Capital Gains Lock-in and Share Repurchases

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ABSTRACT

Anecdotal and empirical evidence suggest that price is an important determinant of firms' share repurchase decisions. We investigate a factor that could affect a firm's stock price around a repurchase and thus the number of shares a firm repurchases. We predict that tax-sensitive investors' reluctance to sell stocks for which they have unrealized capital gains reduces the supply of a firm's shares available in the market, and thus raises the price at which the firm can repurchase its shares. Using unique data on the tax-sensitivity of a sample of institutional investors, we find evidence consistent with our prediction. Moreover, as expected, the negative relation between capital gains lock-in and the number of shares repurchased is only present when the supply of a firm's shares is inelastic.

Many factors drive corporate share repurchase decisions. Chief among them is price. A recent survey of corporate financial executives finds that a firm's current stock price is the single most important factor in its share repurchase decisions (Brav et al. 2005).[1] The price at which a company can repurchase its shares is determined by shareholders' willingness to sell them. If shareholders are willing to supply an unlimited quantity of a firm's shares at a single price that reflects the firm's fundamental value – that is, if the supply of a firm's shares is perfectly-elastic – then supply considerations should not impact repurchases. However, there is substantial evidence that supply and demand in the market for corporate shares is not perfectly-elastic.[2] This raises an important question: Given the price sensitivity of firms when repurchasing their shares, do limits to the supply of a company's shares cause it to repurchase fewer shares than it otherwise would?

We address this question by examining the effect of a well-documented tax-based constraint on the supply of shares. An investor's gain on a stock is subject to taxation only when the investor realizes the gain by selling the stock. This gives taxable investors an incentive to delay selling stocks for which they have unrealized gains.[3] Consistent with this argument, prior studies find that taxable investors refrain from selling shares when they would face large capital gains tax bills upon doing so, an effect typically referred to as capital gains "lock-in."[4] This withholding of shares with unrealized gains reduces the supply of shares available in the market.

[1] See, for example, Dann (1981), Vermaelen (1981), Bartov (1991), Comment and Jarrell (1991), Ikenberry, Lakonishok and Vermaelen (1995), Stephens and Weisbach (1998), and Dittmar (2000).

[2] For evidence that supply of/demand for firms' shares is inelastic, see Scholes (1972), Shleifer (1986), Holthausen, Leftwich and Mayers (1987), Loderer, Cooney and Drunen (1991), Kandel, Sarig and Wohl (1999), Kaul, Mehrotra and Morck (2000), Kalay, Sade and Wohl (2004), Schultz (2008), and Ahern (2010).

[3] Delaying the realization of gains is potentially beneficial because unrealized gains are set to zero upon the death of the investor, because the investor can offset gains with any future capital losses, and because short-term gains are typically taxed at a higher rate than long-term gains.

[4] See, for example, Feldstein, Slemrod and Yitzhaki (1980), Landsman and Shackelford (1995), Reese (1998), Klein (2001), Ayers, Lefanowicz and Robinson (2003), Blouin, Hail and Yetman (2009), Ivkovic, Poterba and Weisbenner (2005), Jin (2006), Ayers, Li and Robinson (2008), and Dai et al. (2008).

If limits to supply are an important driver of repurchase decisions, then a capital gains lock-in-driven supply reduction should have a negative effect on repurchases.

We test this prediction by examining the relation between a firm's repurchases and the unrealized capital gains of its shareholders, and find broadly supportive evidence. We conservatively estimate that firms would have repurchased 2.5 percent, or $38 billion, more of their shares between 1987 and 2008 absent the lock-in effect. The negative effect of capital gains lock-in on repurchases is stronger when the long-term capital gains tax rate is higher (i.e., when selling stocks with unrealized gains exposes investors to greater capital gains tax). This not only supports our conclusions, but also suggests that the anticipated increase in the long-term capital gains tax rate from 15 percent to 20 percent in 2012 could have a negative effect on the tendency of firms to repurchase shares.

We implement our tests using data on the holdings of a set of institutional investors whose sensitivity to taxation we can reliably identify. Specifically, we use unique data on the client composition of investment advisers to classify these advisers as tax-sensitive or tax-insensitive, depending on the tax-sensitivity of their clients. We classify advisers as tax-sensitive if over 50 percent of their clients are high net-worth individuals and as tax-insensitive if over 50 percent of their clients are individuals with tax-deferred accounts or tax-exempt entities (i.e., pensions, state and local governments, and/or charitable organizations).[5] Using Section 13(f) quarterly holdings data, we estimate each investment adviser's quarter-end unrealized capital gain in each stock that it holds.[6]

[5] We collect data on clienteles from Form ADV, which all investment advisers registered with the Securities and Exchange Commission (SEC) must file. We describe the data in more detail in Section II.

[6] Since investors can offset realized gains in a stock with realized losses on other stocks, we focus on "uncovered" capital gains - unrealized gains that cannot be offset by realizing losses on other stocks in the portfolio.

If firms respond to a lock-in-driven supply constraint by repurchasing fewer shares, then tax-sensitive investors' unrealized gains should have a negative effect on share repurchases. However, repurchases could be related to investors' unrealized gains for reasons other than the effect of capital gains lock-in on the supply of shares. For instance, investors with large unrealized gains may have an impetus to sell shares in order to rebalance their portfolios. In addition, investors could exhibit the "disposition effect," defined as the tendency to realize gains at a quicker rate than losses (Shefrin and Statman 1985).[7] Either of these effects could increase the supply of a firm's shares if the shares have appreciated and therefore have a positive effect on repurchases. In other words, these effects bias against us finding our predicted negative relation between capital gains lock-in and shares repurchases.

To isolate the capital gains lock-in effect, we exploit the difference in the tax-sensitivity of the two groups of investors in our sample. Only tax-sensitive investors should exhibit the lock-in effect in their decisions of whether to sell a stock. Consistent with this argument, Jin (2006) shows that tax-sensitive institutions are less likely than tax-insensitive institutions to realize capital gains using a sample similar to ours. Thus, any effect of unrealized capital gains on repurchases due to capital gains lock-in should exist only for unrealized gains of tax-sensitive investors, and not for unrealized gains of tax-insensitive investors. Consider a dollar of unrealized capital gains in the holdings of an investor in a firm that is considering a stock repurchase. If these unrealized gains are in the holdings of a tax-insensitive investor, then the gains could be positively related to the firm's repurchases for reasons such as portfolio rebalancing or the disposition effect. On the other hand, if the unrealized gains are in the

[7] Prior empirical studies find that sophisticated investors are subject to the disposition effect (Grinblatt and Keloharju 2001; Shapira and Venezia 2001; Garvey and Murphy 2004; Locke and Mann 2005; Frazzini 2006; Jin and Scherbina 2006), although to a lesser extent than individual investors (Grinblatt and Keloharju 2001; Shapira and Venezia 2001; Feng and Seasholes 2005).

holdings of a tax-sensitive investor, they should, at a minimum, be less positively related to repurchases if capital gains lock-in has a negative effect on repurchases.

Consistent with capital gains lock-in negatively impacting share repurchases, we find that the relation between shares repurchased and unrealized capital gains is smaller for gains in the holdings of tax-sensitive investors than for those in the holdings of tax-insensitive investors. The results are robust to controlling for, among other things, recent returns on a firm's stock and the holdings of tax-sensitive and tax-insensitive investors in the stock, both of which are likely to be related to unrealized capital gains in the stock. Our estimate that firms would have repurchased approximately $38 billion more of their stock between 1987 and 2008 absent the lock-in effect is conservative. It is based only on the unrealized capital gains of the tax-sensitive investors in our sample, who represent only a fraction of all tax-sensitive investors. Thus the aggregate impact of capital gains lock-in on share repurchases over our sample period is likely greater than $38 billion.

Our interpretation of these results rests on the assumption that any relation between repurchases and unrealized gains other than one driven by capital gains lock-in does not depend on whether the gains are in the holdings of tax-sensitive or tax-insensitive investors. One might naturally worry though that the two groups of investors in our sample differ on dimensions other than their tax sensitivity, and that these differences, rather than the locking in of capital gains, could be driving our results. Indeed, univariate tests suggest that tax-sensitive and tax-insensitive investors in our sample do differ in ways other than their tax-sensitivity. For example, tax-sensitive investment advisers hold smaller portfolios with fewer stocks in them and turn over a smaller percentage of their portfolio each quarter. We address the possibility that differences

between our two groups of investors other than their tax-sensitivity drive our results by exploiting exogenous variation in the long-term capital gains tax rate during our sample period.

Taxable investors' incentive to delay the realization of capital gains is stronger when the capital gains tax rate is higher. Thus we predict that the relation between repurchases and unrealized gains of tax-sensitive investors in our sample becomes more negative as the tax rate increases. We find that this is indeed the case. The relation between repurchases and the unrealized capital gains of tax-*in*sensitive investors in our sample, on the other hand, does not vary with the tax rate. These results suggest that capital gains lock-in, rather than differences between the two groups of investors other than their tax-sensitivity, drives our initial results.

One remaining concern is that characteristics of tax-sensitive investors in our sample, other than their tax-sensitivity, might drift over time in ways that are correlated with changes in the capital gains tax rate. This could explain why the relation between repurchases and the capital gains of tax-sensitive investors in our sample varies with the tax rate. We address this concern by conducting a difference-in-difference analysis where we examine the relation between repurchases and unrealized capital gains of the two investor groups in the period immediately surrounding the second quarter of 1997, when the long-term capital gains tax rate was cut sharply from 28 percent to 20 percent.[8] Consistent with the lock-in effect driving our results, we find that the relation between repurchases and the unrealized gains of tax-sensitive investors decreases significantly from the four quarters before to the four quarters after the tax cut. Again, no such change in relation is observed for the unrealized gains of tax-*in*sensitive investors. While we cannot completely rule out the possibility that differences in investor characteristics

[8] The capital gains tax rate was also cut in 2003. The 2003 tax cut was smaller than the 1997 cut and was accompanied by a change in the dividend tax rate, which we expect also had an effect on payout policy preferences. We therefore focus on the 1997 tax cut.

other than their tax-sensitivity are responsible for our results, it seems unlikely that these differences would change so dramatically over such a short period of time.

In summary, the evidence supports our prediction that capital gains lock-in causes firms to repurchase fewer shares. We base our prediction on the expectation that capital gains lock-in reduces the supply of a firm's shares, increasing the price at which the firm can repurchase shares. Thus, our results should be stronger when a reduction in supply is likely to have a larger impact on price - that is, when the supply curve for the firm's shares is steeper. The supply curve could be steep if there is substantial disagreement about the firm's fundamental value or if there is a lack of liquidity. We use analyst forecast dispersion as a proxy for the amount of disagreement about firm value and turnover volume as a proxy for liquidity. Consistent with our prediction, we find that the impact of capital gains lock-in on repurchases is present only when forecast dispersion is relatively high and only when turnover volume is relatively low.

Finally, if firms that repurchase fewer shares in response to capital gains lock-in use the available cash to invest in real assets, then capital gains lock-in could have real consequences. Consistent with this substitution from repurchases to investment, we find that capital expenditures are positively related to the difference between the unrealized gains of tax-sensitive and tax-insensitive investors before 1997, when the capital gains tax rate was at its highest point over our sample period. Using a difference-in-difference analysis, we also find that the relationship between capital expenditures and the unrealized gains of tax-sensitive investors (but not of tax-insensitive investors) weakens from the four quarters immediately before the 1997 tax rate cut to the four quarters immediately afterwards. In addition, the positive relation between capital expenditures and capital gains lock-in over the period prior to the 1997 tax cut is only present when turnover volume is relatively low (i.e., when the supply curve is likely to be

steep).[9] These results suggest that a higher capital gains tax rate could lead to more corporate investment. This contrasts with prior studies that argue that higher personal tax rates weaken firms' incentives to invest due to their negative effect on after-tax investor returns (see, e.g., Poterba and Summers 1983).

The remainder of the paper proceeds as follows. In Section I, we review the relevant literature. Section II includes a summary of our data and empirical measures. In Section III, we describe the research design and discuss the results. In Section IV, we offer concluding remarks.

I. Background

Over the past thirty years, share repurchases have become an increasingly popular method of paying out cash to shareholders. Grullon and Michaely (2002) report that expenditures on share repurchase programs (relative to total earnings) increased from 4.8 percent in 1980 to 41.8 percent in 2000. Thus, given firms' increased use of share repurchases, it is important to understand the factors that influence firms' repurchase decisions.

Some explanations for why firms repurchase shares are to distribute excess cash flow (Easterbrook 1984; Jensen 1986; Dittmar 2000), to signal or take advantage of undervaluation (Vermaelen 1981; Dittmar 2000), to alter leverage ratios (Bagwell and Shoven 1988; Hovakimian, Opler and Titman 1996; Dittmar 2000), to fend off takeover attempts (Bagwell 1991; Stultz 1988; Dittmar 2000), to counter the dilutive effects of stock options (Dunsby 1994; Jolls 1996; Fenn and Liang 1997; Dittmar 2000), and to better align the interests of management with those of outside shareholders, assuming management either owns stock or has stock options

[9] We also test whether the positive relation between capital expenditures and capital gains lock-in is stronger when forecast dispersion is relatively high. The results are consistent with our expectation but are not statistically significant. The lack of statistical significance is not surprising however since the number of observations is much lower for the forecast dispersion test than for the turnover volume test.

(Allen and Michaely 2003). Our paper offers a tax explanation for why certain firms might *not* repurchase shares.

Our paper adds to prior studies that examine how capital gains lock-in affects corporate payout policy. Lie and Lie (1999) and Moser (2007) find that the proportion of a firm's distributions that are repurchases (rather than dividends) decreases with proxies for unrealized gains of investors and increases with the magnitude of the dividend tax penalty and with ownership by tax-sensitive investors, respectively.[10] Brown and Ryngaert (1992) find that tendering rates in fixed-price self-tender offers are negatively related to proxies for shareholders' unrealized capital gains.[11] Anderson and Dyl (2004) find that premiums offered by firms in fixed-price self-tender offers are positively related to proxies for shareholders' capital gains taxes. Kadapakkam and Seth (1997) find that tender prices in Dutch auctions increase with the capital gains of the marginal tendering shareholder.[12]

Similar to our paper, these papers suggest that capital gains lock-in can affect payout policy decisions by altering the supply of a firm's shares. However, in contrast to our paper, none of these papers asks whether capital gains lock-in actually affects the number of shares that a firm repurchases. In examining the proportion of cash paid out through repurchases rather than dividends, Lie and Lie (1999) and Moser (2007) implicitly assume that repurchases and dividends are substitutes. However, they need not be. A firm may choose to pay out more via repurchases and dividends simultaneously. Brown and Ryngaert (1992), Anderson and Dyl (2004), and Kadapakkam and Seth (1997) examine how lock-in affects pricing and shareholders'

[10] The dividend tax penalty equals the investor-level tax rate on dividend income less the investor-level tax rate on capital gain income.
[11] In a fixed-price self-tender offer, the firm offers to repurchase a specific number of shares at a pre-specified price per share.
[12] In a Dutch auction repurchase, the firm specifies the number of shares that it will repurchase. The price per share is then determined by shareholder bidding, within a price range specified by the firm.

tendering behavior in repurchases, but do not look at how it affects the number of shares that a firm repurchases. Indeed, self-tender offers and Dutch auctions tend to be over-subscribed (Allen and Michaely 2003). As a result, it is unclear whether one should expect capital gains lock-in to affect the size of these repurchases.[13]

All of the papers mentioned above use recent stock price appreciation to proxy for shareholders' unrealized capital gains. In contrast, we measure the unrealized gains of actual investors using data on their holdings. In addition to giving us a more accurate measure of unrealized gains, this approach offers two important advantages. First, it allows us to disentangle unrealized gains from recent returns. This is important because substantial evidence suggests that recent returns have a direct effect on repurchase decisions. Second, we are able to measure tax-sensitive and tax-insensitive investors' unrealized gains separately. Examining how the relation between repurchases and unrealized gains differs according to whether the unrealized gains belong to tax-sensitive or to tax-insensitive investors allows us to more cleanly identify the effect of capital gains lock-in, since only tax-sensitive investors should exhibit the lock-in effect.

Finally, our paper contributes to the recent literature showing that the contraction in supply due to capital gains lock-in affects prices, at least in the short-run. Blouin, Raedy and Shackelford (2003) find temporary price increases around quarterly earnings announcements and additions to the S&P 500 Index caused by investors deferring sales of appreciated stocks until their capital gains qualify for preferential long-term capital gains tax treatment.[14] Jin (2006) finds that for stocks held primarily by tax-sensitive institutional investors, tax-related

[13] Fixed price tender offers and Dutch auction repurchases also represent only a small proportion of total share repurchases, the majority of which take place in the open market. Grullon and Ikenberry (2000) report that in 1999, 96 percent of all repurchases (both in terms of the number of repurchases and in terms of the dollar amount repurchased) were open market repurchases. Banyi, Dyl and Kahle (2008) also find that the majority of repurchases are open market repurchases. They report that 69 percent of all repurchases are open market repurchases. Our paper examines all repurchases, including those taking place in the open market.

[14] Blouin, Raedy and Shackelford (2003) empirically test the predictions from Shackelford and Verrecchia's (2002) theoretical model of intertemporal tax discontinuities.

underselling by tax-sensitive investors with large unrealized capital gains impacts stock prices during large earnings surprises. Our paper provides indirect confirmatory evidence that the price effects of capital gains lock-in are important. Specifically, we show that firms' repurchase decisions are consistent with such an effect.

II. Data and Methodology

A. Data

Institutional investment managers who exercise investment discretion over $100 million or more of Section 13(f) securities must report to the Securities and Exchange Commission (SEC) holdings of more than 10,000 shares or holdings valued in excess of $200,000. Data on these holdings are available from Thomson Reuters. Thomson Reuters divides institutional investors into the following five types: banks, insurance companies, investment companies (open-ended or closed-end mutual funds), independent investment advisers, and others (endowments, foundations, employee stock ownership plans, pensions, etc.).

In order to identify which institutional investors have tax-sensitive individual clients and which have tax-insensitive clients, we collect data on the client types of investment advisers using the SEC's Investment Adviser Public Disclosure (IAPD) database.[15] According to Abarbanell, Bushee and Raedy (2003), there is overlap between the investment companies and independent investment advisers in Thomson Reuters. In addition, beginning in 1998, Thomson Reuters misclassified many investment companies and independent investment advisers by including them in the type "other." Thus, we begin our search for investment adviser client types by compiling a list of all institutional investors classified as an investment company, an

[15] http://www.adviserinfo.sec.gov/IAPD/Content/IapdMain/iapd_SiteMap.aspx. The IAPD database has provided investors with Internet access to the From ADV since September 2001. The most recently updated Form ADV is available for investment advisers who are currently registered with the SEC and for investment advisers who are no longer registered but who were registered at some point since 2001.

independent investment adviser, or "other" in Thomson Reuters. We then check whether the institutional investor from Thomson Reuters is in the IAPD database. If it is, we collect data on the investment adviser's client types. [16]

Form ADV, which SEC-registered investment advisers must file, lists the following ten client types: individuals (other than high net-worth individuals); high net-worth individuals; banking or thrift institutions; investment companies (including mutual funds); pension and profit-sharing plans (other than plan participants); other pooled investment vehicles (e.g., hedge funds); charitable organizations; corporations or other businesses not listed above; state or municipal government entities; and "others" such as non-U.S. government entities.[17] Investment advisers must provide the approximate percentage of their business represented by each client type: none, up to ten percent, 11-25 percent, 26-50 percent, 51-75 percent, or more than 75 percent. We classify an institutional investor as "tax-sensitive" if over 50 percent of its clients consist of high net worth individuals.[18] We classify an institutional investor as "tax-insensitive" if over 50

[16] One other problem with the Thomson Reuters institutional investor quarterly holdings (13F) database is that Thomson Reuters recycles manager numbers, which are the identifiers that it assigns to institutional investors in the database. Brian Bushee has attempted to correct this problem by assigning a unique identifier, which he labels "pky," to each institutional investor in the database. See http://acct3.wharton.upenn.edu/faculty/bushee/IIvars.html#pky for an explanation of Brian's "pky" variable. We thank Brian for sharing this variable with us. We use it rather than the variable "mgrno" in the Thomson Reuters Database to track each institutional investor over time. It is particularly useful in our estimation of unrealized gains and losses since this estimation requires tracking an institution's purchases and sales of individual stocks over time.

[17] The category "individuals" on the Form ADV includes trusts, estates, 401(k) plans and IRAs of individuals and their family members. The Form ADV, which registered investment advisers must file with the SEC, defines a "high net-worth individual" as "an individual with at least $750,000 managed by [the investment adviser], or whose net worth [the investment adviser] reasonably believes exceeds $1,500,000, or who is a 'qualified purchaser' as defined in section 2(a)(51)(A) of the Investment Company Act of 1940. The net worth of an individual may include assets held jointly with his or her spouse."

[18] Other papers that use the IAPD data to identify tax-sensitive institutional investors include Jin (2006), Jin and Kothari (2008), Desai and Jin (2011), and Sikes (2009, 2010). Our conversations with investment advisers confirm that their majority clientele's type generally does not change over time. Thus, we feel comfortable matching an investment adviser's majority client type that we collected from the IAPD database in 2006 with the respective investment adviser's holdings in earlier years. Moreover, to the extent that an investment adviser that we classify as "tax-sensitive" based on 2006 IAPD data was not "tax-sensitive" in the earlier part of our sample period, this would bias against us finding our predicted results. Finally, Jin (2006), Jin and Kothari (2008), Desai and Jin (2011), and Sikes (2009, 2010) collect the IAPD data around the same time that we did and match the client types with investment advisers' holdings in earlier periods.

percent of its clients consist of individual investors' tax-deferred accounts (i.e., trusts, estates, 401(K) plans and IRAs) or of tax-exempt entities (i.e., pensions, state and local governments, and/or charitable organizations). We identify 376 "tax-sensitive" institutional investors and 289 "tax-insensitive" institutional investors.[19]

Our objective is to measure the effect of capital gains lock-in on repurchases. Capital gains by definition reflect stock price appreciation, which can be related to repurchases for many reasons. Substantial price appreciation (i.e., a high positive stock return) might indicate that a firm is overvalued, making management reluctant to repurchase the firm's stock (e.g., Dittmar 2000). Thus, we control for recent stock returns. Moreover, the "disposition effect," which describes the tendency of investors to sell stocks that have appreciated in value and to hold stocks that have fallen in value (Shefrin and Statman 1985), works in the opposite direction of the lock-in effect. Similarly, investors' realization of gains to rebalance their portfolios works in the opposite direction of the lock-in effect. If the shareholders of our sample firms exhibit the disposition effect or realize gains in order to rebalance their portfolios, such actions could increase the supply of shares available on the market after stock price appreciation and thus reduce the firm's cost of repurchasing its shares. If this is the case, it will bias against us finding the predicted negative relation between capital gains lock-in and repurchases. To disentangle the capital gains lock-in effect from non-tax explanations for an association between unrealized capital gains and repurchases, we examine the difference between the effect of unrealized capital gains of tax-sensitive investors and the effect of unrealized capital gains of tax-insensitive

[19] Note that our samples of tax-sensitive and tax-insensitive institutional investors do not encompass all institutional investors. We exclude mutual funds, bank trusts and insurance companies. Mutual funds may or may not be tax-sensitive. The clients of bank trust departments can be taxable or tax-exempt. Insurance companies are taxable overall but could have tax-exempt clients.

investors on repurchases. If investors in our sample differ only in their tax-sensitivity, then this difference will capture the effect of capital gains lock-in.

We begin by comparing the two types of investors in our sample on the basis of a few key variables related to the compositions of their portfolios because we realize that it is unlikely that the two types of investors in our sample differ only in their tax-sensitivity. Panel A of Table I reports the results. Tax-sensitive institutional investors in our sample hold fewer stocks in their portfolios than do tax-insensitive institutional investors. The dollar amount of the long equity positions of tax-sensitive institutional investors in our sample is smaller than the dollar amount of long equity positions of tax-insensitive investors in our sample. Tax-sensitive institutional investors in our sample turn their stocks over less frequently than do the tax-insensitive institutional investors in our sample, which could be consistent with them retaining stocks in order to reduce their capital gains tax liability. The portfolios of tax-sensitive institutional investors are less diversified than those of tax-insensitive institutional investors in our sample. Using the large/small and value/growth classifications from Abarbanell, Bushee and Raedy (2003), we find that the tax-sensitive investors in our sample hold more large growth stocks than large value, small growth, or small value stocks. Their focus on growth stocks is consistent with these investors minimizing their tax liability by avoiding stocks that are more likely to pay dividends. In order to address the possibility that these differences between the tax-sensitive and tax-insensitive institutional investors in our sample contaminate our results, we incorporate exogenous changes in the capital gains tax rate into our analysis, which we explain in more detail in Section III of the paper.

[INSERT TABLE I HERE]

B. Measures of Unrealized Capital Gains

We follow prior studies (Huddart and Narayanan 2002; Frazzini 2006; Jin 2006) in developing our measure of an institutional investor's cumulative unrealized capital gain or loss in a stock. Using quarterly holdings data from Thomson Reuters and stock price data from the Center for Research in Security Prices (CRSP), we measure the unrealized capital gain or loss by institutional investor, by firm, by quarter. We assume that an increase in shares of a stock that an investor holds from the end of the prior quarter to the end of the current quarter reflects a purchase of that many shares at the turnover-weighted average price for the current quarter, which becomes the tax basis for these shares. Likewise, we assume that a decrease in shares reflects a sale of that many shares. We use the end-of-quarter price to calculate the unrealized gain or loss at quarter-end (i.e., if an investor were to sell shares at the end of the quarter, the end-of-quarter price would determine the amount of the realized gain or loss).

Under U.S. tax law, institutions can designate the lot of stocks to be sold, which is relevant in computing unrealized gains if an investor holds multiple lots with different tax bases. We assume that investors in our sample use the highest-in first-out (HIFO) inventory allocation method. With highest-in first-out, an investor sells shares that it purchased at the highest price first. We assume that investors use this approach because it allows an investor to minimize capital gains or maximize capital losses.[20]

An important aspect of the tax code is that it permits taxable investors to offset realized gains with losses that are realized in the same tax year. As a result, a taxable investor can avoid tax liability on the sale of a stock with an unrealized gain by selling stocks with unrealized losses.

[20] We also conduct our tests using alternative assumptions, including first-in first-out ("FIFO") and proportional selling, to calculate unrealized gains and the quarter-end price to estimate the purchase price. The results obtained using these alternative approaches are almost quantitatively identical to the results that we present, with coefficients retaining the same level of statistical significance.

Thus, only unrealized capital gains that cannot be offset by losses elsewhere in an investor's portfolio should be subject to lock-in. We therefore follow Jin (2006) and net any unrealized capital losses in an investment adviser's portfolio at the end of each quarter against the investment adviser's gross unrealized capital gain in a stock in order to calculate the amount of the investment adviser's "uncovered" unrealized capital gain in the stock. [21]

C. Empirical Methodology

As previously mentioned, unrealized capital gains could be related to repurchases for reasons unrelated to taxes (e.g., the disposition effect, portfolio rebalancing). These non-tax factors are likely to impact both tax-sensitive and tax-insensitive investors. To capture the effect of the capital gains lock-in on firms' repurchases, we focus on how the relation between repurchases and unrealized gains differs depending on whether the gains belong to tax-sensitive or to tax-insensitive investors. We estimate the following regression:

$$\begin{aligned}\text{Repurchases} = {} & \alpha + \beta_1 \text{CapGains(TaxSensitive)} + \beta_2 \text{CapGains(TaxInsensitive)} \\ & + \beta_3 \text{Holdings(TaxSensitive)} + \beta_4 \text{Holdings(TaxInsensitive)} + \beta_5 \text{Return\_Lag1} \\ & + \beta_6 \text{Return\_Lag2} + \beta_7 \text{Return\_Lag3} + \beta_8 \text{Return\_Lag4} + \beta_9 \text{CashFlow/MarketCap} \\ & + \beta_{10} \text{Cash/MarketCap} + \beta_{11} \text{Market/Book} + \beta_{12} \text{Dividends/MarketCap} + \beta_{13} \text{Ln(Assets)} \\ & + \beta_{14} \text{(Leverage-TargetLeverage)} + \beta_{15} \text{Volatility} + \varepsilon \qquad (1)\end{aligned}$$

For brevity, we omit subscripts. The observations are firm-quarters over the period 1987Q1-2008Q4. The dependent variable is measured in quarter *q*, and with the exception of *CashFlow/MarketCap*, all explanatory variables are measured in quarter *q*-1.

Our identifying assumption is that any relation between repurchases and shareholders' unrealized gains other than one driven by capital gains lock-in does not depend on whether the

[21] If we use all unrealized gains instead of just uncovered gains, the economic significance of our results increases, but the statistical significance falls slightly (though the main results remain statistically significant at the five percent level).

unrealized gains belong to tax-sensitive or tax-insensitive shareholders. Since capital gains lock-in does not affect tax-insensitive shareholders, β_2 identifies the magnitude of the non-lock-in relation between unrealized gains and repurchases. We therefore subtract β_2 from β_1 to isolate the capital gains lock-in effect on repurchases. Under the null hypothesis that capital gains lock-in does not affect repurchases, $\beta_1 - \beta_2 = 0$. If capital gains lock-in reduces repurchases, then we should observe $\beta_1 - \beta_2 < 0$.

The dependent variable *Repurchases* equals repurchases during the quarter divided by market capitalization at the beginning of the quarter and is constrained to be greater than or equal to zero.[22] Following Dittmar (2000), Grinstein and Michaely (2005), and Kahle (2002), among others, we measure repurchases as total expenditure on the purchase of common and preferred stocks (computed from Compustat quarterly item *prstkcy*) minus any reduction in the redemption value of preferred stock outstanding (Compustat item *pstkq*).[23] Since *prstkcy* is reported each quarter on a year-to-date basis, for the second through fourth quarters of the year, we subtract the value of *prstkcy* in the prior quarter from the value of *prstkcy* for the current quarter to compute the purchase of common and preferred shares during the current quarter. Our sample does not include financial firms and utilities, as expenditures on the purchase of common and preferred stocks are not available in Compustat for these types of firms.[24]

[22] Our results are unchanged if we scale repurchases by assets rather than by market capitalization.

[23] Jagannathan, Stephens and Weisbach (2000) use a similar measure except that their measure is not adjusted to remove repurchases of preferred stock.

[24] Compustat item *prstkcy* includes open market repurchases, fixed-price self-tender offers, and Dutch auctions. As previously mentioned, Grullon and Ikenberry (2000) report that 96 percent of all repurchases are open market repurchases. However, since prior papers (Brown and Ryngaert 1992; Kadapakkam and Seth 1997; Anderson and Dyl 2004) find evidence of the lock-in effect in the case of fixed-price self-tender offers and Dutch auctions, in an untabulated robustness test, we eliminate 463 observations that are associated with a repurchase authorization reported in SDC Platinum that is either wholly or partly a fixed-price self-tender offer or a Dutch Auction in either the current or prior period. Fixed-price self-tender offers and Dutch auctions are generally completed in one month (Allen and Michaely 2003). The results in Table III are unchanged when we eliminate the 463 observations.

The variable *CapGains(TaxSensitive)* equals the uncovered, unrealized capital gains of tax-sensitive institutional investors in a firm's stock divided by the firm's market capitalization at the end of the prior quarter. The variable *CapGains(TaxInsensitive)* equals the uncovered, unrealized capital gains of tax-insensitive institutional investors, divided by the firm's market capitalization at the end of the prior quarter.

We also control for the possibility that unrealized gains simply capture information about investors' holdings of different stocks, which could be related to catering or clientele effects, by including the variables *Holdings(TaxSensitive)* and *Holdings(TaxInsensitive)*. The "catering" hypothesis holds that firms set their payout policies to accommodate the tax preferences of their investors (e.g., Perez-Gonzalez 2002). The "clientele" hypothesis holds that investors select stocks based in part on the personal tax cost associated with firms' payout policies (e.g., Strickland 1996; Grinstein and Michaely 2005; Graham and Kumar 2006; Desai and Jin 2011). *Holdings(TaxSensitive)* equals the dollar value of end-of-the-quarter holdings of tax-sensitive institutional investors, divided by the firm's market capitalization. *Holdings(TaxInsensitive)* equals the dollar value of end-of-the-quarter holdings of tax-insensitive institutional investors, divided by the firm's market capitalization. Since we observe the holdings of only a fraction of all investors, the holdings variables should generally not be large. To mitigate the effects of possible outliers, we drop observations where the holdings of investors in our sample (*Holdings(TaxSensitive)* + *Holdings(TaxInsensitive))* exceeds 0.5. This eliminates fewer than 0.1 percent of the observations in our sample.[25]

We choose the remaining control variables, with the exception of *Volatility*, based on Dittmar (2000), who investigates various motives for share repurchases put forth in prior literature (e.g.,

[25] Our results do not change if we eliminate this screen. We avoid winsorizing the *Holdings* and *CapGains* variables because they are highly inter-related, and winsorizing could artificially change the relations among them. However, our results do not change if we winsorize these variables.

distributing excess cash flow, signaling undervaluation, altering leverage ratios, fending off takeover attempts, countering the dilutive effects of stock options). The undervaluation hypothesis predicts that firms repurchase their shares when their stock is undervalued. While one cannot determine with certainty if a firm is undervalued, a history of low returns has been interpreted as one possible indication of undervaluation. Thus we control for prior stock market performance. The variables *Return_Lag1, Return_Lag2, Return_Lag3,* and *Return_Lag4* equal the abnormal holding period return on the firm's stock, defined as the raw return less the CRSP value-weighted average return in the same quarter, and are lagged one, two, three, and four quarters, respectively.[26]

In a survey of 384 financial executives, Brav et al. (2005) find that firms repurchase shares when they have residual cash flow after investment spending. The variable *CashFlow/MarketCap* equals the ratio of income before extraordinary items plus depreciation and amortization to market capitalization. The variable *Cash/MarketCap* equals the ratio of cash and equivalents to market capitalization. If a firm's need to distribute excess capital significantly affects its repurchase decision, then *CashFlow/MarketCap* and *Cash/MarketCap* will be positively related to aggregate repurchases, holding investment opportunities constant. The variable *Market/Book* controls for a firm's investment opportunities and equals the market value of equity plus the book value of debt, divided by the book value of assets.

We include the variable *Dividends/MarketCap* to control for the possibility that firms that pay fewer dividends are more likely to repurchase shares. It equals the ratio of common dividends to market capitalization. We include the natural log of a firm's total assets, *Ln(Assets)*, to control for information asymmetry. The undervaluation hypothesis holds that one reason that a firm repurchases shares is to signal to investors that the firm is undervalued. In order for the

[26] We obtain similar results if we include raw returns instead.

undervaluation hypothesis to hold true, there must be information asymmetry between managers and investors. According to Vermaelen (1981), information asymmetry is likely to be greater among smaller firms since analysts and the popular press are less likely to follow smaller firms.

The leverage hypothesis predicts that a firm repurchases shares when the firm's leverage ratio is less than the firm's target leverage ratio. To control for this possibility, we include the variable *Leverage-TargetLeverage*, which equals the difference between a firm's net debt-to-asset ratio (where debt is measured as debt minus cash and equivalents) and the firm's target net leverage ratio. Following Dittmar (2000), we measure a firm's target leverage ratio as the median net debt-to-asset ratio of all firms with the same two-digit SIC code. A negative coefficient on *Leverage-TargetLeverage* will support the leverage hypothesis.

The variable *Volatility* is the standard deviation of the daily stock return for the quarter. A firm facing higher volatility may pay out less cash in general to reduce expected future distress costs. This could have a negative effect on repurchases. On the other hand, a firm facing higher volatility might prefer to pay out excess cash through repurchases rather than dividends, since cutting dividends in the future is likely to be costly. This could have a positive effect on repurchases. Thus, we do not make a directional prediction for the relation between repurchases and volatility.

We also estimate equation (1) with two additional control variables: *ExecShares/MarketCap* and *ExecOptions/MarketCap*. ExecShares is the value of shares owned by the firm's top five executives, excluding stock options. ExecOptions is the Black-Scholes value of stock options owned by the firm's top five executives. Both variables are obtained from the Execucomp database. The availability of these two variables restricts the sample period to quarters 1993Q1-2008Q4.

With the exception of the *CapGains* and *Holdings* variables, all of the explanatory variables are winsorized at the 1st and 99th percentiles to mitigate the effects of possible outliers. All explanatory variables except *CashFlow/MarketCap* are lagged one quarter.

Because repurchases are zero for the majority of observations in our sample, inconsistency of estimates of equation (1) obtained using OLS could be a severe problem (Wooldridge 2002, pp. 524-525). Consistent with Dittmar (2000), we estimate (1) using a Tobit specification.[27] For robustness, we also estimate equation (1) using OLS and a log-transformation of the dependent variable and show that doing so yields similar results.

D. Summary Statistics

Table II reports descriptive statistics for the sample. Mean quarterly repurchases in our sample are $10.7 million, though the distribution is highly right-skewed, with the median firm repurchasing zero shares. A repurchase takes place in 29.2 percent of the firm-quarters in our sample (untabulated). Holdings and the capital gains measures also exhibit significant right-skewness.

The mean *Repurchases/MarketCap* equals 0.0036. The mean *Holdings(TaxSensitive)/MarketCap* is 0.0332, while the mean *Holdings(TaxInsensitive)/MarketCap* is 0.0507. These amounts translate into institutional investors in our sample holding approximately eight-and-a-half percent of the average sample

[27] Repurchases can never fall below zero. An underlying model that generates outcomes for the dependent variable that are restricted to be below or above some level is typically called a "censored regression model." Wooldridge (2002, p. 518) argues that a more appropriate name for such a model is "corner solution model," since values of the dependent variable at the minimum or maximum possible value reflect a corner solution to the agent's optimization problem. Some authors advise against using the Tobit model when dealing with corner solution outcomes (e.g., Maddala 1991, p.796), while others consider the Tobit model to be appropriate (e.g., Woolridge 2002, p. 518). Maddala (1991) argues that the Tobit model is inappropriate for corner solution problems because the standard Tobit model assumes that the dependent variable is censored at zero and can, in principle, take on negative values. Because repurchases cannot take on negative values, Maddala's (1991) argument suggests that the Tobit model is inappropriate in our setting. On the other hand, Woolridge (2002) and Green (2003) argue that the Tobit model is appropriate for censored as well as for corner solution regression models.

firm's stock, with the tax-sensitive investors in our sample holding approximately 39 percent of that amount.[28]

One possible concern about our research design is that the tax-sensitive investors in our sample hold only a modest percentage of the average firm's stock. There is, however, significant variation in the size of these holdings across firms. In an untabulated robustness test, we verify that our results continue to hold if we only include firms with *Holdings(TaxSensitive)* above the 80th percentile for a given quarter. For this subsample of 28,753 observations, mean *Holdings(TaxSensitive)* equals 0.1076. The results of the robustness test confirm that the results that we present are not driven by firms in which tax-sensitive investors in our sample hold only a very small percentage of total shares.

[INSERT TABLE II HERE]

III. Empirical Results

A. Capital Gains Lock-in & Repurchases

Table III reports the results of estimating equation (1) with a Tobit specification. Heteroskedasticity-robust standard errors clustered at the firm level are reported in parentheses below the coefficient estimates. All regressions include year-quarter indicator variables. For brevity, we omit the constant term from the presentation of all results in the paper. Column (1) only includes *CapGains(TaxSensitive)* and *CapGains(TaxInsenstive)*. We add the variables *Holdings(TaxSensitive)* and *Holdings(Combined)* in column (2). In column (3), we add the lagged quarterly return variables. Column (4) includes all explanatory variables except

[28] These are lower bound estimates of actual ownership by institutional investors that meet our definition of "tax-sensitive" or "tax-insensitive." Institutional investors file Form 13(f) on a consolidated basis. In some cases, multiple Forms ADV are associated with one consolidated institutional investor's Form 13(f). In these cases, we have no way of knowing the majority clientele that is associated with the holdings reported on the Form 13(f). Thus, we only include a tax-sensitive or tax-insensitive institutional investor in our sample if its name on its Form ADV exactly matches its name on the Form 13(f). Underestimating ownership by tax-sensitive and tax-insensitive investors neither biases in favor of nor against us finding our predicted results. However, the economic magnitude of our findings is likely larger than what we report.

ExecShares/MarketCap and *ExecOptions/MarketCap*, which we add in column (5). Since these two variables are only available for 1993 through 2008, and are not available for some firms, the inclusion of these variables reduces the sample size from 143,764 to 61,184 observations.

At the bottom of the table we report the marginal effects of *CapGains(TaxSensitive)*, *CapGains(TaxInsensitive)*, and the difference between the two, measured at the means of the explanatory variables. This difference represents the estimated effect of capital gains lock-in on repurchases. Consistent with our expectation, the difference is negative and significant ($p < 0.01$) in all five columns.

Because the residuals are not observed for censored observations in a Tobit model, we use simulations to estimate the aggregate impact of capital gains lock-in on repurchases over our sample period. These simulations are based on the regression in column (4) of Table III. We first fit the model using the coefficients from the regression (including the constant term) and the actual explanatory variables to calculate the expected value of the latent dependent variable. We then generate a normally distributed random error term with mean zero and the standard deviation estimated in the regression (0.254658) for each observation in the sample. We add the error term for each observation to the expected latent variable value for that observation. We then calculate the simulated repurchase/market capitalization for each observation as the greater of the simulated latent repurchase level and zero. We multiply this by market capitalization to get the simulated repurchase level. Finally, we sum these simulated repurchase levels over all observations to calculate the simulated level of repurchases for all firms in our sample over the sample period.

We then repeat this exercise, but without the capital gains lock-in effect. Since our approach assumes that the non-tax effects are the same for the unrealized capital gains of tax-sensitive and

tax-insensitive investors in our sample, we set the coefficient on *CapGains(TaxSensitive)* equal to the coefficient on *CapGains(TaxInsensitive)*. The level of repurchases generated from this simulation represents what the level of repurchases would have been in the absence of a lock-in effect. Our estimate of how much our sample firms would have spent on repurchases during the sample period in the absence of capital gains lock-in equals the difference between the simulated aggregate repurchases with and without the capital gains lock-in effect.

We repeat this exercise 10,000 times and calculate the mean additional repurchases in the absence of a lock-in effect from the 10,000 simulations, which is $38.3 billion. In summary, we estimate that had there been no capital gains lock-in effect on repurchases, our sample firms would have repurchased $38.3 billion more of their shares in 1987-2008 than they actually did. This $38.3 billion equals 2.5 percent of the $1.5 trillion of repurchases in our sample. This estimate is a lower bound of the total effect of capital gains lock-in on repurchases since we only observe the unrealized capital gains of the tax-sensitive investors in our sample, which are only a fraction of the unrealized capital gains of all tax-sensitive investors.

The coefficient on *CapGains(TaxInsensitive)* is positive and significant at the one percent level in all five columns of Table III. Although not a focus of this paper, this result is possibly consistent with institutional investors exhibiting the disposition effect or realizing gains to rebalance their portfolios. The positive and significant coefficient on *CapGains(TaxInsensitive)* suggests that investors' eagerness to sell shares of a stock in which they have unrealized gains increases the supply of shares for the particular stock, thereby decreasing the price of the shares and making a repurchase relatively less expensive for the firm. The fact that the difference between the coefficients on *CapGains(TaxSensitive)* and *CapGains(TaxInsensitive)* is negative and significant suggests that the lock-in of capital gains by tax-sensitive institutional investors

offsets the presence of any disposition effect or portfolio rebalancing among tax-sensitive investors, which is also consistent with Sikes (2009).[29] The coefficient on *Holdings(TaxSensitive)* is positive and significant in columns (2) through (5), which could be consistent with a "clientele" effect (i.e., a general preference for repurchases among tax-sensitive investors). The coefficient on *Holdings(TaxInsensitive)* is positive and statistically significant in columns (2) through (4), but not in column (5).[30]

The coefficients on all of the lagged *Return* variables in columns (3), (4) and (5) are negative and statistically significant at the one percent level. This result suggests that the aggregate level of share repurchases is negatively associated with a firm's recent stock market performance, and is consistent with the undervaluation hypothesis. The coefficients on *CashFlow/MarketCap* and *Cash/MarketCap* are positive and significant at the one percent level, suggesting that aggregate share repurchases are positively associated with the need to distribute excess capital. The coefficient on *Market/Book* is insignificant in column (4) but positive and significant at the one percent level in column (5), suggesting that growth firms repurchase more shares. The coefficient on *Dividends/MarketCap* is positive and significant in column (3) but negative and significant in column (4). It is thus unclear whether repurchases and dividends are substitutes or complements.

[29] If the unrealized capital gains of tax-insensitive investors in our sample proxy for price appreciation experienced by employees holding stock options, then another potential explanation for the positive relation between repurchases and unrealized capital gains of tax-insensitive investors is the tendency of employees to exercise stock options after they have experienced appreciation. Prior studies find that firms repurchase shares when employees exercise stock options in order to prevent dilution of the firm's stock price (Dunsby 1994; Jolls 1996; Fenn and Liang 1997; Dittmar 2000).

[30] In order to further control for clientele effects, in an untabulated robustness test, we interact *Holdings(TaxSensitive)* with a variable that equals the difference between the personal tax rate on dividends and the long-term capital gains tax rate. The clientele hypothesis would predict that tax-sensitive investors are attracted more to firms that repurchase shares, as opposed to firms that pay a dividend, the larger the difference between the maximum personal tax rate on dividends and the long-term capital gains tax rate. The results for all variables in column (4) of Table III remain quantitatively and qualitatively the same and the coefficient on the interaction is statistically insignificant.

The coefficient on *Ln(Assets)* is positive and significant at the one percent level, suggesting that firm size is positively associated with aggregate repurchases. Unlike the interpretation of the negative and significant coefficients on the lagged *Return* variables, the positive and significant coefficient on *Ln(Assets)* is inconsistent with the undervaluation hypothesis, which predicts that smaller firms with greater information asymmetry between managers and investors are more likely to repurchase shares than are larger firms. The coefficient on *Leverage-TargetLeverage* is negative and significant at the one percent level. This result supports the leverage hypothesis, which predicts that a firm repurchases shares when the firm's leverage ratio is less than the firm's target leverage ratio. The coefficient on *Volatility* is negative and significant at the one percent level, suggesting that firms with less volatile stock returns repurchase more shares. The coefficient on *ExecOptions/MarketCap* is positive and statistically significant at the one percent level, suggesting that firms that offer executives more stock options also repurchase more shares.[31]

[INSERT TABLE III HERE]

C. Capital Gains Lock-in & Repurchases - Tax Regime Changes

The results shown in Table III are consistent with our prediction that capital gains lock-in has a negative effect on share repurchases. However, as illustrated in Table I and discussed above, there are differences in the portfolio characteristics of tax-sensitive and tax-insensitive institutional investors in our sample. It is possible that these differences are responsible for the results in Table III (i.e., that $(\beta_1 - \beta_2)$ is a biased estimate of the lock-in effect). We next take

[31] The American Jobs Creation Act of 2004 created a temporary holiday that effectively reduced the U.S. tax rate on repatriations from foreign subsidiaries from 35 percent to 5.25 percent. Blouin and Krull (2009) find that firms that repatriate under the Act increase share repurchases during 2005 by approximately $60 billion more than non-repatriating firms. In an untabulated robustness test, we delete repurchases made by firms that repatriated funds under the Act. Doing so reduces our sample size by 1,372 observations. The difference between the marginal effects of *CapGains(TaxSensitive)* and *CapGains(TaxInsensitive)* on *Repurchases* remains statistically significant at the one percent level. We thank Jennifer Blouin and Linda Krull for sharing their sample of repatriating firms with us.

advantage of exogenous variation in the long-term capital gains tax rate to address this concern and to further link our results to capital gains lock-in.

Specifically, we examine whether the relation between unrealized capital gains of tax-sensitive institutional investors and aggregate repurchases varies with the capital gains tax rate. For any given amount of unrealized capital gains, the extent of lock-in should increase with the tax rate since the cost of realizing taxable gains increases. We therefore expect the negative relation between tax-sensitive investors' unrealized gains and repurchases to be stronger when the capital gains tax rate is higher. We test this by re-estimating equation (1) and adding as an explanatory variable the interaction between *CapGains(TaxSensitive)* and the long-term capital gains tax rate for the given quarter. For ease of interpretation, we define the variable *TaxRate* as the long-term capital gains tax rate in quarter *q* less 15 percent, which is the minimum long-term capital gains tax rate in the sample period. The long-term capital gains tax rate was 28 percent at the beginning of our sample period (1987Q1). It fell to 20 percent in 1997Q2 and to 15 percent in 2003Q2, where it remained during the rest of the sample period. We interact the variable *TaxRate* with *CapGains(TaxSensitive)* and *CapGains(TaxInsensitive)*. We expect a negative marginal effect from the interaction with *CapGains(TaxSensitive)* but not from the interaction with *CapGains(TaxInsensitive)*. We omit the quarters 1997Q2 and 2003Q2 since the tax rate changed in these quarters.

Column (1) of Table IV reports the results. Consistent with our expectation, the coefficient on the interaction *CapGains(TaxSensitive)* × *TaxRate* is negative and significant at the five percent level. If capital gains lock-in rather than non-tax differences between investors that we classify as tax-sensitive and tax-insensitive drives our results, then the relation between *CapGains(TaxInsensitive)* and repurchases should not vary with the tax rate. As expected, the

coefficient on the interaction *CapGains(TaxInsensitive)* × *TaxRate* is insignificant. These results provide further evidence that differences other than tax-sensitivity between tax-sensitive and tax-insensitive investors in our sample are not responsible for the negative relation between capital gains lock-in and repurchases documented in Table III.

Because the Tobit model is nonlinear, the marginal effects of these interaction terms could differ in sign from the coefficients. Using the estimates from the regression presented in column (1) of Table IV and the means of the explanatory variables, we calculate the marginal effects of *CapGains(TaxSensitive)* and of *CapGains(TaxInsensitive)* on *Repurchases* separately for each of the three tax rates. We then test whether the difference between the marginal effects for the lowest and highest tax rates in our sample period is statistically significant.

The marginal effect of *CapGains(TaxSensitive)* on *Repurchases* is -0.0244 (t=-2.65), 0.0000 (t=0.00), and 0.0153 (t=2.29) for tax rates of 28 percent, 20 percent, and 15 percent, respectively (untabulated). The difference between the marginal effects for tax rates of 15 percent and 28 percent is statistically significant at the one percent level (t=-3.10). The marginal effect of *CapGains(TaxInsensitive)* on *Repurchases* is 0.0451 (t=3.95), 0.0305 (t=5.14), and 0.0214 (t=2.70) for tax rates of 28 percent, 20 percent, and 15 percent, respectively (untabulated). The difference between the marginal effects for tax rates of 15 percent and 28 percent is not statistically significant (t=1.38). These results provide further evidence that the negative effect of *CapGains(TaxSensitive)* on *Repurchases* is due to capital gains lock-in and not to other differences in the characteristics of the tax-sensitive and tax-insensitive investors in our sample.[32]

[32] We thank Jennifer Blouin, Linda Krull, and Leslie Robinson for drawing our attention to the difficulty of estimating the marginal effect of an interaction term in a Tobit model and to the fact that many studies either do not attempt to properly estimate the marginal effects for interaction terms or apply Ai and Norton's (2003) method

Note that in column (1), we include the main effect of *TaxRate* and exclude the year-quarter indicator variables. We do so because it is easier to calculate how the marginal effects of *CapGains(TaxSensitive)* and *CapGains(TaxInsensitive)* on *Repurchases* vary with the tax rate when the main effect of *TaxRate* is in the regression. In column (2), we include the year-quarter indicator variables, and exclude the main effect of *TaxRate*, since it does not vary within year-quarter. The results in column (2) are quantitatively and qualitatively the same as those in column (1).

The results shown in columns (1) and (2) of Table IV suggest that capital gains lock-in indeed drives the negative relation between repurchases and the unrealized gains of tax-sensitive investors. However, these results could also be consistent with differences in the characteristics of tax-sensitive and tax-insensitive investors coincidentally drifting over time in the same direction as the capital gains tax rate. To address this possibility, we next test whether the relation between repurchases and tax-sensitive investors' unrealized gains weakens immediately after the cut in the long-term capital gains tax rate from 28 percent to 20 percent in 1997. The Taxpayer Relief Act of 1997 is an ideal setting for a natural experiment to test the effect of capital gains tax rate cuts. Unlike other tax acts (e.g., the Jobs and Growth Tax Relief Reconciliation Act of 2003, which reduced the capital gains tax rate and the dividend tax rate), the 1997 act only changed the individual capital gains tax rate. Thus, it is free of confounding effects.[33]

We introduce an indicator variable, *Pre97Q2*, which equals one for the four quarters before 1997Q2 and zero for the four quarters after 1997Q2 (we exclude observations from 1997Q2

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incorrectly to the Tobit model. The appendix of Blouin, Krull, and Robinson (2011) provides valuable guidance on this issue.

[33] Papers that use the 1997 tax cut to study the effect of investor-level capital gains taxes on trading and asset prices include Lang and Shackelford (2000), Cook (2007), Ayers, Li and Robinson (2008), Dai et al. (2008), and Blouin, Hail and Yetman (2009).

since the tax rate changed during this quarter). We interact the indicator variable with *CapGains(TaxSensitive)* and with *CapGains(TaxInsensitive)*. We expect the coefficient on the interaction of *Pre97Q2* and *CapGains(TaxSensitive)* to be negative, indicating that the lock-in effect is stronger before the tax rate cut.

Column (3) of Table IV reports the results. Consistent with our expectation, the coefficient on *CapGains(TaxSensitive)* × *Pre97Q2* is negative and statistically significant at the five percent level. Moreover, further supporting that our results are attributable to capital gains lock-in rather than to non-tax differences between tax-sensitive and tax-insensitive investors in our sample, the coefficient on the interaction of *CapGains(TaxInsensitive)* and *Pre97Q2* is insignificant. With the exception of the coefficient on *Holdings(TaxInsensitive)*, which are insignificant, the results for the explanatory variables are consistent with those in column (3) of Table III.

In column (4), we remove the main effect of *Pre97Q2* since it does not vary across observations within a period and include the year-quarter indicator variables instead. The results are virtually the same as those in column (3). In an untabulated test, we find that the decline in the marginal effect of tax-sensitive investors' unrealized capital gains on repurchases from the four quarters preceding 1997Q2 to the four quarters after 1997Q2 is statistically significant at the five percent level. We find no statistically significant change in the marginal effect of tax-insensitive investors' unrealized capital gains on repurchases. These results provide further evidence that the sensitivity of repurchases to tax-sensitive investors' unrealized gains varies with the long-term capital gains tax rate, as demonstrated in columns (1) through (4), and that changes in characteristics between tax-sensitive and tax-insensitive investors in our sample are not responsible for the variation.

[INSERT TABLE IV HERE]

We use the Tobit specification for the tests reported in Tables III and IV because repurchases are bounded below by zero. As a robustness check, we also re-run the tests in these tables using an OLS specification. We log-transform the dependent variable because the bounding of repurchases at zero results in a highly-skewed distribution. Specifically, we use log (0.001 + *Repurchases/MarketCap*) as the dependent variable in the OLS regression. In general, the results are very similar to those obtained using the Tobit specification. Table V presents a subset of the results.

Column (1) shows results for the OLS specification analogous to those in column (4) of Table III for the Tobit specification. As in Table III, the difference in the coefficients for *CapGains(TaxSensitive)* and *CapGains(TaxInsensitive)* is negative and significant at the one percent level. Columns (2) and (3) show results analogous to those in columns (1) and (3) of Table IV. As in Table IV, the interactions of *CapGains(TaxSensitive)* and either *TaxRate* or the *Pre97Q2* indicator variable are negative and statistically significant at the five percent level, while interactions involving *CapGains(TaxInsensitive)* are much smaller in magnitude and are insignificant. The economic magnitudes of all coefficients are similar to those in Tables III and IV.

[INSERT TABLE V HERE]

E. Elasticity of the Supply Curve

The evidence presented thus far supports our prediction that capital gains lock-in has a negative impact on the number of shares that a firm repurchases. We base this prediction on the argument that, by reducing the supply of a firm's shares available in the market, capital gains lock-in raises the price at which the firm can repurchase its shares. This argument requires that

the supply of the firm's shares be imperfectly-elastic. Otherwise, the withholding of shares by taxable investors will not affect the price at which shares can be purchased. Our results should therefore be stronger when the supply curve for a firm's shares is relatively steep (i.e., when supply is more inelastic). We test this prediction next.

One reason for a steep supply curve for a firm's shares is disagreement about the firm's fundamental value. We use the dispersion in analysts' forecasts of a firm's earnings as a proxy for the level of disagreement about the firm's value. Greater forecast dispersion indicates greater disagreement. We define analyst forecast dispersion as the standard deviation of earnings forecasts divided by the mean of the earnings forecasts. We use the last forecast before the annual earnings announcement and apply the same analyst forecast dispersion measure to all four quarters of a year. We then divide the sample into terciles based on the degree of analyst forecast dispersion, and re-estimate the Tobit regression presented in column (4) of Table III for each of the three terciles.

Table VI presents the results of these regressions. Note that the total number of observations across the three columns is about one-third the number in the full sample because analyst forecast data is not available for all firms. The difference in the marginal effects of *CapGains(TaxSensitive)* and *CapGains(TaxInsensitive)* is negative and significant at the one percent level for the high and medium forecast dispersion groups but insignificant for the low forecast dispersion group. The magnitude of the difference between the marginal effects is also substantially larger for the high and medium forecast dispersion groups than for the low forecast dispersion group. These results are consistent with our expectation that the negative relation between capital gains lock-in and repurchases is present only when there is significant disagreement about firm value.

[INSERT TABLE VI HERE]

Another reason for a steep supply curve is a lack of liquidity. Using data from CRSP, we measure liquidity of a firm's stock as the stock's quarterly turnover volume, divided by the number of shares outstanding at the beginning of the quarter. Turnover is often used as a proxy for liquidity (e.g., Datar, Naik and Radcliffe 1998). More turnover indicates greater liquidity. We divide the sample into terciles based on the liquidity measure, and re-estimate the Tobit regression presented in column (4) of Table III for each of the three terciles.

Table VII presents the results of these regressions. The difference between the marginal effects of *CapGains(TaxSensitive)* and *CapGains(TaxInsensitive)* on *Repurchases* is negative and significant only for the low and medium volume groups (at the ten percent level). The difference for the high volume group is actually positive, but not statistically significant. These results are consistent with our expectation that the negative relation between capital gains lock-in and repurchases is present only when liquidity is relatively low. The results in Tables VI and VII further support the argument that the negative effect of capital gains lock-in on repurchases, as documented in Tables III, IV and V, is due to lock-in induced price pressure.

[INSERT TABLE VII HERE]

F. Capital Gains Lock-in and Investment

A large literature finds that firms sometimes forgo investment opportunities that they cannot finance with internal resources (e.g., Fazzari, Hubbard and Petersen 1988; Blanchard, Lopez-de-Salines and Shleifer 1994; Lamont 1997; Rauh 2006). A firm facing such financing constraints is likely to consider repurchases and capital expenditures to be substitutes. In this case, a firm that repurchases fewer shares because capital gains lock-in makes a repurchase more expensive might use the available cash to undertake more real investment. We explore this possibility by

examining whether capital gains lock-in is positively associated with firms' capital expenditures. Specifically, we re-estimate equation (1) and replace the dependent variable with capital expenditures scaled by market capitalization. Unlike the other regressions in the paper, we estimate the regression as an ordinary least squares regression rather than as a Tobit since few observations for the dependent variable equal zero (results using a Tobit specification are almost identical). We also include four lags of capital expenditures as control variables, since real investment is highly-autocorrelated.

Table VIII reports the results. Column (1) mirrors column (4) of Table III with the exception that the dependent variable is now capital expenditures scaled by market capitalization. The difference in the coefficients on *CapGains(TaxSensitive)* and *CapGains(TaxInsensitive)* is positive, consistent with firms investing more when there are more locked-in capital gains among their tax-sensitive investors. However, it is not statistically significant. This is not surprising though, as any indirect effect of capital gains lock-in on capital expenditures is likely to be much smaller than the direct effect on repurchases and therefore more difficult to detect.

To increase power, we re-estimate the specification in column (1) including only observations prior to the second quarter of 1997, with the results shown in column (2). Prior to this quarter, the long-term capital gains tax rate was 28 percent, while it was 20 percent or lower in all quarters after this quarter. Since the evidence in Table IV shows that unrealized capital gains have a greater impact on repurchases when the capital gains tax rate is higher, focusing on this high-tax rate period should give us more power to detect any effect on capital expenditures. As column (2) shows, the difference in the coefficients on *CapGains(TaxSensitive)* and *CapGains(TaxInsensitive)* is positive and significant at the one percent level. This suggests that,

at least when the capital gains tax rate is relatively high, capital gains lock-in leads to greater investment. This is consistent with firms treating repurchases and real investment as substitutes.

Next, we use exogenous variation in the tax rate to gain some assurance that the results in column (2) are not driven by differences between the tax-sensitive and tax-insensitive investors other than their tax sensitivity. Specifically, we add interactions of the indicator variable *Pre97Q2* (defined previously) with *CapGains(TaxSensitive)* and *CapGains(TaxInsensitive)* to the capital expenditures regression, and estimate the regression including observations in the four quarters before and the four quarters after the second quarter of 1997. The coefficient on the interaction of *Pre97Q2* with *CapGains(TaxSensitive)* is positive and significant at the ten percent level. This result suggests that the positive effect of capital gains lock-in on capital expenditures is stronger in the four quarters preceding the 1997 capital gains tax rate cut than in the four quarters following the tax cut. The coefficient on the interaction of *Pre97Q2* with *CapGains(TaxInsensitive)* is insignificant.

[INSERT TABLE VIII HERE]

Finally, if the positive relation between capital gains lock-in and capital expenditures is indeed the result of firms allocating their available cash to capital expenditures when capital gains lock-in makes repurchasing shares more expensive, then the positive relation should be stronger when the supply curve for the firm's shares is steeper. Similar to the tests in Table VII, we divide the sample into three subsamples based on the quarterly turnover of the firm's stock. We only use firm-quarter observations from the period 1987Q1-1997Q1 since column (2) of Table VIII shows a statistically significant relation between capital expenditures and capital gains lock-in over this period.

Table IX reports the results. Consistent with our expectation, the difference between the coefficient estimates on *CapGains(TaxSensitive)* and *CapGains(TaxInsensitive)* is positive and significant only for the low and medium volume groups (at the ten percent level). For the high turnover group, the difference is actually negative, though not statistically significant. We also test whether the positive relation between capital expenditures and capital gains lock-in is stronger when forecast dispersion is relatively high. The results (untabulated) are consistent with our expectation but are not statistically significant. The lack of statistical significance is not surprising however since the number of observations is much lower for the forecast dispersion test than for the turnover volume test.[34] In summary, the results in Tables VIII and IX support the conclusion that capital gains lock-in has a positive effect on capital expenditures.[35]

[INSERT TABLE IX HERE]

IV. Conclusion

Survey and empirical evidence suggest that price is an important determinant in firms' decisions to repurchase shares. We examine a factor that could impact price once a firm begins to repurchase its shares and in turn could impact a firm's decision of whether and how many shares to repurchase.

Specifically, we test whether capital gains lock-in reduces firms' share repurchases. We estimate the effect of lock-in by examining how repurchases vary with shareholders' unrealized gains depending on whether these gains belong to tax-sensitive or to tax-insensitive investors. Consistent with our expectation, we find that capital gains lock-in reduces the number of shares that a firm repurchases. Furthermore, we show that an exogenous reduction in the capital gains

[34] The number of observations is limited by a combination of the relatively short sample period and the fact that many firms are either not covered by analysts or are only covered by one analyst, which does not allow for calculation of a dispersion measure.

[35] We omit the lagged capital expenditures variables from Tables VIII and IX for the sake of brevity. As expected, the coefficients on these variables are positive and highly statistically-significant.

tax rate decreases the effect of capital gains lock-in on repurchases, which confirms that differences other than tax-sensitivity between the tax-sensitive and tax-insensitive institutional investors in our sample are not responsible for our results. We also find that the negative relation between capital gains lock-in and repurchases is present when the supply curve for the firm's shares is likely to be relatively steep, consistent with our results being driven by lock-in-induced supply constraints.

Finally, we find some evidence that the capital gains lock-in is positively related to capital expenditures. Although we cannot draw strong conclusions regarding the substitution between repurchases and capital expenditures from our analysis, the results provide suggestive evidence that firms that reduce share repurchases due to capital gains lock-in allocate the available cash to real investment. Our results suggest that the pending increase in the capital gains tax rate could increase investment, in contrast to prevailing theories of the effects of personal taxes on investment.

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Table I: Summary Statistics for Sample Institutional Investors

This table presents summary statistics for the sample of institutional investors used in this study. The sample consists of investor-quarter observations for the period 1987Q1-2008Q4. The sample is divided into tax-sensitive and tax-insensitive investors (see text for definitions of these categories). The sample contains 16,707 observations for tax-sensitive investors and 13,810 observations for tax-insensitive investors. Panel A summarizes the general characteristics of the holdings and trading patterns of the two groups. # of stocks is the number of stocks the investor holds in its portfolio. Equity holdings is the total dollar amount of an investor's long equity positions, in millions of 2008 dollars. Quarterly turnover is the percentage of price-weighted shares held at the beginning of the quarter that are not held at the end of the quarter. The stock-level portfolio Herfindahl is defined as $\sum_{ijt} v_{ijt}^2/(\sum_{ijt} v_{ijt})^2$, where v_{ijt} is the market value of investor i's holding of stock j at time t. The SIC2-level portfolio Herfindahl is computed similarly, except that an investor's holdings are aggregated to the two-digit SIC code level before computing. For each variable, the statistical significance of t-tests of the difference in the mean values for the two groups is shown after the mean values for the tax-sensitive group. Panel B presents the proportion of tax-sensitive and tax-insensitive investors in each of the four investment style classifications of Abarbanell, Bushee, Raedy (2003).

Panel A: Investor portfolio characteristics

	Mean	Std. Dev.	5th ptcl.	Median	95th pctl.
Tax-sensitive					
# of stocks	139.0***	209.0	27.0	88.0	411.0
Equity holdings, $millions	1,296.0***	3,904.6	84.8	358.3	4,869.3
Quarterly turnover %	6.76%***	6.82%	0.68%	4.77%	19.54%
Portfolio Herfindahl, stock-level	0.045***	0.071	0.011	0.030	0.111
Portfolio Herfindahl, SIC2-level	0.110***	0.084	0.056	0.089	0.237
Tax-insensitive					
# of stocks	181.2	244.7	33.0	107.0	563.0
Equity holdings	3,509.3	10,305.1	112.5	927.3	13,888.6
Quarterly turnover %	8.54%	7.09%	0.96%	6.79%	21.66%
Portfolio Herfindahl, stock-level	0.029	0.058	0.007	0.022	0.058
Portfolio Herfindahl, SIC2-level	0.088	0.062	0.049	0.075	0.152

***, ** and *: significant at 1%, 5% and 10% levels, respectively.

Panel B: Value-size portfolio composition

	Tax-sensitive		*Tax-insensitive*	
	Value	Growth	Value	Growth
Small	20.6%	20.2%	25.5%	25.7%
Large	22.7%	36.4%	23.1%	25.7%

Table II: Summary Statistics for Sample Firms

This table presents summary statistics for the sample of firms used in this study. The sample consists of firm-quarter observations for the period 1987Q1-2008Q4. Repurchases are computed as total common and preferred repurchases for the current quarter, less any decrease in preferred stock outstanding (*pstkq*) from the end of the prior quarter to the end of the current quarter. Total common and preferred repurchases are calculated from *prstkcy*. Since *prstkcy* is year-to-date repurchases, we subtract the previous quarter's value of *prstkcy* from the current quarter's value of *prstkcy* to calculate total repurchases for quarter q, with the exception of the first quarter of the year where we use the actual value of *prstkcy*. Total assets are *atq*. MarketCap is shares outstanding (*cshoq*) times stock price (*prccq*). $Holdings(TaxSensitive)$ and $Holdings(TaxInsensitive)$ equal the dollar value of the holdings of tax-sensitive and tax-insensitive institutional investors in our sample, respectively. $CapGains(TaxSensitive)$ and $CapGains(TaxInsensitive)$ are uncovered, unrealized capital gains of tax-sensitive and tax-insensitive institutional investors in our sample, respectively. *Return* is the quarterly return on the firm's stock as reported in crsp. $CashFlow$ is pretax income (*piq*) + depreciation and amortization (*dpq*). $Cash$ is cash and short-term investments (*cheq*). $Market/book$ is the ratio of the market value of assets to book value of assets. Market value of assets is MarketCap + long-term debt (*dlttq*) + debt in current liabilities (*dlcq*). *Dividends* are total dividends (backed out from year-to-date dividends, *dvy*) less preferred dividends (backed out from year-to-date preferred dividends, *dvpy*). *Leverage* is defined as long-term debt + debt in current liabilities - cash and short-term investments. $Targetleverage$ is the median leverage in the quarter for firms in the same 2-digit SIC code. $Volatility$ is the standard deviation of the daily stock return for the quarter. *ExecShares* is the value of shares owned by the firm's top 5 executives, excluding stock options. *ExecOptions* is the Black-Scholes value of stock options owned by the firm's top 5 executives. *ExecShares* and *ExecOptions* are measured annually. All variables except the CapGains and Holdings variables are winsorized at the 1st and 99th percentiles. An observation is excluded if any variable (except the executive ownership variables) is missing, or if the combined holdings of investors in our sample is greater than 50% of the firm's total market capitalization.

	Mean	Std. Dev.	5th ptcl.	Median	95th pctl.
Repurchases, $millions	10.7	48.1	0.0	0.0	47.4
Total assets, $millions	2,334.5	6,675.9	19.6	337.7	11,544.0
MarketCap, $millions	2,191.0	6,668.9	17.3	310.9	10,103.7
Holdings(TaxSensitive), $millions	69.3	278.4	0.0	5.2	293.2
Holdings(TaxInsensitive), $millions	148.5	624.8	0.0	9.7	594.0
CapGains(TaxSensitive), $millions	2.4	29.9	0.00	0.00	1.6
CapGains(TaxInsensitive), $millions	4.7	80.4	0.00	0.00	3.0
Repurchases/MarketCap	0.0036	0.0114	0.0000	0.0000	0.0208
Holdings(TaxSensitive)/MarketCap	0.0332	0.0475	0.0000	0.0160	0.1275
Holdings(TaxInsensitive)/MarketCap	0.0507	0.0554	0.0000	0.0342	0.1629
CapGains(TaxSensitive)/MarketCap	0.0003	0.0026	0.0000	0.0000	0.0003
CapGains(TaxInsensitive)/MarketCap	0.0002	0.0018	0.0000	0.0000	0.0001
Return	0.0327	0.2688	-0.3784	0.0149	0.5001
CashFlow/MarketCap	0.0181	0.0694	-0.0754	0.0257	0.0926
Cash/MarketCap	0.1648	0.2409	0.0038	0.0813	0.6089
Market/book	1.7080	1.5742	0.3786	1.2001	4.8329
Dividends/MarketCap	0.0018	0.0037	0.0000	0.0000	0.0095
Leverage - TargetLeverage	-0.0364	0.3014	-0.5932	-0.0117	0.4405
Volatility	0.0331	0.0201	0.0115	0.0277	0.0736
ExecShares/MarketCap	0.0435	0.0866	0.0000	0.0084	0.2386
ExecOptions/MarketCap	0.0098	0.0148	0.0000	0.0042	0.0390

Table III: Capital gains lock-in and repurchases

This table presents results from Tobit regressions in which the dependent variable is repurchases in quarter q divided by market capitalization at the end of quarter q-1. The dependent variable is left-censored at zero. The sample period is 1987-2008. The results in columns (1) through (4) are for all observations in the sample. Availability of the executive ownership variables included in column (5) restricts the sample period to 1993-2008. These executive ownership variables are missing for many observations, further reducing the sample size. A constant term is estimated in each regression but is omitted from the table. All specifications include year-quarter effects. All explanatory variables except $CashFlow/MarketCap$ are lagged one quarter. The marginal effects of $CapGains(TaxSensitive)$ and $CapGains(TaxInsensitive)$ and their difference, evaluated at the mean value of all variables, are shown at the bottom of the table. Heteroskedasticity-robust standard errors clustered at the firm level are reported in parentheses below each point estimate.

	(1)	(2)	(3)	(4)	(5)
CapGains(TaxSensitive)	0.1755***	0.0862	0.1127*	-0.0115	-0.0978
	(0.0637)	(0.0618)	(0.0624)	(0.0565)	(0.0684)
CapGains(TaxInsensitive)	0.6661***	0.5541***	0.5848***	0.2282***	0.1888***
	(0.0988)	(0.0967)	(0.0984)	(0.0711)	(0.0682)
Holdings(TaxSensitive)		0.0260***	0.0251***	0.0128***	0.0108*
		(0.0045)	(0.0045)	(0.0044)	(0.0059)
Holdings(TaxInsensitive)		0.0411***	0.0423***	0.0216***	0.0061
		(0.0035)	(0.0035)	(0.0034)	(0.0046)
Return_Lag1			-0.0028***	-0.0032***	-0.0069***
			(0.0003)	(0.0005)	(0.0007)
Return_Lag2			-0.0030***	-0.0042***	-0.0068***
			(0.0004)	(0.0005)	(0.0006)
Return_Lag3			-0.0025***	-0.0029***	-0.0035***
			(0.0003)	(0.0004)	(0.0007)
Return_Lag4			-0.0024***	-0.0023***	-0.0016***
			(0.0003)	(0.0004)	(0.0005)
CashFlow/MarketCap				0.0306***	0.0275***
				(0.0027)	(0.0048)
Cash/MarketCap				0.0056***	0.0047**
				(0.0011)	(0.0020)
Market/Book				0.0001	0.0009***
				(0.0002)	(0.0002)
Dividends/MarketCap				0.1391**	-0.2290***
				(0.0586)	(0.0835)
ln(Assets)				0.0025***	0.0021***
				(0.0001)	(0.0002)
Leverage - TargetLeverage				-0.0091***	-0.0098***
				(0.0009)	(0.0013)
Volatility				-0.3300***	-0.4406***
				(0.0142)	(0.0251)
ExecShares/MarketCap					-0.0037
					(0.0035)
ExecOptions/MarketCap					0.0573***
					(0.0198)
Marginal effects					
CapGains(TaxSensitive)	0.0461***	0.0225	0.0294*	-0.0028	-0.0335
CapGains(TaxInsensitive)	0.1748***	0.1447***	0.1525***	0.0547***	0.0647***
CapGains(TaxSensitive) - CapGains(TaxInsensitive)	-0.1287***	-0.1222***	-0.1819***	-0.0519***	-0.0982***
Observations	143,764	143,764	143,764	143,764	61,184

***, ** and *: significant at 1%, 5% and 10% levels, respectively.

Table IV: Capital gains lock-in, repurchases, and the capital gains tax rate

This table presents results from Tobit regressions in which the dependent variable is repurchases in quarter q divided by market capitalization at the end of quarter q-1. The variable $TaxRate$ is the long-term capital gains tax rate in quarter q less 15% (the minimum tax rate in the sample period). The tax rate was 28% from 1987 through 1997Q1, 20% from 1997Q3 through 2003Q1, and 15% from 2003Q3 through 2008Q4. Observations in the quarters 1997Q2 and 2003Q2 are omitted from the regressions, as the tax rate changed during these quarters. In column (1), $TaxRate$ and its interactions with $CapGains(TaxSensitive)$ and $CapGains(TaxInsensitive)$ are included. Column (2) has the same specification as column (1), except that we include year-quarter effects instead of including $TaxRate$ directly. Columns (3) and (4) focus on the period around 1997Q2, when the long-term capital gains tax rate decreased from 28% to 20%. The sample in columns (3) and (4) is restricted to the four quarters before and four quarters after 1997Q2 (observations in 1997Q2 itself are omitted). $Pre97Q2$ is an indicator variable taking a value of 1 for the four quarters before 1997Q2 and 0 for the four quarters after 1997Q2. Columns (3) includes $Pre97Q2$ and its interactions with $CapGains(TaxSensitive)$ and $CapGains(TaxInsensitive)$. In column (4), we include year-quarter effects instead of including $Pre97Q2$. All explanatory variables except $CashFlow/MarketCap$, $TaxRate$, and $Pre97Q2$ are lagged one quarter. Heteroskedasticity-robust standard errors clustered at the firm level are reported in parentheses below each point estimate.

	(1)	(2)	(3)	(4)
CapGains(TaxSensitive)	0.1134	0.1333	0.0002	-0.0117
	(0.0855)	(0.0850)	(0.0674)	(0.0670)
CapGains(TaxSensitive) × TaxRate	-2.2695**	-2.6908**		
	(1.0458)	(1.1529)		
CapGains(TaxSensitive) × Pre97Q2			-0.2648**	-0.2346**
			(0.1297)	(0.1287)
CapGains(TaxInsensitive)	0.1583	0.1660	0.3203***	0.3105***
	(0.1021)	(0.1023)	(0.1007)	(0.1015)
CapGains(TaxInsensitive) × TaxRate	1.3667	1.1540		
	(1.2476)	(1.2738)		
CapGains(TaxInsensitive) × Pre97Q2			0.0872	0.1098
			(0.1579)	(0.1570)
TaxRate	-0.0237***			
	(0.0037)			
Pre97Q2			-0.0023***	
			(0.0006)	
Holdings(TaxSensitive)	0.0145***	0.0128***	0.0212**	0.0213**
	(0.0044)	(0.0044)	(0.0093)	(0.0093)
Holdings(TaxInsensitive)	0.0216***	0.0219***	0.0060	0.0065
	(0.0034)	(0.0034)	(0.0078)	(0.0079)
Return_Lag1	-0.0061***	-0.0033***	-0.0024*	-0.0020
	(0.0005)	(0.0005)	(0.0013)	(0.0014)
Return_Lag2	-0.0053***	-0.0043***	-0.0043***	-0.0053***
	(0.0005)	(0.0005)	(0.0012)	(0.0012)
Return_Lag3	-0.0038***	-0.0030***	-0.0023**	-0.0024**
	(0.0004)	(0.0004)	(0.0011)	(0.0011)
Return_Lag4	-0.0025***	-0.0023***	-0.0027**	-0.0024**
	(0.0003)	(0.0004)	(0.0011)	(0.0012)
CashFlow/MarketCap	0.0384***	0.0312***	0.0168**	0.0188**
	(0.0028)	(0.0027)	(0.0077)	(0.0078)
Cash/MarketCap	0.0040***	0.0057***	0.0092***	0.0092***
	(0.0011)	(0.0011)	(0.0030)	(0.0030)
Market/Book	0.0002	0.0001	-0.0001	-0.0001
	(0.0002)	(0.0002)	(0.0003)	(0.0003)
Dividends/MarketCap	0.1965***	0.1486**	0.5243***	0.5284***
	(0.0589)	(0.0584)	(0.1355)	(0.1356)
ln(Assets)	0.0028***	0.0025***	0.0021***	0.0021***
	(0.0001)	(0.0001)	(0.0003)	(0.0003)
Leverage - TargetLeverage	-0.0089***	-0.0091***	-0.0069***	-0.0070***
	(0.0009)	(0.0009)	(0.0017)	(0.0017)
Volatility	-0.2263***	-0.3243***	-0.3844***	-0.3814***
	(0.0120)	(0.0142)	(0.0369)	(0.0370)
Year × quarter effects	No	Yes	No	Yes
Observations	139,080	139,080	18,202	18,202

***, ** and *: significant at 1%, 5% and 10% levels, respectively.

Table V: Capital gains lock-in and repurchases: an alternative specification

This table presents results from OLS regressions in which the dependent variable is ln (0.001 + repurchases/marketcap), where repurchases are measured in quarter q and market capitalization is measured at the end of quarter q-1. The variable $TaxRate$ is the long-term capital gains tax rate in quarter q less 15% (the minimum tax rate in the sample period). The tax rate was 28% from 1987 through 1997Q1, 20% from 1997Q3 through 2003Q1, and 15% from 2003Q3 through 2008Q4. Observations in the quarters 1997Q2 and 2003Q2 are omitted from the regression in column (2), as the tax rate changed during these quarters. $Pre97Q2$ is an indicator variable taking a value of 1 for the four quarters before 1997Q2 and 0 for the four quarters after 1997Q2. Only quarters between 1996Q2 and 1998Q2, excluding 1997Q2, are used in the regression in column (3). All explanatory variables except $CashFlow/MarketCap$, $TaxRate$, and $Pre97Q2$ are lagged one quarter. Heteroskedasticity-robust standard errors clustered at the firm level are reported in parentheses below each point estimate.

	(1)	(2)	(3)
CapGains(TaxSensitive)	-0.0642	5.6281	1.2398
	(2.3054)	(4.2556)	(2.9276)
CapGains(TaxSensitive) × TaxRate		-90.9213**	
		(39.8001)	
CapGains(TaxSensitive) × Pre97Q2			-5.8765**
			(2.9210)
CapGains(TaxInsensitive)	10.8195***	9.6713*	15.9237***
	(3.5455)	(5.1483)	(5.3427)
CapGains(TaxInsensitive) × TaxRate		10.4512	
		(62.3904)	
CapGains(TaxInsensitive) × Pre97Q2			1.7594
			(7.7039)
TaxRate		-0.8343***	
		(0.1103)	
Pre97Q2			-0.0502***
			(0.0164)
Holdings(TaxSensitive)	0.3584**	0.3868**	0.4645
	(0.1502)	(0.1528)	(0.2877)
Holdings(TaxInsensitive)	0.6933***	0.6917***	0.1830
	(0.1218)	(0.1233)	(0.2251)
Return_Lag1	-0.0778***	-0.1400***	-0.0536**
	(0.0091)	(0.0098)	(0.0244)
Return_Lag2	-0.1031***	-0.1243***	-0.0840***
	(0.0093)	(0.0095)	(0.0223)
Return_Lag3	-0.0822***	-0.1003***	-0.0464**
	(0.0085)	(0.0083)	(0.0203)
Return_Lag4	-0.0605***	-0.0673***	-0.0512**
	(0.0077)	(0.0072)	(0.0220)
CashFlow/MarketCap	0.6756***	0.8413***	0.3269**
	(0.0586)	(0.0604)	(0.1305)
Cash/MarketCap	0.1619***	0.1157***	0.2986***
	(0.0433)	(0.0445)	(0.1002)
Market/Book	0.0092*	0.0142***	-0.0032
	(0.0052)	(0.0052)	(0.0081)
Dividends/MarketCap	4.6950**	5.8342***	20.7441***
	(2.0171)	(2.0356)	(4.4981)
ln(Assets)	0.0864***	0.0933***	0.0681***
	(0.0055)	(0.0054)	(0.0099)
Leverage - TargetLeverage	-0.2444***	-0.2418***	-0.1656***
	(0.0279)	(0.0281)	(0.0512)
Volatility	-6.7930***	-4.8418***	-6.6563***
	(0.3338)	(0.2835)	(0.7070)
Year × quarter effects	Yes	No	No
CapGains(TaxSensitive) - CapGains(TaxInsensitive)	-10.8837***		
Observations	143,764	139,080	18,202
Adjusted R2	0.0878	0.0717	0.0694

***, ** and *: significant at 1%, 5% and 10% levels, respectively.

Table VI: Capital gains lock-in, repurchases, and analyst forecast dispersion

This table presents results from Tobit regressions in which the dependent variable is repurchases in quarter q divided by market capitalization at the end of quarter q-1. The full sample is divided into three subsamples based on the mean analyst earnings forecast dispersion for the stock. Analyst earnings forecast dispersion is measured annually as the standard deviation of the final analyst earnings forecast prior to the firm's annual earnings announcement, divided by the mean forecast. The forecast dispersion is then used for all quarters in the year. A constant term is estimated in each regression but is omitted from the table. Each regression includes year-quarter effects. All explanatory variables except $CashFlow/MarketCap$ are lagged one quarter. The marginal effects of $CapGains(TaxSensitive)$ and $CapGains(TaxInsensitive)$ and their difference, evaluated at the mean value of all variables, are shown at the bottom of the table. Heteroskedasticity-robust standard errors clustered at the firm level are reported in parentheses below each point estimate.

	High Forecast Dispersion	Medium Forecast Dispersion	Low Forecast Dispersion
CapGains(TaxSensitive)	-0.2542**	-0.1344	0.0268
	(0.1237)	(0.1540)	(0.1381)
CapGains(TaxInsensitive)	0.3172	0.5229***	0.0363
	(0.2065)	(0.1369)	(0.0774)
Holdings(TaxSensitive)	0.0237**	0.0104	0.0047
	(0.0108)	(0.0090)	(0.0083)
Holdings(TaxInsensitive)	0.0093	0.0125*	0.0182***
	(0.0093)	(0.0073)	(0.0063)
Return_Lag1	-0.0043***	-0.0070***	-0.0081***
	(0.0012)	(0.0012)	(0.0010)
Return_Lag2	-0.0004	-0.0063***	-0.0077***
	(0.0020)	(0.0011)	(0.0010)
Return_Lag3	-0.0037***	-0.0033**	-0.0044***
	(0.0010)	(0.0014)	(0.0009)
Return_Lag4	-0.0013	-0.0035***	-0.0024***
	(0.0010)	(0.0009)	(0.0008)
CashFlow/MarketCap	0.0219***	0.0305***	0.0435***
	(0.0077)	(0.0090)	(0.0105)
Cash/MarketCap	0.0071**	0.0042	0.0043*
	(0.0029)	(0.0028)	(0.0022)
Market/Book	-0.0016***	0.0001	0.0010***
	(0.0004)	(0.0003)	(0.0003)
Dividends/MarketCap	0.0337	-0.0252	-0.0874
	(0.1504)	(0.1261)	(0.1246)
ln(Assets)	0.0015***	0.0021***	0.0026***
	(0.0004)	(0.0003)	(0.0003)
Leverage - TargetLeverage	-0.0136***	-0.0084***	-0.0047***
	(0.0021)	(0.0018)	(0.0017)
Volatility	-0.2856***	-0.3372***	-0.1704***
	(0.0369)	(0.0344)	(0.0267)
Marginal effects			
CapGains(TaxSensitive)	-0.0439**	-0.0358	0.0100
CapGains(TaxInsensitive)	0.0547	0.1391***	0.0135
CapGains(TaxSensitive) - CapGains(TaxInsensitive)	-0.0986***	-0.1749***	-0.0035
Observations	17,028	17,028	17,027

***, ** and *: significant at 1%, 5% and 10% levels, respectively.

Table VII: Capital gains lock-in, repurchases, and turnover volume

This table presents results from Tobit regressions in which the dependent variable is repurchases in quarter q divided by market capitalization at the end of quarter q-1. The full sample is divided into three subsamples based on the quarterly turnover volume of the firm's stock (average daily turnover during the quarter divided by shares outstanding at the beginning of the quarter). A constant term is estimated in each regression but is omitted from the table. Each regression includes year-quarter effects. All explanatory variables except $CashFlow/MarketCap$ are lagged one quarter. The marginal effects of $CapGains(TaxSensitive)$ and $CapGains(TaxInsensitive)$ and their difference, evaluated at the mean value of all variables, are shown at the bottom of the table. Heteroskedasticity-robust standard errors clustered at the firm level are reported in parentheses below each point estimate.

	Low Turnover Volume	Medium Turnover Volume	High Turnover Volume
CapGains(TaxSensitive)	-0.0392	-0.1427	0.0356
	(0.0656)	(0.0934)	(0.1539)
CapGains(TaxInsensitive)	0.1323*	0.1208	0.0326
	(0.0791)	(0.1249)	(0.1888)
Holdings(TaxSensitive)	0.0051	0.0242***	0.0154**
	(0.0053)	(0.0056)	(0.0079)
Holdings(TaxInsensitive)	0.0243***	0.0203***	0.0275***
	(0.0044)	(0.0043)	(0.0067)
Return_Lag1	-0.0105***	-0.0090***	-0.0038***
	(0.0011)	(0.0008)	(0.0006)
Return_Lag2	-0.0086***	-0.0081***	-0.0029***
	(0.0010)	(0.0008)	(0.0007)
Return_Lag3	-0.0051***	-0.0043***	-0.0015***
	(0.0009)	(0.0007)	(0.0005)
Return_Lag4	-0.0032***	-0.0029***	-0.0012**
	(0.0008)	(0.0006)	(0.0005)
CashFlow/MarketCap	0.0123*	0.0546***	0.0393***
	(0.0064)	(0.0054)	(0.0035)
Cash/MarketCap	0.0051***	0.0031*	0.0041***
	(0.0016)	(0.0016)	(0.0013)
Market/Book	0.0021***	0.0002	-0.0014***
	(0.0002)	(0.0002)	(0.0002)
Dividends/MarketCap	-0.2485***	0.4356***	0.7934***
	(0.0723)	(0.0762)	(0.1046)
ln(Assets)	0.0025***	0.0029***	0.0029***
	(0.0002)	(0.0002)	(0.0003)
Leverage - TargetLeverage	-0.0058***	-0.0110***	-0.0137***
	(0.0012)	(0.0012)	(0.0012)
Volatility	-0.4483***	-0.3087***	-0.1468***
	(0.0513)	(0.0434)	(0.0175)
Marginal effects			
CapGains(TaxSensitive)	-0.0147	-0.0355	0.0050
CapGains(TaxInsensitive)	0.0496	0.0300	0.0045
CapGains(TaxSensitive) - CapGains(TaxInsensitive)	-0.0643*	-0.0655*	0.0005
Observations	47,921	47,921	47,922

***, ** and *: significant at 1%, 5% and 10% levels, respectively.

Table VIII: Capital gains lock-in and capital expenditures

This table presents results from OLS regressions in which the dependent variable is capital expenditures in quarter q (backed out from COMPUSTAT item *capxy*, which is year-to-date capital expenditures) divided by market capitalization at the end of quarter q-1. The sample period is 1987-2008. A constant term is estimated in each regression but is omitted from the table. Each regression includes year-quarter effects. Four lags of capital expenditures are included as control variables but are omitted from the table. All other explanatory variables except $CashFlow/MarketCap$ are lagged one quarter. In columns (1) and (2), the difference between the coefficients on $CapGains(TaxSensitive)$ and $CapGains(TaxInsensitive)$ is shown at the bottom of the table. Heteroskedasticity-robust standard errors clustered at the firm level are reported in parentheses below each point estimate.

	(1)	(2)	(3)
CapGains(TaxSensitive)	-0.0103	0.0160	-0.0355
	(0.0114)	(0.0220)	(0.0252)
CapGains(TaxSensitive) × Pre97Q2			0.0708*
			(0.0415)
CapGains(TaxInsensitive)	-0.0235	-0.0696***	-0.0429*
	(0.0190)	(0.0265)	(0.0222)
CapGains(TaxInsensitive) × Pre97Q2			-0.0061
			(0.0374)
Holdings(TaxSensitive)	-0.0016	-0.0052**	-0.0036
	(0.0010)	(0.0025)	(0.0029)
Holdings(TaxInsensitive)	0.0022**	-0.0025	0.0028
	(0.0009)	(0.0027)	(0.0030)
Return_Lag1	-0.0072***	-0.0075***	-0.0071***
	(0.0004)	(0.0006)	(0.0007)
Return_Lag2	-0.0035***	-0.0031***	-0.0026***
	(0.0002)	(0.0006)	(0.0006)
Return_Lag3	-0.0025***	-0.0032***	-0.0018***
	(0.0002)	(0.0006)	(0.0006)
Return_Lag4	-0.0010***	-0.0013**	-0.0022***
	(0.0002)	(0.0005)	(0.0006)
CashFlow/MarketCap	0.0086***	0.0186***	0.0208***
	(0.0018)	(0.0039)	(0.0049)
Cash/MarketCap	0.0057***	0.0060***	0.0075***
	(0.0005)	(0.0012)	(0.0015)
Market/Book	-0.0000	-0.0001	-0.0000
	(0.0000)	(0.0001)	(0.0001)
Dividends/MarketCap	-0.0463**	-0.0985***	-0.0579
	(0.0181)	(0.0380)	(0.0561)
ln(Assets)	0.0002***	0.0000	0.0000
	(0.0000)	(0.0001)	(0.0001)
Leverage - TargetLeverage	0.0023***	0.0024***	0.0021***
	(0.0003)	(0.0006)	(0.0006)
Volatility	0.0371***	0.0219**	0.0121
	(0.0050)	(0.0105)	(0.0130)
Sample period	1987-2008	1987Q1-1997Q1	1996Q2-1998Q2
Year × quarter effects	Yes	Yes	Yes
CapGains(TaxSensitive) - CapGains(TaxInsensitive)	0.0132	0.0856***	
Observations	137,298	31,740	17,165

***, ** and *: significant at 1%, 5% and 10% levels, respectively.

Table IX: Capital gains lock-in, capital expenditures, and turnover volume

This table presents results from OLS regressions in which the dependent variable is capital expenditures in quarter q (backed out from COMPUSTAT item *capxy*, which is year-to-date capital expenditures) divided by market capitalization at the end of quarter q-1. The sample period is 1987Q1-1997Q1. The sample is divided into three subsamples based on the quarterly turnover volume of the firm's stock (average daily turnover during the quarter divided by shares outstanding at the beginning of the quarter). A constant term is estimated in each regression but is omitted from the table. Each regression includes year-quarter effects. Four lags of capital expenditures are included as control variables but are omitted from the table. All other explanatory variables except $CashFlow/MarketCap$ are lagged one quarter. In each column, the difference between the coefficients on $CapGains(TaxSensitive)$ and $CapGains(TaxInsensitive)$ is shown at the bottom of the table. Heteroskedasticity-robust standard errors clustered at the firm level are reported in parentheses below each point estimate.

	Low Turnover Volume	Medium Turnover Volume	High Turnover Volume
CapGains(TaxSensitive)	0.0515*	0.0358	-0.0485
	(0.0291)	(0.0324)	(0.1279)
CapGains(TaxInsensitive)	0.0132	-0.0597	-0.0052
	(0.0333)	(0.0436)	(0.0790)
Holdings(TaxSensitive)	-0.0087**	-0.0083*	0.0009
	(0.0038)	(0.0045)	(0.0054)
Holdings(TaxInsensitive)	0.0017	-0.0079	-0.0016
	(0.0036)	(0.0048)	(0.0056)
Return_Lag1	-0.0141***	-0.0073***	-0.0065***
	(0.0015)	(0.0011)	(0.0008)
Return_Lag2	-0.0074***	-0.0037***	-0.0022**
	(0.0014)	(0.0009)	(0.0008)
Return_Lag3	-0.0070***	-0.0024**	-0.0030***
	(0.0016)	(0.0010)	(0.0008)
Return_Lag4	-0.0046***	-0.0015*	-0.0007
	(0.0013)	(0.0009)	(0.0007)
CashFlow/MarketCap	0.0431***	0.0269***	0.0129**
	(0.0073)	(0.0063)	(0.0051)
Cash/MarketCap	0.0015	0.0026*	0.0108***
	(0.0012)	(0.0014)	(0.0020)
Market/Book	-0.0001	-0.0004***	0.0002
	(0.0001)	(0.0001)	(0.0001)
Dividends/MarketCap	-0.0977**	-0.0954	-0.2211**
	(0.0472)	(0.0702)	(0.1078)
ln(Assets)	-0.0003**	0.0002	0.0004*
	(0.0001)	(0.0002)	(0.0002)
Leverage - TargetLeverage	0.0001	0.0003	0.0055***
	(0.0007)	(0.0008)	(0.0010)
Volatility	0.0943**	0.0878*	0.0343*
	(0.0477)	(0.0503)	(0.0185)
Marginal effects			
CapGains(TaxSensitive) - CapGains(TaxInsensitive)	0.0647*	0.0955*	-0.0433
Observations	10,504	10,447	10,789

***, ** and *: significant at 1%, 5% and 10% levels, respectively.