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Tax Changes and Asset Pricing

By Clemens Sialm*

The tax burden on equity securities has varied substantially over time and remains a source of continuing policy debate. This paper investigates whether investors were compensated for the tax burden of equity securities over the period between 1913 and 2006. Taxes on equity securities vary over time due to changes in dividend and capital gains tax rates and due to changes in corporate payout policies. Equity taxes also vary across firms due to persistent differences in propensities to pay dividends. The results indicate an economically plausible and statistically significant tax capitalization over time and cross-sectionally. (*JEL* G10, G12, H22, H24, N21, N22)

The tax burden on equity securities has varied substantially since US federal income taxes were introduced in 1913. Taxes on equity securities vary over time due to changes in dividend and capital gains tax rates and due to changes in corporate payout policies. Equity taxes also vary across firms due to persistent differences in propensities to pay dividends. Despite the continuing policy debate on the level of dividend and capital gains taxes, there is a paucity of evidence regarding the effects of tax changes on equity valuations. This study investigates empirically whether changes in investment tax rates had an impact on US equity prices over the period between 1913 and 2006.

My paper contrasts two hypotheses of whether taxes are capitalized into equity valuations. Under the tax capitalization hypothesis, aggregate equity valuation measures are inversely related to the tax burden on equity securities. In this case, an increase in investment tax rates reduces the valuation of equity securities generating higher expected before-tax returns. The higher expected returns compensate taxable investors for their increased tax burden. Thus, aggregate equity valuation levels should be relatively low during time periods when investment taxes are high.

In contrast to the tax capitalization hypothesis, Merton H. Miller and Myron S. Scholes (1978) postulate that investment taxes can be avoided in perfect capital markets and that the marginal

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investor is tax-exempt. Under their tax irrelevance hypothesis, investment taxes do not have an impact on equity prices and equity returns. Similarly, investors can also reduce the overall tax burden by sorting themselves into clienteles, where low-tax or tax-exempt investors hold high-dividend yield stocks and high-tax investors hold low- or no-dividend yield stocks, as discussed by Miller and Franco Modigliani (1961) and Franklin Allen, Antonio E. Bernardo, and Ivo Welch (2000). If investors form strong dividend clienteles, then the effect of the income tax burden on equity prices should be small or negligible.

In addition to the time-series variation in tax burdens, there is significant cross-sectional variation. Since dividends tend to be taxed more heavily than capital gains, stocks that distribute a larger fraction of their total returns as dividends tend to be taxed more heavily than stocks that distribute a smaller fraction of dividends. Based on this observation, Michael J. Brennan (1970) derives the after-tax capital asset pricing model (CAPM), where the before-tax return of stocks is positively related to the tax burden of equity securities in the cross section. In his model, stocks paying higher dividend yields should exhibit higher risk-adjusted returns than stocks paying lower or no dividends. These cross-sectional return differences between stocks with differential dividend yields should be particularly pronounced during time periods when dividends are heavily taxed relative to capital gains.

My paper documents substantial time-series and cross-sectional variation in effective tax rates on equity securities. I compute effective personal tax rates on equity securities using the average statutory tax rates on dividend and capital gains for equity investors and using the dividend distribution policies of corporations. I follow James M. Poterba (1987b) in constructing dollar-weighted average tax rates for dividends and short- and long-term capital gains. I find that the aggregate tax burden on equity securities has fluctuated substantially over time. Annual investment taxes on equity securities amounted to more than 3.5 percent of the aggregate value of equity securities in 1950 and declined to 0.4 percent of the value of equity securities in 2006. The aggregate tax burden on equity securities has recently decreased for several reasons. First, tax reforms reduced the statutory tax rates on dividends and capital gains. For example, the top marginal tax rate on dividend income exceeded 90 percent in several years during the 1940s and 1950s and dropped to 15 percent after the 2003 tax reform. Second, the opportunities to invest in tax-qualified environments such as pensions and tax-deferred retirement accounts were expanded significantly over the last decades. In 2006, more than 50 percent of equity securities were held by tax-exempt institutions or in tax-qualified accounts, whereas less then 10 percent of equity securities were held in such tax-sheltered environments before the mid-1950s. Third, corporations replaced a significant fraction of relatively highly taxed dividends with share repurchases reducing the average dividend yield from more than 5 percent prior to the 1980s to around 3 percent after the 1970s. In addition to the time-series variation in tax burdens, there is a significant cross-sectional variation in tax burdens. Dividend paying stocks faced, on average, an effective tax rate that is more than three times the effective tax rate of nondividend paying stocks.

To investigate the relation between investment tax rates and equity prices, I perform two empirical tests. The first test studies the time-series relation between effective tax burdens on equity securities and the aggregate equity valuation levels over the period between 1913 and 2006. Consistent with the tax capitalization hypothesis, I find an economically and statistically significant negative relation between equity valuations and effective tax rates. The negative relation remains robust after controlling for other macroeconomic variables, using alternative proxies for the tax burden, and dividing the sample into subperiods.

The time-series results are consistent with Ellen R. McGrattan and Edward C. Prescott (2005), who derive the quantitative impact of tax and regulatory changes on equity values using a growth theory model. They show that these regulatory changes can explain the large secular movements in corporate equity values relative to GDP over the period between 1960 and 2001. McGrattan and Prescott (2005) base their inferences on a carefully calibrated growth model. However, they do not perform an econometric analysis of the relation between tax rates and asset valuations. My paper contributes to the literature by investigating empirically the relation between aggregate equity valuations and effective tax rates since federal income taxes were introduced in 1913.

The second test investigates the cross-sectional relation between risk-adjusted stock returns and tax burdens on stock portfolios based on the model of Brennan (1970). Tax capitalization implies that high-dividend stocks offer higher risk-adjusted returns than low-dividend stocks, particularly in time periods of high tax rates. I find that risk-adjusted returns of US common stocks over the period between 1927 and 2006 are positively related to their tax burdens, which depend on the dividend yields of the stocks and on the average dividend and capital gains tax rates of equity investors. The impact of taxes on asset returns is economically and statistically significant and remains robust over several subperiods, using various measures of the effective tax rate, and using different econometric specifications.

The cross-sectional results are related to an extensive literature that investigates the effect of dividend yields on equity returns.[1] The results of this literature are sensitive to how dividend yields are measured and whether dividend yields capture omitted risk factors. Black and Scholes (1974) investigate the dividend tax capitalization by adding the dividend yield during the prior 12 months as an independent variable to the market model. They do not find a significant relation between asset returns and dividend yields. On the other hand, Litzenberger and Ramaswamy (1979) find a positive and statistically significant dividend yield coefficient focusing on months in which companies pay dividends. Miller and Scholes (1982) argue that the tests by Litzenberger and Ramaswamy (1979) are due to informational biases and not tax effects, since the estimated dividend yield relies on information that is not yet available to investors.

A second concern of the literature is that dividend yields could capture omitted risk factors. For example, Gordon and Bradford (1980) document that the valuation of dividends is not stable over time and follows a cyclical pattern, indicating that dividend yields might be correlated with systematic risk factors. Similarly, Chen, Grundy, and Stambaugh (1990) and Fama and French (1993) show that common pricing factors are correlated with the dividend yield and suggest using multifactor models of equity returns. More recently, Naranjo, Nimalendran, and Ryngaert (1998) correct for the Fama and French (1993) asset pricing factors to demonstrate that stock returns are positively related to the dividend yield during the period from 1963 to 1994.

Despite the numerous papers in this area, Graham argues that "the profession has made only modest progress documenting whether investor taxes affect asset prices" (2003, 1120). The cross-sectional test in my paper sheds light on this extensive literature by taking into account the substantial time-series variation in dividend and capital gains tax rates. Whereas the dividend yield literature has focused primarily on the relation between dividend yields and equity returns, I investigate the relation between stock returns and their overall tax burden, which depends not only on the dividend yield but also on the dividend and the capital gains tax rates. In addition, my sample covers a substantially longer time horizon than previous studies, improving the power of the econometric tests.

[1] The studies include, for example, Fischer Black and Scholes (1974); Robert H. Litzenberger and Krishna Ramaswamy (1979, 1982); Marshall E. Blume (1980); Roger H. Gordon and David F. Bradford (1980); Miller and Scholes (1982); Poterba and Lawrence H. Summers (1984); Donald B. Keim (1985); Nai-Fu Chen, Bruce Grundy, and Robert F. Stambaugh (1990); William G. Christie (1990); Peter Bossaerts and Robert M. Dammon (1994); Eugene F. Fama and Kenneth R. French (1998); Andy Naranjo, M. Nimalendran, and Mike Ryngaert (1998); Avner Kalay and Roni Michaely (2000); Trevor S. Harris, R. Glenn Hubbard, and Deen Kemsley (2001); Dan Dhaliwal et al. (2003); Dhaliwal, Oliver Zhen Li, and Robert Trezevant (2003); and Michelle Hanlon, James N. Myers, and Terry Shevlin (2003). See Alan Auerbach (2002), Franklin Allen and Michaely (2003), and John R. Graham (2003) for literature reviews.

The tests in my paper mitigate the two concerns of the dividend yield literature described above. My paper uses a dividend yield that is based only on information that is available to investors at the beginning of the return period and is therefore not subject to the informational biases described by Miller and Scholes (1982). Furthermore, my paper employs a multifactor pricing model to adjust for the main risk factors identified in the finance literature.

The paper is structured as follows. Section I derives the historical effective tax rates on equity returns. Section II reports the time-series results, investigating whether there is a relation between the effective tax rate and aggregate equity valuation ratios. Section III reports the results of the empirical test investigating whether there is a cross-sectional relation between equity returns and effective tax burdens. Section IV concludes.

I. Effective Tax Rates

This section derives effective tax rates on equity securities between 1913 and 2006.

A. *Definition of the Tax Burden on Equity Securities*

The effective tax burden on equity securities depends on the statutory tax rates and on the management style of the stock portfolio. The effective taxes on an equity portfolio can be reduced by holding stocks with low dividend yields, by deferring the realization of capital gains or accelerating the realization of capital losses, and by holding a larger proportion of the assets in tax-qualified environments (for example, pensions and tax-deferred retirement accounts).

The expected taxes paid on a portfolio depend first on the marginal dividend and on short- and long-term capital gains tax rates τ_t^{DIV}, τ_t^{SCG}, and τ_t^{LCG}. Second, the composition of the sources of income from equity investments has an important impact on the tax burden of a portfolio. Whereas the expected dividend income of portfolio k at time t $DIV_{k,t}$ is taxed at the dividend tax rate, the expected short- and long-term capital gains realizations $SCG_{k,t}$ and $LCG_{k,t}$ are taxed at the corresponding capital gains tax rates. The total expected tax payments on portfolio k at time t equal

$$T_{k,t} = \tau_t^{DIV}\, DIV_{k,t} + \tau_t^{SCG}\, SCG_{k,t} + \tau_t^{LCG}\, LCG_{k,t}. \tag{1}$$

The expected tax yield $\kappa_{k,t}$ is defined as the proportion of the prior-year value of the portfolio $P_{k,t-1}$ that is anticipated to be taxed:

$$\begin{aligned} \kappa_{k,t} &= \frac{T_{k,t}}{P_{k,t-1}} = \tau_t^{DIV}\frac{DIV_{k,t}}{P_{k,t-1}} + \tau_t^{SCG}\frac{SCG_{k,t}}{P_{k,t-1}} + \tau_t^{LCG}\frac{LCG_{k,t}}{P_{k,t-1}} \\ &= \tau_t^{DIV}\, y_{k,t}^{DIV} + \tau_t^{SCG}\, y_{k,t}^{SCG} + \tau_t^{LCG}\, y_{k,t}^{LCG}. \end{aligned} \tag{2}$$

The anticipated dividend yield $y_{k,t}^{DIV}$ is defined as the expected taxable dividends divided by the value of the portfolio in the prior year. Similarly, the expected short- and long-term capital gains yields $y_{k,t}^{SCG}$ and $y_{k,t}^{LCG}$ are defined as the proportions of the portfolio values that are anticipated to be realized either as short- or long-term capital gains. The remainder of this section and the Data Appendix explain in more detail how these variables are constructed.[2]

[2] The Data Appendix is available on the Web site of the American Economic Review: http://www.aeaweb.org/articles.php?doi=10.1257/aer.99.4.1356.

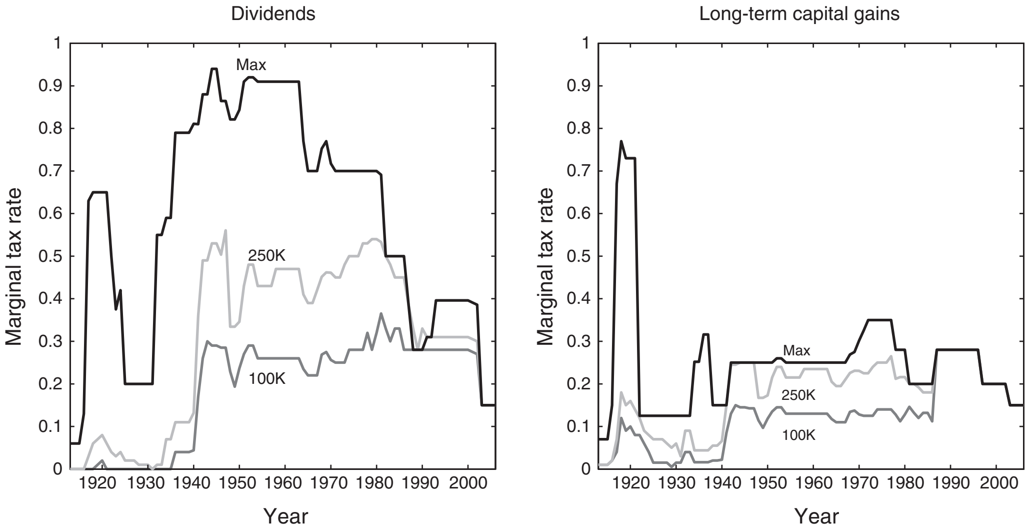

Figure 1. Statutory Federal Marginal Dividend and Long-Term Capital Gains Tax Rates

Notes: The marginal dividend and long-term capital gains tax rates are depicted over the period from 1913 to 2006 for three different real income levels. The two bottom curves correspond to the marginal income tax rates for households with real income levels of $100,000 and $250,000 expressed in 2006 consumer prices. The top curve corresponds to the marginal income tax rate for the top income tax bracket.

B. *Dividend and Capital Gains Tax Rates*

Marginal statutory tax rates on dividends and capital gains have fluctuated considerably. Figure 1 shows the statutory federal marginal dividend and long-term capital gains tax rates for households in three different real income brackets. The two lower income brackets correspond to real income levels of $100,000 and $250,000 expressed in 2006 consumer prices. The third bracket corresponds to the marginal tax rate for the top income bracket. Generally, dividend taxes are considerably higher and more volatile than long-term capital gains tax rates. For example, the top federal dividend tax rate has been as high as 94 percent in 1944 and 1945. The figure does not depict the marginal short-term capital gains tax rates, which are very similar to the marginal dividend tax rates, except for the period after the 2003 tax reforms.

To compute the average tax rates on dividends and capital gains for taxable investors, I follow Poterba (1987b) and construct dollar-weighted average tax rates for dividends and short- and long-term capital gains. Since 1917, the Internal Revenue Service (IRS) has published the distribution of income sources of taxpayers in several income brackets. The marginal tax rate can be determined for each of these income brackets. The value-weighted mean of the marginal tax rates of investors in the various income brackets is called the "average marginal tax rate." Prior to 1965, I hand-collected tax distribution data from different issues of the Statistics of Income of the IRS. Since 1965, the National Bureau of Economic Research (NBER) has published the average marginal tax rates on an annual basis.[3] Figure 2 depicts the average marginal tax rates of dividends and long-term capital gains for equities held by taxable investors. The average

[3] I thank Daniel Feenberg for computing some of these time series specifically for this project. The time series can be downloaded from http://www.nber.org/~taxsim.

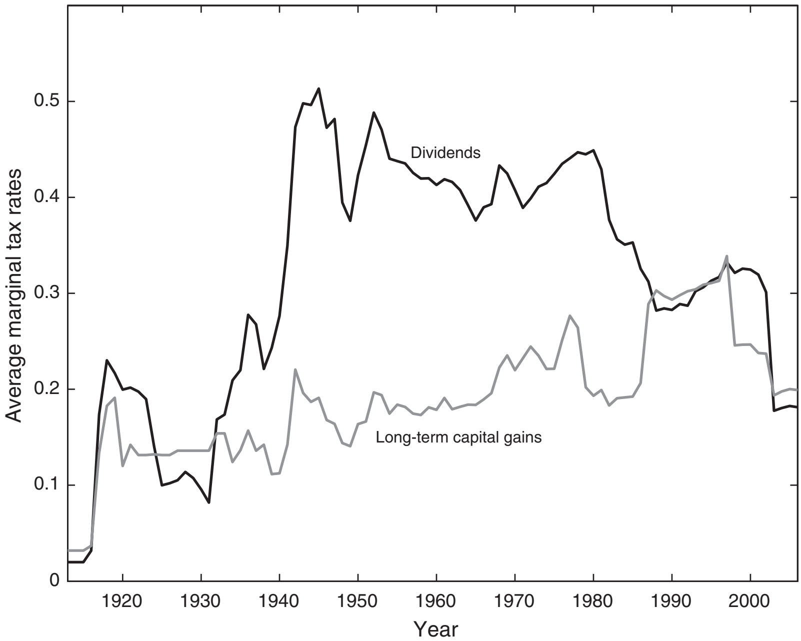

Figure 2. Average Marginal Investment Tax Rates for Taxable Investors

Notes: The dollar-weighted average marginal tax rates on dividends and long-term capital gains for taxable investors are depicted between 1913 and 2006. The tax rates include taxes imposed by state and local governments.

marginal tax rate on realized long-term capital gains is generally less than the average marginal dividend tax.

The expansion of various types of tax-qualified pension and retirement accounts has resulted in a substantial decline in the proportion of stocks held by taxable investors. The proportion of corporate equity held by taxable investors decreased from more than 90 percent in the 1950s to less than 50 percent in 2006 according to the Flow of Funds published by the Board of Governors of the Federal Reserve. Equity securities held in tax-qualified accounts or by tax-exempt institutions are assumed to face zero dividend and capital gains taxes. The overall average marginal tax rates for dividends and short- and long-term capital gains τ_t^{DIV}, τ_t^{SCG}, and τ_t^{LCG} from equation (2) are computed as the proportion of equities held by taxable investors multiplied by the average marginal tax rates on dividends and capital gains for taxable investors. These rates represent equity securities held by taxable and tax-qualified investors.[4]

[4] Dividends and capital gains realizations of stocks held in tax-qualified retirement accounts are tax-exempt. On the other hand, contributions to tax-deferred accounts are tax-deductible and withdrawals from tax-deferred accounts are taxed at the ordinary income tax rates. If households remain in the same tax bracket over their lifetime, then the deductibility of contributions and the taxation of withdrawals exactly offset each other. For a discussion of optimal portfolio decisions between tax-deferred and taxable accounts, see John B. Shoven and Sialm (2003), Dammon, Chester S. Spatt, and Harold H. Zhang (2004), and Jennifer Huang (2008).

C. *Dividends and Capital Gains Realizations*

The sources of investment income for equity securities varied considerably over the sample. Dividend income was the dominant source of income for stock holders during most of the period. In the 1980s and 1990s, dividend yields decreased substantially as companies retained a larger proportion of their earnings and as they increased share repurchases. This change in payout behavior of corporations was at least partially triggered by regulatory changes that eased share repurchases.[5]

The computation of the tax yield as described in equation (2) requires the anticipated dividend yield y_t^{DIV}, which is not observable. Since dividend payout policies are persistent over time, I assume in the base case that the anticipated dividend yield of each portfolio equals the actual dividend payments made during the prior year divided by the stock price one year ago. This definition ensures that the dividend yield is strictly based on past data and is not affected by the informational biases described by Miller and Scholes (1982).

Whereas the dividend distributions are relatively straightforward, it is more difficult to estimate anticipated capital gains distributions. The computation of capital gains yields takes into account that capital gains realizations tend to be smaller for companies that pay higher dividend yields. I assume that investors anticipate realizing a fixed proportion of the expected capital gains. The fixed proportion of short- and long-term capital gains realizations is based on the average propensities to realize capital gains over the whole sample period according to the IRS.[6]

The average short- and long-term capital gains yields over the whole sample period are 0.12 percent and 1.80 percent of the aggregate market value. The capital gains yields are relatively small for several reasons.[7] First, the realization of capital gains can be deferred indefinitely. The deferral of the realization of capital gains is beneficial because the present value of the tax liabilities decreases if the tax payments are postponed. Second, 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. Third, investors can avoid capital gains taxes by contributing their shares to a charitable organization. Finally, tax evasion is more prevalent for capital gains realizations than for dividends. Robustness tests reported in the paper document that the results are not affected qualitatively using alternative capital gains realization behaviors.[8]

[5] The SEC adopted Rule 10b-18 in 1982, which provides a safe harbor for repurchasing firms against the antimanipulative provisions of the Securities Exchange Act of 1934. See Allen and Michaely (2003) for additional details.

[6] As described in more detail in the Data Appendix, the short-term capital gains yield is defined as $y_{k,t}^{SCG} = \bar{y}_{IRS}^{SCG} \times (\bar{r}_M - y_{k,t}^{DIV})/(\bar{r}_M - \bar{y}_M^{DIV})$, where $\bar{y}_{IRS}^{SCG}$ is the average ratio of realized short-term capital gains relative to lagged equity values based on IRS data, $y_{k,t}^{DIV}$ is the actual dividend yield of portfolio k at time t, $\bar{y}_M^{DIV}$ is the average dividend yield of the market portfolio, and $\bar{r}_M$ is the average market return. The long-term capital gains yield is defined equivalently.

[7] George M. Constantinides (1984) and Dammon, Spatt, and Zhang (2001) show that investors can reduce or completely eliminate capital gains taxes by accelerating the realization of capital losses and by deferring the realization of capital gains.

[8] The assumption that only a fraction of the total capital gains are realized results in a lower effective tax rate on capital gains, as discussed by Martin Feldstein, Joel Slemrod, and Shlomo Yitzhaki (1981) and Poterba (1987a). This assumption implicitly takes into account the present value of future tax liabilities. My estimation method results in a ratio between the effective accrual rate of capital gains and the statutory rate of 26.6 percent, which is very close to the 25 percent used by Poterba (1987b). However, this capital gains realization behavior is more tax-efficient than the implied valuations of capital gains taxes from Richard C. Green and Burton Hollifield (2003) and J. B. Chay, Dosoung Choi, and Jeffrey Pontiff (2006). Poterba (1987a); Zoran Ivkovich, Poterba, and Scott Weisbenner (2005); and Li Jin (2006) analyze the capital gains realization behavior of individual and institutional investors. Daniel B. Bergstresser and Pontiff (2008) show the impact of various investment strategies on after-tax returns over the period between 1926 and 2002.

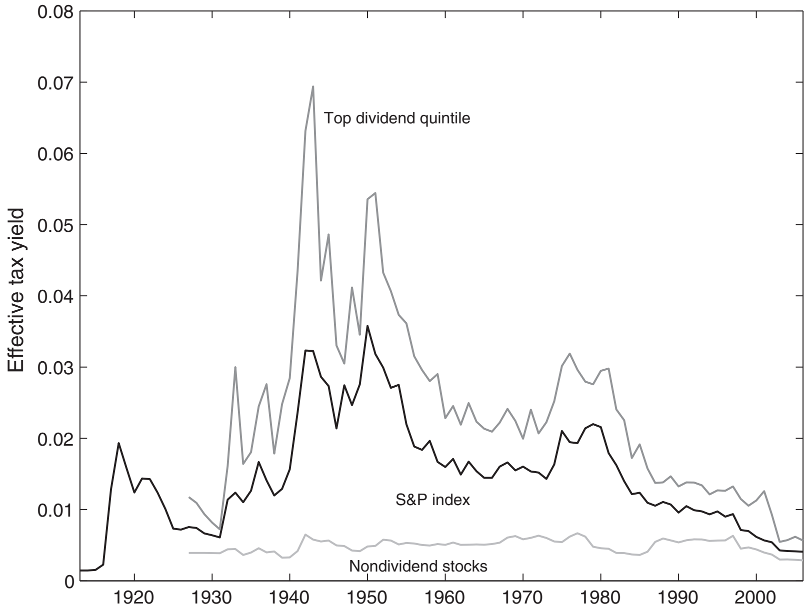

FIGURE 3. DISTRIBUTION OF EFFECTIVE TAX YIELDS

Notes: The effective tax yields are depicted for three stock portfolios. The middle curve corresponds to the effective tax yield of the S&P Composite Index between 1913 and 2006. The lower curve corresponds to the portfolio that includes all the stocks that did not pay any dividends in the previous 12 months, and the upper curve corresponds to the 20 percent of dividend-paying stocks with the highest dividend yields during the prior 12 months according to CRSP. The effective tax yield is defined as $\kappa_{k,t} = \tau_t^{DIV} y_{k,t}^{DIV} + \tau_t^{SCG} y_{k,t}^{SCG} + \tau_t^{LCG} y_{k,t}^{LCG}$, where τ_t^{DIV}, τ_t^{SCG}, and τ_t^{LCG} are the average marginal tax rates on dividends and short- and long-term capital gains, and $y_{k,t}^{DIV}$, $y_{k,t}^{SCG}$, and $y_{k,t}^{LCG}$ are the dividend yields, and the long- and short-term capital gains yields.

D. *Effective Tax Yield*

The empirical part of this paper relates the effective tax yield to the aggregate equity valuations and to equity returns of various portfolios. Figure 3 summarizes the effective tax yield of different equity portfolios. The middle curve shows the effective tax yields using the Standard & Poor's Composite Index between 1913 and 2006. The top and the bottom curves correspond to the tax yields of common stocks from the Center for Research in Security Prices (CRSP) database between 1927 and 2006, which either did not pay any dividends in the prior year (bottom curve) or were in the top dividend yield quintile (top curve). Stocks paying high dividend yields tend to have substantially higher and more volatile effective tax rates than nondividend paying stocks. The cross-sectional variation in tax yields is described in more detail in Section III.

The aggregate effective tax rates are computed based on IRS data and take into account the actual income brackets of investor clienteles. For example, if tax-exempt or low-tax investors focus their portfolios more extensively on high-dividend yield stocks than high-tax investors, then the aggregate tax burden is lower than if the stock portfolios are identical across different tax clienteles. Thus, the time-series test using aggregate data takes into account the impact of tax clienteles. However, due to lack of data availability it is not possible to observe the identity of the investors in the cross-section of securities. In the cross-sectional test, I need to assume that the "average marginal tax rates" on dividends and capital gains are identical for all individual securities. Measurement error in the effective tax rate should bias the results against finding an impact of taxes on asset returns. In several robustness tests, I show that the tax capitalization results are qualitatively unaffected using alternative assumptions for computing effective tax rates.[9]

II. Time-Series Evidence

This section studies the time-series relation between effective tax rates and aggregate equity valuations.

A. *Illustrative Example*

It is helpful to illustrate the relation between taxes and equity values with a simple numerical example. Suppose that the corporate sector is expected to distribute all their cash flows as annual dividends amounting to \$10 per share in perpetuity and that investors discount these uncertain cash flows at a 10 percent rate. These securities should be valued at \$100 per share in a world without taxes and investors can expect a 10 percent rate of return on their equity securities. If the government introduces unexpectedly a permanent dividend tax of 20 percent, then the after-tax cash flow of equity securities would amount to only \$8 per share. The equity securities should now be valued at only \$80 per share if taxes have no impact on the profitability of companies and on the discount rates of investors. In this case, the after-tax return would still equal 10 percent (\$8/\$80), but the before-tax return would increase to 12.5 percent (\$10/\$80) to compensate taxable investors for the newly introduced dividend taxes. An unexpected tax increase results in an immediate decline in equity valuations. In this case, the burden of the tax is borne by the investors who hold the stocks at the time of the announcement of the tax reform. Similar results can be obtained in a general equilibrium model with endogenous discount rates and tax regime changes.[10]

Thus, under the tax capitalization hypothesis, taxes are incorporated into equity prices. In this case, equity valuations tend to be lower and before-tax equity returns tend to be higher when dividend taxes are relatively high. The exact magnitude of the valuation effect depends on the persistence of tax regimes and on the risk aversion of the investors. On the other hand, under the tax irrelevance hypothesis, taxes should not have a relation to equity prices.

[9] Several researchers have found evidence for tax clienteles. However, the tax clienteles effects are not sufficiently strong to completely eliminate taxes on investment income. See for example, Francisco Perez-Gonzalez (2002); Yaniv Grinstein and Michaely (2005); Alon Brav et al. (2005); Raj Chetty and Emmanuel Saez (2005); Graham and Alok Kumar (2006); Magnus Dahlquist, Goran Robertsson, and Kristian Rydqvist (2007); Edith Hotchkiss and Stephen Lawrence (2007); and Mihir Desai and Jin (2007).

[10] The numerical example given above is a special case of the model by Sialm (2005) using log utility and permanent tax regimes. Sialm (2005) derives the asset pricing implications of dividend taxes in a general equilibrium exchange economy with tax regime changes and stochastic dividends. Valuations in high-tax regimes tend to be lower than valuations in low-tax regimes, as long as tax regimes are persistent. Endogenous discount rates magnify the asset pricing effects if investors are risk averse, because risk-averse investors desire to smooth consumption over time and require higher equity returns (and lower equity valuations) during high-tax regimes when their marginal utility of consumption is high.

TABLE 1—SUMMARY STATISTICS OF MACROECONOMIC VARIABLES

		Mean	Standard deviation	Minimum	Maximum	Correlation
(1)	Effective tax yield	0.015	0.008	0.001	0.036	1.000
(2)	Average tax on dividends	0.313	0.129	0.020	0.513	0.778
(3)	Average tax on short capital gains	0.326	0.133	0.020	0.519	0.680
(4)	Average tax on long capital gains	0.190	0.063	0.032	0.339	0.066
(5)	Tax on dividends ($100,000)	0.188	0.123	0.000	0.365	0.422
(6)	Tax on dividends ($250,000)	0.299	0.189	0.000	0.561	0.617
(7)	Tax on dividends (maximum)	0.582	0.265	0.060	0.940	0.845
(8)	Proportion of taxable investors	0.805	0.149	0.456	0.922	0.421
(9)	Dividend yield	0.045	0.017	0.011	0.089	0.514
(10)	Equity Q	0.673	0.312	0.266	1.840	−0.514
(11)	Price-earnings ratio (divided by 100)	0.144	0.071	0.058	0.539	−0.406
(12)	S&P index return	0.118	0.189	−0.403	0.526	0.190
(13)	Interest rate	0.047	0.032	0.005	0.176	−0.186
(14)	Inflation rate	0.034	0.051	−0.108	0.204	0.244
(15)	Per capita growth rate	0.054	0.081	−0.251	0.264	0.307
(16)	Corporate bond quality spread	0.012	0.007	0.004	0.042	−0.202
(17)	Corporate bond term spread	0.012	0.015	−0.035	0.046	−0.142
(18)	Stock participation	0.166	0.080	0.078	0.326	−0.823
(19)	Government expenditures to output	0.225	0.093	0.054	0.353	0.161
(20)	Corporate tax rate	0.339	0.160	0.010	0.528	0.517
(21)	Democratic president	0.511	0.503	0.000	1.000	0.253

Notes: This table summarizes the moments of the various tax rates and macroeconomic variables between 1913 and 2006 (or over the sample period the data are available). The fifth data column shows the correlation between the corresponding variable and the effective tax rate.

B. *Macroeconomic Data*

Table 1 lists summary statistics for the data. The detailed data sources and definitions are listed in the Data Appendix.[11] The first row summarizes the moments of the effective tax yield. Rows 2 to 4 report the average marginal tax rates on dividends and long- and short-term capital gains for taxable investors, and rows 5 to 7 report the marginal statutory tax rates from the federal government for three different income brackets, corresponding to real income levels of $100,000, $250,000, and the maximum income bracket. The tax variables differ in their levels, but they are generally highly correlated, with the exception of the average marginal tax rate on long-term capital gains. Row 8 summarizes the proportion of equity that is held by taxable investors according to the Federal Reserve Board's Flow of Funds. The dividend yield is defined as the dividend payments over the current year divided by the price level of the S&P Composite Index at the end of the prior year. The dividend yield varies significantly over time and ranges between 1.1 (2000) and 8.9 percent (1950).

The empirical tests use two measures of the aggregate valuation levels of US equities summarized in rows 10 and 11. The first measure is equity Q, which is defined as the ratio between the

[11] The S&P Composite Index, the corresponding dividend and earnings variables, the interest rate, and the consumer price index (CPI) series between 1871 and 2006 are taken from Robert J. Shiller's Web page (http://www.econ.yale.edu/~shiller/data.htm) and correspond to the December values from the monthly data series. The equity Q is based on Stephen Wright (2004) between 1900 and 1951 and on the Federal Reserve Board's Flow of Funds Accounts between 1952 and 2006 (http://www.federalreserve.gov/releases/z1/). The output growth rate and the current government expenditures are obtained from the US Bureau of Economic Analysis (BEA) (http://www.bea.gov). The bond yields over the period between 1919 and 2006 are obtained from the Federal Reserve (http://www.federalreserve.gov/releases/h15/data.htm).

market value of equities outstanding and the net worth at market value of nonfinancial corporations. The second measure of the aggregate equity valuation is the price-earnings ratio, which is defined as the S&P index level at the end of the year divided by the reported earnings in the subsequent year. The earnings are defined after subtracting corporate taxes and exclude discontinued operations and extraordinary items. The price-earnings ratio in the regressions is divided by 100 for expositional purposes. The equity *Q* exhibits a correlation with the price-earnings ratio of 63 percent.[12]

Table 1 also summarizes the moments of various macroeconomic variables. The return of the S&P Composite Index is computed by adding the S&P Composite dividend payments in the current year to the corresponding end-of-year price index and dividing by the price index at the end of the prior year. The interest rate corresponds to the compounded annual return of six-month corporate yields. The inflation rate is computed as the growth rate in the CPI. The per capita growth rate is defined as the growth rate of aggregate domestic output divided by the US population.

To capture time-varying risk premia, I use the corporate bond quality spread (i.e., the yield difference between long-term Baa and Aaa corporate bonds) and the corporate bond term spread (i.e., the yield difference between long-term Aaa bonds and the compounded annual return of six-month corporate interest rates).

Stock participation is estimated as the total number of tax returns with dividend income according to the IRS divided by the total number of households. This number likely underestimates the equity participation rate since households owning nondividend paying stocks are not covered by the IRS and since some households that own stocks do not file taxes. The latter bias is particularly significant prior to 1945 when a significant fraction of low- and medium-income households were not required to file taxes. Therefore, the stock participation rate will be considered only after 1945. The stock participation rate has increased gradually from 8 percent in the late 1940s to 33 percent in 2000.

To separate the impact of government policies through taxes and expenditures, I compute the ratio between government expenditures and aggregate domestic output.

Two final control variables are the top marginal federal corporate tax rate based on IRS data and an indicator variable for whether the current president is a Democrat. Both variables are positively correlated to the effective tax rate.

C. *Regression Specification*

In this section, I discuss the relation between taxes and equity valuations. The relation between asset valuations and effective taxes is estimated using the following regression:

$$val_t = \alpha_0 + \alpha_1 \kappa_t + \alpha_2 r_{F,t} + \alpha_3 \pi_t + \alpha_4 g_t + \alpha_5 t + \varepsilon_t. \tag{3}$$

The base case specification uses two proxies for equity valuation levels: the equity *Q* and the price-earnings ratio. The independent variables in the base case are measured in the current year: the effective tax yield is denoted by κ_t; the short-term interest rate by $r_{F,t}$; the inflation rate by π_t; the nominal per capita growth rate by g_t; and the linear time trend by t.

[12] Since the valuation ratios are persistent, it is important to test whether they follow unit roots. Dickey-Fuller tests for unit roots in the equity *Q* and the price-earnings ratios can be rejected at the 10 and the 1 percent levels, respectively. A regression of the difference in the equity *Q* (price-earnings ratio) on the corresponding lagged values have coefficients of −0.138 (−0.252) with standard errors of 0.053 (0.070). In the subsequent estimations, I will take into account the autocorrelation of the dependent variables by computing Newey-West standard errors.

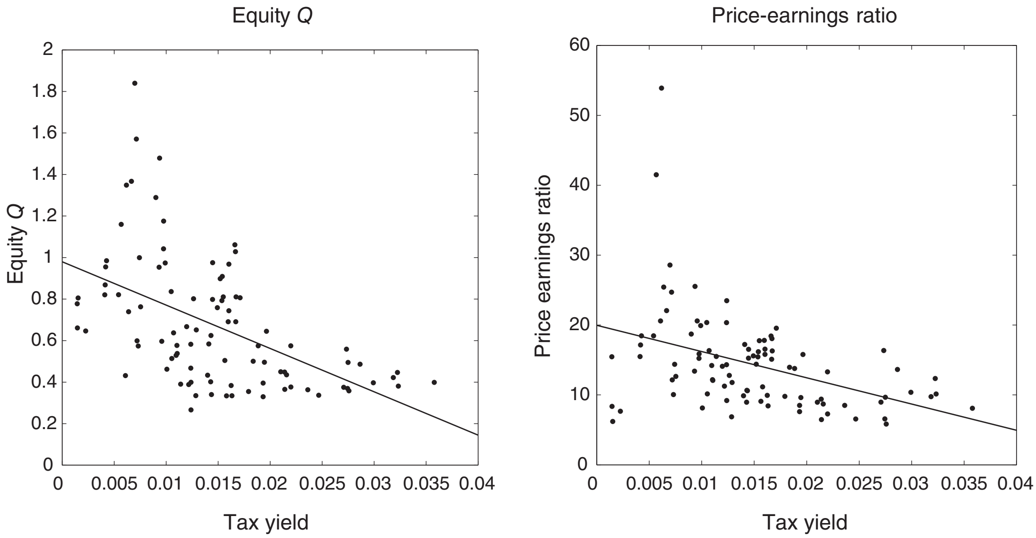

Figure 4. Time-Series Relation between Effective Tax Yield and Equity Valuation Levels

Note: The figure depicts the relation between the effective tax yield and the equity Q ratio and the price-earnings ratio over the period from 1913 to 2006.

If taxes are capitalized into asset prices, then the tax coefficient α_1 should be negative. The level of interest rates might have an impact on asset valuations, since stocks and fixed-income securities are alternative investment options. As interest rates increase, stock valuations should decline as long as risk premia remain unaffected. The inflation rate and the per capita growth rate might capture time-varying risk premia, as time periods of high inflation and low growth tend to be periods with high uncertainty and high equity premia. Thus, equity valuations might be lower with high inflation and low growth rates. However, such times of low growth and high inflation might also be time periods where earnings are temporarily low, resulting in an ambiguous effect on the price-earnings ratio. Several robustness tests introduce additional control variables and demonstrate that the tax effect remains important under alternative specifications.

D. *Regression Estimates*

Figure 4 depicts the relation between the effective tax yield and the two valuation ratios over the period 1913 to 2006. Overall, there is an inverse relation between equity valuation levels and effective tax yields. The corresponding coefficient estimates are summarized in Table 2. The negative relation between tax yields and equity valuation levels is not affected significantly after controlling for macroeconomic control variables. The reported standard errors follow Whitney K. Newey and Kenneth D. West (1987), where the autocorrelation structure is estimated using a four-year lag.[13]

[13] The Newey-West standard errors are significantly higher than the OLS standard errors. For example, the OLS standard errors of the tax variables in multivariate specifications of Table 2 would have been only 3.323 and 0.869 instead of 3.960 and 1.162, respectively. However, increasing the number of lags beyond four does not further increase the standard errors.

Table 2—Taxes and Valuation Ratios

	Equity Q		Price-earnings ratio (divided by 100)	
Tax yield	−20.876***	−20.727***	−3.754**	−3.154***
	(5.158)	(3.960)	(1.585)	(1.162)
Interest rate		−2.639**		−0.324
		(1.136)		(0.214)
Inflation rate		−1.051*		−0.252**
		(0.560)		(0.098)
Growth rate		0.584		−0.017
		(0.385)		(0.052)
Time trend		0.005***		0.001**
		(0.002)		(0.000)
Constant	0.980***	0.855***	0.200***	0.166***
	(0.118)	(0.072)	(0.033)	(0.022)
Observations	94	94	93	93
R^2	0.264	0.498	0.165	0.342

Notes: This table summarizes the coefficients of the following regression: $val_t = \alpha_0 + \alpha_1 \kappa_t + \alpha_2 r_{F,t} + \alpha_3 \pi_t + \alpha_4 g_t + \alpha_5 t + \varepsilon_t$, where val_t is either the equity Q or the price-earnings ratio; κ_t is the effective tax yield; $r_{F,t}$ is the nominal risk-free interest rate; π_t is the inflation rate; g_t is the per capita real growth rate of aggregate output; and t is a linear time trend. The Newey-West standard errors are summarized in parentheses and use a four-year lag.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

The results on the tax coefficient are both economically and statistically significant. For example, the multivariate analysis indicates that a one-standard-deviation increase in the effective tax yield reduces the equity Q by 0.16 (-20.727×0.008) or by 53 percent of the standard deviation of the equity Q. Similarly, a one-standard-deviation increase in the effective tax yield reduces the price-earnings ratio by 2.5 ($-3.154 \times 0.008 \times 100$) or by 35 percent of the standard deviation of the price-earnings ratio. An alternative way to judge the economic significance of the results is to compute the estimated impact of specific tax reforms on equity valuations. For example, the tax reforms of George W. Bush reduced the top dividend tax rate from 39.6 (1993–2000) to 15 percent (2003–2006). This tax reform reduced the corresponding tax yields from 0.84 to 0.42 percent. The multivariate coefficient estimates indicate that this decline in the tax yields increased the equity Q ratio by 0.10, or by approximately 7 percent, and the price-earnings ratio by 1.51, or by about 6 percent of the initial level.

It is noteworthy that the intercept of the univariate regression using equity Q as the dependent variable is not statistically different from one. This result is consistent with the "new view" of Mervyn A. King (1977), Auerbach (1979), and Bradford (1981), where the price of equity in units of capital (Q) equals one in the absence of dividend and capital gains taxes and decreases below one in an environment where dividend taxes exceed capital gains taxes.

The interest rate and the inflation rate also have an important impact on asset valuations. A one-standard-deviation increase in the interest rate decreases the equity Q by 0.084 or by about 27 percent of the standard deviation of the equity Q, whereas a one-standard-deviation increase in the inflation rate reduces the equity Q by 0.054 or by about 17 percent of the standard deviation of the equity Q. The growth rate does not have a significant impact on asset valuation levels and

TABLE 3—TAXES AND VALUATION RATIOS: SUBPERIODS

	Equity Q		Price-earnings ratio (divided by 100)	
	1913–1959	1960–2006	1913–1959	1960–2005
Tax yield	−21.612***	−16.598	−2.313*	−8.736**
	(4.513)	(16.205)	(1.249)	(4.299)
Interest rate	−0.693	−2.518	0.448	0.111
	(2.907)	(2.031)	(0.493)	(0.494)
Inflation rate	−0.702	−2.201	−0.197**	−0.182
	(0.454)	(2.723)	(0.083)	(0.487)
Growth rate	0.618	−1.343	0.010	−0.693***
	(0.417)	(1.416)	(0.063)	(0.239)
Time trend	0.008**	0.002	0.002**	−0.001
	(0.004)	(0.007)	(0.001)	(0.001)
Constant	0.742***	1.183**	0.119***	0.360***
	(0.109)	(0.586)	(0.034)	(0.089)
Observations	47	47	47	46
R^2	0.407	0.461	0.268	0.394

Notes: This table summarizes the coefficients of the following regression: $val_t = \alpha_0 + \alpha_1 \kappa_t + \alpha_2 r_{F,t} + \alpha_3 \pi_t + \alpha_4 g_t + \alpha_5 t + \varepsilon_t$, where val_t is either the equity Q or the price-earnings ratio; κ_t is the effective tax yield; $r_{F,t}$ is the nominal risk-free interest rate; π_t is the inflation rate; g_t is the per capita real growth rate of aggregate output; and t is a linear time trend. The Newey-West standard errors are summarized in parentheses and use a four-year lag.

***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

has opposite signs for the two different valuation ratios. Finally, both asset valuation proxies have a positive time trend over the sample period.[14]

E. *Robustness Tests*

This section tests for the robustness of the previously described results using various subperiods, additional control variables, and different tax rates.

Subperiod Results.—Table 3 divides the sample period into two roughly equal subperiods. The relation between effective tax yields and equity valuations is negative for both subperiods. Whereas the relation is stronger in the first half of the sample for the equity Q ratio, it is stronger in the second half of the sample for the price-earnings ratio.

The sample period can be extended to a regime without personal federal income taxes by including the period prior to 1913. Data on equity Q are available since 1900 and data on the price-earnings ratio can be used after the Civil War taxes were repealed in 1872. During this period prior to 1913, the effective tax yield on equity is set equal to zero. Unreported results

[14] The negative relation between equity values and tax rates is consistent with the results from several event studies that find that equity values are affected by tax rate changes. See, for example, Mark H. Lang and Douglas A. Shackelford (2000); Benjamin C. Ayers, C. Bryan Cloyd, and John R. Robinson (2002); Auerbach and Kevin A. Hassett (2007); and Zhonglan Dai et al. (2008). The influential ex-dividend day literature provides an alternative way to investigate tax capitalization effects. See, for example, Edwin J. Elton and Martin J. Gruber (1970); Kalay (1982); Kenneth M. Eades, Patrick J. Hess, and E. Han Kim (1984); Murray Z. Frank and Ravi Jagannathan (1998); and Graham, Michaely, and Michael R. Roberts (2003).

Table 4—Taxes and Valuation Ratios: Additional Control Variables

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Equity Q						
Tax yield	−24.448***	−24.350***	−27.903***	−18.930***	−23.763***	−21.784***
	(4.297)	(5.687)	(8.142)	(3.349)	(4.645)	(3.606)
Interest rate	−1.779*	−6.333***	−1.571	−2.626**	−2.741**	−1.485
	(0.966)	(1.887)	(1.531)	(1.147)	(1.066)	(1.056)
Inflation rate	−1.354***	−1.160**	−1.389*	−1.061*	−0.994*	−1.681
	(0.505)	(0.548)	(0.765)	(0.574)	(0.567)	(0.607)
Growth rate	0.478*	0.809**	0.851	0.572	0.589	0.498
	(0.261)	(0.330)	(0.788)	(0.377)	(0.380)	(0.367)
Quality spread	−17.366***					
	(4.257)					
Term spread		−10.305***				
		(3.881)				
Stock participation			3.027			
			(2.363)			
Government expenditures				−0.512		
				(1.126)		
Corporate tax					0.226	
					(0.424)	
Democratic president						0.209**
						(0.087)
Time trend	0.003	0.008**	−0.012	0.007	0.004	0.006***
	(0.002)	(0.003)	(0.010)	(0.004)	(0.003)	(0.002)
Constant	1.214***	1.049***	1.475***	0.868***	0.869***	0.717***
	(0.123)	(0.143)	(0.406)	(0.090)	(0.067)	(0.107)
Time period	1919–2006	1919–2006	1946–2006	1913–2006	1913–2006	1913–2006
Observations	88	88	61	94	94	94
R^2	0.579	0.585	0.574	0.500	0.501	0.581

indicate that extending the estimation window over this regime without taxes increases the magnitude and the statistical significance of the coefficients on the effective tax rate using both valuation measures.

One concern is that the high valuation levels in the late 1990s could explain the relation between taxes and valuation levels. Excluding the time period since 1995 does not have a significant impact on the results.

Additional Control Variables.—Table 4 documents that the relation between taxes and asset valuation levels remains unaffected after introducing additional control variables. Panel A uses the equity Q and panel B the price-earnings ratio as the dependent variables. The time periods differ in the various regressions because some control variables are not available over the whole sample period.

The first two control variables are proxies for time-varying risk premia. Both the quality and the term spreads of corporate bonds are negatively related to equity valuation levels, indicating that equity values are lower in periods where bond spreads are larger. The results are economically very significant, as a one percentage point increase in the quality spread between Baa and Aaa bonds reduces the equity Q by 0.17, or by approximately 25 percent.

TABLE 4—TAXES AND VALUATION RATIOS: ADDITIONAL CONTROL VARIABLES (*CONTINUED*)

	(1)	(2)	(3)	(4)	(5)	(6)
Panel B. Price-earnings ratio (divided by 100)						
Tax yield	−4.242***	−4.774***	−6.719***	−2.684**	−2.940**	−3.262***
	(1.357)	(1.459)	(1.483)	(1.118)	(1.242)	(1.227)
Interest rate	−0.268	−1.065***	0.108	−0.322	−0.317	−0.187
	(0.194)	(0.361)	(0.340)	(0.216)	(0.214)	(0.219)
Inflation rate	−0.246**	−0.244*	−0.316**	−0.255**	−0.256**	−0.326***
	(0.121)	(0.129)	(0.149)	(0.099)	(0.100)	(0.106)
Growth rate	−0.030	0.021	0.022	−0.020	−0.017	−0.028
	(0.069)	(0.069)	(0.176)	(0.055)	(0.051)	(0.054)
Quality spread	−1.411					
	(0.853)					
Term spread		−2.009***				
		(0.762)				
Stock participation			0.942			
			(0.639)			
Government expenditures				−0.136		
				(0.355)		
Corporate tax					−0.016	
					(0.086)	
Democratic president						0.024
						(0.020)
Time trend	0.001	0.002**	−0.004	0.002	0.001	0.001**
	(0.000)	(0.001)	(0.003)	(0.001)	(0.001)	(0.000)
Constant	0.218***	0.228***	0.375***	0.170***	0.165***	0.150***
	(0.036)	(0.032)	(0.090)	(0.025)	(0.022)	(0.024)
Time period	1919–2005	1919–2005	1946–2005	1913–2005	1913–2005	1913–2005
Observations	87	87	60	93	93	93
R^2	0.358	0.415	0.451	0.346	0.343	0.365

Notes: This table summarizes the coefficients of the following regression: $val_t = \alpha_0 + \alpha_1\kappa_t + \alpha_2 r_{F,t} + \alpha_3\pi_t + \alpha_4 g_t + \alpha_5 t + \varepsilon_t$, where val_t is either the equity Q or the price-earnings ratio; κ_t is the tax yield; $r_{F,t}$ is the risk-free interest rate; π_t is the inflation rate; g_t is the per capita real growth rate of aggregate output; t is a linear time trend; and x are additional control variables, such as the quality spread between long-term yields on corporate bonds with ratings of Baa and Aaa, the term spread between the yields on long-term corporate bonds with a rating of Aaa and the short-term corporate yield, the percentage of households that own dividend paying stocks, the current government expenditures divided by aggregate output, the top marginal corporate tax rate, and an indicator variable for whether the US president is a Democrat.

*** Significant at the 1 percent level.
** Significant at the 5 percent level.
* Significant at the 10 percent level.

The stock participation measure in the overall population is a proxy for the risk perceptions of investors.[15] Investors are more likely to overcome fixed participation costs in equity markets if they are relatively risk tolerant or if they perceive risks to be relatively low compared to the expected equity premium. The relation between equity valuations and stock participation is positive using both valuation measures. However, the coefficients on the stock participation variable are not statistically significant, possibly due to the limited sample period.

The effective tax yield in the base case specification could proxy for the impact of government expenditures instead of taxes. Adding the ratio of current government expenditures to output as

[15] See N. Gregory Mankiw and Stephen P. Zeldes (1991) and Annette Vissing-Jorgensen (2002) for a discussion of limited asset market participation.

an additional control variable does not significantly affect the coefficient on the tax variable, and government expenditures do not have a significant impact on equity valuations.

Both personal investment taxes and corporate taxes should affect asset prices in equilibrium. However, the impact of corporate taxes on the relative valuation levels used here should be secondary since the valuation ratios are computed by normalizing the price levels by variables that take corporate taxes into account. Over the sample period between 1913 and 2006, the effective personal tax yield on equity securities has a correlation of 51.69 percent with the corporate tax rate. The corporate tax rate does not have a significant relation with the two valuation measures, and adding this control variable does not substantially affect the impact of the effective personal tax yield on equity securities.

Tax rates on equity securities tend to be higher under Democratic administrations. To separate tax policies from other policies, in the last column I introduce an indicator variable that depends on whether the president is a Democrat. There is a positive relation between the two valuation ratios and the indicator variable for Democratic administrations. However, this relation is significant using only the equity Q variable. Under both specifications, the tax yield remains statistically significant.

Alternative Tax Measures.—The derivation of the effective tax yields requires many specific assumptions. Table 5 investigates the impact of different assumptions of estimating effective tax yields. The first column estimates the tax yield of only taxable investors and ignores the time-series variation in the proportion of equity held in tax-qualified environments. The results are in this case very similar to the base case results.

The second column keeps the dividend and capital gains distribution weights constant over the whole sample period. In this case, the variation in effective tax yields is driven only by the variation of dividend and capital gains tax rates.[16] The coefficients on the tax variables in panels A and B become slightly less negative but remain statistically significant. Thus, variations in dividend yields over time contribute but do not completely explain the tax effect.

While it is relatively easy to estimate dividend distributions on a given portfolio, it is more difficult to estimate expected capital gains realizations. The third column assumes that investors never realize any capital gains, whereas the fourth column assumes that investors expect to realize all long-term capital gains annually.[17] The coefficient estimates in these two extreme cases of capital gains realizations do not differ economically or statistically from the base case estimates.

The last three columns use the marginal statutory federal tax rates on dividends and capital gains for investors in three different income brackets corresponding to real income levels of \$100,000, \$250,000, and the top income bracket. Under all three cases, there is a negative relation between the tax yield and the valuation ratios, which is at least statistically significant at the 5 percent level. The level of the coefficient estimates differs between the various specifications, since the different tax variables have very different standard deviations, as summarized in Table 1. Thus, the results are robust to alternative definitions of the relevant tax rate.

Instrumental Variable Estimation.—The effective tax yield is endogenous since tax policies and dividend distribution policies might depend on the economic environment. To address this

[16] The effective tax yield is in this case simply a linear combination of the three marginal tax rates: $\kappa_{k,t} = \tau_t^{DIV} \overline{y}_k^{DIV} + \tau_t^{SCG} \overline{y}_k^{SCG} + \tau_t^{LCG} \overline{y}_t^{LCG} = 0.045\, \tau_t^{DIV} + 0.001\, \tau_t^{SCG} + 0.018\, \tau_t^{LCG}$.

[17] The effective tax yields equal $\kappa_{k,t} = \tau_t^{DIV} y_{k,t}^{DIV}$ in the fourth column and $\kappa_{k,t} = \tau_t^{DIV} y_{k,t}^{DIV} + \tau_t^{cg} (\overline{r}_{k,t} - y_{k,t}^{DIV})$ in the fifth column, where $(\overline{r}_{k,t} - y_{k,t}^{DIV})$ is the expected capital gain and $\tau_t^{cg} = (\overline{y}_k^{SCG} \tau_t^{SCG} + \overline{y}_k^{LCG} \tau_t^{LCG})/(\overline{y}_k^{SCG} + \overline{y}_k^{LCG})$ is the weighted average tax rate on capital gains using the average realized capital gains over the sample period.

TABLE 5—TAXES AND VALUATION RATIOS: ROBUSTNESS TESTS

					Statutory tax rates		
	All taxed	Const. dist.	No gains	Full gains	\$100K	\$250K	Maximum
Panel A. Equity Q							
Tax yield	−21.022***	−17.552***	−22.608***	−14.467***	−26.267***	−15.613***	−10.358***
	(4.015)	(6.603)	(3.944)	(4.231)	(6.258)	(3.658)	(1.766)
Interest rate	−2.175**	−2.323*	−2.657**	−2.470*	−2.052*	−2.160*	−3.048***
	(1.085)	(1.332)	(1.028)	(1.347)	(1.162)	(1.152)	(1.017)
Inflation rate	−0.992*	−1.195*	−1.016*	−1.181*	−1.047*	−0.956	−0.901
	(0.544)	(0.684)	(0.521)	(0.652)	(0.630)	(0.627)	(0.562)
Growth rate	0.631	0.373	0.624	0.457	0.431	0.462	0.485
	(0.373)	(0.466)	(0.372)	(0.425)	(0.407)	(0.417)	(0.420)
Time trend	0.007***	0.006**	0.005***	0.007***	0.008***	0.007***	0.003**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Constant	0.841***	0.753***	0.845***	0.827***	0.623***	0.671***	0.950***
	(0.069)	(0.097)	(0.064)	(0.095)	(0.073)	(0.071)	(0.073)
Observations	94	94	94	94	94	94	94
R^2	0.528	0.378	0.530	0.410	0.467	0.478	0.499
Panel B. Price-earnings ratio (divided by 100)							
Tax yield	−3.345***	−2.446*	−3.462***	−2.145*	−4.589***	−2.644***	−1.264**
	(1.194)	(1.427)	(1.131)	(1.102)	(1.716)	(0.990)	(0.543)
Interest rate	−0.259	−0.267	−0.328*	−0.296	−0.246	−0.261	−0.343
	(0.204)	(0.245)	(0.196)	(0.249)	(0.210)	(0.210)	(0.225)
Inflation rate	−0.240**	−0.279**	−0.246***	−0.274**	−0.241**	−0.228***	−0.248**
	(0.098)	(0.108)	(0.093)	(0.109)	(0.101)	(0.097)	(0.108)
Growth rate	−0.007	−0.051	−0.011	−0.037	−0.035	−0.031	−0.041
	(0.053)	(0.050)	(0.052)	(0.052)	(0.056)	(0.054)	(0.048)
Time trend	0.001***	0.001**	0.001**	0.001**	0.002***	0.001***	0.001*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
Constant	0.166***	0.148***	0.165***	0.161***	0.133***	0.141***	0.168***
	(0.021)	(0.020)	(0.020)	(0.024)	(0.013)	(0.014)	(0.025)
Observations	93	93	93	93	93	93	93
R^2	0.366	0.281	0.359	0.299	0.355	0.355	0.308

Notes: This table summarizes the coefficients of the following regression: $val_t = \alpha_0 + \alpha_1\kappa_t + \alpha_2 r_{F,t} + \alpha_3\pi_t + \alpha_4 g_t + \alpha_5 t + \varepsilon_t$, where val_t is either the equity Q or the price-earnings ratio; κ_t is the tax yield; $r_{F,t}$ is the risk-free interest rate; π_t is the inflation rate; g_t is the per capita real growth rate of aggregate output; and t is a linear time trend. The specifications use different measures of the effective tax rate on equity securities. The Newey-West standard errors are summarized in parentheses and use a four-year lag.

***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

concern, I use an instrumental variables estimation that also controls for autocorrelation. The instrument used here for the effective tax rate is the ratio between current government expenditures and aggregate output. This variable enters the first stage regression of the tax rate with a positive sign that is statistically significant at a 1 percent confidence level, and 50 percent of the variation in tax yields is explained by current government expenditures and the other variables. On the other hand, as shown in Table 4, the current government expenditures are not significantly related to the valuation level. The unreported coefficient estimates on the tax rate remain very similar in this alternative specification compared to the specification in Table 2. For example, the tax yield coefficient using the equity Q ratio changes from −20.727 to −23.315 and remains statistically significant.

Alternative Dependent Variables.—The relation between effective tax rates and equity valuation ratios remains qualitatively unaffected if I use alternative measures of valuation ratios besides the equity Q and the price-earnings ratio. To economize on space, the results are just briefly summarized and not reported in tabular form. For example, defining the price-earnings ratio by dividing the end-of-year price of the S&P Composite Index by the earnings in the current year instead of the subsequent year has a very small impact on the coefficients. Furthermore, the results are slightly more statistically significant if the earnings used to compute the price-earnings ratio are averaged over the prior five or ten years to smooth out short-term variations in earnings due to the business cycle, as recommended by John Y. Campbell and Robert J. Shiller (1998). In addition, the results are robust if the valuation ratio is defined as the ratio between the price of the S&P Composite Index and the dividend of the index, or as the ratio between the market capitalization of all stocks in the CRSP database divided by the total distributions to shareholders (i.e., dividend payments plus share repurchases).

The tax capitalization hypothesis implies that high tax regimes are associated with relatively low equity valuation levels and with relatively high before-tax equity returns. Consistent with this hypothesis, I find a significantly positive relation between effective tax rates and returns on the S&P Composite Index before and after controlling for the macroeconomic variables given in Table 2. The coefficient on the effective tax yields equals 4.67 for the univariate regression and 5.16 for the multivariate regression with standard errors of 1.95 and 1.82, respectively. These coefficients imply that a one standard deviation increase in the tax yield increases nominal stock returns by between 3.6 and 4.0 percent.

III. Cross-Sectional Evidence

This section analyzes the cross-sectional variation in tax burdens by dividing the stocks traded on the major US stock exchanges between 1927 and 2006 into portfolios according to their lagged dividend yield.

A. *Empirical Specification*

The empirical estimation of the tax effects on equity returns is based on the theoretical model of Brennan (1970), who relates the risk-adjusted stock returns to their dividend yields. Whereas the time-series analysis in Section II is performed at an annual frequency, the cross-sectional analysis in this section is performed at a monthly frequency to improve the precision of the risk adjustments.

To adjust for risk and style effects, abnormal asset returns are computed based on conventional factor pricing models, such as the one-factor CAPM, the three-factor Fama and French (1993) model, and the four-factor model by Mark M. Carhart (1997). I add the tax yield $\kappa_{k,t}$ to the pricing models to examine its impact on equity returns. The empirical specification of the extended Fama-French-Carhart model is as follows:

$$(4) \qquad r_{k,t} - r_{F,t} = \alpha + \beta_{k,t}^{M}(r_{M,t} - r_{F,t}) + \beta_{k,t}^{SMB}(r_{S,t} - r_{B,t}) + \beta_{k,t}^{HML}(r_{H,t} - r_{L,t}) + \beta_{k,t}^{UMD}(r_{U,t} - r_{D,t}) + \gamma\kappa_{k,t} + \varepsilon_{k,t}.$$

The return of portfolio k during time period t is denoted by $r_{k,t}$. The index M corresponds to the market portfolio and the index F to the risk-free rate. Portfolios of small and large stocks are denoted by *S* and *B*; portfolios of stocks with high and low ratios between their book values and their market values are denoted by *H* and *L*; and portfolios of stocks with relatively large and small returns during the previous year are denoted by *U* and *D*. The Fama-French-Carhart model nests the CAPM model (which includes only the market factor) and the Fama-French model (which includes the size and the book-to-market factors in addition to the market factor). The four-factor model includes, in addition, the momentum factor by Narasimhan Jegadeesh and Sheridan Titman (1993).[18] The factor loadings $\beta_{k,t}$ denote the sensitivities of the returns to the various factors and are estimated for each of the portfolios separately. To allow the factor loadings to change over time, they are estimated separately for each five-year time period.[19]

The tax yield $\kappa_{k,t}$ of portfolio *k* at time *t* is computed monthly for each portfolio based on its prior dividend yield. The dividend yield is defined as the sum of the taxable dividend distributions over the prior 12 months divided by the stock price 13 months ago. The tax yield coefficient γ is positive if investors are compensated for the personal taxes by obtaining higher before-tax returns for assets facing higher tax burdens, particularly in periods where taxes are relatively high. A coefficient of one implies that the abnormal return increases exactly by the amount of the tax.

B. *Dividend Portfolios*

I divide the common domestic stocks in the CRSP database into portfolios according to the lagged dividend yield and the lagged market capitalization of publicly traded companies. The portfolio returns are computed using market capitalization weights within each portfolio. The portfolios are formed annually at the end of June for three sorting criteria. The first criterion forms two portfolios based on whether companies paid taxable dividends over the prior 12 months. The second sorting criterion forms six portfolios based on the dividend yield over the prior 12 months. One of the six portfolios includes nondividend paying stocks and the other five portfolios are dividend yield quintile portfolios. The third criterion forms 30 portfolios according to the dividend yield and the size of the underlying stocks. All the common stocks in the CRSP database are first sorted monthly into the six groups based on their lagged dividend yields described above. Subsequently, each of the six dividend yield groups is further divided into quintile portfolios according to the lagged market capitalization. The cutoff levels for the market capitalizations of the quintile portfolios are based only on the distribution of the market capitalization on the NYSE to avoid significant changes in the portfolio composition when NASDAQ stocks entered the CRSP database. If a stock gets delisted after the initial portfolio formation, the weights of the remaining stocks are adjusted proportionally. The portfolios are formed at the end of June of each year to obtain consistent rebalancing frequencies with the Fama-French-Carhart factor returns, which are also adjusted only at an annual frequency.

The first two columns of Table 6 show the dividend yields for the portfolios in the year prior and after portfolio formation. Although dividend yields revert toward the mean, dividend payments are relatively persistent at the portfolio level. This justifies using the prior dividend yield as the expected value of the future dividend yield.

Since high-dividend yield stocks are taxed relatively heavily, abnormal equity returns should be relatively high for these stocks. The last three columns of Table 6 summarize the abnormal returns of the portfolios. The abnormal returns α are computed over the whole sample using the

[18] The market, size, book-to-market, momentum factors, and the risk-free rate are obtained from Ken French's Web site (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/index.html).

[19] For example, a separate $\beta_{k,t}^{M}$ is computed for each portfolio *k* over 16 nonoverlapping time periods (1927–1930, 1931–1935, …, 2001–2006). The results of this approach are qualitatively similar to a two-stage approach where the portfolio returns are first adjusted for risk and style using the factor models, and the abnormal returns are subsequently regressed on the tax yield.

Table 6—Dividend Yield Portfolios

	Annual dividend yields		Monthly value-weighted alphas		
	Prior year	Subsequent year	CAPM	Fama-French	Fama-French-Carhart
Panel A. Two dividend yield portfolios					
No dividend portfolio	0.000	0.275	−0.159	−0.171***	−0.162**
			(0.102)	(0.063)	(0.066)
Dividend portfolio	4.383	4.297	0.060***	0.041***	0.047***
			(0.023)	(0.013)	(0.013)
Dividend portfolio minus no dividend portfolio	−4.383	−4.021	0.219*	0.212***	0.208***
			(0.117)	(0.070)	(0.072)
Panel B. Six dividend yield portfolios					
No dividend portfolio	(0.000	0.275	−0.159	−0.171***	−0.162**
			(0.102)	(0.063)	(0.066)
Lowest yield quintile	1.999	2.157	−0.071	0.020	0.060
			(0.052)	(0.046)	(0.049)
Quintile 2	3.356	3.396	0.063	0.127***	0.142***
			(0.045)	(0.042)	(0.044)
Quintile 3	4.412	4.368	0.041	0.003	0.008
			(0.053)	(0.045)	(0.046)
Quintile 4	5.552	5.323	0.197***	0.086*	0.088*
			(0.055)	(0.045)	(0.048)
Highest yield quintile	7.886	7.175	0.264***	0.066	0.044
			(0.072)	(0.059)	(0.059)
Highest yield quintile minus no dividend portfolio	−7.886	−6.899	0.423***	0.237***	0.206**
			(0.136)	(0.091)	(0.094)

Notes: The table summarizes the dividend yields and the abnormal returns for portfolios formed according to the initial dividend yields over the period from 1927 to 2006. The returns are expressed in percent per month, and standard errors are summarized in parentheses.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

conventional factor regressions from equation (4) excluding the tax yield factor. Table 6 demonstrates that stocks paying high-dividend yields tend to have significantly higher average abnormal returns than stocks paying no dividend yields. For example, stocks in the highest dividend quintile outperform nondividend paying stocks by between 21 and 42 basis points per month using the various factor adjustments.

Figure 3 summarizes the variation of expected tax yields for the S&P 500 Composite Index, for stocks that did not pay any taxable dividends in the prior year (bottom curve), and for the 20 percent of dividend paying stocks with the highest dividend yields in the prior year (top curve). The effective tax yield of dividend paying stocks is substantially larger and more volatile than the effective tax yield of nondividend paying stocks. The difference in tax burdens is particularly pronounced in the 1940s, 1950s, and late 1970s.

Figure 5 depicts the cross-sectional relation between average annualized abnormal returns and the average annualized tax yield for the 30 dividend/size portfolios over the whole sample period. For each of the 30 portfolios, I compute the abnormal returns for the one-, three-, and four-factor models using time-varying factor loadings as discussed previously. The figures show a positive relation between average tax yields and average equity returns, regardless of the risk-adjustment method. This result shows that there is a robust cross-sectional relation between tax

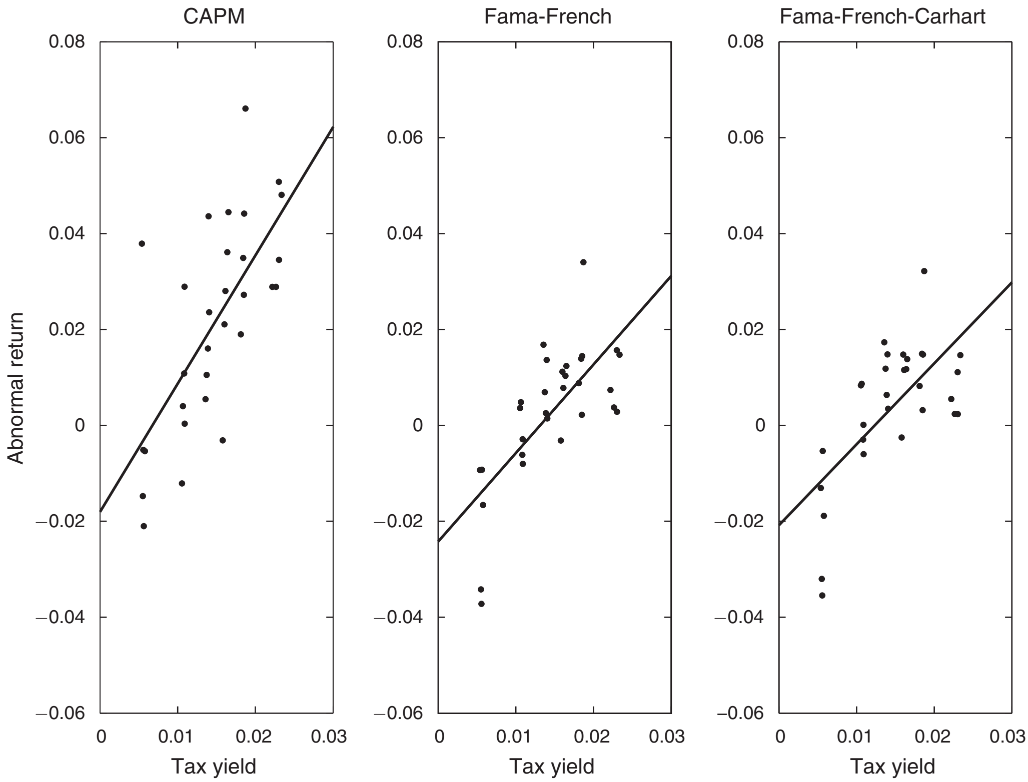

Figure 5. Cross-Sectional Relation between Abnormal Returns and Effective Tax Rates

Notes: The figure relates average tax yields to the performance of 30 value-weighted portfolios formed according to six dividend yield groups and five market capitalization groups between 1927 and 2006. The abnormal returns are computed based on the CAPM, the Fama-French, and the Fama-French-Carhart models.

yields and risk-adjusted stock returns, even after aggregating all observations over time and ignoring the time-series variation in tax burdens.

C. *Tax Capitalization Regression*

The following results take full advantage of the time-series variation in effective tax rates and estimate regression equation (4), including the tax yield factor. Table 7 summarizes the tax yield coefficients γ for the three different portfolio classifications and for the three risk-adjustment methods. The regressions have 1,908, 5,724, and 28,620 observations for the three different portfolio classifications. Since the panel data are not independent, I use clustered standard errors by time to adjust for the cross-sectional correlation.

The tax yield coefficient γ is significantly different from zero in all specifications. The coefficient estimates are more statistically significant after adjusting for the Fama-French-Carhart common factors and using a richer portfolio classification.[20] A tax yield coefficient of one implies that the abnormal return increases exactly by the amount of the tax. The coefficient estimates

[20] Adjusting the returns by introducing the liquidity factor of Lubos Pastor and Stambaugh (2003), in addition to the four Fama-French-Carhart factors, does not affect the qualitative results of the paper for the period between 1966

Table 7—Tax Capitalization Regressions

	CAPM	Fama-French	Fama-French-Carhart
2 dividend yield portfolios	1.056*	1.052***	0.991**
	(0.617)	(0.381)	(0.388)
6 dividend yield portfolios	0.905***	0.573***	0.503**
	(0.292)	(0.213)	(0.225)
30 dividend yield and size portfolios	0.877**	0.768***	0.726***
	(0.416)	(0.194)	(0.197)

Notes: This table summarizes the tax capitalization coefficient γ of the following regression: $r_{k,t} - r_{F,t} = \alpha + \sum_{k,t,f} \beta_{k,t,f}\, fr_{t,f} + \gamma\kappa_{k,t} + \varepsilon_{k,t}$, where $r_{k,t} - r_{F,t}$ is the excess return above the risk-free rate for portfolio k at time t; $\beta_{k,t,f}$ is the factor loading for the f factor at time t for portfolio k and $fr_{t,f}$ is the corresponding factor return; and $\kappa_{k,t}$ is the tax yield of portfolio k at time t. Three different portfolio formation criteria are used: (1) two portfolios based on one portfolio including all nondividend paying stocks and one portfolio including dividend paying stocks; (2) six portfolios based on one portfolio including all nondividend paying stocks and dividend yield quintile portfolios including dividend paying stocks; and (3) 30 portfolios based on six dividend yield groups and five size groups. The stocks in the different portfolios are value-weighted. Abnormal returns are computed using the CAPM, the Fama-French, and the Carhart factors by allowing factor loadings to differ in each five-year period for each of the portfolios using data over the period from 1927 to 2006. The standard errors take into account clustering by time period and are summarized in parentheses.

***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

are generally not statistically significantly different from one, indicating that the tax effect is economically plausible. For example, a coefficient of 0.73 for the Fama-French-Carhart model implies that if the tax yield increases by one percentage point, the abnormal return increases by 0.73 percentage points. The remainder of this section reports various robustness tests using the 30 portfolios formed according to size and dividend yield.

D. *Robustness Tests*

This section investigates the robustness of the cross-sectional results dividing the sample into subperiods and using alternative tax measures.

Subperiod Evidence.—Table 8 reports the tax capitalization coefficients γ from equation (4) for four different subperiods using the 30 dividend/size portfolios. The majority of the coefficient estimates are significantly positive. The tax yield coefficient measures the impact of a fixed change in the tax yield. Whereas the tax yield coefficient is relatively stable over the whole sample period, the standard deviation of the tax yield has decreased over time. For example, the cross-sectional standard deviation in the monthly tax yield ranges between 0.16 percent in 1943 and 0.02 percent in 2006. Thus, the overall impact of taxes on asset returns has decreased dramatically over time.

Different Tax Yields.—To construct the tax yield, it is necessary to make some simplifying assumptions. This section shows that the results are robust to alternative definitions of the tax yield. The first row of Table 9 repeats the base case results from Table 7 for comparison.

and 2004, when the liquidity factor is available. The liquidity factor is obtained from WRDS (http://wrds.wharton.upenn.edu/).

Table 8—Tax Capitalization Regressions: Subperiod Evidence

	CAPM	Fama-French	Fama-French-Carhart
1927–1949	1.141	0.758**	0.755**
	(0.766)	(0.334)	(0.336)
1950–1969	−0.152	0.877***	0.733**
	(0.641)	(0.317)	(0.331)
1970–1989	4.798***	1.322*	1.718***
	(1.166)	(0.701)	(0.653)
1990–2006	3.617	2.045	1.647
	(2.720)	(1.635)	(1.677)

Notes: This table summarizes the tax capitalization coefficient γ of the following regression: $r_{k,t} - r_{F,t} = \alpha + \sum_{k,t,f} \beta_{k,t,f}\, fr_{t,f} + \gamma\kappa_{k,t} + \varepsilon_{k,t}$, where $r_{k,t} - r_{F,t}$ is the excess return above the risk-free rate for portfolio k at time t; $\beta_{k,t,f}$ is the factor loading for the f factor at time t for portfolio k and $fr_{t,f}$ is the corresponding factor return; and $\kappa_{k,t}$ is the tax yield of portfolio k at time t. The estimations are based on 30 portfolios using six dividend yield groups and five size groups. The stocks in the different portfolios are value-weighted. Abnormal returns are computed using the CAPM, the Fama-French, and the Carhart factors by allowing factor loadings to differ in each 5-year period for each of the portfolios using data over the period from 1927 to 2006. The standard errors take into account clustering by time period and are summarized in parentheses.

***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

In the base case, the anticipated dividend yield is assumed to equal the lagged actual dividend yield. This assumption can bias the results due to the mean reversion of the dividend yields as shown in Table 6. To avoid any biases, I use the fitted value of a partial adjustment model as the anticipated dividend yield. In the partial adjustment model, the future dividend yield of portfolio k is regressed on the lagged dividend yield of the corresponding stock portfolio and on the lagged dividend yield of the market portfolio. This partial adjustment model allows for persistence in the dividend yield and for a reversion of the dividend yield toward the aggregate market yield. Row 2 of Table 9 shows that the results using the fitted dividend yield based on the partial adjustment model are not substantially different from the base case.

The base case tax yield is computed by averaging the tax burdens over taxable and tax-qualified investors. Row 3 excludes assets held in tax-qualified accounts and computes the tax yield coefficient for taxable investors only. This change in the tax yield increases that tax yield coefficients slightly.

Investors might not have access to all the available information on current tax rates and income distributions at the beginning of the year. Furthermore, tax rates are endogenous and might depend on the stock market performance during a particular year. Row 4 uses the 12-month lagged tax yield as the explanatory variable. The positive relation between tax yields and risk-adjusted returns remains intact.

In the base case, investors anticipate realizing a fixed proportion of their capital gains every year. Rows 5 and 6 investigate whether different assumptions on the capital gains realization behavior affect the results. The fifth row assumes that investors completely avoid realizing any capital gains and the sixth row assumes that investors do not defer capital gains and expect to realize all capital gains annually. The coefficient estimates are only marginally different from the base case, indicating that the results are driven primarily by dividend taxes and not by capital gains taxes.

The base case assumes that the marginal investor faces a tax rate on dividends and capital gains equal to the tax rate of the average investor. Rows 7 to 9 use, instead, three different federal statutory tax brackets on dividend income and short- and long-term capital gains to compute the

Table 9—Tax Capitalization Regressions: Different Measures of Tax Burden

	CAPM	Fama-French	Fama-French-Carhart
(1) Base case	0.877**	0.768***	0.726***
	(0.416)	(0.194)	(0.197)
(2) Fitted dividend yield	0.914*	0.794***	0.739***
	(0.547)	(0.237)	(0.240)
(3) Taxable accounts only	1.157***	0.830***	0.790***
	(0.401)	(0.190)	(0.191)
(4) Lag tax yield	0.767*	0.844***	0.804***
	(0.411)	(0.197)	(0.203)
(5) No capital gains taxed	0.849**	0.768***	0.728***
	(0.367)	(0.180)	(0.183)
(6) No capital gains deferral	0.735	0.529**	0.494*
	(0.595)	(0.252)	(0.255)
(7) Statutory tax rate ($100,000)	1.477**	1.007***	0.910**
	(0.750)	(0.391)	(0.396)
(8) Statutory tax rate ($250,000)	0.834*	0.592***	0.544***
	(0.429)	(0.205)	(0.207)
(9) Statutory tax rate (maximum)	0.293	0.327***	0.312***
	(0.191)	(0.106)	(0.107)
(10) Current dividend yield	1.528***	1.363***	1.519***
	(0.537)	(0.302)	(0.301)

Notes: This table summarizes the tax capitalization coefficient γ of the following regression: $r_{k,t} - r_{F,t} = \alpha + \sum_{k,t,f} \beta_{k,t,f}\, fr_{t,f} + \gamma\kappa_{k,t} + \varepsilon_{k,t}$, where $r_{k,t} - r_{F,t}$ is the excess return above the risk-free rate for portfolio k at time t; $\beta_{k,t,f}$ is the factor loading for the f factor at time t for portfolio k and $fr_{t,f}$ is the corresponding factor return; and $\kappa_{k,t}$ is the tax yield of portfolio k at time t. The table summarizes the results using different definitions of the effective tax rate. The estimations are based on 30 portfolios using six dividend yield groups and five size groups. The stocks in the different portfolios are value-weighted. Abnormal returns are computed using the CAPM, the Fama-French, and the Carhart factors by allowing factor loadings to differ in each five-year period for each portfolio using data over the period from 1927 to 2006. The standard errors take into account clustering by time period.

***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

tax yield. The tax yield coefficients under these three alternative tax brackets are significantly positive. Whereas the tax capitalization coefficients are around one for the $100,000 income bracket, they are significantly smaller than one for the top tax bracket. This result is consistent with the marginal investor having an intermediate tax bracket.

Researchers use two different ways to define dividend yields. For example, Litzenberger and Ramaswamy (1979) and Naranjo, Nimalendran, and Ryngaert (1998) normalize the expected dividend payments by the most recent stock price ($y_{k,t}^{DIV} = DIV_{k,t}/P_{k,t-1}$). On the other hand, Blume (1980) and Keim (1985) normalize the expected dividend payments by the stock price 13 months ago ($y_{k,t}^{DIV} = DIV_{k,t}/P_{k,t-13}$). Miller and Scholes (1982) show that the inverse of the most recent price $1/P_{k,t-1}$ explains a significant fraction of the cross-sectional stock returns at time t, and argue that normalizing the expected dividends by the most recent stock price can introduce a bias. Furthermore, updating the dividend yields at a monthly frequency could be problematic, since the monthly-updated dividend yield could partially capture the impact of the related book-to-market factor of the Fama-French model, which is updated only annually.

Whereas the base case dividend yield uses the stock price 13 months ago to normalize dividends and is updated only once annually, the alternative dividend yield reported in row 10 of Table 9 uses the most recent stock price to normalize dividends and is updated at a monthly frequency.

The results indicate that the coefficient estimates on the tax yield increase significantly using the current dividend yield. The tax yield coefficient more than doubles using the Fama-French-Carhart factor adjustment. This effect could explain why the magnitude of the yield effect estimated by Naranjo, Nimalendran, and Ryngaert (1998) is too large to be caused by a tax penalty on dividend income.

As discussed in Section I, it is not possible to obtain the tax clienteles for each individual stock since holdings data are not available over the whole sample period. The estimations in this section assume that the average marginal tax rates on dividends and capital gains are identical for all equity securities. This assumption likely biases the results downward if there are clientele effects.[21]

IV. Conclusions

The paper sheds new light on the controversy of whether taxes are capitalized into asset prices taking advantage of both the cross-sectional and the time-series variation in tax burdens. The effective personal taxation of equity securities fluctuated considerably between 1913 and 2006. I find that aggregate valuation levels are related to measures of the aggregate personal tax burden on equity securities. Furthermore, stocks paying a large proportion of their total returns as dividends face significantly higher tax burdens than stocks paying no dividends. The results indicate that there is an economically and statistically significant relation between before-tax abnormal asset returns and effective tax rates. Stocks that have higher tax burdens tend to compensate taxable investors by offering higher before-tax returns.

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