity to save out of payroll taxes than income taxpayers do out of the income tax, as is plausible. These effects are reversed after some point when payroll taxes have been lower and income taxes higher, as holds during the retirement of the baby-boomers. The paper also considers a permanent increase in the trust fund, used to finance lower payroll taxes indefinitely.

[1]I am grateful to Henry Aaron, Jeff Liebman, Peter Orszag, Jim Poterba and members of the MIT macro lunch for comments, to Tal Regev for research assistance and to the National Science Foundation for financial support under grant SES-0239380.

In the 1983 Social Security reform, Congress chose to build a substantial trust fund, with principal and interest both to be used for later benefits. That is, Congress chose payroll tax rates higher than pay-as-you-go levels while the baby-boomers were in the labor force in order to have payroll tax rates lower than pay-as-you-go while the baby-boomers were retired. The impact on national capital of these higher payroll taxes, with the implied trust fund buildup, has been controversial. The impact depends on the response of the rest of the government budget as well as the responses of individuals to these government actions.[2]

In the absence of an empirically supported, widely-accepted connection between Social Security and non-Social Security budgets, research has naturally considered the implications of alternative ways of modeling this connection. In particular, Elmendorf and Liebman (2000) analyzed the impact of Social Security savings on national savings under different assumptions as to the response of the rest of the budget to a Social Security surplus. Implicitly, they assumed a representative taxpayer and so did not distinguish between a payroll tax increase and an income tax cut that might be induced by a payroll tax increase. Yet the distribution of payroll and income tax burdens by income level are very different and propensities to save by income level are also very different. The top quintile in earners in 1995 paid 71 percent of the individual income tax and 37 percent of the Social Security payroll tax.[3]

The 1983 legislation can be viewed as a commitment to finance the additional debt in the Trust Fund out of future income taxes. That is, prefunding through the payroll tax should be seen as a commitment to workers, whether the government and the country save overall or not. If tax changes are proportional to taxes and if income tax changes fully offset payroll tax changes (a

[2]I ignore any possible impact on employer-provided pensions.

[3]In 1995, the individuals and families in the top quintile of people in cash income have incomes above $71,510 (CBO, 1998). These are estimated to pay 71 percent of the individual income tax and 41 percent of social insurance taxes (Table 5). (They also pay 66 percent of the corporate income tax.) Social insurance taxes include the uncapped Medicare tax, and perhaps the unemployment insuracne tax, as well as the capped Social Security tax. Ignoring unemployment insuracne and using SSA data (2002) to convert the percentage of total payroll taxes into the percentage of Social Security payroll taxes (since almost all of Medicare taxes due to earnings above the Social Security taxable maximum of $61,200 are paid by the top quintile in cash incomes, we calculate as if all of it were), we estimate that those in the top quintile pay 37% of the relevant payroll tax. Thus approximately one-third of exactly offsetting income and payroll tax changes would be a redistribution between the top quintile and the other four quintiles

balanced unified budget on the margin), then the legislation could be viewed in part (roughly one-third say, reflecting the differences in shares of the two taxes paid by low earners) as a transfer from current payroll tax payers to current income tax payers with an exactly offsetting (in present discounted value terms) future transfer from income tax payers to payroll tax payers. I believe that very little of the trust fund buildup of the 80's and early 90's resulted in offsetting budgetary changes. Since this belief is not held by all analysts, it is helpful to consider the model with a parametric level of offset.

This note adds to the set of cases analyzed by exploring the link between Social Security savings and national savings if the unified budget responds to the initial social security surplus with a fraction of a Social Security surplus financing an income tax cut. In the first model considered, it is assumed that payroll taxes are raised from the initial period until the baby-boomers retire, with the accumulated trust fund used to lower payroll taxes during the retirement of the baby-boomers. It is assumed that the income tax reacts proportionally, in the opposite direction, to both of these changes. This effect raises national capital until some point during the retirement of the baby-boomers, lowering it after that until the affected life-cycle savers have died.

Also considered is a one-period rise in the payroll tax to permanently increase the trust fund, with the increased interest income used to finance a decrease in all future payroll tax rates. Since future social security budgets are balanced, it is assumed that the income tax rate decreases to partially offset the social security surplus in the first period and thereafter the income tax rate rises by enough to pay the increase in the interest owing on the national debt. That is, after the initial period it is assumed that both the Social Security budget and the unified budget are always balanced. The impact of these government actions on national capital is solved for the end of the initial period and for the asymptotic steady state (reached after all those alive in the initial period have died since the production technology is assumed to be linear). Capital is larger at the end of the initial period. Whether it is higher or lower in the asymptotic steady state depends on the fraction of the payroll tax revenue change that is offset by the income tax. This policy is worth exploring since increasing longevity implies ongoing Social Security financing issues after the baby-boomers are gone.

These effects are derived in a two-types model (as in Diamond and Geanakoplos, forthcoming), where one group, called workers, does no savings while

the other group, called savers, are standard life-cycle optimizers.[4] For convenience the savers are assumed to plan constant consumption as they would with a discount rate equal to the interest rate. Reflecting the empirical observation that those with higher earnings have higher propensities to save (Dynan, Skinner and Zeldes, 2000, Saez, 2002), and the patterns of payroll and income tax liabilities by earnings level, the model assumes that workers pay only payroll taxes and savers pay only income taxes. Thus the model should be interpreted in terms of the differences between the two types of taxes at the margin in response to a payroll tax excess over the level needed for pay-as-you-go.

The logic behind the effects in the initial period in both settings is clear. While the initial payroll tax increase comes fully out of worker consumption, the initial income tax cut is partially saved. This savings comes from a forward-looking spreading of a one-period income increase over consumption in all the remaining periods of life and from the assumed awareness that future income tax rates will be increased. While solved in a specific model, this result would follow more generally when payroll taxpayers have a lower propensity to save out of payroll taxes than income taxpayers do out of the income tax, as is plausible.

In the setting of a temporary trust fund buildup, eventually the only effects are those of the income tax increase, thereby lowering national capital. In the long run with a permanent increase in the trust fund, when income taxes are higher to pay the interest on a larger trust fund, national capital is lower if the income tax offset is large enough. On a dollar-for-dollar basis, once the economy is in a new steady state, the increased capital financed by the trust fund is more than offset by the decreased capital held by savers who are subject to higher lifetime income taxes. If the initial income tax offset is less than 100 percent of additional revenue, long-run capital may rise. A simple calculation suggests that the break-even point for long-run capital is with an 80 percent offset. The paper also considers the implications of using part of the temporary social security surplus for an increase in public consumption (not yet available).

[4]Two-types models can have very different results than representative agent models. For example, see Diamond and Geanakoplos (forthcoming) on diversifying Social Security assets and Saez (2000) on taxing interest income. The contrast between types is stark and overstates the differences between them - many people doing little saving may have a small response to a tax change rather than zero and many people dong considerable savings may not be so responsive to future taxes as is assumed in the model.

The model structure is presented in Section 1. Analysis of a temporary trust fund buildup is in Section 2; and of a permanent buildup in Section 3. A discussion of extensions is in Section 4 and of the history since 1983 in Section 5, with concluding remarks in Section 6. Extensions of the model will be in Appendices, when available.

1 Model Structure

There is great diversity in earnings, savings propensities and in the ratios of payroll to income taxes paid. The starting place for this model is the diversity in savings. Assume two-types, so that in each cohort there are n "workers" who do no saving whatsoever and N "savers" who are standard life-cycle savers. We use lower-case letters to refer to workers and upper-case letters to refer to savers. For notational simplicity, assume no population growth. Given the positive correlation between savings propensities and earnings (Dynan, Skinner and Zeldes, 2000, Saez, 2002), the ratio of payroll taxes to income taxes is higher for workers than savers. For simplicity, we model this by assuming that the workers pay no income taxes at all - a simplification which calls for interpreting the model relative to tax differences. While most savers are also covered by Social Security, for notational simplicity we assume that they are not. Again, this calls for interpretation in terms of the difference between types of taxes paid.

The workers rely on social security for retirement consumption, while the savers do their own retirement savings. In recognition of the tax advantages of retirement savings, we model the income tax as falling only on the earnings of savers. We also assume that labor is inelastically supplied - with work for L periods (length of career) and retirement for $D-L$. We assume that careers are longer than retirements, $L > D-L$. We do not consider differences in career length or life expectancy between the two types.

For simplicity, assume a linear technology, with each worker earning w per period, each saver earning W per period, and capital earning a gross return $R\,(=1+r>1)$.[5] With constant payroll taxes, t, each worker would consume $w\,(1-t)$ while working and a social security benefit of b while retired. For simplicity, assume that savers equalize the consumption each period over their entire lives or their remaining lives when there is a policy change. This

[5]Without this linearity assumption we would need to track the changes in wages and interest rates and their impact on taxes and savings.

would follow from the standard model if the savers have additive lifetime utility functions with the same period utility functions in each period and a utility discount rate that equals the interest rate. With savers choosing the same level of consumption, C, in each of the D periods of life, the present discounted value (PDV) of period consumption for a saver newly entering the labor force is equal to the PDV of L periods of net-of-tax earnings, $W(1-T)$. With unanticipated changes in income taxes, T, we will have to pay attention to the timing of tax changes.

The social security system is partially funded, with a fund of size F. With equally sized cohorts, the social security budget constraint if the fund is held constant is

$$n(D-L)b = nLtw + rF \tag{1}$$

That is, benefits of b are paid to each of the $n(D-L)$ retirees alive in each period. Financing comes from payroll tax revenues and the interest on the trust fund.

For simplicity, we assume no government expenditures other than interest on the outstanding public debt, denoted G. If the debt is constant, per period non-social security budget balance implies

$$NLTW = rG \tag{2}$$

That is, the interest on the total debt outstanding is paid from the income tax on the earnings of the NL savers in the labor force in each period. Thus the income tax on savers finances the non-social security budget while the payroll tax on workers finances the social security budget. The public debt held by the savers is $G-F$, the rest of their savings being in physical capital.

2 Baby-boomers

Assume that in each cohort but one there are n "workers" and N "savers." In one cohort only there are Δn additional workers and ΔN additional savers, with $\Delta n/n$ equal to $\Delta N/N$. This cohort became active sometime in the past and is still active in the initial period (period 1) and will retire beginning in period S. They will die out at the end of period $S+D-L-1$.

2.1 Baseline

We begin with the baseline of a tax structure with a pay-as-you-go policy that preserves the levels of the trust fund and the public debt. That is, we are examining a baseline without the trust fund buildup legislated in 1983. We do not consider the historic pattern of deficits in the non-social security budget, focusing just on politically-induced changes. We assume that benefits per retiree, b, are not changed over time in the baseline, nor as part of the policy change being analyzed.

If there are no advance measures taken to adapt to the bulge in retirees and drop in workers, and if the trust fund and public debt are maintained through their retirement, then the payroll and income taxes must adapt to the variation in labor force and (for social security) in retirees.[6]

We denote by t and T the tax rates when the baby-boomers are in the labor force; by t' and T' those when the baby-boomers are retired; and by t'' and T'' those after the baby-boomers have died. For budget balance with constant benefits per retiree, we would have[7]

$$\begin{aligned} n\left(D-L\right)b &= \left(nL+\Delta n\right)tw+rF \\ \left(n\left(D-L\right)+\Delta n\right)b &= nLt'w+rF \\ n\left(D-L\right)b &= nLt''w+rF \end{aligned} \tag{3}$$

In addition to compressing the birth of the baby-boomers into a single period, this structure ignores the steadily increasing life expectancy that is anticipated.

From these per-period budget-balance equations, we can compare the three payroll tax rates:

$$\begin{aligned} \left(t'-t\right) &= \frac{\Delta n\left(b+tw\right)}{nLw}>0 \\ \left(t'-t''\right) &= \frac{\Delta nb}{nLw}>0 \\ \left(t''-t\right) &= \frac{\Delta ntw}{nLw}>0 \end{aligned} \tag{4}$$

[6]This ignores the general revenue contribution to Medicare.

[7]This ignores the effect the baby-boomers would have on wages and interest rates if the technology were strictly concave rather than linear. It also ignores wage growth over time.

That is, when the baby-boomers retire the payroll tax rate rises to offset both the drop in payroll taxes and the rise in benefits paid. When the baby-boomers die, the tax rate falls since benefits fall, but the tax rate does not fall all the way back to the level when the baby-boomers were in the labor force.

Similarly, for non-social security budget balance, preserving the level of public debt, the income tax rate varies, with only two levels since retirement benefits do not directly impact the income tax rate.

$$\begin{aligned} (N + \Delta N)\, LTW &= rG \\ NLT'W &= rG \\ NLT''W &= rG \end{aligned} \tag{5}$$

Thus, $T' = T''$. Before the baby-boomers entered the labor force, the tax rates were t'' and T'' as well.

In this setting we will consider a temporary increase in the payroll tax rate, possibly offset by a temporary decrease in the income tax rate.

2.1.1 Consumption

Our interest in national capital is derived from our interest in consumption. In the baseline, workers consume their net-of-tax wage. Thus all workers in the labor force have the same consumption in any period. This consumption level is highest while the baby-boomers are in the labor force, lowest when they are retirees, and intermediate after they have died. The primary purpose of the policy being examined is to shift consumption of workers from the years when baby boomers are in the labor force to the years when they are retirees.

For a saver, planned per-period consumption is constant during his or her lifetime, whatever the (predicted) pattern of taxes. The level of consumption varies by birth year however. The more years of higher income taxes, the lower the per period consumption. Thus, the highest consumption belongs to the baby boomers.[8] For those older than the baby-boomers and overlapping with them in the labor force, the older they are, the lower lifetime consumption because they have one more year of income tax rate T'' (before the baby-boomers have entered the labor force) and one fewer year at tax rate T (when they overlap). For those younger than the baby-boomers who overlap

[8]This ignores the effect the baby-boomers would have on wages and interest rates if the technology were strictly concave rather than linear.

with them in the labor force, the later their birth year the lower lifetime consumption because of having one fewer year at tax rate T and one more year at tax rate T' or T''. Any changes in income taxes which are induced by the changes in payroll taxes will shift consumption across cohorts.

2.2 Temporary Payroll Tax Increase

To match the pattern in the 1983 legislation, we consider an increase in the payroll tax rate during the remaining career of the baby-boomers of $\Delta t > 0$, with the plan of using the revenue to lower the payroll tax later.[9] As a result, social security enters the retirement period of the baby boomers with a larger trust fund. Using both the interest on the larger trust fund and the increase in the fund itself, there is then a temporary payroll tax rate change during their retirement period of $\Delta t' < 0$. We assume that the tax change is sufficiently small that the payroll tax rate is still higher during the retirement of the baby-boomers than either earlier or later. We assume that both the tax rate and the trust fund return to their baseline levels once the baby-boomers have died. Then, the two tax rate changes are linked by having a zero present discounted value:

$$\Delta t \left(nL + \Delta n\right) \sum_{z=1}^{S-1} R^{z-1} = -\Delta t' nL \sum_{z=S}^{S+D} R^{z-1} \tag{6}$$

That is, payroll taxes are raised until the baby-boomers retire, which happens in period S. Payroll taxes are lowered during the $D - L$ periods of their retirement. This equation illustrates how the trade-off between taxes before the baby-boomers retire to taxes afterwards depends on how early in their career the temporary tax increase is legislated to begin.

2.2.1 Consumption Change

For workers in the labor force, the policy change implies a drop in consumption during all the periods that the baby-boomers are in the labor force and a rise during the period they are retired. Thus the baby-boomers, who have the highest lifetime consumption in the baseline have the largest decrease in lifetime consumption.

[9] Since we are considering only the payroll tax rate change during the retirement period of the baby-boomers, there is nothing revealed by extending the tax increase into their retirement period.

This policy has two effects on the consumption of workers. For workers who are in the labor force during the periods of higher and lower tax rates, consumption is redistributed from higher consumption years to lower consumption years. In addition, since there are different taxpayers in different years, the payroll-tax policy involves redistribution Those who are in the labor force relatively more of the years that the baby-boomers are also in the labor force have a drop in the PDV of consumption. The redistribution goes to those who are in the labor force relatively more of the years that the baby-boomers are retired. For example, those older than the baby-boomers have a drop in consumption, with no offsetting increase. Those entering the labor force after the baby-boomers retire have a rise in consumption, with no offsetting decrease. Between these two groups, workers have a drop in consumption followed by a rise in consumption. Then sign of the net PDV depends on date of birth.

2.2.2 Change in Capital from the Trust Fund

In each period while the baby-boomers are working there is a primary surplus of $\Delta t\left(nL+\Delta n\right)$. All of these surpluses accumulate with interest. Once the baby-boomers have retired, there is a primary deficit, a budgetary balance of $\Delta t' nL$, which results in a decline in the trust fund and so the interest earned on the trust fund. Thus the change in the trust fund at the end of period z is:

$$\begin{aligned}\Delta F_z &= \Delta tw\left(nL+\Delta n\right)\sum_{i=1}^{z}R^{z-i} for 1\leq z<S \\ \Delta F_z &= \Delta F_{S-1}R^{z-S+1}+\Delta t' wnL\sum_{i=S}^{z}R^{z-i} for S\leq z<S+D-L \quad (7)\end{aligned}$$

That is, the extra tax revenue is accumulated during the remaining working life of the baby-boomers (up to the start of period S) and then decumulated during their retirement period, reaching zero at the end of their last period of life. The growth of the fund is a contribution to national savings in any period and the increase in the fund, ΔF_z, is a contribution to national capital.

Since payroll taxpayers consume all of their after-tax income, there are no changes in private savings as a direct consequence of the payroll tax rate increase.

2.3 Temporary Income Tax Decrease

We consider a mechanistic model of the income tax-setting process. In the baseline, the non-social security budget is balanced in each period. We assume that the income tax reacts to the change in payroll taxation by changing the income tax rate to offset the fraction α ($0 \leq \alpha \leq 1$) of any social security surplus or deficit. In the initial period we have

$$\alpha nLw\Delta t = -NLW\Delta T \tag{8}$$

with the same relationship holding in later periods. Thus the policy response is assumed to be symmetric and to depend only on contemporaneous budget balance, not the level of the debt nor the projection of future budgetary outcomes. Just as the payroll tax changes satisfy a PDV constraint, the linearity and symmetry of the response imply that the same is true for income tax changes

$$\Delta T\left(nL + \Delta n\right)\sum_{z=1}^{S-1} R^{z-1} = -\Delta T' nL \sum_{z=S}^{S+D-L-1} R^{z-1} \tag{9}$$

If we did not have this relationship, we would have a permanent change in the level of debt, which, in turn, would require a permanent change in taxes to finance interest payments.

2.3.1 Change in Capital from the Public Debt

Given the symmetry of responses to surpluses and deficits (and the inelastic supply of labor and taxation only of labor) the relationship between the public debt and the trust fund is simple. Any change in the trust fund induces a change in the public debt of α times the change in the trust fund.[10]

$$\Delta G_z = \alpha \Delta F_z \tag{10}$$

Thus the debt held by the public falls by $(1 - \alpha)$ times the rise in the trust fund. We are assuming that interest payments are treated the same as other expenditures in this induced tax policy. Moreover we are assuming no feedback from debt levels to income tax policy. Thus the non-social security budget not only runs a deficit while the social security is running a surplus,

[10]Note that the additional interest paid on the public debt is α times the additional interest earned by social security.

but the non-social security budget runs a surplus when social security is using the interest and assets in the trust fund to lower the payroll tax rate, thereby running a deficit.

The contribution to national capital, before accounting for the response of private savers is equal to the change in the debt held by the public, which is the change in the trust fund less the change in total public debt. Apart from the changes in private saving, in terms of national capital, the payroll tax policy and induced income tax response together are equivalent to having a payroll tax change that is only $(1 - \alpha)$ as large and no offsetting income tax change. However, there are differences between the two taxes in their effects on private savings.

2.3.2 Private Savings

As with the payroll tax (but in reverse), we have two effects - one from a change in the timing of taxes for savers in the labor force before and during the baby-boomers' retirement and a redistribution to savers with relatively more time in the labor force at the same time as the baby-boomers from those who are in the labor force relatively more while the baby boomers are retired.

Life-cycle optimizers anticipate future as well as current tax changes and spread the change in their lifetime taxes over consumption during their remaining lifetimes after an unexpected tax change. Thus, there is an impact of the income tax change on private wealth accumulation, unlike the absence of an effect of the payroll tax change on people who do no savings. The effect of a delay in taxation for a given PDV of taxes is to increase savings in order to pay the taxes. Indeed, if there were no redistribution across cohorts, the savers would accumulate precisely as much additional savings as the addition to the public debt held by the public, resulting in no impact on either consumption or capital accumulation of the induced change in income taxes. For example, this would hold, given the assumptions on the different taxes, in the model of Mankiw (2000a, 2000b), where in addition to liquidity-constrained workers who do no savings, there are only infinite-horizon savers. However, I think that many life-cycle savers do not react to tax changes so far into the time after their death. Thus I analyze strict life-cycle savers,without a bequest motive. Adding a third group of infinite-horizon savers would be simple, since their response to income tax changes simply offset the government budget effect. For strict life-cycle savers, we need to consider the second

element in the effects of the policy, namely redistribution from later cohorts, supplying relatively more labor when taxes are increased and relatively less when taxes are decreased.

If the initial period comes sufficiently late in the lives of the baby-boomers, there are one or more cohorts of workers who are in the labor force in the initial period and will remain in the labor force throughout the retirement of the baby-boomers. Any such cohorts break even from the income tax changes on a PDV basis.[11] Cohorts older than these gain from the policy change and younger cohorts lose, provided they enter the labor force before the baby-boomers die. As is standard in OLG models, this redistribution results in more consumption by the earlier cohorts and less consumption by the later cohorts and so a decrease in capital from the initial period until the youngest cohort affected by the income tax change has died.

Simply put, those (older than the baby-boomers) who receive tax cuts spread the extra income over their entire lives, thereby holding more wealth in every period they are alive. Those who receive a tax cut followed by a tax increase do additional saving beforehand in order to offset the increase in taxes once the tax rate increases. But those who will receive only a tax increase will consume less and so hold less wealth throughout their lives.

Thus, the private savings response is an increase in wealth up to and including the period when the baby-boomers are retired, with a decrease in wealth for some period of time afterwards. To explore the impact on national capital, we need to examine the behavior of savers in the labor force when the tax policy begins and also those not yet in the labor force in the initial period who will be during some period prior to the death of the baby-boomers.

We consider separately savers in different cohorts - those at least as old as the baby-boomers and working in the initial period, those younger than the baby boomers and in the labor force in the initial period, those entering the labor force after the initial period and before the baby-boomers retire, and those entering the labor force while the baby-boomers are retired. Note that the baby-boomers are $L + 1 - S$ years old in the initial period.

Those at least as old as the baby boomers have lower taxes during their remaining working lives and never have a period of higher taxes. Since they spread their extra net-of-tax incomes over their entire lives, for a worker of

[11] If there is no such cohort, then the break-even occurs for a cohort in the labor force part of the time taxes are lower and part of the time they are higher.

age j in the initial period, $j \geq L+1-S$, consumption changes as:

$$\Delta C_j \sum_{i=j}^{D} R^{-i} = -W\Delta T \sum_{i=j}^{L} R^{-i} \tag{11}$$

With $\Delta T < 0$, we have $\Delta C_j > 0$. Thus we have a contribution to private savings of the change in net-of-tax earnings less the change in consumption:

$$-W\Delta T - \Delta C_j = -W\Delta T \left(1 - \frac{\sum_{i=j}^{L} R^{-i}}{\sum_{i=j}^{D} R^{-i}}\right) > 0 \tag{12}$$

There is also savings of the interest earnings on increased wealth. Therefore, during their working lives, the change in their wealth at the end of period z, $\Delta K_{j,z}$, satisfies

$$\Delta K_{j,z} = (-W\Delta T - \Delta C_j) \sum_{i=1}^{z} R^i > 0 for z \leq L-j \tag{13}$$

Once they are retired, they hold enough wealth to finance consumption over the rest of their lives.

$$\Delta K_{j,z} = \Delta C_j \sum_{i=1}^{D-j-z} R^{-i} > 0 for L-j < z \leq D-j \tag{14}$$

Making use of the change in consumption (equation 11), we can write these as

$$\begin{aligned} \Delta K_{j,z} &= -W\Delta T \left(1 - \frac{\sum_{i=j}^{L} R^{-i}}{\sum_{i=j}^{D} R^{-i}}\right) \sum_{i=1}^{z} R^i for j \leq L-z \\ \Delta K_{j,z} &= -W\Delta T \left(\frac{\sum_{i=j}^{L} R^{-i}}{\sum_{i=j}^{D} R^{-i}}\right) \sum_{i=1}^{D-j-z} R^{-i} for L-j < z \leq D-j \end{aligned} \tag{15}$$

Those who are younger than the baby-boomers and working in the initial period have some time with reduced payroll taxes as well as a period with increased taxes. Provided they retire before the baby-boomers die, their budget constraints are

$$\Delta C_j \sum_{i=j}^{D} R^{-i} = -W\Delta T \sum_{i=j}^{j+S-1} R^{-i} - W\Delta T' \sum_{i=j+S}^{L} R^{-i} \tag{16}$$

From the break even constraint for the income tax changes, these people have an increase in life-time income and so, like the baby-boomers, have more wealth throughout their lives.

If there are workers in the initial period who are still in the labor force when the baby-boomers die, their consumption does not change. They save all of their tax decrease up to period S in order to pay higher taxes in period S and after. So they too hold more wealth throughout the lives of the baby-boomers. If there are such workers, then all those entering the labor force after the initial period (and while the baby-boomers are still alive) have a decrease in their lifetime budget constraint and so in per-period consumption. They save more than their tax decrease up to period S. Thereafter they decumulate, reaching the baseline level of wealth before the death of the baby-boomers, since the wealth they need for lower consumption in later years is less.

If the youngest worker in the initial period retires before the baby-boomers die, then there is a cohort that enters the labor force while the baby-boomers work and retires while the baby-boomers are retired and roughly breaks even on a lifetime basis.[12] Since consumption does not change, they save all of their lower taxes up to period S, and dissave thereafter, reaching the baseline wealth holdings when they retire (since future consumption financed by wealth is unchanged). Those entering the labor force between the initial period and the entry of this break-even cohort have increased lifetime consumption. Thus they accumulate more wealth throughout their lives to finance later taxes and higher retirement consumption. Those entering the labor force in a later year have decreased lifetime consumption, with an amount that varies with the year they enter. Thus they save more than the amount of their lower income taxes until period S, having higher wealth than in the baseline and then lower wealth, ending up with lower wealth when the baby-boomers die and the tax returns to its long-run level.

For those entering the labor force in year j, with $1 < j < S$, and abusing notation somewhat by also calling this ΔC_j, we have different budget constraints depending on whether they retire before or after the baby-boomers

[12]With continuous time, some cohort would exactly break even, with older cohorts gaining and younger cohorts losing. The statement about other cohorts holds for the one that "roughly" breaks even in the discrete time setting.

die:

$$\begin{aligned}\Delta C_j \sum_{i=1}^{D} R^{-i} &= -W\Delta T \sum_{i=j}^{S-1} R^{-i} - W\Delta T' \sum_{i=S}^{j+L} R^{-i} \\ \Delta C_j \sum_{i=1}^{D} R^{-i} &= -W\Delta T \sum_{i=j}^{S-1} R^{-i} - W\Delta T' \sum_{i=S}^{S+D-L-1} R^{-i} \end{aligned} \tag{17}$$

Those who enter the labor market in year S or later (up to $S+D-L-1$) experience only a higher income tax rate than they would have. Continuing to abuse notation by also calling this ΔC_j, we have

$$\Delta C_j \sum_{i=1}^{D} R^{-i} = -W\Delta T' \sum_{i=j}^{S+D-L-1} R^{-i} \tag{18}$$

Since their decrease in consumption is less than their increase in income taxes, they save less than in the baseline.

2.4 National Savings

Putting these piece together, let's look at capital at three dates. In the initial period, workers decrease consumption by the full amount of the payroll tax increase. All of the savers in the labor force increase their consumption by less than the income tax decrease. Indeed, if there are some young enough to anticipate being in the labor force for the full time the baby-boomers will be alive, they do not increase their consumption at all. The largest increase in consumption comes from the baby-boomers themselves, with a size that depends on their age in the initial period. Let us denote this age by J. Then, from their budget constraint we see that

$$\frac{\Delta C_j}{-W\Delta T} = \frac{\sum_{i=J}^{L} R^{-i}}{\sum_{i=J}^{D} R^{-i}} \tag{19}$$

The younger the baby boomers in the initial period the larger this fraction. If the initial period is their first period of work, then assuming a 40-period career and 20-period retirement and a 3% continuously compounded real interest rate (and so a continuous time calculation), the ratio of the consumption increase to the tax decrease is 0.84. That is the fraction of the income tax decrease that is saved by the baby-boomers if they are the youngest in

the labor force is 16 percent. A saver on the verge of retiring saves 94 percent of the income tax decrease. If the baby boomers were half way through their working lives, the fraction saved would be 35 percent. In this case there would be younger workers who would save larger fractions. Furthermore, the income tax decrease may lose less revenue than the payroll tax increase if $\alpha < 1$.

Turning to capital at the start of period S (the end of $S-1$), every saver alive at this time has positive additional wealth as a result of the income tax decrease.

In all periods between the initial period and the retirement of the baby-boomers we have more capital than just the net decrease in the debt held by the public.

We noted that there are one or more cohorts that break even or roughly break even, with older cohorts gaining and younger cohorts losing. Once this break-even cohort has died, all remaining affected cohorts paid more in taxes and so have less consumption. Therefore they have less wealth than in the baseline. Both the trust fund and the public debt have returned to their baselines. Thus national capital is less.

3 Permanent Fund Increase

We began by considering a simplified version of the policy as legislated in 1983. We turn now to the implications of making a permanent increase in the trust fund. Assume that the government increases the payroll tax rate by Δt for one period, using the revenue to permanently increase the trust fund, with the additional interest earnings used to lower the payroll tax rate thereafter. As above, assume that the government decreases the income tax in the initial period by an amount chosen to offset the fraction α ($0 \leq \alpha \leq 1$) of the additional payroll tax revenue, with no changes in either public consumption or government investment.

$$\alpha n L w \Delta t = -NLW\Delta T \tag{20}$$

We assume unified budget balance in all later periods. That is, we are assuming that the deviations from budget balance for the non-social security budget are $-\alpha$ times the deviations in the social security budget. The analysis would be different if the non-social security budget responded to the social security payroll tax revenue less benefit payments, thereby ignoring

the interest on the trust fund. Initially this policy change decreases the debt held by the public by $(1-\alpha)$ times the increase in the trust fund. That is, G increases by α times the increase in F. The trust fund increases in the initial period by $nLw\Delta t$. Thereafter, neither the trust fund nor the debt held by the public make further changes.

With benefits and cohort size unchanged, the payroll tax rate can be reduced because of the interest on the increased revenue from the initial tax increase. Thus, the payroll tax rate after the initial period, t', satisfies

$$t' = t - r\Delta t \tag{21}$$

Similarly, the income tax rate thereafter, T', is increased to pay the increase in interest from the increase in the public debt

$$T' = T - r\Delta T = T + \alpha r \frac{nw}{NW}\Delta t \tag{22}$$

That is, there is an intertemporal trade between payroll taxpayers and income taxpayers, which is balanced in PDV. This also involves changes in the timing of tax payments by each agent and redistribution across cohorts of each type.

The central question is what happens to the time shape of national capital.

3.1 National savings in the initial period

To analyze the impact of the changes in payroll and income taxes on national savings in the initial period we can examine the changes in consumption of workers and savers. In the period of the initial tax change, the aggregate consumption of workers falls by their tax increase: $nLw\Delta t$. In all later periods, the aggregate consumption of workers is higher by $rnLw\Delta t$. This is equal to the return on the increase in the trust fund.[13] Thus, if the trust fund increase were fully an increase in national savings, there would be no impact on national savings after the initial period as the increase in consumption by workers would match the increase in national income. That is, national capital would increase in the initial period and remain at the higher level thereafter. This would be the case in this model if the government did not alter the income tax ($\alpha = 0$). But we have assumed that the income tax

[13]The lack of growth of the labor force simplifies the calculation.

may change, so we must examine the response of savers to the income tax changes, which is more complicated.

The change in income tax in the initial period for a saver who is still working is $W\Delta T$, equal to $-\alpha nw\Delta t/N$. Thereafter there is a tax change of $-rW\Delta T$, equal to $\alpha rnw\Delta t/N$ in each of the remaining $L-z-1$ periods until retirement for a saver of age z in the initial period. In PDV terms, the tax change for an age z saver is $(\alpha nw\Delta t/N)\left(-1+r\sum_{s=z+1}^{L}R^{z-s}\right)$. With a discount rate equal to the interest rate, each saver preserves equal consumption in each remaining period of life. With an unexpected change in taxes starting at age z, the change in consumption each remaining period of life that preserves equality of consumption for the rest of life, is

$$\Delta C_z \sum_{s=z}^{D} R^{z-s} = (\alpha nw\Delta t/N)\left(1 - r\sum_{s=z+1}^{L} R^{z-s}\right) \tag{23}$$

The change in consumption in the initial period is less than the tax cut for two reasons - anticipation of future tax increases and the spreading of consumption over the rest of life.

Summing over working savers, we get an initial consumption increase for savers of

$$\Delta C = N\sum_{z=1}^{L}\Delta C_z = \alpha nw\Delta t\sum_{z=1}^{L}\frac{1-r\sum_{s=z+1}^{L}R^{z-s}}{\sum_{s=z}^{D}R^{z-s}} \tag{24}$$

The change in national savings, ΔNS, in the initial period is equal to minus the change in aggregate consumption:

$$\begin{aligned}\Delta NS &= nw\Delta t\left(L-\alpha\sum_{z=1}^{L}\frac{1-r\sum_{s=z+1}^{L}R^{z-s}}{\sum_{s=z}^{D}R^{z-s}}\right)\\ &= nw\Delta t\sum_{z=1}^{L}\left(1-\frac{\alpha}{\sum_{s=z}^{D}R^{z-s}}+\alpha r\frac{\sum_{s=z+1}^{L}R^{z-s}}{\sum_{s=z}^{D}R^{z-s}}\right)>0\end{aligned} \tag{25}$$

If savers were to consume all of their income tax cut in the initial period and the tax cut balanced the unified budget ($\alpha=1$), there would be no increase in national savings. But they do not consume all of the income tax cut. They save part of their initial tax cut to finance later consumption and part of it to finance higher tax payments in their remaining working years. Thus national savings increase in the initial period even if $\alpha=1$. Insofar as α is less than one there is a further increase in savings in the initial period.

3.2 National capital in the steady state

In later years the pattern changes. Once the savers who received the initial tax cut have all died off, all savers have the same net earnings and so same consumption and we are in a steady state. To examine the impact on steady-state capital, we can consider the impact on consumption since in a steady state with no growth, aggregate consumption equals aggregate output. With a linear technology, the change in output is equal to the interest rate times the change in capital. For convenience we now switch from discrete time to continuous time.

In aggregate, workers have consumption which is higher by the amount of their tax decrease: $rnLw\Delta t$. For savers we need to consider lifetime planning, which determines the constant level of consumption that they choose. We need to calculate how their consumption changes in response to an income tax rate increase of $\alpha rnw\Delta t/NW$.

The lifetime budget constraint for a saver is

$$C' \int_0^D e^{-rs} ds = W\left(1 - T'\right) \int_0^L e^{-rs} ds \tag{26}$$

or

$$C' = W\left(1 - T'\right) \frac{1 - e^{-rL}}{1 - e^{-rD}} \tag{27}$$

The change in aggregate consumption by savers is $ND\Delta C' \left(= -W\Delta T' \frac{1-e^{-rL}}{1-e^{-rD}}\right)$, which equals $-D\frac{1-e^{-rL}}{1-e^{-rD}}\alpha rnw\Delta t$.

Adding the two pieces, aggregate consumption changes by $rnLw\Delta t - D\frac{1-e^{-rL}}{1-e^{-rD}}\alpha rnw\Delta t$, which equals $rnw\Delta t\left(L - \alpha D\frac{1-e^{-rL}}{1-e^{-rD}}\right)$. Thus aggregate capital changes by $nw\Delta t\left(L - \alpha D\frac{1-e^{-rL}}{1-e^{-rD}}\right)$.

Note that if D were equal to L and α equal to 1, this expression would be zero. Moreover, the expression $\frac{D}{1-e^{-rD}}$ is increasing in D, implying that the expression is everywhere negative for $\alpha = 1$ and $D > L$, i. e., assuming the dead do not work. Thus if $\alpha = 1$, capital is decreased in the steady state. The result follows from the same logic as above, run in reverse. Workers have lower taxes, all of which flows into higher consumption. Savers have higher taxes, but the induced consumption decrease is spread over their entire lives. With positive interest, there is a smaller consumption decrease for savers than the increase in consumption of workers.

Thus national capital increases in the steady state if $\alpha = 0$ and decreases in the steady state if $\alpha = 1$. For intermediate values of α we get an increase or

decrease depending on whether α is below or above a critical value, denoted α^*. To find this critical value, we set the change in aggregate capital to zero:

$$\alpha^* = \frac{L\left(1 - e^{-rD}\right)}{D\left(1 - e^{-rL}\right)} \tag{28}$$

For example, with $L = 40$, $D = 60$, and $r = .03$, we have $\alpha^* = .8$. That is, long-run capital is increased if the income tax cut uses up no more than 80 percent of the revenue raised by the payroll tax increase.

4 Extensions

The model was simplified by assuming a stationary population. In Appendix A is a presentation (not yet available) of an extension of the analysis to a growing economy. In some, but not all, places in the equations, this results in replacing the interest rate by the difference between interest and growth rates. Extending the model to include public consumption expenditures is more complex and is shown in Appendix B (not yet available). So too would be addition of the realistic possibility that the level of debt also affects budgetary policy (not yet available).

4.1 Fiscal policy affected by debt levels

In the formal model, legislated decisions about income taxes and expenditures are influenced by the deficit but not the level of debt. This simplification is missing an effect that is plausible (at least for high levels of debt) and has been found by Bohn (1998). While the debt level influences the deficit level through interest expenditures, it is plausible that there is also a direct influence. (Also missing in the model is any effect of debt levels on government interest rates.)

5 History

I have not done or read a detailed history of the budgetary process as Congress attempted to deal with the large deficits that followed the Reagan tax cut. My impression as a daily newspaper reader was that after the initial tax increases, Congress continued to feel that the deficits were much

too large but had difficulty reducing them. To reduce the deficit, Congress needed some combination of higher taxes and/or lower spending. But raising taxes and lowering spending on existing programs are both politically difficult acts because of potential voter backlash. So Congress moved to lower deficits in a slow manner. My reading of the period of large deficits is that the members of Congress were fully aware of the distinction between budgetary deficit measures, whatever fraction of the public was. Moreover, however measured, the deficit was larger than Congress wanted from a public policy perspective. The extent of legislation lowering the deficits was limited by the political difficulty of raising taxes and lowering spending, suggesting that the response was roughly independent of the exact size of the deficit. If this is the right description of Congress in the 80's and early 90's, then pretty much none of the Social Security surplus was offset by other fiscal actions.

The story becomes different once the deficits became smaller and then turned into surpluses. The switch to a publicly-stated target in terms of the non-Social Security budget suggests that the surplus was not offset during that period. However, I suspect that the initial choice of vocabulary (non-Social Security budget balance in 2002) was chosen to have a salient and feasible deficit target, making the role of Social Security surpluses less clear. It is plausible that the impact of a Social Security surplus on the rest of the budget is larger when the deficit is smaller or a surplus. Whether the Bush administration would have sought and obtained roughly the same tax cut in 2001 if there had not been a Social Security surplus is not clear - they were careful to point out that the projections did not involve using the Social Security surplus to cover a projected non-Social Security deficit. Their continued drive for tax cuts in the presence of unified deficits leaves the role of the Social Security surpluses unclear.

I believe that insight into the counterfactual of budgetary policy without the trust fund buildup can only come from case studies. Attempts to do time series analysis (e. g., Smetters, 2002) seem doomed by the short time period since 1983 (or 1977) when the political setting might be considered stochastically similar and the complex intertemporal links between legislation in some years and taxes and spending in later years. Specific pieces of legislation imply different time shapes of revenues and spending changes, there is no simple link between deficits and lagged deficits that could reliably be discovered by time series analysis.

It is impossible to be certain about the counterfactual pattern of taxes and spending if the 1983 Social Security legislation had had lower tax rates

and so no buildup of the trust fund. In the rest of this section I review what Sylvester Schieber and John Shoven (1999) have written about this interaction.

5.1 Schieber and Shoven

I quote extensively from this book about first the buildup of the trust fund and then the eventual use of the assets in the fund for benefits.[14] Their book contains elements that have been stated widely. On the former, they write (pages 204-5):

"The answer to our question whether the Social Security trust fund balance represents wealth that can benefit future generations depends on unobservable or counterfactual behavior. What would federal government spending have been and, for that matter, what would tax collections have been, if the government hadn't had access to Social Security's cash-flow surplus over the last fifteen years or so? The question cannot be answered with certainty, but Figure 13.5 provides some clues. There we see the excess of OASDI revenues, not including interest on the previously accumulated bonds, over costs and the so-called on-budget surplus of the federal government. The figure shows that for the years 1985-1997 the Social Security cash-flow surplus was dwarfed by the deficits in the rest of the federal government budget. To be sure, this doesn't directly answer our question, but it does add to the likelihood that the $757 billion pile of government bonds has not made the future population wealthier."

They correctly present the issue as evaluating a counterfactual. Then they assert, as have others, that the presence of large deficits "does add to the likelihood" that the surplus was not saved. They indicate no logic whatsoever that leads to their conclusion.[15] One such logic might be that large deficits increase the magnitude of offsetting fiscal actions because the marginal response of the non-Social Security budget to the Social Security budget is larger when the deficit is larger. I have argued above that I think this is backwards. Both lower deficits and particularly surpluses in the non-Social Security budget seem to me settings where the impact of a Social Security surplus is likely to be larger, not smaller. At a minimum Schieber

[14]They also discuss the possible allocation of any increased spending in terms of a division between consumption and investment.

[15]Indeed, in terms of percentages of GDP, the largest total deficit (6.0 percent) occurred in 1983 when there was no Social Security surplus.

and Shoven should have given some reason for their conclusion, instead of merely asserting it without explanation.

Turning to the use of the assets in the fund, they write (page 207):

"It may be interesting to review what will happen when the contributions to Social Security begin to fall short of benefit payments in about 2012. At some point slightly later than that, Social Security will need to turn in its bonds to the rest of the federal government and ask for payment. Money will be transferred from the rest of the government to the Social Security system in return for the bonds. Where will the money come from? Presumably from taxes or government borrowing. But these are the same choices that the government would face if the system didn't have the bonds and simply asked for a bailout. The point is that the bonds have helped save the system only if they have resulted in greater investment in the economy and hence higher productivity and higher wages for those who are going to have to either pay the taxes or buy the bonds. Selling the bonds to the rest of the government doesn't really generate money by itself, because in a very real sense, we are selling them to ourselves. Both the accumulation of these bonds and their liquidation are accounting transactions-they don't guarantee real saving during the accumulation phase and real dissaving during the spend-down phase. All in all, the trust fund balances do not offer much reason to be sanguine about the burden we are passing on to future generations."

This quote calls for two observations. First, the bonds help the system even if there is no national savings insofar as one recognizes a difference between income and payroll taxpayers. Second, in light of possible increased savings, consider the statement, also made by a number of other observers: "Where will the money come from? Presumably from taxes or government borrowing. But these are the same choices that the government would face if the system didn't have the bonds and simply asked for a bailout." Ignoring printing money, the government gets money for some purpose from increasing taxes, cutting spending for other purposes or borrowing. In the sense that the available set of actions is the same the statement is factually accurate. But in no way is this an interesting sense. As they acknowledge, insofar as there is increased national capital the same choices are happening in a different context. Insofar as there is increased national capital, there are resources accumulated for later needs and there is more output that can be used for consumption and investment. In the sense of the available set of consumption and investment outcomes, any induced increase in national capital implies a better set of alternative actions. Thus the statement, while

factually accurate, could easily mislead - it is the level of national capital not the fact that some of it is being used for benefits that is relevant for evaluating this policy.

6 Concluding Remarks

The distributions of income and social security taxes are very different. Assuming proportional cuts in income taxes in response to a surplus generated by the payroll tax, there are winners and losers from the two tax changes. Also, there are future winners and losers insofar as current tax changes result in future tax changes. It was convenient to model the economy with savers paying only the income tax and workers paying only the payroll tax. In order to interpret the results, we need to consider the net change in taxes for each group that comes about from the policy change. We have no simple way of distinguishing savers from workers, but approximating this by assuming that top quintile of individuals in terms of family income are savers and the rest are workers, roughly one-third of the payroll tax change can be modeled as above (see footnote 4).[16] For the other two-thirds, an offsetting income tax change results in no net effect.

Given my view that very little of the Social Security surplus showed up in changes in the rest of the budget, I think that most of the surplus has represented an increase in national savings. Taking a view that the political process was more responsive to this change in the unified budget balance, one still has a short run increase in savings, while in different years after the baby-boomers retire, there are increases and decreases in capital.

7 References

Bohn, Henning. The Behavior of U. S. Public Debt and Deficits? unpublished, 1998.

Congressional Budget Office. Estimates of Federal Tax Liabilities for Individuals and Families by Income Category and Family Type for 1995 and 1999, May 1998.

Diamond, Peter (ed.). *Issues in Privatizing Social Security.* Cambridge, MA: MIT Press. 1999.

[16]This assumes that the income tax change is proportional to average taxes.

Diamond, Peter and John Geanakoplos. Social Security Investment in Equities. American Economic Review, forthcoming.

Dynan, Karen E., Jonathan Skinner, and Stephen P. Zeldes, Do the Rich Save More? NBER WP 7906, September 2000.

Elmendorf, Douglas W. and Jeffrey B. Liebman. Reform and National Saving in an Era of Budget Surpluses. Brookings Papers on Economic Activity, 2000, 2, 1-71.

Mankiw, N. Gregory, The Savers-Spenders Theory of Fiscal Policy, American Economic Review, 90, May 2000, 120-125.

Mankiw, N. Gregory, The Savers-Spenders Theory of Fiscal Policy: A Correction, unpublished, July 2000.

Niskanen, William A. Comment. in J. Frankel and P. Orszag (eds.) American Economic Policy in the 1990s. Cambridge: MIT Press, 2002.

Saez, Emmanuel. The Desirability of Commodity Taxation under Non-Linear Income Taxation and Heterogeneous Tastes, Journal of Public Economics,83, 217-230, 2002.

Schieber, Sylvester J. and John B. Shoven. The Real Deal. New Haven: Yale University Press. 1999.

Smetters, Kent. Is the Social Security Trust Fund Worth Anything? unpublished, 2002.

Social Security Administration. Annual Statistical Supplement, 2002.