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PROGRESSIVITY OF CAPITAL GAINS TAXATION WITH OPTIMAL PORTFOLIO SELECTION

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PROGRESSIVITY OF CAPITAL GAINS TAXATION WITH OPTIMAL PORTFOLIO SELECTION

ABSTRACT

We provide new data on capital gains realizations using a five-year stratified panel of taxpayers covering 1985-1989. We find, as earlier studies have, that capital gains realizations are very concentrated among the highest income groups. We use these data and data from the Federal Reserve Board *Survey of Consumer Finances* to draw inferences from a simulation model of the effects on progressivity and efficiency of alternative tax treatment of capital gains.

Tax payments alone are not an accurate indication of the burden of a tax. Taxes generally create costs beyond the dollar value collected by causing persons to change their behavior to avoid the tax. Risk is also affected by the tax system. Beneficial risk-sharing characteristics of the tax system are frequently overlooked when examining the treatment of capital gains. We find that reforms comprising reductions in the capital gains tax rate offset by increases in the tax rate on other investment income are efficiency *reducing*. Surprisingly, we find that for taxpayers for whom loss limits are not binding a switch to accrual taxation is also efficiency *reducing*. For those taxpayers for whom loss limits are potentially binding, we find that large efficiency gains can be achieved by increasing the amount of capital losses that may be deducted against ordinary income. These results are partly attributable to changes in risk-sharing encompassed in these reforms.

1. Introduction

The debate over capital gains taxes has served as a focal point for the larger debate over the desired progressivity of the tax system. Some argue that a reduction in the capital gains tax rate predominantly benefits upper-income taxpayers. Others argue that taxpayers in all income groups receive capital gains and that once-in-a-lifetime gains artificially distort the concentration of gains by income class. In addition to the concern over progressivity, there are debates on the efficiency consequences of capital gains taxes: the degree to which they hinder or promote saving and investment and their effects on portfolio behavior.

In this paper we present new data from the Internal Revenue Service on capital gains realizations between 1985 and 1989 and data from the Federal Reserve Board *Survey of Consumer Finances* on stockholding. These data show a high concentration of stockholding and capital gains realizations in the highest income groups.

Next, we draw upon these data to examine distributional effects and portfolio responses to changes in the tax treatment of capital gains. A simple analysis of tax burden focusing only on tax payments is not an accurate indication of the burden of a tax. Taxes generally create costs beyond the dollar value collected by causing persons to change their behavior to avoid the tax. Economists have long noted the "lock-in" effect as one of these additional costs. Taxes also reduce the variance in after-tax returns. For risk-averse investors this reduction in variance is a benefit.

We examine capital gains taxes using a model based solely on utility-maximizing behavior. Econometric estimates of realization behavior in response to changes in tax rates are frequently criticized for relying on artificial or *ad hoc* specifications of the realization response. Kiefer (1990) presents a simulation model that demonstrates how the realization response can be modeled endogenously. This model, however, is atemporal: risk-neutral agents maximize the expected value of terminal wealth. Intertemporal models of risk-averse agents are modeled by Slemrod (1983), Cook and O'Hare (1992), and Galper, Lucke, and Toder (1988). This latter model is modified to estimate changes in portfolios and

trading behavior by Hendershott, Toder, and Won (1991, 1992). This model has a considerable amount of disaggregation, including 147 separate households, five financial assets, owner-occupied housing, and consumer durables. A corporate sector is modeled and its financial behavior with respect to debt-equity ratios and dividends versus retained earnings is endogenous. A cost of working with a model of this size is that portfolio selection and capital gains realizations decisions have to be simplified.[1]

We have opted instead to use a smaller, stylized model, but allow asset demands and realizations to be derived as solutions to the households' maximization of intertemporal utility of consumption. For this purpose, we incorporate alternative systems of capital gains taxation into a consumption-based model of portfolio selection. We consider a three-period model with two financial assets: a risk-free bond and risky stock. Our model is in the spirit of Auerbach's (1992) analysis based on a similar model. We differ from his analysis by explicitly allowing for a dividend component to stock returns, which analyses of historical data have found to be sizable. We also differ by providing a capital gains asset which is risky in both periods that it may be held, rather than only in the second. This seemingly slight difference is important, because the possibility of a capital loss affects initial asset holdings and realizations. A shortcoming of our model is that the constant *relative* risk aversion parameter, though popular for analysis of portfolio behavior, does not distinguish between risk aversion and elasticity of intertemporal substitution.[2] We hope to incorporate other forms of the utility function where this feature is not present in future research.

We find that reforms comprising reductions in the capital gains tax rate offset by increases in the

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[1] For example, exponential utility functions are used, because they allow derivation of explicit solutions. This utility function, however, displays constant *absolute* risk aversion (i.e., no change in the *amount* of risky asset holdings for different wealth levels). In addition, changes in taxation induce realizations in an *ad hoc* way, and its dependence on other factors such as incomes and risk aversion is ignored.

[2] The same parameter in this utility function affects both the willingness to substitute consumption across states of the world (within a single time period) and substitute consumption over time periods. Hall (1987) has noted the difficulty in separating these parameters in common utility functions. Epstein and Zin (1991) investigate a class of utility functions for which the effects of these parameters on behavior are better separated.

tax rate on other investment income are efficiency *reducing*. Surprisingly, we find that for taxpayers for whom loss limits are not binding a move to accrual taxation is also efficiency *reducing*. These results are partly attributable to a reduction in risk-sharing encompassed in these reforms. We find that for those taxpayers for whom loss limits are potentially binding, large efficiency gains can be achieved by increasing the amount of capital losses that may be deducted against ordinary income.

In the next section we present data on capital gains realizations from tax return data. In section 3 we outline our model. Section 4 presents calculations of portfolio holdings and realizations under the benchmark tax system. In section 5, we examine the effects of alternative capital gains tax cuts. Section 6 examines accrual taxation. The final section presents conclusions.

2. Distribution of Capital Gains Income

This section presents data on the distribution of capital gains income using the Sales of Capital Assets panel data set for 1985-1989. Presently, the panel contains tax information on 11,452 taxpayers for each of the years between 1985 and 1989 (57,260 tax returns).[3] These data are stratified to oversample high-income taxpayers based on their income in 1985. Taxpayers in the highest income decile represent approximately 70 percent of the sample.

Two recent studies have examined capital gains realizations using a panel of tax return information in the public domain. Feenberg and Summers (1990) use a nonstratified panel of returns covering 1979 to 1984. Slemrod (1992) uses a more recent version of the nonstratified panel that includes 1985 and 1986.

These studies find that capital gains realizations in any given year are highly concentrated among taxpayers in the highest income groups. Gains tend to be much more heavily concentrated among these

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[3] The data set is not available in a public-use format. Data presented in this section are based on computations by John O'Hare and Cathy Koch of the Joint Committee on Taxation. The authors greatly appreciate the cooperation of these individuals and the Joint Committee on Taxation in performing these calculations.

high-income taxpayers than other forms of income.

These two studies also examine one standard criticism of studies based on cross-sectional analyses of capital gains: if capital gains are realized only infrequently, a taxpayer of moderate income who has a large one-time realization of capital gains will be classified as "rich" in a study focusing on only a single year's income and realizations. With a single year's data one could address this problem only by classifying taxpayers by an income concept that does not include capital gains. This approach, however, would understate the concentration of gains among taxpayers who have large recurring realizations.

The availability of panel data allow these studies to follow a taxpayer for a number of years to compare cumulative realizations to the taxpayer's average income over this extended period. Slemrod (1992), using the seven-year panel ending in 1985,[4] finds that a one-year study does overstate the concentration of capital gains income accruing to high-income taxpayers. However, even using cumulative capital gains over the seven-year period for each taxpayer and classifying each taxpayer by his average income over this seven-year period, Slemrod finds capital gains still are heavily concentrated among the highest income groups. Slemrod finds that the highest income percentile received 52 percent of all capital gains using the single-year approach, while using income measured over the seven-year period this percentile accounted for 44 percent of all capital gains earned. In contrast, the highest income percentile accounts for 8 percent of income from all sources, regardless of whether measured using the single-year or seven-year measure.

The findings that we report in this section are based on the most recent data available. Our ability to use a stratified random sample of returns reduces sample variance since previous studies have shown capital gains to be concentrated among high-income taxpayers. Our analysis generally confirms earlier findings of Feenberg and Summers (1990) and Slemrod (1992). In fact, we find even a slightly greater

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[4] Slemrod omits 1986 from the study in case of anomalous results due to the large quantity of capital gains realized in advance of the new provisions contained in the 1986 Tax Reform Act.

concentration of gains among the highest income decile than in the earlier studies. This may be due to our use of a stratified sample of returns or reflect a change in concentration over time.

We first examine the extent to which gains realizations tend to be a recurring event for taxpayers during the 1985-1989 period. Sales of stock, other securities, and partnerships comprise about one-half of capital gains. Except for the market crash of October 1987, this period was generally one of rising stock prices. By the close of 1989, the Standard & Poor's 500 composite index had increased by more than 100 percent relative to 1984 and by over 200 percent since June 1982.[5]

Table 1 presents data on the frequency with which net gains were realized by taxpayers between 1985 and 1989. Capital gains for this purpose include net capital gains reported on Schedule D, the excluded portion of long-term gains (for 1985 and 1986), and other distributions listed directly on Form 1040.[6] Over three-fourths of all taxpayers had no realized net gains over this period. Of those who reported a gain in at least one year, nearly 60 percent also reported a net gain in at least one other year. Thus, to some extent gains realizations appear to be a recurring event. Only 2.5 percent of taxpayers reported positive net gains in each of the five years, yet these taxpayers accounted for 42 percent of all net gains. For these taxpayers, capital gains realizations are not only frequent, but constitute a quantitatively important recurring source of income.

Table 2 examines the distribution of capital gains income across income groups. Capital gains

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[5] An important legislative event in this period was the enactment in September 1986 of the Tax Reform Act of 1986. This Act eliminated the 60 percent long-term capital gains exclusion effective January 1, 1987, and may have given some taxpayers an incentive to accelerate the realization of gains in 1986. Because realizations in 1986 may be unusual, all findings reported in the text were also examined for the four-year period excluding 1986. The exclusion of this year does not affect the annual rate of realizations across taxpayers or alter the general distribution of gains.

[6] Taxpayers who receive capital gain distributions from mutual funds and who engage in no other transactions may report these gains directly on Form 1040.

are defined here to include both net gains and net losses.[7] Income is defined to equal AGI plus (i) excluded gains and dividends (for 1985 and 1986) and (ii) statutory adjustments.[8] The panel data are used to examine the discrepancy between annual measures of the distribution of capital gains income and those based on longer periods of observation. In column 2 the data in the panel are treated as if they represented five different single-year observations. In column 3 the data are properly treated as a panel and the five-year distribution of capital gains income is examined relative to five-year income of the taxpayer. Columns 4 and 5 of Table 2 show the distribution of the income measure across income percentiles using both the single-year average and the five-year measure, respectively.

Examining the highest income percentile, one can observe how the single-year measure of the distribution of capital gains income overstates the concentration of gains in this group. Column 2 shows that on average, a single-year study over this period would have estimated that the highest income percentile received 66 percent of all capital gains reported in a given year. When the same taxpayer is followed for each of the five years, column 3 shows that taxpayers in the highest five-year income percentile received 58 percent of all gains reported over the five-year period. Column 5 shows that this highest income percentile received 13 percent of income from all sources over the five-year period.[9]

Although we would prefer to use a longer time period to approximate permanent income, the high concentration of gains in this income percentile and the other groups comprising the top decile (accounting for 82.5 percent of all gains over the five-year period) leads one to conclude as Slemrod (1992) does:

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[7] Reported net capital losses in any year are limited to $3,000. Excess losses may be carried forward and reported in subsequent years by the taxpayer. Certain losses on the stock of qualifying small businesses that would otherwise be classified as capital losses are allowed as ordinary losses up to $100,000. These losses are reported as other income and not on Schedule D.

[8] These adjustments consist mainly of IRA and Keogh contributions and alimony paid. For 1985 and 1986, they additionally include moving expenses, employee business expenses, and the two-earner deduction.

[9] Excluding 1986 data from the panel, the highest income percentile accounts for 55.5 percent of all gains.

capital gains income appears to be "largely a phenomenon of the upper-income classes."[10]

Table 3 presents an alternative examination of the distribution of capital gains income across income groups. In this table, income is defined to exclude all capital gains or losses. Thus, the realization of a large capital gain will not cause a taxpayer to be classified in a higher income group. While this understates the true income of taxpayers with recurring gains, it may be a closer measure of the permanent income of taxpayers with infrequent gains than the measure used in Table 2. Because we exclude capital gains from this income measure, we also increase income by the amount of losses claimed by the taxpayer on business or partnership activities. Losses claimed from these activities may be associated with gains received in other years. For example, an active participant in real estate may claim operating losses on some properties while simultaneously receiving capital gains on other properties (or on the same property in a future year). Eliminating these losses gives a better understanding of gains realizations among taxpayers with low permanent income rather than among those taxpayers with large business losses.

Using this measure of income, column 3 of Table 3 shows that the highest income percentile receives 49 percent of five-year capital gains and the highest decile cumulatively receives 75.6 percent of gains, down from 82.5 percent in Table 2.[11] Income groups between the 60th and 80th percentiles show a modestly higher amount of capital gains. Removal of losses from the definition of income substantially reduces the amount of gains reported among those in the lowest income decile.

Finally, in Table 4 we present data on the realization of capital gains by age group. The Internal Revenue Service matched taxpayer social security numbers for returns included in this panel with social

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[10] One notable exception to the general tendency for gains to be concentrated among the higher income groups is the concentration of gains in the lowest decile (less than $8,000 of income in 1989). This group of taxpayers receives 3.7 percent of five-year capital gains, while accounting for less than 1 percent of total income. Below, we note the concentration of gains in this income group is substantially eliminated when individuals with other tax losses are removed from this category. Even without this adjustment most taxpayers in this decile are unaffected by the tax treatment of capital gains since they either have negative income or the standard deduction and personal exemption eliminate all of their tax liability.

[11] Excluding 1986 data from the panel, the highest income percentile continues to receive 49 percent of all gains, and the highest decile receives 72.4 percent of gains.

security records to determine the age of the taxpayer as of January 1 in the year covered by the return.[12] The data show that most capital gains are received by taxpayers who are under age 60, but that taxpayers over age 60 account for a sizable proportion of gains. Taxpayers age 60 and older in 1985 accounted for 16.7 percent of all tax returns (column 2), but 26.7 percent of all taxpayers claiming gains or losses (column 3) in the five-year period. These older age groups also accounted for 39.4 percent of all gains claimed over the five-year period (column 5). Despite the heavier concentration of gains among older taxpayers, less than half of the taxpayers in these older age groups realized capital gains in at least one of the five years examined.

Taken together, Tables 2 and 3 both show that while all income groups receive some capital gains, the largest part of gains is received by those in the highest income decile of the population. We also find that while it is not true that most capital gains are received by the elderly, or that most elderly receive capital gains, some elderly account for a sizable portion of gains relative to their numbers in the taxpaying population. Although this section has focused primarily on the distribution of capital gains across income groups, the finding that only one-fourth of all taxpayers received any capital gains suggests that examination of the heterogeneity of taxpayers within income groups would be an interesting area for future research.

3. The Model

The results examined in the previous section indicate that high income taxpayers realize most capital gains. As a result, most capital gains taxes are paid by high income taxpayers. The distributional effects of capital gains taxes are incompletely described, however, by focusing only on tax payments. In examining the burden of a tax, one would like to examine both the burden borne directly through the payment of a tax and the burden borne indirectly by altering one's behavior to avoid the tax. These

[12] Public-use data sets provide only data reported on the return and therefore do not include this variable.

indirect costs are frequently ignored in distributional analyses, but they are potentially significant in magnitude. As an extreme example, consider the effects of two alternative taxes on the purchase of a good: a small tax and a tax so large that none of the good is purchased. The large tax in this case collects no revenue. Of course, no one would claim that the large tax is less burdensome than the small tax. A distributional comparison of tax payments under the two alternative taxes would be uninformative. Because the indirect costs of a tax system are as fundamental to any system of taxation as the direct tax payments, we believe that distributional analyses should incorporate these costs.

By modeling the decision to save and allocate savings among various assets we can begin to measure these indirect costs of taxation. In this section we describe our model used to examine both the direct and indirect costs of capital gains taxation. We compute the total burden of the capital gains tax by finding the lump sum tax that would give an individual the same level of utility as the existing capital gains tax. If the capital gains tax creates indirect net costs to the individual, the hypothetical lump sum tax will collect more revenues than the existing tax. In this case, tax payments understate the burden of the capital gains tax. If the capital gains tax creates indirect net benefits, for example, by reducing the riskiness of an asset, then the lump sum tax will collect smaller revenues than the existing capital gains tax.

An advantage of modeling capital gains behavior in a utility-maximizing framework is that we can also examine the distributional effects of alternative tax schemes, after taxpayers have modified their behavior in response to the new system of taxation. This allows us to examine, for example, the claim that a lower rate of tax can result in more tax revenues *and* make individuals better off. Such a claim is dependent on the alternative scheme imposing smaller indirect costs than the current tax system.

Our model economy consists of four types of agents: two groups of expected-utility maximizers, the firm that employs them and issues stocks, and the government that issues fiat money and riskless bonds. Households live for three periods (each period representing twenty years), and they have a choice

between four different assets: currency, government bonds, private loans, and stocks. Currency bears zero nominal interest, it is dominated in return by other riskless assets, and it is therefore optimally held in an amount just sufficient to cover purchases of the consumption good. Since we do not intend to study the monetary transmission mechanism, money is assumed to be neutral in our "cash-in-advance" economy. Its only function is to define the nominal price level. We consider a simple version, where the inflation rate is taken to be known with certainty and to occur at an annualized rate of 3 percent.

Government bonds and private loans are perfect substitutes in agents' portfolios. Perfect substitutability implies a common riskless interest rate. We thus abstract from liquidity constraints in the form of a wedge between the borrowing rates available to the government and to households. This simplifies the portfolio selection problem by allowing us to consider one "riskless asset" and a real riskless rate set at a historically based level. We assume an annual real riskless rate of 3.13%, equal to Siegel's (1992) estimate of the average real rate on bonds in the U.S. over the period 1800-1990. Our simplifying assumption that changes in tax rates do not affect the pre-tax real rate is tantamount to considering a small open economy with a real rate tied to the world interest rate through capital mobility. In view of the absence of inflation uncertainty, constancy of the real rate on bonds does not require the assumption that debt is indexed.

The historical average of annual pre-tax real rates of return on stocks over the period 1800-1990 was calculated by Siegel as 7.77% per annum. Our procedure for calculating appropriate 20-year stock returns for use in our numerical solutions is the following. First, we compute equiprobable "high" and "low" annual stock returns that match both the average annual return computed by Siegel and its standard deviation (18.36). Since each realization can occur with probability 0.5, we compute the expected value and standard deviation of the return over a twenty-year period from this binomial process. Finally, we choose a "high" and a "low" 20-year realization that match these two moments. The 20-year cumulative return is thus set to roughly 7.39 in the good state and -0.46 in the bad state.

The return on stocks consists of capital gains and dividends. We model each of these components separately, given their potentially different tax rates and the ability of the taxpayer to defer capital gains taxes but not dividend taxes. Schwert (1990) has found that dividend yields (i.e., the ratios of end-of-period dividend to beginning-of-period stock price) represent about half the total average stock return in his 1802-1987 sample. Their standard deviation is about 1/20 as large as that of capital gains returns, and there is no evidence of a secular increase in dividend yields since 1800. We have chosen dividend yields for the "high" and "low" states, such that their expected value is half the total expected pretax return on equity. Although it would be natural to assume zero variance of dividend yields, this causes a technical problem: in a two-state world, the total return in the low state is so low relative to the average dividend yield, that it would require implausibly large capital losses, implying negative stock prices in the low second-period state. To avoid this, we allowed for essentially minimum variability in dividend yields consistent with positive stock price in the low state. The resulting coefficient of variation over each 20-year period was .84.

Households choose portfolios of these assets to maximize expected lifetime utility of consumption, assumed to be time separable.[13] Utility in each period exhibits constant relative risk aversion (CRRA), with degree of relative risk aversion denoted by A.[14] The range of A values considered by Mehra and Prescott (1985) as plausible for *representative-agent* models was between 2 and 10, and this is the range we consider. In general, how "plausible" a particular risk parameter is depends on the size (coefficient of variation) of the gamble considered [Kandel and Stambaugh (1991)]. Evidence from the *Survey of Consumer Finances* suggests strongly that the proportion of highly risk-averse individuals is much larger among low-income households than among high-income groups, based on their responses to direct

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[13]The Appendix gives more detail on the model.

[14] Utility in a given state of nature may be written as: $U(c)=(c^{(1-A)}-1)/(1-A)$, $A>0$, where c represents consumption in that state. Utility in each period is time separable. We set the discount factor to .818 for each 20-year period.

questions about attitudes towards risk.[15] Column 2 of Table 5 shows that the percentage of households who responded that they are not willing to undertake any financial risk is virtually a monotonically declining function of income. It ranges from 67% for very low incomes to 6% of households in the 99th percentile. Although we present a number of model predictions for the entire range of degrees of risk aversion, we will often contrast results for high-income households at low A's to those for low-income households with A's at the high end of the spectrum.

After-tax labor income is taken to be exogenous in the model. In our simulations, high-income households are assumed to earn (net of tax) twice as much as low-income households in each period of their life. An element of life-cycle behavior is built into the model by assuming that after-tax labor income in the third period drops to one-fourth of what it was in the first two periods. This generates an incentive to save for the final period of life. In the third (and final) period of life, all assets are liquidated and consumed.[16]

The model incorporates taxation at two rates, t_{ib} and t_{is}, for each group of households i=1,2. Rate t_{ib} is applied to interest earnings on loans to the government and to other households, as well as to dividends received on stocks.[17] The tax rate on capital gains is t_{is}, and it is applied at realization. The U.S. tax code imposes a limit of $3,000 on the net capital losses that can be declared for tax purposes.

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[15] Indeed, Shaw (1989) has suggested that high risk aversion discourages individuals from investing in risky firm-specific human capital and reaching high income levels. It is interesting to note that limited stockholding among low-income households could also be observed if low- and high-income agents had the same degree of risk aversion, but those with low incomes also faced more income uncertainty. Kimball (1989) has derived conditions under which increased background (income) risk reduces exposure to a risky asset in an atemporal model, even though it is uncorrelated with stock returns. He termed this property "standard risk aversion". This is a possibility we cannot explore in the present paper, since we do not incorporate nondiversifiable individual risk.

[16] We assume all asset sales occur while the individual is alive. Thus, we do not consider bequest motives and the possible advantages to deferring realizations until death to allow heirs a step-up of basis.

[17] We do not consider a differential tax rate between long-term and short-term gains. Constantinides (1984) suggests trading strategies involving realization of gains immediately upon their eligibility for long-term treatment. Lyon (1990) finds that this strategy is successful only for high variance stocks and offers only slight benefits over a deferral strategy.

We incorporate a loss limit equal to 5% of the after-tax labor income received by high-income households.[18] This constraint turns out to be binding only for high-income households with degrees of risk aversion of four or less. The Sales of Capital Assets panel data indicate that just 4.5 percent of taxpayers with gains or losses had $3,000 or more in net capital losses in 1985 and 1986. This number increased to 12.9% in 1987, 11.9% in 1988, and 14.9% in 1989.[19] Of course, what matters from a utility-maximizing perspective is not whether the limits bind for *all* states of nature, but whether they are potentially binding constraints for at least a *single* state of nature.

In our simulations of the benchmark case, tax rates for high-income households are equal to 30% on both capital gains and interest income, while those for low-income households are set at 15%. We consider several policy experiments involving reductions in t_{is} (and *endogenously* determined increases in t_{ib}) that preserve the expected utility of the corresponding household group at the benchmark level. We also consider a switch to accrual taxation. Each of these policy changes is assumed to occur in the first period before any saving and portfolio decisions have been made. The excess burden in the benchmark case is compared to that under the different policy experiments. All computations take into account optimal portfolio responses to the tax rates facing the household.

The policy experiments examined either preserve the expected utility of each class of agents or the expected present value of tax collections on the basis of information available at the beginning of the first period. In effect, we are considering cases where decreases in investor risk resulting from higher tax rates are absorbed by the government. The government's ability to reduce risk has received considerable attention in other research dealing with risk sharing.[20]

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[18] Since each period in the model represents 20 years, this percentage was chosen to approximate the effects of the $3,000 limit applied on an annual basis.

[19] Poterba (1987) finds that in 1982 11.2% of taxpayers with gains or losses had more than $3,000 in capital losses.

[20] Examples in the context of income taxation include Eaton and Rosen (1980), Gordon and Varian (1988), and Varian (1980).

A frequently adopted alternative assumption is to focus on policies that preserve the amount of real tax collections in each future time period and state of the world.[21] The motivation for considering such policies is that they leave the government budget constraint unaffected, though this presumption is not strictly accurate to the extent that policy changes influence interest rates on government debt.[22] We intend to investigate the consequences of this and of a range of alternative assumptions about government finance in future research.

The alternative assumption used by others supposes that the government has access to lump sum taxes or transfers that are imposed in an amount necessary to preserve tax revenues *after* returns on risky assets are realized in the future. What is particularly interesting for assessing effects of capital gains taxation on risk taking is that such policies are *revenue* neutral but not *portfolio* neutral. Households are faced *both* with risky asset returns and with risky lump sum taxes and transfers. Because lump sum taxes and transfers are by definition independent of the amount of risky investment undertaken by the household, the government imposes risk even on those who would not have chosen to bear any asset return risk. Tax rate changes result in reallocation of private sector risk between these two sources. The rational response to this risk reallocation is to alter portfolios in order to hedge against unwanted risk.[23] Conditions under which our conclusions would be modified by alternative modeling assumptions remain to be examined. The present paper shows that such modifications would not arise from the cut in capital gains tax rates *per se*, but from the assumption that the government maintains a given level of tax revenue risk by redistributing risk among households.

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[21] For example, this assumption is used in Slemrod (1983) and Galper, Lucke, and Toder (1988).

[22] The assumption ensures that the *primary* budget deficit in each period and state of the world is the same across policy regimes. However, a change in interest rates resulting from the tax policy experiment still affects the total budget deficit and the time path of government monetary and nonmonetary debt.

[23] This may not be possible for households subject to binding short sales constraints. For example, a household which does not desire any stockholding risk would find it optimal to hedge by adopting a short position in stocks, since lump sum taxes are expected to be high when stock returns are low.

We make no attempt to predict the short term effects of changes in tax regime. Unanticipated changes in tax rates during an investor's lifetime have contemporaneous lump-sum tax or subsidy effects that depend on the accumulated capital gains or losses up to that point. It is then optimal for investors to respond to the new tax regime by rebalancing their portfolios in directions suggested by our analysis. The magnitude of these portfolio changes is sensitive to the amount of accrued gains at the time of the legislative change. In this paper, we focus on the permanent effects of such tax changes by comparing regimes in which there are no unanticipated changes in tax rates throughout the investment horizon of each household.

4. The Benchmark Tax System

Under the benchmark system, capital gains are taxed at the same rate as dividend and interest income, but at realization. High-income households face a tax rate of 30%, which is twice that of their low-income counterparts. Since stocks offer higher expected returns than riskless assets and -- starting from a portfolio with no stocks -- have zero covariance with consumption, it is always optimal for expected utility maximizers to hold some stocks.[24] The *extent* of stockholding, however, does depend both on incomes and on risk aversion.

In their first period of life, both high- and low-income households hold stocks and bonds in relative amounts that depend crucially on risk aversion. At low levels of the risk aversion parameter A, it is optimal to engage in arbitrage by borrowing at the low (riskless) rate to invest in stocks. At slightly higher risk aversion levels (around 3 in our simulations), it is optimal for both types of assets to be held in positive amounts, with optimal stockholding still dominating holdings of riskless assets. At risk

[24] Despite their idiosyncratic risk, stocks have zero covariance with a nonstockholder's consumption. As a result of this and of the equity premium, a household increases expected utility by at least marginally increasing stockholding above zero. This attitude of expected utility maximizers towards divisible risky projects was first noted by Arrow (1970), termed by Segal and Spivak (1990) "second order risk aversion", and explored in the context of stockholding behavior by Haliassos and Bertaut (1992) and Bertaut (1992). As stockholding increases, the progressively larger covariance of stock returns with consumption serves to limit stockholding to a finite amount.

aversion levels around 5, the covariance of stock returns with consumption becomes an important consideration, the equity premium notwithstanding; investors characterized by these or higher levels of risk aversion want to hold more riskless assets in their portfolios than stocks.

The levels of risk aversion separating each of these three regimes are slightly lower for the low-income group. This is a consequence of the asymptotic behavior of marginal utility as consumption approaches zero. Households with CRRA are disproportionately interested in marginal utility at low states, and this concern limits their exposure to stockholding risk. As shown in columns 5 and 6 of Table 5, data from the *SCF* show that households in the 95th percentile of income or above hold on average more stocks in their portfolios than riskless assets; the opposite is true for all other income groups examined. Thus, low risk aversion among high-income households is not only corroborated by their responses to attitudinal questions (column 2), but also by their portfolio behavior.

In the second period of life, portfolio behavior is state dependent. In our simulations, the "good" state involves capital gains for stockholders, while the "bad" state involves capital losses. In the bad state, it is optimal for both groups to realize their losses (up to the allowable limit) in order to receive an immediate reduction in tax liability provided by the capital loss, and then to purchase anew all the stocks they want to hold to the third period.[25] In the good state, unconstrained expected utility maximizers find it optimal never to realize capital gains but to engage in short sales of stocks instead, in order to reduce their net stock holdings and smooth their consumption over time. Such a transaction results in the same net stock position as an outright sale, but defers tax liability. We limit the extent by which taxpayers may defer taxes through short sales by imposing quantity constraints on such sales. For the results presented in this paper, short sales are ruled out completely. As a result, households are encouraged to realize some

[25] Technically, such a "wash-sale" is disallowed under the U.S. tax law. If more than thirty days elapse between buy and sell dates, the tax loss is permitted. Because trading periods in our model are to represent periods of 20 years, we do not believe that inclusion of this constraint would alter our results. Stiglitz (1983) discusses strategies of avoiding wash sale and various other legal restrictions pertaining to capital gains taxes.

capital gains in the second period of their life even in a "good" state. We regard this restriction as bringing the model closer to actual trading behavior.

The proportion of capital gains realized in the second period of life is fairly similar across income groups for any *given* risk aversion parameter, but is heavily dependent on that parameter. Households whose A is at the low end of the spectrum realize slightly more than 65% of their gains (Figure 1). The proportion increases at a decreasing rate, reaching 85% for A=10. This, in conjunction with the *SCF* self-reported data on risk aversion, implies that the proportion of capital gains *deferred* on average by high-income households should substantially exceed the corresponding average proportion for low-income households.[26] In our solutions, the proportion of deferrals by high income households with A=3 is about 50 percent larger than for low-income households with A=10. Combined with the much larger stockholding by high-income, less risk-averse households, this implies a very substantial difference in the *size* of unrealized capital gains across the two income groups.

In computing the burden of the benchmark system, we compare it to one of lump sum taxation of (first-period) income. The *equivalent variation* is the lump sum tax on first-period income that results in the same expected utility as the benchmark system of proportional taxation. Alternatively, it is the amount that households faced initially with no taxes would be willing to pay the government to prevent it from imposing proportional taxation (and the associated loss limits). This measure may be the best yardstick to use in comparing the burden of alternative tax instruments. Naturally, this measure is positive, since taxation reduces the households' "feasible set" of consumption opportunities. *Excess burden* is a comparison of the equivalent variation to the present value of tax revenues that are collected

[26] The 1989 *Survey of Consumer Finances* includes questions allowing one to calculate directly unrealized gains by household and to test this implication of the model. Unfortunately, a properly weighted data set is not yet publicly available.

from the proportional tax system.[27] An interesting finding in the context of the expected utility model is that tax revenues far outweigh the amount households would be willing to pay to avoid proportional taxation, so that excess burden is *negative*. In other words, actual capital gains, dividend, and interest tax payments collectively *overstate* the burden of these taxes relative to lump sum taxation. Further, excess burden is more negative for those with low risk aversion, even when expressed as a fraction of tax revenues from that group.

The negative excess burden of the proportional tax system arises primarily from two related factors: (i) the desirable effects capital gains taxation has on stockholding risk (even in the presence of loss limits) and (ii) the portfolio response of households to the introduction of proportional taxation. While it is true that capital gains taxation lowers the *expected* return on stocks, it also reduces its variance, by taxing realizations in the good state and subsidizing losses in the bad one.[28] As explained above, we assume in this model that the government can absorb the risk associated with a risky flow of tax revenues. The finding that excess burden is most negative for households with a low risk aversion parameter and high incomes arises primarily from the fact that both high incomes and low risk aversion are associated with more substantial stockholding.

In our model, we find capital gains taxation generally *encourages* stockholding relative to lump sum taxes that provide the same expected utility.[29] Households make full use of tax loss opportunities in the bad state by holding more stocks to begin with and selling as many as the loss limit allows them to in order to reap the immediate reduction in tax liability. They then repurchase a (larger than otherwise)

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[27] The present value of government tax revenues is computed at the rate relevant for government borrowing, namely the riskless rate on government bonds. In the absence of borrowing constraints for individuals, the excess burden is independent of the period in which the equivalent variation is computed.

[28] This utility increasing feature of proportional taxation was first noted by Domar and Musgrave (1944). Atkinson and Stiglitz (1980) provide a more recent exposition in an atemporal model.

[29] The one exception is for high-income taxpayers with A=2 (for whom the loss limit binds). Replacement of proportional taxation with lump sum taxation increases stockholding by 2.5% in the first period. Excess burden, however, is still negative for this group.

amount of stocks to hold to the third period. Recalling that households' concern with bad states is disproportionate, one can understand why the amount they should be willing to pay to eliminate (or reduce) the distorting proportional taxation is less than the tax revenues collected from them.

The increased stockholding associated with proportional taxes yields substantial tax revenues to the government. Interestingly, the increase in taxes collected under proportional taxation does not arise simply from higher tax collections in the last period of life: even the amount of capital gains realizations in the second period is higher because of the higher overall stockholding. Movement to the lump sum tax system would cause tax liabilities to fall by 50% for high-income taxpayers (A=3) and by 23% for low-income taxpayers (A=10). These changes in tax liability are noted in the first row of Table 6. Of course, the true burden of the proportional tax system is identical to that of the lump sum tax system since equal utilities are attained. Again, this illustrates the shortcoming of focusing only on tax payments to assess the distributional effects of taxation. Because of the risk-sharing element of the tax system, a simple analysis of the burden of capital gains taxes based solely on the amount of taxes collected particularly overstates the *utility cost* of taxation for higher income taxpayers.

The importance of risk-sharing considerations can also be demonstrated by comparing our benchmark system to one without loss limits. High-income taxpayers subject to a 30% tax rate on capital gains and a loss limit can achieve the same utility with a *higher* capital gains tax rate if the loss limit is removed. At A=3, high-income taxpayers would be indifferent between the benchmark system with a loss limit or a counterfactual situation in which the loss limit was eliminated and the capital gains tax rate was increased to 40%. As shown in the second row of Table 6, tax revenues from these taxpayers would increase by over 25% at this higher rate. This indicates that there is a range of feasible tax rates for which both utility and revenue can be increased by eliminating loss limits (or increasing the amount of losses

that may be deducted).[30] In a distributional analysis, of course, these higher tax payments by high-income investors would not be an indication of an increased tax burden.

In the next section we examine a policy experiment involving a reduction in capital gains tax rates and in section 6 we consider a switch to accrual taxation.

5. Effects of a Reduction in Capital Gains Tax Rates

In this section, we examine the effects of a simultaneous reduction in capital gains tax rates and an increase in tax rates on dividend and interest income that preserves the expected utility each income group has under the benchmark system. These simulations also allow us to draw implications for the utility effects of alternative *revenue*-neutral tax schemes. We assume these tax changes take place at the beginning of the first period, before any portfolio decisions have been made. For the main body of our analysis, we consider a 20% reduction in capital gains tax rates (reducing the rate to 24% for high-income households and to 12% for low-income households). The increase in t_{ib} required to maintain the expected utility of income group i differs across income groups and it depends on risk aversion. We carry out sensitivity analysis by considering the entire range of risk aversion parameters from A=2 to A=10.

For the high-income group, the utility preserving t_{1b} ranges from 31.6% for low risk aversion (A=2) to 30.2% for highly risk-averse households (A=10), given a 20% cut in capital gains tax rates. This is to be compared to a rate t_{1b} of 30% assumed under the benchmark system without differential taxation. For low-income households, the utility-preserving t_{2b} is slightly above 15% -- rising to just 15.5% for households with A=2. For both groups, the utility-preserving t_{ib} is inversely related to risk aversion, primarily because holdings of the riskless asset are smaller (often negative) among the less risk-averse.

We find that this differential taxation entails an *increase* in excess burden relative to the

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[30] In a model with multiple capital gains assets (especially negatively correlated ones) this result might not hold. If two negatively correlated assets existed, an investor could always sell the asset that declined in value and defer gain on the asset that appreciated. The portfolio could be partially rebalanced by increasing investment in the asset that was sold rather than by selling shares of the appreciated asset.

benchmark, for both income levels, for the entire range of risk aversion parameters, and for varying sizes of capital gains tax cuts. In Figure 2, we express this increase in excess burden as a proportion of the present value of tax revenues collected from each group in the new equilibrium. In the region where loss limits are not binding (A>4), this measure is uniformly higher for high-income households than for low-income households; and it is inversely related to the degree of risk aversion for any given income level. For the cases we focus on, namely high-income households with A=3 and low-income households with A=10, the changes in excess burden relative to tax revenues are 6.0% and 3.1% respectively. Tax revenues fall for these groups by 5.6% and 3.0% as shown in the third row of Table 6.

Because the cut in capital gains tax rates induces some undesirable effects on the risk properties of capital gains assets, the tax rate on alternative sources of income, t_{ib}, cannot increase substantially if it is to preserve the same expected utility of each group. Although holdings of riskless assets by the least risk-averse are also increased, the increase in t_{ib} is insufficient to make up for the loss in capital gains tax revenues.

To illustrate the importance of portfolio adjustments for our findings, consider how they affect total capital gains realizations. Total realizations depend both on the *level* of stockholding and the *proportion* of gains realized. We examine the effects of the capital gains rate reduction on both components. For taxpayers for whom loss limits are not initially binding, a cut in capital gains taxes induces increased bondholding and discourages stockholding. In the region where the loss limit is binding, only for the least risk-averse (A=2 and A=3) does stockholding increase. Even here, the increase in stockholding is less than 0.5%.

As expected, at the lower capital gains tax rates the proportion of capital gains realized by each group in the "good" state of the second period of life increases. However, this increase is relatively small. In our benchmark simulation, low-income households (with A=10) realize 85.3% of their capital gains in the second period. If capital gains tax rates are reduced by 20% of their benchmark level, this proportion

increases, as expected, but by less than 0.5%. The proportion realized by high-income households is only slightly more sensitive. But even for these high-income taxpayers (with A=3), 75.7% of capital gains are realized under the benchmark system in the second period and this amount increases by only 2.7% when capital gains taxes are reduced.

As a result, for taxpayers for whom the loss limits are not binding, total realizations decline with the cut in capital gains taxes. For those taxpayers for whom the loss limits are binding, total realizations increase, but by a far smaller percentage than the reduction in the tax rate. In either case, tax revenues fall substantially compared to the benchmark system.

In view of the evidence of an inverse relationship between incomes and risk aversion, our findings suggest that the increase in excess burden resulting from a utility-preserving shift to differential taxation will be larger for high-income households than for those with low incomes. Portfolio size turns out to matter significantly for the change in tax revenues and hence for excess burden. The implication is that if the government wants to cut capital gains taxes without affecting welfare, it will suffer a large reduction in tax revenues. If, on the other hand, it decides to raise t_{ib} sufficiently to preserve *tax revenues*, expected utility drops and both income groups are worse off than under the current system.

While the findings we discuss primarily relate to permanent effects of tax changes, our model is consistent with a *short-run* increase in capital gains realizations following a capital gains tax cut. To see this, consider households who have accumulated capital gains and are now at the beginning of the second period of life. Their optimal portfolios at the current capital gains tax rate would dictate realizing a fraction of capital gains in the second period. If it is announced that the applicable tax rate has been reduced, this is a welcome bonus to these households. On the one hand, they experience a lump sum tax bonus on accumulated gains that they were already planning to realize. On the other, the now lower tax rate induces a portfolio response that makes them better off from that point on. Because this portfolio response generally implies lower stockholding than at the higher tax rate, the tax cut will actually generate

larger capital gains realizations in the second period than what households had planned for at the beginning of their lifetime.

This should reconcile our findings with the observation that households with accumulated capital gains tend to favor a reduction in gains tax rates, and with the common perception that such a reduction should encourage realizations in the short run. What appears questionable is the notion that a *permanent* move to lower capital gains tax rates will sufficiently promote stockholding and realizations to provide larger tax revenues over the longer run.

6. Accrual Taxation of Capital Gains

Using our model, we calculate the change in excess burden that results if capital gains were taxed on an accrual basis rather than at realization. We assume that the accrual tax system has no limit on the amount of losses that may be claimed against ordinary income.[31] As in our previous experiments, the policy change holds utility constant. The resulting accrual tax rate thus differs conceptually from the traditional measure that holds the present value of tax payments constant assuming unchanged realizations and portfolios. For taxpayers for whom loss limits are not binding, we find that a move to accrual taxation increases excess burden. In contrast, if loss limits are binding constraints, we find that a move to accrual taxation together with the elimination of loss limits can reduce excess burden. This latter reform is dominated, however, by the retention of taxation at realization but the elimination of loss limitations considered in section 4.

It may at first appear surprising that we find cases where the movement from realization taxation to accrual taxation generates excess burdens. Public finance economists have long emphasized the excess burden created from the "lock-in" effect on capital gains. As our results presented earlier show, the lock-in effect exists in our model, too. It must be remembered, however, that the lock-in only occurs when

[31] If an accrual tax system were enacted, retention of loss limits would appear to be less justified since a taxpayer could no longer claim losses on some assets while deferring gains on other assets.

stocks have appreciated in value. When stocks decline in value, shareholders can claim these losses immediately in the absence of loss limitations. In our model, these taxpayers then repurchase stock after claiming their losses.

For taxpayers not constrained by the loss limits, the accrual tax rate required to make them as well off as under the benchmark system must be lower than the rate under realization taxation. Allowing for behavioral response to the accrual tax system, taxpayers become better off from the elimination of the lock-in effect, but they become worse off by the increase in the variance of returns caused by the lower tax rate. In theory, either effect can dominate. In our simulations, we find that the accrual tax rate necessary to hold utility constant must be sufficiently low that tax revenues fall relative to the benchmark case.[32] For taxpayers for whom the loss limits are binding, the switch to accrual taxation together with the removal of loss limits can generate greater risk-sharing in the bad state than under the benchmark case. These taxpayers benefit both from greater risk-sharing advantage and from the elimination of the lock-in effect.

The loss limitation in our model is binding only for high-income taxpayers with risk aversion coefficients of four and less. For taxpayers with the lowest risk aversion coefficients, desired stockholding is large and the inability to deduct all losses in the event the bad state occurs results in a large loss in utility. These taxpayers are willing to accept a very high accrual tax rate in exchange for removal of the loss limitations. For the least risk-averse (A=2), an accrual tax rate of 50 percent leaves them the same utility as in the benchmark case. At higher rates of risk aversion, stockholding is smaller so that the inability to deduct losses is less costly. At A=4, the accrual tax rate falls to 27.4 percent. In each case here, the accrual tax rate results in higher tax revenues than in the benchmark so that excess burden is reduced. As shown in the fourth row of Table 6, tax payments for high-income taxpayers (with A=3) are

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[32] Our results differ from those of Auerbach (1992) who finds the move to accrual taxation generates efficiency gains. Our results differ, in part, because stock returns in the first period of Auerbach's model are certain. Therefore, the reduction in the accrual tax rate has no effect on variances in returns earned in this period.

16% greater than in the benchmark.

Figure 3 shows the change in excess burden that results from the shift to accrual taxation. The change in excess burden is expressed as a fraction of tax payments made by each group in the new equilibrium. At low levels of risk aversion and high income the welfare gain from switching to accrual taxation appears quite large, approaching 50 percent of tax revenues for the high income group at A=2. These gains appear to be entirely from the elimination of the loss limit. As noted above, the switch to accrual taxation is dominated by the elimination of loss limits and the retention of taxation at realization.

For taxpayers for whom the loss limit is not binding, the increase in excess burden is declining with risk aversion. The change in excess burden ranges from 10 percent of revenues for low-income taxpayers at A=2 to less than 2 percent of tax revenues for low income taxpayers at A=10.

7. Conclusions

In this paper we have examined new data on capital gains realizations by taxpayers in the 1985-1989 period. These data show a high concentration of capital gains among taxpayers in the highest income groups. More than half of all capital gains are realized by the richest one percent of the population. As a result, reductions in capital gains tax rates would reduce tax payments the most for these taxpayers.

We present a stylized model of savings and portfolio behavior. We caution the reader that this model makes a number of simplifying assumptions, but these simplifications allow us to explore in full detail the changes in behavior that occur in response to permanent changes in the taxation of capital gains. Our model suggests that reductions in capital gains tax rates will lead in many cases to a reduction in stockholding. This occurs partly because of the increase in risk that results as capital gains tax rates are lowered. For these taxpayers, even though the lock-in effect is reduced slightly, the increase in the proportion of gains realized is not sufficient to offset the decline in stockholding so that total realizations decline. Only for taxpayers currently constrained by loss limits do we find an increase in stockholding

when capital gains tax rates are reduced. The resulting increase in realizations, however, is not sufficient to make up for the much larger reduction in tax rates, so that total revenues decline. We find that a revenue-neutral reduction in capital gains tax rates offset by increases in taxes on risk-free investment income results in a decline in taxpayer utility. In future research we seek to examine the sensitivity of our results to alternative assumptions about the extent to which the government absorbs fluctuations in tax revenues.

We find that the elimination of loss limits offers a potential welfare gain. The removal of loss limits increases the risk-sharing characteristics of the tax system. With greater risk-sharing, taxpayers in our model respond by holding greater amounts of stock. The removal of loss limits causes the government to collect less tax revenues (in expectation) on stocks that would have been held anyway, but additional tax revenues are collected by the increase in stockholding. Taxpayers are made better off by the elimination of loss limits so that they would be willing to accept slightly higher tax rates on capital gains in return. As a result, net tax revenues can increase and still leave these taxpayers better off.

This example of an efficiency enhancing reform and our other examples of efficiency decreasing tax changes illustrate the trouble with conducting traditional distributional analyses based on the tax payments collected from a household. Table 6, which summarizes the effects of the various policy changes, indicates substantial variation in tax liabilities for each income group. Yet in each experiment, utility of each group is held unchanged. Traditional distributional analysis, which focuses only on tax revenues, would give quite different impressions of the distributional effects of these reforms. As models of taxpayer behavior improve, better distributional analyses of taxes should include measures of excess burden (whether positive or negative) when evaluating the true costs of a tax.

For the case of capital gains taxation considered in this paper, we find that dollar amounts of capital gains taxes paid overstate the burden of these taxes relative to lump sum taxation. Our results suggest that distributional analyses of the overall progressivity of the tax system based on tax payments

probably overstate progressivity, since capital gains tax payments are concentrated in the highest income brackets. Our results further suggest that reductions in the tax liability of capital gains taxes are likely to benefit taxpayers by less than equal size reductions in other taxes.

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Appendix 1
The Formal Model

We consider two classes of households, high- and low-income, each of whom solves:

$$\max_{\substack{N_0,B_0,N_{1i} \\ Q_{1i},B_{1i}}} \quad E_0 \sum_{t=0}^{2} \beta^t U(C_t), \quad i = H,L \tag{1}$$

where i indexes states of the world in period t=1, defined by whether dividend yields are high (H) or low (L). N denotes stock purchases, Q denotes stock sales, and B purchases of one-period riskless bonds. The discount factor is β, $U(C_t)$ is utility of consumption at time t, and E_0 is the mathematical expectations operator. The budget constraint for the first period is:

$$C_0 = Y_0 - N_0 \frac{P_{s0}}{P_0} - \frac{B_0}{P_0} \tag{2}$$

where Y_t denotes real labor income, P_t is the price of the good, and P_{st} is the nominal stock price. In the second period, state-dependent consumption is

$$C_1 = C_{1i} = Y_1 + N_0 d_{i1}(1-t_b) + Q_{1i}\frac{P_{s1i} - (P_{s1i} - P_{s0})t_s}{P_{1i}}$$

$$+ \frac{B_0(1+I_1(1-t_b))}{P_{1i}} - N_{1i}\frac{P_{s1i}}{P_{1i}} - \frac{B_{1i}}{P_{1i}}, \quad i=H,L \tag{3}$$

where real dividends are denoted by d_i, the tax rate on nominal capital gains by t_s, that on dividend and interest income by t_b, and the pre-tax nominal riskless rate by I. In each period, the high- and low-dividend states are equiprobable, but the size of realizations has been chosen to match the first two moments of the data. In the third period, consumption levels are:

$$C_2 = C_{2ij} = Y_2 + (N_0 - Q_{1i} + N_{1i})\left(\frac{P_{s2ij}}{P_{2ij}} + d_j(1-t_b)\right) - (N_0 - Q_{1i})t_s\frac{P_{s2ij} - P_{s0}}{P_{2ij}} -$$

$$- N_{1i}t_s\frac{P_{s2ij} - P_{s1i}}{P_{2ij}} + \frac{B_{1i}}{P_{2ij}}(1+I_2(1-t_b)), \quad (i,j) \in (H,L)\times(H,L) \tag{4}$$

The use of two state subscripts, i and j, allows us to keep track of the history of dividend realizations, which is relevant for consumption.

There are several inequality constraints. Consumption has to be nonnegative:

$$C_0 \geq 0,\ C_{1i} \geq 0,\ C_{2ij} \geq 0 \quad i = H,L; \quad (i,j) \in (H,L)\times(H,L) \tag{5}$$

The short sales constraints on stocks are:

$$N_0 \geq 0, \quad N_{1i} \geq 0, \quad i = H,L \tag{6}$$

The first part of the following double inequality ensures that stock sales are nonnegative and the second that households do not attempt to sell more stocks than they own.

$$0 \leq Q_{1i} \leq N_0, \quad i = H,L \tag{7}$$

The following two equations impose a limit θ to the amount of losses claimed for tax purposes. They are used in some of our simulations.

$$Q_{1L}\frac{P_{s0}-P_{s1L}}{P_{1L}} \leq \theta \tag{8}$$

$$(N_0 - Q_{1i})\ \frac{P_{s0}-P_{s2jL}}{P_{2jL}} + N_{1i}\frac{P_{s1i}-P_{s2jL}}{P_{2jL}} \leq \theta, \quad \forall\ i,j \tag{9}$$

In our model, pre-tax real stock returns in each state are state- but not time-dependent and exogenously determined (asset supplies are infinitely elastic). Bonds are riskless and are assumed to offer constant real returns. Goods prices are exogenous in the model:

$$P_0 = \bar{P}_0;\ \ P_{1i} = \bar{P}_{1i};\ \ P_{2ij} = \bar{P}_{2ij}, \quad i=H,L; \quad (i,j) \in (H,L)\times(H,L) \tag{10}$$

Finally, dividend yields are calibrated to match their historical expected value and variance:

$$k_i \equiv \frac{d_i}{\left(\frac{P_{s0}}{P_0}\right)} = \bar{k}_i, \quad i = H,L \tag{11}$$

$$k_{ij} \equiv \frac{d_j}{\left(\frac{P_{s1i}}{P_{1i}}\right)} = \bar{k}_{ij}, \quad (i,j) \in (H,L)\times(H,L) \tag{12}$$

These determine stock prices in each state at t=0, 1. Stock prices at t=2 are set equal to unity, since the firm is liquidated in the last period.

Table 1

FREQUENCY OF NET CAPITAL GAINS REALIZATIONS, 1985-1989

(1) Number of Years in which Taxpayer Reported Net Gains	(2) Percent of All Taxpayers by Frequency of Net Gains	(3) Percent of Taxpayers Reporting Gains by Frequency of Net Gains	(4) Percent of Reported Net Gains
No years	77.59	-	-
One year	9.11	40.65	7.78
Two years	4.84	21.60	14.60
Three years	3.10	13.83	11.15
Four years	2.89	12.90	24.41
Five years	2.48	11.07	42.06
All taxpayers	100.00	100.00	100.00

Note: Frequency tabulated for taxpayers reporting only net capital gains (sum of net gains reported on Schedule D and other distributions reported on Form 1040).

Source: Sales of Capital Assets Panel, 1985-1989.

Table 2

DISTRIBUTION OF CAPITAL GAINS INCOME AND TOTAL INCOME:
SNAPSHOT VS. TIME EXPOSURE, 1985-1989

(1) Income Percentile	(2) Single-Year Average Capital Gains	(3) Five-Year Capital Gains	(4) Single-Year Average Income	(5) Five-Year Income
0 - 10	3.25	3.70	0.17	0.78
10 - 20	0.10	0.34	2.66	2.86
20 - 30	0.35	0.98	3.78	4.01
30 - 40	0.62	0.52	4.97	5.12
40 - 50	0.76	1.07	6.28	6.43
50 - 60	1.08	2.17	7.99	8.04
60 - 70	0.81	1.34	9.94	9.93
70 - 80	2.27	1.83	12.28	12.30
80 - 90	3.21	5.59	15.69	15.43
90 - 95	5.49	6.48	10.14	10.04
95 - 99	15.76	17.87	12.72	12.45
99 - 100	66.30	58.12	13.38	12.61

Note: Income consists of AGI plus excluded gains and excluded dividends (1985-1986), and statutory adjustments. Capital gains are those reported on Schedule D and other distributions reported on Form 1040.

Source: Sales of Capital Assets Panel, 1985-1989.

Table 3

DISTRIBUTION OF CAPITAL GAINS INCOME AND TOTAL POSITIVE INCOME: SNAPSHOT VS. TIME EXPOSURE, 1985-1989

(1) Positive Income Percentile	(2) Single-Year Capital Gains	(3) Five-Year Capital Gains	(4) Single-Year Average Positive Income	(5) Five-Year Positive Income
0 - 10	0.84	1.05	1.23	1.65
10 - 20	0.97	0.65	2.79	3.00
20 - 30	2.26	0.31	3.86	4.11
30 - 40	1.23	2.20	5.11	5.27
40 - 50	2.96	2.26	6.48	6.61
50 - 60	2.16	1.76	8.24	8.20
60 - 70	4.00	5.09	10.22	10.23
70 - 80	6.52	5.49	12.58	12.53
80 - 90	5.86	5.57	15.94	15.58
90 - 95	6.62	6.32	10.29	10.05
95 - 99	20.37	20.16	12.43	12.31
99 - 100	46.21	49.15	10.81	10.46

Note: Positive Income consists of AGI plus excluded dividends (1985-1986) and statutory adjustments less (i) net capital gain or loss, (ii) Schedule C losses, (iii) Schedule E losses, (iv) Schedule F losses, (v) Form 4797 business property losses, and (vi) negative other income. Capital gains are those reported on Schedule D and other distributions reported on Form 1040.

Source: Sales of Capital Assets Panel, 1985-1989.

Table 4

AGE DISTRIBUTION OF CAPITAL GAINS, 1985-1989

(1) Age in 1985	(2) Percent of All Returns (with or without gains)	(3) Percent of All Taxpayers with Gain or Loss	(4) Percent of Taxpayers with Gain or Loss in 4 or More Years	(5) Percent of 5-Year Net Gain or Loss	(6) Percent of Age Group with Gain or Loss in at Least One Year
less than 30	31.83	15.99	10.95	4.01	12.82
30 - 49	38.55	40.56	31.61	29.35	26.84
50 - 54	6.60	7.78	7.96	14.45	30.10
55 - 59	6.36	8.93	14.74	12.81	35.86
60 - 64	5.14	8.91	8.52	12.87	44.23
65 - 69	3.92	7.14	11.68	10.62	46.45
70 and older	7.60	10.68	14.53	15.91	35.84
All taxpayers	100.00	100.00	100.00	100.00	25.52

Source: Sales of Capital Assets, 1985-1989.

Table 5

RISK PREFERENCES AND PORTFOLIO HOLDINGS

(1) Income Percentile	(2) Percent Desiring No Financial Risk	(3) Percent Holding Riskless Assets	(4) Percent Holding Stock	(5) Average Riskless Financial Assets (1992 $)	(6) Average Stock Holdings (1992 $)
0-10	67	37	6	1,284	664
10-20	70	48	3	2,607	247
20-30	59	52	7	4,959	760
30-40	54	68	14	10,068	1,587
40-50	44	72	13	8,031	2,127
50-60	47	77	15	12,218	2,895
60-70	42	84	19	12,041	1,094
70-80	34	84	26	14,335	6,346
80-90	34	92	30	19,493	6,504
90-95	21	94	44	25,612	20,675
95-99	17	93	55	48,770	68,169
99-100	6	96	78	147,467	801,276

Note: Riskless financial assets are defined to include savings accounts (other than checking), money market funds, CDs, and bonds. Stock ownership includes mutual funds. Holdings in pension funds and IRAs are not included. Income is the sum of all income reported by the respondent.

Source: 1983 Survey of Consumer Finances.

Table 6

SUMMARY OF POLICY EXPERIMENTS EFFECTS ON TAX LIABILITIES

Policy Change	Percentage Change in Actual Tax Liability	
	High-Income Group (A=3)	Low-Income Group (A=10)
(1) Replace benchmark with lump sum tax	-49.7%	-22.9%
(2) Remove loss limits, and increase capital gains tax rate	+28.9%	0%
(3) 20% reduction in capital gains tax rate, increase in t_{ib}	-5.6%	-3.0%
(4) Accrual taxation, and remove loss limits	+15.7%	-1.7%

Note: Each policy change holds the utility of each group constant.

Figure 1

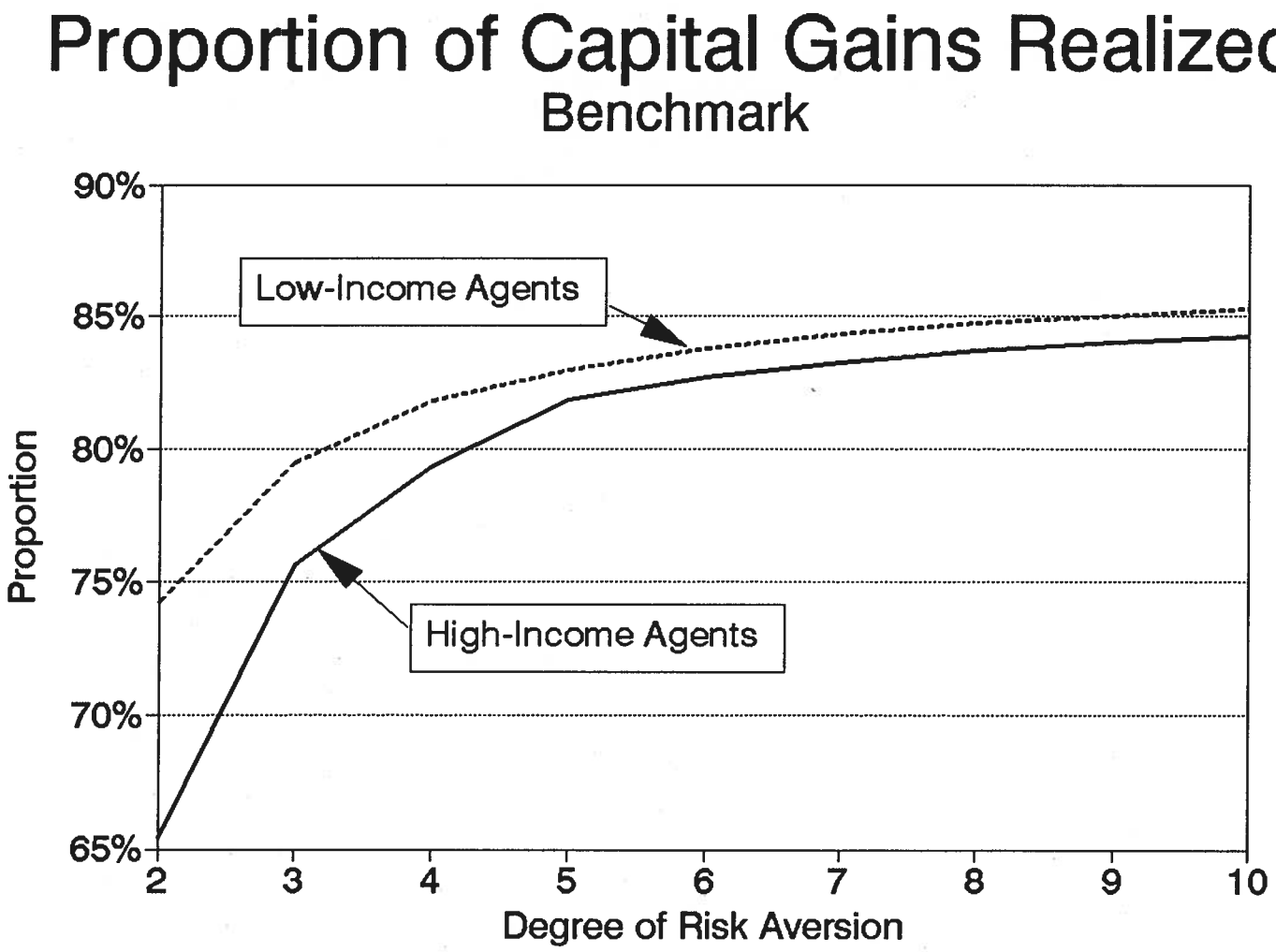

Proportion of Capital Gains Realized
Benchmark
90%
85%
80%
75%
70%
65%
Proportion
Low-Income Agents
High-Income Agents
2
3
4
5
6
7
8
9
10
Degree of Risk Aversion

Figure 2
Increase in Excess Burden: 20% Tax Cut on Capital Gains

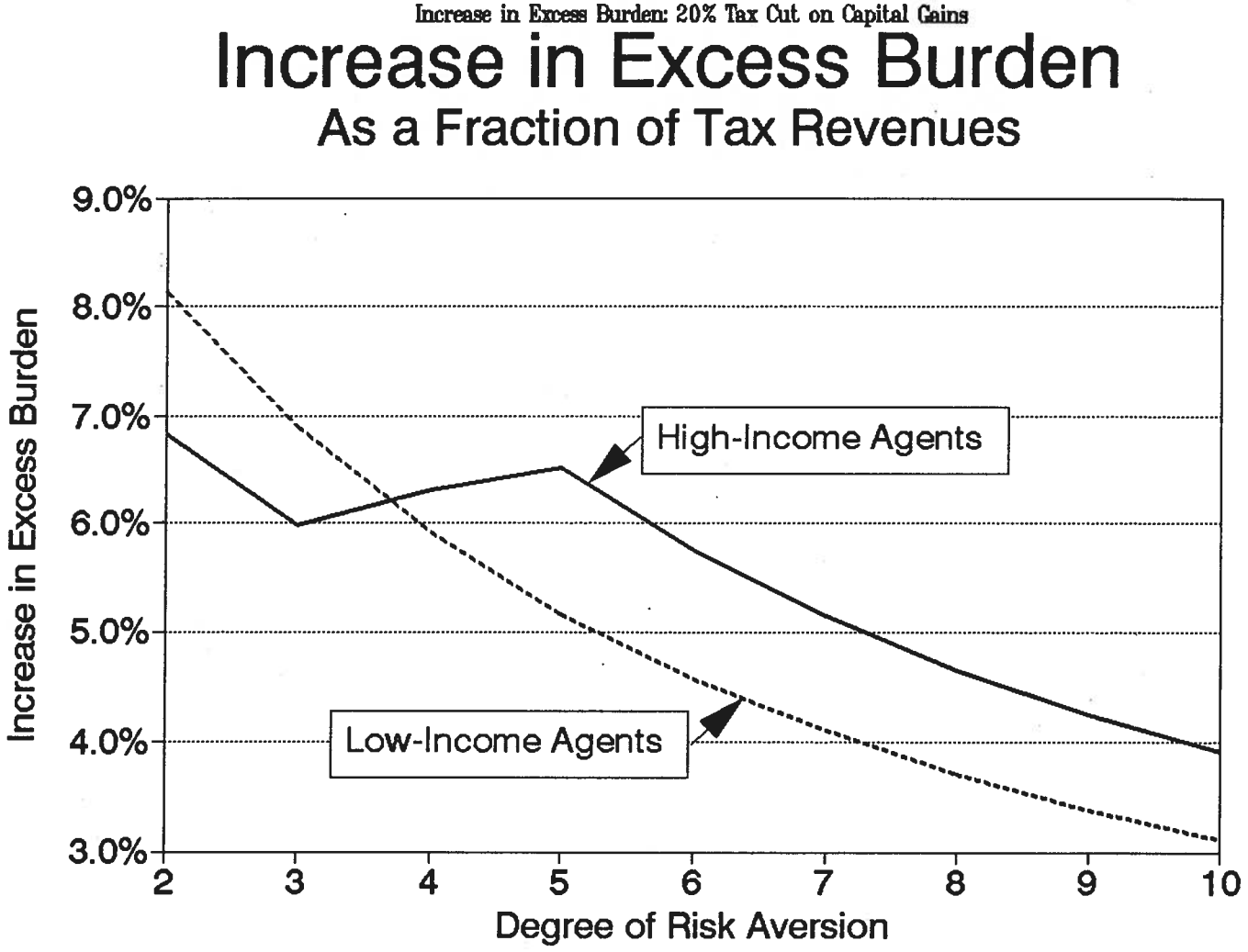
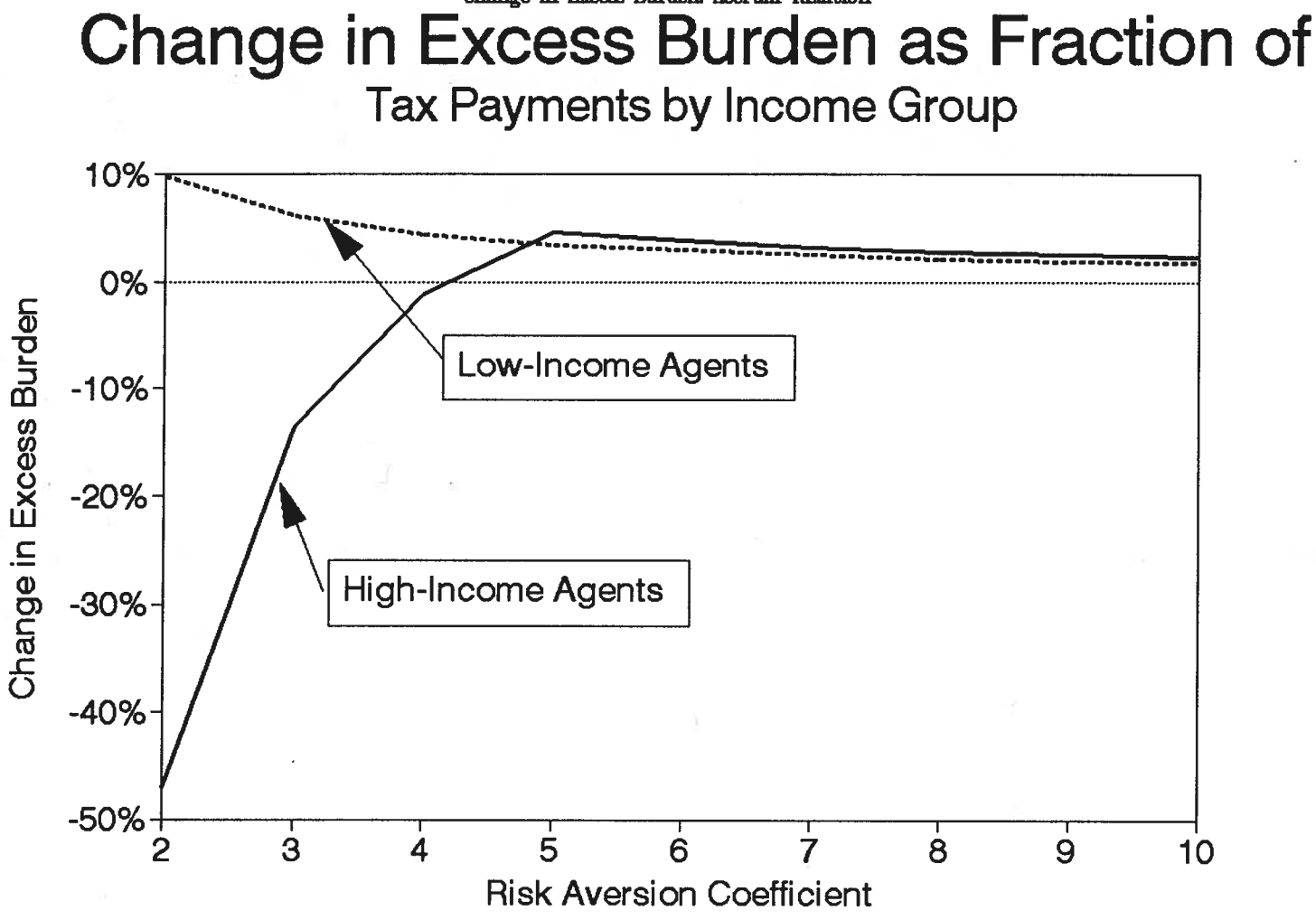


Figure 3
Change in Excess Burden: Accrual Taxation



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