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ABSTRACT

This paper provides an overview of how taxation affects household portfolio structure. It begins by outlining six aspects of portfolio behavior that may be influenced by the tax system. These are asset selection, asset allocation, borrowing, asset location in taxable and tax-deferred accounts, asset turnover, and whether to hold assets directly or through financial intermediaries. The analysis considers how ignoring tax considerations may bias estimates of how other variables, such as income or net worth, affect the structure of household portfolios. The paper then describes the tax rules that apply to various portfolio instruments in a range of major industrialized nations. This illustrates the wide variation in the potential impact of tax rules on portfolio choice. Finally, the paper selectively reviews the existing evidence on how taxation affects portfolio choice. A small but growing literature, primarily based on the analysis of U.S. data, suggests that taxes have important effects on several aspects of portfolio choice. There remain a number of decisions, however, for which it appears difficult to reconcile household choices with tax-efficient behavior.

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Tax rules are a potentially important determinant of household portfolio structure. While media reports typically focus on pre-tax returns, investors actually receive the after-tax returns associated with their investments. Tax rules are often cited as a significant influence on a wide range of household portfolio choices, including whether to hold stocks or bonds, how much to invest in owner-occupied housing, when to sell appreciated securities, and how to accumulate assets for retirement. There is substantial variation across major industrialized nations in the tax treatment of different portfolio assets and in the associated incentives for household portfolio structure.

There are several reasons for analyzing the impact of taxation on portfolio choice. The first is to understand the behavioral effects of the often-complex tax rules that modern tax systems apply to capital income. Such an understanding could ultimately lead to estimates of the efficiency cost of various tax rules. The second justification for examining taxation and portfolio choice is to investigate whether taxation can help to explain some of the stylized patterns that emerge in studies of household portfolios. For some assets, there are clear patterns in the probability of ownership of the asset, and in the share of a household's portfolio invested in the asset, across income and net worth categories. Direct holdings of corporate equities in the United States, for example, are strongly positively correlated with both income and net worth. This pattern may reflect differences in risk tolerance across households in different income and net worth ranges, but it may also reflect the greater tax incentives for equity rather than debt ownership among high-income, high-marginal tax rate households. The tax system may also have important effects on the set of households that takes advantage of opportunities for tax-deferred saving and portfolio accumulation. Finally, recognizing the tax incentives for holding particular assets can be important for interpreting empirical results on how non-tax variables are correlated with portfolio structure. Since household income and net worth are often correlated with

household tax rates, some of the effect of these variables on observed portfolio holdings may operate through their effect on tax rates, and therefore on after-tax rates of return.

While taxation may affect portfolio choice, relatively few empirical studies have established a clear link between taxation and investor behavior. This is largely because marginal tax rates are typically a nonlinear function of household income, which makes convincing identification of tax effects very difficult. In most countries and at most points in time, all households face the same tax system. Differences in the tax incentives facing different households therefore result from differences in their economic circumstances, such as their incomes or their family structures and associated tax deductions. When differences in these variables are the source of differences in marginal tax rates, it is difficult to isolate a pure "taxation effect" on household portfolios.

This paper examines the channels through which taxation can affect portfolio holdings, and it describes the tax incentives facing investors in major industrialized nations. It tries to develop a broad perspective on the ways that taxation may affect portfolio structure and to provide a framework that can be used to integrate empirical findings from different countries and different institutional environments. The paper also summarizes previous work on the links between tax rates and household portfolio structure, and it notes several aspects of household portfolio structure that appear difficult to reconcile with tax-efficient investor behavior. Most of this empirical work is based on data from the United States.

There are many aspects of taxation and portfolio structure that the paper does not explore. It does not consider the structure of employer-provided pensions, and the choice between pension saving and other saving, except in situations where pension saving is done through individually directed accounts. The incentives for pension provision typically depend on both the household and corporate income tax structures. The paper also stops short of considering the detailed tax

and other incentives for investment in specialized financial products, such as the many products offered by insurance companies, on the grounds that there is great heterogeneity across nations in both the products that are available and in their tax treatment. It also focuses primarily on the incentives to hold financial assets, even though non-financial assets such as owner-occupied housing constitute a major share of many households' portfolio.

The paper is divided into five sections. The first describes the many different margins along which households may adjust their portfolios in response to tax incentives. It also notes the tax parameters that interact to determine investor incentives. Section two considers the consequences of omitting tax variables from cross-sectional studies of household portfolio choice, and it notes some of the difficulties that arise in measuring household marginal tax rates. The third section summarizes the differences across countries in the tax rates on interest and dividend income, in the tax treatment of capital gains, and in special tax incentives for retirement and other dedicated saving. Section four presents a brief summary of previous research on how taxes affect portfolio structure. The final section distills several key conclusions about how taxes appear to influence portfolio structure, and it suggests a number of directions that require future investigation.

1. Portfolio Choice in the Presence of Taxation

Most of the modern theory of portfolio choice was developed without reference to taxes. The key results therefore apply directly to the portfolio choices of non-taxable investors, or to the choices of investors who face the same positive tax rate on all types of portfolio income. It is not clear that any taxable investors fall into the latter category, since even when all realized capital income is taxed at the same rate, accrued but unrealized capital gains are typically untaxed until realization.

This section describes a number of dimensions of household portfolio choice that can be influenced by taxation. It begins by summarizing the after-tax capital asset pricing model and its limitations, and then outlines six margins of portfolio choice where taxes can affect investor incentives. The section closes with a discussion of the empirical difficulties that arise in trying to analyze the link between taxes and portfolio choice.

1.1 The After-tax Capital Asset Pricing Model

One way to develop a theory of portfolio choice in the presence of taxation is simply to redefine the returns and covariances of the standard model in after-tax terms. For any investor, the relevant tax rules can be summarized by five parameters. These are the tax rates on interest income (τ_{int}), dividend income (τ_{div}), realized capital gains (τ_{cg}), contributions to tax-deferred saving vehicles ($\tau_{contrib}$), and withdrawals from tax-deferred accounts ($\tau_{withdrawal}$). Many models consider portfolio choice in the absence of tax deferred accounts, so only the first three parameters are important. Yet since tax-deferred accounts play an increasingly important part in the portfolio choices of many households, especially middle-income households, this may be an important omission. The limit on the amount of assets that can be held in these accounts is usually specified as a restriction on the annual contribution to the account, rather than as a constraint on the total amount that may be held in the account. In some countries, the relevant tax rate on a realized capital gain may depend on the length of time for which the asset has been held. This can expand the set of tax rate parameters that need to be considered, and it also raises additional portfolio choice problems of the type considered by Constantinides (1984).

A number of studies have considered the portfolio choice problem facing taxable investors when assets have inherent and immutable tax attributes. The dividend and capital gain components of the income from equities, for example, are assumed to face a given tax rate for a particular investor, while interest income may face a different tax rate for the same investor.

Studies in this tradition include Auerbach and King (1983), Brennan (1970), Elton and Gruber (1978), and Long (1977). These studies consider investment in a range of different risky assets, under the assumption that risky assets (presumably equities) are taxed at a different tax rate than the riskless asset (presumably a bond). While these studies assume that all equities are taxed at the same rate, so that there are effectively only two types of capital income tax (one for bonds, one for equities), it is straightforward to generalize the analysis to consider a wider range of different tax rules.

The central findings of these studies can be summarized easily. Let W_0 denote a household's beginning-of-period investable wealth, S_i denote the household's investment in risky asset i, and assume that the riskless rate of return r_f takes the form of interest that is taxed at rate τ_{int}. All risky assets are taxed at a rate of τ_{eq}, which is a weighted average of the taxes on dividends and realized capital gains, and pretax returns on the N equity securities are given by r_i. The expected pretax return on equity security i is μ_i, the vector of mean returns on equity securities $\{r_1, ..., r_N\}$ is μ, and Ω denotes the N-by-N covariance matrix of risky returns. The covariance between the pretax return on risky assets i and j is σ_{ij}.

The individual investor is assumed to maximize a utility function that can be written in terms of the mean and variance of final wealth, $U(W, \sigma^2_W)$. The investor's expected end-of-period wealth, which depends on the amounts invested in each risky security, is

(1) $$E(W) = [W_0 - \Sigma S_i]*(1-\tau_{int})r_b + \Sigma S_i*(1-\tau_{eq})\mu_i .$$

The variance of end-of-period wealth is

(2) $$V(W) = \Sigma \Sigma S_i*S_j*(1-\tau_{eq})^2*\sigma_{ij} .$$

Manipulating the first-order condition for the asset allocation that maximizes expected utility yields

(3) $$S^* = \delta*\Omega^{-1}*[(1-\tau_{eq})\mu - (1-\tau_{int})r_b*1]$$

where 1 denotes a column vector of 1s. S* is a column vector that contains the optimal asset allocation to each risky security. The term δ is related to the investor's risk aversion: $\delta = U_W/[2U_{\sigma 2}*(1-\tau_{eq})^2]$. If there were no taxes on interest income or equity returns, this expression reduces to the standard expression for risky asset demands. Equation (3) generalizes the standard result from portfolio choice in the presence of taxes to allow for differential tax treatment of different assets, and it shows that the investor's optimal portfolio holdings will depend on after-tax expected returns and after-tax covariances.

Auerbach and King (1983) show that the optimal portfolio in the presence of taxes can be interpreted as a weighted average of two portfolios. One portfolio is the market portfolio, and the other is a portfolio that is chosen on the basis of tax but not risk considerations. The relative weights on these two basic portfolios depend on the investor's tax rates in comparison to the tax rates of other investors, and on the investor's risk aversion. More risk-averse investors will place greater weight on the diversification portfolio, and down-weight the portfolio that derives from tax specialization, relative to less risk averse investors or investors whose tax rates diverge substantially from those of the investing population.

While the after-tax portfolio choice analysis of equation (3) is a useful starting point, it fails to describe the actual portfolio selection environment facing many households. Two factors are important in this regard. First, the analysis that underlies equation (3) assumes that households can take short as well as long positions in all securities. When short selling is costly, this may not be feasible for many investors. Second, and more importantly, equation (3) does not recognize the possibility of holding a given asset in either a taxable form or in a tax-deferred account. For investors in many nations, this is a very real possibility, and it leads to a richer portfolio choice problem.

1.2 The Importance of "Asset Habitat"

One of the most important recent developments in the institutional environment facing investors is the potential separation between an asset's risk characteristics and its tax attributes. Most conceptual analyses of taxes and portfolio choice assume that tax differences across assets are inherent features of the assets, just like their return attributes. But as tax-deferred and tax-exempt saving vehicles become more important in many nations, it is necessary to recognize that an asset's tax attributes may be affected by the habitat in which the asset is held. Consider the case of corporate equities held by individual investors in the United States. When equities are held outside tax-deferred accounts, dividend income is taxed at the investor's ordinary income tax rate, unrealized capital gains are not taxed, and realized capital gains are taxed at either the long- or short-term capital gains tax rate. If the same assets are held in a tax-deferred saving account, however, then neither dividend income nor realized capital gains are taxed until the assets are withdrawn from the account. At that point, the entire amount of the withdrawal is taxed at the investor's ordinary income tax rate, which equals the dividend income tax rate. Depending upon an investor's horizon and the share of the equity return that accrues in the form of dividend payments, the effective tax burden on equities may be greater inside or outside the tax deferred account.

To illustrate the effect of asset habitat, consider an investor who has one dollar of current earnings, and who is considering investing this money by holding stocks in a retirement account or in a traditional taxable setting. Assume that a fraction λ of the returns on corporate equities (r_{eq}) is generated in the form of dividends, and to simplify matters, assume that equity returns are certain. Let the tax rate on withdrawals from tax-deferred accounts equal that on dividend income, which in turn equals the tax rate on earned income. If the investor chooses to invest in a taxable account, his current earnings will face a tax burden of τ_{div}, because the tax rate on earnings equals the dividend tax rate. The investor will therefore have $(1-\tau_{div})$ dollars available for current

investment. The investor's after-tax wealth in T years if the equity is held in a taxable account will be:

(4) $$W_{taxable} = (1-\tau_{div})*\exp\{[(1-\tau_{div})*\lambda + (1-\tau_{cg})*(1-\lambda)]*T*r_{eq}\}.$$

This outcome can be compared with the situation if the investor uses the same amount of pretax earnings to fund a tax-deferred retirement saving account, such as an Individual Retirement Account or a 401(k) plan. In this case the investor will be able to allocate pre-tax earnings to the account, and the value of the equity in the account will grow to $\exp(T*r_{eq})$ after T years. A tax of τ_{div} will be due when the assets are withdrawn from the account, assuming that the investor's ordinary income tax rate is the same at the time of withdrawal as at the time of contribution. (For many investors the former may be smaller than the latter, raising the tax benefit associated with tax-deferred investments.) The after-tax value of the tax-deferred account after T periods will be:

(5) $$W_{tax\text{-}deferred} = (1-\tau_{div})*\exp(T*r_{eq}).$$

The contrast between the values in (4) and (5) underscores the importance of asset habitat in considering the portfolio choices facing investors. When the assets are held in a traditional taxable format, the effective tax burden on equity income depends on the statutory tax rates on dividends and capital gains and on the fraction of equity returns that take the form of dividends. In the tax-deferred account, however, the equity return is untaxed, in the sense that the earnings used to fund the tax-deferred account are only taxed when the funds are withdrawn from the account.

The possibility of holding assets with the same pre-tax returns in different habitats, and thereby subjecting them to different tax treatment, complicates the household's portfolio optimization problem and it makes it more difficult to describe how the tax system affects portfolio choices. In most settings, a household's optimal portfolio plan will involve maximal use

of tax-deferred saving vehicles, with their correspondingly favorable tax treatment, before making investments in traditional taxable accounts.

1.3 Margins Along Which Taxation Affects Portfolio Structure

One way to organize the study of taxes and portfolio choice is to isolate the various margins of portfolio choice that may be affected by taxation. There are at least six such margins, and different aspects of the tax system may influence choices along each margin.

Asset Selection - Which Assets to Own. In simple models of portfolio choice, each household that holds any risky assets holds some of every risky asset, with the household's total holdings of risky assets determined by the household's risk tolerance. (This presumes that there are no dominated assets, i.e. assets that offer a lower payoff in all states of nature than other assets available to investors.) This prediction is distinctly at odds with the patterns we observe in actual portfolios. Most households own an incomplete set of assets. For households with modest wealth, there are typically many asset categories that are not represented in the household portfolio. Asset ownership patterns show that many households choose not to own assets in each broad asset category.

Table 1 presents summary information from the U.S. Surveys of Consumer Finances (SCFs) over the period 1983-1995. Bertaut and McCluer (2000) present complementary information, including some results from the 1998 Survey of Consumer Finances. Table 1 shows the fraction of households who report ownership of positive amounts of assets in a broad range of categories. The table shows that less than twenty percent of households own corporate stock directly, i.e. in a taxable account. Less than one third of households held corporate equity in a tax-deferred account, although there has been substantial growth in this form of stock ownership in the last two decades. (The SCF does not provide definitive information on the asset composition of tax-deferred accounts. Table 1 assumes that accounts that are invested "mostly in

stock" are completely held in equities, and that accounts that are invested in "combinations of stock and interest-bearing assets" are invested half in corporate stock. This approach follows Poterba and Samwick (1997).) A very small fraction of households, slightly more than six percent, reports ownership of tax-exempt debt. There are some categories of assets, such as "interest bearing accounts," where most households report positive ownership. This asset class includes checking accounts and other financial instruments that households typically use to facilitate various transactions.

Incomplete portfolio holdings do not appear to be confined to U.S. households. Hochguertel, Alessie, and vanSoest (1997) report similar findings, for a broader set of asset classes, in a study of Dutch households. Banks and Tanner (2000) present evidence for U.K. households that also suggests a lack of portfolio diversification.

The explanation for portfolio incompleteness is not clear. Leape (1987) argues that if there are fixed costs associated with the purchase of some assets, then households may decide not to purchase some assets because their marginal contribution to the after tax risk-adjusted expected portfolio return is not large enough to outweigh this fixed cost. Bertaut and Haliassos (1995), Haliassos and Michaelides (2000), and Vissing-Jorgensen (1999) also explore the issue of portfolio incompleteness. The costs of asset acquisition may be explicit transaction costs, or the psychological costs associated with learning about various assets. Regardless of the source of these costs, the tax burden on an asset's returns should affect an investor's calculation of whether or not to hold an asset.

It is possible that the tax system contributes to the fixed cost of owning some asset classes. An investor who considers purchasing corporate stock or a mutual fund, for example, but who does not have any other investments in similar assets, may face more complex tax reporting and tax calculation tasks as a result of the investment. This issue would apply to the first investment

in a given asset category, but it would apply with less force to subsequent investments. (The tax system could also have the opposite effect, reducing participation costs. Financial costs of trading are usually a tax-deductible expense when an investor computes capital gains or losses. In situations where there is a fixed cost associated with buying and selling securities, the after-tax cost is smaller than the pretax cost. A similar argument applies to the time that investors spend to learn about investments; the after-tax value of such time is smaller than the before-tax value.)

Another key feature of actual asset holding patterns is the presence of some puzzling patterns in asset cross-ownership. Table 2 shows the conditional probability of owning one asset, given that a household owns another, again using the 1995 Survey of Consumer Finances. There are some findings that are difficult to reconcile with the formation of strong tax-related clienteles. More than half of the households who own tax-exempt bonds also report holding taxable bonds, although only 14 percent of those who own taxable bonds report owning tax-exempt bonds. Of the households who own bonds in their tax-deferred investment accounts, 54 percent also hold equities in tax-deferred accounts. Forty percent of the households with tax-deferred bond holdings report holding taxable bonds as well.

Table 2 also shows interesting patterns with respect to investor specialization in different types of financial intermediaries. Less than one third (28 percent) of the households who have direct holdings of corporate stock hold equity mutual funds, but 41 percent of the households with equity funds also have direct stock holdings. These patterns underscore the importance of considering portfolio choice as a decision to hold a collection of assets, rather than just a set of stand-alone decisions about investing in particular assets.

Asset Allocation -- How Much to Invest in Each Asset. The after-tax capital asset pricing model analysis discussed above is most directly targeted at this aspect of investor behavior. Investors who face different tax burdens on different securities will choose to invest different

amounts in these securities. The key parameters for assessing this aspect of asset demand are the actual marginal tax rates that investors face on the income flows from each asset type. Because portfolio holdings depend on the full vector of returns available to investors, it is difficult to specify simple empirical models of portfolio choice with taxes.

Taxes influence the specification of the covariances across asset returns. One simple strategy for constructing after-tax returns is to multiply the pretax returns on a given asset, or the capital gain or loss component of these returns, by a $(1-\tau_{cg})$ term that indicates that investors receive returns net of capital gains taxes. Poterba (1999) argues that the relevant capital gains tax rate might not be the statutory rate, but rather one based on a forecast of the future pattern of realizations and the associated effective tax burden on current accruing gains.

This approach may understate the interdependence of returns across different assets, however, because an investor's tax rate may itself depend on realized returns. When asset markets generate high returns, investors may have higher-than-expected taxable income, and their marginal tax rates may be higher than they would otherwise have expected. If asset markets generate poor returns, investors may face substantial capital losses, and in nations where losses are not fully deductible against ordinary income, they may become loss-constrained. These features have not yet been considered in models of asset allocation.

How Much to Borrow. While many discussions of taxation and portfolio structure concentrate on the assets that households own, taxes can have at least as much impact on whether households borrow to finance their asset holdings. In many nations, households are able to deduct their interest payments on loans that are used to finance asset purchase, as well as on loans for home purchase. In the United States, until 1986, all consumer interest, even that used to purchase consumer durables, was tax-deductible. In more recent years only borrowing for financial or housing investment has been deductible.

Table 3 presents information on borrowing patterns for U.S. households, again drawing on data from the 1995 Survey of Consumer Finances. Just over forty percent of households report some outstanding mortgage debt, with middle-aged households having the highest probability of such borrowing. The probability of mortgage borrowing is relatively insensitive to household net worth, despite the fact that higher income households (who tend to be higher net worth households) face higher marginal tax rates and therefore a lower after-tax cost of mortgage borrowing.

Table 3 also shows that two-thirds of U.S. households report some non-mortgage borrowing, even though there is no tax subsidy to such borrowing. There is a pronounced decline in the likelihood of non-mortgage borrowing, and in the ratio of non-housing debt to non-housing assets, as one moves up the age distribution and up the net worth distribution. While non-mortgage debt represents more than one-third of the non-housing assets of households with net worth of less than $100,000, it represents less than five percent of non-housing assets for those with net worth of $500,000 or more.

Asset Location. With the emergence of tax-deferred or tax-exempt retirement saving accounts, and other specialized saving vehicles, in many nations, investors face a new decision about where to hold a given asset. Shoven (1999) and Shoven and Sialm (1999) consider the problem of bonds versus stocks in the tax-deferred account, with particular reference to equity mutual funds in the United States. The choice of which assets to hold in tax-favored accounts, and which assets to hold in traditional taxable format, depends on the tax rate on each asset when it is held outside the tax-favored account and on the tax rules that apply to withdrawals from the tax-deferred account.

Table 4 presents information from the 1995 Survey of Consumer Finances on the location of corporate stock holdings for U.S. households. The table shows the fraction of households in

various age and net worth categories that report owning corporate stock directly (in a taxable format) as well as indirectly, through a 401(k) plan or Individual Retirement Account. The roughly one third of households that own some corporate stock are approximately evenly distributed across the three different ownership possibilities. Roughly one third of those who own any stock own stock both through a tax-deferred account and in a taxable format. At low net worth levels, and at young ages, the probability of holding stock only through a tax-deferred account is significantly greater than the probability of holding stock directly or than the chance of owning stock through both mechanisms. This is consistent with a situation in which available of employer-provided saving plans, such as 401(k)s, is drawing young investors, and investors with modest levels of net worth, into the equity market.

Choice of Financial Intermediaries. Yet another aspect of portfolio choice that may be affected by tax rules is the decision of whether to hold securities such as stocks and bonds directly, by purchasing them in the securities market, or through intermediaries such as mutual funds or insurance companies. This choice is likely to depend on the transactions costs, such as expense ratios on mutual funds, that are charged by financial intermediaries, and on the relative tax treatment of assets held directly and held through intermediaries. Dickson and Shoven (1994) describe the current tax rules on mutual funds in the United States, and they note that these rules typically make equity held through a mutual fund a more heavily taxed asset than equity held directly.

Taxes are not the only distinction between assets held directly and through intermediaries: there are typically differences in the pretax returns associated with the transactions costs and other administrative expenses associated with the intermediary. In the United States, for example, Rea, Reid, and Lee (1999) estimate that the average expense charge on equity mutual funds was 135 basis points in 1998. For load funds, the average was 200 basis points, while for no-load funds, it

was 83 basis points. Charges of this magnitude are not trivial in comparison to the expected after-tax returns associated with many asset categories.

When to Trade Assets. The discussion so far has focused on portfolio decisions that concern which assets to hold. Investors must also make decisions, however, about when to sell the assets they hold. The tax treatment of capital gain realizations, and the treatment of losses, can affect this decision. When investors are taxed on realized gains but not on accruing gains, they may become "locked in" to the assets that they hold. Realization-based taxes discourage the sale of capital assets, and the associated portfolio rebalancing that investors might undertake in a world without taxes.

There is no widely accepted theory of what motivates households to trade the assets that they hold. In many standard models of portfolio choice, all households hold a market portfolio, so they are not predicted to trade their holdings of one security for that of another. One can deviate from this structure by assuming that households have private information that leads them to value some securities more than other market participants do, but models of this type are often ad hoc. Further work on the factors that influence trading could be very helpful in guiding research on the efficiency cost of tax rules, such as realization-based capital gains taxes or securities transactions taxes, that make it more expensive for households to rebalance their portfolios.

Patterns of actual trading suggest that high-net-worth households are more likely to trade assets than are households with lower net worth. Table 5 reports data on ownership of and trading of common stocks by U.S. households in 1995. The table shows that the fraction of those households who own corporate stock who have bought or sold stock in the last year rises in household net worth. This fraction is less than forty percent for those with net worth of less than $250,000, compared with more than 85 percent for those with net worth of more than $2.5 million. Since the table shows the share of households who own stock in each net worth category

who trade, the differences cannot be explained by the fact that more high-net-worth households own corporate stock.

2. Empirical Challenges Posed by the Taxation of Investment Income

The fact that investors are taxed on their investment income raises a number of difficult issues for econometric analysis of household portfolios. This section begins by noting how failure to include tax variables in reduced form models that explain household portfolio choices could result in biased estimates of true effect of other variables of interest. It then considers several empirical issues in measuring marginal tax rates and including these variables in econometric work.

2.1 Tax Rates as Omitted Variables

The standard model of household portfolio choice in an after-tax setting would define the amount that household h invests in asset I as a function of that household's expected after-tax returns, μ_{at}, and household net worth, W. Household income (Y) might also affect asset demands for reasons related to precautionary demands for wealth or because income may provide information about other household attributes that affect asset demand. Consider what happens when an investigator estimates a statistical model linking portfolio choices to income, net worth, and pretax returns. In this case the derivative effects of asset demand with respect to income and net worth will reflect not just the effects of these variables on asset demand directly, but also their effects through their impact on marginal tax rates. Thus, (6) $\{dA_i/dY\}_{measured} = (dA_i/dY)_{true} + \Sigma_j \, dA_i/d\mu_j * (d\mu_j/dY)$.

Since tax rates depend on income, there is a presumption that the $d\mu_j/dY$ terms will be non-zero for many assets. This means that omitting after-tax returns can yield results that are difficult to interpret. (Note that the second term in (6) is not limited to substitution effects across assets that

are associated with tax-induced changes in rates of return. There may also be effects of tax rates, through after-tax returns, on the level of saving and hence of overall wealth accumulation.)

Evaluating the bias from omitted tax variables is complicated by the fact that $d\mu_j/dY$ is likely to differ across assets. In the United States, for example, the marginal tax rate on realized capital gains is relatively insensitive to a household's total income, while the marginal tax rate on dividend and interest income follows a progressive schedule that is influenced by total income. As noted in the discussion of the after-tax capital asset pricing model above, changes in marginal tax rates can also affect the after-tax covariances for various assets. This is another source of omitted variable bias when tax rates are not included in the specification.

2.2 The Problem of Measuring Marginal Tax Rates

The preferred alternative to excluding tax rates in defining after-tax returns is computing household marginal tax rates and including these variables in the analysis of portfolio choices. A number of operational problems arise in following this strategy. First, most household surveys do not include as much detailed information as tax returns about specific income flows. This means the data analyst is imputing some of the variables that determine marginal tax rates. The problem is likely to be most serious for high-income households with substantial net worth and substantial portfolio holdings, because their financial affairs are more complicated than those of lower income households. They are also likely to hold a higher fraction of financial assets, and they are correspondingly more important for the study of portfolio choices.

Second, for most investment problems it is necessary to measure not just a household's current marginal tax rate, but its future marginal tax rates as well. Future tax rates matter both because the decision to purchase an asset is often a long-term decision, since the asset may be illiquid or subject to trade only at a substantial discount. If there are costs of portfolio adjustment,

decisions about which assets to hold at a given point in time will depend on both current and future marginal tax rates.

There are two sources of uncertainty in analyzing future marginal tax rates: aggregate tax policy risk, and household-specific rate uncertainty. It is not clear that households forecast future changes in overall tax policy, or why there are differences across households in such forecasts. If there were differences, they could affect the empirical analysis of how current tax rates, or current income or net wealth, affect portfolio choice.

Consider a situation in which high-income households believe that future marginal tax rates will increase, while lower income households do not expect that tax rates will change in the future. Such a situation would lead to differences in the portfolio choices across households in different income groups, which the data analyst would attribute to differences in income, but the differences would in fact be the result of different tax policy perceptions that are correlated with income. With respect to taxpayer-specific variation in marginal tax rates over time, there may be substantial correlation between taxpayer circumstances and projected future tax rates. Older households, for example, may anticipate a decline in their labor income, and correspondingly expect that their marginal tax rates will fall in future periods. Households at the start of the lifecycle may expect rising income and correspondingly rising marginal tax rates. These patterns imply that households may expect different future patterns in the returns on different assets, and they may affect the portfolio structure that we observe.

Uncertain future taxes raise difficult empirical issues for the analysis of any type of long-lived consumer decision, including occupation choice, intertemporal labor supply, as well as portfolio choice. However, portfolio decisions may be particularly sensitive to future tax rates. If an investor buys an asset that appreciates, particularly if the asset does not pay dividends, her after-tax return will be largely dependent on the capital gains tax rate that prevails when the asset

is sold. Other decisions, such as labor supply choices, do not offer payoffs that are so sharply affected by the tax regime at one point in time.

A third complication for portfolio analysis that arises from the presence of taxes is linked to the formation of taxpayer clienteles for particular assets. The after-tax return that a given taxpayer receives from holding a particular type of asset depends only on the asset's pretax return and on the taxpayer's marginal tax rate. Which taxpayers should hold particular assets, however, depends more generally on the structure of marginal tax rates facing all households. Generalizations of Miller's (1977) classic analysis of taxpayer clienteles, such as Auerbach and King (1983) and McDonald (1983), show that the set of taxpayers who should hold particular assets will depend on the relative tax treatment of different taxpayers with respect to different assets. The equilibration process should involve changes in the pretax return on different assets, so that investors in each investor type find their highest post-tax return on the asset for which they have the greatest relative tax advantage.

The fact that optimal portfolio allocation across investors depends not just on the particular investor's tax rate, but on the tax position of other investors as well, is not especially troubling for analyzing cross-sectional patterns of portfolio holdings. The economy-wide aggregate tax situation should drop out in comparisons of portfolios and marginal tax rates across investors. However, this feature of the after-tax portfolio equilibrium makes it difficult to compare two cross sections, or to analyze panel data on tax returns. Just because a given investor's marginal tax rate rises from one point in time to another does not imply that the investor has a smaller incentive to hold a heavily taxed asset. The investor's incentive to hold such an asset will depend on the change in the investor's tax treatment relative to the treatment of all other investors.

3. The Tax Rules Facing Investors in Different Nations: A Brief Summary

The discussion so far has considered taxation and portfolio choice at a general level, without reference to the specific tax rules that apply to investors in various nations. One of the difficult problems in studying how taxes affect investor behavior is the very detailed nature of many tax incentives. For example, in countries that tax capital gains realizations, the tax rate on a gain can depend on the specific nature of the transaction that generated the gain, both with respect to the underlying asset and to the length of time that the asset was owned. In most countries, whether a taxpayer can deduct interest payments depends on the purpose for which the taxpayer borrowed.

The present paper is too short to provide a comprehensive introduction to the heterogeneous tax treatment of capital income in major industrialized nations. Nevertheless, it is useful to provide some information on the nature of the cross-national variation in tax incentives for household portfolio choice. This section reports on three sets of tax rules that may affect portfolio structure: the tax treatment of interest, dividends, and capital gains; the availability of tax-deferred retirement saving accounts; and the tax treatment of household borrowing. Poterba (1994) offers a more detailed, if somewhat dated, discussion of the tax provisions in each nation, and more recent information is usually available from various accounting firms that advise multinational firms and their employees.

3.1 Tax Rules on Interest, Dividends, and Capital Gains

There are substantial differences across countries in the tax rules that apply to capital income. There are differences in the rules faced by middle-income households, and there are differences between the tax treatment of middle-income and high-income households across nations. Since many nations apply progressive income tax schedules to a household's taxable income, there is variation in marginal tax rates across different households within each nation.

This makes it hard to select a single summary statistic for "the" tax rate on interest, or dividends, in a particular nation.

This difficulty notwithstanding, Table 6 presents an overview of the tax treatment of capital income in eight major industrialized nations. The table shows that the level of marginal tax rates on each of the different income flows varies from country to country, and that the relative tax burdens on different types of income also differ.

The tax treatment of capital gains provides a tractable starting point for analyzing the information in Table 6. The last two columns of the table describe the general tax treatment of realized capital gains, along with the rules that affect the relationship between an asset's holding period and the tax burden on any gain. In two of the eight nations shown in the table, Germany and the Netherlands, capital gains are effectively untaxed. None of the eight countries tax accruing capital gains, while six tax gains at realization. (Germany taxes short-term capital gains but does not tax long-term gains, so most realized gains are untaxed.)

The United States has the most complicated set of rules for determining the tax treatment of capital gain. There are both short-term and long-term gains, with short-term gains more heavily taxed. There have been recent periods, such as 1997-1998, when there were three different capital gains tax rates in the United States. These rates applied to short term gains (less than twelve month holding period), intermediate term gains (12-18 months), and long-term gains (holding period of longer than 18 months).

The United Kingdom, which levies a 40 percent capital gains tax on gains above a threshold, has the highest statutory tax rate on capital gains, although gains are defined in real rather than nominal terms. Of the countries that tax gains, Japan and Italy have the lowest rates, since investors who realize gains can choose to pay a tax equal to one percent (Japan) or a roughly

similar fraction (Italy) of their asset's value, rather than to pay tax on their realized gain. This set of tax rules effectively limits the capital gains tax rate to one percent.

Table 6 also shows that there is substantial heterogeneity in the tax treatment of dividend income. It is important to consider the combined tax burden at the corporate as well as the investor level in analyzing dividend taxes. The United States levies the highest tax burden, among the eight nations in Table 6, on dividend payments. The corporate income tax is not integrated with the investor-level tax, so dividends are paid from fully taxed corporate earnings and they are then subject to another round of taxation when the investor receives them. The United Kingdom, Germany, and France have tax codes that provide investors with a tax credit for the corporate tax paid on the earnings that underlie their dividend income. The other nations shown in Table 6 have more modest, "partial integration" schemes that also reduce the tax burden relative to the "classical" system in the United States.

Finally, Table 6 illustrates the variation across nations in the tax treatment of interest income. Both Japan and Italy apply a relatively low tax rate, 15 percent and 16.2 percent respectively, to household interest income. (In Italy, some types of interest may be subject to higher tax rates.) In other nations the tax burden on interest income, and consequently the tax disincentive for high tax bracket investors to hold bonds or other interest-generating assets, is more substantial. The top marginal tax rate on interest income is 39.6 percent in the United States, 56.2 percent in France, and 60 percent in the Netherlands. These tax rates would play a key role in determining the tax incentives for investors to hold fixed-income assets rather than other securities in their portfolios.

3.2 Tax-Deferred Saving Opportunities

Just as marginal tax rates vary across nations, the opportunities for households to engage in tax-deferred saving also vary significantly. Table 7 sketches the current provisions for tax-

deferred saving in the eight nations that were included in Table 6. In two countries, France and Japan, households do not currently have access to tax-deferred saving vehicles. Japan historically offered maruyu postal saving accounts to small investors, with favorable tax treatment. These accounts were phased out in 1986. For the remaining six nations, households can contribute to retirement saving accounts using pre-tax dollars.

The amounts that households can accumulate through tax-deferred saving vehicles is a function of the amount that can be contributed to these accounts, and there is significant cross-country variation on this dimension. In Italy, households can contribute two percent of wages, and in Germany, the annual contribution limit is roughly $2000. Canada, the United Kingdom, and the United States all allow more generous plans, with contribution limits in the range of $10,000 or above. In the United States, as in some other nations, the limit on the amount that a household can contribute to tax-deferred accounts may depend on the household's employment circumstances. All taxpayers can contribute $2000 to either a traditional or a "Roth" Individual Retirement Account (IRA). In addition, an employee who works at a firm that offers a 401(k) retirement saving plan can contribute up to $10,500 to this type of tax-deferred account. A self-employed person could make even larger contributions to a tax-deferred account known as a "Keogh plan." This heterogeneity is not atypical for nations with tax-deferred plans; the United Kingdom also offers a range of different options for tax-deferred saving. Beginning in 2000, U.K. taxpayers will be able to contribute up to ✯5000 to Individual Saving Accounts (ISAs) each year.

Table 7 does not capture the full richness of the cross-national differences in access to retirement saving plans, but it does illustrate the broad variation between nations with larger and smaller programs for tax-deferred accumulation. Issues such as the "asset location" problem discussed above are likely to be more serious concerns for households in the United States, the

United Kingdom, and Canada, where higher contribution limits make it possible to accumulate substantial amounts of wealth in tax-deferred saving vehicles.

3.3 The Tax Treatment of Interest Payments

A final source of tax variation across nations, with potentially important implications for portfolio structure, involves the tax deductibility of interest payments. Table 8 reports the tax rules the affect mortgage interest deductibility and the deduction of consumer interest in various nations. All of the countries considered here allow households to deduct interest on debt that is incurred in the context of portfolio investments. Only one of the eight nations, the Netherlands, currently allows any tax deduction for consumer borrowing, and there is a limit on such borrowing. Four of the eight nations allow households to deduct mortgage interest payments. In the United Kingdom, which has historically allowed a mortgage interest deduction for tax purposes, there has been gradual erosion of this deduction; it will be eliminated beginning in April 2000. Japan does not allow taxpayers to deduct mortgage interest, but it does offer a special tax credit to first-time homeowners for six years after they purchase their home.

Three countries, the United States, the Netherlands, and France, allow relatively unrestricted deductions for mortgage interest, and a fourth, Italy, allows mortgage interest deductions for first-time homeowners. In the United States, households cannot deduct interest on more than $1,000,000 of mortgage debt, but this is a constraint that binds for relatively few households. In light of this cross-sectional heterogeneity in tax rules, one should expect households to allocate a greater share of their portfolios to housing assets in the U.S., France, and the Netherlands, and to rely more on mortgage debt in these countries, than in other nations.

4. Previous Studies of Taxation and Portfolio Choice

A number of empirical studies have tried to measure the impact of taxation on the structure of household portfolios. Most of these studies have relied on information from the United States, largely because of the historical availability of household-level information on balance sheets. This section provides a brief introduction to the existing literature on taxation and portfolio behavior. Poterba (forthcoming) offers a more detailed review than the current summary.

4.1 Asset Selection and Asset Allocation

The two issues in portfolio choice that have received the most attention in previous empirical research are asset selection and asset allocation. A number of studies have suggested important links between tax rules and the structure of household portfolios. This sub-section begins with a review of previous studies, and then summarizes the findings in Poterba and Samwick's (1999) analysis of taxation, asset selection, and asset allocation in the 1995 U.S. Survey of Consumer Finances.

4.1.1 Previous Research

The first major study to analyze how taxation affects household portfolios was Feldstein's (1976) paper using the 1962 Survey of Financial Characteristics of Consumers. At the time of this survey, the top marginal tax rate in the federal income tax code was 91 percent. Feldstein argued that net worth should be the key variable that influenced a household's choice of portfolio structure, and that parameters such as household risk tolerance were likely to be related to net worth but not to income. He therefore studied how portfolio structure was related to both household net worth and household income. He found that higher income households were more likely than lower-income households to hold equity, conditional on wealth. Since equity is taxed less heavily than debt under the tax rules in the United States, this finding is consistent with the view that taxes affect portfolio

structure. It is premised on the view that income does not affect portfolio choice except through its impact on tax rates.

King and Leape (1998) present related evidence on how marginal tax rates are related to portfolio choice. They find that tax variables affect which assets investors decide to hold, but they find very limited support for a link between tax rates and the fraction of the household's portfolio that is held in different assets. They analyze data from a 1978 survey conducted by SRI International. In addition to their findings on the patterns of asset holdings and taxes, they also report that many investors have zero holdings of broad asset categories such as corporate stock, corporate bonds, and tax-exempt bonds. This study finds only weak evidence for the formation of tax-related portfolio clienteles.

A third study that investigates how taxes affect portfolio choice is Hubbard's (1985) analysis of data collected by the U.S. President's Commission on Pension Policy. Hubbard estimates the marginal tax rate facing different households, and he then relates these marginal tax rates to the structure of household portfolios. This study does not rely simply on the fact that income is related to marginal tax rates to investigate how taxes affect investor behavior, but it uses the detailed structure of the tax code to pin down the structure of marginal tax rates. Income, along with the marginal tax rate, is an explanatory variable that helps to account for the cross-sectional pattern of portfolio holdings.

Two more recent studies that examine the link between taxes and portfolio structure are Scholz (1994) and Samwick (1997). Both of these studies rely on data from the Survey of Consumer Finances. This survey has been carried out in the United States every three years since 1983. The 1983, 1986, and 1989 surveys were linked together to provide a panel data set, but a high rate of attrition between the surveys led to discontinuation of the panel component. (Detailed information on the structure of the surveys may be found in Kennickell and Starr-McCluer (1997).)

Subsequent surveys have been cross-sectional. Scholz studies portfolio changes between 1983 and 1989, a period that includes the substantial Tax Reform Act of 1986. He finds relatively small changes in portfolio structure between these two years, with the notable exception of some restructuring of household debt into the tax-favored mortgage category, in spite of the fact that marginal tax rates were changed substantially. Samwick (1997) is also concerned with changes that may have been induced by the tax reforms of the last two decades. While there is a clear cross-sectional relationship between marginal tax rates and portfolio structure, the changes over time in portfolio structure are difficult to explain based on changes in marginal tax rates.

These studies leave two issues unresolved. One is whether the three years is too short a time period over which to find major shifts in portfolio structure. What theoretical guidance we have with respect to taxation and portfolio structure provides very little insight on the question of how portfolios adjust over time. Factors including the capital gains tax rate, the tax treatment of losses, and the trading costs associated with financial transactions can play a central role in determining these effects.

There is also a second, and perhaps deeper, conceptual point that arises in analyzing portfolio changes over time. The set of assets available in the economy is endogenous, and the amount of assets supplied by firms and other users of capital is affected by the required returns demanded by those who hold these assets. A major tax reform can have a wide range of consequences for the equilibrium structure of household portfolios. This can make it difficult to test a steady-state theory of portfolio structure with fixed asset supplies by analyzing a set of repeated portfolio cross-sections.

4.1.2 Evidence from the Survey of Consumer Finances

Poterba and Samwick (1999) explore the relationship between household marginal tax rates, asset ownership decisions, and asset allocation using data from the Survey of Consumer Finances.

Bertaut and McCluer (2000) present a related analysis with somewhat different empirical models. To motivate the analysis, recall that heavily-taxed capital assets in the United States, such as bonds held outside of tax-deferred accounts, dividend-paying common stocks, and many mutual funds, generate at least some of their income in a form that is subject to ordinary income taxation. Less heavily taxed assets, those that generate capital gains or tax-exempt interest, as some state and local government bonds do, provide investors with income flows that are not taxed at ordinary income tax rates. A household's marginal tax rate on ordinary income is the key factor that influences the relative attractiveness of various assets.

To test the hypothesis that taxes affect portfolio choices, Poterba and Samwick (1999) impute marginal tax rates to all of the households in the Survey of Consumer Finances. This is done by using the data on SCF households to construct as many items as possible from a household's tax return. These marginal tax rates are nonlinear functions of pretax household income and a variety of household characteristics, such as the number of dependents. This tax rate imputation algorithm tries to overcome one of the empirical difficulties noted above, namely the lack of detailed sample survey information on household attributes that affect marginal tax rates.

The actual empirical tests consist of probit models for household ownership of assets in eight broad asset categories, along with tobit models for the share of household portfolios that are invested in each asset class. These reduced form equations include a range of other covariates that are included to control for heterogeneity across households. These covariates include a set of indicator variables for seven different ranges of household income, five ranges of household net worth, five ranges for the age of the household head, and four indicators for the education level of the household head. The reduced form equations are estimated using single year cross-sections from the Survey of Consumer Finances.

Table 9 reports findings from probit models that explain which asset classes households own, while Table 10 reports tobit models for the share of the household's portfolio that is held in each asset class. The results are reported in the form of derivatives of asset holding probabilities, or derivatives of asset shares, with respect to a ten percentage point increase in the marginal tax rate on ordinary income. These derivatives are calculated for each household in the sample, and the results are averaged to yield the entries in Tables 9 and 10. Table 10 also reports the change in the portfolio share for various asset classes associated with a marginal tax rate increase, scaled by the initial portfolio share for the asset in question. This addresses the fact that some derivatives are small in part because the asset accounts for a relatively small share of the household sector's portfolio.

The empirical findings offer support for the view that taxes affect portfolio structure. In the spirit of King and Leape's (1998) results, the evidence for a link between tax rates and the set of assets households own (asset selection) is stronger than the evidence of a link between taxes and portfolio shares (asset allocation). Consider the results in Table 9. The probability that a household owns tax-deferred assets, either equity or bonds, is a positive function of the household's marginal tax rate. The estimated effects are statistically significantly different from zero for most of the survey years, and the findings are substantively important. In 1995, for example, the results suggest that a ten percentage point increase in a household's marginal tax rate on ordinary income raises the probabilities of holding tax-deferred bonds or tax-deferred equity by 26 percent and 22 percent, respectively. There is also clear evidence of a link between marginal tax rates and the likelihood of holding tax-exempt bonds, which generate untaxed interest income.

The tobit results in Table 10 are less consistent across years than the findings in Table 9. There are also fewer statistically significant results in Table 10. There is clear evidence that households with higher marginal tax rates are more likely to hold a significant share of their portfolio in the form of tax-exempt bonds. There is also some evidence, particularly for 1995, that

higher marginal tax rate households have a larger share of their portfolio in tax-deferred equities and tax-deferred bonds. High marginal tax rates are associated with lower shares of the portfolio in interest-bearing accounts, which are a heavily taxed asset.

These findings are generally supportive of a link between taxes and portfolio structure, although there are some results that are surprising. One might have expected a stronger effect of tax rates on the portfolio share in directly-held equity, since equity is a relatively tax favored asset. The positive association between marginal tax rates and the portfolio share in taxable equity mutual funds is also surprising, since these funds are typically more heavily taxed than direct equity investments.

4.1.3 Non-U.S. Evidence on Taxes, Asset Allocation, and Asset Selection

The empirical studies considered above focus on taxes and portfolio choice in the United States. There is a small literature that reports empirical results for other countries. For example, Hochguertel, Alessie, and vanSoest (1997) find that the choice between holding risky and riskless assets for a large sample of households in the Netherlands is significantly affected by the household's marginal tax rate. Higher marginal tax rates are associated with a greater portfolio share for risky assets, which generate potential returns in the form of capital gains. Since capital gains are not taxed in the Netherlands, this is a natural asset selection effect to find. For Sweden, Agell and Edin (1991) present evidence that taxes influence the allocation of household portfolios across a set of relatively broad asset categories.

4.2 Taxes and Borrowing Behavior

The substantial tax wedge between the pretax and after-tax cost of borrowing provides a clear inducement for households to borrow when the tax system allows interest deductibility. In the United States, there have been substantial changes in the tax treatment of borrowing over time, and these provide an opportunity to study whether borrowing decisions are sensitive to investor tax

rates. Both Scholz (1994) and Maki (1996) examine the response of household borrowing to the Tax Reform Act of 1986. These studies conclude that when non-mortgage debt became more expensive in after-tax terms after 1986, households responded by changing the character of their debt. These studies do not provide evidence of the overall interest elasticity of consumer borrowing.

Casual cross-national comparisons suggest that households in the United States, which offers relatively generous treatment of mortgage borrowing, hold more of their wealth in housing than do households in other nations. Firm conclusions of this type are difficult, however, because it is hard to control for all of the other factors that may vary across nations and that may affect the fraction of household wealth that is held in the form of housing. There are significant differences in down-payment requirements, for example, between many continental European countries and the United States. The availability of mortgage finance more generally is likely to be an important factor explaining cross-national differences in the share of housing wealth in household portfolios.

4.3 Taxes and Asset Location

Relatively little research has considered how investors decide whether to hold heavily taxed assets in their tax-deferred accounts. There is currently no consensus on the optimal asset allocation strategy for investors, and therefore on the "null hypothesis" that should be tested in this context.

The traditional analysis of how to allocate portfolio assets for investors with access to a tax-deferred account holds that if the investor is holding any bonds, heavily taxed assets that generate taxable interest income, they should be held in the tax-deferred account. Consider a situation in which stocks and bonds have the same risk-adjusted return. Assume that a household with access to a tax-deferred account is holding both stocks and bonds, and that the household has all of its bond holdings in a taxable account. A simple asset reallocation, moving all of the bonds to the tax-deferred account and moving equities with an equal value to the taxable account, will increase the

household's after-tax risk-adjusted return. This is a pure "tax arbitrage" in the sense that the household's after-tax return can be increased without changing its risk exposure.

Shoven (1998) has recently challenged the general applicability of this arbitrage argument to the asset location problem facing most households. He does not dispute the logic of the tax arbitrage claim, but he notes that most households invest their tax-deferred accounts through mutual funds or other financial intermediaries. At least in the United States, the historical behavior of equity mutual fund managers has resulted in higher tax burdens on investors in these funds than in directly held equity portfolios. Shoven (1998) argues that the higher tax burden on equity mutual funds, relative to direct equity investments, reduces the gain from holding them on taxable account while bonds are held in a tax-deferred account. In addition, if households have access to lightly taxed alternatives to bonds that deliver similar return profiles in a less heavily taxed fashion, such as state and local government bonds that generate tax-exempt interest, then the standard analysis may overstate the benefits of holding bonds in the tax-deferred account. One clear lesson of Shoven's (1998) analysis is that the optimal structure of asset allocation between taxable and tax-exempt accounts is likely to be sensitive to the broad menu of assets that are available to households. This set of assets may vary across households, and it also may vary across nations, so that general prescriptions on optimal asset location may be an elusive goal.

There is relatively limited empirical evidence on the way households allocate assets between taxable and tax-deferred accounts. The most directly relevant study is Bodie and Crane (1997)'s analysis of the asset mix that U.S. households choose in their taxable and tax-deferred accounts. This study uses data from a sample of participants in a large pension system, the Teachers Insurance Annuity Association-College Retirement Equity Fund (TIAA-CREF). Survey participants reported information on the assets that they held in taxable accounts, and this information was matched to detailed records on their asset allocation in the tax-deferred accounts managed by TIAA-CREF.

The general findings suggest modest differences, if any, between the asset allocations that investors choose in their taxable accounts, and their asset allocations for tax-deferred assets. This finding may reflect a lack of investor sophistication in considering the optimal strategy for allocating assets when there are both taxable and tax-deferred habitats available.

There is some evidence that investors change their asset allocations in self-directed retirement accounts infrequently. Ameriks and Zeldes (2000) provide some evidence for this phenomenon amongst TIAA-CREF participants. Since there are substantial changes over time in the tax environment, and these changes may influence the relative attractiveness of different allocation strategies, this may provide further support for the notion that many investors are not considering the broad structure of their portfolios. It is possible that households think of their retirement accounts and their other (taxable) accounts in different ways, as the "mental accounts" literature would suggest. This may result in sub-optimal asset allocation from the standpoint of maximizing after-tax returns.

4.4 The Choice of Financial Intermediaries

Relatively little research has focused on how investors choose between holding assets directly and holding them through a financial intermediary, such as a mutual fund or an insurance company. Several of the country chapters in Poterba (1994) note that insurance companies offer attractive vehicles for asset accumulation, in part because of the favorable tax treatment of insurance assets. Yet there has been little attention to modeling these incentives in conjunction with data on household balance sheets, in order to estimate the elasticity of demand for insurance industry products as a function of the tax subsidy.

With respect to other financial intermediaries, such as mutual funds, there are both advantages and disadvantages to intermediary-based investment strategies. Intermediaries often provide greater portfolio diversification than the investor could achieve alone, given the scale of his

or her own investments. In addition, the record-keeping and possible liquidity services that financial intermediaries provide may be valuable benefits from the household's standpoint. There are disadvantages, however, associated with investing through intermediaries. Most intermediaries charge for their services, and in many cases the asset management fee is substantial. The management services provided by the intermediary compensate the investor for these costs, but there is an active academic debate on whether active management offers sufficiently higher returns to offset its costs.

There is also a tax-related disadvantage associated with holding assets through intermediaries, particularly mutual funds. Many fund managers, at least in the United States, appear to take decisions that are not optimal from the standpoint of maximizing a taxpayer's after-tax returns. This may either be the result of general practices that are not tax-efficient (see Dickson and Shoven (1995)), or it may be due to the fact that individual taxpayers have idiosyncratic tax positions that are unlikely to be recognized when the investment manager makes decisions. There is little evidence on the tax consequences of investing through equity mutual funds outside the United States; this probably reflects the greater importance of equity funds as investment vehicles in the United States.

There has been a recent trend toward investing through intermediaries, at least in the United States. The U.S. household sector has been a net seller of common stock for most of the last decade. More importantly, the number of households in the United States who own corporate stock directly fell in the early 1990s, while number of households investing through equity mutual funds has risen for the last decade. Poterba and Samwick (1999) present some evidence suggesting that higher marginal tax rate households are more likely to invest in equity mutual funds. This finding suggests that these investors are not focusing solely on the tax consequences of their investments when they decide whether or not to invest through a financial intermediary. There is virtually no empirical

research the addresses the choice of direct rather than indirect financial investment and that assesses the importance of taxes or other factors in such investment.

4.5 Taxes and Asset Trading Decisions

While there is no consensus on why investors trade, there is general agreement that decisions about when to trade assets are quite sensitive to investor marginal tax rates. Most of the research on this issue comes from the United States, where there have been many substantial changes in capital gains tax rules. There is limited evidence on trading and taxation in other nations. Umlauf (1993) presents interesting evidence on how the location of trade may be affected by tax rates. He shows that volume on the Stockholm Stock Exchange plummeted after the Swedish government introduced a transaction tax on trades. Transactions volume roes again, and the trading of Swedish securities on the London Stock Exchange decline, when the tax was rescinded.

The empirical research on taxation and capital gain realizations takes two forms. There are time series studies that document a large elasticity of total gain realizations with respect to the after-tax amount that investors receive when they realize gains. There are also studies using household–level data to estimate the realization elasticity; studies vary in whether they use simple cross-sections or panel data for this purpose. Burman (1999) and Poterba (forthcoming) review this large literature.

There are two primary findings in the capital gains tax literature. First, the elasticity of capital gains realizations with respect to the after-tax price of capital gains is large, possibly large enough to result in an increase in total capital gains tax revenues when the capital gains tax rate is reduced. The estimates of this realization elasticity tend to be somewhat larger in time-series rather than household data studies.

Second, there is an important difference between investor responses to anticipated tax changes, or to transitory changes in the capital gains tax rate, and those to permanent changes in the

tax rate. In one household-level study of capital gain realizations, Auten and Clotfelter (1983), the elasticity of realizations with respect to a one-year change in the capital gains tax rate was three times as large as the elasticity with respect to a permanent rate change. This differential presumably reflects the relatively low cost that investors perceive when they consider re-timing asset trades from one year to the next. If an investor is planning to sell an appreciated asset, and if he knows that the capital gains tax rate next year will exceed that in the current year, then he may try to move the asset sale into the current tax year. The difference between this year and next year's capital gains tax rates that will induce such a change may be much smaller than the tax rate change that will lead the investor to sell an asset that he had never considered selling before.

These results leave little doubt that taxation matters for asset trading decisions. What is not clear from previous research is whether the distortions in trading behavior that flow from tax incentives affect the welfare of investing households. Analyzing the efficiency cost of tax-induced trading requires a model of why investors trade in the absence of tax considerations, and at present there are no generally accepted models of trading. Balcer and Judd (1987) tackle part of this issue, in studying how the timing of investments and liquidations over the lifecycle will be affected by a realization-based capital gains tax. Kovenock and Rothschild (1987) explore the static portfolio distortions associated with capital gains taxes when they try to model the welfare cost of an undiversified portfolio. Further work along these lines may provide additional leads for modeling tax distortions and estimating their costs.

5. General Patterns and Directions for Further Work

To organize the analysis of taxation and household portfolio behavior, it is helpful to identify six margins on which taxes may affect investor behavior. These are asset selection, asset allocation, asset location, borrowing, asset trading, and the choice of whether or not to invest

through financial intermediaries. After reviewing the tax rules affecting investors in a number of industrialized nations, and the existing empirical evidence on taxation and portfolio structure, several conclusions emerge.

First, the evidence for a link between after-tax returns and whether households own particular assets seems to be stronger than the evidence of a link between after-tax returns and the amounts that households invest in different assets. This finding could be explained by the notion that investors are more attuned to questions about what they should invest in than they are to questions about precisely how much to invest in different assets. There may be an important element of history in the structure of household portfolios. Portfolio rebalancing may be something that investors do less frequently than asking if they are holding the right kind of assets; this suggests that asset selection may be more sensitive to taxation than asset allocation.

Second, asset trading appears to be affected by tax rules. There is clear evidence, from capital gains tax reforms in the United States and other policy changes, that asset trading behavior responds when investors perceive a tax-induced reward to trading at one point in time rather than another. There seems to be a similar effect on the geographical location of trades -- when taxes make it expensive to carry out trades in one location, the trades may move elsewhere. It is not clear how much of the trading response to capital gains tax changes, for example, is the result of re-timing of trades that would otherwise take place at a different point in time, and how much is "new" trading.

Third, investors choose to invest through financial intermediaries, even when these intermediaries impose substantial tax costs or other expenses on their investors. The factors that explain the growth of financial intermediaries are not clear. It may be that investors value the asset-management services provided by mutual funds and other asset managers. It may be that they benefit from the record-keeping and other services that such managers perform. There is an open

question about the trade-offs between cost, after-tax return, expenses, and investor asset inflows in the market for financial services, and this is an area that requires further study.

Fourth, the limited evidence on asset location decisions by investors in the United States suggests that relatively few investors are choosing markedly different asset allocation patterns in their taxable and in their tax-deferred accounts. Whether this reflects lack of attention to the specialized tax benefits of investment through tax-deferred accounts, or something else, is not clear.

Finally, there is relatively clear evidence that when the tax code permits households to borrow and deduct their interest payments from taxable income, households try to structure their affairs to take advantage of this opportunity. It seems likely that overall borrowing is greater when such borrowing is tax-deductible, but the limited time-series variation in interest deduction rules within nations makes it difficult to assess this issue.

If there is a clear direction for further work on the subject of taxation and household portfolios, it probably involves the linkage between theoretical models of household portfolio structure and empirical evidence on household balance sheets. Unlike the analysis of how taxation distorts other margins of household behavior, such as hours of work, there is no agreement on the underlying theoretical model that drives investor behavior. This is particularly evident in discussions of asset trading decisions, but it is also clear with respect to the basic structure of household portfolios. Existing models require some assumptions, such as the possibility of short selling, that are probably not appropriate for a large set of households. Developing more realistic models of the institutional constraints confronting taxable investors, recognizing the importance of asset attributes as well as asset habitat for affecting after-tax returns, and finding the ultimate utility level that households can derive under different tax rules, represents a substantial agenda for future work.

A related direction for further study would involve linking portfolio decisions about non-financial assets with choices concerning financial assets. There are likely to be close interconnections between home ownership, mortgage borrowing, and other borrowing. Recent research has just begun to explore the effect of other non-financial investments, such as direct investment in a self-employment venture or investment in non-residential real estate, on the structure of financial portfolios. Yet Carroll (2000), Heaton and Lucas (forthcoming), and others have noted that such non-financial investments figure prominently in the portfolios of many high net worth households. Exploring the interactions between these assets and financial assets is a natural direction for future work.

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Table 1: Ownership Probabilities for Various Assets, United States, 1995-1983

	1995	1992	1989	1983
Directly Held Equity	16.41	18.13	17.91	19.08
Equity Mutual Funds	11.26	8.35	5.86	3.03
Tax-Deferred Equity	30.40	25.67	20.42	19.51
Tax-Deferred Bonds	30.54	30.35	30.54	26.10
Tax-Exempt Bonds	6.44	6.79	6.40	3.31
Taxable Bonds	26.17	27.29	28.14	23.99
Interest Bearing Accounts	87.22	87.24	85.52	87.63
Other Financial Assets	42.96	44.56	48.29	36.52

Source: Tabulations from Survey of Consumer Finances surveys in various years, as reported in Poterba and Samwick (1999).

Table 2: Conditional Probabilities of Asset Ownership, 1995 Survey of Consumer Finances

	Directly Held Equity	Equity Mutual Funds	Tax Deferred Equity	Tax Deferred Bonds	Tax Exempt Bonds	Taxable Bonds	Interest Bearing Accounts	Other Financial Assets
Directly Held Equity	100.00	28.23	52.61	45.38	19.27	49.65	99.72	60.10
Equity Mutual Funds	41.13	100.00	58.86	45.85	29.36	57.08	99.56	57.28
Tax-Deferred Equity	28.40	21.81	100.00	54.36	11.26	41.58	97.63	53.13
Tax-Deferred Bonds	24.38	16.91	54.10	100.00	9.68	39.66	96.96	52.96
Tax-Exempt Bonds	49.11	51.35	53.14	45.92	100.00	55.60	98.84	67.27
Taxable Bonds	31.13	24.56	48.30	46.28	13.68	100.00	98.00	58.10
Interest Bearing Accounts	18.76	12.86	34.03	33.95	7.30	29.41	100.00	46.33
Other Financial Assets	22.96	15.02	37.60	37.66	10.09	35.40	94.08	100.00

Notes: Each entry is the probability that a household owns the asset in the column, conditional on owning the asset in the row. Households are weighted by sample weights. This table is drawn from Poterba and Samwick (1999).

Table 3: Household Borrowing by Net Worth and Age Categories, 1995 United States

	Households with Mortgage Debt	Households with Non-Mortgage Debt	Total Debt/Total Assets	Non-Housing Debt/Non-Housing Assets
Net Worth Category				
< 100K	34.7%	71.6%	48.6%	34.9%
100-250K	52.3	67.3	20.9	10.2
250-500K	50.7	56.8	13.7	6.8
500K-1M	53.7	55.8	10.3	5.2
1 - 2.5M	58.9	50.1	8.0	4.2
> 2.5M	51.9	54.1	4.8	3.5
Age of Household Head				
< 34	32.9	80.0	44.1	24.3
35-49	56.7	80.6	23.9	9.3
50-64	51.3	68.2	12.5	6.9
>65	16.9	36.6	4.1	3.1
All	41.0	68.3	16.0	7.5

Source: Author's tabulations using 1995 Survey of Consumer Finances.

Table 4: Ownership of Corporate Equity in Taxable and Tax-Deferred Accounts, 1995 United States

	Only Direct Holdings	Only Tax-Deferred Holdings	Both Taxable and Tax- Deferred Holdings	No Corporate Equity
Net Worth Category				
< 100K	6.3%	14.0%	4.9%	74.8%
100-250K	16.9	16.7	14.1	52.4
250-500K	28.1	14.3	24.1	33.4
500K - 1M	25.8	12.9	35.4	25.8
1 - 2.5M	35.8	12.0	38.8	13.4
> 2.5M	35.0	5.9	40.8	18.2
Age of Household Head				
< 35	6.7	16.6	9.7	66.9
35-49	10.0	20.0	13.3	56.6
50-64	11.9	13.5	13.7	60.9
> 64	20.5	4.1	4.6	70.9
All	11.9	14.4	10.6	63.1

Source: Author's tabulations using 1995 Survey of Consumer Finances.

Table 5: Probability of Trading Corporate Stock, United States, 1995

	Probability of Owning Stock Directly	Probability of Buying or Selling in the Last Year, Conditional on Owning Directly
Net Worth Category		
< 100K	7.3%	39.0%
100-250K	21.0	38.7
250-500K	36.2	57.3
500K-1M	39.8	96.4
1-2.5M	55.1	88.3
> 2.5M	65.6	87.2
Age of Household Head		
< 35	10.8	53.1
35-49	15.4	48.7
50-64	16.1	69.9
> 64	19.1	49.3
All	15.2	54.1

Source: Author's tabulations using 1995 Survey of Consumer Finances. The question "over the past year, about how many times did you or anyone in your family living here buy or sell stocks or other securities through a broker?" is asked of anyone who reports having a brokerage account. Not all stockholders have brokerage accounts, and brokerage accounts are uncommon amongst those who only own stock indirectly, for example through a retirement account. It is also possible that some households with brokerage accounts, who are asked about their trading, are not current stockholders.

Table 6: Tax Rules on Investment Income, Major Industrial Nations

Country	Tax Treatment of Interest	Tax Treatment of Dividends	Tax Treatment of Capital Gains	Short- vs. Long-Term Capital Gain Distinction
Canada	Provincial and Federal Tax; Combined Rates 27-48%	Partial Integration; Dividends Grossed Up by 25%, Then 13.3% Tax Credit	Taxable at 23.8% Maximum Rate; $100,000 Lifetime Capital Gains Exemption	No
France	Taxable at flat-rate withholding of 56.2%	Integrated Corporate and Personal Tax Systems	Taxable at 18.1% Rate	No
Germany	Marginal Tax Rate Up to 53% But Generous Exclusion, Only Very High Income Pay tax	Taxed as Ordinary Income (Rates to 53%) But Full Integration with German Corporate Income Tax (36%)	Long-Term Untaxed, Short-Term "Speculative Profits" Taxed	Short Term (< 6 Months) Taxed at Up to 53%
Italy	Subject to flat rate tax of 16.2%; higher tax rates on deposits and postal saving accounts	Partial Integration System; Average Marginal Tax Rate on Dividends Near 50%	Realized Gains Taxed at 25% Rate, or Value of Asset Sold Taxed at Between 0.3 and 1.05 Percent	No
Japan	15% flat rate tax	Partial integration with progressive degree of integration	Tax of 20% of Gain OR 1% of Sale Price; Specific Rules on Housing, Land	No
Netherlands	Taxed at Progressive Marginal Rates, 36.4, 50, and 60%	Partial Integration; Dividends Included with Other Taxable Income	Untaxed	No
United Kingdom	Taxable at Marginal Rate of 25 or 40 Percent	Integration of Corporate & Personal Income Taxes	Real Gains Above Indexed Asset Basis, in Excess of L7100, Taxed at 40% Rate	No
United States	Taxed at Marginal Rates of 15 to 39.6%	Taxed at Marginal Rates of 15 to 39.6%	39.6% Top Rate on Short-term Gains, 20% on Long Term	Long-Term Gains and Losses Are Held More than 12 Months

Source: American Council on Capital Formation (1996), Poterba (1994).

Table 7: Retirement Saving Incentives in Major Industrial Nations

Country	Retirement Saving Accounts?	Contribution Limit	Contributions Deductible?	Special Notes
Canada	Yes	~$9400 ($15,500 Canadian), Indexed	Yes	Limits on Foreign Stock; Carryforward Unused Contributions
France	No	----	---	---
Germany	Yes	Vermogensbildungsgesetz Limit ~ $2200	Yes	Investment in "Long Term Funds"; Other Programs to Accumulate Housing Down Payments
Italy	Yes	2% of wages or $1414	Yes	
Japan	No	----	---	Universal "Maruyu" postal saving accounts were phased out in 1986
Netherlands	Yes	1700 Guilders, or Approximately $850 per Year for Employee Saving Scheme	Yes	"Employee Saving Scheme" and"Premium Saving Scheme"; Four Year "Vesting Period" Before Withdrawal
United Kingdom	Yes	Personal Pensions, contributions of 17.5 - 40 percent of earnings; Individual Saving Accounts (ISAs), limit of ✯5000/year contribution starting in 2000	Yes	ISAs face restrictions on investment choices; total contribution limits were higher in years before 2000
United States	Yes	$2000 for Individual Retirement Accounts, $10,500 for 401(k) Plans	Yes	Other Variants Include "Roth IRAs" and 403(b) Plans

Source: American Council on Capital Formation (1998) and comments from country chapter authors.

Table 8: Tax Treatment of Borrowing, Major Industrial Nations

Country	Is Mortgage Interest Deductible?	Tax Treatment of Consumer Borrowing
Canada	No	Not Deductible
France	Yes	Not Deductible
Germany	No	Not Deductible
Italy	Only For First-Time Homebuyers	Not Deductible
Japan	No, But Tax Credit for Six Years for New Homebuyers	Not Deductible
Netherlands	Yes	Deductible Subject to a Cap
United Kingdom	No (Effective April 2000)	Not Dedictible
United States	Yes, Subject to Rarely-Binding Limit	Not Deductible

Source: Poterba (1994) and information provided by country portfolio research teams.

Table 9: Estimated Impact of a 10 Percentage Point Change in a Household's Marginal Tax Rate on Asset Ownership Probabilities, 1983-1995 Surveys of Consumer Finances

	1995	1992	1989	1983
Directly Held Equity	0.0130	0.2455	0.1414	0.1263
Equity Mutual Funds	0.4221*	0.3462*	0.6510*	0.0110
Tax-Deferred Equity	0.2196*	0.1934	0.4957*	0.3729*
Tax-Deferred Bonds	0.2571*	0.2720*	0.2087*	0.5693*
Tax-Exempt Bonds	0.3200*	0.4245*	0.6382*	0.2324
Taxable Bonds	0.0331	0.2770*	0.1155	0.2546
Interest Bearing Accounts	0.1716	0.3306*	0.3181	0.5638*
Other Financial Assets	0.0575	0.0689	0.0688	0.1480

Source: Poterba and Samwick (1999). Starred entries are statistically significantly different from zero at the 95 percent confidence level.

Table 10: Marginal Impact of Changes in Marginal Tax Rate on Portfolio Ownership Share

	1995	1992	1989	1983
Impact of Tax Rate Change on Portfolio Share				
Directly Held Equity	-0.0219	0.0192	0.0048	-0.0151
Equity Mutual Funds	0.0495*	0.0177	0.0355*	-0.0010
Tax-Deferred Equity	0.0477*	0.0419	0.0509	0.0637*
Tax-Deferred Bonds	0.0396*	0.0720	0.0052	0.1080*
Tax-Exempt Bonds	0.0334*	0.0423*	0.0636*	0.0094
Taxable Bonds	-0.0029	0.0279	-0.0148	0.0020
Interest Bearing Accounts	-0.0926*	-0.0631	-0.0926	-0.1835*
Other Financial Assets	-0.0526*	-0.1579*	-0.0528	0.0165
Impact on Portfolio Share as a Percentage of Initial Share				
Directly Held Equity	-5.3%	4.4%	1.1%	-3.1%
Equity Mutual Funds	17.2%	11.9%	42.1%	-4.0%
Tax-Deferred Equity	4.1%	5.2%	8.8%	11.2%
Tax-Deferred Bonds	3.7%	6.6%	0.5%	13.7%
Tax-Exempt Bonds	28.1%	24.4%	41.2%	13.8%
Taxable Bonds	-0.8%	7.2%	-3.8%	0.6%
Interest Bearing Accounts	-1.9%	-1.2%	-1.6%	-2.9%
Other Financial Assets	-3.3%	-10.4%	-3.3%	1.1%

Source: Poterba and Samwick (1999). Starred entries are statistically significantly different from zero at the 95 percent confidence level.