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Essays on Capital Gains, Household Consumption and Corporate Payout Policy

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ESSAYS ON CAPITAL GAINS, HOUSEHOLD CONSUMPTION, AND CORPORATE PAYOUT POLICY

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by

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Abstract

My dissertation consists of three chapters related to accrued capital gains. The first essay is concerned with estimating the marginal propensity to consume (MPC) out of accrued capital gains on owner-occupied housing in Canada. Its main methodological contribution lies in using a hedonic price equation to value these gains. The results suggest that for every 1 dollar increase in expected housing capital gains households increase total consumption by approximately 9.4 cents, and increase non-durable consumption by 7.3 cents.

The second essay of this thesis proposes a model of economic behaviour that can explain why corporations pay dividends despite their tax disadvantage relative to share repurchases. The key result is that firms must pay a premium above the intrinsic value of equity to repurchase shares, reflecting the lock-in effect caused by a realization-based capital gains tax system. In equilibrium, firms pay dividends whenever this additional cost is sufficiently high.

The third essay examines the effect of capital income taxation on corporate payout policy in Canada. The analysis makes use of a new dataset on share repurchases carried out by Toronto Stock Exchange listed Canadian corporations over the period 1987-2008. It also uses new estimates of Canadian average marginal tax rates applied to capital income. The results suggest that total payout is positively related to changes in both the corporate income tax rate and the capital gains tax rate, but is unaffected by the dividend tax rate.

The results also suggest that share repurchase levels are positively related to changes in the dividend tax rate and negatively related to changes in the capital gains tax rate. Dividend payments are found to have a positive relationship with changes to the capital gains tax rate.

Acknowledgements

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Chapter 1

Introduction

My dissertation consists of three chapters. A unifying theme in this work is accrued capital gains. I study the impact of these gains on household consumption expenditures, and explore the relationships between capital gains taxation and corporate payout policy.

The first chapter is concerned with estimating the marginal propensity to consume out of accrued capital gains on owner-occupied housing in Canada. It is the first such study to use Canadian micro data, and it makes an important methodological contribution by using a hedonic regression approach to estimate capital gains. Earlier studies, mostly in the USA and the UK, have relied on regional house-price indices and other proxies, whereas the hedonic approach estimates accrued gains based on actual housing transactions.

The analysis is based on data from the Survey of Household Spending (SHS)

over the years 2000-2006. The SHS is a Canada-wide cross-sectional survey containing comprehensive information on household consumption expenditures and dwelling characteristics. The latter information is used to estimate seven hedonic equations, one for each year between 2000-2006, which relate the market price of a home to its characteristics in that year, and changes in regression coefficients over time are used to compute capital gains.

The results suggest that household consumption expenditures increase in the level of accrued capital gains on housing, and that the sustainability of these gains is important for the magnitude of the increase. When the level of accrued capital gains is persistent over time, total household consumption increases by approximately 9.4 cents for every dollar of capital gains income. Spending on non-durable consumption increases by approximately 7.3 cents. When the accrued capital gain is temporary, total consumption increases by approximately 1.6 cents for every dollar of capital gains income. These results are consistent with the permanent income hypothesis.

My second chapter addresses the corporate payout puzzle, originally identified by Black (1976). Out of their after-tax profits, corporations pay dividends and often repurchase shares, generating accrued capital gains for their shareholders. Capital gains typically attract lower effective rates of tax than dividends, which leads to the payout puzzle: why do corporations continue to pay

dividends in spite of their relative tax disadvantage? This paper develops a model of corporate payout policy to explain some aspects of the puzzle.

The key element of the model is the lock-in effect caused by the fact that capital gains are taxed only upon realization, which implies that taxpayers can reduce the effective rate of tax by postponing realizations, i.e., by locking in accrued capital gains. Shareholders with an accrued capital gain, thus, would require a lock-in premium to compensate them for their higher tax liability resulting from the sale. This premium is an increasing function of accrued capital gains and the desired holding period for shares. In this setting firms pay dividends in equilibrium whenever the lock-in premium is high relative to the tax disadvantage of dividend payments. It follows that firms with a relatively high proportion of shareholders with sizeable capital gains and/or long holding periods face higher repurchasing costs and are thus more likely to pay dividends.

The third chapter explores the empirical relationships between capital income taxation and corporate payout policy. The issue is addressed with a unique dataset on share repurchase programs executed by Toronto Stock Exchange listed Canadian corporations, and with new estimates of Canadian average marginal tax rates on corporate income, realized capital gains income, and dividend income. With these resources, the effects of these taxes on total

payout, dividend payout, share repurchases, and the payout mix are analysed.

It is found that taxes matter for corporate payout decisions. The results suggest that dividends are positively related to changes in the capital gains tax rate, whereas share repurchases are positively related to changes in the dividend tax rate, and negatively related to changes in the capital gains tax rate. Total payout is positively related to changes in both the capital gains tax rate and the corporate tax rate, but is unaffected by the dividend tax. These results are consistent with the theoretical analysis of the second chapter. To the best of my knowledge, this analysis is the first to simultaneously estimate the effect of tax changes on dividend payments, share repurchases and total payout. Examining all three components of corporate payout simultaneously provides a more complete view of the empirical relationships between tax policy and payout policy.

Chapter 2

Real Estate Capital Gains and Consumer Spending: Some Results from Canadian Micro Data

2.1 Introduction

Recent turmoil in US and Canadian housing markets has renewed interest in the link between house values and household consumption expenditures. The nature of this link is largely unknown for Canada, and the literature has made little attempt to analyse it. The current chapter seeks to narrow this gap in our understanding by estimating the parameters of a consumption function for Canada, explicitly taking into account the capital gains accruing on owner-occupied housing, as well as non-housing income. This is accomplished using a unique data set, taken from the Survey of Household Spending, that contains

detailed and comprehensive consumption data, and by using an innovative approach to calculate the capital gains accruing on owner occupied housing. This approach is based on the hedonic price method, where the value of a house is estimated using its characteristics and a function linking those characteristics to overall house prices. This method permits a substantial degree of price variability across observations and provides more accurate estimates compared with other methods commonly used in the literature. The analysis demonstrates that capital gains on housing are an important driver of consumption expenditures in Canada, and capital gains perceived to be persistent have a much larger effect on consumption than one-off gains.[1]

The main findings of this chapter are as follows: households in the sample increase total consumption by approximately 9.4 cents for every 1 dollar increase in permanent housing capital gains, and increase non-durable consumption by approximately 7.3 cents.[2] Households increase total consumption by approximately 1.6 cents for every 1 dollar increase in contemporaneous one-off capital gains. This lower estimate for one-off gains is consistent with the permanent income hypothesis.

It is also found that the elasticity of consumption with respect to "luxury"

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[1]One-off gains are defined here as the sum of permanent and transitory gains in a particular year.

[2]The measure of total consumption used in this chapter includes the value of durable good purchases, not an estimate of the consumption services derived from durable goods.

goods is approximately 2.5 times higher than the elasticity for total consumption, non-durable consumption, and food purchases, which all have approximately equal elasticities.

The remainder of this chapter is organized as follows. Section 2.2 discusses other relevant literature. Section 2.3 describes the data and provides summary statistics on Canadian housing wealth. Section 2.4 discusses the method used to estimate accrued capital gains on owner-occupied housing. Section 2.5 discusses the approach taken to estimate the consumption function. Section 2.6 reports the estimation results, and Section 2.7 concludes.

2.2   Other Literature

Past studies have typically assumed that housing enters the consumption function in one of two ways, either through a wealth effect, popularized by Ando and Modiglinai (1963)'s life cycle model, or through an income effect, where capital gains on housing are treated as part of total income. These methodologies are closely related.[3] The method ultimately chosen depends on the available data; the former method requires data on household wealth stocks, the latter on wealth flows. This chapter focuses on the latter method, though the former

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[3]The life cycle model is concerned with housing wealth, whereas the income model is concerned with the rate of return on housing wealth.

is treated most often in the literature.[4]

The results of early work by Elliott (1980) seemed to demonstrate that housing capital gains had no effect on consumption expenditures in the US. However, this work was put into question by Peek (1983) and Bhatia (1987), both showing that capital gains had a significant positive effect. Bhatia (1987) attributed Elliott (1980)'s findings to poorly measured real estate values, which were based on production costs rather than actual market prices.

Skinner (1989), the first micro-data study to analyse housing wealth effects found a positive effect on consumption expenditures. Skinner, using data from the Panel Study of Income Dynamics (PSID), from the late 70's and early 80's, showed that this effect is small but significant, and that predictable house price changes have a larger effect on consumption expenditure than unpredictable changes. Lehnert (2004), also using data from the PSID, and covering a longer time span (1963-1999), finds that the marginal propensity to consume (MPC) out of housing wealth is between 1.9 and 3.1 cents for US residents, depending on the model specification used.

Studies based on non-US data have also found positive effects. Bover (2005), using Spanish data, estimates the MPC out of housing wealth to be 2 cents for

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[4]See Muellbauer (2008) for a survey of papers looking at the effects of housing assets on consumption.

the entire population, and 4-6 cents for "prime" aged households, aged 35-44. Gan (2008), using a unique Hong Kong data set on credit card purchases, estimates the MPC out of housing wealth to be 1.6 cents, and found consumption is twice as elastic for discretionary spending as for non-discretionary spending. Campbell and Cocco (2007), using the UK Family Expenditure Survey over the years 1988 to 2000 estimate the elasticity of consumption with respect to changes in overall house prices. They find that a 1% increase in UK house prices lead to, on average, a 1.22% increase in non-durable consumption. For the average UK house (worth 81,628 UK pounds in 2000) this translates into 8 pence out over every pound increase in housing.

Case, Quigley, and Shiller (2005) (CQS), a recent international study, uses a panel of 14 OECD countries to estimate the elasticity of consumption with respect to housing and non-housing wealth. CQS find that the elasticity of consumption with respect to housing wealth ranges from .11 to .17 depending on the model specification used, and that the elasticity of consumption with respect to non-housing financial wealth is, on average, only .02. The authors point to a number of reasons for this asymmetry, including differences in the perceived permanence of capital gains on different asset-types, differences in the tax treatment across asset-types, and the difficulty of measuring certain forms of wealth.

Among the limited number of Canadian studies is Pichette and Tremblay (2003).[5] This study uses aggregate annual Canadian time series data to analyse the effect of housing wealth on the consumption of non-durable goods and services. The authors find that the MPC out of housing wealth is 5.7 cents, and like CQS, the MPC out of financial wealth is small - and in this case insignificant. The current study differs from Pichette and Tremblay (2003) in two main respects. First, capital gains on housing are analysed, not housing wealth, and second, this study uses micro-data.

The literature is not completely one sided on the significance of housing wealth for consumption. Miles (1997), using the UK Family Expenditure Survey, and Juster et al. (2005) using the PSID, find that consumption is, for the most part, unresponsive to capital gains on housing. Engelhardt (1996), also using the PSID, finds the MPC from capital gains is approximately 3 cents, but notes an asymmetric behavioural response; households experiencing a capital loss reduce consumption, whereas households experiencing a capital gain leave consumption unchanged. Levin (1998), using micro-data from the Retirement History Survey finds no effect on consumption from housing wealth.

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[5]Another Canadian study is Engelhardt (1994), which finds higher house prices reduce the probability that renters save for a down payment.

2.3 Data and Summary Statistics

The primary analysis of this chapter is based on data from the Survey of Household Spending (SHS), covering the years 2000-2006. The SHS is a Canada-wide cross-sectional survey containing comprehensive information on household consumption expenditures, incomes, household member composition, and dwelling characteristics. Each year the survey interviews approximately 16,000 respondent households, and is representative of approximately 98% of the Canadian population.[6] Data from the 2005 Survey of Financial Security (SFS) is also used to construct the summary statistics below. The SFS provides information on the value of Canadian household assets and liabilities.

The importance of housing wealth for Canadian household balance sheets is sizeable. Figure 2.2 reports the average value of various household asset-types as a fraction of the average total value. The single largest component of household wealth is housing, accounting for approximately one third of the total, followed by employer pension plans at 18.5%. The relative value of housing is highest for low-to-middle income households, though it remains the most valuable asset across all income groups. Housing is also the most widely held asset (not including bank deposits); 62% of households own a home, followed by

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[6]The survey omits particular groups such as Native Americans living on reservations, members of religious groups living in communal colonies, people living in residences for senior citizens, people living in full time institutions, and Canadian Forces members living in military camps.

RRSPs/LIRAs (51.2%), employer pension plans (48.7%), and other real estate (15.9%).

Figure 2.1: Household Assets as a Fraction of Total Assets (2005)
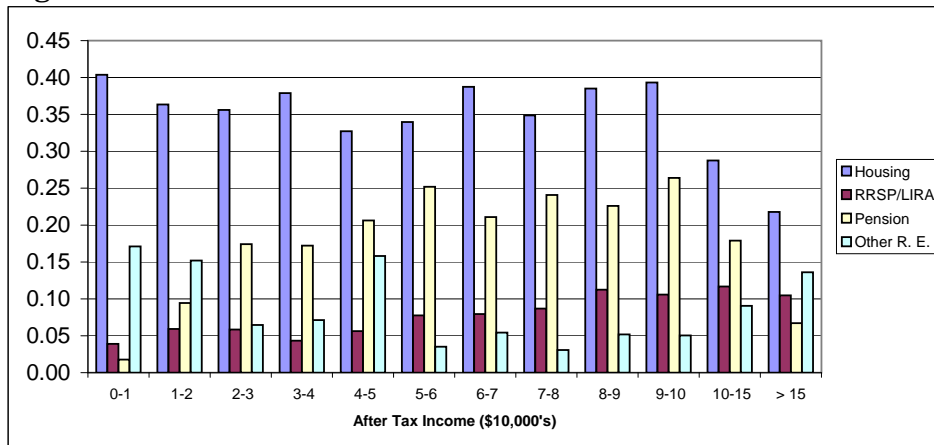
Figure 2.2: Household Asset Ownership Rates (2005)
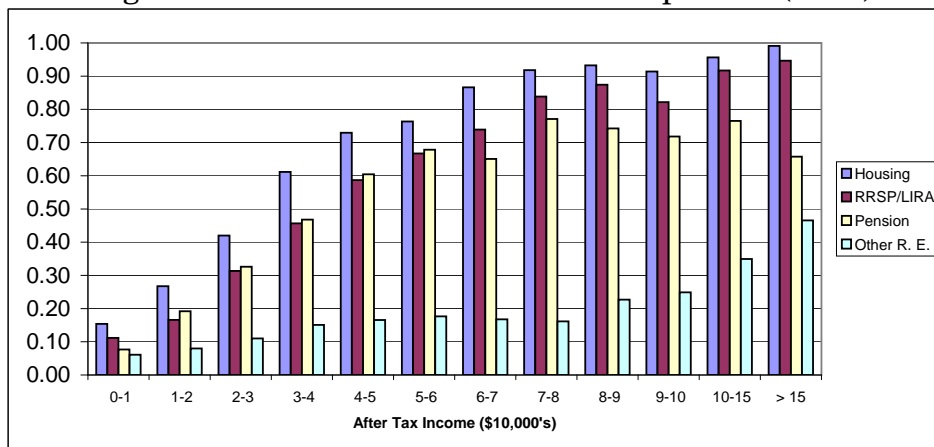
As Figure 2.2 illustrates, home ownership rates are increasing in household income. Over 70% of households with an after tax income grater than $40,000 own a home, and over 90% of households with an after tax income greater than

$70,000 own a home.

In addition to being a large and widely held asset, housing was also responsible for almost 45% of the total increase in household assets from 1999 to 2005. These facts highlight the importance of housing wealth for Canadian household balance sheets, and demonstrate that changes in house prices have a sizeable effect on aggregate household capital gains.

Unlike the SFS, the SHS does not contain direct house price measures. Therefore, these must be estimated for the current study. The next section discusses the estimation strategy used.

2.4   House Price Estimates

So far as can be determined, no data set currently exists that contains information on household consumption expenditures and also contains direct information on the market value of owner-occupied housing. Past studies, therefore, have relied on alternative house-price measures. The two most prevalent of which seem to be the use of inter-regional house price averages,[7] and respondent-generated house-price estimates (in the case of US studies relying on data from the PSID).

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[7]For instance state averages for the US, provincial averages for Canada, and regions for England.

This chapter takes a different approach to value housing. The market value of a household's primary residence is estimated using a hedonic price function (HPF). That is, the characteristics of a respondent's home - such as age, location, number of rooms etc. - are used in conjunction with an equation linking these characteristics with overall house prices to estimate its value. The hedonic approach is often used to assess real-estate values for millage taxation, and is used in the construction of house price indices. However, this chapter marks the first time an HPF is used for this type of analysis.

A benefit of using the hedonic approach is it permits a substantial degree of price variability across individual observations; this benefit is largely absent when studies rely on inter-regional house price averages as proxies. Also, unlike respondent-generated house-price estimates, the hedonic regressions used in this study are based on actual real-estate transactions, this may be beneficial if respondents tend to systematically miss-price their own homes.[8]

2.4.1 Hedonic Price Functions

Hedonic price theory is based on the assumption that a good's value is a function of its characteristics. An empirical HPF estimates the parameters of this

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[8]See Bhatia (2012) for an appraisal of this approach, especially compared with regional house-price indices and respondent generated estimates.

function by regressing the price of a product on the characteristics of that product. Once an empirical HPF is estimated, it can be used to estimate the value of a product with any combination of these characteristics. Also, the derivatives of this function can be used to estimate the marginal contribution of each characteristic towards the good's overall price. As with any fitted value, the price estimates derived from an HPF contain error, and only capture the average price of a product with certain characteristics. Even so, the hedonic method is used in numerous economic applications requiring a method for pricing heterogeneous goods, such as computers, automobiles, houses etc.

A large body of literature on the construction of hedonic price functions has emerged, in which a variety of model specifications and estimation methodologies are proposed. The appropriateness of any particular one depends on the product being analysed, and the nature and quality of the available data. However, the most commonly chosen specifications appear to be the linear equation, log-linear equation, and the double-log form. The most commonly chosen estimation method is Ordinary Least Squares (OLS). The choice of a particular specification is important for deriving unbiased estimates, however, as shown in Triplett (2004), general economic theory is unable to guide us on the appropriate functional form of hedonic equations, and their selection becomes an empirical issue.[9]

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[9]The HPF coefficient estimates are not of interest in their own right (in the current study), but rather, are of interest for their ability to generate regressors for a second stage regression

In keeping with most practitioners and housing studies, the base HPFs take a linear form, and are estimated using OLS. The choice of a linear HPF is less of an issue for the current study, however, as most of the housing characteristics are dummy variables - with the exception of room numbers. Also, as there is no compelling evidence in the literature for a non-linear functional form, this specification is thought to be appropriate. However, as a robustness check, HPFs based on a double log and single log (dependent variable) specification are also estimated and used to estimate capital gains for the second stage consumption function regressions - the results of which are reported in Appendix C. The results based on all three HPF specifications are similar.

To estimate a hedonic price function, data on house prices and housing characteristics are needed. Fortunately, the SHS provides both. Each respondent is asked a number of questions pertaining to the characteristics of their home, and if a respondent purchased their home in the survey year they are also asked to report the purchase price. With this information, HPFs based on the same characteristics reported by each respondent can be calculated, thus providing an internally consistent way of estimating house prices.

- the consumption function. As long as the parameters of each HPF - which may be more accurately described as linear projections, not structural equations - can be consistently estimated, then the estimates in the second stage will also be consistent.

Due to sample size restrictions, and the relative uninformativeness of certain housing characteristics, some characteristics contained in the survey are excluded from the HPFs. The characteristics that are included are often used in the literature (for a survey of the characteristics most often used in the literature see Sirmans et al. (2005)), and are thought to be the most important for explaining the variability in house prices across unit and time.[10]

In total, seven HPFs are estimated spanning the years 2000-2006. Table 2.1 below reports the coefficient estimates from the 2006 HPF, along with the sample size and R-squared. Appendix A reports the coefficient estimates for all other years. The housing characteristics can be grouped into 6 categories: province; town type/size; room numbers; type of structure; year built; and type of heating equipment. As mentioned above, a primary benefit of using the hedonic method is it permits a substantial degree of price variability across households. If inter-regional house price averages were used instead, for instance provincial averages, all of the intra-provincial variability stemming from location and structural differences would have been lost.

Estimates of yearly one-off housing capital gains are derived by first calculating the value of each respondent's home using the HPFs, and then taking

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[10]Variables that are redundant, such as "heating fuel", which is made redundant by the variable "heating equipment," are omitted. Also, housing characteristics that are deemed less important, such as whether a house is equipped with a washing machine and/or dishwasher are also omitted.

Table 2.1: Hedonic Regression Coefficients: 2006

Province			Type of House		
P.E.I.	-44171.86	(28932)*	Semi-Detached	-22923.03	(16711)*
Nova Scotia	21761.28	(22040)	Row or Terrace	-34337.04	(17841)**
New Brunswick	-2590.47	(22493)	Duplex	7841.27	(25609)
Quebec	73165.33	(18626)***	Apartment (Condo)	-44388.31	(17354)***
Ontario	110473.40	(18813)***			
Manitoba	16424.55	(19918)	Year Built		
Saskatchewan	-9340.80	(19998)	Between 46-60	3626.98	(16750)
Alberta	122833.10	(19036)***	Between 61-70	7955.48	(16779)
British Columbia	188983.10	(19084)***	Between 71-80	-34788.43	(15625)***
			Between 81-90	6090.64	(15575)
Town Type/Size			After 91	39711.41	(14514)***
Urban Under 100K	-89697.27	(9525)***			
Rural	-82719.68	(13226)***	Heating Equipment		
			Forced Air Furnace	-41663.74	(16782)***
Number of Rooms			Heating Stoves	-71087.24	(25386)***
Total	9840.25	(3009)***	Electric Heating	-39121.38	(17788)***
Number of Bedrooms	10711.08	(6012)**			
Number of Bathrooms	50601.42	(7698)***	Constant	20844.78	(29688)
Sample Size		634	Adjusted R-Squared		0.55

The constant contains: Newfound Land (Province), Single Detached (Type of House), Before 46 (Year Built) Urban Over 100K (Town Type/Size), Steam or Hot Water Furnace (Heating Equipment). Robust standard errors in parenthesis. ***-significant at the 5% level, **-significant at the 10% level, *-significant at the 20% level.

first differences. This is done for each respondent household over a four year period - the survey year and the three previous years - providing four observations on yearly one-off capital gains for each household, which are use in Section 2.5 to calculate expectations regarding future capital gains.

2.4.2 Hedonic House Price Index

To determine how well the hedonic regressions do at predicting average intertemporal house price movements, an index is constructed using these regressions, which is compared with the Teranet House Price Index (THPI). The THPI is a Canada-wide house price index sponsored by the National Bank of Canada, and serves as the benchmark index in that country. It uses a repeat

sales methodology, and covers approximately 100,000 dwellings each year (for an explanation of the repeat sales methodology see Shiller (1991)). The index is calculated using data from 6 major Canadian cities: Ottawa; Toronto; Calgary; Vancouver; Montreal; and Halifax, across five provinces.

In an attempt to use the same type of household as in the THPI, the hedonic index uses data on respondents domiciled in the same five provinces, and living in urban areas with a population in excess of one hundred thousand. For each of these respondents the market value of their home is estimated using the HPFs discussed above. The index is constructed by first calculating the average house price in each year, and then dividing these values by the average house price in the numeraire year (2000). As with the repeat sales methodology, a hedonic price index controls for changes in housing stock characteristics, which may be partially responsible for intertemporal average house price movements. Table 2.2 presents the year-over-year percentage change in each index. The indices track one another fairly closely, though the hedonic index is more variable.

Table 2.2: Hedonic Approach Vs. Teranet Composite: Year-Over-Year Appreciations

Year	2006-05	2005-04	2004-03	2003-02	2002-01	2001-00
Hedonic Approach	.1471	.0625	.0723	.1416	.0715	.0813
Teranet Composite	.1164	.0788	.0798	.0824	.0790	.0461

2.5 The Consumption Function

This section discusses the consumption function. We start with a discussion of its functional form, and then discuss a number of control variables used in the regressions. The consumption variable itself is discussed last.

2.5.1 Characterizing the Consumption Function

The consumption function specification used in this chapter is based on Friedman (1957)'s Permanent Income Hypothesis (PIH). That is, it is assumed that a household's level of current consumption is a function of its expected level of permanent income, where, strictly speaking, permanent income is the amount a household can spend in perpetuity and keep wealth constant over time. With regard to housing wealth, permanent income is equal to the expected permanent level of capital gains accruing on a home - if the implicit income/consumption derived from occupying a home is excluded, which it is here.

Income from housing capital gains may be used for current consumption in two broad ways. Either through the use of financial products such as second mortgages, reverse mortgages, secured lines of credit, etc., or through reductions in current saving, meant to offset increases in housing wealth.

Accrued capital gains on housing are conceptually equivalent to income

originating from other forms of wealth - such as human capital, corporate equity, bonds etc. - and should therefore enter the consumption function in a similar fashion. However, the MPC from each form of income is unlikely to be identical. The results of this chapter, and those mentioned above, suggest that they are in fact different. Therefore, housing capital gains are separated from other types of income when estimating the Canadian consumption function parameters.

To make the empirical analysis operational, an estimate of expected permanent housing capital gains is required for each household, and hence an assumption on how expectations are formed in practice is needed. Toward this end it is assumed that households form expectations adaptively, that is, they use information on past gains to form expectations about permanent gains.

The decision to use adaptive expectations, rather than rational expectations, has two components. First, rational expectations require a general equilibrium framework and additional assumptions on the behaviour of market participants. It is felt that this would add little to the analysis and complicate matters. Secondly, adaptive expectations only depend on past gains, a variable we have reliable estimates of. Given these two reasons, it is felt that adaptive expectations are appropriate for this analysis.

The adaptive expectations equation is characterized by a linear function of past gains, and two weighting structures are used. The first is a geometrically declining distributed lag, where the importance of a particular realization, in determining permanent capital gains, is a decreasing function of the elapsed time subsequent to this realization. The weights of a distributed lag are determined by a single parameter (λ) and take the following form:

$$\text{Weight 1} = \lambda, \text{ Weight 2} = \lambda(1-\lambda), \text{ Weight 3} = \lambda(1-\lambda)^2, \text{ etc.,}$$

where λ is estimated jointly with the other consumption function parameters.[11] The distributed lag approach is used extensively in the PIH literature to characterize expectations; for examples of its use see Cagan (1956) and Bhatia (1972). The second imposes no structure on the weights.[12] This method allows the data to reveal the true weighting structure. As shown below, the two methods produce weight estimates with similar characteristics, and the use of one vs. the other does not affect the consumption function parameter estimates materially.

The consumption function specification used in this chapter is as follows:

$$C_{i(t)} = \alpha + \gamma Inc_{i(t)} + \beta(\delta_1 CG_{i(t),t} + \delta_2 CG_{i(t),t-1} + \delta_3 CG_{i(t),t-2} + \delta_4 CG_{i(t),t-3}) + \theta X_{i(t)} + \varepsilon_{i(t)} \tag{1}$$

[11]The infinite sequence $\{\lambda, \lambda(1-\lambda), \lambda(1-\lambda)^2, ...\}$ sums to one. In the regressions below, the weights are constrained to sum to one, therefore, each weight is set equal to the corresponding distributed lag term divided by the sum of the distributed lag terms.

[12]However, the identifying restriction that weights sum to one is imposed.

$$s.t. \sum_{h=1}^{4} \delta_h = 1 \quad and \quad \delta_h \geq 0 \, \forall \, h,$$

where $i(t)$ denotes household i of survey year t, $C_{i(t)}$ denotes the household's purchase of consumption goods, $Inc_{i(t)}$ denotes the household's current-period non-housing after-tax income (discussed below), $CG_{i(t),t}$, $CG_{i(t),t-1}$, $CG_{i(t),t-2}$, $CG_{i(t),t-3}$ denote the estimates of one-off housing capital gains for the current period, 1st lag, 2nd lag, and 3rd lag respectively, $X_{i(t)}$ are household characteristics (discussed below), δ_h are the adaptive expectation weights, γ, β, and θ are the coefficients of interest, and $\varepsilon_{i(t)}$, is the error term.

2.5.2 Other Independent Variables

A household's consumption function also depends on permanent income from wages, financial wealth, non-housing real estate, transfers, and business income. Unfortunately, the SHS does not provide direct information on these variables. It does, however, report the income received by a household in the survey year, and lacking a direct measure of permanent non-housing income, current non-housing income is used as a proxy variable.[13] To be certain, permanent income and current income are imperfectly correlated. This will lead to a biased coefficient estimate on non-housing income. However, it is believed that current non-housing income is likely to be a sufficiently good proxy that any endogeneity bias that might have arisen from the possible correlation between

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[13]Household income reported by the SHS is comprehensive.

permanent housing income and permanent non-housing income is eliminated. The non-housing income variable used in this study includes the entire set of income variables reported by the SHS, less any taxes paid on this income.

In addition to current non-housing income, and permanent accrued capital gains on housing, a number of variables related to household characteristics may also affect current consumption. As many of these are added as possible. The set includes household composition variables, the number of working individuals, and the age and education level of household members.

2.5.3 The Consumption Variable

A principal benefit of using the SHS is it contains detailed and comprehensive data on household consumption expenditures. Appendix B lists the set of consumption categories used for the current analysis. As evidenced by this list, the SHS includes most household consumption items. This provides us with a fairly complete picture of total household consumption expenditure.

This level of inclusivity is not pervasive throughout the household consumption literature. For instance, a number of early US studies using PSID data relied primarily on food expenditure data. It is possible to estimate an MPC with a limited number of consumption categories, but these estimates are prone to bias insofar as income elasticities differ across consumption goods, and these

differences are not accounted for properly.[14] Thus, to generate reliable MPC estimates it is beneficial to have complete data on household consumption expenditures.

In addition to being comprehensive, the consumption data is detailed. Consumption expenditures are reported at disaggregated levels, and this feature of the data is exploited to derive elasticity estimates over sets of consumption goods. It is shown below that permanent housing capital gains affect various components of consumption - such as total consumption, non-durables, luxury goods etc. - differently.

One drawback of using data from the SHS is that the consumption variables likely suffer from measurement error. Respondents are given the difficult task of estimating annual consumption expenditures, and although encouraged to reference receipts, credit card statement, bank records etc., a portion of consumption is almost certainly misstated. However, if these errors are uncorrelated with the regressors, then the estimates will be consistent.

In the regressions below, a pooled sample is created using three cohorts covering 2004-2006. The sample is restricted to include only households that

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[14]For instance an MPC may be estimated by regressing a subset of consumption expenditures on a regressor of interest, and then scaling the resulting coefficient estimate by the average ratio of total consumption expenditures to expenditures on this subset. This method is used in Skinner (1989) and Lehnert (2004).

own their home (as opposed to renters), had one economic family in the home, and had lived in their homes for over 1 year.[15]

2.6 Estimation Results

Table 2.3 presents the main regression results when a distributive lag is used, and Table 2.4 presents the results when free weights are used. The second column of each table has total consumption as the dependent variable, and the third column has non-durable consumption as the dependent variable.[16]

Before discussing the MPC estimates, it is instructive to discuss the adaptive expectation weights, as they form the basis of the permanent housing capital gains measure. As mentioned above, the weights are estimated jointly with the other consumption function variables - by Non Linear Least Squares (NLS) - using total consumption as the dependent variable. They are plotted in Figure 2.3.

In the free-weight case, the weight estimates on the first and second lag are

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[15]Since capital gains are calculated over a four year period for each respondent (including three lags), restricting the sample to include only households with a tenure of more than three years would have been desirable. However, due to the way the house-tenure variable is grouped, doing this would have forced the exclusion of respondents that moved to their home after 1990, which the author believed was too costly in terms of sample size and sample representativeness.

[16]The weight estimates obtained using total consumption as the dependent variable are used in the non-durable consumption regressions also; it assumed that weights are constant across subsets of consumption goods.

Table 2.3: Consumption Function Results (Distributed Lag (λ)): Pooled Sample (2004-2006)

	Total Consumption		Non-Durable Consumption	
Permanent Housing CG	0.094**	(0.012)	0.073**	(0.007)
After-Tax Income	0.270**	(0.005)	0.176**	(0.003)
Lambda	0.019	(0.085)		
Children 0-4	-723.80**	(179.97)	-579.86**	(105.40)
Children 5-17	732.16**	(95.10)	709.06**	(52.93)
Children 18-24	753.64**	(159.18)	581.76**	(98.50)
Adults 25-64	-307.89**	(124.04)	-293.62**	(78.76)
Adults Over 65	-103.03	(144.73)	-60.70	(93.81)
Couple	2059.09**	(428.61)	659.49**	(260.14)
Couple w Children	4038.23**	(420.92)	3126.40**	(259.89)
Couple w Other	4345.53**	(533.98)	3758.01**	(328.01)
Lone Parent	2166.88**	(257.05)	2595.16**	(161.44)
Other w Relatives	2061.14**	(383.40)	2513.37**	(228.94)
Number of Full Time Earners	1255.33**	(149.52)	1114.36**	(84.80)
Number of Part Time Earners	1613.91**	(111.49)	1212.25**	(69.84)
Head Female	-1622.81**	(199.61)	-590.39**	(116.51)
Head Age	819.02**	(98.60)	875.10**	(59.79)
Head Education	175.68**	(29.97)	226.40**	(19.62)
Spouse Age	64.29	(41.71)	171.27**	(24.79)
Spouse Education	101.71**	(41.65)	186.41**	(25.99)
Head Age Squared	-76.21**	(5.89)	-67.24**	(3.69)
2005	596.12**	(178.39)	495.34**	(119.72)
2004	-169.71	(183.05)	-27.98	(120.55)
Constant	5518.19**	(451.99)	3163.69**	(277.96)

The weight structure estimated for total consumption is used for non-durable consumption. A description of each household-specific regressor is contained in Appendix B. Bootstrap standard errors in parenthesis.
**-significant at the 5% level. All nominal variables are converted into $2006 Cdn.

large and similar, while the weight estimates on the contemporary gain and the third lag are relatively small. It is not surprising to find a small weight on the third lag; the information content of past gains, in computing permanent gains, is likely to be a decreasing function of time. It is also not surprising to find a low first weight in the free-weight case. This likely reflects a timing effect; contemporary capital gains are fully realized at the end of a period, reducing their information content within a period. This timing effect cannot be accounted for with a distributed lag, however, as the weights are constrained to be monotonic. Each weight structure is plausible, and no stand is taken on

Table 2.4: Consumption Function Results (Free Weights): Pooled Sample (2004-2006)

	Total Consumption		Non-Durable Consumption	
Permanent Housing CG	0.108**	(0.014)	0.079**	(0.008)
After-Tax Income	0.270**	(0.005)	0.176**	(0.003)
Free Weight Contemporary	0.191			
Free Weight 1st Lag	0.317**	(0.031)		
Free Weight 2nd Lag	0.337**	(0.028)		
Free Weight 3rd Lag	0.155**	(0.046)		
Children 0-4	-702.57**	(178.48)	-561.36**	(104.79)
Children 5-17	745.27**	(95.53)	721.42**	(53.19)
Children 18-24	763.53**	(156.01)	591.88**	(99.94)
Adults 25-64	-290.98**	(123.39)	-280.11**	(79.15)
Adults Over 65	-85.66	(143.50)	-42.96	(93.84)
Couple	2051.88**	(422.01)	645.63**	(259.24)
Couple w Children	3996.70**	(414.46)	3090.40**	(258.51)
Couple w Other	4291.64**	(538.13)	3717.21**	(328.04)
Lone Parent	2147.28**	(252.43)	2583.18**	(162.16)
Other w Relatives	2060.34**	(387.82)	2513.91**	(227.79)
Number of Full Time Earners	1268.00**	(146.92)	1124.56**	(84.94)
Number of Part Time Earners	1630.88**	(109.58)	1222.49**	(69.71)
Head Female	-1625.77**	(201.80)	-592.84**	(116.61)
Head Age	808.89**	(98.02)	868.31**	(59.96)
Head Education	167.07**	(29.86)	222.20**	(20.17)
Spouse Age	61.00	(41.51)	169.51**	(24.81)
Spouse Education	98.52**	(40.92)	185.30**	(26.24)
Head Age Squared	-75.21**	(5.84)	-66.59**	(3.71)
2005	435.35**	(172.21)	372.64**	(105.68)
2004	-413.27**	(195.86)	-213.62	(130.42)
Constant	5584.81**	(465.95)	3230.08**	(281.44)

The weight structure estimated for total consumption is used for non-durable consumption. The contemporary weight is set equal to one minus the other three weights, it is not estimated separately. A description of each household-specific regressor is contained in Appendix B. Bootstrap standard errors in parenthesis.

**-significant at the 5% level. All nominal variables are converted into $2006 Cdn.

the appropriateness of one over the other, however, as the results do not differ substantially from one weight structure to the other, for brevity, only results using a distributed lag are discussed.

The MPC estimates from Table 2.3 suggest that households spend an additional 9.4 cents on total consumption for every 1 dollar increase in permanent

Figure 2.3: Adaptive Expectations Weights
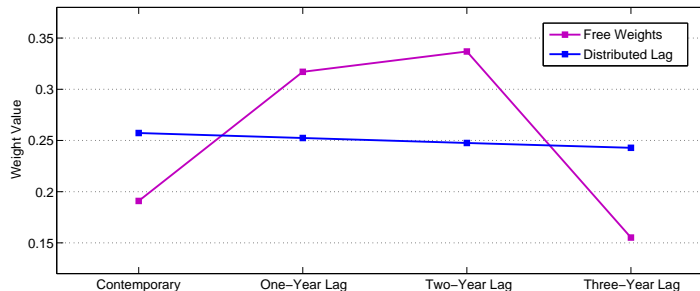
housing capital gains, and spend approximately 7.3 cents on non-durable consumption only.[17] These results imply that permanent housing capital gains are an important driver of household consumption spending in Canada. The MPC estimates are also larger than usually found in the literature, likely owing to the use of permanent capital gains.

The MPC estimate on non-housing income is low at approximately 27 cents, which may be due to the use of current non-housing income as a proxy for permanent non-housing income. As mentioned above, current income is equal to permanent income plus a random error term - uncorrelated with the latter variable. This type of measurement error has likely biased the estimate downward. An additional explanation is that the consumption measure, although

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[17]The consumption function regressions are based on generated regressors (capital gains). Although this does not affect consistency (as mentioned above) NLS standard errors may be biased (see Pagan (1984) for a discussion of this). Therefore, Bootstrap standard errors are computed as follows. HPF estimates are generated using bootstrap samples. These estimates are used to generate capital gains for the second stage regression. The consumption function parameters are then estimated using bootstrap samples over these data sets. The Bootstrap coefficient estimates from the second stage regression are then used to calculate standard errors.

comprehensive, excludes some components. This may bias the MPC estimate downward for both housing, and non-housing income. However, the average household in the sample spends \$33,526 (2006 dollars) on consumption - excluding shelter - which seems to be a reasonable approximation to the actual average, although it may be a little low.

2.6.1 One-Off Capital Gains

It has been maintained throughout this chapter that permanent rather than one-off housing capital gains drive consumption. However, it is instructive to analyse the effect of one-off gains alone, and so a consumption function regression is run where permanent housing capital gains are replaced with one-off gains[18] (both the contemporaneous gain, and the one-year lagged gain), the results of which are reported in Table 2.5 (the coefficient estimates on household characteristics are omitted from this table for brevity).

Table 2.5: One-Off Housing Capital Gains: Pooled Sample (2004-2006)

	Contemporary		One Year Lag	
One-Off Housing Capital Gains	0.016**	(0.0037)	0.018**	(0.0039)
After Tax Income	0.275**	(0.0055)	0.275**	(0.0051)

Bootstrap standard errors in parenthesis. ** - Significant at the 5% level. All nominal variables are converted into \$2006 Cdn.

The coefficient estimates on one-off housing capital gains are smaller than

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[18]Where total consumption is the dependent variable.

on permanent gains. The coefficient estimate on contemporaneous one-off gains is 1.6 cents, and the estimate on lagged one-off gains is 1.8 cents. The small size of these estimates, compared with those from permanent gains, is likely due to the measurement error on one-off gains - as a proxy for permanent gains.

These results have interesting implications. They imply that temporary swings in housing returns will have little effect on current consumption, whereas prolonged changes will have large effects. Policy aimed at mitigating the adverse effects of a downturn in house prices (or house price growth) should first be concerned with the expected duration. If a downturn is expected to be short-lived, minimal action may be required, if persistent, policies aimed at boosting consumption may be needed to keep levels constant.

2.6.2 Consumption Elasticities

The last empirical exercise takes advantage of the SHS's disaggregated consumption data to estimate the income elasticity of various subsets of consumption with respect to permanent housing capital gains.[19] This is done for total consumption, non-durable consumption, food purchased from stores, and a set of goods that are deemed to be non-essential ("luxury").[20]

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[19]Using the distributed lag specification/weights.

[20]The definition of non-essential is open to interpretation. This set of goods was chosen using the author's best judgement, and is reported in Appendix B.

Table 2.6 presents the elasticity estimate for each consumption subset. The elasticity estimate for non-durable consumption is only slightly lower than for total consumption. On the other hand, the elasticity estimate for luxury goods is approximately 2.5 times higher than for food (.093 and .036 respectively) - the latter variable is intended to be representative of non-discretionary expenditures.

Table 2.6: Elasticity Estimates

Total Consumption	0.032
Non-Durable	0.032
Food	0.036
Luxury	0.093

These elasticity estimates are calculated using average expenditures on each consumption category, and the average house price across all households.

2.7   Conclusion

This chapter uses cross-sectional data from the Survey of Household Spending, a Canadian data set, to estimate the effect of accrued capital gains from owner-occupied housing on the decision to purchase consumption goods. It adds to the rather limited research for Canada by estimating such a relationship for two broad consumption categories and for two measures of capital gains (permanent and one-off).

It is found that, on average, when permanent capital gains on owner occupied housing increase by 1 dollar, Canadian households spend an additional 9.4 cents on total consumption, and 7.3 cents on non-durable consumption only. The relationship between one-off capital gains and consumption is found to be much smaller in magnitude. The results suggest that a 1 dollar increase in contemporaneous one-off capital gains leads to a 1.6 cent increase in consumption. This lower MPC estimate for current gains may be attributed to the idea that consumption decisions are based on permanent capital gains, rather than one-off capital gains.

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Chapter 3

The Lock-In Effect and the Corporate Payout Puzzle

3.1 Introduction

This chapter proposes a new model of corporate payout policy that can explain some aspects of the corporate payout puzzle. The question of whether taxes affect payout choice - dividend payments vs. share repurchases - has received considerable attention in the economics literature. Authors arguing that capital income taxation affects payout choice have the burden of explaining why dividends are paid in practice despite their tax disadvantage relative to share repurchases. The explanations provided include diverse factors such as the mitigation of agency costs, the signalling role of payout, the intrinsic value of dividend payments, and constraints on the ability to repurchase shares. This chapter offers an additional explanation, arguing that there is a dead-weight

cost associated with share repurchases, which makes dividend payments desirable in certain situations. In practice, firms likely pay dividends for a number of these reasons. Isolating and exploring each helps our understanding of firm payout decisions.

In their pioneering work, Modigliani and Miller (1961) show that firm value is independent of its payout mix in the absence of personal taxes; arbitrage opportunities ensure equity markets value dividend payments and share repurchases identically when capital markets are complete. The authors go on to show that management's influence over firm value is limited to its choice over investment level and total payout - the payout method is irrelevant. A justification for this view is provided by Miller and Scholes (1978), who argue that marginal investors may be unaffected by personal taxes. Miller and Scholes (1978) point out that nuances in the US tax code allow for the avoidance of capital income taxes by some taxable individuals, and tax-exempt entities such as pension funds avoid personal taxes altogether.

When complete tax avoidance is not possible, the payout choice is likely to be relevant for firm value. Indeed, a tax differential on payout method can enable management to influence firm value through the payout mix. For example Black (1976) argues that relatively high dividend taxes vs. capital gains taxes[1]

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[1]Income generated from a share repurchase takes the form of a capital gain.

from 1965-1972 in the United States made dividend payments an inferior form of payout. He claims that the existence of dividend payments over this period, given their tax disadvantage, is a puzzle. The payment of dividends in light of their tax disadvantage is highlighted in a number of economic studies and seems to be prevalent in both the US and Canada. Poterba (2004) argues that dividend payments were tax disadvantaged in the US from 1929 to 2003, and it is argued below that there was a similar tax disadvantage in Canada from 1987-2008. During these respective periods, a substantial fraction of total payout in the US and Canada was made in the form of dividends. Dividends account for the majority of total payout in Canada, and until recently, were also the majority payout method in the US (Brav et al. (2008)). This chapter presents a model of firm payout which addresses the payout puzzle.

The model explores the possibility that shareholder lock-in effects (i.e., the incentive to postpone the sale of equity with an accrued capital gain) make repurchasing shares sufficiently expensive that dividend payments become the marginal form of payout for some firms. Capital gains are taxed upon realization in the model, consistent with capital gains taxation in both Canada and the US. Under this tax structure, investors can reduce the effective rate of tax on accrued capital gains by postponing realizations, thereby deferring the tax liability. It follows that when equity has an accrued capital gain the locked-in value exceeds the after-tax value of liquidating the position. Shareholders

with an accrued capital gain will thus require a lock-in premium to sell equity back to the firm. This premium is an increasing function of accrued capital gains and the desired holding period for firm equity. When shareholders are heterogeneous with respect to these arguments they have heterogeneous required lock-in premiums. This leads to upward sloping equity supply curves, and causes the marginal benefit of a repurchase to fall as more shares are repurchased. In equilibrium firms repurchase shares until the marginal benefit of doing so equals the marginal benefit of paying dividends. At this point firms start paying dividends. Empirical evidence supporting upward sloping equity supply curves, caused by heterogeneous shareholder lock-in effects, is found in Bagwell (1992) and Landsman and Shackelford (1995) for the United States. McNally et al. (2003) reports similar findings for Canada.

The equity supply curve depends in large part on the joint distribution over accrued capital gains and desired holding period specific to a firm's shareholders. In order to examine the effect of this distribution on dividend payments, the model is solved numerically, and comparative statics are run for a number of distributional forms and parameterizations. In general, when the average accrued capital gain is high, the average desired holding period is long, and the variance of each is low, firms face higher lock-in premiums and are more likely to pay large dividends.

The model is also used to explore the consequences of corporate and personal tax policy for firm investment and payout decisions. It is found that both the corporate tax and the capital gains tax reduce the level of corporate investment, whereas the dividend tax has no effect. Short run total payout increases in both the corporate tax and the capital gains tax, whereas long-run total payout decreases in both. The dividend tax has no effect on total payout in either the short-run or the long-run.[2]

The remainder of this chapter is organized as follows. Section 3.2 contains a further literature review. Section 3.3 presents Canadian summary data which supports the existence of a Canadian payout puzzle. Section 3.4 discusses the payout model and its predictions for corporate payout and investment. Section 3.5 uses numerical methods to solve the model and presents comparative statics and dynamic simulations. Section 3.6 concludes.

3.2   Other Literature

The use of repurchase premiums to explain dividend payments is also explored in Chowdhry and Nanda (1994). In their signalling model of payout, a firm's

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[2]Firms in this model are financed exclusively through equity. Capital income tax changes may affect firm investment/payout decisions differently when debt financing is allowed. However, this issue is beyond the scope of the current chapter.

true value is the private information of management. When equity is temporarily undervalued share repurchases are used to increase non-tendering shareholder wealth. In this way, share repurchases become a signal of undervaluation, and investors demand a premium to tender shares. This premium adds to the cost of a repurchase, and tax disadvantaged dividend payments are made when the premium is high relative to the undervaluation. Unlike this model, the current model assumes no informational asymmetries; the firm's market value is known by both management and investors. The repurchase premium in Chowdhry and Nanda (1994) stems from the information content of repurchases, whereas the repurchase premium in the current model is caused by shareholder-specific lock-in effects.

Signalling models also appeal to tax clienteles and their differential ability to monitor firms. For instance Allen et al. (2000) argue for a model of tax clienteles, in which non-taxed "institutional" investors have the ability and initiative to discover the true value of firms, while taxed "retail" investors do not. Both investor types own a positive fraction of all firms for purposes of diversification. To compensate retail investors for relatively high dividend taxes, the pre-tax yield on dividend paying stocks is higher. This higher yield attracts a larger proportion of institutional investors to dividend paying stocks, which is desirable for high quality firms seeking to signal their true value. In a separating equilibrium, high quality firms pay dividends and low quality firms fail

to pay dividends.

A second class of payout model explains dividends by appealing to agency costs. Easterbrook (1984) proposes that dividends can mitigate two types of agency costs. The first is caused by management's incentive to protect job tenure. Reinvesting firm profits in low-risk low-return projects can reduce the chance of firm bankruptcy and increase the probability that management remains employed. This investment strategy enhances the value of corporate debt at the expense of equity. Dividend payments are a way of reducing the amount of free cash flow available for this purpose. The second type of agency cost is related to monitoring firm management. When firms are widely held, the cost of monitoring by an individual investor is usually prohibitively high relative to the potential gain. Reducing cash reserves by way of dividends forces management to seek financing in capital markets more often. New investors provide capital only when compensated for existing agency costs, incentivizing their reduction by management.

Other papers, such as Busaba (2012), postulate that dividends are the result of agency costs but do not mitigate them. Busaba (2012) argues that the ability to secure debt with collateralizable assets can reduce the agency costs faced by creditors. Small firms with few collateralizable assets are unable to secure debt financing cheaply, and are forced to rely on internal funds at the

cost of dividends. Larger firms with sizeable collateralizable assets have fewer agency costs associated with debt and are able to obtain debt financing cheaply, allowing them to pay dividends.

Within the class of perfect information payout models, in which this chapter fits, the "Traditional" view, discussed in Auerbach and Hassett (2002), and the "New" view, developed by Auerbach (1979), Bradford (1981), and King (1977), are prominent. In the Traditional view, investors derive an intrinsic value from dividend payments. Equity markets react positively to their payment, which reduces the cost of capital and increases market value. In the New view, firms face an exogenous binding repurchase constraint, and are unable to use share repurchases to satisfy the whole of total payout; any payout in excess of this amount is paid in the form of dividends. Both models have received criticism based on their assumptions. The intrinsic value of dividends has little theoretical or empirical justification, as noted in Poterba and Summers (1984), and the repurchase constraint, assumed in the New view, may have been defensible in the US prior to the SEC's 1982 adoption of Rule 10b-18, which eased restrictions on share repurchases,[3] but has little justification at present in both the US and Canada.[4] The results of these models are compared with the current

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[3]See Allen and Michaely (2003) for a discussion of this rule, and its implications for US share repurchases.

[4]In Canada firms are able to repurchase up to 10% of the public float or 5% of shares outstanding (of a particular class) annually - see Ikenberry et al. (2000) or TSE (2008) for more information on the regulations regarding share repurchases by Toronto Stock Exchange listed corporations. However, this constraint was found to be non-binding in practice by the author.

one below.

3.3   Summary Data

This section provides statistics on Canadian marginal tax rates and Canadian payout policy to illustrate the empirical basis for the payout puzzle in Canada.

The marginal tax rates faced by individual shareholders on income from dividends and realized capital gains are functions of individual tax brackets - determined by total income (along with deductions and tax credits), and province of residence - determining tax schedules. Average statutory rates are estimated using the methodology in Sialm (2009), which takes a weighted average of individual marginal rates, weighted by the individual's share of total income from dividends and realized capital gains. That is:

$$T_{b,t}^{Avg} = \sum_{l} \Theta_{l,b,t} \cdot T_{l,b,t} \quad b \,\epsilon\, \{d,g\},$$

where $T_{d,t}^{Avg}$ is the average marginal tax rate on dividend income in year t, $T_{g,t}^{Avg}$ is the average marginal tax rate on realized capital gains income in year t, $\Theta_{l,d,t}$ is the proportion of total dividend income earned by individual l in year t, $\Theta_{l,g,t}$ is the proportion of total realized capital gains income earned by individual l

in year t, $T_{l,d,t}$ is individual l's marginal tax rate in year t on income from dividends, and $T_{l,g,t}$ is individual l's marginal tax rate in year t on income from realized capital gains. Figure 3.1 plots these average Canadian marginal tax rates from 1987 to 2008.[5]

Figure 3.1: Average Canadian Marginal Tax Rates: Dividends and Realized Capital Gains 1987-2008
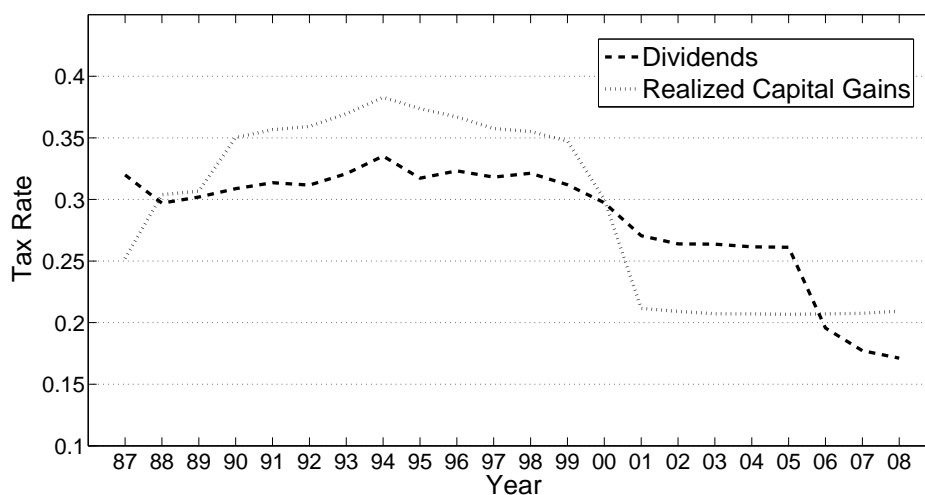
Due to the postponement of capital gains taxes until realization, the effective tax rate on *accrued* capital gains is necessarily lower than the statutory rate on *realized* capital gains. Share repurchases generate income in the form of an accrued capital gain,[6] and therefore, the applicable tax liability is the effective rate, not the statutory rate. A number of economic studies have estimated the effective accrual capital gains tax rate as a fraction of the statutory

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[5]Chapter 4 contains a detailed discussion of how these rates are calculated.

[6]They also generate income in the form of a realized capital gain for selling shareholders.

rate. The estimate in Poterba (1987) is approximately .25, whereas the estimates in Protopapadakis (1983) range from .56 to .59. The true ratio is a matter of some debate.

The numerical section of this chapter estimates the effective tax rate using a discrete-time extended version of the methodology in Davies and Glenday (1990), which also incorporates income from both dividends and accrued capital gains.[7] This methodology, known as the accrual equivalent capital gains tax rate (AECGTR), is the rate of tax, that if applied to capital gains as they accrue, would result in the same future value of after-tax capital gains income as taxing capital gains upon realization.[8] The Canadian AECGTR is estimated using an average total yield (on equity) of 6%, split evenly between dividends and capital gains,[9] the average dividend and capital gain tax rates presented above (over the period 1987-2008) and a ten year average holding period. This produces an effective-to-statutory capital gains tax ratio of .76.

Table 3.1 reports the relative tax burden (RTB) of dividends vs. capital gains over the period 1987-2008 using all three tax ratios provided above,[10] where the relative tax burden is defined as in Poterba (2004):

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[7]Davies and Glenday (1990) use a continuous time methodology that omits income from dividends.

[8]Appendix D presents a discussion of how this rate is derived.

[9]This yield is in line with the range of estimates and assumptions found in Campbell (2008), which provides estimates of the average long-run yield on Canadian equity over the period 1982-2007.

[10]For Protopapadakis (1983), the middle of his range of estimates is used.

$$RTB_t = \frac{(1 - T_{d,t}^{Avg})}{(1 - T_{g,t}^{Avg} \cdot Ratio)},$$

where $Ratio$ is the ratio of effective to statutory capital gains taxes.

Table 3.1: Relative Tax Burden of Dividends vs. Capital Gains: 1987-2008

Year	.25 Ratio	.575 Ratio	.76 Ratio	**Year**	.25 Ratio	.575 Ratio	.76 Ratio
1987	0.726	0.795	0.841	**1998**	0.745	0.853	0.930
1988	0.761	0.852	0.914	**1999**	0.753	0.860	0.935
1989	0.756	0.848	0.910	**2000**	0.760	0.849	0.910
1990	0.758	0.866	0.942	**2001**	0.770	0.830	0.869
1991	0.754	0.863	0.942	**2002**	0.777	0.837	0.875
1992	0.756	0.868	0.947	**2003**	0.777	0.836	0.874
1993	0.748	0.862	0.944	**2004**	0.779	0.838	0.876
1994	0.735	0.852	0.938	**2005**	0.779	0.838	0.877
1995	0.753	0.870	0.954	**2006**	0.848	0.913	0.955
1996	0.745	0.858	0.939	**2007**	0.868	0.934	0.977
1997	0.749	0.858	0.936	**2008**	0.875	0.942	0.986

In all three series the relative tax burden of dividends is below unity, meaning that dividend payments yielded a lower after-tax return to shareholders than repurchasing firm equity. Due to this tax disadvantage, it would appear that Canadian firms could have maximized market value by choosing a payout policy excluding dividend payments altogether. This was not the case in Canada, however. Despite their tax disadvantage, dividend payments have persisted in Canada over the period 1987-2008. They are the largest form of payout in Canada, and are used by more firms than are share repurchases.

To illustrate this, Figure 3.2 plots aggregate dividend payments made by Toronto Stock Exchange (TSE) listed Canadian corporations from 1987 to 2008, and Figure 3.3 plots aggregate share repurchases over the same period.[11] Aggregate dividend payments were higher in each of the 22 years reported. Dividend payments were 87 times higher than share repurchases in 1987, and 223 times higher in 1991. From 1991 onward the multiple has decreased substantially, reaching a low in 2007 of 2.8 times share repurchases.

Figure 3.2: Aggregate Dividend Payments: TSE Listed Canadian Corporations ($2008)
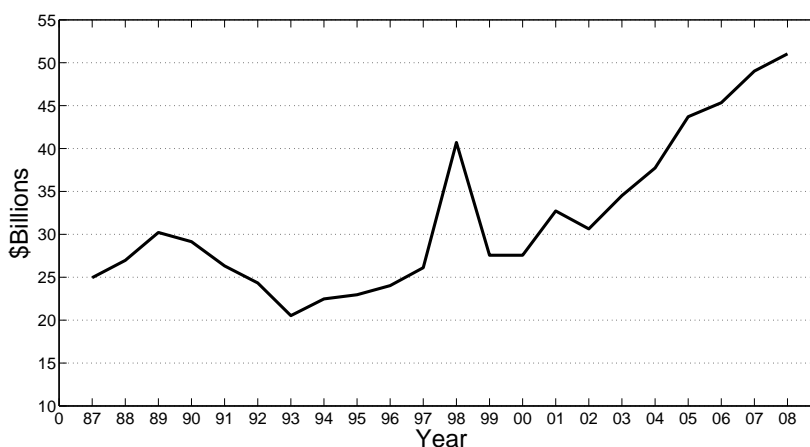
The average dividend payment is also higher, as Figure 3.4 illustrates. The average dividend payment among dividend paying firms, and the average amount spent repurchasing shares among repurchasing firms, have both increased over the period 1987-2008. The average amount spent repurchasing shares increased 21 fold over the period 1987-2006, later dropping to 9.5 times 1987

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[11]Chapter 4 contains a detailed discussion of how these series are derived.

Figure 3.3: Aggregate Share Repurchases: TSE Listed Canadian Corporations ($2008)
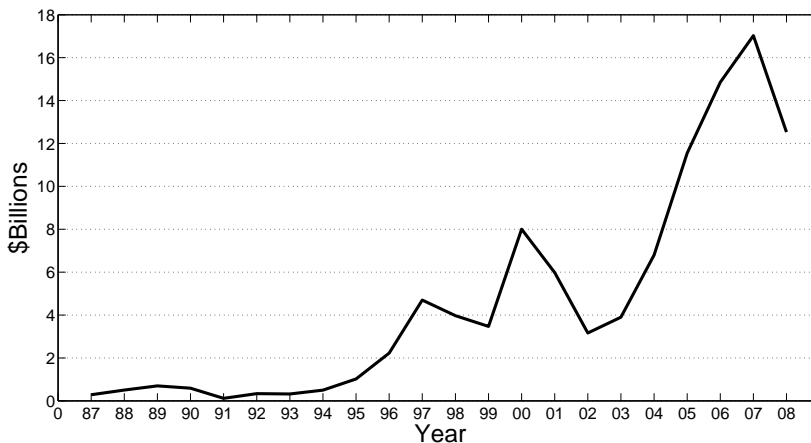
levels in 2008. Average dividend payments rose more steadily over this period, increasing a little over twofold from 1987-2008. In spite of the higher growth rate, average share repurchases were lower than average dividend payments in each of the 22 years.

Figure 3.4: Average Payout by Paying Firms: Dividends and Share Repurchases, TSE Listed Canadian Corporations ($2008)
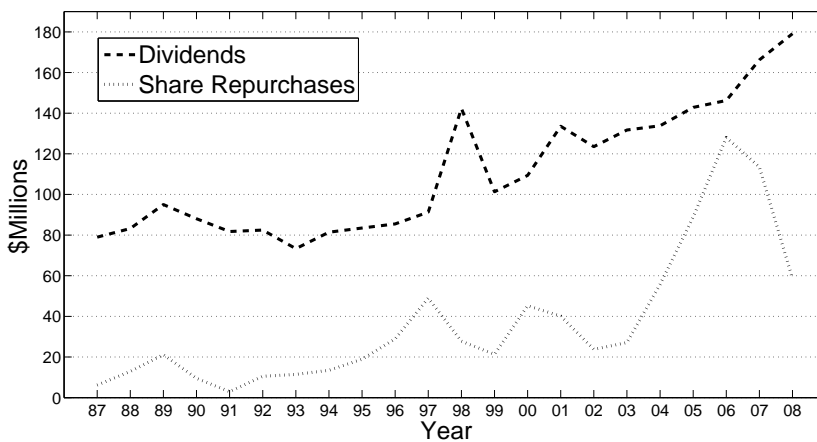
Figure 3.5: Fraction of Firms Paying Dividends and Repurchasing Shares: TSE Listed Canadian Corporations
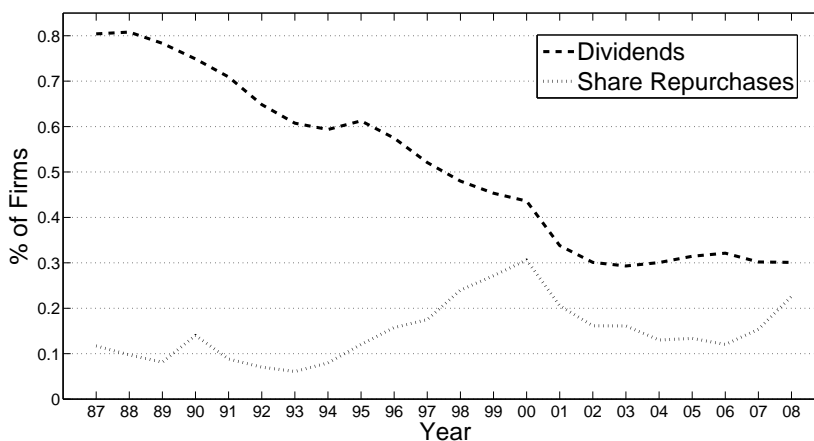
In addition to higher levels, a larger number of Canadian firms chose to pay dividends than repurchase shares, as Figure 3.5 illustrates. Dividend payments were chosen by more firms in each of the 22 years reported. However, the fraction of firms paying dividends has decreased over time. In 1987 80% of firms paid a dividend, whereas only 30% of firms paid one in 2008. The trend is opposite for repurchases; in 2008 23% of firms repurchased stock, whereas only 12% repurchased stock in 1987. This trend is similar to that found in the United States.

Share repurchases have become a more prominent form of payout as of late. However, Canadian firms still have a preference for paying dividends. The model presented in the next section provides an explanation for why dividends are paid in practice.

3.4   The Lock-In Model

The economy is assumed to be populated by a number of corporations each producing a single good sold in markets with perfectly elastic demand. Profit functions have decreasing returns and only depend on non-depreciating capital. Firms are financed exclusively through equity via capital markets with perfectly elastic supply. There is no uncertainty about future output demand or the required after-tax rate of return on capital, which are both constant over time. Firms live forever and seek to maximize shareholder wealth by maximizing current market value. Profits generated by the firm are subject to corporate income tax, which is constant across firms; after-tax profits can be retained, used to pay dividends, or used to repurchase shares.

Each firm is owned by a large number (continuum) of shareholders requiring an after-tax rate of return equal to ρ.[12] Shareholders are heterogeneous with respect to their desired holding periods and level of accrued capital gains on firm equity.[13] A joint realization over desired holding period (H) and tax base (α) (one minus the ratio of capital gains to equity value) characterizes

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[12]This rate of return is satisfied through dividend payments and appreciations in the intrinsic value of firm equity (discussed below).

[13]The potential processes that generate each source of heterogeneity are not modelled in the current chapter. This would complicate the analysis while adding little to the main thesis. In practice, both sources of heterogeneity are witnessed. The first depends on factors such as retirement planning and portfolio management, while the second depends on the timing of past share purchases.

an investor-type, and each firm faces a stationary distribution over investor-types. Denote the distribution over investor types by $F(\alpha, H)$ and the corresponding density by $f(\alpha, H)$.[14] Shareholders seek to maximize wealth and are indifferent between receiving after-tax income in the form of dividends and accrued/realized capital gains; all three sources of income are identical according to the Haig-Simons income definition.

At the personal level, dividend income results in an immediate tax liability, whereas capital gains are taxed upon realization.[15] To simplify the model, a single dividend tax rate, and a single tax rate on realized capital gains, are used. This is standard in the literature (for example, see Poterba and Summers (1984)) and reduces the model's complexity. The after-tax value of dividend income is straightforward to calculate; it equals the gross dividend payment multiplied by one minus the dividend tax rate. The after-tax value of accrued capital gains is more complicated due to the postponement of capital gains taxes. As discussed in Section 3.3, an AECGTR is used to value accrued capital gains income. The AECGTR is shareholder specific, owing to differences among optimal holding periods.[16] For the current model, a single AECGTR is used to value accrued capital gains income. This rate can be thought of as an

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[14]Shareholders are distributed continuously over tax base, and discretely - in one year intervals - over optimal holding period.

[15]This system of taxation is used in both Canada and the United States. For a discussion of Canadian capital income tax policy see Monaghan and Wilson (2012).

[16]It also depends on shareholder tax brackets via the realized capital gains tax rate, and the dividend tax rate. It was assumed above that these rates were constant across shareholders.

average among the firm's shareholders.

The timing of firm operations is as follows. Firms have a specific level of capital to start each period, which they use to produce output. At the end of each period firms sell output, generate profits, and pay corporate tax. The remaining net income can then be used to pay dividends, repurchase shares, and purchase capital. Firms purchase capital first, pay dividends next, and repurchase shares last. Firms may also sell capital at the end of each period to pay dividends and repurchase shares. The value of a firm in period t takes the following form:

$$V_t = \frac{(1 - \tau_d)D_t}{(1 + \rho)} + \frac{(1 - \tau_a)[\frac{V_{t+1}}{(1-\delta_t)} - V_t]}{(1 + \rho)} + \frac{V_t}{(1 + \rho)}, \qquad (1)$$

where V_t is the value at time t, D_t is the dividend payment made at the end of period t, δ_t is the fraction of the firm repurchased at the end of period t, V_{t+1} is the value of the firm at the beginning of period $t + 1$ (which occurs simultaneously with the end of period t), τ_d is the dividend tax rate, τ_a is the AECGTR, and ρ is the after-tax required rate of return on equity. Accrued capital gains ($[\frac{V_{t+1}}{(1-\delta_t)} - V_t]$) can be generated in one of two ways: by increasing the market value of the firm (V_{t+1}) through capital acquisition; and by repurchasing shares (δ_t). After a share repurchase, the remaining shareholders own a larger fraction of the firm. Provided the firm's value does not decrease by too large an amount the market value of each remaining share will increase, leading to an

accrued capital gain.

In both the New view and Traditional view models of corporate payout policy, all shares are repurchased at a price equal to the intrinsic value of equity.[17] The current model differs in this respect by arguing that most shareholders will in fact require a premium over this price to sell their shares during a repurchase program. The origins of this premium are discussed next.

The ability to postpone taxes on income from accrued capital gains produces a lock-in effect, wherein shareholders have a financial incentive to postpone their realization. Once capital gains are realized, the resulting tax liability reduces an investor's gross wealth by the tax. That part of gross wealth used to pay the tax is no longer available for investment, and the returns that would have accrued on it are lost. A remuneration above the intrinsic value of equity must be offered for an investor to be indifferent between selling equity with an accrued capital gain and holding it for a desired number of years. We will call this remuneration the lock-in cost, which is characterized by the following equation:[18]

$$L(\alpha, H) = X \left\{ \frac{(1-\alpha\tau_g)\{(1-\tau_g)\Omega(H)+\tau_g(1-\tau_d)d\cdot\sum_{h=0}^{H-1}\Omega(h)\}+\alpha\tau_g(1-\tau_g)}{(1-\tau_g)\{(1-\tau_g)\Omega(H)+\tau_g(1-\tau_d)d\cdot\sum_{h=0}^{H-1}\Omega(h)\}+\tau_g(1-\tau_g)} - 1 \right\},$$

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[17]The stock's intrinsic value is the maximum amount an outside investor would pay for it.

[18]See Appendix E for a derivation of the lock-in cost function. This function holds for $H \geq 1$. When $H = 0$ the lock-in cost is 0 (i.e., $L(\alpha, 0) = 0$).

$$S.T. \ \Omega(v) = (1 + r + (1 - \tau_d)d)^v,$$

where X is the intrinsic value of the stock, α is the ratio of tax base to market value, H is the desired holding period, τ_g is the realized capital gains tax rate, τ_d is the dividend tax rate, d is the rate of return from dividends, and r is the rate of return from capital gains. The lock-in cost is decreasing in the tax base and increasing in the desired holding period.[19] Recall that shareholders are heterogeneous with respect to these arguments, implying heterogeneity among shareholder-specific lock-in costs. Figure 3.6 below graphs a numerical example of the lock-in cost as a function of tax base (α) and holding period (H).

Figure 3.6: Lock-In Cost Example
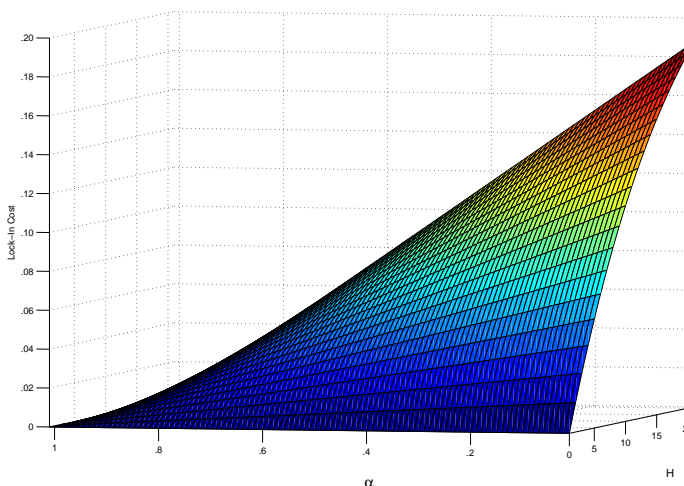
For this example, the intrinsic value of equity (X) is equal to 1, the gross rates of return on dividends and capital gains are each 3.5%, the tax rate on dividends is 17.1%, and the tax rate on realized capital gains is 20.9% (which are the average rates for 2008 from Section 3.3).

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[19]See Appendix F for a proof of these results.

The firm's equity supply curve can be derived by ranking shareholders according to their lock-in costs, from lowest to highest. The equity supply curve is an increasing function (possibly weakly over some intervals) of the amount repurchased. However, the exact shape depends on the shareholder distribution over tax base and desired holding period ($F(\alpha, H)$). If we denote the equity supply curve by S(q), where q is the number of shares repurchased, and S(q) is the reservation price of the marginal shareholder, i.e., the intrinsic value of equity (X) plus the marginal shareholder's lock-in cost, then it is characterized by the following equations:

$$S(q) = X + \widehat{L(q)},$$

$$q = \sum_{H=0}^{H_M} \int_{\{(\alpha,H)|L(\alpha,H)\leq\widehat{L(q)}\}} f(\alpha, H)d\alpha,$$

where H_M is the maximum desired holding period among shareholders of the firm, and $\{(\alpha, H)|L(\alpha, H) \leq \widehat{L(q)}\}$ is the set of shareholders with holding period H that have lock-in costs less than $\widehat{L(q)}$.

As shown below, optimal firm behaviour dictates that shares are repurchased in the most inexpensive way possible. This ensures that the market value of equity - with respect to the remaining shareholders - is maximized. Due to shareholder-specific lock-in costs firms must pay a premium over the

intrinsic value of equity to attract shareholders with an accrued capital gain and non-zero holding period. We will call this the lock-in premium. The lock-in premium required by each shareholder constrains the number of shares that can be repurchased for a given amount spent. The extent to which this happens depends on the tendering[20] behaviour of shareholders, i.e., the relationship between a shareholder's lock-in cost and the lock-in premium they demand. We can derive upper and lower bounds on this premium as a function of investor type, amount spent, and the distribution over investor type.

If $F(\cdot)$ is the distribution over investor type and A is the total amount spent on a repurchase, then the minimum lock-in premium demanded by investor type (α, H) is:

$$P((\alpha, H), F(\cdot), A) = L(\alpha, H),$$

where $P(\cdot)$ is the lock-in premium and $L(\alpha, H)$ is investor type (α, H)'s lock-in cost. Any lock-in premium below this amount decreases investor type (α, H)'s wealth. The maximum lock-in premium demanded by investor type (α, H) is:

$$P((\alpha, H), F(\cdot), A) = max_{\{(\alpha,H)\}^B}\{L(\alpha, H)\},$$

where $\{(\alpha, H)\}^B$ is the set of investor types from which shares are repurchased.[21]

[20]The word tendering is meant to denote the sale of stock back to the firm.
[21]This set is determined by the distribution over investor-types ($F(\cdot)$) and the amount spent

That is, the maximum lock-in premium demanded by investor type (α, H) is equal to the maximum lock-in cost among the set of shareholders that sell equity back to the firm. To see this, note that if an investor type $(\alpha', H')\epsilon\{(\alpha, H)\}^B$ demands a price above the intrinsic value of equity (X) plus this lock-in premium, e.g. $X + P((\alpha', H'), F(\cdot), A) + \beta, (\beta > 0)$, then given the continuity of α, and the continuity of the lock-in cost function with respect to α, there exists an $\eta > 0$ and investor type $(\alpha'', H'')\epsilon\{(\alpha, H)\}^{NB} = \{(\alpha, H)\}^U/\{(\alpha, H)\}^B$ such that $X + L(\alpha'', H'') + \eta < X + P((\alpha, H), F(\cdot), A) + \beta$[22]. If investor type (α'', H'') offers this price[23] firms choose to repurchase from them and not (α', H') - they can repurchase shares more cheaply this way. Investor type (α', H') is worse off by $P((\alpha, H), F(\cdot), A) - L(\alpha', H') \geq 0$ and would therefore not choose to demand a higher price.

Given these lower and upper bounds on lock-in premiums, tendering behaviour is modelled two ways. The first assumes that shareholders are willing to tender shares at a price equal to the intrinsic value of equity plus their specific lock-in cost. This tendering behaviour is analogous to perfect price discrimination, except that here, the buyer pays different amounts for the same good. The second assumes that shareholders are willing to tender shares at a price equal to the intrinsic value of equity plus the maximum lock-in cost (A).

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[22]Where $\{(\alpha, H)\}^U$ is the set of all shareholders.

[23]I.e., $X + L(\alpha'', H'') + \eta$

among the set of tendering shareholders. This tendering behaviour is some-what analogous to perfect competition, where a single market clearing price is paid for all goods sold. In both cases the most inexpensive way to repurchase shares is to repurchase from the pool of shareholders with the lowest lock-in costs, i.e. those with relatively low accrued capital gains and/or those wishing to sell relatively soon. The repurchase function - defined as the intrinsic value of equity repurchased for a given amount spent repurchasing shares - based on the first tendering assumption, denoted the weak repurchase function (WRF), is characterized as follows:

$$R(A) = max_{\{\alpha(H)\}} \left[\sum_{H=0}^{H_M} \int_{\alpha(H)}^{1} f(\alpha, H) \, d\alpha \right] X$$

$$S.T. \quad \sum_{H=0}^{H_M} \int_{\alpha(H)}^{1} [X + L(\alpha, H)] \cdot f(\alpha, H) \, d\alpha = A.$$

These equations state that for every H, firms choose an $\alpha(H)$ such that the intrinsic value of shares repurchased ($R(A)$) is maximized, while adhering to the constraint that the cost of repurchasing these shares is equal to the amount spent (A). Where the cost of each share repurchased is equal to the intrinsic value (X) plus the shareholder-specific lock-in cost ($L(\alpha, H)$). This repurchase function represents the cheapest possible way a firm can repurchase shares. Appendix C includes an alternate derivation of the WRF using the firm's equity supply curve.

The repurchase function based on the second tendering assumption, denoted the strong repurchase function (SRF), is characterized as follows:

$$R(A) = max_{\{\alpha(H)\}} \left[\sum_{H=0}^{H_M} \int_{\alpha(H)}^{1} f(\alpha, H) \, d\alpha \right] X$$

$$S.T. \quad [max_{\{H\}} L(\alpha(H), H) + X] \cdot \sum_{H=0}^{H_M} \int_{\alpha(H)}^{1} f(\alpha, H) \, d\alpha = A.$$

The interpretation of these equations is similar to those of the WRF except that the cost of each share is equal to the intrinsic value of equity plus the maximum lock-in cost among the repurchased shares $(max_{\{H\}} L(\alpha(H), H))$. This repurchase function represents the most expensive way to repurchase firm equity. Appendix C includes a derivation of the SRF using the firm's equity supply curve.

For any distribution over investor-type, both the weak and strong repurchase functions are increasing in the amount spent and below (possibly weakly) the $45°$ line. As more shares are repurchased, the marginal shareholder's lock-in cost increases. From this, it follows that the WRF is concave in the amount spent.[24] The concavity of the SRF depends on the distribution over investor type. However, the SRF is bounded above by the WRF, i.e., for any amount spent, fewer shares are repurchased using the SRF.[25] The derivative of each

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[24]For a proof of this result see Appendix C.
[25]For a proof of this result also see Appendix C.

repurchase function is decreasing in the intrinsic value of the firm. As the intrinsic value of the firm declines more shares are repurchased for a given amount spent, and the marginal shareholder's lock-in cost becomes higher.

At this point it is not important to choose among the two functional forms when discussing firm equilibrium behaviour; the qualitative results are identical with both. A specific functional form is specified in the numeric section, but for now we will refer to both as the "repurchase function".

3.4.1 Firm Equilibrium Behavior

With the modelling environment now characterized, we can turn to the firm's equilibrium behaviour next. Recall that firms seek to maximize market value, represented by equation 1. This can be re-written as:

$$V_t = \frac{(1 - \tau_d)D_t}{(1 + \rho)} + \frac{(1 - \tau_a)[V_{t+1} + R(A_t) - V_t]}{(1 + \rho)} + \frac{V_t}{(1 + \rho)},$$

since the fraction of the firm repurchased (δ_t,), equals $\frac{R(A_t)}{V_{t+1} + R(A_t)}$.[26] Solving for V_t gives us:

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[26]The fraction of the firm repurchased equals the intrinsic value of repurchases divided by the market value of the firm, which equals the continuation value (value after shares are repurchased) plus the intrinsic value of repurchases.

$$V_t = [1 + \frac{\rho}{(1 - \tau_a)}]^{-1} \{D_t \frac{(1 - \tau_d)}{(1 - \tau_a)} + R(A_t) + V_{t+1}\}.$$

This equation can be rewritten further as the following infinite sum (with transversality condition: $lim_{t\to\infty}[(1 + \frac{\rho}{(1-\tau_a)})^{-t} \cdot V_t] = 0$)

$$V_t = \sum_{t=1}^{\infty} [1 + \frac{\rho}{(1 - \tau_a)}]^{-t} [D_t \frac{(1 - \tau_d)}{(1 - \tau_a)} + R(A_t)].$$

The per-period budget constraint is:

$$(1 - \tau_c)\pi(K_t) = D_t + A_t + I_t,$$

where τ_c is the corporate tax rate, K_t is the capital stock available at the beginning of period t, $\pi(\cdot)$ is the decreasing returns profit function, A_t is the amount spent repurchasing shares at the end of period t, and I_t is the level of investment made at the end of period t.[27] The law of motion for capital is:

$$K_{t+1} = K_t + I_t.$$

Since dividends cannot be negative, the following constraint also applies:

$$D_t \geq 0.$$

---

[27]Given this budget constraint, it is clear that for any amount spent repurchasing shares (A_t), the firm's value is largest when shares are repurchased in the most inexpensive way, i.e., when $R(A_t)$ is maximized for a given A_t.

The Lagrangian for the infinite sum is:

$$\mathcal{L} = \sum_{t=1}^{\infty} [1 + \frac{\rho}{(1-\tau_a)}]^{-t} \{ [D_t \frac{(1-\tau_d)}{(1-\tau_a)} + R(A_t)] \quad + \quad \mu_t[\pi(K_t)(1-\tau_c) - D_t - A_t - I_t]$$

$$+ \quad \lambda_t[K_t - K_{t+1} + I_t] \quad + \quad \xi_t[D_t]\},$$

where λ_t, μ_t, and ξ_t are Lagrange multipliers. The first order conditions are:

$$D_t : \frac{(1-\tau_d)}{(1-\tau_a)} - \mu_t + \xi_t = 0, \qquad (2)$$

$$K_{t+1} : \lambda_{t+1} + \mu_{t+1}\pi'(K_{t+1})(1-\tau_c) - (1 + \frac{\rho}{(1-\tau_a)})\lambda_t = 0, \qquad (3)$$

$$I_t : \mu_t - \lambda_{t+1} = 0, \qquad (4)$$

$$A_t : R'(A_t) - \mu_t = 0. \qquad (5)$$

3.4.2   Equilibrium Firm Payout and the Payout Puzzle

The shadow value of net profit is equal to $R'(A_t)$ from equation 5, i.e., the marginal value of total payout is always equal to the marginal value of share repurchases. When the dividend constraint binds (i.e., firms fail to pay dividends) the multiplier on the dividend constraint (ξ_t) is positive and $R'(A_t) >$

$\frac{(1-\tau_d)}{(1-\tau_a)}$ from equation 2. In this case, a marginal share repurchase is more valuable than a dividend payment, and share repurchases are the marginal (and only) form of payout. When the dividend constraint fails to bind (i.e. firms wish to pay dividends) the Lagrange multiplier on dividends (ξ_t) is zero. From equation 2 we know $R'(A_t) = \frac{(1-\tau_d)}{(1-\tau_a)}$, i.e., the marginal benefit of a share repurchase is equal to the marginal benefit of dividends. Since the repurchase function is concave, whenever dividends are paid they become the marginal form of payout.[28] This is intuitive since the marginal value of dividends is constant at $\frac{(1-\tau_d)}{(1-\tau_a)}$, while the marginal benefit of a repurchase is decreasing in the amount spent. Firms repurchase shares up to the point where the marginal benefit of doing so equals the marginal benefit of paying dividends. At this point firms stop repurchasing shares and switch to dividend payments. In equilibrium dividends are paid when the repurchase function is sufficiently concave, total payout is sufficiently large, and/or the relative tax burden is sufficiently high. The crucial assumption here is the existence of heterogeneous lock-in costs which cause the marginal benefit of repurchases ($R'(A_t)$) to fall as more shares are repurchased.

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[28] The WRF is everywhere concave. The SRF is concave locally whenever dividends become the marginal form of payout.

3.4.3 The Value of Firm Capital

The marginal value of capital in the Traditional view - also known as marginal q - is equal to unity (see Poterba and Summers (1984)). This follows from share repurchases being the marginal form of payout, and the ability of firms to re-purchase all shares for their intrinsic value. In the New view, dividends are the marginal form of payout, and the marginal value of capital is $\frac{(1-\tau_d)}{(1-\tau_a)} < 1$ (also see Poterba and Summers (1984)). That is, the value of capital within a firm is less than its replacement cost; capital is essentially "trapped" within a firm.

The marginal value of capital in the Lock-In model (λ_t) can be derived using equations 4 & 5, which gives us $\lambda_t = R'(A_t)$. If firms pay dividends, marginal q equals $\frac{(1-\tau_d)}{(1-\tau_a)}$. As with the New view, when dividends are the marginal form of payout, capital is trapped within a firm. When share repurchases are the marginal form of payout, marginal q is greater than $\frac{(1-\tau_d)}{(1-\tau_a)}$ but also less than unity. Unlike the Traditional view, when share repurchases are the marginal form of payout the marginal value of capital within a firm is less than its re-placement cost. In the Lock-In model, capital is trapped within a firm regard-less of the marginal form of payout. Shareholders would like to reduce the amount of firm capital, since its internal value is less than its outside value, but have no way of doing so without incurring costs. In the case of dividends, the cost is a high dividend tax rate; in the case of share repurchases, the cost is a repurchase premium.

3.4.4 Investment Levels

The level of corporate investment and the aggregate capital stock affect the long-term aggregate welfare in an economy. This section discusses the effects of taxes on the level of corporate investment and the capital stock.

Optimal corporate investment requires that the rate of return on a marginal investment is equal to the user cost of capital. If we denote by i the gross return on a marginal investment, then undertaking this investment yields $i(1 - \tau_c)$ in net-of-corporate-tax profit, one period hence. If $R'(A_t)$ is the marginal value of total payout in period t (discussed above), and $R'(A_{t+1})$ is the marginal value of total payout in period $t + 1$, then the marginal investment generates an accrued capital gain of: $i(1 - \tau_c)R'(A_{t+1}) + [R'(A_{t+1}) - R'(A_t)]$. The first term of this expression is the after-corporate-tax value of profits generated by the investment, while the second is the intertemporal difference in the marginal value of capital. Since accrued capital gains generate a tax liability, captured by the AECGTR (τ_a), only $(1 - \tau_a)\{i(1 - \tau_c)R'(A_{t+1}) + [R'(A_{t+1}) - R'(A_t)]\}$ of the investment's return is left after both taxes (corporate and AECGTR) are accounted for. The cost of this investment is the forgone marginal value of total payout in period t $(R'(A_t))$, leading to the following after tax return:

$$\frac{(1 - \tau_a)\{i(1 - \tau_c)R'(A_{t+1}) + [R'(A_{t+1}) - R'(A_t)]\} + R'(A_{t+1})}{R'(A_t)} - 1.$$

Shareholders require a constant after-tax rate of return ρ. Equating the above return with ρ, and solving for i characterizes the user cost of capital:

$$i^* = \frac{R'(A_t)}{R'(A_{t+1})} \left\{ \frac{\rho}{(1 - \tau_c)(1 - \tau_a)} + \frac{1}{(1 - \tau_c)}[1 - \frac{R'(A_{t+1})}{R'(A_t)}] \right\}. \qquad (6)$$

In an equilibrium, firms invest up to the point where a marginal investment yields a return equal to the user cost of capital, i.e. $\pi'(K_t) = i^*$.

The user cost of capital is an increasing function of both the corporate tax rate and capital gains tax rate. Both taxes reduce the net return on investment, requiring a larger gross return to satisfy a shareholder's required after-tax return (ρ). Given the decreasing returns profit function, both taxes also reduce the level of corporate capital.[29] Dividend taxes do not affect the user cost of capital, and like the New view, have no effect on capital levels.

In a steady state $A_{t+1} = A_t$, and the user cost of capital is: $\frac{\rho}{(1 - \tau_c)(1 - \tau_a)}$, its long-run level. When firms are not in a steady state the user cost of capital depends on whether dividends are paid. When dividends are paid $R'(A_{t+1}) = R'(A_t) = \frac{(1 - \tau_d)}{(1 - \tau_a)}$, and the user cost of capital is equal to the steady state level.

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[29]See Appendix J for a proof of this result.

Here, investment is a function of exogenous variables only (τ_g, τ_c, ρ, and $\pi'(\cdot)$). When dividends are not paid A_{t+1} does not equal A_t, and total investment depends on the functional form of $R(\cdot)$. In this case, investment and total payout depend on endogenous variables, i.e., the amount spent on repurchases over time. In both the Traditional view and the New view, a new steady state can be reached immediately following a permanent corporate and/or capital gains tax change. In the Lock-In model, transition to a new steady state is gradual when share repurchases are the marginal form of payout.

3.4.5 The Effect of Tax Changes on Corporate Payout

Corporate Tax Rate

From the discussion above, we know that the user cost of capital is an increasing function of the corporate tax rate, i.e., $\frac{\partial[i*]}{\partial \tau_c} = \frac{\rho}{(1-\tau_c)^2(1-\tau_a)} > 0$. Short-run investment moves in the opposite direction of a corporate tax change (given the decreasing returns profit function, and the condition $\pi'(K_t) = i^*$), causing short-run total payout to move in the same direction.[30] In a long-run equilibrium, both the capital stock and total payout move in the opposite direction of a corporate tax change, whereas investment is unaffected due to the non-depreciating capital assumption.

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[30]Conditional on a certain level of net income.

Realized Capital Gains Tax Rate

The capital gains tax rate affects the user cost of capital in a fashion similar to the corporate tax rate (through the AECGTR). Recall that the user cost of capital is an increasing function of the capital gains tax rate. This causes short-run total payout to be an increasing function as well. The level of investment, and the long-run capital stock, move in the opposite direction of a capital gains tax change, and therefore, log-run total payout moves in the opposite direction also.

Dividend Tax Rate

The dividend tax has no effect on the user cost of capital, and therefore no effect on the level of investment or total payout. To see why the dividend tax leaves the user cost of capital unaffected, first suppose dividends are the marginal form of payout. Then a dividend tax change causes the marginal value of capital to change by $\frac{\partial \frac{(1-\tau_d)}{(1-\tau_a)}}{\partial \tau_d} = \frac{(-1)}{(1-\tau_a)}$ times the tax change, in both the current and subsequent period. From equation 6 we know that when both $R'(A_t)$ and $R'(A_{t+1})$ change by the same proportion the user cost of capital is unaffected. Therefore, a dividend tax change has no effect on the user cost of capital when dividends are the marginal form of payout.

When share repurchases are the marginal form of payout the same result

holds. When the dividend yield is zero (which must be the case when share repurchases are the marginal form of payout) a dividend tax change has no effect on the repurchase function's first derivative,[31] and therefore no effect on the marginal value of capital in both the current and subsequent period. Given that $R'(A_t)$ and $R'(A_{t+1})$ are unaffected, the user cost of capital is also unaffected. In both cases the user cost of capital remains constant following a dividend tax change, leaving the level of investment and total payout unchanged as well.

3.5   Numerical Solution to the Lock-In model

This section presents steady-state comparative statics of the Lock-In model using a numerical solution to the firm's problem. It also presents simulated dynamic responses to various tax changes. The results are intended to supplement the general results provided above and give us a better understanding of how modelling assumptions affect equilibrium outcomes.

An important building block of the Lock-In model is the multivariate distribution over accrued capital gains and holding period specific to a company's

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[31]See Appendix H for a proof of this result.

shareholders. This distribution characterizes the measure of shareholders having each possible lock-in cost and it plays a significant role in determining the cost of a share repurchase program, and thus equilibrium outcomes. Ideally, a number of company-specific empirical distributions could be estimated and used in the numerical exercises. However, lacking the necessary data on basis values and shareholder characteristics, this task is beyond the scope of the current chapter. Instead, the joint distribution is parametrized, and comparative statics are run when these parameters are changed. There is no claim that the distributions used in this exercise reflect any true empirical distribution; however, an attempt is made to make clear how the chosen parameters affect equilibrium outcomes.

The first set of parameter values characterize the joint distribution's support. For the base-case distribution it is assumed that investors hold assets between zero years (would like to sell immediately) and twenty years, and have between zero and one hundred percent capital gain. We shall initially ignore the case where shares are held with a capital loss, reflecting the work of Constantinides (1983), where it is shown that holding assets with a loss is never optimal when capital markets are complete and capital loss offsets exist. Such positions are optimally sold immediately. Second, bivariate normality is imposed (truncated and discretized over the support), the mean is centred on the support, and each standard deviation is set to 50% of the mean. Last, the

correlation coefficient between accrued capital gains and holding period is assumed to be negative. The rationale for this assumption is as follows: investors purchase stock with an ideal initial holding period, those with shorter current holding periods have thus, on average, held the stock for longer and have accumulated larger capital gains.[32] If we make the stronger assumption that investors have uniform initial holding periods, and equity returns are constant, then the correlation coefficient would be negative one. However, investors have different initial holding periods and equity returns are stochastic in practice, so the correlation coefficient is likely greater than negative one. For the initial parametrization a correlation coefficient of -.35 is chosen, which is allowed to change in the comparative statics section.[33]

In addition to the joint distribution over investor type, the company's repurchase function also depends on the parameter values of the lock-in cost function, which include the company's equity value (X), the statutory tax rate on income from dividends and realized capital gains (τ_d and τ_g respectively), and the firm's payout policy (the yield on dividends (d) and on capital gains (r)). Recall the lock-in cost function:

$$L(\alpha, H) = X \left\{ \frac{(1-\alpha\tau_g)\{(1-\tau_g)\Omega(H)+\tau_g(1-\tau_d)d\cdot\sum_{h=0}^{H-1}\Omega(h)\}+\alpha\tau_g(1-\tau_g)}{(1-\tau_g)\{(1-\tau_g)\Omega(H)+\tau_g(1-\tau_d)d\cdot\sum_{h=0}^{H-1}\Omega(h)\}+\tau_g(1-\tau_g)} - 1 \right\},$$

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[32]Given a positive return from accrued capital gains.

[33]There is no particular motivation for choosing a correlation coefficient of -.35 for the base-case parametrization.

$$S.T. \ \Omega(v) = (1 + r + (1 - \tau_d)d)^v.$$

In the base-case parametrization the most recent estimates of the average statutory tax rate paid by Canadian investors on income from dividends and realized capital gains are used, which are 17.1% and 20.9%, respectively in 2008.

In a steady state, both firm value and the firm's payout policy are equilibrium quantities that depend on the repurchase function itself, the profit function, statutory tax rates (both corporate and personal), the AECGTR, and the required after-tax rate of return ρ. In addition, the AECGTR is endogenous with respect to the yield on dividends and capital gains. This gives rise to a fixed point problem in four variables: firm value, dividend yield, capital gain yield, and the AECGTR. These fixed points are solved for using numerical methods.

In the base-case parametrization, the 2008 estimate of the average national corporate tax rate paid by Canadian firms[34] is used, which was 31.5%. A 6% after-tax required rate of return is used, which is in line with the range of

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[34]Chapter 4 includes a detailed discussion of how this average corporate tax rate is calculated.

equity returns estimated by Campbell (2008) for Canadian firms over the period 1982-2007, which was discussed above. For simplicity, a logarithmic profit function is used.[35] Table 3.2 reports steady-state equilibrium values using the base-case model for both the weak and strong repurchase functions.

Table 3.2: Steady State Equilibrium Values: Benchmark Parametrization

Class of Distribution	Firm Value	Capital Stock	Dividends Level (Yield %)	Repurchases Level (Yield %)	AECGTR
Strong	21.85	8.58	.86 (3.9)	.72 (3.3)	16.38
Weak	21.91	8.57	.13 (.6)	1.44 (6.6)	16.43

As this table illustrates, equilibrium values depend on the type of repurchase function used. The SRF's first derivative is everywhere lower than that of the WRF, causing the marginal benefit of a repurchase to fall faster when the SRF is used. Firms pay dividends once the marginal benefit of doing so equals the marginal benefit of repurchasing shares, therefore, firms pay more dividends with the SRF. The dividend yield is 3.9% when the SRF is used, which is 6.5 times higher than for the WRF (.6%). Due to the higher dividend yield, the AECGTR is lower for the SRF, which causes the steady-state capital stock to be higher. Total payout is higher for the SRF, but the average after-tax value

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[35]To ensure profits are positive, the profit function is: ln(K+1), since K can be less than 1 in principle.

of total payout is lower, since more payout is made in the form of tax disadvantaged dividends. The gross return using the SRF is 7.24% compared to only 7.21% using the WRF.

If we subtract the intrinsic value of repurchases from the amount spent repurchasing shares we can calculate the repurchase premium. Both the absolute value of the repurchase premium and the per-share repurchase premium are higher for the SRF. The absolute value is $.006 for the SRF and $.0055 for the WRF. The per-share repurchase premium is $.19 for the SRF, and only $.09 for the WRF.

3.5.1   Comparative Statics

Comparative statics (CS) will now be presented when the parameter values of the investor-type distribution are changed. These results are derived using only the SRF. The results are qualitatively identical for both types. The distribution's truncated normality is maintained at first, and dividend payout is analysed when adjustments are made to the mean, covariance matrix, and support, while holding constant the AECGTR from the base-case model. The second set of CS exercises act on the class of investor-type distribution.

Table 3.3 reports the fraction of total payout going toward dividends when

the mean of the investor-type distribution is adjusted. The table's columns correspond to changes in average holding period, which is varied from 7 to 13 years. The rows correspond to changes in average base, which is varied from 35% to 65%.

Dividend payments increase in average holding period and decrease in average base. For instance, no dividends are paid when the average investor has a base of 65% and holding period of 7 years. When the average holding period is increased to 13 years, and the average base is 35%, dividend payments make up 80% of total payout. As average holding period increases and average base decreases, a larger fraction of shareholders require higher lock-in premia to sell their shares. This makes large share repurchases less desirable, and increases the fraction of payout made with dividends.

Table 3.3: Fraction of Total Payout Going Toward Dividends: Comparative Statics - Mean Adjustments

Average Holding Period (Years)

		7	8	9	10	11	12	13
	35	0.469	0.569	0.644	0.702	0.743	0.776	0.801
	40	0.410	0.510	0.602	0.660	0.718	0.743	0.776
Avg.	45	0.319	0.435	0.544	0.619	0.660	0.702	0.735
Base	50	0.210	0.344	0.452	0.544	0.602	0.660	0.685
(%)	55	0.076	0.218	0.344	0.452	0.527	0.585	0.627
	60	0.000	0.076	0.218	0.327	0.419	0.494	0.544
	65	0.000	0.000	0.067	0.210	0.302	0.377	0.435

The next CS exercise acts on the covariance matrix. Table 3.4 reports the

fraction of total payout going toward dividends when the standard deviations of both holding period and base, as well as the correlation coefficient between the two, are adjusted. The rows of Table 3.4 report adjustments to the standard deviation of both base and holding period, which are varied between 30% and 90% of their respective means. The columns of Table 3.4 correspond to adjustments to the correlation coefficient, which is varied between -.65 and -.05.

The payment of dividends decreases in the standard deviation and increases in the correlation coefficient. As the standard deviation increases the mass of shareholders requiring both low and high lock-in premia also increases. The fraction of equity that may be repurchased in a given period is limited by the inability to issue debt and the constant profit stream assumed by the model. Because repurchase programs target low-cost shares, it follows that all selling shareholders have below-average lock-in costs, making changes to the distribution of shareholders with above-average lock-in costs irrelevant for the repurchase decision.[36] The net result of this is that a higher standard deviation increases the number of cheap shares, which makes repurchase programs more desirable, and reduces the yield on dividends.

A high correlation coefficient (one that is closer to zero) reduces the mass of

[36]This follows from the fact that, given a reasonable after-tax required rate of return, net profit is less than half of the firm's market value in every year. For instance, in the base-case model, net profit is less than 10% of the firm's market value when both the strong and weak repurchase functions are used.

shareholders with relatively short holding periods *and* few capital gains, and simultaneously increases both the mass of shareholders with relatively short holding periods *and* large capital gains, and shareholders with long holding periods *and* few capital gains.[37] The first effect increases the cost of a repurchase program whereas the last two decrease it. On net, the first effect dominates, and the cost of a repurchase program increases in the correlation coefficient.

Table 3.4: Fraction of Total Payout Going Toward Dividends: Comparative Statics - Covariance Matrix Adjustments

		Correlation Coefficient Between α and H					
		-0.65	-0.55	-0.45	-0.35	-0.25	-0.15	-0.05
Standard	30	0.801	0.801	0.818	0.818	0.835	0.843	0.859
Deviation	40	0.660	0.677	0.677	0.685	0.685	0.702	0.718
of α and H	50	0.510	0.510	0.527	0.544	0.560	0.569	0.585
(% of Mean)	60	0.360	0.360	0.377	0.394	0.410	0.419	0.435
	70	0.235	0.235	0.252	0.252	0.268	0.285	0.302
	80	0.143	0.143	0.143	0.159	0.159	0.176	0.193
	90	0.076	0.076	0.076	0.076	0.076	0.092	0.109

The next CS exercise acts on the support of the investor-type distribution. Table 3.5 reports the fraction of total payout going toward dividends when shareholders are allowed to maintain equity positions with capital losses, and the maximum holding period is varied between 17 and 23 years. The columns correspond to upper bounds on tax base, which are varied between 1 and 1.3 times the current market price.[38] The rows correspond to maximum holding

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[37]It also decreases the mass of shareholders with long holding periods and large capital gains - those with a high lock-in cost - which, as argued above, is not relevant for repurchase decisions.

[38]A tax base ratio greater than 1 means that the initial stock price was greater than the

periods. All shares with a capital loss are sold for a price at least as great as the intrinsic value of equity since capital markets have perfectly elastic supply.

When the upper bound on tax base increases the fraction of total payout going toward dividends declines. This happens because the measure of cheap shares increases, decreasing the repurchase premium for any amount spent, and increasing the benefit of a repurchase program. The fraction of total payout going towards dividends decreases in the maximum holding period. As the maximum holding period increases the slope of the investor-type distribution falls everywhere. This decreases the absolute value of the second derivative of the repurchase function, enabling more shares to be repurchased before the marginal benefit of repurchasing shares equals the marginal benefit of paying dividends.

Table 3.5: Fraction of Total Payout Going Toward Dividends: Comparative Statics - Support Adjustments

		Upper Bound of Base (%)						
		1.3	**1.25**	**1.2**	**1.15**	**1.1**	**1.05**	**1**
	17	0.050	0.159	0.268	0.377	0.452	0.527	0.585
Upper	**18**	0.034	0.143	0.252	0.344	0.435	0.510	0.569
Bound of	**19**	0.000	0.126	0.218	0.327	0.419	0.494	0.560
Holding	**20**	0.000	0.092	0.210	0.302	0.394	0.469	0.544
Period	**21**	0.000	0.076	0.193	0.285	0.377	0.452	0.527
(Years)	**22**	0.000	0.067	0.176	0.268	0.360	0.435	0.510
	23	0.000	0.050	0.159	0.252	0.344	0.419	0.494

current market price: a capital loss.

In the final CS exercise the class of investor-type distribution is changed. Table 3.6 reports the steady-state equilibrium values when the distribution is: uniform; log-normal; and chi-squared. With a uniform distribution, a larger mass of shareholders have low lock-in costs, and the repurchase function is less concave due to a constant sloping CDF, as compared with the base-case normal distribution. More shares are repurchased, and the dividend yield is lower as a result. Both the log-normal and chi-squared distributions have higher sloping PDF's over the set of tendering shareholders, as compared with the benchmark normal distribution. This results in more concave repurchase functions, and less shares are repurchased.[39]

Table 3.6: Steady State Equilibrium Values: Different Distribution Class'

Class of Distribution	Firm Value	Capital Stock	Dividends Level (Yield %)	Repurchases Level (Yield %)	AECGTR
Uniform	21.90	8.55	.03 (.1)	1.55 (7.1)	16.59
Chi-Squared	21.83	8.58	1.07 (4.9)	.51 (2.3)	16.36
Log-Normal	21.83	8.58	.95 (4.3)	.63 (2.9)	16.41

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[39]The mean of all three distributions are the same as the base-case model. The covariance of the log-normal distribution is also the same as the base-case model. The uniform and chi-squared distributions do not have covariance parameters.

3.5.2   Dynamic Simulations

This section presents impulse response functions (IRF) for changes in the cor-
porate tax rate, dividend tax rate, and the realized capital gains tax rate. Ini-
tial tax rates and parameter values are taken from the base-case model above.

The top two sub-plots of Figure 3.7 show IRF's for a change in the corpo-
rate tax rate, where the change happens in period t. The upper-left sub-plot
shows the IRF for a 1% increase in the corporate tax rate. This tax change
increases the user cost of capital, which reduces the optimal level of capital.
Investment in period t decreases as a result, and total payout increases. The
lower steady-state level of capital is realized in period t+1 and total payout is
lower from that period forward. The higher tax liability on corporate profits,
and lower total payout after period t, reduce total firm value. This reduces
the marginal benefit of repurchasing shares for any amount spent, as a larger
fraction of the firm is repurchased, implying higher lock-in premia as more
expensive shareholders are involved. As a result, the amount spent repurchas-
ing shares declines. Firm value in period t is slightly higher than in period
t+1 onward, owing to the liquidation value of corporate capital and the corre-
sponding higher total payout. Dividend payments increase in period t owing
to higher total payout and lower repurchases. They decline in period t+1 on-
ward due to lower total payout. The yield on dividends and capital gains are
unchanged in the new steady state. The upper-right sub-plot shows the IRF for

a 1% decrease in the corporate tax rate. The effect on equilibrium quantities are opposite those for a 1% increase.

The middle two sub-plots show IRF's for a change in the capital gains tax. The middle-left sub-plot shows the IRF for a 1% increase in the tax during period t. By increasing the AECGTR, the increased capital gains tax raises the user cost of capital and lowers the steady-state capital stock. This reduces investment and increases total payout in period t. The new steady-state capital stock is realized in period t+1, and total payout is lower from that point onward. Share repurchases are lower for three reasons. First, firm value is reduced by the AECGTR in a similar fashion to the corporate tax, reducing the marginal benefit of a repurchase for any amount spent. Second, the increased capital gains tax rate further reduces the marginal benefit of a repurchase by strengthening the lock-in effect. Third, dividend payments become more desirable as they reduce a now higher tax liability on capital gains. As a result, repurchases decline. Dividend payments are higher in period t for two reasons: first, the reduced level of share repurchases, and second, the higher level of total payout. From period t+1 onward dividends are higher owing to the first reason, which outweighs the lower level of total payout. The middle-right sub-plot shows the IRF for a 1% decrease in the capital gains tax rate, the effects of this on equilibrium quantities are opposite for the 1% increase.

Figure 3.7: Dynamic Response to Tax Changes

The bottom two sub-plots show IRF's for dividend tax changes. The bottom-left sub-plot shows the IRF for a 1% increase in the dividend tax in period t. Unlike the previous two tax changes, a change in the dividend tax has no effect on the user cost of capital, and therefore no effect on the capital stock, investment levels, and total payout. A higher dividend tax reduces the benefit of paying dividends by reducing the after-tax value of gross dividends. It also increases the marginal benefit of repurchasing shares by weakening the lock-in effect, but reduces it by decreasing firm value. On net, the weaker lock-in effect and decreased benefit of dividends dominates the firm value effect, and share repurchases increase. Total payout is constant and dividends decrease. The new steady state payout levels are achieved in period t+1. The bottom-right sub-plot shows the IRF for a 1% decrease in the dividend tax, again, the effects on equilibrium quantities are opposite those above.

3.6   Conclusion

Studies have shown that dividends are tax disadvantaged in the United States relative to share repurchases. This chapter has argued that dividends are likely to be tax disadvantaged in Canada also. Despite this, dividend payments constitute a significant fraction of total corporate payout in both countries, giving rise to a payout puzzle: persistent dividend payments appear to be an inferior form of payout from a firm value maximization perspective.

This chapter has proposed a model of corporate payout policy which offers an explanation for the payout puzzle by appealing to the lock-in effect caused by the postponement of taxes on capital gains. It is argued that shareholder lock-in effects require firms to pay a premium over the intrinsic value of equity when repurchasing shares. This premium adds to the cost of a share repurchase program, and tax disadvantaged dividends are paid whenever this premium is sufficiently high.

The premium depends on the shareholder distribution over accrued capital gains and desired holding period specific to a firm. It also depends on the tendering behaviour of shareholders, i.e., the relationship between a shareholder's lock-in cost and the premium demanded. Repurchase functions are derived that reflect lower and upper bounds on these premiums, and the model is solved using a number of shareholder distributions. In general, dividend payments are highest when shareholders demand the maximum lock-in premium, when the average accrued capital gain is high, the average holding period is long, and when the variance of these arguments is low.

The model is used to explore the consequences of tax policy for corporate investment and payout policy. It is found that investment is a decreasing function of both the corporate tax and the capital gains tax, and is unaffected by the

dividend tax. Short-run total payout increases in both the corporate tax and the capital gains tax, whereas long-run total payout decreases in both. The dividend tax has no effect on total payout in either the short-run or the long-run.

The model is also used to derive the marginal value of corporate capital. It is found that the outside value of corporate capital, i.e., its replacement cost, is higher than its marginal value within a firm. That is to say, corporations are overcapitalised, shareholders would like to reduce the amount of capital within a firm but are unable to do so without incurring a cost. When dividends are the marginal form of payout the cost is a relatively high dividend tax rate; when share repurchases are the marginal form of payout the cost is a repurchase premium.

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Chapter 4

Capital Income Taxation and Corporate Payout Policy: Empirical Results from Canada

4.1 Introduction

A key assumption of the model developed in Chapter 3 is that shareholders face personal tax on income from dividends and realized capital gains. These taxes affect equity value through corporate payout policy, and corporate managers - assumed to maximize shareholder wealth - select the level of payout, and the payout mix, in accordance with prevailing tax rates. When taxes adjust, firm value is affected, and optimal payout policy is likely to change. Capital income taxation, therefore, has two effects in Chapter 3, one on firm value, the other on payout policy. This chapter focuses on the the second effect, the relationship between taxes and payout policy, while a number of empirical studies from the US have identified the first effect.

Among US firm-value studies is Ayers et al. (2002) which demonstrates that the 1993 US dividend tax increase[1] caused a reduction in stock prices, and that stocks with high dividend yields experienced the greatest price declines. In addition, Lang and Shackelford (2000) and Dai et al. (2006) show that the 1997 US tax cut on long-term capital gains[2] caused a general stock-price appreciation. Both Lang and Shackelford (2000) and Dai et al. (2006) conclude that the appreciation resulted from a capitalization of the expected future tax savings on realized capital gains brought about by the tax decrease.[3] In addition, Sialm (2009) supports the conclusion that dividend taxation and capital gains taxation both affect stock prices. This study, based on US data over the period 1913-2006, shows that aggregate equity valuation during this time was negatively related to the average tax liability on income from dividends and realized capital gains. In light of the evidence provided by these studies, it is reasonable to conclude that capital income taxation matters for firm value. The author takes this effect as given and addresses the second effect: do firms respond to tax changes?[4]

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[1]The 1993 US Revenue Reconciliation Act increased the maximum tax rate on dividend income from 31% to 39.6%.

[2]This tax cut was part of the 1997 US Taxpayer Relief Act, which reduced the tax rate on long-term capital gains from 28% to 20% among investors in the top income bracket.

[3]This analysis is complicated by the tax's potential to have two offsetting effects. First, the reduced tax liability on capital gains is expected to be capitalized into the stock's price, thereby increasing firm value. Second, the reduced capital gains tax rate is expected to reduce the lock-in effect, thereby lowering shareholder reservation prices and putting downward pressure on stock prices.

[4]Despite the empirical evidence in support of a tax effect on stock prices, some in the literature still argue that such an effect may not exist. Prominent articles cited in support of

This is done using a unique dataset complied by the author on corporate stock repurchases executed by Canadian corporations listed on the Toronto Stock Exchange (TSE), and new estimates of average Canadian capital income tax rates over the period 1985-2008. The main findings of this chapter are as follows: 1) Total payout is positively related to year-over-year changes in the corporate income tax rate and the realized capital gains tax rate, whereas total payout is unaffected by changes in the dividend tax rate. These effects, however, appear with a one year lag. That is, the current first difference of each tax has no effect on total payout, while the lagged first difference has the stated effect. The finding that total payout is positively related to changes in both the corporate tax rate and the capital gains tax rate, and is unaffected by the dividend tax rate, is consistent with the predictions in Chapter 3. These results are also consistent with the "New view" model of corporate payout policy, while they are inconsistent with the "Traditional view" model, which predicts a dividend tax effect.[5] 2) The results also suggest that share repurchases are

this claim include Miller and Scholes (1978) and Stiglitz (1983), which together provide a number of sophisticated financial strategies that can eliminate the personal tax on equity income. However, both Miller and Scholes (1978) and Stiglitz (1983) require strong assumptions for their results to hold. Some of these do not hold in practice, and others are unlikely to hold in practice. Other authors have argued that the payout method is irrelevant for firm value since investors can equalize the tax liability on dividends and accrued capital gains by selling and repurchasing equity around the ex-dividend day. If these transactions are carried out with non-taxed entities, such as pension funds, the tax liability on both sources of income can be equalized (for an explanation of how this strategy works see Allen and Michaely (2003) and Kalay (1984)). However, the effectiveness of this strategy relies on factors such as bid-ask spreads and the transactions costs of selling and buying equity. Elton et al. (1984) argue that these, and other costs, make this strategy ineffectual.

[5]The New and Traditional view models were formulated to explain the corporate payout

positively related to changes in the dividend tax rate and negatively related to changes in the capital gains tax rate. These results provide evidence that firms choose to repurchase more shares when the relative tax penalty on dividends increases, either through an increase in the dividend tax rate or a decrease in the capital gains tax rate. It is also found that share repurchases are positively related to changes in the corporate income tax rate. 3) Dividend payments are positively related to changes in the capital gains tax rate, but are unaffected by changes to the dividend tax rate at any reasonable significance level. However, the coefficient estimates on the dividend tax are all negative.

This study also analyses the effect of taxes on the fraction of total payout distributed as a dividend. It is found that firms increase this ratio when the capital gains tax increases, and decrease this ratio when the dividend tax increases. This finding is consistent with the prediction in Chapter 3 that firms substitute between payout method as the relative tax burden changes.

The remainder of this chapter is organized as follows. Section 4.2 provides a brief overview of the literature. Section 4.3 discusses the data set. Section 4.4 presents summary statistics on corporate payout policy over the period

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puzzle. In the New view model, firms face an exogenous binding repurchase constraint. All payout above this constrained amount must be made with dividends. In the Traditional view model, investors derive an intrinsic value from dividends, implying that dividends can reduce the user cost of capital and increase firm value. For a discussion of these models see Poterba and Summers (1984).

1987-2008. Section 4.5 discusses the empirical specification for the payout-level equations (i.e., the level of total payout, dividends and share repurchases) and presents the estimation results. Section 4.6 discusses the empirical specification for the payout mix equation (i.e., the fraction of total payout used for dividends) and presents the estimation results, and Section 4.7 concludes.

4.2   Other Literature

The existing literature has generally found that taxes matter for payout policy. Moser (2007), which analyses US firms over the period 1986-2004, when a number of key tax regime changes took place, finds that firms are more likely to distribute funds via share repurchases when the tax rate on dividend income is high relative to the tax rate on realized capital gains. When Moser separates firms according to shareholder tax sensitivity (i.e. the degree of shareholder tax exposure), he finds that firms with a relatively high proportion of tax sensitive shareholders are more likely to substitute dividends for share repurchases when the dividend tax rate is relatively high.

In their analysis of the 2003 US Jobs and Growth Tax Relief Reconciliation Act, which reduced the tax rate on dividend income for all taxable individuals,[6] Chetty and Saez (2005) find that the fraction of firms paying dividends, and the

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[6]Taxpayers in the bottom two income tax brackets, facing a marginal tax rate of 10 and 15 percent faced a 5 percent tax rate after the reform. Taxpayers facing marginal rates of 25, 28, 33 and 35 percent faced a 15 percent rate after the reform.

average dividend payment among payers, both increased following the tax reform. The authors also find that total payout increased during this period, and reject the hypothesis that share repurchases were substituted for dividends. Further, they find that dividend payments increased by a larger amount when firms had tax sensitive shareholders, similar to Moser (2007). Using the same tax reform, Brav et al. (2008) also find evidence that dividends increased following the dividend tax cut. However, the authors argue that these increases were short-lived, and conclude that the tax cut had no long-term effect.

Contrary to Brav et al. (2008), the results in Poterba (2004) suggest that the dividend tax penalty[7] has no short-run effect on dividend payout, but a significant long-run effect. The estimates of Poterba (2004) are based on US firms over the period 1935-2002. He finds that the average long-run elasticity of dividend payments with respect to the dividend tax penalty is 3.3. Lie and Lie (1999) also find a positive relationship between share repurchases and the dividend tax rate using a sample of US firms over the period 1980-1994.

De Jong et al. (2003) use 1997 survey response data from 191 of the 500 largest non-financial Canadian firms listed on the TSE to determine which factors are most important for payout decisions. Their results suggest that personal capital income taxation is an important factor for both types of payout.

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[7]Defined as the ratio of one minus the dividend tax rate to one minus the effective tax rate on accrued capital gains.

It is found that firms are more likely to repurchase shares when shareholders have a tax-induced preference for repurchases, and are more likely to pay dividends when shareholders have a tax preference for dividends. In addition, De Jong et al. (2003) also find that managerial stock options reduce the probability that dividends are paid, and asymmetric information among outsiders reduces the chance that shares are repurchased.[8]

In a study similar to De Jong et al. (2003), Brav et al. (2005) survey 384 US financial executives to determine the factors that drive corporate payout decisions. They find that dividend initiations are heavily influenced by sustainable increases in earnings and the demand for dividends by institutional investors, while share repurchases are mostly used to offset option dilution and to take advantage of under-priced equity. Unlike De Jong et al. (2003), Brav et al. (2005) find that, although a subset of respondents reported that personal capital income taxation is a factor in the payout decision, the majority of firms claim that taxes are of second-order importance to the factors mentioned above. However, as mentioned in Brav et al. (2005) market participants need not understand the reasons for performing certain behaviours for economic models to be predictive. It may be that financial executives do not understand the true impact of capital income taxation. The survey design in De Jong et al. (2003)

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[8]This last result is consistent with the theory of Brennan and Thakor (1990), which proposes that during a repurchase program uninformed shareholders (those who do not know the firm's true value) may transfer wealth to informed shareholders by selling under-priced equity and failing to sell overpriced equity. This reduces the desirability of repurchase programs for uninformed investors.

is intended to limit such problems.[9]

4.3   Data Set Construction

This chapter makes extensive use of data on average marginal tax rates and corporate share repurchases in Canada. In this section, the steps taken to estimate each are discussed.

4.3.1   Personal Marginal Tax Rates on Dividend and Realized Capital Gains Income in Canada

The marginal tax rate on income from dividends and realized capital gains faced by taxable Canadian shareholders depends on their level of taxable income (total income less deductions), tax credits,[10] and province of residence. Canada uses a bracket system of income taxation, with generally rising rates. During the last 25 years, Canada has imposed a number of surtaxes and clawbacks that also depend on income. These factors led to non-linear tax schedules at both the federal and provincial levels. All Canadians face the same federal

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[9]The survey questions in De Jong et al. (2003) do not explicitly indicate the relationships of interest. Also, multiple questions are used to elicit the same information in an attempt to reduce the respondent's bias. Unlike Brav et al. (2005), De Jong et al. (2003) use the survey to identify firm characteristics, which are then linked to payout policy behaviour.

[10]In cases where taxes payable are less then allowed non-refundable tax credits.

tax schedule,[11] but provincial tax schedules generally differ by province; in addition, both federal and provincial tax schedules often differ by year. Using tax forms provided by the Canada Revenue Agency (CRA) and Revenue Quebec, federal and provincial tax schedules for dividend income and capital gains income are calculated for each province and for each year over the period 1985-2008.[12] All tax schedules are derived by setting tax credits, other then the basic personal amount for individuals, equal to zero.

Every year the CRA publishes the aggregate amount of taxable income claimed by individuals across income brackets, broken down by source of income. From these statistics, the proportion of dividend and capital gains income claimed by individuals in each bracket can be calculated. For instance, in 2008 Canadian taxpayers claimed $38.5 billion in aggregate taxable dividends and $13.6 billion in aggregate taxable capital gains.[13] Of these totals, individuals with taxable incomes between $45,000 - $50,000 claimed taxable dividends of $860 million and taxable capital gains of $199 million, which were 2.2% and 1.5% of their respective totals, while individuals with taxable incomes above $250,000 claimed taxable dividends of $16.6 billion and taxable capital gains of $7.3 billion, which were 43% and 54% of their respective totals. These fractions are calculated for each income bracket in each year over the period

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[11]Other than residents of Quebec, which can reduce the federal tax using the refundable Quebec abatement.

[12]The marginal tax rate on income from dividends and realized capital gains is different from other forms of income. See Appendix I for an explanation of how these rates are calculated.

[13]That is, taxpayers received this income in 2008.

1985-2008.

The marginal tax rate on each source of income within each income bracket, and in each province, is then calculated using the tax schedules derived above.[14] For instance, in 2008 the marginal tax rate on dividend income faced by Ontario residents with taxable incomes between $45,000 - $50,000 was 7.5%, and 15.6% for realized capital gains. For individuals with taxable incomes over $250,000, the marginal tax rate on dividend income was 24%, and 23.2% for realized capital gains. Average marginal tax rates for each province are then calculated by taking a weighted average of the bracket-specific marginal tax rates, weighted by the proportion of total income (from dividends and realized capital gains) claimed by individuals within each bracket. This is done for every year, and every province.

The CRA also publishes the aggregate amount of income claimed by residents of each province broken down by income type. To derive national average marginal tax rates on dividends and realized capital gains, a weighted average of the provincial averages is taken, where the weights are the proportion of total income (from dividends and realized capital gains) claimed by

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[14]At times an income bracket has multiple marginal tax rates. The average marginal tax rate within these brackets is calculated by taking a weighted average of the individual rates, weighted by the proportion of the bracket's income range subject to each tax.

4.3.2   The Marginal Tax Rate on Corporate Income

The Canadian average corporate tax rate is also used in the estimations below. Its construction is discussed next.

In Canada, there are three rates of corporate tax, one for small business, one for large manufacturing firms, and one for large non-manufacturing firms. The firms used in the empirical analysis are all sufficiently large that none would qualify for the first rate. Each Canadian corporation pays the same federal corporate tax rate, and a unique provincial rate. Ideally, the actual corporate tax rate faced by each firm in the sample could be calculated, however, the author has limited firm-sector data and no data on province of incorporation. Therefore the national average corporate tax rate is estimated as follows. For each province, corporate tax rates are calculated for manufacturing and non-manufacturing firms.[16] The national average rate for each sector is then calculated by taking a weighted average of the province-specific rates (plus the federal rate), weighted by the province's share of national corporate income. To estimate the average Canadian corporate tax rate, a weighted average of the national average rates on manufacturing and non-manufacturing firms is taken, weighted by the proportion of corporate income generated by firms designated as manufacturing and non-manufacturing. This provides the national average Canadian corporate tax rate series used in the current analysis.

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[16]Annual issues of "Finances of the Nation" (published by the Canadian Tax Foundation) provide historical corporate tax rates.

4.3.3   Share Repurchases and Dividends

As discussed below, estimating the value of corporate share repurchases is complicated by data limitations. The estimation method used in the current chapter is discussed next. This is followed with a discussion of its limitations, and a comparison to other methods used in the literature.

The TSE reports the number of securities repurchased each month by TSE listed corporations in its publication "The Daily Record." Back-dated issues of this publication are used to create a data set containing all common stock repurchases made by TSE listed corporations from 2001 to 2008, and data is used from McNally et al. (2003) for common stock repurchases spanning 1987 to 2000. These two data sets are combined to produce a unique data set containing all monthly repurchases of common stock made by TSE listed companies from 1987 to 2008.

The Daily Record also publishes monthly repurchase data on preferred shares and income trust units. However, these data were omitted, the former due to the debt-like qualities of preferred shares, and the latter due to the special tax treatment of income trusts.

To estimate the amount spent by each repurchasing firm in each month, the

number of shares repurchased is multiplied by the average monthly stock price of these shares. This is estimated using daily price data from Datastream.[17] In some cases, especially in early years, price data is unavailable. These firm-years are omitted from the data set. This underestimates aggregate repurchase figures, and may also bias average numbers, although the sign and magnitude of this bias is unknown. Dividend numbers are taken from Datastream, and when unavailable, from Compustat.[18] If firms had missing dividend data they were also omitted from the data set. This underestimates aggregate numbers, and may also bias averages.

This estimation strategy for share repurchases is subject to error for at least two reasons. First, the time and day that shares are repurchased within a month is not observed. Insofar as share prices fluctuate over the period of a month, the monthly repurchase numbers will overestimate (underestimate) actual repurchases when firms repurchase a large fraction of shares on days with relatively low (high) stock prices. Second, if firms have superior market timing, they may be able to systematically repurchase shares at a price below that faced by the average investor. Evidence that firms have this ability during Canadian repurchase programs is provided by McNally et al. (2006), where it is shown that over the period 1987-2000 repurchasing firms paid an average

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[17]Datastream is published by Thomson Reuters. It contains a number of time series data sets on stock prices and other firm level, and aggregate, data.

[18]Compustat is published by Standard & Poor's. Like Datastream, it contains company-specific data.

of 6.6% less for shares than an average investor over the repurchase program year.[19] It is likely that 6.6% is an upper bound on any systematic over-pricing inherent in the data set however, since firms not only choose the day(s) of the month on which to repurchase shares but also the month itself. If firms re-purchase more shares during months with relatively low share prices, to time the market, then the share repurchase estimates used in this study should have systematic under-pricing less than 6.6%, since the repurchase measure accounts for variability between months.[20]

Although the share repurchase estimates contain error, they may be an im-provement over the share repurchase series used in the literature. Most US studies involving share repurchase data use the Compustat series "Purchases of Common and Preferred Stock" (Compustat data item A115) for company-specific repurchases. This series is problematic however, since it aggregates a number of different transactions including purchases of common stock, pur-chases of preferred stock, conversions of other classes of stock into common stock, purchases of treasury stock, retirement of common or preferred stock, and redemptions of redeemable preferred stock.[21] Although some authors at-tempt to overcome this problem using various methods (for instance see Fenn

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[19]TSE regulations stipulate that repurchase programs last for a duration of one year. For more information on TSE regulations regarding repurchase programs see TSE (2008).

[20]If firms are able to time the market, as evidenced by the 6.6% price advantage, than this assumption is likely justified.

[21]This series reports the dollar amount spent on these transactions.

and Liang (2001)), a substantial amount of error is likely to remain. The current repurchase series, on the other hand, only contains common stock repurchases.

Another source for US share repurchase data is the Securities Data Company (SDC), which is used, for instance, in Jagannathan et al. (2000). This series is also problematic, however. The share repurchase numbers found in the SDC represent statements that a firm intends to repurchase the reported number of shares; firms have no obligation to actually repurchase the stated amount. Second, since the SDC aggregates share repurchase announcements from a number of sources, double counting may arise. The repurchase series used in this chapter contains actual share repurchases, and there is no double counting.

In addition to these measures, Stephens and Weisbach (1998) propose three others, specifically the change in shares outstanding reported by the Center for Research in Security Prices (CRSP)[22] and Compustat, and the dollar change in treasury stocks reported by Compustat. However, all three measures are contaminated by non-repurchase activity affecting the number of outstanding shares. This activity includes share distributions through benefit plans, the

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[22]CRSP is maintained by the Chicago Booth School of Business, and contains a number of time series data sets related to stock prices and the number of shares outstanding.

exercise of executive stock options and contemporaneous stock sales. In addition, the first two measures suffer from the same problem as the measure used here, i.e., one must price the repurchased shares.

With regard to Canadian data, studies may also use the Ontario Securities Commission's (OSC) Insider Reporting Database, which reports the price at which repurchase trades occurred. However, this dataset is incomplete. According to McNally et al. (2006) around half of the repurchase programs implemented over the period 1987-2000 do not appear in the OSC database. In addition, of the repurchase programs that do appear in the OSC database, many are incomplete. For instance, only 72% of the repurchase programs that appear in the OSC have reported total share repurchases within 25% of the actual amount (McNally et al. (2006)). Given this level of incompleteness, the OSC database is inappropriate for the current analysis.

4.4   Summary Statistics

The data set used in this chapter contains financial information on 1,924 firms listed on the TSE over the period 1987 to 2008. Firms in the data set appear an average of 7 years over the sample period, with a median of 6 years. Of the 1,924 firms in the sample, 33%, or 630 firms repurchased shares in at least one

year, and 41% or 786 firms paid a dividend in at least one year. Firms that repurchased shares did so an average of 41% of the time, while dividend-paying firms made dividend payments 75% of the time. The perceived "stickiness" of dividends is reflected in this higher percentage. The stickiness of dividends is usually attributed to the market's negative reaction to a dividend cut. For instance, Denis et al. (1994) finds that US firms listed on the New York Stock Exchange and the American Stock Exchange over the period 1962-1988 experienced an average negative abnormal return of approximately 6% over the two days surrounding a dividend reduction announcement. Similar results are found in Below and Johnson (1996).

Of the 1,034 firms with positive payout over at least one year in the sample, 37% paid a dividend and repurchased some equity, while 39% paid a dividend only, and 24% repurchased shares only. Of the dividend paying firms, 49% also repurchased shares, while 61% of repurchasing firms also paid a dividend.

Table 4.1 reports the number of firms appearing in the sample in each year, and also reports the number of firms that repurchased shares and paid dividends. From this table we can see that the absolute number of firms paying dividends has remained relatively constant over time, with a low of 245 firms in 2001 and a high of 331 firms in 1990. However, the fraction of firms paying

dividends has declined over time owing to a growing number of TSE listed companies. The number of firms repurchasing shares was relatively constant over the latter part of the 1980's and the early part of the 1990's. After this point the number of repurchasing firms increased markedly. Indeed, more firms repurchased shares over the four years 1996-1999 than over the preceding nine years combined. The number of repurchasing firms peaked in 2000 with 177, and then declined to 149 in 2001. Over the six years following this, the number of repurchasing firms remained relatively constant, and then in 2008 the number peaked again to 214, the highest level up to that point.

Table 4.1: Number of TSE-Listed Firms in the Sample by Year: 1987-2008

Year	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Firms	393	401	406	442	454	455	461	465	449	489	549
Repurchasers	46	39	33	62	40	32	28	37	54	77	96
Dividends Paid	316	324	318	331	322	295	280	276	275	281	286

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Firms	596	600	578	725	824	894	938	973	965	977	946
Repurchasers	143	163	177	149	133	144	122	130	116	150	214
Dividends Paid	286	272	252	245	248	262	282	306	310	295	285

This table reports the number of firms contained in the dataset in each year between 1987-2008, and how many of these firms paid a dividend and repurchased shares.

Table 4.2 reports aggregate dividend and share repurchase levels over the period 1987-2008. Aggregate dividends were relatively flat over the period 1987-1997, fluctuating within a $10 billion range that centred around $25 billion. In 1998 dividends increased to over $40 billion, a 56% increase over the previous year. Dividends reverted back to their 1997 levels the following year,

Table 4.2: Aggregate Dividend and Share Repurchase Levels 1987-2008: TSE Listed Canadian Corporations (Millions of $2008)

Year	Repurchases	Dividends	Year	Repurchases	Dividends
1987	285.26	24,953.36	**1998**	3,970.60	40,712.16
1988	503.16	26,962.84	**1999**	3,470.95	27,563.76
1989	697.11	30,220.86	**2000**	8,004.51	27,568.43
1990	590.07	29,144.07	**2001**	5,979.45	32,726.81
1991	117.74	26,321.35	**2002**	3,165.30	30,634.14
1992	337.09	24,328.58	**2003**	3,900.91	34,509.86
1993	320.58	20,523.80	**2004**	6,796.77	37,729.89
1994	498.48	22,472.16	**2005**	11,553.22	43,710.10
1995	1,020.83	22,959.75	**2006**	14,850.87	45,337.03
1996	2,225.18	24,020.76	**2007**	17,026.48	49,031.58
1997	4,699.34	26,111.45	**2008**	12,528.24	51,039.48

and began a steady climb over the next ten years, reaching a high of $51 billion in 2008. Share repurchases were relatively constant over the period 1987-1994, remaining under $1 billion. In 1995 share repurchases grew considerably, doubling the previous year's amount. Over the next two years share repurchases continued to double year-over-year, and finally levelled off over the period 1997-1999. In 2000 share repurchases spiked to over $8 billion, the highest level up to that point. In 2001 share repurchases dropped to $6 billion and started an upward trend which peaked in 2007 at $17 billion. In 2008 share repurchases fell to $12.5 billion.

4.5 Empirical Analysis of Payout Levels

As mentioned above, the primary focus of this chapter is on estimating the effect of tax rate changes at the personal and corporate level on corporate payout policy. We start by looking at total payout, and then at each component of total payout. The empirical specification for the total payout regression is discussed next. It is based on the theory developed in Chapter 3.

4.5.1 Empirical Specification

As in Chapter 3, total payout in period t (TP_t) is equal to net income minus investment, or

$$TP_t = (1 - \tau_t^c)\pi(K_t) - I_t,$$

where $\pi(\cdot)$ is the profit function, K_t is capital in place at the start of period t, τ_t^c is the corporate tax rate, and I_t is the level of investment. Alternatively, investment can be written as the difference between the future capital stock and the current capital stock, or

$$TP_t = (1 - \tau_t^c)\pi(K_t) - [K_{t+1} - K_t].$$

Noting that capital levels are the solution to a firm-value maximization problem that depends on the corporate tax rate, the accrued capital gains tax rate

(τ_t^a), and the dividend tax rate (τ_t^d), we can write total payout as

$$TP_t = (1 - \tau_t^c)\pi(K^*(\tau_{t-1}^c, \tau_{t-1}^a, \tau_{t-1}^d)) - [K^*(\tau_t^c, \tau_t^a, \tau_t^d) - K^*(\tau_{t-1}^c, \tau_{t-1}^a, \tau_{t-1}^d)],$$

where K^* is the optimal level of capital. This expression states that capital is the solution to a firm-value maximization problem that depends on tax rates. In Appendix J it is show that K^* is a decreasing function of the corporate tax rate and the capital gains tax rate, and is unaffected by the dividend tax, or

$$\frac{\partial K^*(\tau_t^c, \tau_t^a, \tau_t^d)}{\partial \tau_t^c} < 0,$$

$$\frac{\partial K^*(\tau_t^c, \tau_t^a, \tau_t^d)}{\partial \tau_t^a} < 0,$$

$$\frac{\partial K^*(\tau_t^c, \tau_t^a, \tau_t^d)}{\partial \tau_t^d} = 0.$$

Current capital (K_t) is determined in period $t - 1$ and is therefore pre-determined in period t. In addition, tax rates are exogenous to the firm's decision. The choice variables include investment (I_t), dividend payout (D_t), and share repurchases (A_t). The expected value of total payout, which is the summation of dividends and share repurchases, conditional on net income (NI_t) is

$$E[TP_t|NI_t] = NI_t - E[K^*(\tau_t^c, \tau_t^a, \tau_t^d) - K^*(\tau_{t-1}^c, \tau_{t-1}^a, \tau_{t-1}^d)|NI_t],$$

where $NI_t = (1 - \tau_t^c)\pi(K_t)$. When firms are in a steady state the following must hold $\tau_t^b = \tau_{t-1}^b$ for $b \, \epsilon \, (c, a, d)$. Thus $E[I_t|NI_t] = 0$ from the non-depreciating capital assumption in Chapter 3. Therefore $TP_t = NI_t$, that is, total payout is completely explained by net income in a steady state; taxes have no independent explanatory power. However, taxes partially explain total payout in the short run whenever they change, due to their effect on optimal capital stocks and the level of investment, i.e.:

$$\frac{\partial[K_{t+1} - K_t]}{\partial[\tau_t^c - \tau_{t-1}^c]} < 0,$$

$$\frac{\partial[K_{t+1} - K_t]}{\partial[\tau_t^a - \tau_{t-1}^a]} < 0,$$

$$\frac{\partial[K_{t+1} - K_t]}{\partial[\tau_t^d - \tau_{t-1}^d]} = 0.$$

This motivates the following empirical specification:

$$TP_t^j = \alpha + \gamma NI_t^j + \sum_{b \epsilon (c,g,d)} \beta_b[\tau_t^b - \tau_{t-1}^b] + \delta Z_t^j + \varepsilon_t^j,$$

where j denotes a specific firm, α is the constant, Z is a set of control variables discussed below, τ^g is the realized capital gains tax rate (derived above), which

is used in place of τ^a.[23] γ, δ, and β_b b ϵ (c, g, d) are coefficients to be estimated, and ε_t^j is the error term, assumed to have a conditional mean zero normal distribution.

Firms may elect to have zero payout in any particular year. Due to these corner solution outcomes, the process that generates total payout is modelled as a type 1 Tobit, similarly to Fenn and Liang (2001). That is, firms are assumed to have a latent desired level of total payout TP_t^j (described above), with conditional mean zero normally distributed errors. Total payout cannot be negative in practice however.[24] Therefore, whenever the latent total payout variable is negative, firms optimally choose zero total payout, which is observed. That is:

$$
TP_t^{j*} = \begin{cases} TP_t^j & \text{if } TP_t^j > 0, \\ 0 & \text{if } TP_t^j \leq 0, \end{cases}
$$

where TP_t^{j*} is observed total payout. The conditional likelihood function that results from this data generating process is:

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[23]In Chapter 3 it is shown that τ^a is necessarily smaller than τ^g due to the postponement of taxes on accrued capital gains. However, τ^a is unknown. A standard approach in the literature for estimating τ^a is to scale τ^g by a constant smaller than one (for instance see Poterba (2004)). This is usually an acceptable approach. However, it may be problematic in Canada over the period 1985-1993 due to the lifetime capital gains exemption (LCGE) introduced in 1985. In 1985 the LCGE allowed for an individual to exempt up to $500,000 of capital gains income over his/her lifetime. The exemption was reduced to $100,000 in 1987 except for farm property and shares held in qualifying small businesses. In 1994 the exemption was eliminated, except in the case of capital gains originating from farm property and small business. This exemption served to reduce the tax rate on accrued capital gains. This issue, and the proposed solution to it, are discussed below.

[24]Firms are unable to extract dividend payments from investors, although they are able to issue new shares. However, the issuance of new shares is a financing decision, and is conceptually different from the decision to repurchase shares.

$$f(TP_t^{j*}|X_t^j;\beta) = \left\{1 - \Phi\left(\frac{-\beta X_t^j}{\sigma_\varepsilon}\right)\right\}^{I[TP_t^{j*}=0]} \left\{\frac{1}{\sigma_\varepsilon}\phi\left(\frac{TP_t^{j*} - \beta X_t^j}{\sigma_\varepsilon}\right)\right\}^{I[TP_t^{j*}>0]},$$

where X is the complete set of independent variables outlined below, β is the complete set of coefficients, $I[\cdot]$ is the indicator function, Φ is the standard normal cumulative distribution function, ϕ is the standard normal probability density function, and σ_ε is the standard error. The results from estimating the coefficients of this model are presented in Section 4.5.3.

4.5.2 Additional Variables

The theoretical model underlying this empirical specification omits a number of factors that have been shown to affect firm payout. Including them will increase the efficiency of the tax rate coefficient estimates. The first additional firm-specific variable is the firm's debt to asset ratio. Firms that are unable to obtain cheap debt financing are generally thought to be more likely to use internal funds for investment (see e.g. Busaba (2012)). Therefore, the level of debt may provide a proxy for a firm's ability to acquire debt financing inexpensively. If this is the case, then a positive coefficient estimate on the debt to asset ratio is expected. The variance of net income is also included as an independent variable. Although there is little reason to expect that the variance of net income affects total payout directly, there is theoretical and empirical evidence to suggest that it affects the form of payout. Markets react negatively

to dividend cuts, and therefore, corporations with high income variability may find share repurchases are a more attractive form of payout. The variance of net income, therefore, belongs in the dividend and share repurchase regressions below; it is included in the total payout regressions for consistency. The final firm-specific variable included is total assets. This serves as a proxy for firm size. We expect total payout to increase in total assets; as firms become larger and more established, their growth opportunities decrease, and a higher proportion of their earnings are paid out to investors (see Allen and Michaely (2003) for evidence of this).

Three time series variables that are not firm-specific are also included. These are: Canadian real GDP; the S&P 500 index divided by the book value of firms in the sample; and the interest rate on 3-month government of Canada debt. Canadian real GDP is included to proxy for overall economic conditions in Canada. The S&P 500 index, divided by the book value of the sample firms, is included to proxy for the level of accrued capital gains on firm equity. Chapter 3 predicts that the level of share repurchases will decrease as the level of accrued capital gains increases. As discussed below, this is not found to be the case. The final variable included is the interest rate on three month Government of Canada debt. In the model of Chapter 3, the required after-tax rate of return is assumed to be constant. In practice, this rate may be time dependent. A high required rate of return places downward pressure on capital stocks and

investment, and may therefore affect conditional payout. This rate is proxied for by the Government of Canada interest rate discussed above.

As mentioned above, the capital gains tax series does not take into account the lifetime capital gains exemption (LCGE) introduced in 1985.[25] The $500,000 lifetime exemption likely reduced the effective tax rate on accrued capital gains markedly. Due to this, the tax years 1985-1986 have been excluded from the capital gains time series. Since the tax variables are year-over-year changes, the sample of firms must be restricted to the years 1988-2008 when the first difference of tax rates are included, and to 1989-2008 when lagged first differences are included. This reduces the sample by 2.8% in the former case, and by 5.7% in the latter case.

From 1987 onward a $100,000 lifetime exemption remained, which also acted to reduce the effective tax rate on accrued capital gains until it was eliminated in 1994. However, the effect of this exemption on the accrued capital gains tax rate is likely to be small for two reasons. First, the absolute size of the exemption is small considering that in 2008, for example, 66% of realized capital gains were claimed by individuals with average realizations of $83,000

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[25]See footnote 23 infra.

in 1987 dollars and \$104,000 in 1993 dollars.[26] Second, the large surge in realizations in 1985 and 1986 likely eliminated a large fraction of the \$100,000 capacity that remained after 1986. In addition, excluding all LCGE years would reduce the sample size considerably. Limiting the sample to the years 1995-2008 would reduce the sample size by 24.9%; limiting the sample to the years 1996-2008, in the case of a lagged first difference, would reduce the sample size by 28%.[27]

4.5.3 Results

Column two of Table 4.3 presents coefficient estimates when the first difference of taxes - the contemporary tax rate minus the one year lag - are included as independent variables (Model 1). Unsurprisingly, the coefficient estimate on net income is positive and significant. This result is predicted by the model of Chapter 3 and is intuitive. Total assets also appear to have a positive effect on total payout levels. This is likely the result of two factors. First, firms with larger assets likely have larger permanent incomes. If permanent income is an important determinant of total payout (for example see Brav et al. (2005)), then asset levels may provide information that current income does not. Second, as mentioned above, well established firms with limited growth opportunities are

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[26]These individuals were selected for having after-tax incomes greater than \$150,000.

[27]It may be possible to derive a reasonable estimate of the effective capital gains tax rate over the period 1985-2008 that accounts for the LCGE, and other factors that affect this rate. However, this task is complicated by a number of factors, such as the behavioural response of shareholders to the LCGE, and is beyond the scope of the current analysis.

likely to have a larger stock of assets, and less need for investment. The results also suggest that total payout is positively related to the ratio of debt to assets, although this effect is only significant at the 11% level. Conversely, the variance of net income appears to have a negative effect on total payout, although, as with the ratio of debt to assets, this estimate is significant at the 11% level only. GDP has a negative effect on total payout. This is likely due to the positive relationship between GDP and the growth opportunities of firms. As predicted by the model in Chapter 3, the interest rate variable is positively related to total payout. A higher interest rate implies a higher user cost of capital, which serves to reduce the optimal capital stock and investment.

Turning our attention to tax changes, we can see that all three coefficient estimates are not statistically different from zero, implying that there is insufficient evidence to support the claim that firms adjust total payout when differences between current and lagged taxes arise. This is contrary to the predictions of Chapter 3. In order to explore tax effects further, the lagged first difference of taxes is also included. The results of this regression are reported in the third column of Table 4.3 (Model 2). Here, taxes seem to matter. The coefficient estimates are positive and significant for both the corporate tax and the capital gains tax. These estimates suggest that firms adjust total payout in response to tax changes, but with a lag. Two possible reasons for this are 1) the speed with which investment can be adjusted, and 2) the timing of tax

Table 4.3: Determinants of Total Payout Levels, Canadian Firms 1988-2008: Tobit Results

Variable	Model 1 Year > 1987		Model 2 Year > 1988		Model 1 Year > 1988	
Net Income	0.154**	(0.043)	0.149**	(0.043)	0.149**	(0.043)
Income Variance	-4.30E-11	(2.7E-11)	-4.33E-11*	(2.6E-11)	-4.20E-11*	(2.6E-11)
Assets	0.0049**	(7.8E-04)	0.0050**	(7.9E-04)	0.0050**	(7.9E-04)
Debt/Assets	4,766	(2,946)	4,756	(3,022)	4,834	(3,015)
Index/Book	8,750,065**	(3.5E+06)	4,794,241	(3.1E+06)	8,873,071**	(3.6E+06)
GDP	-0.321**	(0.111)	-0.226**	(0.091)	-0.326**	(0.118)
Interest-Govn't Can.	11,074**	(2,073)	11,976**	(3,485)	11,197**	(2,114)
Constant	83,081	(66,978)	16,465	(68,025)	84,619	(72,389)
Div: Cur-Lag1	**29,238**	**(179,986)**	**146,295**	**(259,874)**	**30,573**	**(212,384)**
Div: Lag1-Lag2			**-87,928**	**(182,868)**		
CapGain: Cur-Lag1	**139,648**	**(114,792)**	**24,107**	**(135,183)**	**140,991**	**(133,221)**
CapGain: Lag1-Lag2			**305,456****	**(114,840)**		
Corp: Cur-Lag1	**-278,546**	**(255,631)**	**-419,263**	**(340,757)**	**-286,056**	**(336,646)**
Corp: Lag1-Lag2			**927,836***	**(520,086)**		
Pseudo R^2	0.0287		0.0283		0.0282	
Pseudo Log Likelihood	-99716		-95183		-95190	

Model 1 has 6690 left-censored observations, 6897 uncensored observations, model 2 has 6617 left-censored observations, 6569 uncensored observations. ** - significant at the 5% level, * - significant at the 10% level. Robust standard errors in parentheses. All regression variables are in thousands of 2008 Canadian dollars other than interest and tax rates (which are represented as fractions), and GDP which is in millions of 2008 Canadian dollars. "Cur-Lag1" denotes the current first difference and "Lag1-Lag2" denotes the lagged first difference.

change announcements. In the model of Chapter 3, investment is adjusted immediately, whereas in practice investment levels may take time to adjust. Second, tax changes in Canada are usually announced at the end of the first quarter of each year. Payout decisions made prior to this date may be based on the previous year's tax rates. The positive coefficient estimates on the corporate tax and the capital gains tax are predicted by the model of Chapter 3, as discussed above. The coefficient estimates on the dividend tax are not significantly different from zero, also consistent with the predictions of Chapter 3.

The coefficient estimates on the non-tax variables from model 2 are similar to those of model 1. The fourth column of Table 4.3 reports coefficient estimates for model 1 using the sub-sample that was used to estimate the coefficients for model 2. This regression is run in order to test whether the results of model 2 are an artifact of the sub-sample used for this regression. This is likely not the case, as the coefficient estimates from model 1 using both sub-samples are nearly identical.

4.5.4   Levels of Share Repurchases and Dividends

The next set of regressions analyse the effect of taxes on the level of dividends and share repurchases, using the empirical specification above. A Tobit model is also used for these regressions, reflecting a number of zero observations on both dividends and share repurchases.

Table 4.4 reports coefficient estimates when the dependent variable is share repurchases. Column two reports estimates when the current first difference is included, and column three includes a lagged first difference. In both specifications the capital gains tax is found to have a negative effect on the level of share repurchases. Conversely, the dividend tax is found to have a positive effect on repurchases in both models. It would appear that firms increase

Table 4.4: Determinants of Share Repurchase Levels, Canadian Firms 1988-2008: Tobit Results

Variable	Model 1 Year > 1987		Model 2 Year > 1988		Model 1 Year > 1988	
Net Income	0.014*	(0.008)	0.015*	(0.009)	0.015*	(0.009)
Income Variance	-6.32E-14	(1.1E-11)	-5.28E-13	(1.1E-11)	-2.96E-13	(1.1E-11)
Assets	0.0012**	(1.8E-04)	0.0012**	(1.8E-04)	0.0012**	(1.8E-04)
Debt/Assets	-11,600	(9,909)	-10,991	(10,005)	-9,550	(9,898)
Index/Book	1.75E+07**	(3.3E+06)	1.36E+07**	(3.3E+06)	1.72E+07**	(3.4E+06)
GDP	-0.191**	(0.076)	0.021	(0.093)	-0.180**	(0.081)
Interest-Govn't Can.	2,017	(2,518)	11,733**	(3,516)	2,005	(2,540)
Constant	-215,585**	(72,503)	-442,751**	(102,406)	-227,488**	(75,496)
Div: Cur-Lag1	**449,580****	**(224,300)**	**1,000,420****	**(290,958)**	**499,424****	**(249,013)**
Div: Lag1-Lag2			**393,940***	**(221,468)**		
CapGain: Cur-Lag1	**-511,118****	**(134,294)**	**-444,059****	**(150,165)**	**-543,752****	**(146,511)**
CapGain: Lag1-Lag2			**-514,432****	**(136,702)**		
Corp: Cur-Lag1	**-442,721**	**(328,651)**	**212,763**	**(401,955)**	**-348,592**	**(385,739)**
Corp: Lag1-Lag2			**1,252,341****	**(403,977)**		
Pseudo R^2	0.0081		0.0084		0.0080	
Pseudo Log Likelihood	-32396		-31795		-31806	

Model 1 has 11448 left-censored observations, 2139 uncensored observations, model 2 has 11086 left-censored observations, 2100 uncensored observations. ** - significant at the 5% level, * - significant at the 10% level. Robust standard errors in parentheses. All regression variables are in thousands of 2008 Canadian dollars other than interest and tax rates (which are represented as fractions), and GDP which is in millions of 2008 Canadian dollars. "Cur-Lag1" denotes the current first difference and "Lag1-Lag2" denotes the lagged first difference.

the level of share repurchases when the relative tax penalty for dividends increases, either through an increase in the dividend tax rate or a reduction in the capital gains tax rate. The corporate tax rate is found to have a positive effect on share repurchases in the second model. The positive estimate may be a result of higher total payout following a corporate tax increase (which was found in the total payout regressions) where part of this higher total payout flows into share repurchases.

With respect to the non-tax variables, it appears that share repurchases are

increasing in both net income and total assets. In model 1, share repurchases are decreasing in GDP, and in model 2 repurchases are increasing in the interest rate. Share repurchases are positively related to the index-to-book-value variable. This is likely due to a price effect; higher share prices increase the cost of repurchasing shares for any number repurchased. Column three reports the results using model 1 on the sub-sample from model 2. As with total payout, the coefficient estimates are almost identical using both sub-samples.

Table 4.5: Determinants of Dividend Levels, Canadian Firms 1988-2008: Tobit Results

Variable	Model 1 $Year > 1987$		Model 2 $Year > 1988$		Model 1 $Year > 1988$	
Net Income	0.154**	(0.044)	0.148**	(0.043)	0.149**	(0.043)
Income Variance	-5.30E-11	(4.1E-11)	-5.46E-11	(4.0E-11)	-5.35E-11	(4.0E-11)
Assets	0.0044**	(8.3E-04)	0.0045**	(8.4E-04)	0.0045**	(8.4E-04)
Debt/Assets	5,888*	(3,475)	5,894*	(3,571)	5,963*	(3,565)
Index/Book	5,180,227	(3.5E+06)	1,974,433	(3.2E+06)	5,522,642	(3.7E+06)
GDP	-0.342**	(0.128)	-0.286**	(0.109)	-0.356**	(0.137)
Interest-Govn't Can.	11,415**	(2,345)	10,366**	(3,568)	11,519**	(2,400)
Constant	104,752	(71,426)	78,408	(71,375)	112,627	(77,821)
Div: Cur-Lag1	**-128,360**	**(165,673)**	**-122,290**	**(223,568)**	**-157,093**	**(198,784)**
Div: Lag1-Lag2			**-130,269**	**(178,329)**		
CapGain: Cur-Lag1	**343,098****	**(148,557)**	**222,806**	**(162,308)**	**365,885****	**(169,523)**
CapGain: Lag1-Lag2			**427,371****	**(131,336)**		
Corp: Cur-Lag1	**16,944**	**(231,602)**	**-224,149**	**(322,130)**	**-38,402**	**(315,177)**
Corp: Lag1-Lag2			**639,794**	**(512,463)**		
Pseudo R^2	0.0302		0.0297		0.0296	
Pseudo Log Likelihood	-87632		-83152		-83159	

Model 1 has 7556 left-censored observations, 6031 uncensored observations, model 2 has 7479 left-censored observations, 5707 uncensored observations. ** - significant at the 5% level, * - significant at the 10% level. Robust standard errors in parentheses. All regression variables are in thousands of 2008 Canadian dollars other than interest and tax rates (which are represented as fractions), and GDP which is in millions of 2008 Canadian dollars. "Cur-Lag1" denotes the current first difference and "Lag1-Lag2" denotes the lagged first difference.

Table 4.5 reports coefficient estimates when dividends are the dependent

variable using the same regression models outlined above. In all three regressions the capital gains tax has a positive effect on dividend payout; when the capital gains tax increases, dividends become less tax disadvantaged relative to share repurchases, and firms seem to increase dividend payout as a result. However, the coefficient estimates on the dividend tax are not significantly different from zero, although they do have an intuitive sign.

As with the total payout and share repurchase regressions, the level of net income is positively related to the level of dividend payout. In addition, total assets, the debt to asset ratio, and the interest rate on government debt are also positively related to dividend payout. Whereas the variance of net income and the level of GDP are negatively related to dividend payout.

In summary, the capital gains tax has a significant effect on total payout, dividends, and share repurchases. The effect is positive for total payout and dividends, and negative for share repurchases. The dividend tax has a positive effect on share repurchases and no effect on dividends or total payout. The corporate tax has a positive effect on total payout and share repurchases.

4.6   Empirical Analysis of the Payout Mix

We have examined the effect of tax changes on corporate payout levels. The next empirical exercise is to analyse the effect of tax rate changes on the share of corporate payout paid in the form of dividends. This provides a better understanding of how firms substitute between dividends and share repurchases in response to tax changes. So far as can be determined, this is the first study to examine the effect of all three capital income taxes on the share of payout paid in the form of dividends. However, a number of studies have examined the effect of other firm-specific variables on this fraction.

Loudermilk (forthcoming), using US data over the period 1992-2002, estimates the effect of firm level variables including the volatility of earnings, market-to-book ratio, operating income to total assets and non-operating income to total assets, on the fraction of total payout used to repurchase shares, using a two-limit pooled Tobit estimator. She finds that operating income and the lagged dependent variable have a positive effect on the ratio of share repurchases to total payout, and finds no significant effect for the other three variables.

Fenn and Liang (2001) analyse the effect of various company-specific variables on the ratio of repurchases to total payout in the United States over the

period 1993-1997 using a two-limit Tobit model. They find this ratio is increasing in the market to book ratio and the volatility of net operating income, but is unaffected by the level of operating income, assets, and debt. The authors argue that the insignificant coefficient estimates on operating income, assets, and debt, confirm their hypothesis that dividends and share repurchases are substitutes, and hypothesise that the positive coefficient estimate on the market to book ratio reflects a positive relationship between a firm's growth prospects and the uncertainty of future cash flows. As cash flows become more uncertain, repurchases are preferred to dividends, given the former payout method's flexibility.

4.6.1 Empirical Specification

The ratio of dividends to total payout is a fraction that lies between zero and one, with probability mass at each end point. Due to the double-censored nature of the payout ratio variable, a two-limit Tobit model is used. More formally, if $\delta = \beta X + \varepsilon$ is the latent variable representing the desired fraction of total payout used to pay dividends, where X is a set of independent variables discussed below, and ε is the error term, then the observed fraction δ^* is characterized by the following:

$$\delta^* = \begin{cases} 0 & \text{if } \delta \leq 0, \\ \delta & \text{if } 0 < \delta < 1, \\ 1 & \text{if } \delta \geq 1. \end{cases}$$

If the assumption is made that ε is a normally distributed, conditional mean zero random variable, then the conditional likelihood function takes the following form:

$$f(\delta_j^{t*}|X_j^t; \beta) = \Phi\left(\frac{-\beta X_j^t}{\sigma_\varepsilon}\right)^{I[\delta_j^{t*}=0]} \Phi\left(\frac{-\beta X_j^t}{\sigma_\varepsilon}\right)^{I[\delta_j^{t*}=1]} \left\{\frac{1}{\sigma_\varepsilon}\phi\left(\frac{\delta_{i,t} - \beta X_j^t}{\sigma_\varepsilon}\right)\right\}^{I[0<\delta_j^{t*}<1]}.$$

This model is estimated using the set of firm-year observations with positive payout. This is done to avoid undefined payout ratios. The set of firm specific independent variables used in the level equations are also used here, except now they are scale by the firm's level of total assets. This is done to control for firm size (for each firm specific independent variable) since the dependent variable has no firm-size specific scale. In addition, the log of total assets is substituted for the level of total assets. The results of this regression are reported in Table 4.6.

4.6.2 Results

The second column of Table 4.6 includes the current first difference of all three taxes, the third column includes the lagged first difference, and the last column

Table 4.6: Dividends as a Fraction of Total Payout, Canadian Firms 1988-2008: Two Sided Tobit Results

Variable	Model 1 Year > 1987		Model 2 Year > 1988		Model 1 Year > 1988	
Net Income/Assets	0.00016	(0.00018)	0.00016	(0.00018)	0.00016	(0.00018)
Inc. Var./Assets	-2.04E-10**	(3.8E-11)	-2.06E-10**	(3.8E-11)	-2.07E-10**	(3.8E-11)
Log of Assets	0.111**	(0.0081)	0.115**	(0.0085)	0.116**	(0.0085)
Debt/Assets	0.663**	(0.116)	0.686**	(0.118)	0.657**	(0.119)
GDP	-2.50E-06**	(2.2E-07)	-3.89E-06**	(3.1E-07)	-2.68E-06**	(2.3E-07)
Interest	0.0062	(0.015)	-0.0889**	(0.020)	0.0063	(0.016)
Constant	2.594**	(0.303)	4.350**	(0.403)	2.713**	(0.314)
Div: Cur-Lag1	**-6.121****	**(1.372)**	**-12.041****	**(1.696)**	**-7.708****	**(1.543)**
Div: Lag1-Lag2			**-5.736****	**(1.411)**		
CapGain: Cur-Lag1	**7.998****	**(0.822)**	**7.080****	**(0.918)**	**8.773****	**(0.888)**
CapGain: Lag1-Lag2			**6.224****	**(1.021)**		
Corp: Cur-Lag1	**0.875**	**(1.867)**	**-4.609***	**(2.377)**	**-1.659**	**(2.141)**
Corp: Lag1-Lag2			**-9.118****	**(2.421)**		
Pseudo R^2	0.09		0.0905		0.0855	
Pseudo Log Likelihood	-5097		-4942		-4969	

Model 1 has 866 left-censored observations, 4758 right-censored observations, and 1273 uncensored observations, model 2 has 862 left-censored observations, 4469 right-censored observations, and 1238 uncensored observations. ** - significant at the 5% Level, * - significant at the 10% level. Robust standard errors in parentheses. Interest and tax rates are represented as fractions, GDP is in millions of $2008 Cdn. "Cur-Lag1" denotes the current first difference and "Lag1-Lag2" denotes the lagged first difference.

presents the results of model 1 estimated over the sub-sample used for model 2. The coefficient estimates for the firm-specific non-tax variables are similar across the three regressions. They suggest that current income has no statistically significant effect on the payout ratio. This is consistent with Fenn and Liang (2001), but runs counter to Loudermilk (forthcoming), which, as mentioned earlier, finds a positive effect.

It is found that the variance of net income has a negative effect on the payout ratio. This is also consistent with Fenn and Liang (2001), and inconsistent

with Loudermilk (forthcoming), which finds no such relationship. This result is further evidence in support of the hypothesis that share repurchases are a more flexible form of payout; firms with higher income variability may find it harder to maintain a steady stream of dividends. It is found that larger firms, i.e., those with larger assets, are more likely to use dividends to a larger extent. It is also found that more highly leveraged firms, i.e., those with higher debt to asset ratios, are more likely to use dividends than share repurchases. Fenn and Liang (2001) finds no such relationship. GDP is found to have a negative effect on the payout ratio in model 1, as does the interest rate in model 2.

Regarding tax rates, we can see that the first difference of personal capital income taxation matters for the payout ratio from model 1. When the dividend tax increases, firms substitute share repurchases for dividends in an apparent attempt to reduce the tax liability of shareholders. When the tax rate on capital gains increases, the opposite occurs, firms substitute away from share repurchases and toward dividends.

When lagged first differences of capital income taxes are also included, the results are similar. From model 2, we see that both the current and lagged first difference of dividend taxation have a negative effect on the ratio of dividends to total payout, while the current and lagged first difference of the capital gains tax rate have a positive effect.

The corporate tax rate appears to have a negative effect on the payout ratio in model 2. This effect is significant at the 10% level for the contemporary first difference, and significant at the 5% level for the lagged first difference. This last result may be due to the reduction in accrued capital gains following a corporate tax rate increase.[28] Lower levels of accrued capital gains will reduce the lock-in effect and make share repurchases more attractive. The coefficient estimates using model 1, estimated over both sub-samples, are almost identical.

4.7   Conclusion

This chapter provides new evidence that firms adjust corporate payout policy in response to tax changes at the corporate and personal level. The empirical analysis employs a unique dataset on share repurchases and Canadian average marginal tax rates on income from dividends and realized capital gains. The sample consists of 1,924 firms listed on the TSE over the period 1987-2008, which provides 13,587 firm-year observations. It is found that firms increase total payout in response to increases in both the capital gains tax rate and the corporate income tax rate, but that total payout does not respond to changes in the dividend tax rate. These results are consistent with the predictions of

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[28]An increase in the corporate tax rate will reduce firm value by reducing net income levels for any amount of gross income.

Chapter 3.

In addition to the level of total payout, this chapter also analyses the components of total payout, i.e., the level of dividends and share repurchases, in isolation. The results suggest that share repurchases are negatively related to changes in the capital gains tax rate and positively related to changes in the dividend tax rate. As the tax penalty on dividends increases, either through an increase in the dividend tax rate or a reduction in the capital gains tax rate, firms increase share repurchases. Dividend levels, on the other hand, are positively related to changes in the capital gains tax rate, but are unaffected by changes in the dividend tax rate. This last result is surprising. If the dividend tax penalty increases from a decrease in the capital gains tax rate, firms increase dividend payments, but do not alter dividend payments when the tax penalty adjusts following a dividend tax rate change. The corporate tax rate is found to have a positive effect on share repurchases and no effect on dividend levels.

When examining the ratio of dividends to total payout, we find that this ratio is positively related to changes in the capital gains tax rate and negatively related to changes in the dividend tax rate, suggesting that firms substitute away from dividends when the relative tax penalty on dividends decreases, as we would expect.

There is an ongoing debate as to whether firms adjust payout policy in response to tax changes.[29] This chapter adds to this debate by demonstrating that capital income taxation likely has an effect on corporate payout policy in Canada.

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[29]Although the majority of the empirical evidence suggests that firms do adjust payout in response to tax changes. See Section 4.2 for a brief literature review.

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Chapter 5

Conclusion

This thesis makes several contributions to the economics literature related to accrued capital gains. The first chapter presents estimates of the marginal propensity to consume (MPC) out of accrued capital gains on owner-occupied housing in Canada. It uses a set of hedonic price functions to estimate the value of each respondent's house over a number of years. First differences of these estimates are used to derive estimates of accrued capital gains. A notable benefit of using the hedonic method is it permits a substantial degree of house-price variability across individual observations. Also, unlike a number of studies that use respondent-generated house price estimates, the estimated capital gains used in this chapter are based on actual real-estate transactions. If respondents tend to misprice housing (see Bhatia 2012 for a literature survey on this point), then MPC estimates based on capital gains derived from hedonic price functions may be better for inference based on observable house

price changes.

It is maintained throughout this chapter that permanent, rather than current, housing capital gains drive consumption. To estimate these gains an adaptive expectations approach is used that incorporates four years of one-off gains. The results suggest that Canadian households spend an average of 9.4 cents more on total consumption for every 1 dollar increase in permanent housing capital gains. As predicted by the permanent income hypothesis (see Friedman (1957)), when current gains are substituted for permanent gains the MPC estimate falls to 1.6 cents.

The second chapter develops a model of corporate payout policy that can explain some aspects of the corporate payout puzzle, that is, the payment of dividends in practice despite their tax disadvantage relative to share repurchases. It is argued that personal taxes on realized capital gains produce a financial disincentive among shareholders toward selling corporate equity with an accrued capital gain and non-zero desired holding period. This is known as the lock-in effect. Repurchasing firms, therefore, must pay a premium above the intrinsic value of equity to offset this effect. This premium adds a cost to share repurchases. Firms pay tax disadvantaged dividends whenever this cost is sufficiently high.

The model is used to explore the effects of capital income taxation on optimal corporate capital stocks and corporate payout policy. It predicts that optimal capital stocks are a decreasing function of both the corporate tax rate and the capital gains tax rate, but are unaffected by the dividend tax rate. As the first two taxes increase, the user cost of capital also increases, which causes firms to divest capital. This causes higher total payout initially, but lower total payout when the new steady state is reached - when lower capital stocks are realized.

The final chapter of this thesis presents estimates of some empirical relationships between capital income taxation and corporate payout policy in Canada. It makes use of a new dataset on corporate share repurchases carried out by Toronto Stock Exchange listed Canadian corporations over the period 1987-2008, and new estimates of Canadian national average marginal tax rates on capital income. The share repurchase series used for this analysis is likely to be an improvement over other series used in the literature, owing to the disaggregation of common stock repurchases from other corporate financial transactions.

The results of this chapter suggest that total payout levels are positively related to changes in both the corporate tax rate, and the realized capital gains tax rate, but are unaffected by changes to the dividend tax rate. These results

are consistent with the predictions of chapter 3. The results also suggest that share repurchases are positively related to changes in the dividend tax rate and negatively related to changes in the capital gains tax rate. Conversely, dividends are found to be positively related to changes in the capital gains tax rate..

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Appendix A

Hedonic Coefficient Estimates

2000-2005

Table A.1: Hedonic Regression Coefficients: 2005

Province			Type of House		
P.E.I.	-57251.32	(23593)***	Semi-Detached	-36461.03	(18200)***
Nova Scotia	28012.35	(18170)*	Row or Terrace	-39141.83	(16045)***
New Brunswick	5483.15	(17541)	Duplex	61272.48	(20510)***
Quebec	54074.40	(17013)***	Apartment (Condo)	-58952.54	(15065)***
Ontario	122734.20	(18671)***			
Manitoba	27220.92	(18132)*	Year Built		
Saskatchewan	19313.32	(18971)	Between 46-60	-17467.50	(15617)
Alberta	98638.50	(18073)***	Between 61-70	-5681.16	(14973)
British Columbia	179963.80	(17433)***	Between 71-80	-21158.30	(13077)*
			Between 81-90	6142.13	(13578)
Town Type/Size			After 91	38978.17	(11892)***
Urban Under 100K	-73852.37	(8507)***			
Rural	-69984.87	(10783)***	Heating Equipment		
			Forced Air Furnace	-54812.66	(12443)***
Number of Rooms			Heating Stoves	-61158.46	(21828)***
Total	15231.60	(2653)***	Electric Heating	-46378.10	(13222)***
Number of Bedrooms	-6868.42	(5679)			
Number of Bathrooms	30708.75	(6862)***	Constant	51934.43	(24605)***
Sample Size		599	Adjusted R-Squared		0.55

The constant contains the same variables as in the regressions of Table 2.1. Robust standard errors in parenthesis.

***-significant at the 5% level, **-significant at the 10% level, *-significant at the 20% level.

Table A.2: Hedonic Regression Coefficients: 2004

Province			Type of House		
P.E.I.	-33993.00	(22175)*	Semi-Detached	-12077.92	(14765)
Nova Scotia	-3541.60	(15681)	Row or Terrace	-28625.44	(17462)*
New Brunswick	20310.76	(16257)	Duplex	32206.16	(20913)*
Quebec	43379.86	(15266)***	Apartment (Condo)	17712.06	(16098)
Ontario	92805.17	(15291)***			
Manitoba	-8184.06	(16652)	Year Built		
Saskatchewan	-15761.00	(16155)	Between 46-60	-8470.53	(14130)
Alberta	56107.57	(15696)***	Between 61-70	-15780.80	(15039)
British Columbia	110789.70	(15194)***	Between 71-80	-8915.82	(13024)
			Between 81-90	25346.84	(13104)**
Town Type/Size			After 91	37963.32	(12381)***
Urban Under 100K	-60903.36	(7883)***			
Rural	-62478.73	(10247)***	Heating Equipment		
			Forced Air Furnace	-21963.47	(12834)**
Number of Rooms			Heating Stoves	-22169.92	(22433)
Total	16003.63	(2473)***	Electric Heating	-48488.64	(13214)***
Number of Bedrooms	-5478.01	(4995)			
Number of Bathrooms	34167.38	(6436)***	Constant	19141.66	(23141)
Sample Size		634	Adjusted R-Squared		0.55

The constant contains the same variables as in the regressions of Table 2.1. Robust standard errors in parenthesis.

***-significant at the 5% level, **-significant at the 10% level, *-significant at the 20% level.

Table A.3: Hedonic Regression Coefficients: 2003

Province			Type of House		
P.E.I.	-47937.92	(22197)***	Semi-Detached	41782.17	(16084)***
Nova Scotia	2364.54	(18949)	Row or Terrace	-13157.92	(12338)
New Brunswick	-4815.29	(19221)	Duplex	8279.10	(16923)
Quebec	13021.78	(16277)	Apartment (Condo)	1617.26	(13913)
Ontario	114512.90	(18079)***			
Manitoba	3778.05	(18355)	Year Built		
Saskatchewan	-16383.39	(19811)	Between 46-60	-15590.75	(13609)
Alberta	50117.36	(18097)***	Between 61-70	-1220.21	(13706)
British Columbia	93296.59	(17800)***	Between 71-80	-29883.68	(12354)***
			Between 81-90	-13643.02	(12645)
Town Type/Size			After 91	6156.27	(12433)
Urban Under 100K	-60924.08	(8085)***			
Rural	-48949.34	(8921)***	Heating Equipment		
			Forced Air Furnace	-25800.64	(12292)***
Number of Rooms			Heating Stoves	-38871.64	(19329)***
Total	8676.75	(2288)***	Electric Heating	-29709.99	(12996)***
Number of Bedrooms	7417.07	(4749)*			
Number of Bathrooms	35122.15	(5710)***	Constant	31069.04	(23867)*
Sample Size		611	Adjusted R-Squared		0.52

The constant contains the same variables as in the regressions of Table 2.1. Robust standard errors in parenthesis.

***-significant at the 5% level, **-significant at the 10% level, *-significant at the 20% level.

Table A.4: Hedonic Regression Coefficients: 2002

Province			Type of House		
P.E.I.	-36046.05	(19848)***	Semi-Detached	-432.72	(17059)
Nova Scotia	6599.46	(16313)	Row or Terrace	-21461.79	(12701)**
New Brunswick	-1316.82	(17782)	Duplex	21510.99	(18364)
Quebec	6429.78	(15449)	Apartment (Condo)	-12417.08	(14762)
Ontario	80471.47	(15489)***			
Manitoba	12426.97	(16183)	Year Built		
Saskatchewan	-17748.98	(16351)	Between 46-60	2079.23	(12457)
Alberta	42854.75	(15679)***	Between 61-70	1432.65	(12969)
British Columbia	73641.75	(15328)***	Between 71-80	-9474.55	(11094)
			Between 81-90	8504.05	(11850)
Town Type/Size			After 91	38055.43	(11153)***
Urban Under 100K	-45289.07	(8146)***			
Rural	-42820.09	(8343)***	Heating Equipment		
			Forced Air Furnace	-15783.98	(12748)
Number of Rooms			Heating Stoves	-37089.71	(19790)**
Total	8324.57	(2357)***	Electric Heating	-28489.01	(13187)***
Number of Bedrooms	448.57	(5015)			
Number of Bathrooms	25423.15	(5684)***	Constant	36292.83	(21779)**
Sample Size		614	Adjusted R-Squared		0.40

The constant contains the same variables as in the regressions of Table 2.1. Robust standard errors in parenthesis.

***-significant at the 5% level, **-significant at the 10% level, *-significant at the 20% level.

Table A.5: Hedonic Regression Coefficients: 2001

Province			Type of House		
P.E.I.	-28967.65	(23264)	Semi-Detached	1909.20	(14224)
Nova Scotia	12164.42	(15714)	Row or Terrace	-32033.79	(13417)***
New Brunswick	3553.70	(16429)	Duplex	-12304.60	(18983)
Quebec	14106.39	(15560)	Apartment (Condo)	25369.08	(13712)**
Ontario	81934.58	(15860)***			
Manitoba	2922.27	(16395)	Year Built		
Saskatchewan	6895.61	(16356)	Between 46-60	-38888.09	(14621)***
Alberta	48134.38	(15874)***	Between 61-70	-37932.11	(10682)***
British Columbia	97651.15	(15522)***	Between 71-80	-40034.09	(10563)***
			Between 81-90	-45283.70	(8044)***
Town Type/Size			After 91	-32119.26	(8605)***
Urban Under 100K	-49518.04	(7864)***			
Rural	-60435.79	(8323)***	Heating Equipment		
			Forced Air Furnace	-10894.91	(11838)
Number of Rooms			Heating Stoves	-2325.12	(16308)
Total	11997.89	(2243)***	Electric Heating	-12420.98	(13042)
Number of Bedrooms	-4415.35	(4840)			
Number of Bathrooms	35872.03	(5365)***	Constant	23819.88	(21079)
Sample Size		584	Adjusted R-Squared		0.51

The constant contains the same variables as in the regressions of Table 2.1. Robust standard errors in parenthesis.

***-significant at the 5% level, **-significant at the 10% level, *-significant at the 20% level.

Table A.6: Hedonic Regression Coefficients: 2000

Province			Type of House		
P.E.I.	-25965.31	(17051)*	Semi-Detached	7350.57	(19572)
Nova Scotia	-7015.47	(12859)	Row or Terrace	-21671.01	(10061)***
New Brunswick	2143.65	(13127)	Duplex	4319.60	(15632)
Quebec	7235.06	(12637)	Apartment (Condo)	-21160.56	(12314)**
Ontario	68692.67	(12536)***			
Manitoba	4829.25	(12859)	Year Built		
Saskatchewan	1094.96	(13319)	Between 46-60	-19822.76	(11763)**
Alberta	31888.30	(12211)***	Between 61-70	-23334.02	(9313)***
British Columbia	90891.27	(12315)***	Between 71-80	-36335.39	(9242)***
			Between 81-90	-30886.76	(7308)***
Town Type/Size			After 91	-10877.17	(7925)*
Urban Under 100K	-42009.82	(6901)***			
Rural	-49437.23	(7178)***	Heating Equipment		
			Forced Air Furnace	-1301.40	(9489)
Number of Rooms			Heating Stoves	-1850.85	(16749)
Total	6902.60	(1868)***	Electric Heating	-361.95	(10710)
Number of Bedrooms	3202.51	(4230)			
Number of Bathrooms	37898.80	(5141)***	Constant	11592.77	(18562)
Sample Size		509	Adjusted R-Squared		0.53

The constant contains the same variables as in the regressions of Table 2.1. Robust standard errors in parenthesis.

***-significant at the 5% level, **-significant at the 10% level, *-significant at the 20% level.

Appendix B

Consumption Categories and Regressor Descriptions

B.1   Consumption Categories

Non-Durables

Movies.
Sports Events.
Live Arts.
Heritage Centers.
Rented and leased vehicles.
Total expenditure for gas and other fuels for owned and leased automobiles.
Total other maintenance and repair expenses for automobiles.
Total expenditure for parking costs.
Recreation vehicle operation.
Rented recreational vehicles.
Total expenditure for charitable contributions.
Total expenditure for clothing.
Total expenditure for telephone services.
Expenditure for cellular services.

Expenditure for Internet services.
Expenditure for domestic help.
Total expenditure for food.
Expenditure for rental of DVDs, video tapes, videodiscs and video games.
Expenditure for rental of audio, video, computer and communications equipment.
Total expenditure for rental of cablevision and satellite services.
Total expenditure for reading materials and other printed matter.
Expenditure for sports and athletic equipment.
Toys, electronic games and arts/hobby materials.
Total expenditure for photographic goods and services.
Total expenditure for the use of recreation facilities.
Total expenditure for tobacco products and alcoholic beverages.
Expenditure for package trips.
Total expenditure for pet expenses.

Durables

Automobile and truck purchases.
Accessories for owned vehicles.
Total expenditure for purchases of recreational vehicles.
Audio equipment.
Expenditure for televisions, VCRs, DVD players, DVD recorders, video cameras, and other television/video components.
Total expenditure for household furnishings.
Total expenditure for household equipment.
Total expenditure for computer equipment and supplies.
Expenditure for purchases of bicycles, parts and accessories.

B.2   Non-Essential Consumption Goods (Luxuries)

Live Arts.
Sports Events.
Heritage Centers.

Expenditure for domestic help, for example housekeepers, cleaners, and paid companions.

Expenditure for meals and snacks purchased from restaurants.

Total expenditure for the use of recreation facilities.

Expenditure for other cultural and recreational services, for example fishing and hunting licenses, guide services, party planning, and other rental of sports facilities.

Expenditure for package trips.

B.3 Regressor Descriptions

Variable Name	Variable Description
Children 0to4	Number of children aged 0 to 4.
Children 5to17	Number of children aged 5 to 17.
Children 18to24	Number of children aged 18 to 24.
Adults 25to64	Number of adults aged 25 to 64.
Adults 65Older	Number of adults aged 65 and older.
Number of Full Time Earners	Number of full-time earners in the household.
Number of Part Time Earners	Number of part-time earners in the household.
Head Female	The head of the household is a female (single mother).
Head (Spouse) Age	Age of the household head (spouse if applicable): 5-year intervals for ages 25-84, and dummies used for ages under 25 and over 84.
Head (Spouse) Education	Education level attained by the household head (spouse if applicable): Variable ranges from 1-8, representing 8 attainment levels in ascending order.
Head Age Squared	The head's age squared.
Couple	Husband and wife with no children and no additional persons.
Couple w Children	Couple with single children and no additional persons.
Couple w Other	Couple with additional related persons (may have children).
Lone Parent	Lone-parent household with no additional persons.
Other w Relatives	Any other household where there is a related secondary person and no unrelated secondary person, or household with spouse not married or not present.

Appendix C

Consumption Function Regression Results Using Alternate Hedonic Equation Specifications

The following four tables report estimation results using alternate HPF specifications when deriving housing capital gains. The results in Tables C.1 and C.2 are based on a distributed lag specification (for the household's adaptive expectations equation), and Tables C.3 and C.4 use a free-weight specification. The results in Tables C.1 and C.3 are derived using estimates of capital gains derived from a double-log HPF specification, and the results in Tables C.2 and C.4 are derived using estimates of capital gains derived from a single-log (i.e., log of house prices) HPF specification. A description of each regressor is contained in Appendix B.

Table C.1: Consumption Function Results: Distributed Lag (λ) - Double Log

	Total Consumption		Non-Durable Consumption	
Permanent Housing CG	0.089**	(0.011)	0.068**	(0.008)
After-Tax Income	0.269**	(0.005)	0.175**	(0.003)
Lambda	0.145*	(0.081)		
Children 0-4	-701.70**	(163.78)	-562.12**	(99.00)
Children 5-17	712.18**	(92.13)	694.49**	(54.50)
Children 18-24	709.78**	(160.50)	548.96**	(86.62)
Adults 25-64	-320.54**	(125.29)	-302.77**	(83.29)
Adults Over 65	-118.74	(159.66)	-71.47	(88.76)
Couple	2015.06**	(449.84)	628.26**	(240.66)
Couple w Children	3959.80**	(422.45)	3068.66**	(236.71)
Couple w Other	4157.46**	(583.05)	3617.28**	(324.00)
Lone Parent	2155.84**	(260.01)	2586.10**	(172.62)
Other w Relatives	2044.69**	(358.11)	2502.46**	(215.16)
Number of Full Time Earners	1284.31**	(132.44)	1136.64**	(81.19)
Number of Part Time Earners	1614.10**	(114.11)	1212.31**	(70.27)
Head Female	-1666.89**	(189.96)	-617.55**	(113.62)
Head Age	812.53**	(101.71)	870.03**	(55.90)
Head Education	167.34**	(34.35)	220.55**	(19.23)
Spouse Age	65.41	(43.88)	172.60**	(24.34)
Spouse Education	108.25**	(38.93)	191.60**	(23.15)
Head Age Squared	-76.28**	(5.90)	-67.31**	(3.27)
2005	535.82**	(177.67)	449.69**	(128.84)
2004	-248.37	(174.83)	-88.91	(117.07)
Constant	5854.87**	(512.81)	3419.21**	(282.20)

The weight structure estimated for total consumption is used for non-durable consumption. Bootstrap standard errors in parenthesis. **-significant at the 5% level, *-significant at the 10% level. All nominal variables are converted into $2006 Cdn.

Table C.2: Consumption Function Results: Distributed Lag (λ) - Single Log

	Total Consumption		Non-Durable Consumption	
Permanent Housing CG	0.090**	(0.011)	0.068**	(0.008)
After-Tax Income	0.268**	(0.006)	0.175**	(0.004)
Lambda	0.160*	(0.087)		
Children 0-4	-696.54**	(176.98)	-557.90**	(105.40)
Children 5-17	709.90**	(93.66)	693.63**	(53.27)
Children 18-24	708.76**	(157.95)	549.35**	(99.93)
Adults 25-64	-317.10**	(131.55)	-300.00**	(79.58)
Adults Over 65	-120.74	(145.43)	-71.62	(93.15)
Couple	2031.27**	(446.31)	634.43**	(259.27)
Couple w Children	3981.54**	(413.83)	3081.01**	(258.80)
Couple w Other	4170.47**	(525.95)	3625.50**	(322.15)
Lone Parent	2168.24**	(265.24)	2597.30**	(161.07)
Other w Relatives	2063.67**	(393.17)	2515.81**	(228.54)
Number of Full Time Earners	1287.37**	(151.82)	1138.95**	(84.74)
Number of Part Time Earners	1611.32**	(118.35)	1209.27**	(71.13)
Head Female	-1665.81**	(197.47)	-622.91**	(116.23)
Head Age	810.93**	(100.11)	869.30**	(59.09)
Head Education	166.32**	(29.07)	220.35**	(19.61)
Spouse Age	64.84	(41.38)	171.99**	(24.52)
Spouse Education	107.08**	(39.12)	191.04**	(25.78)
Head Age Squared	-76.06**	(5.93)	-67.17**	(3.64)
2005	591.12**	(193.30)	489.08**	(129.96)
2004	-183.87	(183.28)	-42.31	(123.08)
Constant	5822.61**	(501.96)	3401.42**	(276.68)

The weight structure estimated for total consumption is used for non-durable consumption. Bootstrap standard errors in parenthesis. **-significant at the 5% level, *-significant at the 10% level. All nominal variables are converted into $2006 Cdn.

Table C.3: Consumption Function Results: Free Weights - Double Log

	Total Consumption		Non-Durable Consumption	
Permanent Housing CG	0.097**	(0.012)	0.071**	(0.009)
After-Tax Income	0.268**	(0.005)	0.175**	(0.003)
Free Weight Contemporary	0.257			
Free Weight 1st Lag	0.348**	(0.040)		
Free Weight 2nd Lag	0.292**	(0.038)		
Free Weight 3rd Lag	0.103**	(0.047)		
Children 0-4	-687.79**	(164.19)	-550.48**	(99.29)
Children 5-17	726.03**	(92.02)	707.21**	(54.17)
Children 18-24	725.05**	(159.94)	563.53**	(87.26)
Adults 25-64	-289.90**	(125.25)	-279.08**	(82.77)
Adults Over 65	-110.34	(159.98)	-61.25	(88.63)
Couple	1998.65**	(451.10)	610.96**	(241.95)
Couple w Children	3907.66**	(423.64)	3028.28**	(237.66)
Couple w Other	4096.64**	(582.73)	3576.81**	(324.28)
Lone Parent	2125.46**	(262.19)	2565.63**	(172.67)
Other w Relatives	2005.68**	(359.18)	2474.98**	(215.76)
Number of Full Time Earners	1297.58**	(131.15)	1146.12**	(81.48)
Number of Part Time Earners	1628.86**	(113.90)	1221.59**	(70.19)
Head Female	-1670.52**	(189.79)	-619.16**	(114.20)
Head Age	801.50**	(102.70)	862.56**	(55.94)
Head Education	164.19**	(34.59)	219.97**	(19.48)
Spouse Age	65.45**	(43.99)	173.09**	(24.34)
Spouse Education	104.93**	(38.57)	189.84**	(23.22)
Head Age Squared	-75.33**	(5.94)	-66.67**	(3.27)
2005	503.18**	(160.33)	423.75**	(113.36)
2004	-383.37	(181.11)	-191.11	(119.10)
Constant	5864.30**	(520.43)	3428.97**	(284.12)

The weight structure estimated for total consumption is used for non-durable consumption. The contemporary weight is set equal to one minus the other three weights, it is not estimated separately. Bootstrap standard errors in parenthesis. **-significant at the 5% level. All nominal variables are converted into $2006 Cdn.

Table C.4: Consumption Function Results: Free Weights - Single Log

	Total Consumption		Non-Durable Consumption	
Permanent Housing CG	0.099**	(0.012)	0.071**	(0.009)
After-Tax Income	0.268**	(0.006)	0.175**	(0.004)
Free Weight Contemporary	0.264			
Free Weight 1st Lag	0.356**	(0.047)		
Free Weight 2nd Lag	0.290**	(0.043)		
Free Weight 3rd Lag	0.090*	(0.054)		
Children 0-4	-679.42**	(177.56)	-544.29**	(98.81)
Children 5-17	726.50**	(94.61)	708.13**	(53.74)
Children 18-24	724.91**	(158.12)	564.23**	(92.37)
Adults 25-64	-281.67**	(132.72)	-273.29**	(76.47)
Adults Over 65	-111.60	(144.67)	-61.15	(92.53)
Couple	2016.67**	(447.64)	618.95**	(261.34)
Couple w Children	3925.51**	(413.69)	3038.27**	(256.46)
Couple w Other	4099.20**	(526.56)	3577.87**	(327.02)
Lone Parent	2135.10**	(265.61)	2574.80**	(163.77)
Other w Relatives	2018.97**	(389.79)	2484.08**	(217.19)
Number of Full Time Earners	1300.58**	(151.61)	1148.23**	(90.27)
Number of Part Time Earners	1627.98**	(118.84)	1219.98**	(65.97)
Head Female	-1666.77**	(197.76)	-622.57**	(116.60)
Head Age	796.88**	(101.24)	859.76**	(55.18)
Head Education	162.14**	(28.86)	218.98**	(18.53)
Spouse Age	64.85	(41.49)	172.42**	(25.78)
Spouse Education	102.68**	(39.36)	188.51**	(22.63)
Head Age Squared	-74.89**	(6.01)	-66.37**	(3.17)
2005	555.43**	(184.47)	459.89**	(113.68)
2004	-334.42*	(195.83)	-156.09	(132.64)
Constant	5837.26**	(499.87)	3415.13**	(302.13)

The weight structure estimated for total consumption is used for non-durable consumption. The contemporary weight is set equal to one minus the other three weights, it is not estimated separately. Bootstrap standard errors in parenthesis. **-significant at the 5% level, *-significant at the 10% level. All nominal variables are converted into $2006 Cdn.

Appendix D

Accrual Equivalent Capital Gains Tax Rate

The AECGTR is calculated based on the assumption that after-tax dividend income is reinvested in the firm. If we denote the stock's intrinsic value by X, the dividend tax rate by τ_d, the tax rate on realized capital gains by τ_g, the AECGTR by τ_a, the rate of return from dividends as d, and the rate of return from capital gains as r, then the after-tax value of equity using a realization based tax system (τ_g) is

$$
\begin{aligned}
ATV_H^{\tau_g} &= (1-\tau_g)X[(1+r+(1-\tau_d)d)^H - 1 - (1-\tau_d)d\sum_{h=0}^{H-1}(1+r+(1-\tau_d)d)^h] \\
&\quad + X[1+(1-\tau_d)d\sum_{h=0}^{H-1}(1+r+(1-\tau_d)d)^h].
\end{aligned}
$$

This equation is derived in Appendix E. The after-tax value of equity using an accrual based tax system (τ_a) is

$$
ATV_H^{\tau_a} = X(1+(1-\tau_\alpha)r+(1-\tau_d)d)^H.
$$

Equating the after-tax value from both taxation schemes, and solving for τ_a yields

$$\tau_a\big(\tau_m, \tau_g, r, d, H\big) = \frac{(1+r+(1-\tau_d)d)}{r} - \frac{((1-\tau_g)(1+r+(1-\tau_d)d)^H+\tau_g(1+(1-\tau_d)d\cdot SUM))^{\frac{1}{H}}}{r},$$

where

$$SUM = \sum_{h=0}^{H-1}(1+r+(1-\tau_d)d)^h.$$

Appendix E

Derivation of the Lock-In Cost Function

The lock-in cost function is calculated based on the assumption that after-tax dividend income is reinvested in the firm. If we denote the stock's intrinsic value by X, the dividend tax rate by τ_d, the tax rate on realized capital gains by τ_g, the rate of return from dividends by d, the rate of return from capital gains by r, the ratio of tax base to market value by α, and the desired holding period by H, then the future after-tax value of equity (ATV) with respect to investor type (α, H) after H years is

$$
\begin{aligned}
ATV(\alpha, H) \quad = \quad & (1 - \tau_g)X[(1 + r + (1 - \tau_d)d)^H - \alpha - (1 - \tau_d)d \sum_{h=0}^{H-1} (1 + r + (1 - \tau_d)d)^h] \\
& + X[\alpha + (1 - \tau_d)d \sum_{h=0}^{H-1} (1 + r + (1 - \tau_d)d)^h].
\end{aligned}
$$

To see this, note that when H is equal to 1 the following is true about the stock's market value (MV), tax base (B), capital gain (CG), and future after-tax value after one year:

$$MV(\alpha, 1) = X(1 + r + (1 - \tau_d)d),$$

$$B(\alpha, 1) = X[\alpha + (1 - \tau_d)d],$$

$$CG(\alpha, 1) = MV(\alpha, 1) - B(\alpha, 1) = X[(1 + r + (1 - \tau_d)d) - \alpha - (1 - \tau_d)d],$$

$$ATV(\alpha, 1) = (1 - \tau_g)X[(1 + r + (1 - \tau_d)d) - \alpha - (1 - \tau_d)d] + X[\alpha + (1 - \tau_d)d].$$

Note: the equation for MV assumes that the after-tax dividend payment is reinvested prior to the stock's sale.

When H is equal to 2, the following is true about the stock's market value, tax base, capital gain, and future after-tax value after two years:

$$MV(\alpha, 2) = X(1 + r + (1 - \tau_d)d)^2,$$

$$B(\alpha, 2) = X[\alpha + (1 - \tau_d)d + (1 - \tau_d)d(1 + r + (1 - \tau_d)d)],$$

$$CG(\alpha, 2) = MV(\alpha, 2) - B(\alpha, 2) = X[(1 + r + (1 - \tau_d)d)^2 - \alpha - (1 - \tau_d)d - (1 - \tau_d)d(1 + r + (1 - \tau_d)d)],$$

$$\begin{aligned} ATV(\alpha, 2) \;=\; & (1 - \tau_g)X[(1 + r + (1 - \tau_d)d)^2 - \alpha - (1 - \tau_d)d - (1 - \tau_d)d(1 + r + (1 - \tau_d)d)] \\ & + X[\alpha + (1 - \tau_d)d + (1 - \tau_d)d(1 + r + (1 - \tau_d)d)]. \end{aligned}$$

Continuing this process produces the general formula above for $ATV(H)$.

When a company repurchases stock from investor type (α, H) for the amount Y, the investor realizes the capital gain and pays the capital gains tax. The net amount remaining for reinvestment (NR), after paying the capital gains tax, is

$$NR(\alpha, H) = (1 - \tau_g)[Y - \alpha X] + \alpha X,$$

and the future after tax value of this new position (ATV^Y), after H years is

$$
\begin{aligned}
ATV^Y(\alpha, H) &= (1 - \tau_g)NR(\alpha, H)[(1 + r + (1 - \tau_d)d)^H - 1 - (1 - \tau_d)d \sum_{h=0}^{H-1}(1 + r + (1 - \tau_d)d)^h] \\
&\quad + NR(\alpha, H)[1 + (1 - \tau_d)d \sum_{h=0}^{H-1}(1 + r + (1 - \tau_d)d)^h].
\end{aligned}
$$

Notice that α is replaced by 1 in this equation, since the tax base just after reinvestment is equal to the market value of the new position just after reinvestment (the capital gain was realized). Also, notice that the starting value of the new position is $NR(\alpha, H)$, instead of X.

The lock-in cost $(L(\alpha, H) = Y - X)$ is the remuneration above the stock's intrinsic value X such that an investor type (α, H) would be indifferent between selling equity back to the firm for Y and holding it for the desired number of years. Therefore, Y solves the following equation:

$$ATV^y(\alpha, H) = ATV(\alpha, H).$$

$$\Rightarrow (1 - \tau_g)[(1 - \tau_g)[Y - \alpha X] + \alpha X] \cdot [\delta - 1 - \omega] + [(1 - \tau_g)[Y - \alpha X] \cdot [1 + \omega] =$$

$$(1 - \tau_g)X[\delta - \alpha - \omega] + X[\alpha + \omega],$$

such that

$\delta = (1 + r + (1 - \tau_d)d)^H,$

$\omega = (1 - \tau_d)d \sum_{h=0}^{H-1}(1 + r + (1 - \tau_d)d)^h.$

This equation can be rewritten as follows:

$$(1 - \tau_g)^2 Y[\delta - 1 - \omega] + (1 - \tau_g)Y[1 + \omega] =$$

$$= (1 - \tau_g)X[\delta - \omega] + X\omega + \tau_g\alpha X - \{(1 - \tau_g)\tau_g\alpha X[\delta - \omega] + \alpha\tau_g X\omega - \tau_g^2\alpha X\} =$$

$$= (1 - \alpha\tau_g)\{(1 - \tau_g)X\delta + \tau_g X\omega\} + \alpha X\tau_g(1 - \tau_g).$$

$$\Rightarrow Y = \frac{(1 - \alpha\tau_g)\{(1 - \tau_g)X\delta + \tau_g X\omega\} + \alpha X\tau_g(1 - \tau_g)}{(1 - \tau_g)\{(1 - \tau_g)\delta + \tau_g\omega\} + \tau_g(1 - \tau_g)},$$

and solving for $L(\alpha, H)$ gives us

$$L(\alpha, H) = X \left\{ \frac{(1-\alpha\tau_g)\{(1-\tau_g)\Omega(H)+\tau_g(1-\tau_d)d\cdot\sum_{h=0}^{H-1}\Omega(h)\}+\alpha\tau_g(1-\tau_g)}{(1-\tau_g)\{(1-\tau_g)\Omega(H)+\tau_g(1-\tau_d)d\cdot\sum_{h=0}^{H-1}\Omega(h)\}+\tau_g(1-\tau_g)} - 1 \right\},$$

$$s.t. \ \ \Omega(v) = (1 + r + (1 - \tau_d)d)^v.$$

Appendix F

Lock-In Cost Function

Derivatives

The lock-in cost function is

$$L(\alpha, H) = X\{\frac{(1-\alpha\tau_g)\{(1-\tau_g)(1+r+(1-\tau_d)d)^H+\tau_g(1-\tau_d)d\cdot SUM\}+\alpha\tau_g(1-\tau_g)}{(1-\tau_g)\{(1-\tau_g)(1+r+(1-\tau_d)d)^H+\tau_g(1-\tau_d)d\cdot SUM\}+\tau_g(1-\tau_g)} - 1\},$$

where

$$SUM = \sum_{h=0}^{H-1}(1+r+(1-\tau_d)d)^h.$$

Define: $l(\alpha, H) = \frac{(1-\alpha\tau_g)\{(1-\tau_g)(1+r+(1-\tau_d)d)^H+\tau_g(1-\tau_d)d\cdot SUM\}+\alpha\tau_g(1-\tau_g)}{(1-\tau_g)\{(1-\tau_g)(1+r+(1-\tau_d)d)^H+\tau_g(1-\tau_d)d\cdot SUM\}+\tau_g(1-\tau_g)}$

F.1 The Derivative of the Lock-In Cost Function with Respect to α

Note that:

$$\frac{\partial L(\alpha, H)}{\partial \alpha} \cdot \frac{1}{X} = \frac{\partial l(\alpha, H)}{\partial \alpha} = \frac{[\gamma \cdot \theta - \eta \cdot \lambda]}{\theta^2},$$

where

$$\lambda = (1 - \alpha \tau_g)\{(1 - \tau_g)(1 + r + (1 - \tau_d)d)^H + \tau_g(1 - \tau_d)d \cdot SUM\} + \alpha \tau_g(1 - \tau_g),$$

$$\gamma = -\tau_g\{(1 - \tau_g)(1 + r + (1 - \tau_d)d)^H + \tau_g(1 - \tau_d)d \cdot SUM\} + \tau_g(1 - \tau_g),$$

$$\theta = (1 - \tau_g)\{(1 - \tau_g)(1 + r + (1 - \tau_d)d)^H + \tau_g(1 - \tau_d)d \cdot SUM\} + \tau_g(1 - \tau_g),$$

$$\eta = 0.$$

The denominator of this expression is positive; to show $\frac{\partial L(\alpha, H)}{\partial \alpha}$ is negative we must show the numerator is also negative.

The numerator is

$$[-\tau_g(\psi) + \tau_g(1 - \tau_g)] \cdot [(1 - \tau_g)(\psi) + \tau_g(1 - \tau_g)],$$

where $\psi = (1 - \tau_g)(1 + r + (1 - \tau_d)d)^H + \tau_g(1 - \tau_d)d \cdot SUM$.

Expanding this expression and collecting like terms gives us the following

$$\tau_g(1 - \tau_g)(1 - 2\tau_g)(\psi) - \tau_g(1 - \tau_g)(\psi)^2 + \tau_g^2(1 - \tau_g)^2,$$

$$\Rightarrow \tau_g(1-\tau_g)(\psi)[(1-2\tau_g) - \psi] + \tau_g^2(1-\tau_g)^2.$$

Note:

$$(1-2\tau_g) - \psi = (1-2\tau_g) - (1-\tau_g)(1+r+(1-\tau_d)d)^H - \tau_g(1-\tau_d)d \cdot SUM <$$

$$< (1-2\tau_g) - (1-\tau_g)(1+r+(1-\tau_d)d)^H \leq (1-2\tau_g) - (1-\tau_g) = -\tau_g.$$

Therefore

$$\tau_g(1-\tau_g)(\psi)[(1-2\tau_g) - \psi] < -\tau_g^2(1-\tau_g)(\psi) =$$

$$= -\tau_g^2(1-\tau_g)[(1-\tau_g)(1+r+(1-\tau_d)d)^H + \tau_g(1-\tau_d)d \cdot SUM] < -\tau_g^2(1-\tau_g)^2.$$

Which shows that

$$\tau_g(1-\tau_g)(1-2\tau_g)(\psi) - \tau_g(1-\tau_g)(\psi)^2 + \tau_g^2(1-\tau_g)^2 < 0,$$

and thus, $\frac{\partial L(\alpha,H)}{\partial \alpha}$ is negative.

F.2 The Change in the Lock-In Cost Function with Respect to H

Note that:

$$\frac{L(\alpha,H) - L(\alpha,H-1)}{X} = \frac{(1-\alpha\tau_g)\vartheta(H) + \alpha\tau_g(1-\tau_g)}{(1-\tau_g)\vartheta(H) + \tau_g(1-\tau_g)} - \frac{(1-\alpha\tau_g)\vartheta(H-1) + \alpha\tau_g(1-\tau_g)}{(1-\tau_g)\vartheta(H-1) + \tau_g(1-\tau_g)},$$

where

$$\vartheta(H) = (1 - \tau_g)(1 + r + (1 - \tau_d)d)^H + \tau_g(1 - \tau_d)d \cdot SUM(H),$$

$$\vartheta(H - 1) = (1 - \tau_g)(1 + r + (1 - \tau_d)d)^{(H-1)} + \tau_g(1 - \tau_d)d \cdot SUM(H - 1),$$

$$SUM(H) = \sum_{h=0}^{H-1}(1 + r + (1 - \tau_d)d)^h,$$

$$SUM(H - 1) = \sum_{h=0}^{H-2}(1 + r + (1 - \tau_d)d)^h.$$

Note that $\vartheta(H) > \vartheta(H - 1)$.

Finding a common denominator and cancelling like terms gives us

$$\frac{[\alpha\tau_g(1-\tau_g)^2\vartheta(H-1)+(1-\alpha\tau_g)\tau_g(1-\tau_g)\vartheta(H)]-[\alpha\tau_g(1-\tau_g)^2\vartheta(H)+(1-\alpha\tau_g)\tau_g(1-\tau_g)\vartheta(H-1)]}{[(1-\tau_g)\vartheta(H)+\tau_g(1-\tau_g)]\cdot[(1-\tau_g)\vartheta(H-1)+\tau_g(1-\tau_g)]}.$$

The denominator of this expression is the product of two positive terms and is therefore positive. To show the lock-in cost function increases in H, we must show the numerator is also positive. The numerator can be rearranged as follows

$$[\alpha\tau_g(1 - \tau_g)^2 - (1 - \alpha\tau_g)\tau_g(1 - \tau_g)] \cdot [\vartheta(H - 1) - \vartheta(H)].$$

Since $(1-\alpha\tau_g) > (1-\tau_g)$, and $\tau_g > \alpha\tau_g$, both terms in the numerator are negative, and therefore the lock-in cost function is increasing in H.

F.3   The Derivative of $l(\alpha, H)$ with Respect to τ_d

Note that:

$$\frac{\partial l(\alpha, H)}{\partial \tau_d} = \frac{\gamma \cdot \theta - \eta \cdot \lambda}{\theta^2},$$

where

$$\lambda = (1 - \alpha\tau_g)\{(1 - \tau_g)(1 + r + (1 - \tau_d)d)^H + \tau_g(1 - \tau_d)d \cdot SUM\} + \alpha\tau_g(1 - \tau_g),$$

$$\gamma = (1 - \alpha\tau_g)\{-(1 - \tau_g) \cdot H \cdot (1 + r + (1 - \tau_d)d)^{H-1} \cdot d - \tau_g \cdot d \cdot SUM + \tau_g \cdot d \cdot (1 - \tau_d) \cdot SUM'\},$$

$$\theta = (1 - \tau_g)\{(1 - \tau_g)(1 + r + (1 - \tau_d)d)^H + \tau_g(1 - \tau_d)d \cdot SUM\} + \tau_g(1 - \tau_g),$$

$$\eta = (1 - \tau_g)\{-(1 - \tau_g) \cdot H \cdot (1 + r + (1 - \tau_d)d)^{H-1} \cdot d - \tau_g \cdot d \cdot SUM + \tau_g \cdot d \cdot (1 - \tau_d) \cdot SUM'\},$$

$$SUM' = \sum_{h=0}^{H-1} -d \cdot (h)(1 + r + (1 - \tau_d)d)^{(h-1)}.$$

The denominator of this expression is positive; to show $\frac{\partial l(\alpha, H)}{\partial \tau_d}$ is zero (when $d = 0$) we must show the numerator is also zero.

The numerator is

$$(1 - \alpha\tau_g)(\delta) \cdot \{(1 - \tau_g)(\psi) + \tau_g(1 - \tau_g)\} - (1 - \tau_g)(\delta) \cdot \{(1 - \alpha\tau_g)(\psi) + \alpha\tau_g(1 - \tau_g)\},$$

where, $\psi = (1 - \tau_g)(1 + r + (1 - \tau_d)d)^H + \tau_g(1 - \tau_d)d \cdot SUM,$

and $\delta = -d(1 - \tau_g)H(1 + r + (1 - \tau_d)d)^{(H-1)} - \tau_g d \cdot SUM + \tau_g d(1 - \tau_d) \cdot SUM'.$

After expanding this expression and cancelling terms we are left with

$$(1 - \alpha)(1 - \tau_g)\tau_g\delta.$$

Each of these terms is positive other than δ, which is zero when $d = 0$. To see this note that when $d = 0$ all three terms of δ are zero, and therefore $\frac{\partial l(\alpha, H)}{\partial \tau_d}$ is zero.

Appendix G

Derivation of Each Repurchase Function Using the Equity Supply Curve

Recall the equity supply curve

$$S(q) = X + \widehat{L(q)},$$

$$where \quad q = \sum_{H=0}^{H_M} \int_{\{(\alpha, H) | L(\alpha, H) \leq \widehat{L(q)}\}} f(\alpha, H) d\alpha.$$
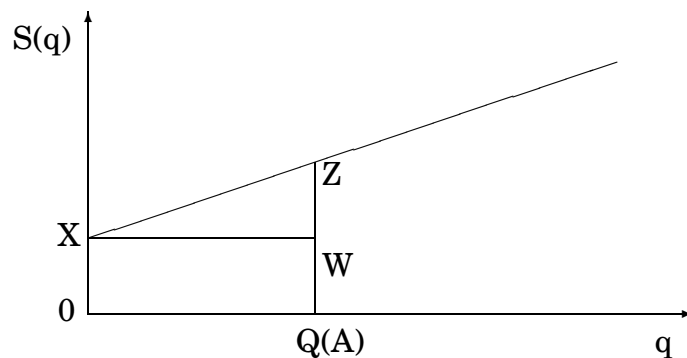
G.1   The Weak Repurchase Function

The weak repurchase function is characterized as follows

$$R(A) = X \cdot Q(A),$$

$$where \quad A = \int_0^{Q(A)} S(q)dq.$$

That is, the repurchase function is equal to the intrinsic value of the shares repurchased ($X \cdot Q(A)$), where the number of shares repurchased ($Q(A)$) is such that the integral below the supply curve from zero to the number of shares repurchased equals the amount spent. Graphically, this repurchase function can be represented as follows (note: S(q) is not necessarily linear)

where A is equal to the area (0, X, Z, Q(A)), and R(A) is equal to X·Q(A). The aggregate lock-in premium in this case is the area (X, Z, W).

G.2   The Strong Repurchase Function

The strong repurchase function is characterized as follows

$$R(A) = X \cdot Q(A),$$

$$where \quad A = S(Q(A)) \cdot Q(A).$$

That is, the repurchase function is equal to the intrinsic value of the shares repurchased ($X \cdot Q(A)$), such that the amount spent repurchasing shares (A) is equal to the product of the quantity of shares repurchased ($Q(A)$) and the largest lock-in cost among the repurchased shares ($S(Q(A))$). Graphically, this repurchase function can be represented as follows
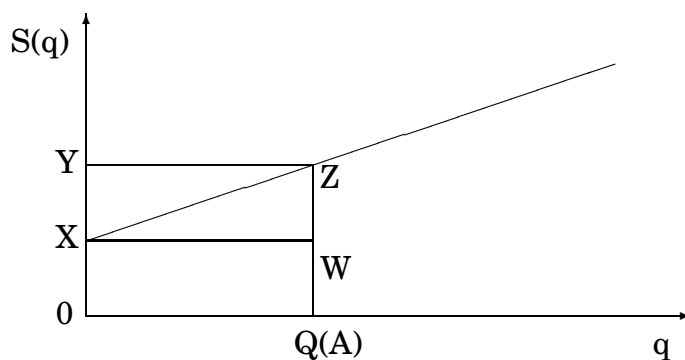
where A is equal to the area (0, Y, Z, Q(A)), and R(A) is equal to X·Q(A). The aggregate lock-in premium in this case is the area (X, Y, Z, W).

Appendix H

Properties of Each Repurchase Function

H.1   The Weak Repurchase Function is Everywhere Concave

The weak repurchase function is

$$R(A) = max_{\{\alpha(H)\}} \left[\sum_{H=0}^{H_M} \int_{\alpha(H)}^{1} f(\alpha, H) \, d\alpha \right] X$$

$$S.T. \quad \sum_{H=0}^{H_M} \int_{\alpha(H)}^{1} [X + L(\alpha, H)] \cdot f(\alpha, H) \, d\alpha = A.$$

where X is the equilibrium intrinsic value of firm equity. We can take the inverse of this function (amount spent given an amount repurchased), which is

$$A(R) = min_{\{\alpha(H)\}} \sum_{H=0}^{H_M} \int_{\alpha(H)}^{1} [L(\alpha, H) + X] \cdot f(\alpha, H) \, d\alpha$$

$$S.T. \quad R = \left[\sum_{H=0}^{H_M} \int_{\alpha(H)}^{1} f(\alpha, H) \, d\alpha \right] X,$$

$$\Rightarrow R = \sum_{H=0}^{H_M} [F(1, H) - F(\alpha(H), H)] X,$$

$$\Rightarrow \frac{\partial R}{\partial \alpha(H)} = -f(\alpha(H), H) X.$$

As R increases, at least one of the $\alpha(H) > 0$ must decrease. Without loss of generality, suppose an increase in R is made through $\alpha(H^*) > 0$, then

$$\frac{\partial \alpha(H^*)}{\partial R} = \frac{-1}{f(\alpha(H^*), H^*) X}.$$

The change in A(R) given a change in $\alpha(H^*)$ is

$$\frac{\partial A(R)}{\partial \alpha(H^*)} - l(\alpha(H^*), H^*) \cdot f(\alpha(H^*), H^*) X, {}^{[1]}$$

$$\Rightarrow \frac{\partial A(R)}{\partial R} = l(\alpha(H^*), H^*).$$

This implies that A(R) is an increasing function of R (when the increase is made through $\alpha(H^*)$). The derivative of this function with respect to $\alpha(H^*)$ is

$$\frac{\partial \partial A(R)}{\partial R \partial \alpha(H^*)} = \frac{\partial l(\alpha(H^*), H^*)}{\partial \alpha(H^*)} < 0$$

(See above for a proof that $\frac{\partial l(\alpha(H^*), H^*)}{\partial \alpha(H^*)} < 0$).

$$\Rightarrow \frac{\partial \partial A(R)}{\partial R \partial R} = -\frac{\partial l(\alpha(H^*), H^*)}{\partial \alpha(H^*)} \cdot \frac{1}{f(\alpha(H^*), H^*) X} > 0.$$

Therefore, the function A(R) is convex in R using any $\alpha(H) > 0$ to expand the set of repurchased shares. Therefore the inverse of this function (R(A)) is concave.

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[1] Where $l(\alpha(H^*), H^*)$ is defined in Appendix F.

H.2 The Strong Repurchase Function is Everywhere Below the Weak Repurchase Function

The strong repurchase function is

$$R(A) = max_{\{\alpha(H)\}} \left[\sum_{H=0}^{H_M} \int_{\alpha(H)}^{1} f(\alpha, H) \, d\alpha \right] X$$

$$S.T. \quad [max_{\{H\}} L(\alpha(H), H) + X] \cdot \sum_{H=0}^{H_M} \int_{\alpha(H)}^{1} f(\alpha, H) \, d\alpha = A.$$

We can take the inverse of this function (amount spent given an amount repurchased), which is

$$A(R) = min_{\{\alpha(H)\}} \{ [max_{\{H\}} L(\alpha(H), H) + X] \cdot \sum_{H=0}^{H_M} \int_{\alpha(H)}^{1} f(\alpha, H) \, d\alpha \}$$

$$S.T. \quad R = \left[\sum_{H=0}^{H_M} \int_{\alpha(H)}^{1} f(\alpha, H) \, d\alpha \right] X$$

Recall from the main text that firms repurchase from the pool of shareholders with the lowest lock-in effects regardless of shareholder tendering behaviour. Therefore, for any amount repurchased (R), the $\alpha(H)s$ are the same for both the weak amount spent function and the strong amount spent function for a given value of X. Subtracting the weak amount spent function (denoted by $A(R)^{weak}$) from the strong amount spent function (denoted by $A(R)^{strong}$), for a given R, results in

$$A(R)^{strong} - A(R)^{weak} = \sum_{H=0}^{H_M} \int_{\alpha(H)}^{1} \{ [max_{\{H\}} l(\alpha(H), H)] - l(\alpha, H) \} \cdot f(\alpha, H) \, d\alpha,$$

where the $\alpha(H)s$ are the solutions to both minimization problems.

Since $[max_{\{H\}}\, l(\alpha(H), H)] - l(\alpha, H) > 0$ for all $\alpha > \alpha(H)$ and all H, the above expression is an integral over two positive functions, which is itself positive. This shows that for any amount repurchased the amount spent must be higher, or conversely, for any amount spent the amount repurchased must be lower for a given X.[2] This shows that the strong repurchase function is everywhere below the weak repurchase function.

H.3   Change in the Repurchase Function Derivative with Respect to a Change in τ_d

The weak repurchase function is

$$R(A) = max_{\{\alpha(H)\}} \left[\sum_{H=0}^{H_M} \int_{\alpha(H)}^{1} f(\alpha, H)\, d\alpha \right] X$$

$$S.T. \quad \sum_{H=0}^{H_M} \int_{\alpha(H)}^{1} [X + L(\alpha, H)] \cdot f(\alpha, H)\, d\alpha = A.$$

The strong repurchase function is

$$R(A) = max_{\{\alpha(H)\}} \left[\sum_{H=0}^{H_M} \int_{\alpha(H)}^{1} f(\alpha, H)\, d\alpha \right] X$$

$$S.T. \quad [max_{\{H\}}\, L(\alpha(H), H) + X] \cdot \sum_{H=0}^{H_M} \int_{\alpha(H)}^{1} f(\alpha, H)\, d\alpha = A.$$

Derivative of the weak repurchase function: when A increases at least one of the $\alpha(H)s$ must decrease. Suppose that $\alpha(H^*)$ decreases, then

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[2]This result will also hold when the firm's value is lower when if faces a SRF vs. a WRF, all else equal.

$$\frac{\partial A}{\partial \alpha(H^*)} = -l(\alpha(H^*), H^*) \cdot f(\alpha(H^*), H^*)X,$$

and

$$\frac{\partial R(A)^{weak}}{\partial \alpha(H^*)} = -f(\alpha(H^*), H^*)X,$$

$$\Rightarrow \frac{\partial R(A)^{weak}}{\partial A} = \frac{1}{l(\alpha(H^*), H^*)}.$$

Derivative of the strong repurchase function: when A increases at least one of the $\alpha(H)s$ must decrease. Suppose that $\alpha(H^*)$ decreases, then

$$\frac{\partial A}{\partial \alpha(H^*)} = \frac{\partial l(\alpha(H^*), H^*)X}{\partial \alpha(H^*)} \cdot \sum_{H=0}^{H_M} \int_{\alpha(H)}^{1} f(\alpha, H)d\alpha - [l(\alpha(H^*), H^*) \cdot f(\alpha(H^*), H^*)X],$$

and since

$$\frac{\partial R(A)^{strong}}{\partial \alpha(H^*)} = -f(\alpha(H^*), H^*)X,$$

$$\Rightarrow \frac{\partial R(A)^{strong}}{\partial A} = \frac{-f(\alpha(H^*),H^*)}{\frac{\partial l(\alpha(H^*),H^*)}{\partial \alpha(H^*)} \cdot \sum_{H=0}^{H_M} \int_{\alpha(H)}^{1} f(\alpha,H)d\alpha - [l(\alpha(H^*),H^*) \cdot f(\alpha(H^*),H^*)]}.$$

Now we look at the change in $\frac{\partial R(A)}{\partial A}$ for both the weak and strong repurchase functions when τ_d changes.

Weak repurchase function:

$$\frac{\partial \partial R(A)^{weak}}{\partial A \partial \tau_d} = \frac{-\frac{\partial l(\alpha(H^*),H^*)}{\tau_d}}{l(\alpha(H^*), H^*)^2}.$$

It has been shown that $\frac{\partial l(\alpha(H^*),H^*)}{\tau_d}$ is zero when $d = 0$, therefore when $d = 0$ the numerator is zero. Since $l(\alpha(H^*), H^*)^2$ is positive $\frac{\partial \partial R(A)}{\partial A \partial \tau_d}$ is zero.

Strong repurchase function:

$$\frac{\partial\partial R(A)^{strong}}{\partial A\partial\tau_d} = \frac{f(\alpha(H^*),H^*)\cdot\{\frac{\partial\partial l(\alpha(H^*),H^*)}{\partial\alpha(H^*)\partial\tau_d}\cdot\sum_{H=0}^{H_M}\int_{\alpha(H)}^1 f(\alpha,H)d\alpha - \frac{\partial l(\alpha(H^*),H^*)}{\partial\tau_d}\cdot f(\alpha(H^*),H^*)\}}{DEN^2},$$

where $DEN = \frac{\partial l(\alpha(H^*),H^*)}{\partial\alpha(H^*)}\cdot\sum_{H=0}^{H_M}\int_{\alpha(H)}^1 f(\alpha,H)d\alpha - l(\alpha(H^*),H^*)\cdot f(\alpha(H^*),H^*).$

With regard to the numerator of this expression, $f(\alpha(H^*),H^*)$ is positive, $\frac{\partial\partial l(\alpha(H^*),H^*)}{\partial\alpha(H^*)\partial\tau_d}$ is zero when $d = 0$ (as shown below), $\sum_{H=0}^{H_M}\int_{\alpha(H)}^1 f(\alpha,H)d\alpha$ is positive, $\frac{\partial l(\alpha(H^*),H^*)}{\partial\tau_d}$ is zero when $d = 0$, and $f(\alpha(H^*),H^*)$ is positive. Therefore the numerator is zero when $d = 0$. The denominator (DEN^2) is positive, and therefore $\frac{\partial\partial R(A)^{strong}}{\partial A\partial\tau_d}$ is zero when $d = 0$.

Proof that $\frac{\partial\partial l(\alpha(H^*),H^*)}{\partial\alpha(H^*)\partial\tau_d}$ is zero when $d = 0$.

$$\frac{\partial l(\alpha(H^*),H^*)}{\partial\alpha(H^*)} = \frac{\tau_g(1-\tau_g)(1-2\tau_g)\psi - \tau_g(1-\tau_g)\psi^2 + \tau_g^2(1-\tau_g)^2}{((1-\tau_g)\{(1-\tau_g)(1+r+(1-\tau_d)d)^H + \tau_g(1-\tau_d)d\cdot SUM\} + \tau_g(1-\tau_g))^2},$$

from above, where

$$\psi = (1-\tau_g)(1+r+(1-\tau_d)d)^H + \tau_g(1-\tau_d)d\cdot SUM,$$

$$SUM = \sum_{h=0}^{H-1}(1+r+(1-\tau_d)d)^h.$$

Thus $\frac{\partial\partial l(\alpha(H^*),H^*)}{\partial\alpha(H^*)\partial\tau_d} = \frac{NUM'\cdot DEN - 2\cdot DEN'\cdot NUM}{DEN^3},$

where

$$NUM = \tau_g(1-\tau_g)(1-2\tau_g)\psi - \tau_g(1-\tau_g)\psi^2 + \tau_g^2(1-\tau_g)^2,$$

$$DEN = (1-\tau_g)\{(1-\tau_g)(1+r+(1-\tau_d)d)^H + \tau_g(1-\tau_d)d\cdot SUM\} + \tau_g(1-\tau_g),$$

$$NUM' = \tau_g(1-\tau_g)(1-2\tau_g)\psi(\tau_d)' - 2\tau_g(1-\tau_g)\psi\psi(\tau_d)',$$

$$DEN' = (1-\tau_g)\{-d(1-\tau_g)H(1+r+(1-\tau_d)d)^{(H-1)}-d\tau_g SUM+\tau_g(1-\tau_d)d \cdot SUM(\tau_d)'\},$$

$$\psi(\tau_d)' = -d(1-\tau_g)H(1+r+(1-\tau_d)d)^{(H-1)} - \tau_g dSUM + \tau_g(1-\tau_d)d \cdot \ SUM(\tau_d)',$$

$$SUM(\tau_d)' = \sum_{h=0}^{H-1} -d(h)(1+r+(1-\tau_d)d)^{(h-1)}.$$

Expanding the numerator of $\frac{\partial\partial l(\alpha(H^*),H^*)}{\partial\alpha(H^*)\partial\tau_d}$ and cancelling like terms results in

$$\tau_g^2(1-\tau_g)^2(1-2\tau_g)\psi(\tau_d)' - 2\tau_g^2(1-\tau_g)^2\psi \cdot \psi(\tau_d)' - \tau_g(1-\tau_g)^2(1-2\tau_g)\psi \cdot \psi(\tau_d)' - 2\tau_g^2(1-\tau_g)^3\psi(\tau_d)'.$$

Reducing this expression further, leads to

$$-\tau_g(1-\tau_g)^2\psi(\tau_d)'(\tau_g + \psi).$$

This expression is zero since $\tau_g(1-\tau_g)$ is positive, $\psi(\tau_d)'$ is zero, and $(\tau_g + \psi)$ is positive. Since DEN is always positive, $\frac{\partial\partial l(\alpha(H^*),H^*)}{\partial\alpha(H^*)\partial\tau_d}$ is the quotient of zero and a positive number.

Appendix I

Dividend and Realized Capital Gains Taxes in Canada

In an attempt to reduce the double taxation of dividend income, Canada has instituted a rather complicated system of dividend taxation. Dividend income is initially "grossed up" by a factor intended to reflect the value of gross corporate income from which dividends are paid. This factor is currently 1.41[1] for "eligible" dividends.[2] Shareholders pay regular tax on this amount, which is analogous to paying tax on the amount of gross corporate income. In this way corporate income is treated in a manner similar to flow-through income, as is the case for non-corporate business income in Canada. Next, shareholders are allowed to claim a tax credit on the grossed up amount of dividend income to offset the corporate taxes already paid by the firm. The federal tax credit is currently 16.44%[3] for eligible dividends. The provincial tax credit varies by province.

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[1]For the 2011 tax year.

[2]The CRA makes a distinction between "eligible" dividends and "non-eligible" dividends. The former constitute the vast majority of dividend payments made by public Canadian corporations. The gross up rate on non-eligible dividends is currently 1.25 (for the 2011 tax year). Non-eligible dividends are primarily paid by Canadian controlled private corporations, which are subject to the small business tax rate.

[3]For the 2011 tax year.

This system does not eliminate double taxation altogether, but it does reduce it. The degree to which this happens is a function of the individual's marginal tax rate on dividend income. In general the higher is the individual's marginal tax rate the less effective is the elimination. For a more detailed discussion of the tax treatment of dividend income, and for a discussion of how this system affects individuals with different income levels see Rosen et al. (2008).

The marginal tax rate on realized capital gains is equal to the marginal tax rate on regular income multiplied by the inclusion rate. The inclusion rate has changed over time, and is currently equal to 50%.[4]

I.1 Bibliography

ROSEN, H., B. DAHLBY, R. SMITH, J. WEN, AND T. SNODDON (2008): *Public Finance in Canada*. McGraw-Hill Ryerson, Toronto, third edn.

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[4]For the 2011 tax year.

Appendix J

Change in Optimal Capital: Tax Changes

From the user cost of capital condition in Chapter 3 we have

$$\pi'(K^*) = i^* = \frac{R'(A_t)}{R'(A_{t+1})} \left\{ \frac{\rho}{(1 - \tau^c)(1 - \tau^a)} + \frac{1}{(1 - \tau^c)} \left[1 - \frac{R'(A_{t+1})}{R'(A_t)} \right] \right\},$$

where $\pi(\cdot)$ is the firm's profit function, i^* is the user cost of capital, $R(\cdot)$ is the repurchase function,[1] ρ is the required after-tax rate of return demanded by shareholders, and τ^c and τ^a are tax rates on corporate income and accrued capital gains respectively. Solving for K^* gives us

$$K^* = \pi'^{-1}(i^*),$$

where $\pi'^{-1}(i)$ is the inverse function of $\pi'(K)$. It was assumed that $\pi(K)$ is strictly concave in K, which implies that $\pi'^{-1}(i)$ is monotonically decreasing.

It will now be shown that K^* is strictly decreasing in both τ^c and τ^a, but is unaffected by τ^d. Whenever dividends are paid before and after a tax change,

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[1]For the following discussion, it is assumed that the repurchase function is of the weak form. See Chapter 3 for a definition of the weak repurchase function.

they are the marginal form of payout, and $R'(A) = \frac{(1-\tau^d)}{(1-\tau^a)}$. Therefore

$$i^* = \frac{\rho}{(1-\tau^c)(1-\tau^a)},$$

since $R'(A_t) = R'(A_{(t+1)})$. The derivative of i^* with respect to τ^c is

$$\frac{\partial i^*}{\partial \tau^c} = \frac{\rho}{(1-\tau^c)^2(1-\tau^a)} > 0,$$

and the derivative of i^* with respect to τ^a is

$$\frac{\partial i^*}{\partial \tau^a} = \frac{\rho}{(1-\tau^c)(1-\tau^a)^2} > 0.$$

The derivative of i^* with respect to τ^d is clearly zero. Therefore, when dividends are the marginal form of payout i^* is an increasing function of both τ^c and τ^a, whereas i^* is unaffected by changes in τ^d. Since $K^* = \pi'^{-1}(i^*)$ is a decreasing function of i^*, it follows that K^* is a decreasing function of both τ^c and τ^a, and is unaffected by τ^d.

Showing that i^* increases in both τ^c and τ^a, when share repurchases are the marginal form of payout, is more involved. The derivative of i^* with respect to τ^c is equal to

$$\frac{\partial i}{\partial \tau^c} = \left[\frac{R''(A_t) \cdot R'(A_{t+1})}{R'(A_{t+1})^2} \frac{\partial A_t}{\partial \tau^c} - \frac{R'(A_t) \cdot R''(A_{t+1})}{R'(A_{t+1})^2} \frac{\partial A_{t+1}}{\partial \tau^c} \right] \left\{ \frac{\rho}{(1-\tau^c)(1-\tau^a)} + \frac{1}{(1-\tau^c)} \left[1 - \frac{R'(A_{t+1})}{R'(A_t)} \right] \right\} +$$

$$\frac{R'(A_t)}{R'(A_{t+1})} \left\{ \frac{\rho}{(1-\tau^c)^2(1-\tau^a)} + \frac{1}{(1-\tau^c)^2} \left[1 - \frac{R'(A_{t+1})}{R'(A_t)} \right] + \frac{1}{(1-\tau^c)} \left[\frac{R'(A_{t+1}) \cdot R''(A_t)}{R'(A_t)^2} \frac{\partial A_t}{\partial \tau^c} - \frac{R''(A_{t+1}) \cdot R'(A_t)}{R'(A_t)^2} \frac{\partial A_{t+1}}{\partial \tau^c} \right] \right\}.$$

When firms are initially in a steady state $A_t = A_{t+1}$ and the above equation reduces to

$$\frac{\partial i}{\partial \tau^c} = \left(\frac{\partial A_t}{\partial \tau^c} - \frac{\partial A_{t+1}}{\partial \tau^c} \right) \frac{R''(A_t)}{R'(A_t)} \left\{ \frac{\rho}{(1-\tau^c)(1-\tau^a)} + \frac{1}{(1-\tau^c)} \right\} + \left\{ \frac{\rho}{(1-\tau^c)^2(1-\tau^a)} \right\} \quad (1).$$

The second part of this expression is positive. For i^* to decrease (and K^* to increase) when τ^c decreases it must be that $\frac{\partial A_t}{\partial \tau^c} > \frac{\partial A_{t+1}}{\partial \tau^c}$, since $\frac{R''(A_t)}{R'(A_t)} < 0$, from

the concavity assumption on $R(A_t)$. When share repurchases are the marginal form of payout the following two equations hold:

$$TP_t = A_t = (1 - \tau^c)\pi(K_t) - I_t,$$

$$TP_t = A_{t+1} = (1 - \tau^c)\pi(K_t + I_t) - I_{t+1}.$$

Taking derivatives of both, with respect to τ^c leads to the following two equations:

$$\frac{\partial A_t}{\partial \tau^c} = -\pi(K_t) - \frac{\partial I_t}{\partial \tau^c},$$

$$\frac{\partial A_{t+1}}{\partial \tau^c} = -\pi(K_t + I_t) + (1 - \tau^c)\pi'(K_t + I_t)\frac{\partial I_t}{\partial \tau^c} + \frac{\partial I_{t+1}}{\partial \tau^c}.$$

In addition, for K^* to increase it must be that $\frac{\partial I_t}{\partial \tau^c} > 0$. For $\frac{\partial A_t}{\partial \tau^c} > \frac{\partial A_{t+1}}{\partial \tau^c}$ the following must hold:

$$\frac{\partial I_{t+1}}{\partial \tau^c} > [1 + (1 - \tau^c)\pi'(K_t)]\frac{\partial I_t}{\partial \tau^c},$$

which follows from $I_t = 0$ in an initial steady state. This states that investment in period $t + 1$ must be higher than investment in period t by a factor of $[1 + (1 - \tau^c)\pi'(K_t)] > 1$, i.e., the increase in investment from period t to $t + 1$ must exceed the additional profit generated by I_t. For this to happen, it must also be the case that $i_{t+1}^* < i_t^*$ which requires that $\frac{\partial A_{t+1}}{\partial \tau^c} > \frac{\partial A_{t+2}}{\partial \tau^c}$. By the same logic as above, $I_{t+2} > [1 + (1 - \tau^c)\pi'(K_t)]I_{t+1}$. Therefore

$$I_{t+s} > [1 + (1 - \tau^c)\pi'(K_t)]^{s-1}I_t,$$

and in the limit

$$lim_{s \to \infty}I_{t+s} = \infty.$$

Therefore, there must be some s, such that $A_{t+s} = 0$ (i.e., all profits are used for investment). Whenever $A \leq 0$ $R'(A) = 1$, i.e. when a firm repurchases nothing, or issues shares, the marginal value of a repurchase necessarily equals 1. This follows from the assumption of chapter 3 that each combination (α, H) has positive density, and therefore, there is a positive mass of shares that can be

repurchased for the intrinsic value. At the point were $A_{t+s} = 0$ and $A_{t+s+1} < 0$, $\frac{R'(A_{t+s})}{R'(A_{t+s+1})} = 1$ and $i^* = \frac{\rho}{(1-\tau^c)(1-\tau^a)}$, which contradicts the earlier requirement that $\frac{\rho}{(1-\tau^c)(1-\tau^a)} > i_t^* > i_{t+1}^* > ....$ Therefore, when share repurchases are the marginal form of payout, an increase in the corporate tax rate leads to a decline in the optimal level of capital.

For i^* to increase (and K^* to decrease) when τ^c decreases, it must be that $\frac{\partial A_t}{\partial \tau^c} < \frac{\partial A_{t+1}}{\partial \tau^c}$ from (1). This implies the following:

$$\frac{\partial I_{t+1}}{\partial \tau^c} < [1 + (1 - \tau^c)\pi'(K_t)]\frac{\partial I_t}{\partial \tau^c},$$

and that $\frac{\partial I_t}{\partial \tau^c} < 0$. The divestment in period $t + 1$ must therefore be larger than the divestment in period t. For this to occur it must be that $i_{t+1}^* > i_t^*$, which implies that $\frac{\partial A_{t+1}}{\partial \tau^c} < \frac{\partial A_{t+2}}{\partial \tau^c}$. By the same logic as above, this requires that $I_{t+2} < [1 + (1 - \tau^c)\pi'(K_t)]I_{t+1}$. Therefore

$$I_{t+s} < [1 + (1 - \tau^c)\pi'(K_t)]^{s-1}I_t,$$

and in the limit

$$lim_{s \to \infty} I_{t+s} = -\infty$$

Therefore, there must exist some s such that $I_{t+s} < K_{t+s}$, i.e., since there is a finite amount of capital to start each period, and divestment tends to negative infinity, there must exist some future time period such that all capital is divested. At this point, the only way to divest further is to issue equity. When firms issue equity $R'(A) = 1$, and $i^* = \frac{\rho}{(1-\tau^c)(1-\tau^a)}$. This contradicts the earlier requirement that $\frac{\rho}{(1-\tau^c)(1-\tau^a)} < i_t^* < i_{t+1}^* < ....$ Therefore, when share repurchases are the marginal form of payout, a decrease in the corporate tax rate leads to an increase in the optimal level of capital.

To show that optimal capital decreases in τ^a note that the derivative of i^* with respect to τ^a, when firms are initially in a steady state, is

$$\frac{\partial i}{\partial \tau^a} = \left(\frac{\partial A_t}{\partial \tau^a} - \frac{\partial A_{t+1}}{\partial \tau^a}\right)\frac{R''(A_t)}{R'(A_t)}\left\{\frac{\rho}{(1-\tau^c)(1-\tau^a)}\right\} + \left\{\frac{\rho}{(1-\tau^c)(1-\tau^a)^2}\right\}.$$

This expression is almost identical to (1) except $\frac{1}{(1-\tau^c)}$ does not appear in the first curly bracket, and the derivatives of A_t, A_{t+1} and $\frac{\rho}{(1-\tau^c)(1-\tau^a)}$ are with respect to τ^a. It can be verified that the proofs used to show K^* is a decreasing function of τ^c also hold for τ^a.

What remains to be shown is that i^* is unaffected by a change in the dividend tax. It is clear that both $\frac{\rho}{(1-\tau^c)(1-\tau^a)}$ and $\frac{1}{(1-\tau^c)}$ are unaffected by τ^d. Appendix H shows that the repurchase function is also unaffected by the dividend tax when share repurchases are the marginal form of payout (since the dividend yield is necessarily zero in this case). Therefore, $\frac{R'(A_t)}{R'(A_{t+1})}$ is independent of the dividend tax, and thus i^* and K^* are unaffected by τ^d.

Currirculum Vitae

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