The Elasticity of Deferred Income With Respect to Marginal Income Tax Rates

Aspen Gorry, Utah State University

Kevin A. Hassett, American Enterprise Institute

R. Glenn Hubbard, Columbia University and the National Bureau of Economic Research

Aparna Mathur, American Enterprise Institute*

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Abstract

A substantial body of theoretical and empirical analysis of time-varying income tax rates focuses on the response of taxable income to changes in the tax rate. Given the increasing use of stock options in executive compensation, we document that income deferral is an important margin of adjustment in response to tax rate changes. The option to defer income changes the welfare effect of taxation as it allows individuals to shift income into the future, reducing their overall tax burden. To account for this option in the empirical analysis, we explore both realization and deferral by estimating the elasticity of deferred income. Our empirical results suggest a large impact of taxes on income timing with magnitude of the elasticity of deferred income that is greater than one.

Keywords: deferred Income, executive compensation, tax policy, elasticity of taxable income.

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**Email*: amathur@aei.org. Address: 1150 17th St, NW, Washington D.C., 20036. The authors would like to thank Matthew Jensen for excellent research assistance.

1. Introduction

Harberger's (1964) seminal analysis of the efficiency costs of income taxation focused on the distortionary effects of personal income taxes on labor supply. Following his analysis, this labor supply elasticity became a key policy parameter to measure the behavioral response to taxes. Feldstein (1999), however, argued that the labor supply elasticity greatly underestimates the total deadweight loss of income taxation because it ignores the effect of higher income tax rates on tax avoidance through changing the form of compensation and/or the pattern of consumption. He shows that in a static environment, measuring the elasticity of taxable income rather than labor supply is a sufficient statistic for the deadweight loss of taxation. A large body of research has arisen to provide better estimates of the elasticity of taxable income with respect to marginal tax rates (ETI).[1]

However, in a dynamic setting or when income can be shifted to other tax bases, ETI is not a sufficient statistic for welfare. We estimate the dynamic effects of taxes on the elasticity of deferred income, where deferred income is defined as the untaxed portion of annual compensation. Standard estimates of ETI do not account for changes in the timing of income realization. This omission leads to biased estimates as reported income in any period can differ substantially from earned income when individuals have the option to defer income realizations. Better understanding these dynamic effects is important as it helps us better understand the behavioral response to taxation and because it helps us better understand the changes in the form of compensation. In recent decades, the form of compensation has changed significantly with stock options and other forms of incentive pay representing a larger share of the overall package. Frydman and Saks (2010) show that this is particularly true for executive and managerial employees. Moreover, this shift has created a means through which executives can choose to defer taxation on their current compensation. For example, executives often pay taxes on stock options when such options are exercised rather than in the year that the option was earned.

To estimate the elasticity of deferred income we follow Goolsbee (2000) by using the permanent income tax rate as an instrument. Our empirical results suggest that deferral of

[1] While the research estimating the ETI is too extensive to include a full review here, prominent estimates of ETI include Lindsey (1987), Feldstein (1995), Carroll (1998), Auten and Carroll (1999), Slemrod (1996), Goolsbee (2000), Gruber and Saez (2002), Saez (2003), Giertz (2006), Auten, Carroll, and Gee (2008), and Heim (2009) among others. For a review of this body of research, see Saez, Slemrod, and Giertz (2012).

income is highly elastic with respect to the tax price. The current period elasticity or the short-run elasticity with respect to the tax price is approximately -3. The long-run elasticity, which looks at the response over future periods, is still negative, with an absolute value greater than one. We conduct several robustness checks, including using sub-samples of executives at different income levels, using sub-samples of executives with different years of data and using alternative definitions of deferred income. The estimated elasticity is consistently negative with magnitude greater than one.

The exercising of options is voluntary on the part of the executive and is likely to be driven at least in part by the after-tax value of these gains. To the extent that tax rates influence the choice of compensation, understanding the elasticity of deferral is important for estimating the behavioral response to taxes. If, for example, the top marginal tax rate is scheduled to increase, individuals may seek to realize income in the year before the increase, but they may also significantly increase deferral activity after the tax rate has risen in anticipation of a future tax rate reduction. Thus, an increase in marginal tax rates may create incentives for executives to receive deferred compensation through stock options and stock grants, rather than salaries and bonuses that are taxed immediately.

In particular, the timing of taxable income can generate important tax benefits for at least four reasons. First, when workers face uncertainty about future tax rates, having a stock of deferred income creates an option value. Second, with graduated income tax brackets, deferring income can help workers avoid taxes by pushing income forward into periods in which they earn less. Third, when capital gains are taxed differently than labor income, the returns on deferred income (such as options) could also be taxed at different rates, providing an incentive for workers to defer income. Finally, even with equal tax treatment deferral allows individuals to earn returns on the pre-tax value of their savings creating an additional tax benefit.

We study the elasticity of deferred income using Execucomp data. While this data is limited to a select sample of very high income individuals and hence may not be representative of the population for understanding how our results change the overall elasticity of taxable income, it does allow us to better understand the nature of executive compensation. Moreover, income deferral is likely to be lower for other income groups as typical workers potentially have less ability to defer their income to future years since they have less access to stock options.[2] These high-income responses are particularly important because of high-income taxpayers' large contribution to revenue and because of their central focus in the debate to extend or repeal the 2001 and 2003 tax changes.[3] While much of the past literature on executive compensation has focused on the role of managerial incentives, managerial power, and tax benefits for the firm on the form of executive compensation, our results contribute to the executive compensation literature by estimating how tax policy can influence the choice of payment on the part of the executive.[4]

These findings are also related to the elasticity of taxable income literature. Changes in the timing of taxable income are omitted from Feldstein's (1999) original static analysis. Chetty (2009) extends the basic model to include cases in which evasion and avoidance imply that the ETI may not be a sufficient statistic for welfare. In our case, while increased use of deferral in response to higher marginal tax rates will show up as a reduction in taxable income, hence influencing the taxable income elasticity, the fact that deferred income potentially shows up in future tax years implies that the elasticity of taxable income is no longer a sufficient statistic for the deadweight loss of taxation. This idea has been pointed out by Slemrod (1998) who argues that if revenue loss in the current year is offset by revenue gains in future years then the deadweight loss associated with a particular elasticity of taxable income can be misleading. While understanding individual components that make up the ETI are of interest on their own, it is even more the case when the dynamic consequences have implications for welfare. As Slemrod (1998) suggests, the present value of revenue can be studied to get a more complete picture of the effects of taxation. However, this has not been done perhaps because existing data has short samples that make such estimates impractical. As an alternative, we suggest an approach of studying both deferrals and realizations.

To clarify this approach it must be recognized that the option to defer income implies that tax policy changes have dynamic welfare consequences. To make the comparison clear a

[2] While typical workers do not have access to stock options, their ability to defer income with tax deferred savings accounts such as the IRA and 401(k) could enable them to defer a larger fraction of their income than higher earners. Understanding how tax policy influences the use of such deferral behavior is even more important given that the use of such tax deferred savings accounts have large effects on individual welfare and aggregate capital accumulation. See Imrohorglu, Imrohorglu, and Joines (1998), Kitao (2010, and Ho (2014) for a discussion.
[3] Goolsbee, Hall, and Katz (1999) summarize the evidence of the existence of a high-income Laffer Curve.
[4] See Hall and Liebman (2000), Frydman and Jenter (2010), and Frydman and Molloy (2014) for recent summaries.

few simple equations relate our results to Feldstein's (1999) analysis, we write taxable income, Z_t, as static period income, Y_t, less net deferrals, N_t:

$$Z_t = Y_t - N_t \ . \tag{1}$$

To be consistent with Feldstein's notation, we denote static-period income is given by:

$$Y_t = w(1 - L_t) - E_t - D_t \ . \tag{2}$$

Here $w(1 - L_t)$ is labor income, E_t denotes individual exclusions, and D_t is deductions. In the static framework, Feldstein shows that, with no deferrals, the elasticity of taxable income is a sufficient statistic for welfare. While this sufficiency condition holds when $Z_t = Y_t$, with deferred income dynamic considerations, the elasticity of taxable income is no longer a sufficient statistic. The dynamic budget constraint implies that the elasticity of taxable income is given by:

$$\epsilon_Z = \frac{Y}{Z}\epsilon_Y - \frac{N}{Z}\epsilon_N \ . \tag{3}$$

This equation shows that the elasticity of taxable income is now the difference between two terms. The first term depends on the static elasticity of period income, the object of interest for understanding the size of static distortions from Feldstein (1999). The second term depends on the elasticity of deferred income. Each term is weighted by the size of the income relative to taxable income. Previous approaches estimate the elasticity of taxable income using a formula that treats exclusions, deductions, and deferrals as equivalent reductions in taxable income. While exclusions and deductions fully reduce taxable income, deferrals are at least partially recovered as income in future years, although they may be taxed at lower rates or not at all. It should be noted that if the time to realization is long enough, deferrals will fully reduce taxable individual income.

While deferral might mitigate the welfare cost of taxation estimated by the ETI because taxable income lost in a given period can be shifted to tax bases in other years rather than being entirely lost, the use of deferral still involves losses of revenue to the government. Indeed, we construct a simple dynamic model (shown in the appendix) to illustrate that changes in the timing of taxes, which affect the reporting of incomes, have important welfare effects even when there is no change in individual labor supply. In the model, deferral generates losses of tax revenue compared to an economy facing tax rate certainty or losses in welfare compared to a deterministic tax policy that raises the same revenue. These dynamic effects can be large even without changes in labor supply because when tax policy is uncertain there is an asymmetry between the incentive to realize income in a low-tax year and the incentive to defer income in a high-tax year. This asymmetry arises because the deferral of income today creates the option to realize the income in a later year when taxes are lower. This option has positive value when tax policy is uncertain. Alternatively, the realization of income into the current year extinguishes the option to realize the income in a later year when taxes are lower. In the real world, such deferral behavior can be even more costly in terms of government revenue as it allows individuals to take advantage of other tax benefits from deferral such as shifting earnings into the capital gains rate or earning returns on the pre-tax value of their income before realization.

In the next section, we discuss our methodology and estimation. Section III summarizes the data and presents the empirical results. Section IV concludes.

II. Empirical Methodology

The deferral elasticity is an important element in measuring the true dynamic, behavioral response to a tax change. We begin by estimating the elasticity of taxable income as the elasticity of realized income with respect to tax changes following the methodology in Goolsbee (2000). This estimate provides the total change in taxable income, but does not explicitly account for the fraction of that income that is deferred into future periods by the executive using stock options or other means. To better understand the use of options, we calculate the elasticity of deferred income by focusing on the unrealized components of overall income, and estimating their response to tax changes.

A. Data Sample Focuses on High Income Executives

For our analysis, we use data on executive compensation from the COMPUSTAT database for the period 1992-2007, accessed through Wharton Research Data Services. The data are maintained by Standard and Poor's in its Execucomp database and provide information on salary, bonus, options and stock awards, non-equity incentive plans, pensions, and other compensation items collected directly from the corporation's annual proxy statements. Execucomp collects data on up to nine executives per firm per year, though most companies report data for only the top five executives. The executives are identified by name and individual identification variables. In addition, there is a unique executive-company variable, which links each executive to the specific company at which he or she worked in each year. Therefore, it is possible to track executives and their compensation over time. This information is particularly useful for measuring behavioral responses of individuals to changes in tax rates.

In contrast to much of the prior research analyzing on the elasticity of taxable income with respect to marginal tax rates, we emphasize high-income individuals. There are advantages and disadvantages to working with a restricted sample of high-income taxpayers. A disadvantage is that this group may not be truly representative even of other high-income taxpayers. In other words, we are not working with a random sample from the population. However, it is still an interesting group on which to focus because executive compensation is often the focus of public debate, particularly when we consider executives with earnings above $250,000, which make up the majority of our sample. The data in Carroll (1998) suggest that executives are a large fraction of high-income people. Moreover, this lack of randomness is not necessarily a problem for the purposes of our analysis. In a recent review of the research, Saez, Slemrod, and Giertz (2009) conclude that the findings from most empirical studies suggest that the behavioral response to changes in marginal tax rates is likely to be concentrated at the top of the income distribution, with less evidence of any response for the middle- and upper-middle-income individuals. Further, according to the Congressional Budget Office (2012), in 2009, the top quintile of tax filers paid more than 94.1 percent of all individual income taxes, with an effective individual income tax rate of 13.4 percent.[5] In contrast, the lowest two quintiles had negative effective tax rates. Saez, Slemrod, and Giertz (2009) also point out that over the past three decades in the United States the largest absolute changes in tax rates have taken place at the top of the income distribution, with smaller absolute changes for the broad middle of the distribution of taxable income. For instance, the share of income reported by the top one percent of the population showed a striking increase in 1981, when marginal tax rates were reduced under the Economic Recovery Tax Act of 1981, and then again between 1986 and 1988, following the Tax Reform

[5] http://www.cbo.gov/publication/43373

Act of 1986. Not only are we likely to observe measurable responses of income to the marginal tax rate from high-income taxpayers, econometric identification of these responses is more feasible. This approach also implies, of course, that such estimates are likely to constitute an upper bound for the overall elasticity of income to tax rates.

We define the total compensation of executives in our data as the sum of salary, bonus, long-term incentive plans, options awarded, restricted stock grants, and all other annual income.[6] Total compensation has increased by more than a 100 percent during our sample period. In 1991 dollars, the average total compensation increased from $887,583 in 1992 to $1,855,575 in 2007. However, there is wide variation in the compensation levels across executives because our data include not just the CEOs, but vice presidents, general counsels, and so on. About 14 percent of the sample has incomes less than $250,000. Between 1992 and 1996, nearly 17 percent of the executives had incomes less than $250,000, the lower income cutoff for the top taxable income bracket for that period. Hence, there is cross-sectional variation in the tax rates faced by executives. For instance, in 2000, about 8 percent of the sample fell into the second highest tax bracket (of 36 percent), while the rest were nearly all in the top tax bracket. While some executives face low tax rates, they are generally those who own equity in the company and receive little cash compensation.

There is also time-series variation in tax rates. The tax rate for those with high incomes increased between 1992 and 1993. For those individuals reporting more than $140,000 and less than $250,000 in taxable income, the top rate went from 31 to 36 percent. For those earning more than $250,000, the rate went from 31 percent to 39.6 percent.[7] Changes in the tax brackets also induced changes in the tax rate paid by individuals. In nominal terms, an individual earning marginally higher than $140,000 in 1993 and 1994 experienced an increase in the tax rate from 31 to 36 percent. The next major change in federal tax rates accompanied the passage the 2001 and 2003 tax acts, respectively. Tax cuts in these acts were gradually phased in and reduced the rate in the highest income tax bracket from 39.6 percent to 35 percent, and the rate on the second highest income bracket from 36 to 33 percent. The combination of cross-sectional and time-

[6] Note that in matching incomes to tax rates, we are unable to account for factors that might affect the taxable income of individuals such as deductions and spousal income. However, this concern is less important for our study as opposed to studies that focus exclusively on taxable incomes since our permanent income tax rate uses income that includes all income, and it is unlikely that the value of deductions and other sheltering activity is large enough to cause these individuals to move out of the top tax brackets that they face.

[7] In addition, the tax cap on the Medicare payroll tax was abolished in 1993, resulting in an increase in marginal tax rates of 2.9 percent for individuals earning more than $135,000.

series variation in the applicable tax rates enables us to identify the effect of tax rates on incomes. In addition, because we know the location of the executive (and the firm), we are also able to include state tax rates in our estimation strategy, contributing an additional source of variation for our analysis.

B. Deferred Income

We denote the "income" concept for our dependent variable by "deferred income;" we calculate it as the sum of the non-taxed components of an executive's compensation. In other words, instead of focusing our analysis on the taxable component of income (as in previous studies), we explore whether executives change the form in which they receive compensation in order to avoid paying a tax in years of high marginal tax rates. For example, Goolsbee (2000) defines all taxable compensation as the sum of salary, bonus, options exercised, and long-term incentive payments (LTIPs).[8] These payments are typically taxed on an annual basis.[9] LTIPs are usually a mixture of cash and shares of the company which are almost always subject to vesting restrictions. A vesting period refers to the period of time before which the holder of the shares has the right to transfer shares and realize value. Typically, the vesting period is three to five years (hence the term long-term incentives). However, assuming that the bulk of these payments are in cash, we include them in taxable income.

Executives can also be compensated through the use of stock options and restricted stock grants. Payments of options grant the executive the right, but not the obligation, to buy shares of stock from the company at a pre-set price and within a pre-set term. The pre-set price is called a strike price and is usually, but not always, set at the current market price of the stock when the options are issued. An executive generates income when exercising the option when the current stock price is higher than the strike price. If the strike price is $100 and the spot price is $110 then the executive can buy a share worth $110 for only $100 and earn $10 in pre-tax profit.

There are two main types of options used for compensation and their tax treatment differ, nonqualified stock options (NQSOs) and incentive stock options (ISOs). For the executive, the profit from exercising NQSOs is taxed at the personal income level when the NQSOs are

[8] There is also an "other annual income" category that is small.

[9] In some cases, bonus payments may be reported for the current year by the firm, but actually payments and taxes occur only in the next year.

exercised. If the executive continues to hold the shares, then any appreciation is taxed at the applicable long-term or short-term capital gains rate according to the fact that the shares are purchased when the options are exercised. The company receives a deduction equal to the executive's profit from exercising the NQSOs. Options are considered performance-related pay, so the company receives this deduction even for pay over $1 million. ISOs are similar to NQSOs in structure, but are limited by a cap of $100,000 on the amount that can vest to an executive per year, and their appreciation is not tax-deductible for the company. There is a tax advantage, however, for the executive because the profits from exercising ISOs are not taxed as ordinary income: The executive is only exposed to a capital gains tax on any appreciation of the shares gained from exercising the options.[10]

In addition to granting options, a company can also directly issue shares to an executive as restricted stock— restricted by a vesting period. The executive has the choice to be taxed as the shares vest or when the shares are granted and is taxed at the personal income rate. [11]

In recent research, Bebchuk and Grinstein (2005) and Frydman and Saks (2010) document the recent shift in the composition of executive compensation toward stock options and other forms of incentive pay. This equity-based compensation today accounts for more than 50 percent of the total compensation package for executives. The growth of equity-based compensation enables executives to defer taxation in high-tax-rate years. In addition, this type of compensation enables executives to substitute away from cash compensation which is immediately taxable and therefore to defer taxation on this compensation as well. As such, our measure of deferred income is calculated as the difference between total compensation, which includes salary, bonus, LTIP, options awarded and restricted stock grants, and taxable compensation. The difference in the two definitions is mainly the equity compensation, which is not realized in the taxed year.

Using this income measure as the dependent variable allows us to better understand how changes in tax rates change taxpayer behavior with respect to the use of deferral. If the total

[10] The top personal income tax rate was consistently higher than the capital gains tax rate during our sample period. The top personal income tax rate was 31 percent in 1992; 39.6 percent from 1993–2000; 39.1 percent in 2000; 38.6 percent in 2001; and 35 percent from 2003–2006. The corresponding capital gains tax rates were significantly lower: 28 percent from 1992–May 6, 1997; 20 percent from May 7, 1997–July 28, 1997; 28 percent for assets held from 12 to 18 months and 20 percent for assets held more than 18 months from July 29, 1997–July 21, 1998; 20 percent from July 22, 1998–May 5, 2003; and 15 percent from May 6, 2003–2006.

[11] At the corporate level, all cash compensation is fully deductible under $1 million against corporate income, and (since 1993) only performance-based pay over $1 million is deductible.

compensation is x dollars, then taxpayers have a choice of whether to report x as taxable compensation, or to report a smaller number. If all x is cash, then (assuming no evasion), all x is currently taxable. However, if x can be partly shifted into long-term equity-based compensation, then taxation can be deferred. Deferring income allows individuals to shift their payment of taxes into the future where they may face lower tax rates either due to changes in tax policy or individual changes in income.

The choice of deferral incorporates longer-term expectations about what is likely to happen to tax rates. If taxpayers are uncertain about tax policy, or expect that a tax increase will be followed by a tax decrease some years later, then they may choose to take more of their compensation in options or stock grants. However, with cash income such as salaries or bonuses, there is less of a response to a future tax hike or decrease because executives are less likely to put off receiving wage and salary increases for future years.

C. Permanent Income Tax Rate

In order to compare our paper with earlier studies, we provide results in the next section with the taxable income as the dependent variable and the respective applicable federal (or federal and state) marginal tax rate as the independent variable. Of course, an issue with including the marginal tax rate as an independent variable is that it is clearly not exogenous. The higher the taxable income, the higher is the tax bracket into which that income falls. Therefore, the identification occurs via the use of an instrumental variable for the tax rate. Auten, Carroll, and Gee (2008) use a lagged tax rate as an instrument. Auten and Joulfaian (2009) use the top federal and state income tax rates as instruments. In this paper, we follow Goolsbee (2000) and use the "permanent income" tax rate as an instrument. We define "permanent income" as the executive's average income over all the years in our sample. We use this measure of income because if executives anticipate or know that a tax rate hike is likely to happen, they may reduce their current income to move into a lower tax bracket. So if we classify executives as belonging to a certain tax bracket based on their income *after* the change occurs, we may find that the tax change has no effect on reported taxable incomes. However, if we use the income just before the tax change, then mean reversion will lead to overestimates of the impact of tax policy (as pointed out by Goolsbee, 2000).

The permanent income criterion provides us a better means of classifying executives into income categories since we are using their average income over a sufficiently long period. The permanent income tax rate is the rate that would apply to the permanent income of the executive, which represents their income in the absence of any behavioral response.[12] A problem with averaging income and applying permanent income tax rates to that income is that it may introduce errors and bias our results toward finding a zero response. However, if the responses for the top of the income distribution are sufficiently large, we should still be able to identify the effect.

D. Model and Estimation

Our analysis is distinct from the earlier studies of the elasticity of taxable income in at least two fundamental ways. First, in addition to analysis of taxable income elasticity, we also investigate the responsiveness of the (log of) deferred income to tax changes. Second, we apply the marginal tax rates that would apply to the executive's permanent income (or average total income) rather than taxable income. This approach is similar to that of Goolsbee (2000) except that he defines permanent income as the average of total taxable income, and we define permanent income as the average over total compensation. The reason we use total compensation is that this measure tells us the tax rate that the executive would pay if he or she did *not* defer compensation. Therefore, this tax rate is the relevant rate to use to measure responsiveness. The higher this rate, the higher will be the incentive to defer taxation. Our baseline specification for deferral parallels that employed for the study of taxable income in the past. The equation is then:

$$\log(ydef_{ijt}) = e\log(1-\tau_{ijt}) + other\ controls + time + d_{ij} + \varepsilon_{ijt},$$

where $ydef_{it}$ refers to total deferred income (in real dollars) for executive *i* at company *j* at time *t* and τ_{ijt} refers to the marginal (federal) income tax rate that would apply to the executive's current taxable income at time *t*. Our instrument for this tax rate is the tax rate that would apply to the executive's permanent income at time *t*, which we call ρ_{ijt}. Note that we calculate permanent income as the average of total compensation for all the years for which the executive is in the database. In general, we included executives who were present for at least two years in

[12] We experimented with alternative measures of permanent income. For example, we used the period from 1992-1998 to construct a measure of permanent incomes, and then applied the tax rates that would apply on that income for the remaining years, 1999-2006. We obtained even larger estimates in this case than with our current sample. However, using data for the entire period helps to smoothen out short-term fluctuations in income.

the sample. However, we also experimented with a sample that included executives with data for at least five years in the database so that the permanent income measure would be influenced less by extremely high or low values in certain years. We further tested robustness by including only executives who were present in the sample for all years between 1992 and 2007. Aside from tax rates, stock prices and other market variables may also influence the decision of the executives to realize income. In accordance with previous studies, we include other control variables such as the market value of the company's shares as well as total company assets (or the earnings-to-assets ratio). Finally, we also include a time trend and a company/executive fixed effect. Note that we use the time trend instead of the usual year fixed effects because there is limited time series variation in our explanatory variable, the federal marginal tax rate. Over the course of our sample period, there were only two major tax changes to the top federal rate. One occurred in 1993, and the other took place over 2001-2003. Hence including time dummies tends to absorb much of the variation in the tax rate, and leads to problems with estimation. In particular, while estimates look similar and remain statistically significantly different from zero when we use time dummies for the period 1994-2007, adding a time dummy for the year 1993 leads to a statistically insignificant coefficient on the instrumented tax rate. Therefore, it is likely that this is being driven by the correlation between the year dummy and the tax rate, rather than by the fact that other unobservables are causing the estimated coefficient to be insignificant. To test this further, we also experimented by using sub-period dummies for the periods 1992-1996, 1997-2001. Results with this approach are similar to that with the time trends.

Given this specification, the elasticity, e, is identified as the coefficient on the net-of-tax price, $(1 - \rho_{ijt})$.

In results presented later, we extend the baseline specification to account for the long-run elasticity as well by including a variable that is measured as the (log) difference in the current tax price and the future tax price. In general, the estimated coefficient on this variable captures the overall elasticity (both short- and long-term) of deferred income to tax changes.

III. Empirical Analysis

A. Description of Variables

Table 1 provides a description of each of our variables. The major difference between our total compensation variable and the taxable compensation variable is that total compensation includes all options awarded (Black-Scholes value) and all restricted stock grants, while taxable compensation includes only those options that are exercised. In alternative specifications, we define deferred income either as the difference between these variables, or more specifically as simply, options awarded and stocks granted.

Table 2 shows the average value of all the income variables and the tax rate variables.[13] Over our sample period, real total compensation averaged $2,136,255 (or $1,656,908 in 1991 dollars). Taxable compensation averaged $1,514,767 (or $1,176,596 in 1991 dollars) and deferred compensation averaged $455,346 ($353,946 in 1991 dollars).[14] Options were by far the largest component of total compensation, averaging $641,566 across all years, with salaries at $366,036 and bonuses at $299,557. The value of options exercised was approximately $747,693, making this component of taxable compensation the most significant.

The marginal income tax rate averaged 36.7 percent over the period, while the permanent income tax rate was somewhat higher at 37.5 percent. Therefore, on average, most executives in our sample fall within the top two income brackets. If we restrict the sample to the period between 1992 and 1995, we obtain averages similar to Goolsbee (2000), with real taxable incomes at $735,593.[15]

Because we are interested in the response to annual changes in tax rates, we adjuste the raw data to include only firms with a fiscal year end date of December. Further, our raw data showed some executives with total compensation at either $0 or $1. Several of these include founding partners or owners of firms, or those with an otherwise high equity ownership in the firm.[16] We exclude these observations from the sample and also exclude cases where taxable income is negative. Finally, we include only observations for which the executives are observed in the database for more than one year. On average, we have 24,749 executive-company groups, with approximately 118,175 observations for the taxable income regressions and 79,308 observations for the deferred income regressions.

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[13] We excluded values of total income and taxable income that seemed unusually low and were probably erroneous.

[14] Note that for some observations we were unable to construct a total income number due to missing data for some of the components of income. Therefore, there are cases where we have a value for taxable income, but no value for total income. Deferred Income is only defined when both total and taxable income are observed.

[15] Goolsbee (2000) reports an average value of income of $852,000. However, his sample includes the period 1991, while we were unable to get compensation data for 1991 from Execucomp**.** Our results below, however, are fairly similar to Goolsbee's when we estimate his equation, even though we appear to have one less year of data.

[16] For example, Steve Jobs, Larry Page, and Sergey Brin show up in the data with $1 in total income.

Table 3 shows the distribution of (nominal) incomes across years. Similar to the pattern in Goolsbee (2000) and Feldstein and Feenberg (2006), taxable incomes decline between 1992 and 1993. Average taxable incomes declined from $832,507 in 1992 to $727,493 in 1993—a decline of nearly $105,014, or 13 percent. Anecdotally, this drop can most likely be attributed to anticipation of increase in tax rates in 1993. While taxable incomes declined over this period, total compensation, in fact, rose from $914,302 in 1992 to $1,009,077 in 1993, an increase of more than 10 percent. This increase is not surprising, as this period marked the beginning of the economic expansion that continued through the 1990s. Thus, there is clearly a behavioral response to the change in tax rates, because in the absence of such a response taxable incomes should have increased between 1992 and 1993.[17]

To understand the behavioral change, we look at the specific components of compensation. Table 3 also provides a disaggregated look at the types of compensation. There was little change in the magnitude of cash compensation or salaries between the two periods. Equity-based compensation, however, showed more responsiveness to the increase in tax rates. Option awards increased from $220,100 in 1992 to $259,000 in 1993 and $352,800 in 1994. In particular, options awarded and stock grants become a much larger fraction of overall compensation in 1994. For instance, in 1992, salaries and bonuses were more than 70 percent of total compensation, while LTIP, options, and stock grants were about 24 percent. Between 1993 and 2000, this ratio declined to nearly 53 percent for salaries and 42 percent for LTIPS, options and stocks. Hence, the composition of compensation changed significantly after the 1993 tax increase, with equity based compensation comprising a much larger fraction of overall income. [18]

It is also interesting to observe changes in compensation around the time of the 2001 and 2003 tax cuts. The proposed cuts were fully phased in by 2003. In 2001, the top marginal income tax rate was reduced from 39.6 to 39.1 percent, and in 2002, the rate was cut to 38.6 percent. Finally, in 2003, the rate was reduced to 35 percent. In support of our theory that the behavioral response came in the form of a change in the mix of compensation (or deferred compensation), the share of cash compensation rose from 52 percent to 56 percent between 2000 and 2003, while the share of equity compensation (primarily options) declined from 43 percent to 37

[17] These changes are large even in constant-dollar terms. Real taxable incomes declined from $808,179 in 1992 to $685,707 in 1993. At the same time, total real incomes increased from $887,583 to $951,117.
[18] For a discussion of executive compensation patterns prior to our period, see Frydman and Saks (2007).

percent.[19] Figure 1 shows these changes graphically. The long-term trends in the nature of executive compensation show a clear response to tax rates. Higher expected tax rates show a shift toward more equity-based compensation that can be deferred, while lower tax rates show a shift toward more cash compensation.

Goolsbee (2000) conjectured that the behavioral response was simply due to a change in the exercising of options. When executives anticipated higher tax rates in 1993, they responded by exercising more options in 1992, and less in 1993 and 1994. Therefore, the response was driven by a timing shift, and the long-term elasticity was close to zero. We examine data for a much longer time span and find that changes in tax policy have sizable impact on deferral behavior. Options exercised were much higher in 1992 and declined in 1993 and 1994 corresponding with the tax increase in 1993. This pattern is reversed when we examine the 2001 and 2003 tax rate changes. Given that rates were about to be reduced in 2001, 2002, and 2003, there was a substantial decline in options exercised over this timespan. Starting in 2004 individuals took advantage of the lower tax rates with a substantial increase in the value of options exercised. This decline is the opposite of what one might expect if tax cuts induce executives to exercise their options. Figure 2 shows this change graphically.[20]

Table 4 provides a distribution of real total, taxable, and deferred incomes at different permanent income tax rates. Under our argument, one should expect more deferred incomes at higher permanent income tax rates. Indeed, the highest deferred incomes show up in the top income tax brackets. For instance, if we compare the 35 percent tax bracket (which was the top tax bracket for the period since 2003) with the 39.6 percent bracket (the top bracket for almost the entire period before 2001), while total incomes were higher in the 35 percent bracket, deferred incomes were lower. A higher expected tax rate on total income is on average associated with greater deferred income.

[19] Restricted stock grants in fact showed some increase over this period. This could be due to the nature of taxation of grants. As mentioned earlier, executives can choose to be taxed on grants at the time of the award. Therefore, it is likely that some executives substituted away from options and toward grants in order to pay the lower tax rates in 2003.

[20] In contrast to this pattern in the data, Hall and Leibman (2000) find little evidence that previous tax changes influenced the exercising of stock options. For instance, the Economic Recovery Tax Act of 1981 reduced the top marginal tax rate from 70 percent in 1980 to 50 percent in 1982. However, there was no significant decline in options exercised in 1980 and 1981, and no significant increase in 1982. Similarly, the highest year of stock-option gains in the period around 1986 was 1987, even though taxpayers would have known that the personal rate would be ten percentage points lower if they waited until the following year.

Table 5 provides a disaggregated look at the types of compensation at different permanent income tax rates. Individuals who are likely to fall into higher permanent income tax brackets receive more of their compensation in the form of options and stocks, rather than cash. Therefore, a longer-term look at the data reveals that the behavioral response derives from the mix of compensation (as the new tax responsiveness studies predict) rather than simply a timing shift. In the next section, we test our hypothesis by using a measure of deferred compensation as the dependent variable, and regressing it on the permanent income tax rate (in most cases, the top tax rate). The responsiveness of deferred income is larger than the responsiveness of taxable income to tax rates.

B. Estimation Results

We begin the presentation of our results by specifying a conventional regression of the log of taxable income on the log of the net-of-tax share, or the tax price; see Table 6. This specification is the one used in nearly all prior studies; estimation results are in Column (1). Standard errors are clustered at the individual level. We estimate a taxable income elasticity of -4.7. However, as noted in earlier studies, this specification is subject to endogeneity bias—because the higher the taxable income, the higher is the tax bracket into which that income falls. Following Goolsbee (2000), we use as an instrumental variable for the tax rate in this specification the permanent income tax rate that would apply to this income rather than the current income tax rate. Column (2) shows the 2SLS estimate, using the permanent income tax rate as an instrument. The estimated coefficient switches sign and the magnitude is approximately 0.5. Indeed, this estimate matches the estimate from the panel regressions reported in Carroll (1998), Auten and Carroll (1999), Gruber and Saez (2002), Kopczuk (2005), and Giertz (2007). However, if we restrict the sample to the period before 1997, the estimate increases to 1.4, which is closer to Goolsbee's (2007) estimate of the elasticity. In fact, this estimate matches the estimates obtained by Feldstein (1995) and Navratil (1995) for the top income groups. This higher estimated elasticity is likely due to the fact that a major change in tax rates happened during this period, making the identification of the response easier. In fact, if we focus on the other major period of tax cuts starting in 2001, the estimated elasticity is even larger. Therefore, one reason why the estimated elasticity is measurably smaller over longer periods could be because we include periods with insignificant changes in tax rates, while the response to the tax change is concentrated around the period of the tax change.

Column (3) reports estimates for the elasticity of deferred income. Using deferred income as the dependent variable, calculated as the difference between total compensation and taxable income, the elasticity estimate is -2.8. In other words, the higher the tax price (the lower the current tax rate), the lower is deferred income. Potentially, the current tax rate could be subject to the same endogeneity bias in this regression as in the taxable income regression. Because, intuitively, deferred income is simply the part of total income that is not taxed, the choice of how much to report as taxable income is also a choice of how much of income to defer to the next period. Therefore, the larger the taxable income, the lower the deferred income, and this relation could bias the estimation.[21] That is, taxable income can be thought of as an omitted variable affecting both tax rates as well as deferred income. Therefore, we use the permanent income tax rates as instruments for the current income tax rates. The 2SLS results in Column (4) show an even larger estimate of the elasticity at -3.1. Therefore, deferred incomes show significant responsiveness to changes in tax rates. [22]

We also experimented with an alternative instrument for the correct income tax rate. In results not shown here, we defined the instrument as the top marginal income tax rate. This rate is exogenous because it is an aggregate change, not one driven by individual-level changes in deferred or taxable incomes. As such, the identification comes mainly through time-series variation in the top tax rate. As mentioned earlier, the top rate changed from 31 to 39.6 percent between 1992 and 1993. It stayed at that level through 2000. In 2001, the top rate declined to 39.1 percent, in 2002 to 38.6 percent, and in 2003 to 35 percent. It then remained at 35 percent for the rest of our sample period. The estimated elasticity with this specification is -3.04. This

[21] The raw data do show some negative correlation between the current marginal tax rates and deferred incomes. For example, deferred incomes were extremely high for people with low marginal tax rates, and were significantly lower for individuals with marginal tax rates in the range of 35 percent. However, deferred incomes were again high for the top tax rate group. So there is no clear correlation across the sample. This pattern may help explain the negative coefficient in Column (3). In principle, endogeneity should lead to a positive sign on the elasticity estimate with the current income tax price on the right-hand-side. This relationship does not hold. Therefore, endogeneity is not a major concern for our estimation.

[22] In other models not shown here, we included a dummy variable for executives who received more than $1 million in salary after 1993. In 1993, section 162(m) of the Internal Revenue Code was enacted, limiting the deductibility of executive compensation in excess of $1 million, unless the compensation was performance-related. Our results are robust to the inclusion of this variable. Further, if we include year dummies instead of a time trend, the estimated coefficient is -1.5, and is statistically significantly different from zero.

estimate's similarity to the 2SLS estimate confirms that our instrument is working sufficiently well in identifying the income response to exogenous tax rate changes.

Column (5) calculates the timing shift -- the non-transitory elasticity -- by studying the responsiveness of executives' incomes to changes in future tax rates. For example, the 1993 tax cuts were anticipated by executives. Their response to the cuts would have been conditioned by the fact that the tax rates in 1993 were going to be significantly higher than in 1992. Therefore, we include a variable that captures this difference in tax rates.[23] We calculate this variable as the (log of) current tax price minus the future tax price. In other words, if the future tax rates were higher than the current rates, then this variable would increase in value. Our results show that the long-term elasticity is significant, negative and close to or higher than one. Therefore, higher future tax rates result in lower deferred income.

In unreported regressions, we included the top corporate income tax rate and the capital gains tax rate as additional controls since changes to these rates may also influence the nature and value of compensation. We find no change in the estimated coefficient on the instrumented tax rate, though the corporate tax rate does show up as negative and statistically significant.

Note that using this definition of deferred income, we obtain several cases in which deferred incomes are negative. This result happens primarily when the value of options exercised exceeds the (Black-Scholes) value of options granted. Our double-log specification drops these observations from the sample. To test the sensitivity of our results to the inclusion of these observations, we used a log-linear model where the dependent variable is in (real) dollar terms while the tax price term is in logs. The coefficient on the (log) tax price remained higher than one, negative and significant at one percent in this specification.

Table 7 presents results of tests for robustness of this specification. In Column (1), we measure the non-transitory elasticity by including the permanent income tax rates directly in the specification, rather than as instruments for the current income tax rates. Because permanent income tax rates are exogenous, we can use them directly in the equation. In Columns (2) and (3), we include a measure of company performance as well as company assets. These controls

[23] Slemrod (1995) includes the actual change in tax rates between the future and the current period as an explanatory variable. Goolsbee (2000) uses a slightly different specification where the coefficient on the current tax price is different from the coefficient on the future tax rate. He then uses the difference in the estimated coefficient values as the measure of the non-transitory elasticity. We follow the Slemrod (1995) specification, though all our results are robust to including the current and the future tax rate as separate variables. The estimated elasticities are larger under the latter specification.

are standard in studies of executive compensation.[24] We calculate the market value of the company as the number of outstanding shares multiplied by the share price at the end of the fiscal year. In Column (4), we introduce the current and future rates as separate variables to match Goolsbee's (2000) specification. The long-term elasticity is the sum of the coefficients on all tax rate variables. Note that this specification aims to capture the true long-term elasticity by approximating expectations of future tax rates using actual rates. This assumption is partly justified since for the two major tax changes in our model, the 1993 tax increases and the 2001 and 2003 tax decreases, people had some idea of what was likely to happen to tax rates going forward. For example, the data on deferred incomes show that people responded to the 1993 tax hikes by increasing deferred incomes significantly between 1992 and 2000. In contrast, deferred incomes declined during the tax cuts of 2001 and 2003. In other words, there was a secular trend of rising deferred incomes over the decade of the 1990s, which was not simply a timing shift, or a one period response to changing tax rates, but a long-term change in the nature of compensation. The value of the estimated elasticity is consistently above one in all these specifications. Finally, in Column (5), we define the tax rate variable as the sum of the federal and state tax rates that would apply to permanent income. We were able to match the state tax rate because Execucomp provides information on the state in which the company is located. This combination introduces more variation in the tax rates. The estimated coefficient is statistically significantly different from zero at five percent level, and the elasticity is about -1.4.

Table 8 reports results for different measures of deferred compensation. In Column (1), we redefine our dependent variable as the sum of the values of options awarded and restricted stock grants. Note that this variable is different from our earlier measure of deferred income in that it does not net out options exercised.[25] Further, there are no negative values to complicate the analysis. The elasticity in this case is -1.2. These results are robust to the inclusion of a variable capturing the total stock of options at the beginning of the year. Column (2) focuses specifically on options awarded as the dependent variable. The elasticity in this case is significantly higher than in Column (1), suggesting that options are much more responsive to tax rates than stock grants. Hall and Liebman (2000) use a somewhat similar specification in trying

[24] For a recent review of this research, see Murphy, *et al*. (2004).

[25] There is also an "All Other Income" category that is included in total compensation but not in taxable income. This category typically includes premiums for life insurance policies and company matching contributions to 401(k) retirement accounts.

to explain the rise of option awards in executive compensation over the period 1980-1994. The tax variable however is the tax advantage to both the firm and the CEO of compensation in the form of stock options rather than salary and bonuses. The tax advantage derives from the divergence in rates between personal, corporate and income tax rates. The elasticity with respect to this variable is 2.4. However, in an alternative specification, Hall and Liebman (2000) include the corporate, personal, and capital gains tax rates as separate variables, and in this case only the corporate tax rate is significant. It is possible that this results from a high degree of correlation between the top personal tax rate and the corporate rate. Also, there is no attempt to employ an instrument for the tax rates in their specification even though they acknowledge the possibility of endogeneity bias. [26]

A potential problem with our approach is that option awards and stock grants often include restrictions tied to the exercising of these awards. For instance, vesting restrictions determine when the ownership of the shares is transferred to the executive and when they can freely exercise them. If the option's value is sufficiently in the money, then the executive may prefer to exercise the option. However, vesting restrictions may not allow him or her to do so. So vesting restrictions may affect the executive's choice of how much compensation to receive as options. Huddart and Lang (2006) and Fu and Ligon (2009) find that managers exercise a substantial portion of their options as soon as they vest.[27] For our purposes, it may be interesting to see whether executives choose *not to* exercise vested options in response to high tax rates. Column (3) presents these results. In general, the higher the expected future tax rates, the lower the unexercised vested options. The non-transitory elasticity is approximately -0.6. In Column (4), we define the dependent variable as the ratio of number of exercised options to the number of vested but unexercised options. In support of the deferred income hypothesis, the higher the

[26] Hall and Liebman (2000) provide an interesting overview of the growth in performance-based pay and the factors responsible for it. The first factor they consider is whether the tax advantage to both the firm and the executive from the grant of options may be responsible for the tremendous increase in this form of compensation. Stock options are preferred by the executive as well as the firm for two reasons. First, they enable the executive to defer compensation and thereby lower taxes. Second, for the firm, the payment of compensation can be deducted against their corporate profits. Hall and Liebman (2000) show that there is a moderate tax advantage to both the firm and the executive of issuing NSOs relative to cash. (ISOs, by contrast, are tax disadvantaged, as a result we see very few ISOs being issued.) Other factors highlighted by the authors include the rise of institutional investors and the size of the board. Broadly, these factors would fall under the category of corporate governance. Our paper does not directly control for these factors in the regression equation, but the company-executive fixed effect should account for firm specific factors.

[27] Cadman, Rusticus, and Sunder (2010) discuss determinants of option vesting schedules.

future tax rate, the higher the ratio of exercised options to exercisable options. Finally, Column (5) uses the ratio of the estimated value of in-the-money unexercised exercisable options upon the value of exercised options as the dependent variable. An option's being in the money essentially means that the executive can exercise the right to sell the share at a price higher than the prevailing market price. Again, this variable shows significant responsiveness to future tax rates. In other words, when future tax rates are high, unexercised options are lower.

Behavioral responses are likely to be strongest at the top of the income distribution. Table 9 groups executives into different income levels: those with more than $275,000 in permanent income, more than $500,000 in permanent income, and more than $1,000,000 in permanent incomes. The non-transitory elasticity is remarkably consistent across the three groups. Each group has an elasticity between -1.63 and -1.7. It should be emphasized that all three of these subgroups earn very high incomes, so the results are likely to be different for lower income individuals or non-executives who have less ability to defer income as compensation is more equity based for the highest-income groups. The possibility of receiving compensation as options and stock grants makes the response to tax rates for this group highly elastic, even in the long run. The final column in this table allows for the possibility that non-tax-related factors might affect different income groups differently over time. Also, stock market performance might have different impacts across income groups. To control for these factors, we divided the executives into four different income groups, and interacted the dummies for each group with the time variable as well as the market value variable, respectively. The coefficient after allowing for these controls is approximately -3.02.

Finally, we present the results of tests for robustness to different samples of executives in Table 10. While all of our earlier regressions included all executives with at least two years of data, we now exclude executives who were in the database for more than five years, or more than ten or more than 15 years (the entire sample period), respectively. If our results are biased in any way by including executives with too few observations, this bias should surface in these regressions. In fact, as the estimated elasticities show, our results become stronger as we work with a more balanced panel. The elasticity for those who show up in the data for all periods is nearly twice that for our baseline regression.

Our paper examines the behavioral effects of tax changes on deferred income rather than taxable income. We account for the behavioral response to be captured through changes in the nature of compensation that enable tax-shifting to future periods, rather than simply reported taxable incomes. We calculate the elasticity of deferred income with respect to the marginal net-of-tax rate. A ten-percentage-point increase in the top income tax rate would lead to an increase in deferred income in the short-run of 47.2 percent, and in the long-run of 18.8 percent. Relative to the earlier taxable income elasticity studies, results from Column (2) of Table 7 suggest that the taxable income response is about 8 percent—that is, there would be a decline in reported taxable incomes of 8 percent.

IV. Conclusion

This paper uses data on high-income executives to calculate the behavioral response to tax changes. We find that the evolution in the mix of compensation for these individuals has created opportunities to defer income and therefore, to defer taxation on that income. While cash incomes—mainly salaries and bonuses—have grown steadily, equity compensation in the form of stock options and restricted stock grants has complicated measurements of the elasticity of taxable income. Much of the empirical and theoretical analysis has used reported taxable incomes as the base for measuring this elasticity. Given the increasing importance of stock options in executive compensation it is of interest to understand how taxation influences deferral. Such deferral can also contribute to measured taxable income elasticities. To study deferral, we use the difference between total compensation and current year taxable income as the relevant income variable for measuring the elasticity, accordingly terming it the deferred income elasticity. Our results suggest a value of this elasticity close to or greater than one. While the nature of the compensation package may depend also on other, non-tax corporate-level factors that we are unable to include in the analysis, we include firm-executive fixed effects. Further, if compensation were influenced by factors other than taxes, this omission should bias our estimated effect of tax rates downward, rather than leading to a large estimated value of the elasticity. To summarize, incorporating this form of deferred income in traditional elasticity regressions is critical for understanding the behavioral response of high income taxpayers to tax rate changes.

Appendix A. A Simple Dynamic Model of Tax Deferral

1. The Model

To motivate our empirical analysis, we present an infinite-horizon model of tax deferral in which an individual gets a constant flow of income and faces stochastic tax rates. To highlight the differences from the analysis in Feldstein (1999), we construct the model so that the worker makes no decision about how much labor to supply to the market; as a consequence, there are no distortions from the labor supply decision. We make this choice deliberately, so that welfare consequences in the model result solely from the dynamic decisions of when to realize income rather than from the static labor supply decisions captured in previous research. To begin, we characterize an infinitely lived representative agent with preferences over her lifetime stream of consumption given by:

$$\sum_{t=0}^{\infty} \beta^t \, \mathrm{u}(c_t) \, . \tag{A1}$$

The agent has a stock of deferred income, d_t, and a constant stream of income, y. Each period, she must decide how much income to realize, z_t. Realized income will be taxed and the remainder consumed. Her stock of deferred income must be positive. This characterization gives the following constraints:

$$d_{t+1} = (1+r)\, d_t + y - \, z_t \, , \tag{A2}$$

$$c_t = (1-\tau_t)\, z_t \, , \tag{A3}$$

and

$$d_t \, \geq 0 \, . \tag{A4}$$

Here, deferred income gets a return r, where we assume that $(1+r)\beta = 1$. Combining the constraints gives the following equation:

$$c_t = (1-\tau_t)\,[y - (d_{t+1} - (1+r)d_t)] \, . \tag{A5}$$

In this framework, z_t is taxable income, y is total income, and $d_{t+1} - (1 + r)d_t$ is net deferred income.[28] The tax rate, τ_t, follows a stochastic process that is known to the agent at time zero. The current tax rate is known before the agent makes her decision about how much income to realize.

We solve this problem recursively using the stock of deferred income, d, and the current tax rate, τ, as state variables. The associated value function is:

$$V(d, \tau) = \max_{d' \in [0, Rd+y]} u((1 - \tau)((1 + r)d + y - d')) + \beta E_{\tau'|\tau} V(d', \tau') . \qquad \text{(A6)}$$

Here, d' and τ' denote the choice of deferred income in the next period and the tax rate in the next period. We solve the problem numerically with a stochastic tax process using policy function iteration as described below. It is worth noting that when the tax rate is not stochastic, $\tau' = \tau$, the model has a simple solution. Combining first-order and envelope conditions under this assumption gives the Euler equation:

$$u'(c_t) = u'(c_{t+1}) . \qquad \text{(A7)}$$

Equation (10) implies that the optimal consumption stream for the individual is constant and realized income is constant. To satisfy this condition, the agent optimally realizes all of her current income and the returns on her current stock of deferred income, keeping the stock of deferred income constant. These results are similar to the tax smoothing results in Barro (1974) and (1979). This illustration highlights that any welfare effects in the dynamic model arise from the option value of deferred income in a world with tax uncertainty rather than previously studied distortions to the individual's labor supply decision.

2. Choice of Parameters

[28] This formulation of the budget constraint is the dynamic version of the static budget constraint in Feldstein (1999). Taxable income is composed of two components: total income and deferred income. This model abstracts away from changes to labor income, exclusions, and deductions as studied by Feldstein by assuming that y is constant and demonstrates that the option to defer income has welfare consequences. More generally, the elasticity of taxable income can be decomposed into observed changes in period income (through labor supply responses and the use of exclusions and deductions) and net deferrals that shift income over time. We develop this idea further in our empirical analysis.

Solving the stochastic tax model numerically requires us to choose the following parameters: the level of income, the discount factor and interest rate, a functional form for the utility function, and the stochastic process for taxes.

We normalize the agent's stream of income to be one in each period. We set the interest rate to 3.5 percent which implies $\beta = 0.966$. The period utility function is assumed to exhibit constant elasticity of substitution: $u(c) = \frac{c^{1-\gamma}}{1-\gamma}$. The parameter γ, set at 0.5, determines the elasticity of intertemporal substitution, 2 in our parameterization[29] Finally, we assume that the process for taxes follows a three-state Markov process, selected to match an AR(1) whose parameters are estimated from the top marginal income tax rate in the United States between 1992 and 2007. The crucial motivation for an individual's deferring income in the model arises due to uncertainty about future tax policy. Using observed tax changes to parameterize the stochastic process provides a conservative estimate of the amount of tax uncertainty facing individuals when making decisions about how much income to defer. The OLS estimate of the AR(1) process generates a mean tax rate $\mu = 37.5$ percent, a persistence parameter $\rho = 0.409$, and a standard deviation of the error term of $\sigma = 1.81$. Using these three parameters, we choose the stochastic process is chosen using the method in Adda and Cooper (2003). With this procedure, tax rates for the three states are given by $\tau_1 = 0.356$, $\tau_2 = 0.375$, and $\tau_3 = 0.395$. Finally, the transition probabilities of going from state *i* to *j* are given by the following Markov transition matrix:

$$\prod_{ij} = \begin{pmatrix} 0.537 & 0.287 & 0.176 \\ 0.334 & 0.332 & 0.334 \\ 0.176 & 0.287 & 0.537 \end{pmatrix}.$$

3. Numerical Results and Discussion

[29] This estimate is a relatively high value for the elasticity of intertemporal substitution. Many estimates from consumption data such as those found in Hall (1988) find an elasticity close to zero. In this model, the elasticity determines by how much individuals smooth their consumption in response to a tax change. For log utility, the income and substitution effect cancel, so that individuals do not change their stock of deferrals in response to tax changes. When the elasticity is less than one, consumption-smoothing dominates such that individuals defer income when tax rates are low. When the elasticity is greater than one, income is deferred when taxes are high and realized when they are low, as observed in the data. We choose an elasticity greater than one, so that preferences are between log and linear and that deferral behavior is consistent with what is observed in the data. We believe this choice is appropriate as, for simplicity, the model leaves out other assets that individuals can use to smooth their consumption. Deferrals are then used more for tax avoidance than as an avenue for consumption smoothing. The model generates positive welfare gains for moving to a non-stochastic constant tax rate for any parameter choice of the elasticity of intertemporal substitution.

We solve the model numerically, generating optimal policy functions for the choice of deferred income next period given the current stock of deferred income and the current tax rate. Figure 3 illustrates the model solution. The left panel plots the individual value functions for each of the three tax rates. Each of the policy functions is increasing in the stock of deferred income. Moreover, lower tax rates are associated with higher expected future lifetime utility. The right panel plots the change in the stock of deferred income for each tax rate and current level of deferred income by subtracting the current stock of deferred income from the optimal policy rule. The top line represents a case in which taxes are high (τ_3) and shows that individuals choose to increase their stock of deferred income to avoid high current taxes. When taxes are at their intermediate level, the agent slightly increases her stock of deferred income, and when taxes are low, the stock is reduced.

The response to tax changes is asymmetric, with tax increases leading to a larger increase in deferred income than the decrease in deferrals from an equal sized reduction in taxes, as Figure 4 shows. The figure plots the difference between the amount of increase in deferrals in moving from the middle tax rate to the top, and from moving from the middle to the bottom. This pattern suggests that the focus of previous researchers on realizations may have significantly understated the consequences of tax-rate variation. Finally, we use the numerical model to compare different tax policy regimes. To do so, we make a welfare comparison between the model and an economy with a constant tax rate that generates the same revenue. The first row of Table 1 reports the welfare change in percent of lifetime consumption equivalents in moving from the constant-tax economy to the stochastic model for various values of γ. In the baseline case, when $\gamma = 0.5$, the stochastic tax policy produces a small welfare loss of 0.06 percent of lifetime consumption. The welfare numbers reported for other values of γ corresponding to values of the elasticity of intertemporal substitution between 0.5 and 5.

Table 11 also reports the loss in government revenue in the model compared to the model with the same mean marginal tax rate of τ_2. In the baseline parameterization, moving from the constant tax policy to the stochastic model involves a loss of 0.1 percent of tax revenue each year. The size of the loss in government revenue depends on the amount of deferred income, as the loss is very small when deferrals do not change in the case with log preferences.

These welfare effects, while modest, address only the dynamic effects of taxation; such welfare costs are *in addition* to the typical welfare losses from the elasticity of taxable income, as there are no adjustments to labor income in the model. Optimal tax analysis with labor supply adjustments yield welfare changes of 0.5-1.0 percent of lifetime consumption equivalents, so the changes we describe are not that much smaller (particularly as we consider only changes in the timing of realized income in a model with few efficiency costs of taxation). Moreover, we generate these effects from the expectation about future tax policy changes estimated from actual observed policy changes. If there were greater uncertainty over possible policy outcomes, the welfare effects could be larger. Top marginal rates in the period we consider do not contain changes as large as in a longer time series. We use these rates in this example, as they correspond to the tax rates we use to produce our empirical estimates.

These sizable welfare consequences of individuals deferring income motivate our empirical investigation of the elasticity of deferred income to observed tax policy changes.

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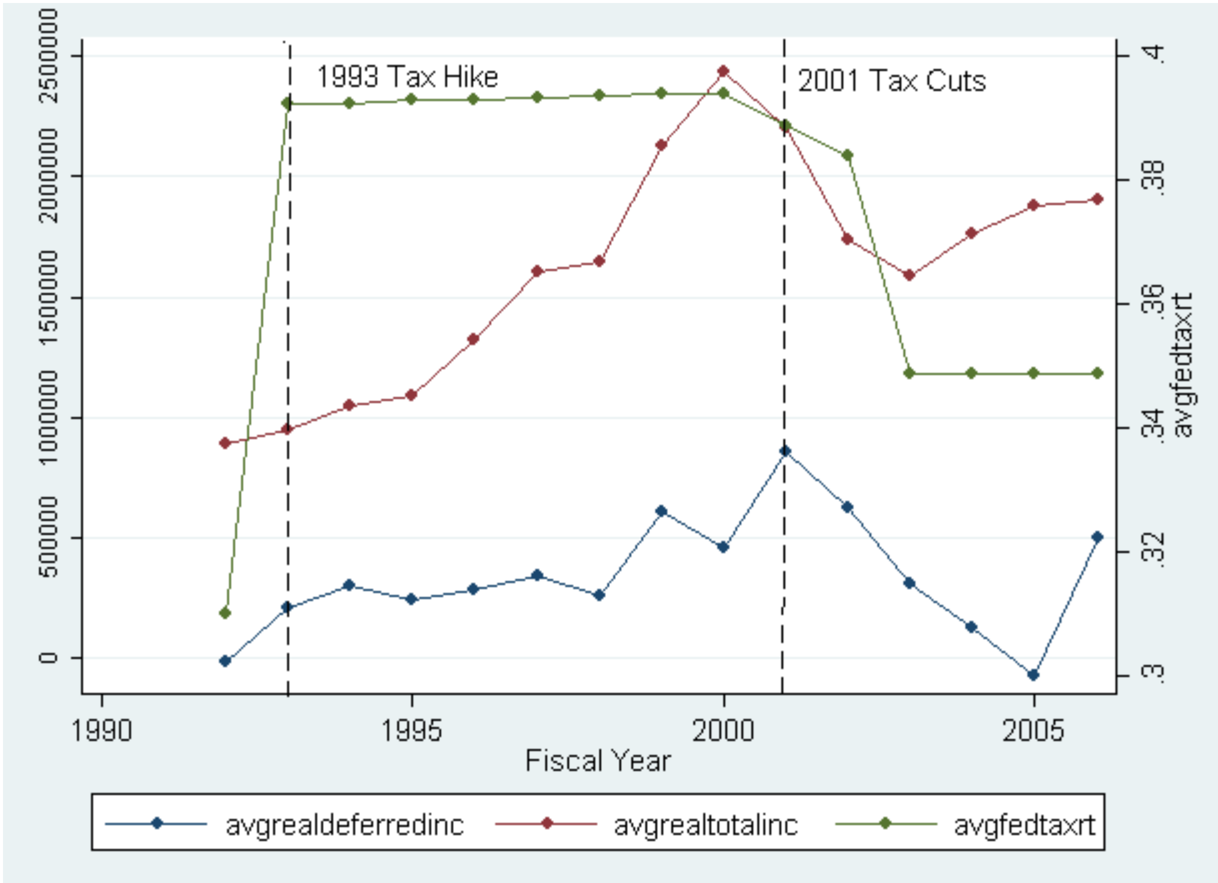
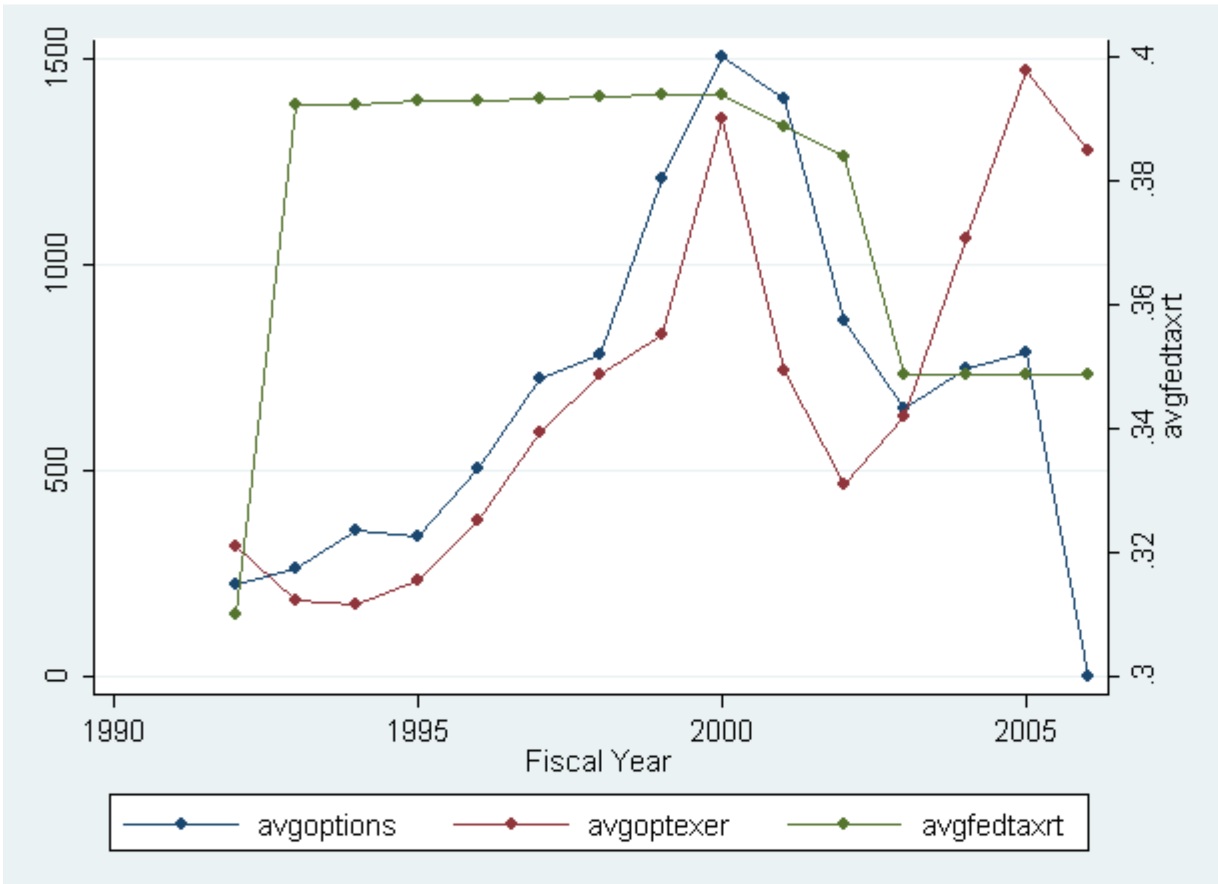
Figure 1: Average Permanent Income Tax Rate, Average Deferred and Total Income, By Year



Note:

The tax rate is the tax rate on permanent income. Real deferred income is the difference between real total income and real taxable income as defined in the text.

Figure 2: Average Value of Options Awarded and Exercised, by Year



Note:

The tax rate is the tax rate on permanent income. Options awarded are valued at their Black-Scholes value. All option values are in thousands of dollars.

Figure 3: Model Solution.

The left panel plots the individual value function by current stock of deferred income and tax rate. The right panel plots the change in deferred income for each stock of deferral and tax rate (optimal policy function minus current stock of deferred income).

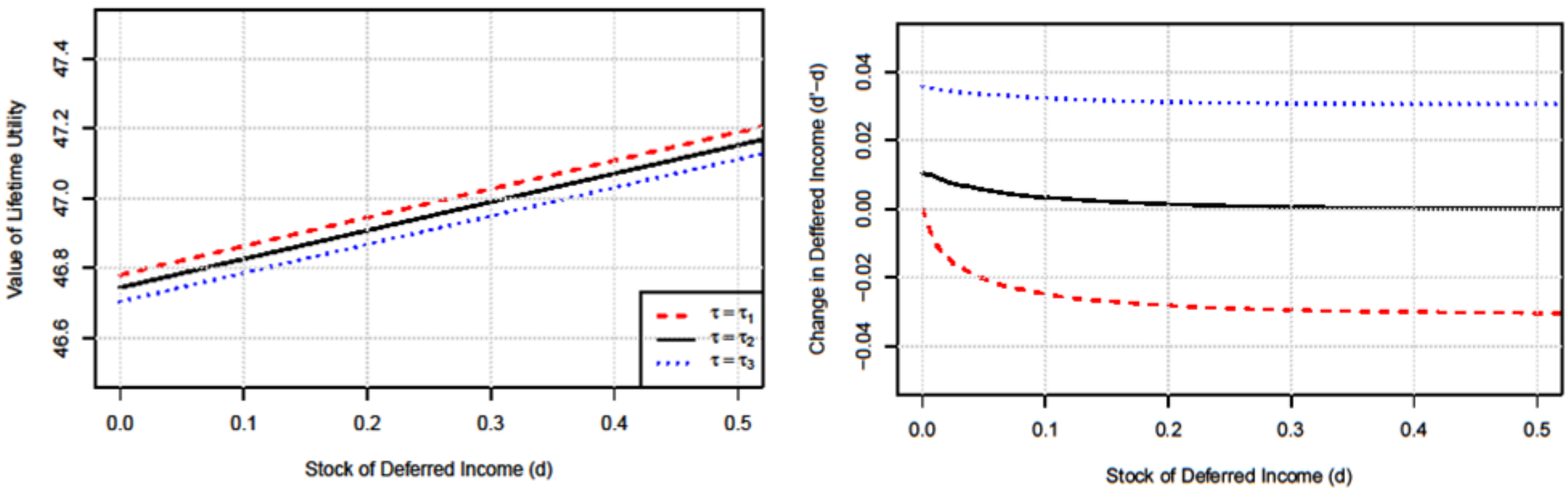


Figure 4: Asymmetric Response to Tax Change:

The figure shows the difference in the change in the stock of deferred income involved in moving from middle to high tax rate minus the change in moving from the middle to low tax rates.

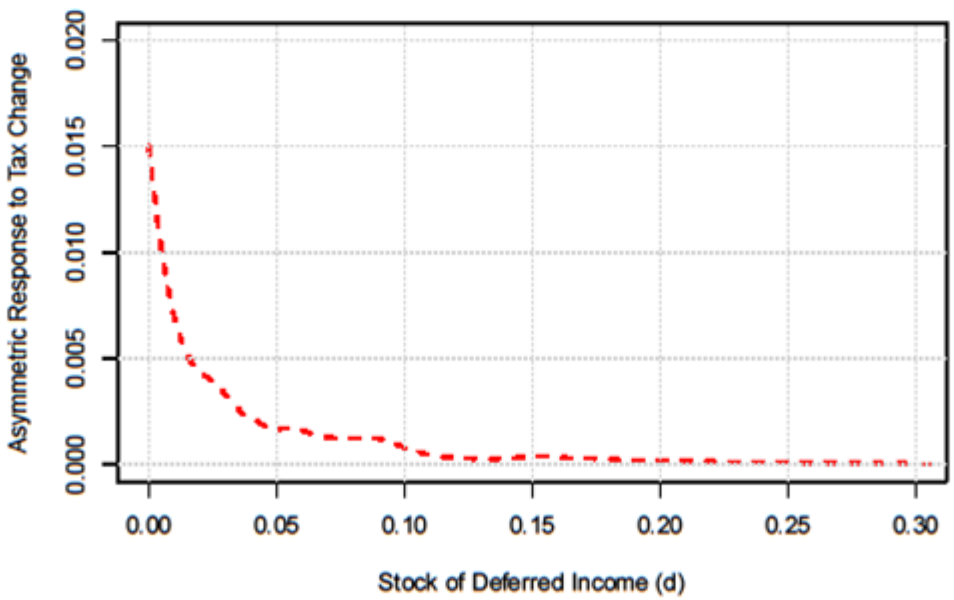


Table 1: Variable Definitions

Name	Definition	Measurement/Data Source
ytax	Real Taxable Income	Salary+Bonus+LTIP+Exercised Options+Other Annual/COMPUSTAT
ytotal	Real Total Income	Salary+Bonus+LTIP+Other Annual+Options Awarded (Black-Scholes value)+Restricted Stock Grants+ All Other Total/COMPUSTAT
ydef	Real Deferred Income	ytotal-ytax
yperm	Permanent Income	Average of total income over 1992-2007
yopt	Income From Option Awards	Black-Scholes value of Options Awarded/COMPUSTAT
ystock	Income from Restricted Stock Grants	COMPUSTAT
τ	Federal Marginal Tax Rate on Current Taxable Income	Federal Tax Schedule/NBER TAXSIM
ρ	Federal Marginal Tax Rate On Permanent Income	Federal Tax Schedule/NBER TAXSIM
θ	Combination of Federal and State Marginal Tax Rates on Permanent Income	State Tax Schedule/NBER TAXSIM

Table 2: Summary Statistics, 1992-2007

Variable	Mean	Std. Dev.
Log($ytax_t$)	13.152	1.093
Log(ytotal)	13.650	1.070
Log(ydef)	12.273	1.982
Log(yperm)	13.760	0.975
mtr	0.367	0.035
mtr_perm	0.375	0.026
state_mtr	0.051	0.031
state_mtr_perm	0.052	0.032
Log(Mkt.Value)	21.176	1.659
Log(Assets)	21.427	1.864
Salary (‘000)	366.036	258.993
Bonus(‘000)	299.557	898.860
LTIP(‘000)	77.909	596.838
Restricted Stock Grants(‘000)	155.575	881.081
Options Awarded (Black-Scholes Value) (‘000)	641.566	3320.532
Options Exercised(‘000)	747.693	4752.867

Table 3: Distribution of Nominal Incomes by Year

Year	Total Income	Taxable Income	Deferred Income	Salary ('000)	Bonus ('000)	LTIP ('000)	Restricted Stock Grants ('000)	Options Awarded (Black-Scholes Value) ('000)	Options Exercised ('000)
1992	914301.5	832507	-14317.1	285.5	160.3	54.1	58.7	220.1	314.0
1993	1009077	727493.3	215683.1	290.0	189.9	42.5	62.4	259.0	184.7
1994	1143030	750275.1	327603.9	296.5	216.7	46.1	66.1	352.8	172.5
1995	1219829	861974.1	267540.7	302.9	237.9	68.4	78.6	336.6	233.3
1996	1524624	1075816	320964.4	310.7	276.1	89.3	99.5	504.5	378.2
1997	1893629	1317496	398821.9	316.9	292.7	97.1	133.6	722.4	589.5
1998	1973028	1451306	310243.4	328.4	283.8	84.8	140.9	780.5	731.4
1999	2601977	1638157	738373.6	344.1	339.6	100.6	54.7	1209.8	828.4
2000	3081310	2215940	572402.4	360.7	368.2	105.7	218.7	1502.7	1354.3
2001	2867298	1537295	1110729	374.5	315.6	72.7	199.4	1400.4	743.1
2002	2292770	1317152	825210.4	382.4	355.8	80.4	215.1	864.6	462.3
2003	2145911	1572650	419799.8	391.3	402.2	112.4	270.9	648.8	630.9
2004	2443918	2133599	171608.5	417.3	493.8	120.7	385.8	747.6	1061.5
2005	2689573	2775239	-103698	452.5	588.8	215.9	481.1	783.2	1471.7
2006	2813695	1894905	741457.7	440.8	175.6	0.4	0.9	0.4	1276.3
2007	2824235	1993593	763410.4	462.914	151.706	0	0	0	1377.507

Source: Authors' calculations using COMPUSTAT data, 1992-2007

Table 4: Distribution of Real Incomes by Permanent Income Tax Rates (Federal)

ρ	*ydef*	*ytotal*	*ytax*
0.15	11883	26919	17856
0.25	15923	64495	61541
0.27	6214	58112	51898
0.275	6029	48503	42474
0.28	2415	99156	95615
0.3	1675	102422	101206
0.305	7214	113409	103091
0.31	-13763	829211	757218
0.33	-26018	200558	218469
0.35	227943	1829221	1494822
0.355	15826	198958	176207
0.36	-30053	188641	205842
0.386	653284	1808738	1037823
0.391	894997	2303294	1231396
0.396	364952	1651748	1142366

Source: Authors' calculations using COMPUSTAT data, 1992-2007

Table 5: Distribution of Compensation across Permanent Income Tax Brackets

(Nominal, in thousands)

Permanent Income Tax Rate	Salary	Bonus	LTIP	Restricted Stock Grants	Options Awarded (Black-Scholes Value)	Options Exercised
0.15	11.2604	0.3368	0.0000	7.7679	0.0000	0.0000
0.25	85.8969	1.1905	0.0000	8.4357	0.5844	0.0000
0.27	63.2130	2.3490	0.0000	6.8375	0.0000	0.0000
0.275	52.0125	0.0000	0.0000	7.0225	0.0000	0.0000
0.28	100.8865	15.9521	0.0000	5.7885	4.0475	12.5145
0.3	112.4415	14.0210	0.0000	5.0867	2.6705	5.7479
0.305	114.6052	15.3871	0.0000	2.1062	5.9456	2.2401
0.31	272.0553	149.2046	50.1431	54.4937	204.2100	292.4117
0.33	177.7907	36.0985	1.4300	9.9526	20.9768	90.5731
0.35	431.8036	421.5339	112.4980	286.9819	558.4870	1114.6180
0.355	158.4142	30.1730	3.0834	5.0955	33.8563	34.0632
0.36	142.4329	28.5442	2.1306	2.7898	23.8336	63.7040
0.386	393.3716	371.5790	84.1704	225.1692	905.4130	483.7264
0.391	385.3034	329.4664	76.1093	208.7531	1466.4990	777.4971
0.396	332.6390	296.3683	86.2838	130.2335	778.1554	613.8948

Source: Authors’ calculations using COMPUSTAT data, 1992-2007

Table 6: Taxable Income and Deferred Income Elasticity

	(1) Fixed Effects	(2) 2SLS with Fixed Effects	(3) Fixed Effects	(4) 2SLS with Fixed Effects	(5) Fixed Effects	(6) 2SLS with Fixed Effects
	Log($ytax_t$)	Log($ytax_t$)	Log(*ydeft*)	Log(*ydeft*)	Log(*ydeft*)	Log(*ydeft*)
Log($1-\tau_t$)	-4.695 (48.26)**	0.457 (6.09)**	-2.82 (14.39)**	-3.066 (14.65)**		
Time	0.116 (83.66)**	0.111 (77.05)**	0.151 (48.85)**	0.152 (49.10)**	0.147 (39.91)**	0.145 (38.59)**
Log($1-\tau_t$)-Log($1-\tau_{t+1}$)					-0.844 (4.02)**	-1.219 (4.84)**
Observations	116,381	116,381	79,308	79,308	61,523	56,107
Number of executive/company combinations	23,001	23,001	21,831	21,831	18,654	13,238
Absolute value of *t* statistics in parentheses						
* significant at 5% level; ** significant at 1% level						

Notes:
1. y_t refers to real taxable income. $ydef_t$ refers to real deferred income. The tax rate, τ_t, is the federal marginal tax rate applicable to taxable income. Columns (2), (4), and (6) report results using the permanent income tax rate as an instrument for the marginal tax rate. We define the permanent income tax rate as the tax rate applied to the long-term average total income for the entire period 1992-2007. This table uses only the federal marginal tax rate schedule.
2. When defining deferred income, some observations become negative. Because the specification is in terms of logs, we drop the negative observations. However, the results are robust to a non-log specification as well.
3. Specifications (4) and (5) rely on the difference in the future and current tax price on permanent income.
4. All specifications include a constant term.

Table 7: Response of Deferred Income to Anticipated Tax Changes: 2SLS Estimates With Fixed Effects

	(1)	(2)	(3)	(4)	(5)
	Log($ydef_t$)	Log($ydef_t$)	Log($ydef_t$)	Log($ydef_t$)	Log($ydef_t$)
Log($1-\rho_t$)-Log($1-\rho_{t+1}$)	-1.219 (4.84)**	-1.671 (6.70)**	-1.626 (6.52)**		
Log($1-\theta_t$)- Log($1-\theta_{t+1}$)					-1.375 (5.15)**
Log($1-\rho_t$)				-1.842 (7.46)**	
Log($1-\rho_{t+1}$)				-5.329 (9.02)**	
Log($1- \rho_{t+2}$)				1.589 (2.74)**	
Log(*Mkt. Value*)		0.404 (21.83)**	0.375 (17.70)**	0.283 (11.71)**	0.395 (17.84)**
Log(*Assets*)			0.103 (3.32)**	0.151 (4.31)**	0.095 (3.37)**
Time	0.146 (38.59)**	0.099 (23.62)**	0.091 (18.97)**	0.128 (17.56) **	0.101 (21.55)**
Observations	56,107	55,547	55,542	45,696	41,730
Number of executive/company combinations	13,238	13,117	13,115	14,117	11,825
Absolute value of *t* statistics in parentheses					
* significant at 5% level; ** significant at 1% level					

Notes:

1. $ydef_t$ refers to real deferred income. The tax rate, τ_t, is the federal marginal tax rate applicable to taxable income. The tax rate, ρ_t, refers to the permanent income tax rate and not the tax rate on current taxable income. Columns (1)-(4) only use the federal tax rates.
2. We define Market Value as the number of outstanding shares multiplied by the share price at the end of the fiscal year.
3. We present fixed-effects estimates with clustered standard errors. These results are from a 2SLS estimation with fixed effects, that instruments for the marginal tax rate on current income using the permanent income tax rate. All specifications include a constant term.
4. In Column (5), we instrument for the tax rate, θ_t, which includes both the federal as well as the state tax rates that apply to permanent incomes.

Table 8: Alternative Measures of Deferred Income and Tax Rates

	(1)	(2)	(3)	(4)	(5)
	Log($yopt_t$+$ystock_t$)	Log($yopt_t$)	Log($unexopt_t$)	Log($optratio_t$)	Log($ydefratio_t$)
Log(1-ρ_t)- Log(1-ρ_{t+1})	-1.339 (9.48)**	-2.405 (18.13)**	-0.667 (5.50)**	2.432 (7.32)**	-0.776 (1.91)*
Log($Mkt.Value_t$)	0.352 (27.13)**	0.366 (29.50)**	-0.084 (6.81)**	0.639 (18.19)**	0.500 (11.75)**
Log($Assets_t$)	0.140 (6.59)**	0.157 (7.28)**	0.173 (8.07)**	-0.483 (9.67)**	-0.515 (9.20)**
Time	0.099 (27.34)**	0.058 (15.54)**	0.231 (62.24)**	-0.036 (4.67)**	-0.017 (1.85)*
Observations	54,154	46,065	57,139	21,138	20,341
Number of executive/company combinations	12,478	10,856	12,189	5,805	5,628
Absolute value of *t* statistics in parentheses					
* significant at 5% level; ** significant at 1% level					

Notes:

1. Column (1) uses the sum of options awarded and restricted stock grants as a measure of deferred income.
2. Column (2) uses the total options awarded as the dependent variable. The options are valued using Black-Scholes calculations.
3. Column (3) uses the number of unexercised exercisable (vested) options as the dependent variable.
4. Column (4) uses the ratio of the number of exercised options to unexercised exercisable options as the dependent variable.
5. Column (5) uses the ratio of the estimated value of in-the-money unexercised exercisable options upon the value of exercised options as the dependent variable.
6. We define Market Value as the number of outstanding shares multiplied by the share price at the end of the fiscal year.
7. We present fixed-effects estimates with clustered standard errors. These results are from a 2SLS estimation, that instruments for the marginal tax rate on current income using the permanent income tax rate. All specifications include a constant term.

Table 9: Responsiveness at Different Permanent Income Levels

	(1)	(2)	(3)	(4)
	Log($ydef_t$) yperm>275,000	Log($ydef_t$) yperm>500,000	Log($ydef_t$) yperm>1,000,000	Log($ydef_t$)
Log($1-\rho_t$)- Log($1-\rho_{t+1}$)	-1.639 (6.56)**	-1.705 (6.46)**	-1.678 (5.30)**	
Log($1-\rho_t$)				-3.021 (14.51)***
Group1*time				.023 (1.24)
Group2*time				.024 (1.28)
Group3*time				-.001 (0.04)
Group1*logmktvalue				.240 (4.54)**
Group2*logmktvalue				.204 (3.11)**
Group3*logmktvalue				.149 (2.15)*
Log($Mkt.Value_t$)	0.379 (17.52)**	0.390 (16.42)**	0.396 (13.37)**	.133 (2.22)**
Log($Assets_t$)	0.110 (3.47)**	0.102 (3.03)**	0.127 (3.22)**	.045 (1.67)
Time	0.090 (18.36)**	0.091 (17.34)**	0.088 (14.01)**	.092 (6.26)**
Observations	53,341	46,266	32,581	74,332
Number of executive/company combinations	12,455	10,557	7,161	17,426

Notes:

1. $ydef_t$ refers to real deferred income. The tax rate, τ_t, is the federal marginal tax rate applicable to taxable income. The tax rate, ρ_t, refers to the permanent income tax rate and not the tax rate on current taxable income. The tax rate, ρ_t, refers to the permanent income tax rate and not the tax rate on current taxable income. This only uses the federal tax rates.
2. Group 1 refers to those with permanent incomes less than $275,000. Group 2 refers to those with permanent incomes between 275,000 and 500,000. Group 3 refers to those with incomes between $500,000 and $1,000,000. The omitted category includes those with incomes above $1 million.
3. We define Market Value as the number of outstanding shares multiplied by the share price at the end of the fiscal year.
4. We present fixed-effects estimates with clustered standard errors. These results are from a 2SLS estimation, that instruments for the marginal tax rate on current income using the permanent income tax rate.All specifications include a constant term.

Table 10: Responsiveness Among Executives With More Years of Data

	(1)	(2)	(3)
	Log($ydef_t$) Observations>5	Log($ydef_t$) Observations>10	Log($ydef_t$) Observations=16
Log($1-\rho_t$)- Log($1-\rho_{t+1}$)	-1.950 (6.59)**	-3.208 (6.68)**	-2.799 (1.64)**
Log($Mkt.Value_t$)	0.373 (16.34)**	0.395 (10.91)**	0.324 (2.00)**
Log($Assets_t$)	0.096 (2.93)**	0.029 (0.62)	0.249 (1.21)
Time	0.091 (18.58)**	0.093 (13.83)**	0.086 (3.68)**
Observations	42,377	15,945	1,334
Number of executive/company combinations	7,916	1,935	128
Absolute value of t statistics in parentheses			
* significant at 5% level; ** significant at 1% level			

Notes:

1. $ydef_t$ refers to real deferred income. The tax rate, τ_t, is the federal marginal tax rate applicable to taxable income. The tax rate, ρ_t, refers to the permanent income tax rate and not the tax rate on current taxable income. This only uses the federal tax rates.
2. We define Market Value as the number of outstanding shares multiplied by the share price at the end of the fiscal year.
3. We present fixed-effects estimates with clustered standard errors. These results are from a 2SLS estimation, that instruments for the marginal tax rate on current income using the permanent income tax rate. All specifications include a constant term.

Table 11: Welfare Effects of Stochastic Tax Policy

γ	2	1	0.5	0.2
Welfare Change	-0.03%	-0.04%	-0.06%	-0.14%
Change in Revenue	-0.04%	-0.005%	-0.10%	-0.38%

Notes:

1. The first row shows the welfare effects for a stochastic tax policy in comparison with the constant tax policy that generates the same amount of revenue for various values of γ.
2. The second row shows level of revenue generated from the stochastic model compared to the model with a constant tax policy at the same average tax rate for various values of γ.