Tax Changes and Asset Pricing: An Investigation of the Time-Series Evidence

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Abstract

This study investigates whether personal taxes are related to asset valuations. The effective tax rate of investment income fluctuated considerably since federal income taxes were introduced. The main result of the paper demonstrates that there is an economically and statistically significant relationship between asset valuations and personal tax rates. Stock valuations tend to be higher when taxes are low and lower when taxes are high. This result is consistent with the observation that stock and bond returns tend to be higher in periods when taxes decrease and lower when taxes increase.

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1 Introduction

Personal taxes on investment income have a substantial impact on the after-tax returns for assets held in taxable accounts. This study derives the effective personal tax burden of equity securities and investigates whether the valuations of equity and fixed-income securities are related to personal taxes using time-series data of U.S. tax rates over the period between 1917 to 2000.

Dividend and capital gains taxes changed numerous times since federal taxes were introduced. The first part of the paper indicates that effective tax rates of equity securities held by households decreased from 35 percent in the early 1950s to less than 8 percent in 2000. There are three primary reasons for this substantial decrease in the tax burden of equity. First, statutory tax rates decreased, as policy makers decreased the marginal income tax rates in several tax reforms. Second, dividend yields decreased significantly since the early 1980s, as corporations started to retain a larger proportion of their earnings and as they increased share repurchases. The fall in the dividend yield decreased the effective tax burden on equity, because it allowed investors to defer the taxation of investment income by postponing the realization of capital gains and because long-term capital gains were taxed at a lower tax rate than dividend payments. Third, several tax reforms over the last forty years expanded the opportunities for investors to hold stocks in tax-qualified pension and retirement accounts. The proportion of stocks held in taxable accounts decreased from around 90 percent in the 1950s to less than 50 percent in 2000.

The main result of this paper is that asset valuations and personal tax rates have an economically and statistically significant relationship. Stock valuations tend to be higher when personal taxes are low and they tend to be lower when personal taxes are high. Tax changes have an effect on both equity and fixed-income securities. Returns of both asset classes tend to be lower during a transition period before tax increases and higher before tax decreases. As investors learn about future tax reforms, stock and bond prices adjust, which results in temporarily higher returns when taxes increase and temporarily lower returns when taxes decrease. Tax changes affect assets with long duration, such as long-term bonds and stocks, more than assets with shorter duration.

This paper follows Poterba (1987b) and McGrattan and Prescott (2001) in constructing dollar-weighted average tax rates for equity securities. Poterba (1987b) discusses the impact of changes in personal and corporate taxation on

corporate saving. McGrattan and Prescott (2001) demonstrate in a standard growth model that the rise in equity prices between 1960 and 2000 can be explained by changes in tax rates on dividends and by the introduction of tax-deferred retirement accounts, which decreased the effective taxes on stock returns. Their paper does not empirically test the effects of these tax changes on asset valuations.

The effect of personal dividend and capital gains taxes on stock prices has been analyzed by many researchers in accounting, economics, and finance.[1] There is large disagreement whether taxes are capitalized or not. The conclusions range from the irrelevance of taxes by Miller and Scholes (1982) to the significant tax capitalization in several countries as noted by Harris, Hubbard, and Kemsley (2001).

The current paper extends this large tax capitalization literature in two directions. First, instead of looking at the short-term effects of individual tax reforms, I study the long-term correlation between asset prices and the major income tax reforms using time-series over the period from 1917 to 2000. Second, I do not only analyze the effects of tax reforms on stock returns, I also look at the effects on the returns of fixed-income securities. This allows me to answer the question whether the effects of tax changes depend on the duration and other characteristics of financial assets.

Section 2 summarizes the major tax reforms between 1913 and 2000 and derives the historical effective tax rates on asset returns over this period. Section 3 studies whether there is a systematic relationship between the effective tax rate of equity and equity valuations. Section 4 investigates whether the returns of different asset classes are affected differently by tax changes.

[1]The effect of dividend taxes is studied by Elton and Gruber (1970), King (1977), Miller (1977), Auerbach (1979), Miller and Scholes (1978), Gordon and Bradford (1980), Bradford (1981), Miller and Scholes (1982), Eades, Hess, and Kim (1984), Poterba and Summers (1984), Poterba and Summers (1985), Scholes and Wolfson (1992), Auerbach and Hassett (2002), Fama and French (2001), Harris, Hubbard, and Kemsley (2001), Elton, Gruber, and Blake (2002), Hanlon, Myers, and Shevlin (2003), and Dhaliwal, Erickson, Frank, and Banyi (2003), among many others. The impact of capital gains taxes is studied by Amoako-Adu, Rashid, and Stebbins (1992), Guenther and Willenborg (1999), Lang and Shackelford (2000), Poterba and Weisbenner (2001), Blouin, Raedy, and Shackelford (2000), Sinai and Gyourko (2003). Poterba (2002) and Auerbach (2002) are recent surveys of this literature.

2 Effective Tax Rates

One of the biggest challenges of analyzing the effects of taxes on asset prices is the identity of the marginal taxpayer. Taxes are irrelevant in asset pricing if the marginal taxpayer is tax-exempt. On the other hand, taxes might have a large impact on asset prices if the marginal taxpayer is a high-income individual.

This section describes in detail the derivation of the effective tax rate of equity securities over the period between 1917 and 2000. This study follows Poterba (1987b), Poterba (1998), and McGrattan and Prescott (2001) and constructs dollar-weighted average tax rates for equity securities.

The effective tax rate of stocks held by households depends not only on the statutory tax rates but also on the management style of the stock portfolio. The tax burden on equity can be reduced by holding assets with low dividend yields, by deferring the realization of capital gains, by accelerating the realization of capital losses, and by holding assets in tax-qualified environments (for example, pensions and tax-deferred retirement accounts). The effective tax rate of stocks at time t τ_t^s is given by the following equation:

$$\tau_t^s = w_t^{tax}(w_t^d \tau_t^d + w_t^{scg} \tau_t^{scg} + w_t^{lcg} \tau_t^{lcg}). \tag{1}$$

The effective tax rate depends first on the marginal tax rates on dividends τ_t^d and short- and long-term capital gains τ_t^{scg} and τ_t^{lcg}. While realized short-term capital gains are taxed at the ordinary income tax rate, realized long-term capital gains are taxed at the lower capital gains tax rate.

Second, the composition of the sources of income from equity investments has an important effect on the tax burden of an asset portfolio. The proportion of the returns paid as dividends is denoted by w_t^d while the proportions of realized short- and long-term capital gains are denoted by w_t^{scg} and w_t^{lcg}.[2] The deferral of the taxation of capital gains is beneficial because the present value of the tax liabilities decreases if the tax payments are postponed. In addition, the taxation of capital gains can be avoided completely due to the "step-up of the cost basis" at the time of death, which eliminates the taxation of all unrealized capital gains. Optimal deferral and avoidance strategies can reduce the effective tax rates significantly.[3]

[2]Note that the proportions of dividends and realized capital gains do not necessarily add to 100 percent, because unrealized capital gains are not taxed.

[3]Constantinides (1983), Stiglitz (1983), Constantinides (1984), and Scholes and Wolfson

Third, the ability to invest through pension accounts and other tax-qualified savings vehicles reduces the effective tax rate of stocks. The proportion of stocks held in taxable accounts is denoted by w_t^{tax}. I assume for simplicity that asset returns in pension accounts and other tax-qualified accounts are completely tax-exempt.[4]

The following sections explain in more detail how these different components of the effective tax rates are estimated. Section 2.1 describes the time series of the statutory federal income tax rates. Section 2.2 derives dollar-weighted average marginal tax rates for dividend income and capital gains, which also include taxes imposed by local and state governments. I analyze the composition of stock returns between dividends and capital gains in more detail in Section 2.3. The variation of tax-deferred investment opportunities is described in Section 2.4. An effective tax rate on stock returns is estimated in Section 2.5.

2.1 Statutory Federal Tax Rates

Marginal income tax rates have fluctuated considerably, as depicted in Figure 1. The figure shows the statutory federal marginal income tax rates for households in five different tax brackets. The four lower tax brackets correspond to real income levels of 50, 100, 250, and 500 thousand U.S. dollars expressed in 1999 consumer prices. The fifth curve corresponds to the top marginal income tax rate. A detailed description of the construction of these tax rates is given in the Appendix.

The Tariff Act of 1913 introduced relatively modest tax rates, which were increased temporarily during World War I. Herbert Hoover's response to higher government deficits after the 1929 stock market crash was to raise

(1992) describe several investment strategies to minimize the taxes of financial returns. Poterba (1987a) and Auerbach, Burman, and Siegel (2000) show that a large part of the investing public does not engage in tax-minimizing portfolio transactions.

[4]Asset returns remain untaxed in tax-preferred accounts, such as ROTH-IRA accounts, as long as investors do not take non-qualified distributions. However, the returns in tax-deferred savings accounts, such as regular IRAs and 401(k) accounts, are not completely tax-exempt. Contributions to tax-deferred accounts are deducted from taxable income while the total withdrawals are taxed at the ordinary income tax rate. If investors remain in the same tax bracket throughout their lifetimes, then savings in a tax-deferred account accumulate completely tax-free. If investors are in a lower (higher) tax bracket during retirement compared to before retirement, then they face effectively negative (positive) taxes on their accumulated savings in a tax-deferred account.

taxes. The Revenue Act of 1932 increased personal income taxes across the board, with the top rate increasing from 25 percent to 63 percent. Personal income taxation was expanded dramatically during World War II. In the five years between 1939 and 1944 the number of tax returns filed rose sharply from 6 percent of the population to 34 percent.[5] The highest marginal income tax rate amounted to 94 percent in 1944 and 1945. The Kennedy-Johnson Revenue Act of 1964 decreased the highest marginal income tax rate from 91 to 70 percent. The tax increases in the 1970s were primarily due to "bracket creep", the gradual push of taxpayers in higher tax brackets due to high inflation. The Economic Recovery Tax Act of 1981 reduced rates in all brackets substantially and provided for automatic adjustments of tax brackets for inflation. In October 1986, Ronald Reagan signed the Tax Reform Act of 1986, which simplified the tax code and reduced income tax rates. To reduce the budget deficit, income tax rates were raised in 1990 and 1993. George W. Bush's Economic Growth and Tax Relief Reconciliation Act of 2001 reduced marginal income tax rates and increased contribution limits to retirement accounts. The Jobs and Growth Tax Reconciliation Act of 2003 capped the maximum tax on dividends and long-term capital gains at 15 percent.

A large portion of financial assets is held by individuals in relatively high income tax brackets.[6] While the top tax rate has fallen substantially since the early 1960s, revenues as a fraction of GDP have changed little since World War II.[7] Marginal income tax rates of high-income individuals varied more than marginal income tax rates of medium- and low-income individuals.

Tables 1 and 2 list summary statistics for the marginal income tax rate of an individual with a taxable real income of $250,000 and for an individual in the highest tax bracket. The table includes additional tax rates, which will be described in more detail in the next sections.

2.2 Average Marginal Tax Rates

The Internal Revenue Service publishes annually since 1917 the distribution of income sources of different taxpayers in the Statistics of Income. The tables

[5] Slemrod and Bakija (1996), p. 22-30.

[6] Poterba (2000) shows that the top one percent of equity holders account for 53.2 percent of household holdings of corporate stock according to the 1998 Survey of Consumer Finances.

[7] See Pechman (1987) and Slemrod and Bakija (1996) for additional information about the history of the federal tax code.

summarize the total dividends declared by individuals in different income brackets. The marginal tax rate can be determined for each of these income brackets. This information allows the computation of the dollar-weighted marginal tax rate faced by taxable investors on dividend income, as suggested by Poterba (1987b). This tax rate is called the "average marginal tax rate". Such tax rates will also be computed for short- and long-term capital gains, for interest income, and for wage income.

State and local governments impose additional taxes on income from financial assets. State and local governments do not publish as detailed information on the distribution of income sources of taxpayers as the federal government. I assume that the marginal tax rate from states and localities is a fixed proportion of the federal tax rate according to the current revenues of states and local governments relative to the federal government. The appendix explains the construction of the different time series in more detail.

Figure 2 depicts the average marginal tax rates of different sources of investment income between 1917 and 2000. The tax rates include the estimated tax rates of state and local governments. Dividend tax rates increased from approximately 10 percent in 1925 to more than 50 percent in 1943. The dividend tax rates remained relatively high until Reagan's tax cuts in the 1980s. Since 1988, dividend taxes increased slightly. However, the current dividend taxes are lower than they have been most of the time since 1940. The average marginal tax rate on dividend payments was 36.5 percent in 2000. The Jobs and Growth Tax Reconciliation Act of 2003 caps the marginal tax rate on dividend payments at 15 percent. This tax reduction will decrease the total average marginal tax rate on dividends substantially.

The average marginal tax rate on realized long-term capital gains is generally smaller than the average marginal dividend tax. Until 1921, long-term capital gains did not receive a preferential tax treatment relative to other income sources. Congress established in that year a 12.5 percent maximum capital gains tax rate. Capital gains tax rates were substantially lower than dividend tax rates between 1932 and 1986. The Tax Reform Act of 1986 briefly eliminated the distinction between capital gains and ordinary income. This reform resulted in average capital gains taxes exceeding average dividend taxes between 1988 and 1990. In 1997, the maximum capital gains tax rate was lowered from 28 to 20 percent, which resulted in a relatively significant drop in the average capital gains tax rate. The Jobs and Growth Tax Reconciliation Act of 2003 further reduces the federal marginal tax rate on realized long-term capital gains to 15 percent.

Table 1 summarizes in rows three to six of each panel the average marginal tax rates for dividends, long-term capital gains, interest income, and wages. The dividend tax rates were consistently higher than the tax rates on interest income and the tax rates on wages. The average dividend tax rate between 1917 and 2000 was 35.55 percent, while the average interest and wage tax rates were 24.34 and 20.03 percent, respectively. This indicates that dividend income is received by investors in considerably higher tax brackets than interest and wage income. The tax rate of dividends is very similar to the marginal tax rate of an individual with a real income level of $250,000. The correlation between these two tax rates is 0.96. On the other hand, the correlation between the top marginal income tax rate and the dividend tax rate is 0.62.

2.3 Sources of Investment Income for Equity

The sources of investment income for equity securities varied considerably between 1917 and 2000. Dividend income was the dominant source for stock holders during most of the period and capital gains became a relatively more important income source during the last two decades. Figure 3 depicts the dividend yield of the Standard and Poor's Composite Index. The dividend yield is defined as the total dividends paid by the components of the Standard and Poor's Index divided by the value of the index at the beginning of the year. The data sources are described in more detail in Appendix A.4. The solid curve shows the actual annual dividend yield and the dotted curve shows the moving average of the dividend yield over the previous ten years. The actual dividend yield is influenced by many short-term effects on dividends and asset prices. The moving average of the dividend yield might be a better reflection of the expected long-term level of dividends relative to stock prices. The dividend yield of the Standard and Poor's Index is used as an approximation of the dividend yield of taxable investors.[8]

The average dividend yield amounts to approximately 5 percent between 1917 and 1979. In the 1980s and 1990s, dividend yields decreased substan-

[8]The dividend yield of taxable investors should be smaller than the dividend yield of the market portfolio if investors follow optimal asset location strategies as described in Dammon, Spatt, and Zhang (2003), Huang (2000), and Shoven and Sialm (2003). Empirical studies by Amromin (2002), Barber and Odean (2003), and Bergstresser and Poterba (2003) indicate that households do not locate their assets very efficiently between tax-deferred and taxable accounts.

tially as companies retained a larger proportion of their earnings and as they recognized that share repurchases have tax advantages for taxable shareholders compared to dividend payments. This recent drop in the dividend yield decreased the total tax burden of stock investors.[9]

The annual Statistics of Income of the Internal Revenue Service report for most years in our sample the total short- and long-term capital gains and the dividends declared by individuals. During most years since 1950, realized short-term capital losses exceeded the realized short-term gains as investors avoided to realize short-term capital gains, which were taxed heavily relatively to long-term capital gains. Long-term capital gains realizations were positive for all the years in the sample. The net short-term capital gains tended to be considerably smaller in absolute terms than the net long-term capital gains. For example, the average net realized short-term capital loss amounted to just 4.4 percent of the total realized long-term capital gains over the period between 1950 and 2000.[10]

The short- and long-term capital gains yields $scgy_t$ and $lcgy_t$ are defined as the product between the dividend yield dy_t and the ratio between the short- and long-term realized capital gains SCG_t and LCG_t divided by the total dividend payments D_t:

$$scgy_t = dy_t \frac{LCG_t}{D_t}, \tag{2}$$

$$lcgy_t = dy_t \frac{SCG_t}{D_t}. \tag{3}$$

2.4 Proportion of Taxable Equity

The proportion of corporate equity held by non-taxable entities, such as pension funds, tax-deferred retirement accounts, and nonprofit organizations,

[9] Green and Hollifield (2003) show that the costs of capital are reduced significantly if companies repurchase stocks instead of paying dividends.

[10] The capital gains given by the Statistics of Income include capital gains from many sources and not just from stock transactions. The IRS does unfortunately not report every year the proportion of capital gains that result from transactions of corporate equities. However, for eight years between 1959 and 1998, the IRS reported the sources of capital gains in more detail. On average, about 35 percent of the capital gains result from transactions of corporate equity. I used the fraction of stock capital gains for these eight years to estimate the fraction for the remaining years.

increased from a few percent in the 1950s to more than 50 percent in 2000. The proportion of equity held in taxable accounts is estimated using the Flow of Funds published by the Board of Governors of the Federal Reserve Bank.[11]

Figure 4 shows the proportion of stocks held by taxable investors over the period between 1945 to 2000.[12] In 1945, more than 90 percent of the stocks are held in taxable accounts. This proportion decreased substantially as pension funds gained popularity in the 1970s. An additional decrease of the proportion of stocks held in taxable accounts occurred in the 1980s, as the opportunity to invest in tax-deferred retirement accounts was expanded significantly.

2.5 Effective Stock Tax Rates

The effective tax rate on stocks can be derived using equation (1) and the data derived in the previous sections.[13] The proportion of dividend distributions w_t^d is computed as the ratio of the dividend yield dy_t and the average real stock return over the whole time period $E(r)$:

$$w_t^d = \frac{dy_t}{E(r)}. \tag{4}$$

The average real return of the Standard & Poor's Composite Index equals 8.99 percent between 1917 and 2000 after the inclusion of dividend payments. This historical average return is used as the value for the expected value of the before-tax returns of stocks. Higher expected returns would result in lower effective tax rates and lower expected returns would results in higher estimated effective tax rates. The average proportion of dividend distributions equals 51.35 percent.

The proportions of the short- and long-run capital gains distributions w_t^{scg} and w_t^{lcg} are estimated as the ratios of the short- and long-term capital gains yields divided by the average real stock return over the whole time period $E(r)$:

[11] Chaplinsky and Seyhun (1990) examine the aggregate dividend tax savings provided to individuals through tax-exempt and tax-deferred savings opportunities.

[12] Earlier data on the flows of funds are not available.

[13] Since the Flow of Funds is only available since 1945, I assume that the proportion of stocks held by taxable investors between 1917 and 1944 equals the ratio of returns paid as dividends in 1945, which is 91.92 percent.

$$w_t^{lcg} = \frac{lcgy_t}{E(r)} = \frac{dy_t}{E(r)} \frac{LCG_t}{D_t}, \tag{5}$$

$$w_t^{scg} = \frac{scgy_t}{E(r)} = \frac{dy_t}{E(r)} \frac{SCG_t}{D_t} \tag{6}$$

The average value of the total proportion of both short- and long-term capital gains equals 20.28 percent. On average, 72.71 percent of the expected real returns are either realized as dividends or as capital gains. It is surprising that such a large portion of the total returns of stocks are realized and that U.S. taxpayers do not seem to take more advantage of opportunities to defer capital gains taxes.

Finally, the tax rates for dividends τ_t^d and short- and long-term capital gains τ_t^{scg} and τ_t^{lcg} are taken from the average marginal tax rate computations, as described in Section 2.2.

Figure 5 summarizes the different effective tax rates. The top curve depicts the average marginal tax rate on dividend payments τ_t^d. This curve is exactly identical to the one found in Figure 2. The middle curve shows the effective tax rate for taxable stocks τ_t^{ts}. This tax depends on the dividend and the capital gains tax rates and on the sources of investment income for equity:

$$\tau_t^{ts} = w_t^d \tau_t^d + w_t^{scg} \tau_t^{scg} + w_t^{lcg} \tau_t^{lcg}. \tag{7}$$

The effective tax rate for taxable stocks is usually considerably lower than the tax rate of dividends. The fact that capital gains are usually taxed at lower rates than dividends and that some capital gains can be deferred or completely avoided reduces the total tax burden of stocks.

The third curve depicts the effective tax rate of all stocks. The effective tax rate for all stocks τ_t^s takes also into account the proportion of assets held in tax-qualified accounts and by tax-exempt institutions:

$$\tau_t^s = w_t^{tax} \tau_t^{ts}. \tag{8}$$

The difference between the effective tax rate of taxable stocks and the effective tax rate of all stocks depends on the proportion of stocks held in tax-sheltered environments. This difference is relatively small until the 1960s, because most stocks are held during this period in taxable accounts. The

gap between the two tax rates widens substantially after the introduction of pensions and other tax-qualified savings vehicles.

These results show that the effective tax rate of stocks decreased significantly since the mid 1950s. The effective tax rate of stocks amounted to 35.12 percent in 1952 and decreased to 7.60 percent in 2000. There are three primary reasons for the decrease in effective tax rates over the last four decades: First, statutory tax rates for high-income individuals decreased over the last decades. Second, dividend payments decreased significantly as a portion of the total market capitalization since the early 1980s. This enabled investors to defer the taxation of capital gains and to take advantage of the lower capital gains tax rate. Third, tax law changes gave investors the opportunity to accumulate assets in tax-qualified environments.

3 Equity Valuation

I study in this section the correlation between equity valuation and effective tax rates. The first section summarizes the data used in the estimation and the two following sections report univariate and multivariate regression estimates.

There are several challenges of estimating the interaction between tax policies and asset prices. First, there have only been a few large reforms since federal income taxes were introduced. This makes a precise estimation of the effects of tax changes difficult. Second, many variables used in the empirical analysis are measured with error. In particular, effective tax rates are not observable and they can differ from the estimated tax rates in this paper. This measurement error might make it more difficult to obtain a significant relationship between taxes and asset valuations. Third, asset prices are affected by many factors. Omitted and unobservable variables correlated with tax rates might bias the estimates of the effects of taxes. Fourth, tax rates are endogenous. It is not clear whether tax changes cause asset price changes or whether price changes cause tax changes. Fifth, the enactment of tax reforms should not affect asset prices if these changes are anticipated. Asset prices change gradually prior to the implementation of a new tax law if individuals learn gradually about future tax reforms. These challenges should be taken into account when interpreting the results of this study.

3.1 Data

This section uses an updated version of the dataset in Shiller (1989) covering the period between 1917 and 2000. The data are described in more detail in Appendix A.4. Figure 6 shows the price-earnings ratio of the Standard and Poor's Composite Index over the period between 1913 and 2000. The solid curve depicts the ratio between the January index value divided by the total earnings of each year. The dotted curve depicts the ratio between the real January index value divided by the moving average of the real earnings over the previous ten years, which decreases the effect of short-term variations in earnings. The ratio varies considerably through time.[14]

Table 3 lists some important summary statistics for the data used in this section. The price-earnings ratio has a mean of 13.88 over the whole period and varies between 5.94 (1950) and 28.51 (2000). The price-earnings ratio is relatively stationary and has very similar means over the two periods between 1917 and 1949 and between 1950 and 2000.

3.2 Univariate Regression Results

The following estimations analyze the relationship between the effective tax rates and the price-earnings ratio. Figure 7 depicts the relationship between the effective tax rate and the price-earnings ratio. The solid line shows the univariate regression results over the whole sample period. The figure indicates that there is a negative correlation between effective tax rates and the price-earnings ratio.

The first column of Panel A of Table 4 summarizes the results of this univariate regression. The standard errors are given in parentheses and follow Newey and West (1987), where the autocorrelation structure is estimated using a two year lag. These standard errors are robust with respect to heteroskedasticity and autocorrelation. The significance levels are abbreviated with asterisks: One, two, and three asterisks denote statistical significance at the 10, 5, and 1 percent level, respectively. The regression results indicate that the tax coefficient is statistically significant at a one percent confidence

[14] Campbell and Shiller (2003) analyze the time-series of the price-earnings and the price-dividend ratio and conclude that these ratios perform poorly in forecasting future dividend growth, future earnings growth, or future productivity growth. The ratios appear to be useful primarily in forecasting future stock price changes. They do not analyze the relationship between taxes and valuation ratios.

level. The results are also economically significant: A decrease in the effective tax rate of one percentage point is associated with an increase in the price-earnings ratio of 0.3 points, which is about 2 percent of the average price-earnings ratio.

Regressions over both sub-periods result in negative relationships between effective tax rates and asset valuations. The results are larger and more significant for the second period between 1950 and 2000, as indicated in Panel C of Table 4. There are at least two reasons which justify to focus on the more recent sample period. First, prior to the early 1940s, only a minority of individuals paid income taxes. A broader coverage might result in larger tax effects. Second, asset performance during the Great Depression and World War II was extremely volatile and might dominate the average returns of the whole sample.

3.3 Multivariate Regression Estimates

The univariate regressions in Section 3.2 show the total effect of taxes on asset valuations. It is possible that omitted variables affect the tax rates and the asset valuations, thereby causing a bias in the coefficient estimates. The partial effect of taxes on asset valuations might differ once additional macroeconomic variables are included. For example, periods of high inflation might be periods of tax increases and low asset valuations. This section shows that effective tax rates remain an important determinant of asset valuations even if additional macroeconomic variables are included.

The second column of Table 4 shows the results of multivariate regressions including additional macroeconomic variables. The additional explanatory variables are the consumer price inflation rate π_t, the real per-capita growth rate of GDP g_t, and a short-term commercial paper interest rate r_t. The sources of the variables are summarized in the Appendix A.4. Panel A describes the results for the whole time period between 1917-2000 and Panels B and C for the two sub-periods.

The coefficient estimates on the effective tax rate do not change significantly after controlling for additional macroeconomic variables. The inflation rate is highly statistically significant. Asset valuations tend to be lower when inflation is higher. An increase in the inflation rate of one percentage point is associated with a decrease of the price-earnings ratio of 0.28 points, or about 2 percent of the average price-earnings ratio. The interest rate and the output growth rate are both negatively associated with the price-earnings

ratio. Surprisingly, the interest rate effect is not statistically significant. The comparison of columns two and three demonstrates that the elimination of the tax rate as an explanatory variable reduces the fit of the regression by about one third. This analysis does not resolve the omitted variable bias completely, because other excluded variables might determine both the tax rates and the stock valuations.

The relationship between effective tax rates and asset valuations becomes considerably stronger and more significant over the more recent period between 1950 and 2000, as shown in Panel C of Table 4. A decrease in the effective tax rate of 1 percentage point is associated with an increase of the price-earnings ratio of 0.56 points in the multivariate model. This change corresponds to about 4 percent of the average price-earnings ratio. However, this estimate has a relatively large standard error. The tax coefficient is statistically significant at any conventional confidence levels. On the other hand, the tax coefficient over the first sub-period is not significantly different from zero.

All the explanatory variables in the previous regressions are endogenous. Column four of Table 4 shows that the coefficients of an instrumental variables regression are generally consistent with the previous results. It is difficult to find good instruments that are correlated with the endogenous variables but not with the error term. I use the lagged effective tax rate, the lagged inflation rate, the lagged growth rate, the lagged interest rate, and the lagged maximum income tax rate. The coefficient estimates of the tax rate remain qualitatively similar using an instrumental variables estimation.

The current version of this paper investigates the effect of personal tax rates on valuation levels and ignores corporate income tax rates. Theoretically, it is not clear whether higher corporate tax rates increase or decrease the price-earnings ratio, because the earnings are measured after subtracting corporate taxes. The coefficient on the corporate tax rate is significantly positive over the whole time period and insignificantly negative over the second sub-sample. However, the coefficients on the effective personal income tax are not affected if we include the marginal corporate tax rate as an additional explanatory variable. A more detailed analysis of the total impact of personal and corporate taxes on asset valuations will be incorporated into future versions of this paper.

3.4 Effects of Different Tax Rates

The derivation of the effective tax rates requires many specific assumptions. Table 5 analyzes whether the impact of taxes depends on the exact specification of the tax rate. The first column repeats the regression results from Table 4 using the effective tax rate for all stocks.

The second column uses the current dividend and capital gains yield instead of the 10-year moving average to compute the effective tax rate. The statistical significance of the tax coefficient increases substantially for all periods. The magnitude of the effect does not change much relative to the base case in the first column.

The third column assumes that the dividend and the capital gains yield are constant and equal to their sample averages between 1917-2000. In this case, the variation in the effective tax rate is determined by changes in the dividend and capital gains tax rates and by the change in the proportion of stocks held in taxable accounts. The tax coefficient becomes insignificant over the whole time period. This result is not too surprising since a large portion of the variation in the effective tax rate is determined by the fluctuations in the proportion of investment income that is distributed as dividends and capital gains. However, the tax coefficient remains large and significant over the second time period.

The fourth column uses the average marginal tax rate for dividend payments as the tax variable. This eliminates the effect of the decreasing fraction of stocks that are held in taxable accounts and the effects of changes in the capital gains taxes. The coefficient estimate on the tax variable is again not statistically significant over the whole sample, while the estimate is economically and statistically significant over the second time period.

The fifth and the sixth columns use the statutory income tax rates for households in the top income tax bracket and the tax bracket corresponding to a taxable income of $250,000 expressed in 1999 consumer prices. The coefficient estimates are not statistically significant between 1917-2000, but they are statistically significant at a 5 percent level between 1950-2000. The magnitude of the coefficients decreases relative to the regressions using effective tax rates because the standard deviation of the statutory marginal income tax rates is larger than the standard deviation of the effective tax rate, as shown in Table 1. The coefficient estimates of the other macroeconomic variables are not affected much by the choice of different measures of the tax burden. The effects of personal taxes are considerably more statistically

significant over the last fifty years than over the whole time period.

3.5 Different Valuation Ratios

Table 6 analyzes the relationship between the effective tax rate on equity and different valuation measures. The first column repeats the estimates in the base case using the price-earnings ratio as the dependent variable. The second column uses the ratio of the current S&P 500 Index value divided by the moving average of the real earnings during the previous ten years. By averaging earnings over several years it is possible to isolate variations in the stock valuations from short-term variations in earnings due to the business cycle, as explained by Campbell and Shiller (1998). The coefficient estimates of the effective tax rate increase in absolute terms for all periods. The tax coefficient is highly statistically significant over both time periods using this alternative valuation measure. The third and the fourth columns of Table 6 show that there is a significant relationship between the effective tax rate on equity and the price-dividend ratio for both sub-periods.[15]

4 Tax Changes and Equity and Bond Returns

The previous section demonstrates that the valuation levels of stocks are related to the effective tax rate. The regression results indicate that equity valuations tend to be higher in low-tax regimes and lower in high-tax regimes. This implies that equity valuations should adjust whenever taxes change unexpectedly. Thus, the returns of stocks should be relatively high in periods where tax rates increase unexpectedly and they should be relatively low in periods where tax rates decrease unexpectedly. The empirical estimations in this section test whether we can identify such changes in asset valuations due to changes in statutory tax rates.

This section extends the results from Section 3 in two directions: First, this section studies asset returns instead of asset valuations. Asset returns

[15]The coefficient estimates are statistically and economically more significant if we use Tobin's Q as the measure of stock valuation. Tobin's Q is defined as the ratio between the market value of equity and debt divided by the replacement costs of capital in the nonfinancial corporate sector. These results are not reported in detail here, because they might be partially affected by the corporate tax, which should have an impact on Tobin's Q.

have a low autocorrelation and are not directly affected by earnings and dividends payments. Second, this section analyzes the effects of tax changes on different asset classes, such as equity and short- and long-term bonds. This allows a comparison of the effects of tax changes on different asset classes.

4.1 Average Returns and Tax Changes

The annual returns of stocks and several bonds used to determine the correlation between statutory tax changes and asset returns cover the period between 1926 and 1999. Section A.4 in the Appendix describes the data sources. I use the statutory marginal income tax rate, because it would be inappropriate to use the effective tax rate on equity to study the effects of taxes on bond returns. Using the statutory income tax rates enables a direct comparison of the results using different asset classes.[16]

Figure 8 and Table 7 summarize the average real returns of five asset classes in the year prior to large tax increases or decreases. I analyze the returns of Treasury bills, intermediate- and long-term Treasury bonds, long-term corporate bonds, and stocks. The annual observations are divided into three groups: The first group includes years where the marginal tax rate for an individual with a real income level of $250,000 increases by more than 2.5 percentage points (Taxes Increase). The second group includes years where tax rate changes by less than 2.5 percentage points (No Change). And the third group includes years where the tax rate decreases by more than 2.5 percentage points (Taxes Decrease). Panel A shows the average returns in the years prior to the changes in the tax rates for the whole period between 1926-1999. Over this period, tax rates increase by more than 2.5 percentage points in 16 years, they decrease by more than 2.5 percentage points in 9 years, and they change by less than 2.5 percentage points in the remaining 49 years. The average tax increase amounts to 6.24 percentage points and the average decrease amounts to 7.69 percentage points.

Two main conclusions can be drawn. First, tax changes and asset returns are related in a systematic way. The average returns of all the assets are higher in the years prior to tax decreases compared to years prior to tax increases. This result is consistent with the fact that the price-earnings ratio is higher in the low-tax regime. The valuation levels decrease as investors

[16]The impact of the the effective tax rate of equity on stock returns is very similar to the impact of the statutory tax rate, because the two measures are very highly correlated as described in Table 2.

learn about tax rate increases. This results in relatively low stock returns during a transition period. Second, assets with long durations, such as stocks and long-term bonds, are much more affected by tax rate changes than assets with shorter durations (such as short-term bonds). This result is consistent with the theoretical result given in Sialm (2002). The difference between the returns in periods where taxes increase and periods where they decrease is strictly increasing in the duration of the assets. The difference for Treasury bills equals only 1.44 percentage points (-1.07 percent during periods of increasing taxes versus 0.38 percent during periods of decreasing taxes), the difference for long-term Treasury bonds equals 8.06 percentage points (-0.54 versus 7.52 percent), and the difference for stock portfolios equals 10.55 percentage points (4.07 versus 14.62 percent). The results do not change qualitatively if the cutoff level of 2.5 percentage points is changed or if tax rates from an individual in a different tax bracket are used. The average return differentials in the different periods are economically very significant.

To determine whether the results are also statistically significant, I use 10,000 bootstrap simulations to generate a probability distribution of average asset returns. In each simulation, a random sequence of returns is drawn with replacement from the history of returns and linked to the actual history of tax rates. Table 7 reports the p-values of these simulations in brackets. The p-values are defined as the proportion of the simulations that have lower outcomes than the sample averages. The average returns for tax increases tend to be relatively more significant than the average returns for tax decreases because there are more years with tax increases than with tax decreases. The significance of the difference between the average returns prior to taxes increases and tax decreases is particularly high for bonds with long maturities. The difference between the average returns of stocks has a p-value slightly higher than 10 percent.

The average returns are also computed over the shorter period from 1950 to 1999. Panel B of Table 7 summarizes the results since 1950. Over this period, tax rates increase by more than 2.5 percentage points in 9 years, they decrease by more than 2.5 percentage points in 7 years, and they do not change by more than 2.5 percentage points in the remaining 34 years. The average increase amounts to 5.00 percentage points and the average decrease amounts to 6.53 percentage points. The bootstrap simulations are performed drawing from the whole sample of asset returns (i.e., from 1926-1999), resulting in more conservative significance levels, because the first third of the sample (i.e., from 1926-1949) experiences more extreme variations

in asset returns.

During the more recent period, tax changes have a stronger association with asset returns and the results are more statistically significant. The return differences between periods of tax increases and tax decreases amount to 2.82 percent for Treasury bills, to 14.78 percent for long-term Treasury bonds, and to 18.21 percent for stocks. The return differences for intermediate- and long-term bonds are highly significant. Larger return differences between periods of tax increases and tax decreases for stocks occur only in 3.67 percent of the bootstrap simulations.

4.2 Regression Analysis

The relationship between asset returns and tax rate changes might be biased because tax rate changes could be a proxy for other variables which are not included in the analysis. Asset returns are regressed on the level of the tax rates τ_t, on tax rate changes $\tau_{t+1} - \tau_t$, on the inflation rate π_t, and on the per-capita growth rate of the economy g_t.

Table 8 reports the coefficient estimates. The Newey-West standard errors are given in parentheses and are robust to autocorrelation and heteroscedasticity. Panel A summarizes the coefficient estimates over the whole period. The level of the tax rates never has a significant impact on asset returns. The estimates of the effect of tax changes on asset returns are all negative and increase with the duration of the underlying assets. A 10 percent increase in the tax rate depresses the returns of Treasury bills, long-term Treasury bonds, and stocks by 1.0, 4.0, and 7.2 percentage points, respectively. However, the coefficient estimates of the tax changes are usually not statistically significant. The relationship between real asset returns and inflation rates is very strong and negative because real asset returns are obtained by subtracting the rate of inflation. The growth rate of per capita output does not play an important role in explaining asset returns.

All the independent variables in the previous regression are endogenous. To mitigate the effects of endogeneity, I instrument for these variables with a constant, a lagged tax rate, a lagged inflation rate, a lagged growth rate, and a current and a lagged implicit tax rate on municipal bonds.[17] The implicit tax rate is measured at the beginning of each year. Changes in

[17]The implicit municipal tax rate $\tau_t^M = 1 - y_t^M/[0.5(y_t^A + y_t^B)]$ is computed from the yields of the corporate bonds with a AAA rating y_t^A and with a BAA rating y_t^B and the yields of the municipal bonds y_t^M.

the implicit tax rates are a proxy of anticipated changes in the marginal income tax rate. Panel B reports the results of the instrumental variable estimation. The effects of tax rate changes are larger and more significant for both samples in the IV-estimation compared to the regression estimation. A 10 percent increase in the tax rate depresses the returns of Treasury bills, long-term Treasury bonds, and stocks by 6.2, 12.2, and 9.0 percentage points, respectively. Inflation rates do not have a statistically significant effect on asset returns in the instrumental variables estimation.

The results in this section confirm the results in Section 3. Tax levels are related to asset valuations and tax changes are related to the returns of different asset classes. Several different empirical estimation methods generate similar results.

5 Conclusions

This paper investigates the effective taxation of different asset classes and studies whether personal taxes are capitalized in asset prices. The paper makes three major conclusions: First, the effective personal taxation of investment income fluctuated considerably since taxes were introduced in 1913. The effective tax rate of stocks decreased over the last fifty years, because statutory tax rates decreased, because the dividend yield decreased, and because a larger portion of stocks is held today in tax-exempt accounts. Interest income is taxed on average at a lower marginal rate than dividend income, because a larger portion of dividends are received by investors in the highest tax brackets.

Second, empirical estimations indicate that stock valuations tend to be high when taxes are relatively low and low when taxes are relatively high. This relationship remains after controlling for additional macroeconomic variables, such as inflation, economic growth, and interest rates. This result is confirmed by the fact that asset returns tend to be higher in years prior to tax decreases and lower in years prior to tax increases.

Third, statutory tax changes have an effect on both equity and fixed-income securities. Assets with long duration, such as equity and long-term bonds, are affected more by tax changes than assets with shorter duration, such as short-term bonds.

It is important to interpret the results of this study with caution, because the empirical estimations using autocorrelated time-series face numer-

ous challenges. First, there have only been a few large reforms since federal income taxes were introduced. This makes a precise estimation of the effects of tax changes difficult. Second, many variables used in the empirical analysis are measured with error. In particular, effective tax rates are not observable and they can differ from the estimated tax rates in this paper. Third, asset prices are affected by many factors. Omitted and unobservable variables correlated with tax rates might bias the estimates of the effects of taxes. Fourth, tax rates are endogenous. It is not clear whether tax changes cause asset price changes or whether price changes cause tax changes. Fifth, the enactment of tax reforms should not affect asset prices if these changes are anticipated.

Additional research is necessary to determine whether the relationship between effective taxes is robust. First, it will be necessary to include a measure of the corporate tax burden of equity securities. Second, it might be helpful to take advantage of cross-sectional differences in the tax burden. For example, value stocks face higher tax burdens than growth stocks because a larger portion of the expected returns of value stocks are paid as highly taxed dividends. It will be interesting to analyze whether these two different asset classes are affected differently by tax reforms.

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A Data

A.1 Statutory Tax Rates

Taxable income is derived for five real income levels after deducting exemptions for a married couple filing jointly with two dependent children from the fixed income levels. The proportion of total deductions relative to the adjusted gross income is assumed to equal the proportion of total deductions in the whole population for each year as reported by the Internal Revenue Service. The IRS does not report the proportion of total gross income for the first three years (1913-1916). In these cases, I set the proportion of total deductions in those years with missing data equal to the average in the three following or previous years.

The marginal income tax brackets and exemptions are determined using the Statistics of Income of the Internal Revenue Service (1954) for the years 1913-1943, Pechman (1987) for the years 1944-1987, and different issues of the Instructions to Form 1040 from the IRS for the remaining years between 1988-2000. The values of the Consumer Price Index from 1913-1957 are taken from Mitchell (1983) and for the other years from the Council of Economic Advisors (2001). Total deductions as a proportion of adjusted gross income (AGI) are derived from different issues of the Statistics of Income of the IRS. Marginal income tax rates for individuals in five different tax brackets corresponding to Adjusted Gross Income levels of 50, 100, 250, 500 thousand U.S. dollars (with 1999 consumer prices), as well as the highest marginal income tax rate are derived.

The long-term capital gains tax rates applies to realized gains with a holding period of more than five years. The data source for the capital gains tax rates for 1913-1950 is the Synopsis of Federal Tax Laws from the Statistics of Income for 1950. The remaining tax rates are taken from different issues of the General Explanations of Tax Legislation by the Joint Committee on Taxation (1998) and Table 2-4 from Burman (1999).

A.2 Average Marginal Tax Rates

The time series for the average marginal tax rates of dividends, capital gains, interest income, and wage income are computed using different annual issues of the Statistics of Income between 1917 and 1964 and for 2000 and the average marginal tax rates from the National Bureau of Economic Research

between 1965-1999. The NBER publishes average marginal tax rates for selected income sources since 1960 using their taxsim software.[18]

State and local governments do not generally have as detailed information on the distribution of income sources of taxpayers as the federal government. The National Income and Product Accounts published by the Bureau of Economic Analysis summarize the current personal income tax receipts of state and local governments (Table 3.3) and the federal government (Table 3.2).[19] I assume simply that the state and local government tax rate is a fixed proportion of the federal tax rate according to the current revenues. For example, in 1999, the personal income tax receipts of state and local governments were 22.4 percent of the personal income tax receipts of the federal government. The NBER computes for that year an average marginal dividend tax rate of 29.3 percent on the federal level. Thus, dividends are assumed to face a 6.6 percent ($= 0.293 * 0.224$) tax rate from state and local governments. Note that this approximation of the marginal tax rates of state and local governments is biased if the state tax codes are more or less progressive than the federal tax codes and if states and local governments use a different tax basis.

The proportion of equity held in taxable accounts is estimated using the Flow of Funds published by the Board of Governors of the Federal Reserve Bank.[20] The proportion is only computed for the equities held by domestic investors, as it would be impossible to determine the marginal tax rates faced by international stock investors.

A.3 Stock Valuations

The stock price, dividend, earnings, and interest rates series between 1913 and 1987 used in Section 3 are taken from Robert Shiller's webpage and are an updated version of the data given in Shiller (1989).[21] The stock prices are the average values in January of the Standard and Poor's Composite index. The dividends and the earnings per share are adjusted to the S&P Composite index (4 Quarter Total).

[18]The time series can be downloaded from http://www.nber.org/ taxsim.
[19]The data can be downloaded from http://www.bea.gov.
[20]The data can be downloaded from http://www.federalreserve.gov/releases/Z1/.
[21]The data can be downloaded from http://aida.econ.yale.edu/ shiller/.

A.4 Asset Returns

The asset return data for Section 4 and the inflation data are annualized given the monthly data from Ibbotson Associates (2000).The nominal monthly yields on long-term corporate bonds with ratings of AAA and BAA are taken from the Board of the Governors of the Federal Reserve (Data series RIMLPAAAR and RIMLPBAAR). The nominal yields on long-term municipal bonds correspond to the 'Bond Buyer's Index of the Municipal Bond Market'. The Bond buyers index is the result of averaging the returns over 20 bonds. The data before 1953 are from Moody's Manual of Investments (Porter 1954) and data after 1953 are from the Federal Reserve (Data series RIBLGNG20). The three yields are taken at the beginning of the year.

Figure 1: Statutory Marginal Income Tax Rates at Different Real Income Levels

The marginal income tax rates are depicted over the period from 1913 to 2000 for five different real income levels. The four lower curves correspond to the marginal income tax rates for households with real income levels of 50, 100, 250, and 500 thousand U.S. dollars expressed in 1999 consumer prices. The highest curve corresponds to the maxium marginal income tax rate.

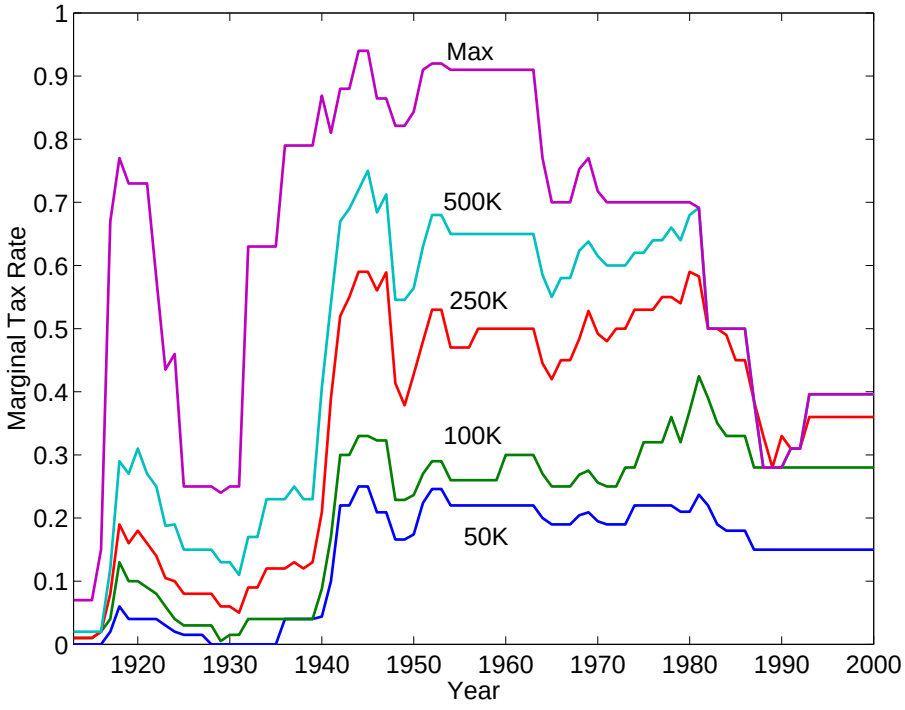


Figure 2: Average Marginal Investment Income Tax Rates
The dollar-weighted average marginal tax rates on dividend income, interest income, and capital gains are depicted between 1917 and 2000. The tax rates include taxes imposed by state and local governments.

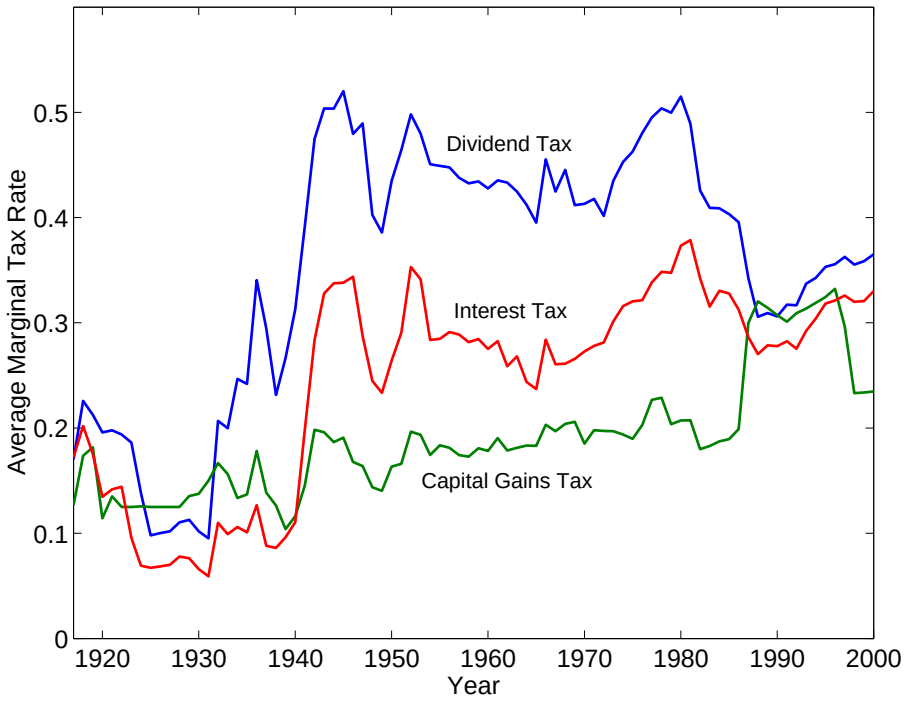


Figure 3: Dividend Yield
The annual dividend yield is depicted for the Standard and Poor's Composite Index. The dotted curve corresponds to the 10-year moving average of the dividend yield.

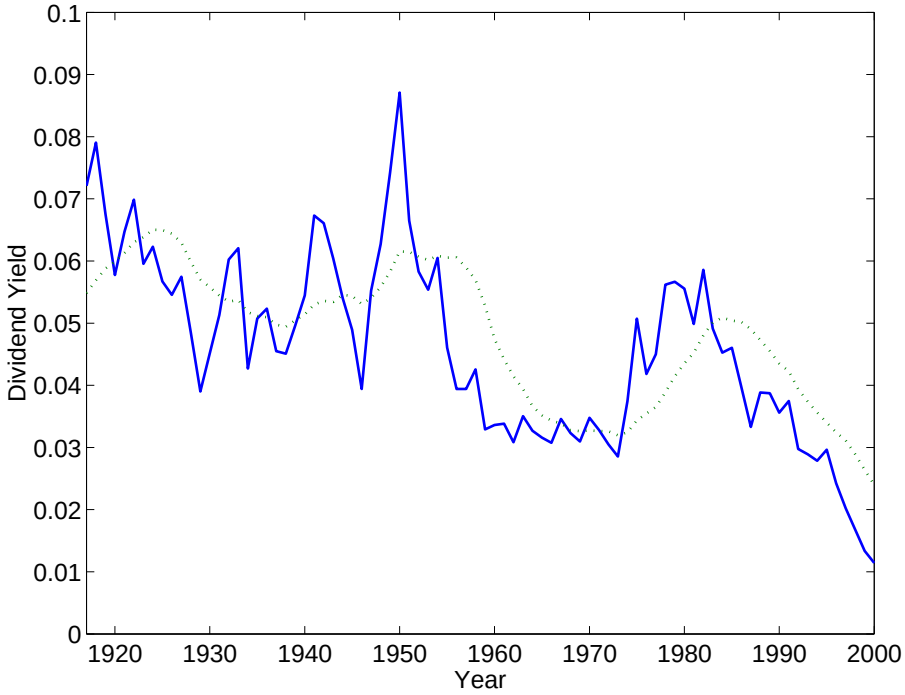


Figure 4: Proportion of Stocks Held by Taxable Investors
This figure depicts the proportion of U.S. stocks that are held by domestic investors in taxable accounts. The remaining stocks are held in pension funds, in tax-deferred saving vehicles, or by tax-exempt institutions.

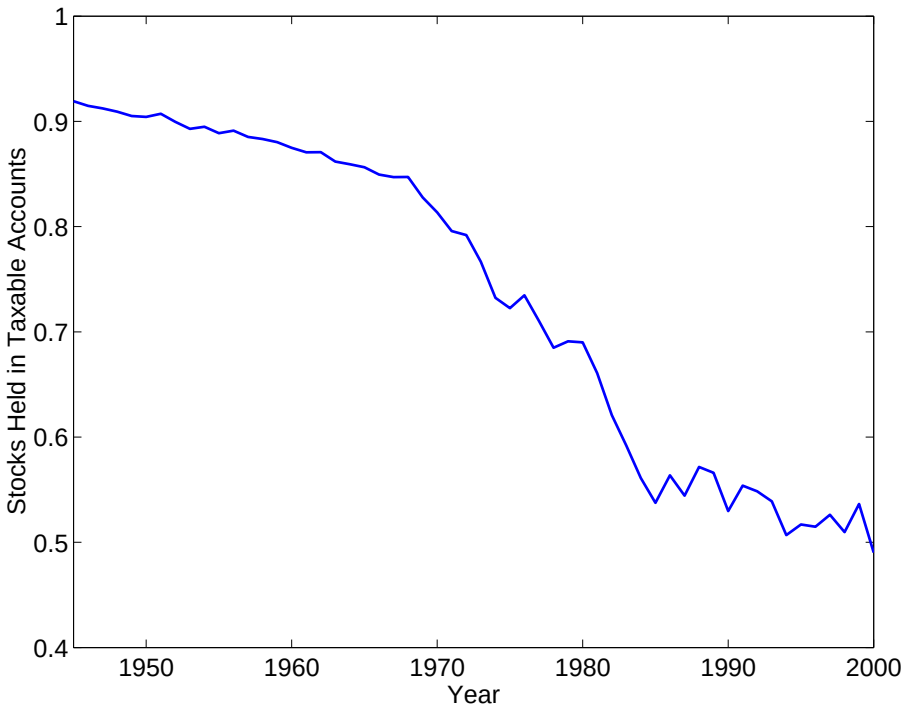


Figure 5: Effective Tax Rate on Stock Returns
This figure depicts the average marginal tax rates for dividends, the effective tax rates for stocks held by taxable investors, and the effective tax rates for all stocks. The effective tax rates are estimated using the average marginal capital gains and dividend tax rates, the dividend and the capital gains yield, and the proportion of stocks held by taxable investors.

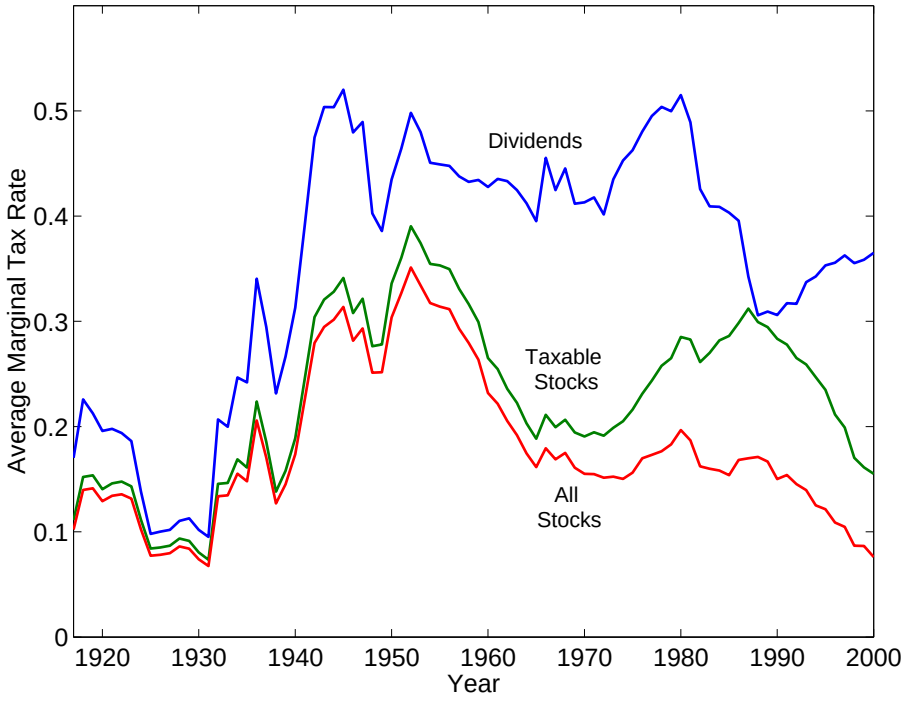


Figure 6: Stock Valuation Ratios
The price-earnings ratio is depicted over the period from 1917-2000. The solid curve depicts the ratio between the S&P Composite index value at the beginning of each year divided by the earnings generated in this year. The dotted curve shows the ratio between the S&P Composite index value at the beginning of each year divided by the average of the real earnings over the previous ten years.

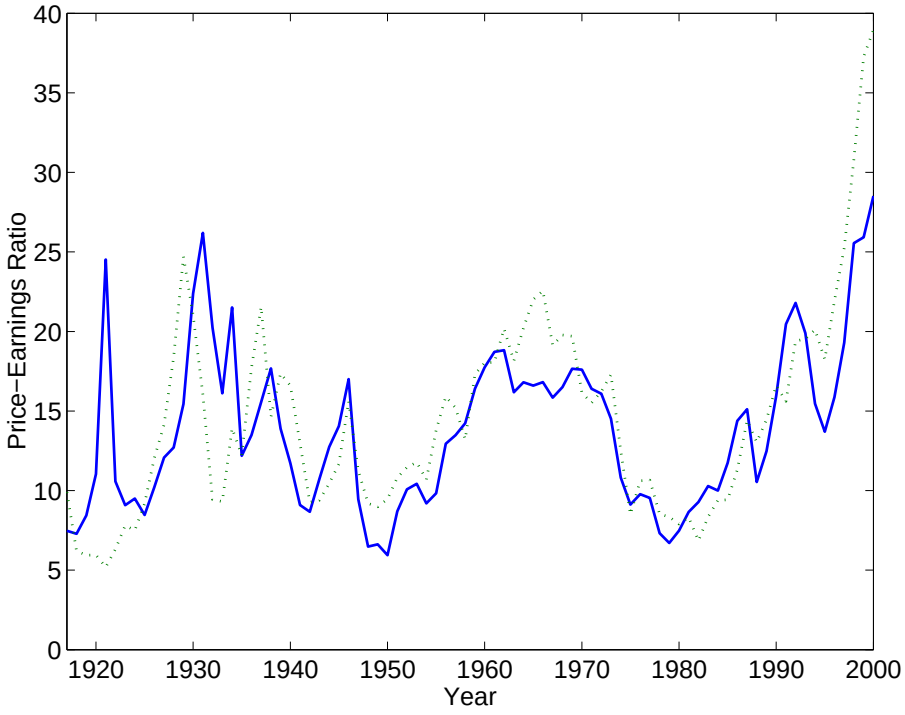


Figure 7: Relationship between Tax Rates and Price-Earnings Ratio
This figure shows the relationship between the effective tax rate and the price-earnings ratio. The solid line results from a univariate regression over the whole period. The coefficient values and their standard errors are summarized in Table 4.

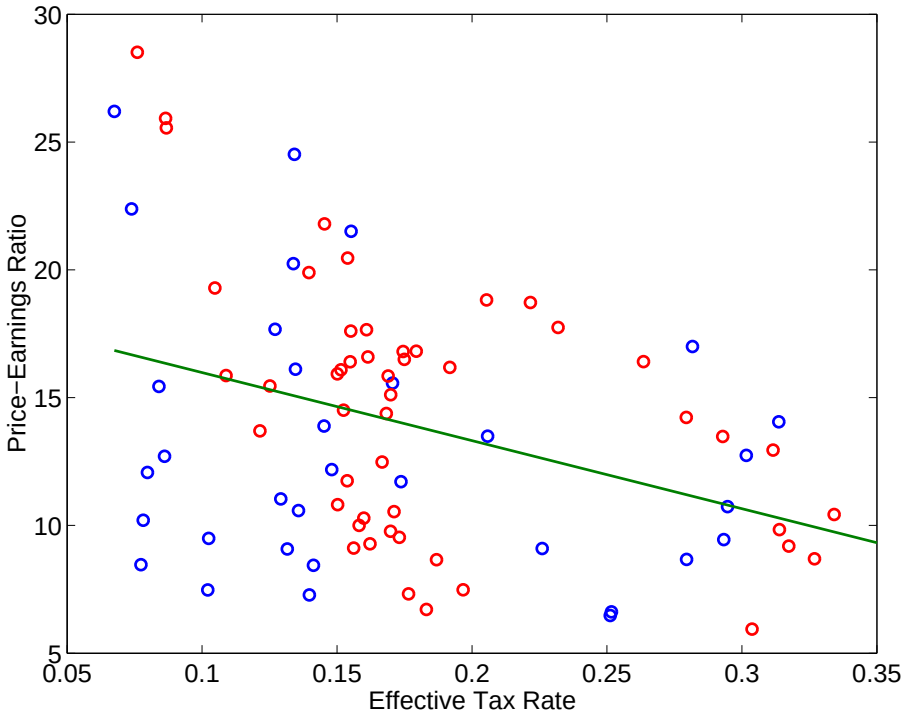
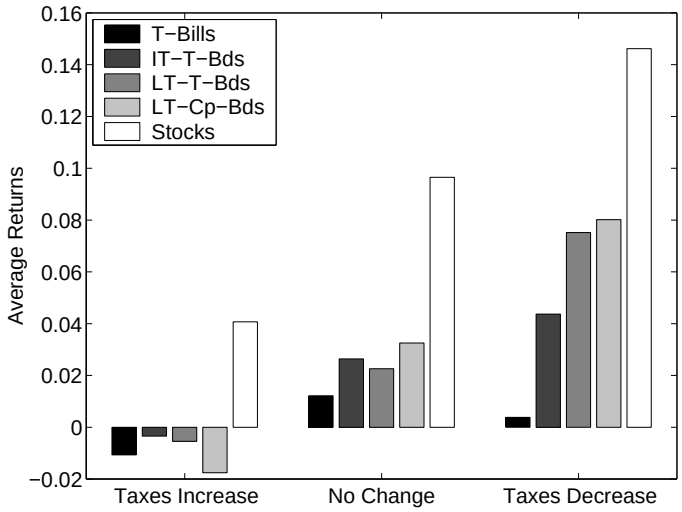


Figure 8: Tax Changes and Asset Returns
The average real returns of five assets are depicted for years prior to periods where the marginal tax rate for an individual in the middle tax bracket increases by more than 2.5 percent (Taxes Increase), where it changes by less than 2.5 percent (No Change), and where it decreases by more than 2.5 percent (Taxes Decrease). The p-values of the average returns are summarized in Table 7.

Panel A: 1926-1999



Panel B: 1950-1999

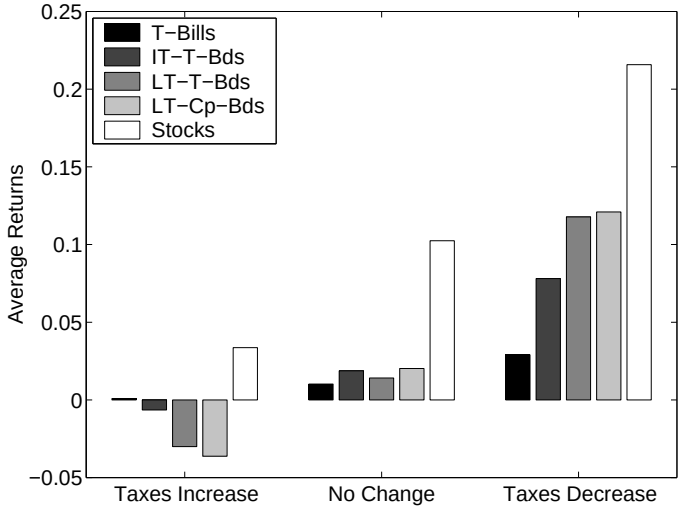


Table 1: Summary Statistics of Tax Rates
This table summarizes the time-series of different tax rates. The first row shows the marginal income tax rate for a household with a real income level of $250,000 expressed in consumer prices of 1999. The second row summarizes the marginal income tax rates in the highest tax bracket. Rows three to six show summary statistics for the average marginal tax rates for dividend income, long-term realized capital gains, interest income, and wages. Rows seven and eight summarize the effective tax rates on stock returns for taxable investors and for all investors, respectively.

Income Source	Mean	Std.	Min.	Max.
Panel A: 1917-2000				
Income of $250,000	36.38	17.46	5.00	59.00
Highest Income	64.55	22.42	24.00	94.00
Dividends	35.55	12.17	9.52	52.01
Long-Term Capital Gains	19.08	5.65	10.40	33.23
Interest Income	24.34	9.48	5.92	37.86
Wages	20.03	10.65	2.92	35.99
Taxable Stocks Returns	22.76	7.97	7.34	39.04
All Stocks Returns	17.89	7.24	6.75	35.12
Panel B: 1917-1949				
Income of $250,000	22.17	18.78	5.00	59.00
Highest Income	64.29	23.89	24.00	94.00
Dividends	26.47	13.94	9.52	52.01
Long-Term Capital Gains	14.61	2.59	10.40	19.84
Interest Income	15.57	9.26	5.92	34.38
Wages	8.87	7.19	2.92	24.75
Taxable Stocks Returns	17.64	7.94	7.45	33.24
All Stocks Returns	16.19	7.26	6.85	30.55
Panel C: 1950-2000				
Income of $250,000	45.58	7.80	28.00	59.00
Highest Income	64.72	21.66	28.00	92.00
Dividends	41.43	5.64	30.57	51.50
Long-Term Capital Gains	21.98	5.19	16.34	33.23
Interest Income	30.02	3.25	23.70	37.86
Wages	27.25	4.46	17.62	35.99
Taxable Stocks Returns	25.84	5.90	15.50	39.04
All Stocks Returns	18.79	6.84	7.60	35.12

Table 2: Correlation Coefficients of Tax Rates
This table summarizes the correlation coefficients between different tax rates. The first column uses the marginal income tax rate for a household with a real income level of $250,000. The second column uses the marginal income tax rates for the highest tax bracket. Columns three to six show the correlations for the average marginal tax rates for dividend income, long-term realized capital gains, interest income, and wages. Columns seven and eight summarize the correlations of the tax rates on stock returns for taxable investors and for all investors, respectively.

Income Source	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: 1917-2000							
(1) Income of $250,000	1						
(2) Highest Income	0.51	1					
(3) Dividends	0.96	0.62	1				
(4) Long-Term Capital Gains	0.36	−0.34	0.33	1			
(5) Interest Income	0.91	0.27	0.88	0.61	1		
(6) Wages	0.83	0.04	0.77	0.72	0.95	1	
(7) Taxable Stocks Returns	0.76	0.50	0.81	0.38	0.75	0.63	1
(8) All Stocks Returns	0.63	0.78	0.70	−0.05	0.47	0.25	0.86
Panel B: 1917-1949							
(1) Income of $250,000	1						
(2) Highest Income	0.70	1					
(3) Dividends	0.94	0.85	1				
(4) Long-Term Capital Gains	0.65	0.48	0.65	1			
(5) Interest Income	0.95	0.73	0.90	0.72	1		
(6) Wages	0.98	0.68	0.92	0.70	0.97	1	
(7) Taxable Stocks Returns	0.95	0.82	0.99	0.66	0.92	0.94	1
(8) All Stocks Returns	0.95	0.82	0.99	0.67	0.92	0.94	0.99
Panel C: 1950-2000							
(1) Income of $250,000	1						
(2) Highest Income	0.76	1					
(3) Dividends	0.93	0.79	1				
(4) Long-Term Capital Gains	−0.77	−0.82	−0.75	1			
(5) Interest Income	0.33	−0.15	0.38	0.05	1		
(6) Wages	−0.02	−0.62	−0.08	0.38	0.78	1	
(7) Taxable Stocks Returns	0.14	0.31	0.22	−0.13	0.13	−0.21	1
(8) All Stocks Returns	0.42	0.76	0.53	−0.52	−0.09	−0.60	0.83

Table 3: Summary Statistics
This table summarizes the macroeconomic variables used in the empirical analysis. The P-E and P-D ratios are the ratios of the S&P Composite index values at the beginning of each year divided by the earnings and the dividends in the corresponding years. The P-E10 and the P-D10 are price-earnings and price-dividend ratios which use the moving averages of earnings and dividends during the previous ten years. The table summarizes also the inflation rate, the growth rate of the economy, and the nominal interest rate.

	Mean	Std.	Min.	Max.
Panel A: 1917-2000				
P-E Ratio	13.88	5.11	5.94	28.51
P-D Ratio	24.96	12.09	11.48	87.62
P-E10 Ratio	14.53	6.40	5.19	38.95
P-D10 Ratio	26.28	13.66	8.86	89.60
Inflation Rate (in %)	3.41	5.40	−11.05	19.66
Growth Rate (in %)	2.03	6.95	−23.97	22.12
Interest Rate (in %)	4.84	3.36	0.53	17.63
Panel B: 1917-1949				
P-E Ratio	13.11	5.21	6.48	26.20
P-D Ratio	18.14	3.30	12.65	25.63
P-E10 Ratio	12.18	4.96	5.19	24.70
P-D10 Ratio	18.11	6.76	8.86	39.59
Inflation Rate (in %)	2.41	7.65	−11.05	19.66
Growth Rate (in %)	2.00	10.41	−23.97	22.12
Interest Rate (in %)	2.80	2.22	0.53	7.44
Panel C: 1950-2000				
P-E Ratio	14.37	5.04	5.94	28.51
P-D Ratio	29.37	13.61	11.48	87.62
P-E10 Ratio	16.06	6.80	6.85	38.95
P-D10 Ratio	31.57	14.42	16.11	89.60
Inflation Rate (in %)	4.06	3.12	−0.74	13.91
Growth Rate (in %)	2.06	3.29	−5.47	10.43
Interest Rate (in %)	6.17	3.31	1.32	17.63

Table 4: Multivariate Regression Estimates of the Price-Earnings Ratio
This table summarizes the regression results of the price-earnings ratio on the effective tax rate, the inflation rate, the per-capita real growth rate of GDP, and a short-term interest rate. The Newey-West standard errors are summarized in parentheses and use a two year lag. The instruments for the IV-estimation are the lagged effective tax rate, the lagged inflation rate, the lagged real growth rate, the lagged interest rate, and the lagged top marginal income tax rate. The significance levels are abbreviated with asterisks: One, two, and three asterisks denote significance at the 10, 5, and 1 percent level, respectively.

		OLS		IV
Panel A: 1917-2000				
Effective Tax: α_1	-26.63^{***}	-26.29^{**}		-19.76^{**}
	(10.32)	(11.04)		(9.80)
Inflation Rate: α_2		-28.49^{***}	-38.01^{***}	-54.41^{***}
		(11.36)	(9.57)	(15.59)
Growth Rate: α_3		-12.06^{*}	-10.64	7.59
		(7.31)	(7.16)	(21.29)
Interest Rate: α_4		-26.57	-1.72	-3.32
		(16.42)	(20.81)	(23.75)
R^2	0.14	0.33	0.22	0.24
Panel B: 1917-1949				
Effective Tax: α_1	-17.92	-22.00		-2.13
	(14.79)	(15.43)		(32.69)
Inflation Rate: α_2		-23.43^{**}	-30.73^{***}	-56.35^{*}
		(10.32)	(9.71)	(30.23)
Growth Rate: α_3		-20.23^{***}	-17.03^{**}	5.66
		(6.48)	(7.64)	(22.22)
Interest Rate: α_4		-91.91^{**}	-40.99	-12.00
		(37.33)	(31.68)	(97.20)
R^2	0.07	0.47	0.41	0.20
Panel C: 1950-2000				
Effective Tax: α_1	-37.41^{***}	-56.17^{***}		-56.00^{***}
	(12.12)	(10.96)		(14.51)
Inflation Rate: α_2		-57.44^{***}	-76.46^{**}	-36.47^{***}
		(17.60)	(30.15)	(33.05)
Growth Rate: α_3		-16.21	-3.17	6.39
		(13.41)	(20.34)	(56.92)
Interest Rate: α_4		-62.46^{***}	7.75	-79.72^{*}
		(22.82)	(41.11)	(45.38)
R^2	0.26	0.64	0.20	0.59

Table 5: Price-Earnings Regressions with Different Tax Variables
This table summarizes the regression results of the price-earnings ratio on different tax rates, the inflation rate, the growth rate, and the short-term interest rate. Six different variables are considered for taxes: Column (1) repeats the results in the base case with the effective tax rate; Column (2) uses the current dividend and capital gains yield instead of the 10-year moving average to compute the effective tax rate; Column (3) assumes that the dividend and the capital gains yield are constant and equal their sample averages; Column (4) uses the average marginal tax rate for dividends; Column (5) uses the statutory tax rate for an individual in the highest tax bracket; And column (6) uses the statutory tax rate for an individual with a real income of $250,000. The Newey-West standard errors are summarized in parentheses and use a two-year lag. The significance levels are abbreviated with asterisks: One, two, and three asterisks denote significance at the 10, 5, and 1 percent level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: 1917-2000						
Tax Rate	-26.29^{**}	-34.68^{***}	-13.97	-1.46	-5.67	-1.03
	(11.04)	(8.50)	(13.89)	(5.86)	(4.11)	(3.63)
Inflation Rate	-28.49^{***}	-18.46^{*}	-32.49^{***}	-36.90^{***}	-29.98^{***}	-36.93^{***}
	(11.36)	(11.21)	(10.36)	(9.65)	(9.17)	(9.66)
Growth Rate	-12.06^{*}	-11.87^{*}	-10.86	-10.52	-12.54	-10.68
	(7.31)	(6.88)	(7.42)	(7.36)	(7.04)	(7.22)
Interest Rate	-26.57	-31.27^{**}	-9.65	-1.51	-19.69	-0.93
	(16.42)	(12.51)	(19.70)	(20.76)	(20.15)	(21.28)
R^2	0.33	0.47	0.24	0.22	0.22	0.27
Panel B: 1917-1949						
Tax Rate	-22.00	-26.03^{*}	-20.09	-11.35	-3.72	-8.50^{*}
	(15.43)	(13.67)	(16.80)	(9.01)	(5.34)	(4.70)
Inflation Rate	-23.43^{**}	-19.61^{*}	-24.26^{**}	-23.68^{**}	-25.96^{**}	-22.45^{**}
	(10.32)	(10.40)	(9.98)	(10.30)	(10.31)	(10.43)
Growth Rate	-20.23^{***}	-19.96^{***}	-19.74^{***}	-19.96^{***}	-19.17^{**}	-21.34^{***}
	(6.48)	(6.08)	(6.70)	(6.58)	(7.38)	(6.29)
Interest Rate	-91.91^{**}	-100.38^{**}	-85.15^{**}	-91.29^{**}	-63.82	-81.69^{**}
	(37.33)	(37.43)	(39.52)	(41.13)	(39.24)	(30.98)
R^2	0.47	0.53	0.44	0.22	0.43	0.47
Panel C: 1950-2000						
Tax Rate	-56.17^{***}	-50.65^{***}	-51.29^{**}	-45.25^{***}	-10.16^{**}	-28.80^{**}
	(10.96)	(9.02)	(21.18)	(16.80)	(4.54)	(12.81)
Inflation Rate	-57.44^{***}	-24.37^{*}	-47.06^{*}	-36.90	-58.16^{**}	-50.11^{*}
	(17.60)	(13.29)	(27.21)	(27.63)	(27.17)	(28.10)
Growth Rate	-16.21	-5.84	-5.90	-5.49	-5.80	-6.05
	(13.41)	(10.71)	(18.09)	(15.60)	(16.79)	(15.64)
Interest Rate	-62.46^{***}	-45.69^{***}	-36.77	-12.95	-30.07	3.40
	(22.82)	(15.72)	(31.39)	(27.49)	(30.74)	(31.03)
R^2	0.64	0.71	0.38	0.42	0.37	0.35

Table 6: Tax Regressions with Different Valuation Ratios
This table summarizes the regression results of different valuation ratios on the effective tax rate, the inflation rate, the real growth rate of GDP per capita, and a short-term interest rate. Four different variables are considered for the equity valuation: Column (1) repeats the results in the base case with the price-earnings ratio; Column (2) uses the ratio of the S&P Composite index divided by the moving average of the real earnings during the last 10 years as the dependent variable; Column (3) uses the ratio of the S&P Composite index divided by the dividend payments of the companies in the index; Column (4) uses the ratio of the S&P Composite index divided by the moving average of the real dividends during the last 10 years as the dependent variable. The significance levels are abbreviated with asterisks: One, two, and three asterisks denote significance at the 10, 5, and 1 percent level, respectively.

Dependent Variable	P-E	P-E10	P-D	P-D10
Panel A: 1917-2000				
Tax Rate	-26.29^{**}	-30.09^{*}	-49.25	-49.14
	(11.04)	(15.89)	(34.73)	(37.32)
Inflation Rate	-28.49^{***}	-15.81	-12.08	-27.72
	(11.36)	(18.97)	(33.09)	(36.53)
Growth Rate	-12.06^{*}	14.35	16.55	28.33
	(7.31)	(12.00)	(18.23)	(23.71)
Interest Rate	-26.57	-26.42	32.26	39.35
	(16.42)	(24.11)	(47.41)	(56.64)
R^2	0.33	0.15	0.11	0.10
Panel B: 1917-1949				
Tax Rate	-22.00	-35.06^{***}	-15.06^{*}	-41.64^{**}
	(15.43)	(9.69)	(7.66)	(16.01)
Inflation Rate	-23.43^{**}	-5.47	-2.48	-6.16
	(10.32)	(11.65)	(12.29)	(19.40)
Growth Rate	-20.23^{***}	-0.03	-5.91	0.11
	(6.48)	(9.04)	(7.54)	(13.91)
Interest Rate	-91.91^{**}	-145.20^{**}	-80.26^{**}	-121.18
	(37.33)	(58.99)	(35.65)	(100.08)
R^2	0.47	0.30	0.18	0.17
Panel C: 1950-2000				
Tax Rate	-56.17^{***}	-73.50^{***}	-158.47^{***}	-156.82^{***}
	(10.96)	(19.65)	(46.69)	(49.99)
Inflation Rate	-57.44^{***}	-47.79^{*}	-79.73^{*}	-97.42^{**}
	(17.60)	(26.10)	(40.12)	(48.02)
Growth Rate	-16.21	9.92	7.75	20.93
	(13.41)	(18.12)	(30.19)	(34.32)
Interest Rate	-62.46^{***}	-97.15^{**}	-135.62^{**}	-157.43
	(22.82)	(38.64)	(65.19)	(77.04)
R^2	0.64	0.56	0.55	0.51

Table 7: Tax Changes and Asset Returns
This table summarizes the average real returns of Treasury bills, intermediate- and long-term Treasury bonds, long-term corporate bonds, and large stocks in the year prior to periods where the effective tax rate increase and decrease by more than 2.5 percentage points, and where it changes by less than 2.5 percentage points (No Change). The bootstrapped p-values are shown in brackets. The (two-sided) significance levels are abbreviated with asterisks: One, two, and three asterisks denote significance at the 10, 5, and 1 percent level, respectively. All the values are expressed in percent.

	Taxes Increase	No Change	Taxes Decrease	Difference
Panel A: 1926-1999				
T-Bills	-1.07^{*}	1.44	0.38	-1.44
	[3.86]	[87.22]	[36.89]	[19.59]
IT-T-Bds	-0.34	2.80	4.37	-4.71
	[6.14]	[69.30]	[81.56]	[5.43]
LT-T-Bds	-0.54	2.57	7.52	-8.06^{*}
	[12.54]	[52.84]	[91.96]	[3.74]
LT-Corp-Bds	-1.76^{**}	3.51	8.02^{*}	-9.77^{**}
	[2.10]	[66.76]	[93.09]	[1.07]
Stocks	4.07	11.08	14.62	-10.55
	[11.92]	[65.33]	[75.18]	[10.30]
Panel B: 1950-1999				
T-Bills	0.09	1.02	2.90	-2.82
	[29.31]	[64.43]	[92.29]	[8.29]
IT-T-Bds	-0.65	1.87	7.81^{**}	-8.46^{**}
	[9.65]	[36.70]	[97.62]	[0.80]
LT-T-Bds	-3.01^{*}	1.41	11.78^{**}	-14.78^{***}
	[4.94]	[27.57]	[98.46]	[0.33]
LT-Corp-Bds	-3.62^{**}	2.02	12.10^{**}	-15.72^{***}
	[1.72]	[30.65]	[98.77]	[0.11]
Stocks	3.36	10.25	21.58	-18.21^{*}
	[16.18]	[52.59]	[93.61]	[3.67]

Table 8: Regressions of Asset Returns on Tax Changes
Asset returns are regressed on the level of the tax rates, on tax rate changes, on the inflation rate, and on the growth rate. The IV-estimation uses the following instruments: a constant, a lagged tax rate, a lagged inflation rate, a lagged growth rate, and a current and a lagged implicit tax rate on municipal bonds. The standard errors of the coefficients are given in brackets and are robust to autocorrelation and heteroscedasticity. The significance levels are abbreviated with asterisks: '*', '**', and '***' are significant at the 10, 5, and 1 percent level.

Asset	Tax Level	Tax Change	Inflation Rate	Growth Rate	R^2
	α_1	α_2	α_3	α_4	
Panel A: OLS					
T-Bills	0.02	−0.10	−0.67***	−0.15**	0.62
	(0.03)	(0.08)	(0.16)	(0.09)	
IT-T-Bds	−0.02	−0.27	−0.86***	−0.12	0.42
	(0.04)	(0.20)	(0.15)	(0.09)	
LT-T-Bds	−0.01	−0.40	−1.19***	−0.07	0.32
	(0.06)	(0.30)	(0.20)	(0.12)	
LT-Corp-Bds	−0.04	−0.49	−1.10***	0.01	0.37
	(0.06)	(0.31)	(0.18)	(0.10)	
Stocks	0.16	−0.72*	−1.42*	0.58	0.10
	(0.18)	(0.43)	(0.74)	(0.52)	
Panel B: IV					
T-Bills	−0.08	−0.62*	−0.16	−0.09	0.27
	(0.08)	(0.33)	(0.40)	(0.28)	
IT-T-Bds	−0.26**	−1.25**	0.24	0.49	0.08
	(0.13)	(0.55)	(0.69)	(0.52)	
LT-T-Bds	−0.26	−1.22*	−0.09	0.63	0.11
	(0.16)	(0.67)	(0.82)	(0.57)	
LT-Corp-Bds	−0.31	−1.49**	−0.26	0.64	0.16
	(0.15)	(0.70)	(0.84)	(0.57)	
Stocks	0.10	−0.90	−0.75	0.25	0.07
	(0.28)	(0.92)	(1.32)	(0.89)	