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ABSTRACT

Given the increasing use of stock options in executive compensation, we examine how taxes influence the choice of compensation and document that income deferral is an important margin of adjustment in response to tax rate changes. To account for this option in the empirical analysis, we explore deferral by estimating how executives' choice of compensation between current and deferred income depends on changes in tax policy. Our empirical results suggest a significant impact of taxes on the composition of executive compensation.

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I. Introduction

Since 1980, there have been significant changes in the form of executive compensation. Not only has there been dramatic growth in total compensation, but Bebchuk and Grinstein (2005) and Frydman and Saks (2010) document that stock options and other forms of incentive pay now represent a larger share of the overall pay package. Indeed, during our sample period (1992-2005) total income of executives more than doubled while deferred income, which we define as the sum of the value of options and restricted stock grants awarded, more than tripled. The growth of equity-based compensation enables executives to substitute away from cash compensation which is immediately taxable and defer taxation on their income in high tax years.

This paper uses data from Execucomp to study how the use of deferred income as a form of executive compensation is influenced by tax policy between 1992 and 2005. While studying deferral behavior among executives does not offer a representative analysis of the entire population, given the interest in executive compensation and due to the fact that high-income earners represent a large share of earnings, studying how those earners respond to changes in tax policy has implications for both total government revenue and the efficiency of the tax system. The use of options and stock grants in compensation creates a means through which executives can choose to defer taxation on their current compensation.[1]

Deferring income can generate important tax benefits to individuals for at least four reasons. First, when workers face uncertainty about future tax rates (because tax rates vary over time), 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 a lower rate. Finally, even with equal tax treatment, deferral allows individuals to earn returns on the pre-tax value of their savings. Each of these mechanisms implies that executives have a greater incentive to defer income when they face higher tax rates. Moreover, the tax treatment of stock options can create additional tax incentives through the corporate tax rate. In particular, deferred

[1] Such means of deferral are not available to typical workers. In particular, executives have access to forms of deferred compensation such as stock options that are not offered to typical workers who only have limited access to tax deferred savings accounts such as the IRA and 401(k). For possible welfare effects of these accounts on welfare of non-executives see Imrohorglu, Imrohorglu, and Joines (1998), Kitao (2010), and Ho (2014) for a discussion. Of course, one must be cautious in broadly interpreting our results. Goolsbee, Hall, and Katz (1999) summarize the evidence of the existence of a high-income Laffer curve.

compensation delays when the firm can claim a deduction and potentially allows the firm to generate a larger deduction due to the million dollar limit on deductibility of non-incentive based pay. Hall and Liebman (2000) summarize tax and accounting rules regarding different forms of executive compensation and the total payoff to the firm and the executive of cash compensation as opposed to deferred income.

Changes in tax rates can influence both the choice of executive compensation and the timing of exercise of vested options. Changing the timing of exercising options allows executives to shift their income either forward or back in order to reduce tax payments when there are anticipated changes in tax policy. This paper, however, focuses exclusively on the question of how taxes affect the initial choice of compensation between cash (salary and bonus) and deferred income because timing decisions have been extensively studied by Feldstein (1995) for the 1986 tax reform and Goolsbee (2000a,b) for the 1993 tax changes. Moreover, the exercise of options is often a mechanical decision; for example, Huddart and Lang (2006) and Fu and Ligon (2010) find that managers exercise a substantial portion of their options as soon as they vest.[2]

A challenge in estimating the response of deferred income to changes in taxes is that the tax rate that the executive faces is endogenous, depending on the executive's current year income. To address this potential endogeneity bias, we follow Goolsbee (2000a) by using the permanent income tax rate, defined as the executive's personal tax rate based on average income over all the years in our sample, as an instrument. Our empirical results suggest that deferral of income is highly elastic with respect to the tax price.

Deferred income, in our paper, is defined as the sum of option awards and restricted stock grants. Since both executive compensation and the use of stock options grew rapidly during our sample period, we study deferred income as a share of total compensation. The estimated current-period coefficient on the tax price is -0.072 in the baseline specification in which a full set of controls is included, though it is not statistically significantly different from zero. The lack of significance arises as we find that the two components of deferred compensation, stock options and stock grants, respond in opposite ways to tax changes. Because restricted stock grants face a different tax treatment than options, we study how taxation influences the share of options and stock grants separately. We find that the tax-price response of option shares is -0.403, and the response of the stock grants share is 0.331. The incentive to defer income comes

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

mainly from option awards rather than stock grants. This difference arises partly because restricted stock grants are not treated as incentive pay for tax purposes and so are subject to the million dollar rule on corporate deductibility. Moreover, restricted stock grants allow the executive to decide to be taxed immediately or when the stock vests, so it is unclear if taxation is actually deferred.

In analyzing the responsiveness of compensation to taxes, we also consider the effect of corporate tax rates as they can influence the total tax benefit of options, because compensation is deductible against corporate profits. When executives defer realizations of income, this deferral influences the firm's current corporate tax payments because deductions occur at the time of realizations of income. We find little evidence that the corporate tax rate influences deferral decisions. This finding could be explained by the fact that we separately control for the corporate deductibility of income. Once the corporate deductibility is accounted for, if there are no expected changes in future corporate tax rates then corporate taxes should not influence the efficiency cost of changes in the personal tax rate as discussed in Appendix A.

We do, however, find evidence that the use of stock options is responsive to the million dollar restriction on executive salaries that was enacted in 1993 (section 162(m) of the Internal Revenue Code). This rule limits the corporate deductibility of non-incentive-based compensation to one million dollars. Because options are classified as incentive pay and are therefore exempt from the rule, theory would predict that there is a tax advantage to taking all pay in excess of one million dollars in stock options. In line with the theory, we find that the share of income above one million dollars is a strong predictor of the use of deferred income with a coefficient of 0.571 in the deferred income specification and 0.466 when stock options are considered.[3]

Our work contrasts with previous papers that do not find a strong relationship between taxes and the form of executive compensation. Hall and Liebman (2000) study the period from 1980-1994 and conclude that taxes have only a modest impact on the use of options while changes in corporate governance such as the role of institutional investors and managerial incentives play a much larger role.[4] Similarly, Frydman and Molloy (2014) study how tax policy

[3] These coefficients imply that nearly half of compensation in excess of one million dollars is taken as stock options. Part of the remaining payments could be paid as a bonus as bonus pay is also considered to be incentive pay and is therefore exempt from the million dollar rule.

[4] In particular, they find that the tax benefit variable that calculates the period tax benefit of options over cash compensation using statutory rates is significant, but only find significant results for the corporate statutory rate when regressing tax rates separately. They also estimate specifications taking into account tax loss carryforwards

affects the level of executive compensation between 1946 and 2005, with special focus on the years from 1946-1972. In particular, they look at how changes in labor income taxes influence the use of salary and bonus, stock options, and bonuses after retirement. Using *ex ante* versus *ex post* comparisons over tax changes, they find little effect of taxes on the level of compensation.

Relative to previous studies, our paper focuses on a more recent period where options are a larger share of executive compensation and pay is subject to the million dollar rule. Indeed, stock options have only recently become a common form of compensation. Hall and Liebman (2000) find that the median CEO did not receive stock options until 1985. Moreover, previous work studied periods where the million dollar rule did not exist. For example, Hall and Liebman's sample ends in 1994, only one year after Section 162(m) was enacted. This is important as we find that the combined tax benefit to the firm and individual from deferred compensation depends greatly on the corporate deductibility of the income. For instance, when all income is deductible we find small gains of between three and four percent to deferral in line with the findings of Hall and Leibman (2000). However, when cash compensation is not deductible then the gain to deferral is in excess of 50 percent. This fact may explain why they find a limited impact of tax policy on compensation. We find that both individual tax rates and excess pay over one million dollars have a significant effect on the use of options. Additionally, previous studies do not attempt to control for the endogeneity of tax rates in order to provide causal estimates of the effect of taxes on form of compensation. Finally, we use firm-specific corporate tax rates that account for tax loss carryforwards, provide more variation across firms, and more accurately measure firm's marginal tax rate than simply relying on the statutory rate.

Our findings are also related to the body of research estimating the elasticity of taxable income (ETI). A large body of research has arisen to provide estimates of the elasticity of taxable income with respect to marginal tax rates since Feldstein (1999) showed that this elasticity is a sufficient statistic for the deadweight loss of taxation under certain conditions.[5] However, 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

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and find no effects of corporate taxes on the use of options. Using current statutory rates is problematic, as options are deducted in the year of exercise and firms' effective marginal tax rates are highly variable. To account for differences in firm marginal tax rates we use firm-specific rates constructed by Graham (1996a).

[5]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 (2010), Auten, Carroll, and Gee (2008), and Heim (2009) among others. For a review of this body of research, see Saez, Slemrod, and Giertz (2012).

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 shows up as a reduction in taxable income, influencing the taxable income elasticity, the fact that deferred income can be taxed in future 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, their importance rises when the dynamic consequences have implications for welfare. As Slemrod (1998) suggests, one can study the present value of revenue to get a more complete picture of the effects of taxation. In order to highlight this point, we extend Feldstein's simple model to calculate the present value of revenue in Appendix A and construct a simple dynamic model to illustrate that fluctuations in the tax rate have important welfare and revenue implications when individuals can defer income even when there is no change in individual labor supply in Appendix B. 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. Moreover, 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.

II. Empirical Methodology

A. Data Sample Focused on High-Income Executives

For our analysis, we use data on executive compensation from the COMPUSTAT database for the period 1992-2005, 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.

Our data contain almost exclusively information on high-income individuals. There are advantages and disadvantages to working with a restricted sample of high-income taxpayers. The main disadvantage is that this group of top executives is not representative of the population as a whole and may not even be representative of other high-income taxpayers. Indeed, for our particular focus it may be the case that this group of individuals is particularly unique in their ability to use stock options to defer income. However, it is still an interesting group to study 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. Moreover, the data in Carroll (1998) suggest that executives are a large fraction of high-income taxpayers.

Focusing on high income earners is also of interest because these individuals display the most responsiveness to changes in taxes and have experienced the largest changes in their tax rates over time. 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. Therefore, our paper sheds light on a particular method used by executives to shift their tax burden. Moreover, focusing on high income individuals helps to identify the effect of tax policy on behavior because 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. 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. Of course, estimates from this sample are likely to constitute an upper bound for behavioral responses 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 more than doubled during our sample period as can be seen in Table 3. In real 1991 dollars, the average total compensation increased from $887,583 in 1992 to $1,854,289 in 2005.[7] There is cross-sectional variation in compensation levels across executives because our data include not just the CEOs, but vice presidents, general counsels, and so on. Only 12.4 percent of the sample has (real) total incomes less than $250,000. Between 1992 and 1996, nearly 19 percent of the executives had incomes less than $250,000, the lower income cutoff for the top taxable income bracket for that period. In 2000, only about 8 percent of the sample fell into the second highest federal income tax bracket (of 36 percent), while nearly all of the rest were in the top tax bracket.[8] 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.[9] The next major change in federal tax rates accompanied the passage of 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-series variation in the applicable tax rates, though limited, enables us to identify the effect of tax rates form of executive compensation.[10]

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[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, income from sources not reported in the data set, and spousal income. However, this concern is less important for our study as opposed to studies that focus exclusively on the full population because most individuals in our sample are in the top bracket and other income sources are unlikely to influence their marginal rate. Moreover, our permanent income tax rate includes all income, so 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 most of them face.

[7] The value of average total compensation in 2005 dollars was $2,658,903 in 2005 and $1,272,723 in 1992.

[8] A one-way analysis-of-variance table shows that the estimated standard deviation of tax rates across firm-executives is approximately 0.025 and within executive-firm groups is about 0.039.

[9] Additionally, 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.

[10] In addition to the federal personal tax rate, in specifications not shown here, we also include the payroll tax rate or the state tax rate (based on the firm's location) when calculating the executive's marginal tax rate. Because we know the location of the firm, we have also run specifications with this noisy measure of the executive's state tax rate and found the results to be similar.

B. **Deferred Income**

The income concept we use for our dependent variable is deferred income, defined as the sum of the non-taxed components of an executive's compensation. Instead of focusing our analysis on the taxable component of income, 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. In contrast, Goolsbee (2000a) focuses on all taxable compensation defined as the sum of salary, bonus, options exercised, and long-term incentive payments (LTIPs).[11]

To defer income, executives are increasingly compensated through the use of stock options and restricted stock grants. While we discuss the specific tax rules for each of these types of deferred income separately below, the level of personal, corporate and capital gains tax rates all influence the incentive to defer income. To make the intuition clear, we follow the framework in Hall and Liebman (2000) to measure the total tax benefit to the firm and executive from the use of options over current cash compensation. While this analysis highlights the forces that generate a tax benefit, the static environment assumes that there are no changes in tax rates over time. Therefore, there is no option value of holding on to a stock of deferred income in this framework, although the dynamic model in appendix B shows that tax changes can generate substantial tax savings when individuals have the ability to defer income.

As shown by Hall and Liebman (2000), the tax advantage of options is derived from avoiding capital gains taxes. To see this consider a firm which is going to make a pre-tax payment of P to an executive (consider this a marginal payment of P dollars). Assume that the executive saves all income in the form of equity that earns the same rate of return as the internal firm return. The firm would receive the same present value of tax deduction by paying the executive cash today or reinvesting the money in the firm and paying the total value later as an option. Similarly, the executive would receive the same total earnings except that capital gains earned on a cash payment today would be taxed at the capital gains rate, while gains in case of

[11] LTIPs are usually a mixture of cash and shares of the company which are almost always subject to vesting restrictions. 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, they are included in current year taxable income. There is also an "other annual income" category that is small. This income includes contributions to 401Ks, life insurance premiums, tax reimbursements, etc. Beginning in 2006, after our sample period, the income components in this category are further classified into different types of deferred compensation variables. Finally, in some cases, bonus payments may be reported for the current year by the firm, but actual payments and taxes occur only in the next year.

the stock option would be untaxed. Hence, the total tax advantage to the individual (and firm) from the use of options over cash compensation is given by:

$$P\,T_{cg}\left(1-T_p\right)\left[\left(1+r(1-T_c)\right)^N-1\right]. \quad (1)$$

In the above equation, T_{cg} is the capital gains tax rate, T_p is the personal tax rate, r is the firm's pre-tax profit rate, T_c is the corporate tax rate, and N is the time horizon of the deferred income. The gain is simply the amount of capital gains tax that is avoided by using the option if the full cash payment is invested in equity over the N year horizon. The equation would be complicated if the firm and individual earned different rates of return on their investment. However, given this gain, the basic theory justifies our specific empirical model of the use of deferred income to depend on each of these three tax rates in addition to variables that account for the firm level of returns. In a dynamic setting, expected future values of each of these variables in addition to interest rates are also important.

The formula shows that in a static sense, the tax advantage of avoiding the capital gains tax rate is increasing in the capital gains tax rate and decreasing in the personal and corporate rates. Using the above net payoff calculation, let the corporate and personal tax rates be given by $T_c = T_p = 0.35$ and the capital gains tax rate be given as $T_{cg} = 0.15$. Then, if we assume that the pre-tax corporate profit rate $r = 0.05$ and follow Hall and Liebman (2000) in considering a ten-year horizon, we find that the net payoff to the executive and the firm of options relative to cash is \$3.67 per \$100 of compensation. In other words, deferral has a modest tax benefit over tax compensation.

However, this modest gain changes dramatically when cash compensation is no longer deductible at the margin, as is the case for many executives after 1993 who earn more than the million dollar cap on corporate deductibility. In this case, we can re-derive the net gain formula by allowing option payments to be fully deductible but removing the corporate deductibility from cash payments. With this assumption, the net gain formula becomes:

$$P\left(1+r(1-T_c)\right)^N\left(1-T_p+T_c\right)-P\left(1+r(1-T_c)\right)^N(1-T_P)+ \quad (2)$$
$$P\,T_{cg}(1-T_p)\left[\left(1+r(1-T_c)\right)^N-1\right].$$

Here, the first term is the total after tax benefit to an individual for being paid an additional P dollars in options after N years (assuming a pre-tax corporate profit rate r) and the second two terms subtract the benefit from cash compensation when the initial cash payment is not

deductible (again assuming that all income is invested for N years with return r). The two terns for the benefit of cash compensation are the after tax payment and the capital gains taxes owed on the subsequent returns from investing the initial income. Notice that the first component of the cash compensation would cancel with the benefit from options term recovering Equation (1) except now the corporate taxes are no longer deductible. In this case the static gain to the use of deferral becomes \$51.86 per \$100 of compensation. With the million dollar rule, the gain to deferral now generates a considerable tax advantage of option compensation relative to cash that could help account for large changes in the form of compensation that are observed. Of course, since bonus pay is exempt from the million dollar limit, deferral does not necessarily generate such a large gain. However, Frydman and Jenter (2010) note that bonus pay is typically non-discretionary and tied to some of the firm's annual accounting performance measures. Moreover, options may be preferred to bonus pay on the grounds that they make executive compensation more closely aligned with the firm's stock market performance.[12]

We now consider the specific tax rules that apply to each form of compensation. 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. There are two main types of options used for compensation, nonqualified stock options (NQSOs) and incentive stock options (ISOs). The tax treatment of these two types of options differs. For the executive, the profit from exercising NQSOs is taxed at the personal income level when the NQSOs are 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 one million dollars. 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. However, there is a tax advantage 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

[12] While our tax example only applies to comparisons of salary and options, it is illustrative that the tax gain to options could be much larger than previous calculations suggest if other forms of exempt pay are less attractive than options. Even though we find new evidence that taxes influence the form of compensation, other incentives such as managerial incentives and corporate governance are still important. See Frydman and Jenter (2010) for a nice survey of the literature on CEO compensation.

gained from exercising the options.[13] For the firm, there is no clear tax advantage to issuing ISOs because the firm does not get to take a deduction against corporate profits. Hall and Liebman (2000) find that ISOs account for less than five percent of total option awards. We are unable to separately identify the use of these two types of options in our data.

In addition to granting options, a company can also directly issue shares to an executive as restricted stock— restricted by a vesting period. Unlike options, restricted stock gives executives voting and dividend rights. The executive has the choice to be taxed at the personal tax rate on the value of the restricted stock as the shares vest or when the shares are granted. If taxed at the time of grant date, then all subsequent appreciation is taxed at the capital gains rate. The company receives a deduction equal to the amount of the executive's income when the executive is taxed. Unlike options, stock grants are typically subject to the million dollar rule because they are not considered to be performance-related pay. With these differences in tax treatment, restricted options are used less than stock options during our sample period and potentially have different responsiveness to changes in taxes.

C. Permanent Income Tax Rate

We provide results in the next section with the share of deferred income as the dependent variable and the respective applicable federal 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 not exogenous. The higher the taxable income, the higher is the tax bracket into which that income falls. However since income deferral lowers taxable income in the current period, the tax rate is endogenous in each of our specifications. 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 (2000a) and use the "permanent income" tax rate as an instrument. We define "permanent income" as the executive's average total income over all the years in our sample.

[13] 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.

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 deferral. 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 can still identify the effect.

D. Model and Estimation

When considering the optimal use of deferred income, theory predicts that the total tax benefit between the executive and corporation should be considered. Therefore, individual, corporate, and capital gains taxes are all included in our analysis. We estimate how the share of deferred income responds to changes in the log of the tax price using a two stage least squares approach with executive-firm fixed effects. This approach is similar to that of Goolsbee (2000a) 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 is this rate, the higher will be the incentive to defer taxation. We use robust standard errors that are clustered both by year and firm-executive pair. Our baseline specification for deferral is:

$$ydefincshare_{ijt} = e_1 \log(1-\tau_{ijt}) + e_2 \log(1-\alpha_{ijt}) +$$
$$e_3(Net\ Income\ Share\ over\ \$1\ Million) + e_4 Return_t + e_5 Return_{t+1} + e_6 Return_{t-1} +$$
$$e_7 \log(1-\eta_{ijt}) + e_8 \log(1-\eta_{ijt}) * Return_{t+1} + e_9 tenyearate + e_{10} \log(Mkt.Value) +$$
$$e_{11} \log(Assets) + time + d_{ij} + \varepsilon_{ijt},$$

where $ydefincshare_{it}$ refers to deferred income as a share of total compensation (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*. Given this specification, the coefficient, e_1, is identified as the coefficient on the net-of-tax price, $(1-\tau_{ijt})$. We also consider specifications where the dependent variable is given as different components of deferred income (the value of stock options granted and the value of restricted stock grants) as a

share of total income. To control for the growth in total compensation over the period, we consider deferred income as a share of total income rather than in levels.

Our main instrument for the tax rate is the 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 the sample.[14] In addition, for robustness, we report results using as an instrument the federal marginal tax rate that is applicable to total income in each year.

In addition, both corporate and capital gains tax rates are likely to influence the level of deferred compensation. Accordingly, α_{ijt} refers to a firm specific corporate tax rate computed by Graham (1996a) and η_{ijt} refers to the capital gains tax rate faced by the executive. In the baseline specification we treat individual and corporate tax rates symmetrically by only including the current period. In other results, we consider leads of these variables since the use of deferred income means that taxes paid by the executive and the tax deduction received by the firm will occur in the future. The final tax variable used in the analysis is the share of $Net\ Income\ over\ \$1\ Million$ in total compensation. This variable takes the value of 0 if total income is less than one million dollars or if the year is 1992, and otherwise is the share of the executive's total income that exceeds one million dollars. This factor is important after 1993, as the corporate tax deductibility of income is capped at one million dollars, but options are exempt from the cap because they are considered to be incentive compensation.[15]

Beyond tax rates we control for other factors that could affect the value of deferred income. We include variables for lagged, current, and future stock returns ($Return$) to control for the fact that if stock returns are expected to be low it would favor cash compensation over the option. Alternately, executives are more likely to choose compensation in the form of options if stock returns have been high or are expected to go up in the future. Moreover, interest rates ($tenyearate$) may influence the choice of deferred compensation since they affect the net

[14] However, we also experiment 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 test robustness by including only executives who were present in the sample for all years between 1992 and 2005.

[15] Our regressions allow for a more general effect of taxes on form of pay. Potentially we could use differences in current personal and corporate tax rates and differences in future personal and corporate tax rates to affect deferred compensation, but if these differences are important, the effects should show up in our specification as well.

present value of compensation to be realized in the future. We also 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 include a time trend and a company/executive fixed effect.[16]

In results presented later, we extend the baseline specification to study responses over future tax rates. This extension is potentially important because the choice of deferral incorporates expectations about what is likely to happen to future 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.

III. Empirical Analysis

A. Description of Variables

Table 1 provides a description of each of our variables. The major difference between total compensation and taxable compensation is that total compensation includes options (Black-Scholes value) and restricted stock grants awarded in a given year, while taxable compensation includes the value of options that are exercised. Deferred income is simply the value of options awarded and restricted stock grants. We define the dependent variable in different specifications as either deferred income as a share of total compensation or the two components separately as a share of total compensation.

Table 2 shows the average value of all the income variables and the tax rate variables. Over our sample period, total compensation averaged $2,030,450 (or $1,621,779 in 1991 dollars). Taxable compensation averaged $1,293,578 (or $1,161,464 in 1991 dollars). Options awarded were by far the largest component of total compensation, averaging $607,725 across all years, with salaries at $282,679, bonuses at $259,873, and restricted stock grants at $142,363 (all values in real 1991 dollars).

[16] 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. Hence including time dummies absorbs much of the variation in the tax rate, and leads to problems with estimation.

The marginal income tax rate averaged 37 percent over the period, while the permanent income tax rate was somewhat higher at 37.8 percent. On average, most executives in our sample fall within the top two income brackets.[17] We include only observations for which the executives are observed in the database for more than one year.

Table 3 shows the average income, in real 1991 dollars, across years. Similar to the pattern in Goolsbee (2000a) and Feldstein and Feenberg (2006), taxable incomes declined between 1992 and 1993. Average real (nominal) taxable incomes declined from $808,179 ($928,619) in 1992 to $685,707 ($793,394) in 1993—a decline of nearly $122,472, or 15 percent. Anecdotally, this drop can most likely be attributed to anticipation of an increase in tax rates in 1993. While taxable incomes declined over this period, in real terms, total compensation rose from $887,583 ($914,302 in nominal dollars) in 1992 to $951,117 ($1,009,077 in nominal dollars) in 1993, an increase of more than 10 percent. Over the sample there was a large increase in the use of deferred compensation. 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 bonuses, 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. The share of cash compensation rose from 52 percent to 57 percent between 2000 and 2003, while the share of equity compensation (primarily options) declined from 43 percent to 37 percent. Restricted stock grants showed some increase over this period. This increase 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. 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

[17] There are some outliers that we exclude from the sample. For example, Steve Jobs, Larry Page, and Sergey Brin show up in the data with $1 in total income.

[18] For a discussion of executive compensation patterns prior to our period, see Frydman and Saks (2007).

more equity-based compensation that can be deferred, while lower tax rates show a shift toward more cash compensation.

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).

B. Estimation Results

Our baseline result of interest is a regression of the share of deferred income on the log of the net-of-tax share, or the tax price presented in Table 4. Standard errors are clustered at the individual/company level as well as by year. Potentially, the current tax rate could be subject to endogeneity bias in this regression. 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.[19] 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. Using the share of total deferred income, the sum of option awards and stock grants, as the dependent variable in column (1), the coefficient on the (log) tax price is -0.072 and is not statistically significant. The coefficient is not significantly different than zero because as we will see, stock options and stock grants respond in significant but opposite ways to tax changes.

As discussed earlier, corporate tax rates may influence the decision of how much compensation is provided as option awards, since firms are able to deduct these payments from their tax liability as well at the time the options are exercised. To study this effect, we included the firm-specific marginal corporate tax rates as constructed by Graham (1996a). These are simulated tax rates which allow for variation in the marginal corporate tax rates across firms due to the presence of tax loss carryforwards. In a follow-up paper, Graham (1996b) shows that these simulated tax rates are a good proxy for the true marginal tax rates faced by firms. In this specification the current corporate tax rate is also not significant. While Hall and Liebman's (2000) static analysis shows that holding other tax rates constant, lower corporate tax rates increase the relative gain to options over cash compensation, the theory is less clear in a dynamic

[19] The raw data do show some negative correlation between current marginal tax rates and deferred incomes.

setting once we separately control for deductibility with the million dollar rule as discussed in Appendix A.

We include a variable *Net Income Share* defined as total compensation over one million dollars as a share of total compensation. The variable takes the value of zero if total compensation is below one million and is the difference between total compensation and one million if above. This variable is only defined for 1993 and later years, and in the regression specification is defined as a share of total compensation. In 1993, section 162(m) of the Internal Revenue Code was enacted, limiting the deductibility of executive compensation in excess of one million dollars, unless the compensation was performance-related. Because this cap does not apply to performance-based payments, options, LTIPS, and bonuses are effectively excluded. In effect, this rule may cause firms to provide all compensation above this limit as incentive pay, which could include either bonus or options. Our results suggest that this effect is present in our sample since the coefficient on the *Net Income Share* variable is positive and statistically significantly different from zero at the one percent level. We find that nearly half of the pay in excess of one million dollars is paid in options. These results suggest that the corporate tax deductibility of performance based pay does provide firms an incentive to use these types of deferred compensation.[20]

When deciding whether to defer income, executives may also care about changes in capital gains tax rates. We include the capital gains tax price as an additional variable, and also interact the future returns variable with the capital gains tax price, since future returns are likely to be taxed at capital gains tax rates. However, we do not find any significant effect of these rates on deferral.

In addition, executives' decision of how much income to defer may depend upon their expectations of future stock returns, as well as the realizations of past stock returns. To estimate

[20] Hall and Liebman (2000) use a similar specification in trying to explain the rise of option awards in executive compensation over the period 1980-1994. The tax variable in their analysis 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 is computed from the divergence in statutory personal, corporate, and income tax rates. They find a significant effect of the payoff difference between options and cash compensation on the share of compensation paid in stock options. However, in an alternative specification, Hall and Liebman (2000) include the statutory, corporate, personal, and capital gains tax rates as separate variables. In this case, only the corporate tax rate is significant. Moreover, the corporate rate becomes insignificant when accounting for tax-loss carryforwards. These results could differ from ours in that we look at a more recent time period and use forward-looking firm specific corporate tax rates from Graham (1996a). It is possible that their results arise 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 personal tax rates in their specification even though the authors acknowledge the possibility of endogeneity bias.

returns, we obtained data on company common stock returns from the Center for Research in Security Prices (CRSP) for each month of each year in our sample, and then defined the annual return as the cumulative return over the twelve month period. These data were not available for all firms and for all years in our sample, though we were able to merge approximately 70 percent of our sample companies to the stock return data. As in Goolsbee (2000b), we included current returns, past-year returns and one-year-ahead returns data. In making decisions about whether to take more compensation as options or stocks, executives are likely to be guided by these data on stock returns and their expectation of the future rates of return. However, we find that neither past, future or current returns are significant in explaining the share of deferred income.

Another variable we include is the interest rate on the 10-year Treasury bond as a proxy for an executive's discount rate. Interest rates fluctuated a lot over our period, and these could influence an executive's decision of whether to take compensation now or in the future. The coefficient on the interest rate is positive but not statistically significant.

We also include controls to test for robustness of these coefficients. Log(*Mkt. Value*) is calculated as the number of outstanding shares multiplied by the share price at the end of the fiscal year. This variable controls for changes in firm values or company performance and other market shocks that affect the firm, that are not captured by the firm/executive fixed effect and time trends. We also control for the asset base of the firm. These controls are standard in studies of executive compensation.[21]

Because the tax treatment of stock options and restricted stock grants differ, we split the two components of deferred income to study tax responsiveness separately in columns (2) and (3). As expected, increases in taxes lead to a larger share of options in total compensation. The regression of option shares on the tax price yields an estimated coefficient of -0.403. In contrast, personal taxes are associated with less use of restricted stock grants as the coefficient is positive and significant at 0.331. This effect may arise because restricted stocks are either taxed when issued or as soon as they become vested and liquid. In other words, there is less flexibility associated with restricted stock because the executive cannot choose to fully optimize the timing of taxation. Further, restricted stocks are also not considered to be incentive pay so they may not qualify for a corporate deduction if the executive is subject to the million dollar rule. This may explain why very few firms in our sample offer restricted stock compensation. These offsetting

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

effects of the use of options and restricted stock grants explain the insignificant finding on total deferred income.

In each of these three specifications corporate taxes enter the equation symmetrically to personal income taxes, but are not found to have significant effects on the choice of compensation. The capital gains tax price is also not statistically significant.

A potential concern is that using a fixed permanent income when calculating the tax rate in each period when total compensation in each year was increasing rapidly could generate a downward bias in the estimated change in the tax rates faced by the executives. This could then bias the results. In order to provide some evidence that this issue is not important, we estimate the same specifications but using the federal marginal tax rate applicable to total income in each year as an instrument. Results, presented in the last three columns of Table 4, are similar to the baseline with a larger increase in the use of options for any increase in personal income taxes. The coefficient on the personal tax price for the share of options is -0.705 and significant at the five percent level. Column (6) repeats this specification but uses the share of stock grants in total income as the dependent variable. In this case, the coefficient on the personal tax price is 0.273.[22]

In results not shown here, we define the instrument as the top federal 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, we obtain identification mainly through time-series variation in the top tax rate. The estimated coefficient in the option share regression with this specification is -0.385 while for the stock share regression is 0.302. Further, while the firm-specific corporate tax rate should be exogenous to the compensation for any individual executive, in order to rule out the possibility of any bias, we instrumented for the firm specific corporate tax rate with the headline marginal corporate tax rate. The estimated coefficient in this variable was statistically insignificant across different specifications.

In Table 5, we study whether there are long-term responses to changes in tax rates. For instance, Goolsbee (2000) finds that the taxable income response to current tax rates is close to 1, but accounting for the response in the next period, the overall elasticity is significantly lower, at

[22] In estimates not shown, we also define the current tax price using the sum of the federal and payroll tax rate on permanent income as the instrument. Because the payroll tax only applies to incomes of less than $100,000 over our entire sample period, the marginal impact of this tax is negligible in our sample. Another alternative is to use the combination of the federal and state tax rates (using the location of the firm) applicable on permanent income as the instrument for the combined tax rate. Results with these specifications were similar to those reported in Table 4.

0.4. As the 1993 tax cuts were anticipated by executives, their response to the cuts would have been conditioned by the fact that tax rates in 1993 were going to be significantly higher than in 1992. We introduce current and future personal tax price variables in our specification as separate variables. The long-term or non-transitory effect is the sum of the coefficients on all tax rate variables. The purpose behind this specification is to examine whether the effects of taxes on deferred incomes are reversed in future periods or persist. This is reasonable because for the two major tax changes in our model, the 1993 tax increases and the 2001 and 2003 tax decreases, taxpayers had some idea of what was likely to happen to tax rates going forward. For example, our 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. We find a substantial increase in the share of options for an increase in the tax rate at one lead and continue to find no significant effects of the corporate tax rate on the form of compensation once we control for the share of compensation in excess of one million dollars. It is interesting that in this specification interest rates enter positively for the option share and deferred income share regressions, suggesting that higher interest rates are associated with a greater share of options in total compensation. This finding is in line with Schrenk (2008), who suggests that an increase in the risk-free interest rate causes a shift toward equity compensation.

To summarize, we find a large response in the share of options in total income associated with changes in the personal tax rate and little impact of corporate tax rates on the nature of the compensation package. While Hall and Liebman (2000) conclude that tax policy plays little role in executive compensation, our results suggest the opposite. One possibility is that over the period studied by Hall and Liebman, 1980-1994, options were not a significant component of overall compensation. Further, Section 162(m) which has caused a shift in compensation toward options and away from salaries and bonuses would have been enacted toward the end of their sample period, so may not have shown much impact in their data.

From a policy perspective, we would like to understand the implication of these results for government revenue. A simple way to do this is to use the revenue implied by the tax treatment of deferred income from Hall and Liebman (2000). We again assume that returns are

computed over a N year horizon and that the government, individual, and corporate rates of return are identical. Let s_d be the share of income that the executive chooses to defer. Then total tax revenue for the government for non-deferred income over the N year horizon is the immediate tax revenues from a payment P that gains the government the personal income tax rate but are expensed at the corporate rate (then increased by the government rate of return that is assumed to be identical to the corporate rate of return over the horizon) plus the additional revenues from capital gains earned by the individual who invests the income. For deferred income the government gets the personal tax rate minus the corporate tax deduction in the year that the income is earned (assumed to be in year N). With these assumptions government revenue from a pre-tax payment P to the executive can be written as:

$$P\,(1-s_d)\left[(T_p-T_c)[1+r(1-T_c)]^N+T_{cg}\,(1-T_p)\,\left[\left(1+r(1-T_c)\right)^N-1\right]\right]+ \qquad (3)$$
$$Ps_d(T_p-T_c)[1+r(1-T_c)]^N.$$

The first term is revenue from the initial cash compensation. The second term is the tax revenue from the deferred portion of the income. Noticing that the taxes from the immediate and deferred compensation are identical, the revenue equation can be simplified to:

$$P\,(1-s_d)\left[T_{cg}\,(1-T_p)\,\left[\left(1+r(1-T_c)\right)^N-1\right]\right]+P(T_p-T_c)[1+r(1-T_c)]^N. \qquad (4)$$

One way to understand the magnitude of our results on deferred income is to consider a change in the personal tax rate and compute the percentage difference in revenues if executives react by changing their share of deferred income or not. To do so, we consider the following initial values that roughly correspond to tax rates at the end of our sample in 2005. Let $T_c = T_p = 0.35$, $T_{cg} = 0.15$, and $s_d = 0.285$ to correspond with values in 2005. The share of deferred income here only includes the share of options in total compensation. Also, we assume that the pre-tax corporate profit rate $r = 0.05$ and will follow Hall and Liebman (2000) in considering a ten-year horizon. Given these assumptions the government would receive about \$2.63 per \$100 of pre-tax payment if the payment is fully deductible for the firm.

We now consider an increase in the personal tax rate from 0.35 to 0.40. Without accounting for the change in the share of deferred income, \$100 of pre-tax compensation would then generate \$9.31. However, when we account for our estimates of how taxes influence the share of options in compensation (using the coefficient of -0.403 from Table 4) the share of options would increase by 0.031 to 0.315. With both changes the revenue would be \$9.21.

Therefore, the actual change in revenue from the tax change would be 1.6 percent lower than it would be if the change in the share of options in compensation was not considered. Or the government would get 1.6 percent less revenue from a change in taxes due to shifts in the form of compensation.

This static calculation results in small revenue losses as it only reflects the benefit to the executive of avoiding capital gains taxes on deferred income. However, revenue losses can be much greater if the cash compensation is not deductible by the firm (as may be the relevant case for executives given the million dollar rule if firms prefer to use options instead of bonus pay). In this case, the first revenue term in equation (3) is modified by not subtracting the corporate tax rates. Therefore, in the baseline the government would earn $37.13 in revenue on $100 of compensation and an increase in the personal tax rate to 0.40 would be expected to generate $43.81 with no change in deferral behavior. With the estimated change in deferral the government would only receive $42.21. In other words it would lose 23.9 percent of the expected increase in revenue from the tax change. These much larger benefits to deferral when cash compensation is not deductible could explain much of the use of deferral in our sample and reconcile our results with earlier studies that did not find effects of tax policy on the form of executive compensation.

It should be emphasized that the static estimates in both cases presented above are likely to understate the effect on revenues as they do not account for potential changes in tax rates over time that can generate an additional option value from deferral.

IV. Conclusion

This paper uses data on high-income executives to estimate 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. Given the increasing importance of stock options in executive compensation it is of interest to understand how taxation influences deferral. Our results suggest that deferral is responsive to the personal tax rate. The persistence of these effects suggests that our results document a change in the nature of compensation rather than a simple timing shift.

Appendix A: Deferred Income and the Elasticity of Taxable Income

The option to defer income implies that tax policy changes have dynamic welfare consequences. Here we extend Feldstein's (1999) analysis to make a clear comparison with how income deferral can influence the elasticity of taxable income. We can write taxable income, Z_t, as static period income, Y_t, less net deferrals, N_t:

$$Z_t = Y_t - N_t \ . \tag{A1}$$

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

$$Y_t = w(1 - L_t) - E_t - D_t \ . \tag{A2}$$

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.

To proceed, we consider how changes in taxes influence the present value of tax revenue when an individual can use deferral to shift their income. Assuming that the return on deferred income is exactly offset by discounting future revenue, total tax revenue from income earned in period t is given by:

$$Y_t T_{pt} - N_t\big(T_{pt} - T_{ct}\big) + N_t \mathbb{E}[T_{pf} - T_{cf}] \ . \tag{A3}$$

In this equation, T_{pt} and T_{ct} are current period corporate and personal tax rates respectively. T_{pf} and T_{cf} are future personal and corporate rates at the date that deferred income becomes taxable. The final term takes expectations over these future rates. With this formulation we are also assuming that changes in period income do not influence corporate income. One justification for this is that the firm should break even by changes in labor input at the margin. However, increased pay does influence personal taxes paid to the government.

Taking the derivative of revenue with respect to the current personal tax rate gives:

$$Y_t - N_t + T_{pt}\frac{dY_t}{dT_{pt}} - \big[\big(T_{pt} - \mathbb{E}\big[T_{pf}\big]\big) - \big(T_{ct} - \mathbb{E}\big[T_{cf}\big]\big)\big]\frac{dN_t}{dT_{pt}} \ . \tag{A4}$$

Because the direct effect of a change in the personal income tax rate is $Y_t - N_t$, the excess burden is given by:

$$-T_{pt}\frac{dY_t}{dT_{pt}} + \big[\big(T_{pt} - \mathbb{E}\big[T_{pf}\big]\big) - \big(T_{ct} - \mathbb{E}\big[T_{cf}\big]\big)\big]\frac{dN_t}{dT_{pt}} \ . \tag{A5}$$

A number of conclusions can be drawn from this expression. First, deferring income from years with high tax rates to years with low tax rates generates an efficiency cost. This cost is clear from the second term that differences current and expected future personal tax rates. Second, the deductibility of income on the corporate side also influences the excess burden as shifting income from a year when the income is not deductible to a year when it is would also generate an efficiency loss. Finally, the formula for excess burden can help to reconcile why our results show significant effects of personal taxes on the share of options in compensation while corporate taxes do not have any significant effect despite showing up symmetrically in the net tax gain formulas in the paper. In particular, corporate taxes will not show into the excess burden calculations if controlling for the share of income above one million dollars in our empirical specifications picks up the efficiency cost generated by shifting income from a year when it is not deductible to a year when it is deductible and we assume that $T_{ct} = \mathbb{E}\left[T_{cf}\right]$ in other cases.[23]

[23] We thank Roger Gordon for pointing out this explanation for our findings.

Appendix B: A Simple Dynamic Model of Tax Deferral

1. The Model

To motivate our empirical analysis, we present here 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 defer 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:

$$\sum_{t=0}^{\infty} \beta^t \, \mathrm{u}(c_t) \, . \tag{B1}$$

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 defer. Her realized income is denoted by 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:

$$d_{t+1} = (1 + r) \, d_t + y - \, z_t \, , \tag{B2}$$

$$c_t = (1 - \tau_t) \, z_t \, , \tag{B3}$$

and

$$d_t \geq 0 \, . \tag{B4}$$

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

$$c_t = (1 - \tau_t) \, [y - (d_{t+1} - (1 + r) d_t)] \, . \tag{B5}$$

In this framework, z_t is taxable income, y is total income, and $d_{t+1} - (1 + r) d_t$ is net deferred income.[24] 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 defer.

[24] 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 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:

$$V(d,\tau) = \max_{d' \in [0, Rd+y]} u((1-\tau)\big((1+r)d + y - d'\big)) + \beta E_{\tau'|\tau} V(d',\tau') . \quad \text{(B6)}$$

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 familiar Euler equation:

$$u'(c_t) = u'(c_{t+1}) . \quad \text{(B7)}$$

Equation (B7) 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, 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

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.[25] Finally, we assume that the

[25] 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) estimate 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.

process for taxes follows a three-state Markov process, selected to match an AR(1) process, parameters of which are estimated from the top marginal income tax rate in the United States between 1992 and 2007. While we include only individual tax rates for simplicity, including variation in both individual and corporate rates could generate additional option value given greater variation in tax policy over time. 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 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

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 B1 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. This

asymmetry can be seen in the right panel of Figure B1 as the policy functions for high and low taxes are not symmetric around the middle tax rate. 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 B1 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, with $\gamma = 0.5$, the stochastic tax policy produces a small welfare loss of 0.06 percent of lifetime consumption. The welfare estimates reported for other values of γ correspond to values of the elasticity of intertemporal substitution between 0.5 and 5.

Table B1 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. 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.

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Table 1: Income and Tax Variables 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	Options Awarded (Black-Scholes value)+Restricted Stock/COMPUSTAT
yperm	Permanent Income	Average of total income over 1992-2005/COMPUSTAT
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
π	Federal Marginal Tax Rate on Total Annual Income	Federal Tax Schedule/NBER TAXSIM
θ	Combination of Federal and Payroll Marginal Tax Rates on Permanent Income	State Tax Schedule/NBER TAXSIM
n	Capital Gains Tax Rate	Tax Policy Center
α	Firm Specific Corporate Tax Rate	Graham (1996a)

Table 2: Summary Statistics, 1992-2005

Variable	Mean	Std. Dev.
ytax	1,161,464	3,800,080
ytotal	1,621,779	3,858,246
τ	0.370	0.032
ρ	0.378	0.026
π	0.377	0.028
θ	0.378	0.026
α	0.315	0.088
n	0.215	0.048
Log(Mkt.Value)	21.141	1.645
Log(Assets)	21.401	1.869
Salary	282,679	195,232
Bonus	259,873	684,607
LTIP	73,952	502,939
ystock	142,363	732,402
yopt (Black-Scholes Value)	607,725	2,874,543
Options Exercised	522,837	3,444,014

Note: All dollar values are in real 1991 dollars.

Table 3: Mean Real Incomes (in 1991 Dollars) and Income Shares by Year

Year	Total Income	Taxable Income	Deferred Income (Share in Total)	Salary (Share in Total)	Bonus (Share in Total)	LTIP (Share in Total)	Options Awarded (Black-Scholes Value) (Share in Total)	Restricted Stock Grants (Share in Total)
1992	887,583	808,179	0.21	0.52	0.18	0.03	0.18	0.04
1993	951,117	685,707	0.24	0.48	0.19	0.03	0.20	0.04
1994	1,050,606	689,610	0.26	0.46	0.20	0.03	0.22	0.04
1995	1,090,162	770,347	0.25	0.45	0.20	0.04	0.21	0.04
1996	1,323,478	933,882	0.30	0.41	0.19	0.04	0.26	0.04
1997	1,606,930	1,118,024	0.34	0.38	0.19	0.04	0.29	0.04
1998	1,648,629	1,212,686	0.36	0.38	0.18	0.03	0.31	0.05
1999	2,127,383	1,339,372	0.39	0.35	0.18	0.03	0.35	0.04
2000	2,437,360	1,752,840	0.40	0.35	0.17	0.03	0.35	0.05
2001	2,205,115	1,182,268	0.42	0.35	0.15	0.02	0.37	0.05
2002	1,735,979	997,317	0.38	0.36	0.18	0.02	0.32	0.06
2003	1,589,098	1,164,537	0.35	0.37	0.20	0.03	0.26	0.08
2004	1,762,408	1,538,578	0.36	0.33	0.22	0.03	0.25	0.11
2005	1,854,289	1,989,046	0.35	0.33	0.22	0.04	0.22	0.13

Source: Authors' calculations using COMPUSTAT data, 1992-2005.

Table 4: The Response of Deferred Income to Changes in Tax Rates

	(1) $defincshare_t$	(2) $optshare_t$	(3) $stockshare_t$	(4) $defincshare_t$	(5) $optshare_t$	(6) $stockshare_t$
Log($1-\tau_t$)	-0.072	-0.403*	0.331**	-0.431	-0.705*	0.273**
	(0.123)	(0.202)	(0.083)	(0.275)	(0.319)	(0.059)
Log($1-\alpha_t$)	0.019	0.029	-0.009	0.025	0.033+	-0.008
	(0.023)	(0.020)	(0.011)	(0.023)	(0.020)	(0.011)
Net Income Share	0.571**	0.466**	0.104**	0.561**	0.458**	0.103**
	(0.061)	(0.052)	(0.018)	(0.061)	(0.053)	(0.018)
Ret_t	0.021	0.018	0.003	0.019	0.017	0.002
	(0.021)	(0.027)	(0.010)	(0.021)	(0.026)	(0.011)
Ret_{t+1}	0.134	0.159	-0.026	0.074	0.109	-0.035
	(0.100)	(0.120)	(0.042)	(0.101)	(0.120)	(0.042)
Ret_{t-1}	0.027	0.023	0.004	0.036	0.031	0.005
	(0.030)	(0.032)	(0.007)	(0.033)	(0.033)	(0.008)
$Log(1-n_t)$	0.138	0.217	-0.079	0.263	0.322	-0.059
	(0.138)	(0.191)	(0.064)	(0.174)	(0.213)	(0.064)
$Log(1-n_t)*Ret_{t+1}$	0.588	0.658	-0.070	0.358	0.465	-0.107
	(0.386)	(0.425)	(0.141)	(0.390)	(0.432)	(0.140)
$Interest\ Rate_t$	0.009	0.010	-0.001	0.007	0.008	-0.001
	(0.009)	(0.013)	(0.005)	(0.013)	(0.017)	(0.004)
Log($Mkt.Value_t$)	-0.025**	-0.027**	0.002	-0.026**	-0.028**	0.002
	(0.005)	(0.006)	(0.002)	(0.005)	(0.005)	(0.002)
Log($Assets_t$)	0.027*	0.031**	-0.004	0.025*	0.029**	-0.004
	(0.010)	(0.010)	(0.004)	(0.011)	(0.010)	(0.004)
Time	-0.011**	-0.015**	0.003+	-0.013**	-0.016**	0.003+
	(0.004)	(0.005)	(0.002)	(0.004)	(0.005)	(0.002)
Observations	35,819	35,819	35,819	35,819	35,819	35,819
Executive/company combinations	7,915	7,915	7,915	7,915	7,915	7,915
Robust Standard Errors in parentheses ** significant at 1% level; * significant at 5% level;+ significant at 10% level						

Notes:

1. $defincshare_t$ is the share of option awards and stock grants in total income. $optshare_t$ and $stockshare_t$ are the share of options and stocks, respectively, in total income.
2. The tax rate, τ_t, is the federal marginal tax rate applicable to taxable income. The first three columns use the permanent income tax rate as an instrument for the federal marginal tax rate. The permanent income tax rate is the tax rate applied to the long-term average total income for the entire period 1992-2005. The last three columns use the tax rate applicable to annual total income as an instrument for the federal marginal tax rate.
3. α_t is the firm specific corporate tax rate and n_t is the capital gains tax rate. Net income share is the executive's total income above one million dollars as a share of total compensation. This variable is defined for every year after 1992 since the million dollar rule became applicable only in 1993. *Ret* is the company's stock return on its common stock.
4. We present fixed-effects estimates with standard errors clustered by individual/company and year. These results are from a 2SLS estimation that instruments for the marginal tax rate on current income. All specifications include a constant term.

Table 5: The Response of Deferred Income to Anticipated Tax Changes

	(1) $defincshare_t$	(2) $optshare_t$	(3) $stockshare_t$
Log($1-\tau_t$)	0.316**	0.097	0.219**
	(0.098)	(0.147)	(0.060)
Log($1-\tau_{t+1}$)	-0.553**	-0.633**	0.079*
	(0.126)	(0.149)	(0.040)
Log($1-\tau_{t+2}$)	-0.000	0.089	-0.090+
	(0.121)	(0.153)	(0.049)
Log(1-α_t)	0.043	0.047	-0.004
	(0.030)	(0.030)	(0.009)
Log(1-α_{t+1})	0.039	0.044	-0.005
	(0.031)	(0.031)	(0.013)
Net Income Share	0.565**	0.479**	0.086**
	(0.071)	(0.058)	(0.017)
Ret_t	-0.019	-0.028	0.010
	(0.018)	(0.020)	(0.011)
Ret_{t+1}	0.123	0.083	0.041
	(0.139)	(0.140)	(0.051)
Ret_{t-1}	0.006	-0.003	0.009
	(0.026)	(0.026)	(0.007)
$Log(1-n_t)$	-0.101	-0.078	-0.023
	(0.095)	(0.127)	(0.039)
$Log(1-n_t)*Ret_{t+1}$	0.616	0.422	0.194
	(0.588)	(0.564)	(0.175)
$Interest\ Rate_t$	0.011*	0.017**	-0.006**
	(0.005)	(0.006)	(0.002)
Log($Mkt.Value_t$)	-0.017**	-0.015**	-0.001
	(0.004)	(0.004)	(0.002)
Log($Assets_t$)	0.016	0.013	0.004
	(0.013)	(0.012)	(0.004)
Time	0.000	0.001	-0.001
	(0.002)	(0.002)	(0.001)
Observations	22,823	22,823	22,823
Executive/company combinations	5,277	5,277	5,277
Robust Standard Errors in parentheses ** significant at 1% level; * significant at 5% level;+ significant at 10% level			

Notes:

1. $defincshare_t$ is the share of option awards and stock grants in total income. $optshare_t$ and $stockshare_t$ are the share of options and stocks, respectively, in total income.
2. The tax rate, τ_t, is the federal marginal tax rate applicable to taxable income. These results are from a 2SLS estimation where the permanent income tax rate is used as an instrument for the federal marginal tax rate.
3. α_t is the firm specific corporate tax rate and n_t is the capital gains tax rate. Net income share is the executive's total income above one million dollars as a share of total compensation. This variable is defined for every year after 1992 since the million dollar rule became applicable only in 1993. *Ret* is the company's stock return on its common stock.
4. We present fixed-effects estimates with standard errors clustered by individual/company and year. All specifications include a constant term.

Figure B1: 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).

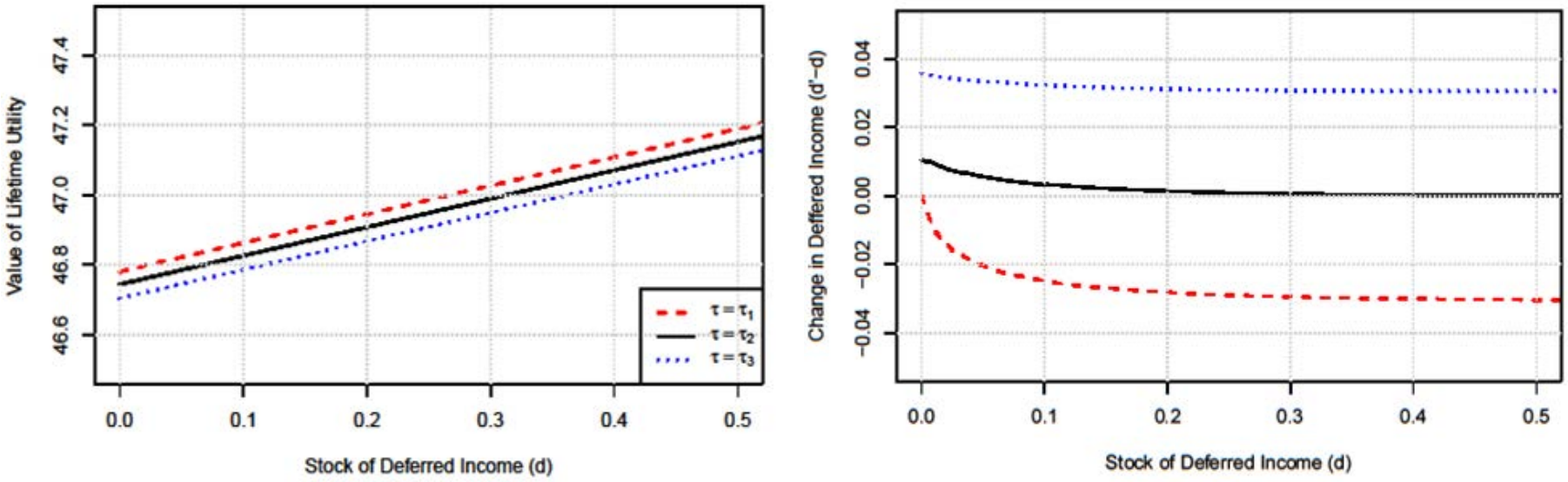

Table B1: Welfare Effects of Stochastic Tax Policy

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.