The Evolution of Aggregate Stock Ownership

A Unified Explanation

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Abstract

Since World War II, the fraction of stocks owned directly by households has decreased by more than 50 percentage points. We argue that tax policy is the driving force. Using data from eight countries, we show that tax-favored investors have replaced households as stockholders and that the fraction of household ownership decreases with measures of the effective marginal tax rate. These findings are important for policy considerations on effective taxation and for financial economics research on the long-term effects of taxation on corporate finance and asset prices.

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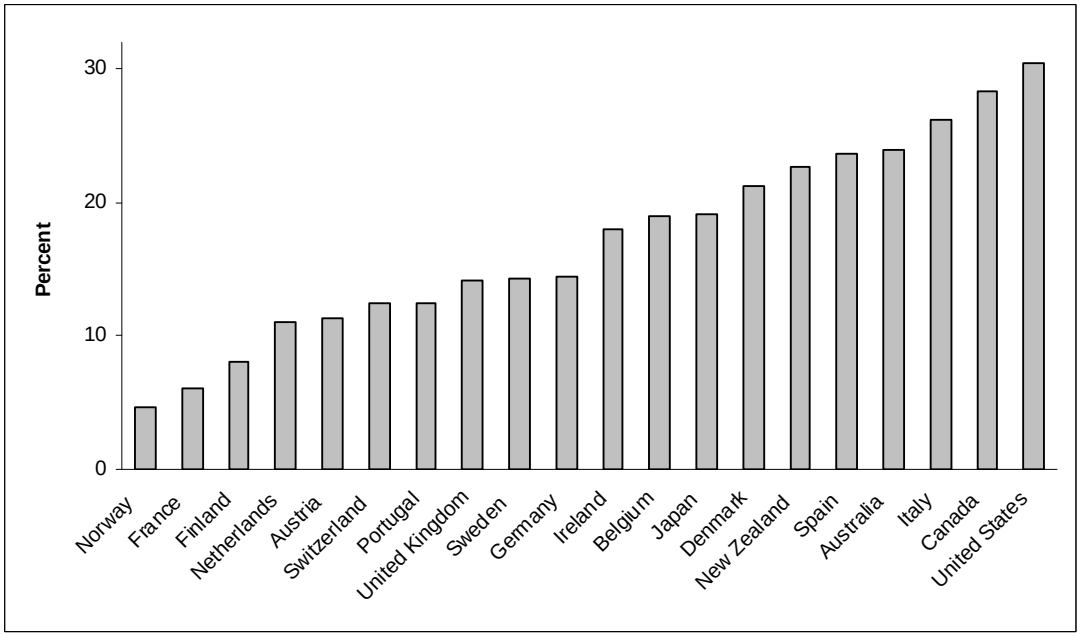
1 Introduction

One of the starkest stylized facts in finance is the decline of households' direct equity ownership. In the United States, individuals owned more than 90% of the stock market right after World War II compared to 30% in 2006. Large changes in the stock ownership structure have occurred also in other countries for which data exist over long time periods. Since World War II, the average fraction of household ownership has decreased from 55% in Canada, Finland, Germany, Japan, Sweden, and the United Kingdom down to 15% in 2006. With this in mind, the cross-country evidence in Figure 1 on the fraction of household ownership in recent years is telling. There is not a single developed country where households own more than half of the equity market directly, with the average across countries being just 17%.

Figure 1: Households' Direct Ownership Fraction of Stocks



The figure shows the aggregate fraction of household direct ownership of equity in 20 countries. The data are the most recently available between 2004 and 2006. Data sources: Flow of Funds (United States), Statistics Canada, Australian Bureau of Statistics, FESE (2007), Goldman & Sachs (New Zealand), and Nordic Central Securities Depository (Finland and Sweden). The number for the United States has been adjusted for the ownership of closely-held firms and non-profit organizations.

This paper's contribution is three-fold. First, we document stylized facts in the evolution of aggregate stock ownership in eight countries over the span of fifty years. Second, we propose and

test a unified explanation of the global decline in the fraction of household ownership. Finally, we explore the implications of our findings for policy and a number of fundamental issues in financial economics.

The explanation is tax based. In a nutshell, households sell to tax-advantaged financial institutions. Household income from stock ownership is subject to personal income tax, while financial institutions that manage pension assets can defer income taxes to the time of withdrawal of funds. The principles for the taxation of pension assets in the United States date back to the Revenue Act of 1921. Similar tax benefits are granted pension asset management in other countries, but the institutional arrangements vary widely and include assets managed by pension funds, mutual funds (defined contribution plans), life insurance companies, trust banks (Japan), and book reserves held on the employer's own balance sheet (Germany).

Personal income taxes were relatively small before World War II, and the tax advantage of pensions was insignificant. However, income taxes increased dramatically in the beginning of World War II creating a strong tax incentive to save inside a retirement account. Interestingly and important for our argument, income taxes remained at high levels after World War II and, in fact, rapidly increased through the invisible hand of inflation and nominally-fixed tax tables. The process of rising income taxes ended with the Tax Reform Act of 1986 (TRA 1986), the corresponding tax reforms in other countries, and the subsequent reduction of world-wide inflation.[1] However, by this point in time, direct ownership of stocks had largely been replaced by financial institutions and reached the low levels we see in Figure 1. In our data, the combined effects of tax and inflation appears to have had the strongest impact on the stock ownership structure in the United States, United Kingdom, and Sweden. At the other end of the spectrum, the combined effects of tax and inflation on stock ownership structure appear to be relatively mild in Germany due to tight monetary policy and Japan due to low effective marginal tax rates.

Many non-tax explanations have been offered for the long-term decrease in household ownership. Allen and Santomero (1998) provide a risk-based explanation for the growth in financial intermediation. They argue that the cost of executing a trade has decreased over time, as evidenced by the

[1]Formal indexation of personal tax tables begins with TRA 1986.

higher trading volume, and should therefore raise the fraction of household ownership. Since the data show the opposite traits, they propose that participation costs for wealthy individuals have increased. In particular, financial intermediaries can use derivatives and dynamic trading strategies to generate risk sharing services beyond that of providing a well-diversified stock portfolio at low cost. Friedman (1996) proposes that intermediated ownership grows because professional investment management may improve all the stock market's basic functions: capital allocation and accumulation, risk sharing, liquidity, and price discovery. Finally, labor economists explain how pension contracts can be designed to screen and incentivize workers. To this end, Bernheim (2002) concludes in his survey that the tax benefits of private pension plans do not imply that "the growth of the pension system is exclusively, or even primarily attributable to the tax system."

Arguably, all of these explanations have merit and are consistent with the decreasing trend in household ownership. Since we cannot quantify variables such as participation costs, agency costs, screening, or incentives, we cannot rule out any of these explanations either. However, the alternative explanations are silent about the statistical correlations between changes in household ownership and tax variables that we report in this paper, i.e., the alternative explanations face the challenge to explain why country-specific ownership paths are associated with country-specific provisions of the tax code. Interestingly, when tax variables are added into a regression framework, we cannot reject the null hypothesis that the underlying time trend in household ownership is zero.

The empirical researcher of tax effects encounters several difficulties. First, time-series variation is primarily associated with a handful of significant tax reforms (the beginning of World War II and TRA 1986) and one needs to identify an appropriate source of variation in marginal tax rates (see Bernheim (2002) for a discussion). We approach this statistical problem by relying on both time-series and cross-country variation. Hence, we collect detailed historical information on aggregate equity ownership and tax systems since World War II in eight developed countries. Another empirical issue is to estimate effective, as opposed to statutory, marginal tax rates. We solve this problem by constructing a proxy for the effective marginal tax rate from tax tables and GDP-per-capita time series. For the United States and United Kingdom, our proxy captures the level and the dynamics of effective marginal tax rates estimated from tax returns. We show that

the rate of change in the fraction of household ownership is strongly statistically related to the proxy for the effective marginal tax rate. Yet a third difficulty is to determine the tax status of mutual funds. Income of mutual funds passes through, and tax is levied on the fund owner. A tax-based explanation must therefore show that indirect stock ownership through a mutual fund is tax-advantaged relative to direct stock ownership. Consistent with the tax explanation, we find that the US mutual fund industry is small and does not begin to grow until the enactment of 401(k) in 1981. We also estimate that 57% of mutual fund stock portfolios are held in tax-deferred retirement accounts.

The tax mechanism and the resulting current structure of equity ownership have important implications for both policy debates and research agendas in financial economics. The role of taxation in shaping financial institutions is largely ignored by researchers with the exception of Ippolito (1986). In particular, the evidence suggests that not only the existence of pension funds as we know them (as suggested by Ippolito), but also the existence and significance of mutual funds and life insurance companies owe a great deal to the specific features of the tax code. Thus, the tax mechanism in the United States facilitates a gradual replacement of widely-held direct ownership to widely-held indirect ownership by financial intermediaries. By the same token, the tax mechanism can potentially explain not only the portfolio behavior of households, but also the transfer of shares to large corporations in some countries. For example, pension funds in Germany, Japan, and Sweden are small because corporations carry pension liabilities on their books. We provide an alternative explanation for the growth of business groups that by the 1980s have come to dominate the financial systems in these three countries.

At a more fundamental level, our results add to the ongoing discussion about the origins of financial systems. LaPorta, Lopez-De-Silanes, Shleifer, and Vishny (1997) claim that financial institutions are largely determined by static or very slowly changing legal systems, while Rajan and Zingales (2003) show that countries with less efficient legal systems were financially well developed in the beginning of the Twentieth Century. Our findings squarely support the dynamic side of the argument by Rajan and Zingales (2003). Government tax regulation has shaped financial institutions by creating tax clienteles and leading economic agents to invent ways to circumvent

their tax obligations. This inadvertently has implications for the functioning of the financial system.

The evidence in Figure 1 casts doubt on the importance of the ongoing debate on capital income taxation. As equity ownership has largely shifted away from households to tax-favored institutions, the economic effects of manipulating marginal tax rates for households may be relatively small. For example, the effect of the Jobs and Growth Tax Relief Reconciliation Act of 2003 (JGTRRA) is likely to be much smaller than predicted.[2] Also, a number of important insights on the role of personal taxation are no longer practical or relevant and a frequently expressed desire of professors to avoid incorporating personal taxes in their MBA valuation lectures seems to be justified.[3] In particular, the payout puzzle (Black (1976)), why corporations keep paying dividends in lieu of tax-favored share repurchases, is no longer a puzzle if most shareholders do not pay tax on dividends and capital gains.

The rest of the paper proceeds as follows. Section 2 presents our evidence on the evolution of stock ownership and shows the main stylized fact. Section 3 presents the hypothesis and the methodology. Section 4 discusses personal income tax systems in the sample countries and reports effective marginal tax rates. Section 5 presents our empirical results. Section 7 concludes. The appendix provides details on the tax rules in each of the sample countries.

2 Evolution of Aggregate Stock Ownership

This section reports common trends in aggregate stock ownership in eight developed countries: the United States, Japan, United Kingdom, Canada, Germany, France, Sweden, and Finland. The world market capitalization weights of these countries sum up to more than 90%.[4]

[2] See the discussion in Poterba (2004), Julio and Ikenberry (2004), Chetty and Saez (2005), Brav, Graham, Harvey, and Michaely (2005).

[3] Classical finance papers that emphasize and study the role of personal income tax include Brennan (1970) (Tax-CAPM), Elton and Gruber (1970) (tax clienteles), Black and Scholes (1974) (cross-section of returns), Black (1976) (payout policy), Miller (1977) (capital structure), and Constantinides (1983) (trading strategies). It is important to note that all these papers are published before TRA 1986 when marginal rates were high and when the household direct equity ownership was more significant. Standard MBA textbooks incorporate personal taxation as an important tool in valuation (see e.g. Brealey, Myers, and Allen (2007), Berk and DeMarzo (2007)).

[4] According to the World Federation of Exchanges for the year 2005: United States 51%, Japan 23%, United Kingdom 9%, Canada 4.5%, Germany 3.7%, and Sweden 1.2%. Market capitalization weights for France and Finland are missing.

2.1 Ownership Data

Annual ownership statistics exist for the United States since 1945, Japan 1949, Germany 1950, Canada 1961, and France 1977. Ownership data for the United Kingdom, Sweden, and Finland are incomplete and only available for some years. The data sources are listed in the notes of Table 1.

The US ownership shares are reported as fractions of both listed and non-listed stocks. The Federal Reserve starts with the market value of listed stocks, adds an estimate of non-listed stocks, eliminates inter-corporate ownership, and subtracts the ownership of financial institutions. The residual is labeled the "Household sector" and consists of households and non-profit organizations. This methodology means that the US household sector is upward biased relative to the household sector in most other countries in Figure 1. The bias arises from including non-listed stocks and non-profit organizations, and from eliminating inter-corporate ownership. The bias from non-listed stocks can be estimated from the difference between the Flow of Funds total and stock market capitalization, and the ownership of non-profit organizations is available from 1987–2000 (Table L.100a). Non-listed stocks and non-profit organizations account for approximately four percentage points each of the household sector in 2006. Correcting for these biases, the fraction of household ownership in the United States is 30%. We have no methodology to estimate inter-corporate ownership.[5] In the statistical analysis below, we use the original numbers from the Flow of Funds.[6]

The Canadian ownership shares are constructed as in the United States except that the total is defined as the book value of listed and non-listed stocks. The household sector is derived as the residual and consists of actual households and non-profit organizations. Inter-corporate ownership is explicit, but quite small. The average of the aggregate book-to-market ratio over 1980–2005 is 1.26. In the analysis below, we adjust the fractions from Statistics Canada by the overshooting 26 percentage points (see footnote 6). Specifically, for households, we subtract 0.26 from the observed fraction of household ownership and divide by 1-0.26 and, for all others, we divide the observed

[5] According to Statistics of Income, 1960-2007, non-financial corporations receive 9% of taxable dividends over the period 1960-2007. We do not know the proportion of these dividends that are paid by wholly-owned subsidiaries.

[6] Below, we analyze changes rather than levels of ownership. If the level bias is uncorrelated with changes in ownership, it does not influence the statistical inference. Poterba and Samwick (1995) and French (2008) make further attempts to adjust the household sector.

fraction of ownership by 1-0.26. The adjusted fraction of household ownership in 2006 is 29% as shown in Figure 1. A time-series based on market values is under construction and will be analyzed in a future version of the paper.

The Japanese ownership shares are reported as fractions of the number of shares outstanding before 1970 and as fractions of market values from 1970 onwards. Given that household portfolios tend to be concentrated in small cap stocks, the aggregate household ownership share in 1949–1970 is likely to be overestimated. For the United Kingdom, Germany, France, and Sweden, the ownership shares are fractions of market values. The UK ownership statistics are based on company surveys with the most recent ownership statistics from the share registry. The official share registry is also the basis for the ownership statistics from recent years in Sweden (since 1975) and Finland (since 1994). The older data are compiled using a variety of methods.[7]

2.2 Common Patterns

Table 1 reports the level of stock ownership for six broad investor classes at three points of time: the earliest available data point, 1990, and the most recent data point. For Japan and Germany, we choose 1953 as the starting point to eliminate the effects of some initial turbulence shortly after World War II. The table provides several clear patterns.

Household ownership decreases. Column (1) shows that the reduction in the fraction of household ownership is very large. The difference between the ownership shares in the first and the third rows in each panel measures how much it falls since World War II. The equally-weighted average of the decline across the eight countries is 39.4%.

Financial institutions ownership increases. The ownership fractions of pension funds, investment funds, and insurance companies are shown in columns (2)–(4). At first glance, the growth in financial institutions is large. To get a quantitative measure of this long-term growth, we sum

[7]Sweden: the 1950 data is based on a survey of household finances by Statistics Sweden. The 1961 and 1970 data are computed as the residual from point estimates of the portfolios of financial institutions and business corporations. The ownership fractions are based on market values. Finland: the 1958 data are based on tax-assessed values, the 1972 data on market values, and the 1980–1986 data on nominal share values.

Table 1: Evolution of Stock Ownership

	Households (1)	Pension funds (2)	Investment funds (3)	Insurance companies (4)	Non-financial businesses (5)	Foreign investors (6)
United States						
1945	93.1	0.0	1.5	2.3	n/a	2.3
1990	55.5	25.2	7.1	4.6	n/a	6.9
2006	38.5	20.2	22.9	6.6	n/a	10.3
Canada						
1961	48.6	2.7	2.4	2.0	4.0	27.0
1990	44.9	22.2	4.4	5.6	1.8	6.1
2006	28.9	18.5	13.3	11.2	1.1	9.9
United Kingdom						
1957	65.8	3.4	5.7	8.8	2.7	4.4
1990	20.3	31.7	7.7	20.4	2.8	11.8
2004	14.1	15.7	5.2	17.2	0.6	32.6
Sweden						
1950	70.0	2.5	0.0	1.5	5.1	7.5
1990	18.1	8.0	8.5	14.6	22.3	7.7
2006	14.3	5.3	11.2	8.1	9.0	37.2
Japan						
1953	53.8	n/a	6.7	n/a	13.5	1.7
1990	20.4	10.7	3.7	15.9	30.1	4.7
2006	18.1	21.4	4.7	7.6	20.7	26.7
Germany						
1953	32.8	n/a	n/a	1.2	39.9	10.7
1990	17.8	n/a	1.3	11.7	43.4	12.7
2005	12.5	n/a	5.1	12.4	27.8	20.1
France						
1977	29.5	n/a	7.3	6.4	25.3	8.5
1990	26.2	n/a	10.8	7.2	23.3	15.4
2005	6.9	n/a	13.4	5.7	21.3	39.5
Finland						
1958	52.1	n/a	n/a	1.6	12.9	3.1
1990	24.8	n/a	n/a	10.1	26.5	8.0
2004	8.7	3.8	0.1	1.4	3.4	70.7

The table shows the ownership shares of broad investor classes. Pension funds include private pension funds, public pension funds, social security funds and, in Japan, trust banks and annuity trusts. Investment funds are mutual funds, closed-end funds, and exchange-traded funds. In Sweden and Germany, closed-end funds and holding companies are not included. Insurance companies represent life insurance and property and casualty insurance. The rows do not add up to 100%. The ownership of banks, holding companies, non-profit organizations, the public sector, and other investor classes are omitted. Data sources: Flow of Funds (United States); Statistics Canada; Revell and Moyle (1966), Moyle (1971), and Statistics United Kingdom; Spånt (1975), Boman (1982), and Statistics Sweden; the Shareholder Survey and the Fact Book of the Tokyo Stock Exchange (Japan); Deutsches Aktieninstitut (Germany); Bank of France; Grandell (1959), Laakso (1979), Airaksinen and Kallinen (1987), Karhunen and Keloharju (2001) (Finland).

across columns (2)–(4) and take the difference between the sum in the first and the third rows in each panel. The average difference across the eight countries is 24.2%.

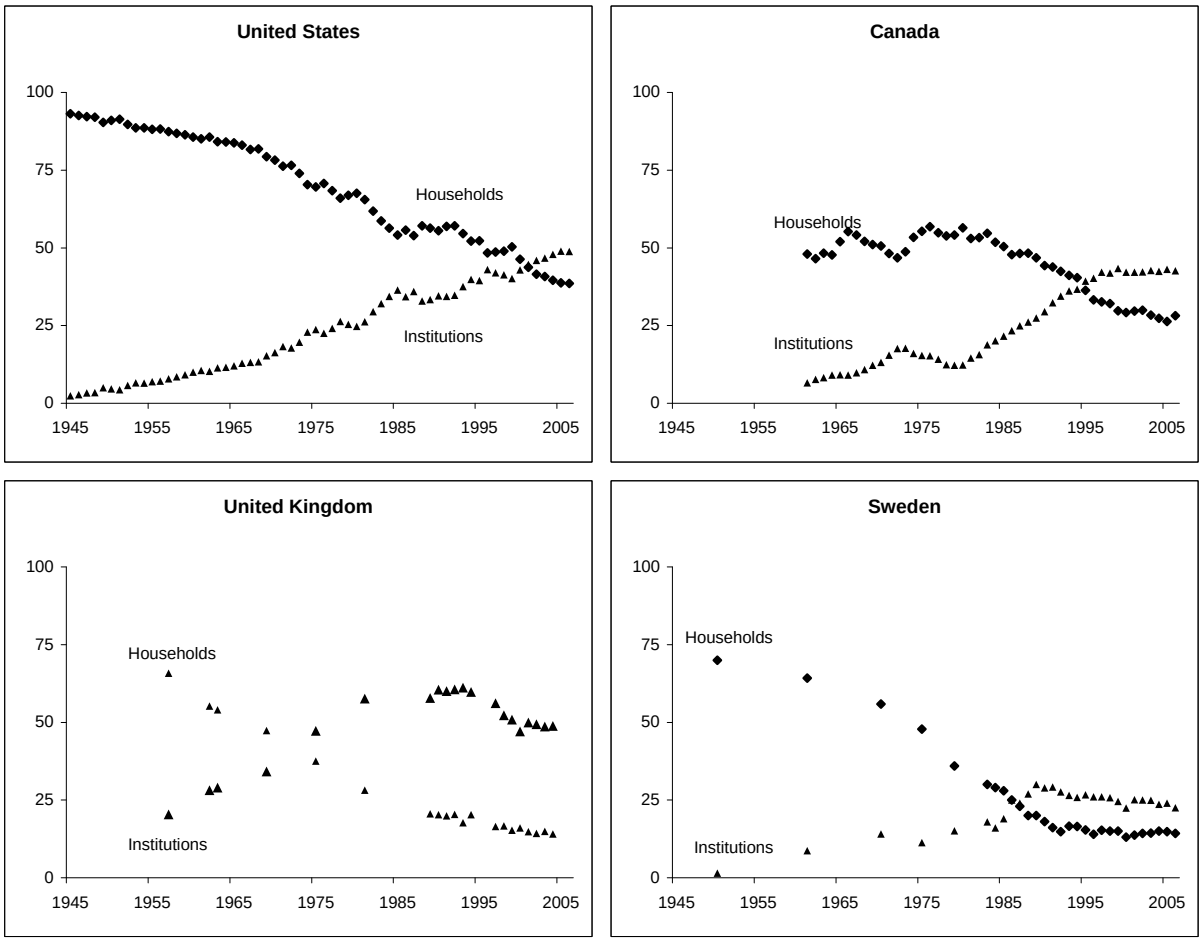
Inter-corporate ownership increases before 1990. Inter-corporate ownership in column (5) is significant in the countries placed in the bottom of Table 1. The average difference between the first and the second row in Sweden, Japan, Germany, and Finland is 12.7%. We exclude France with a relatively short time-series.

Foreign ownership increases after 1990. The foreign ownership fraction is reported in column (6). Foreign ownership takes off in 1990 after the removal of capital controls (OECD (2002)). Capital controls in Australia, Canada, Finland, New Zealand, Sweden, and United Kingdom were adopted in preparation for or during World War II. Other countries established capital controls in the immediate reconstruction period after the war. Canada removed its capital controls in 1951 and Germany in 1958. The United States had capital controls in place during the Vietnam War (1963–1973). The process of removing capital controls began in the United Kingdom in 1979 and continued in Japan 1980, Australia 1983, France 1986, Sweden 1989, Italy and Norway 1990, and Finland 1991.

Figure 2a plots the complete time-series of household and institutional ownership in the United States, Canada, United Kingdom, and Sweden. The decrease in household ownership corresponds closely to the increase in institutional ownership in the United States, Canada, and United Kingdom. In Sweden, business corporations pick up the residual (not shown). The plots also show that the rate of change varies over time. In the United States, the fraction of household ownership decreases at an accelerating rate before TRA 1986, but the secular decline continues afterwards. In Canada, the fraction of household ownership starts at a lower level and does not begin its decline until 1980. In the United Kingdom, household ownership decreases steadily until 1990 after which the time-series of household ownership becomes stationary. In Sweden, we observe a dramatic reduction in the fraction of household ownership between 1970 and 1990, when the ownership fraction decreases by 40 percentage points or by approximately 2% per year.

Figure 2b plots the time-series of household and institutional ownership in Japan, Germany, France, and Finland. For Japan, we use different symbols for the time periods before and after 1970

Figure 2a: Evolution of Stock Ownership

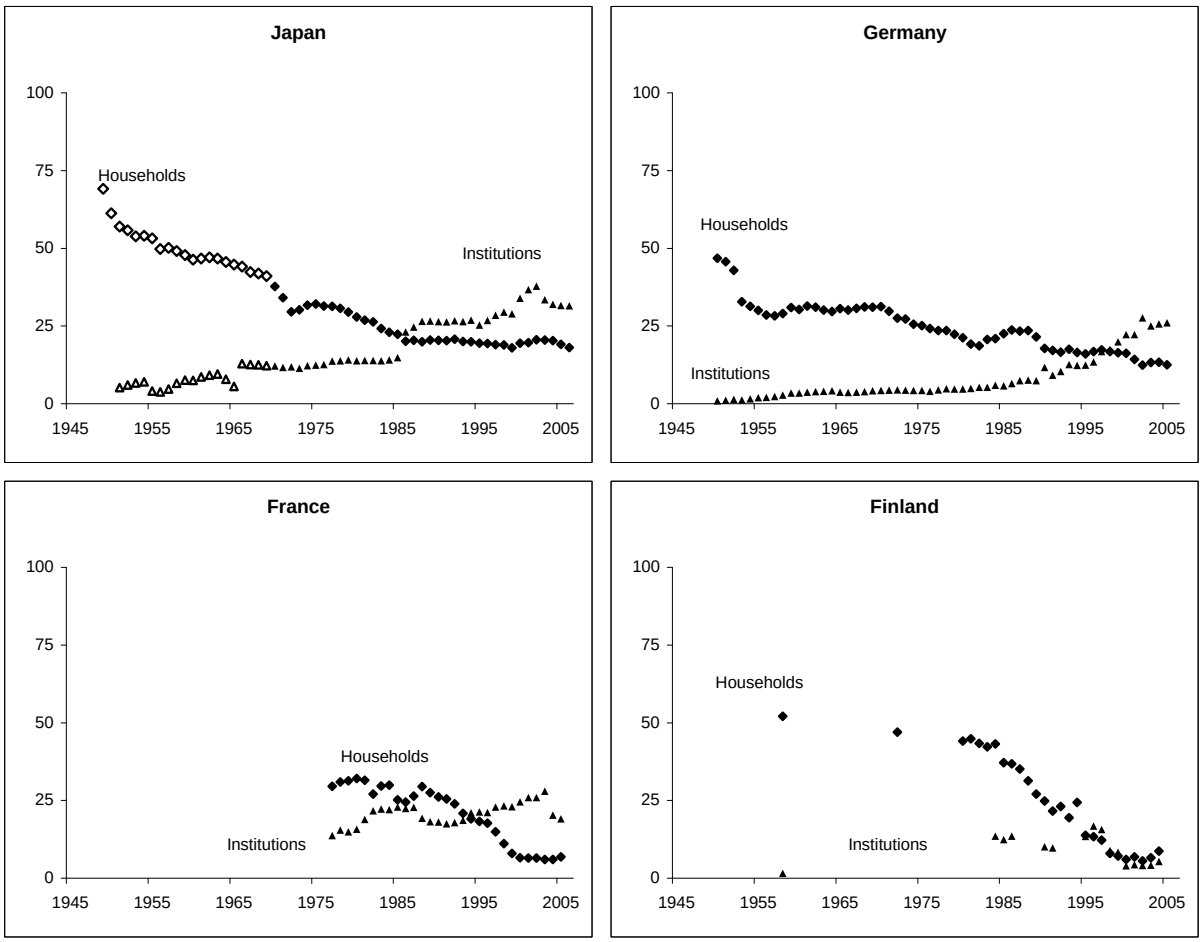


The figure shows the aggregate ownership fraction of households and financial institutions (pension funds, mutual funds, and life insurance companies) in percent.

to mark the merger of two time-series with different qualities. The household shares are picked up by financial institutions and business corporations in approximately equal shares. The four plots emphasize interesting cross-country variation relative to the countries in Figure 2a. The average decline in the fraction of household ownership is about 1% per year in the United States, United Kingdom, and Sweden, and it is about 0.5% in the other five countries. Household ownership decreases slowly in Japan in 1970–2006, when ownership shares are based on market values, in

Germany throughout most of the post-war period, and in France and Finland before the entrance of foreign investors around 1990. The starting point for the fraction of household ownership is also lower than in Figure 2a. Small-sample evidence by Franks, Mayer, and Wagner (2005) suggests that the transformation from direct ownership by households to intercorporate ownership took place in Germany in the 1920s and the 1930s.

Figure 2b: Evolution of Stock Ownership



The figure shows the aggregate ownership fraction of households and financial institutions (pension funds, mutual funds, and life insurance companies) in percent.

3 Hypothesis and Methodology

3.1 Tax Theory of Pensions

In the United States, the Internal Revenue Act of 1921 provides the principles for the taxation of pensions: contributions are made before tax, investment returns accrue tax free, and distributions are taxed as personal income. The consumption-tax treatment of pensions is different from the income-tax treatment of regular savings, where contributions are taxed at the time of investment, investment returns are taxed upon realization, but distributions are exempt from personal tax. The tax code requires that the pension liability is backed by off-balance sheet assets held by a pension fund. Therefore, households must choose indirect ownership to earn the related tax benefits. Ippolito (1986) proposes the hypothesis that the growth of pension funds in the United States is a direct consequence of the difference in taxation of pensions and regular savings. Individual retirement accounts that allow households to hold stocks directly are relatively recent additions.[8]

The consumption-tax treatment of funded pension schemes is the general principle used in all the sample countries, but the institutional arrangements vary widely. In the United States, pension assets are managed by pension funds, mutual funds (see above), and life insurance companies. Pension funds, life insurance companies, and trust banks manage significant pension assets in Canada, United Kingdom, and Japan. Pension funds are small in Germany, Sweden, and Finland, where life insurance companies are major carriers of funded pensions. Book reserves play an important role in Germany, Japan, and Sweden. Private pension plans in France are primarily unfunded (pay-as-you-go plans). Public pension plans such as US social security are mostly unfunded and not part of our analysis.

The following stylized setting illustrates the argument. Suppose an individual chooses between saving inside or outside a retirement account. The annual rate of return is r and the time to retirement is N years. Personal income is taxed at rate τ_0 when it is earned and at rate τ_w when it is withdrawn. Investment returns outside the retirement account are taxed at rate $\tau_i, i = 1, ..., N$. All taxes and the horizon are known at time 0. Consider the individual who decides to set aside

[8] Individual retirement accounts can be found in Canada from 1957, United States 1975, Sweden 1994, and Germany 2002.

$100 pre-tax money for retirement. If he invests outside a retirement account, the after-tax payoff after N years equals:

$$H = [100(1 - \tau_0)] \times [1 + r(1 - \tau_i)]^N. \quad (1)$$

Equation (1) shows that savings are taxed at rate τ_0 when income is earned and at rate τ_i when income is reinvested. Hence, household savings outside the retirement account are taxed twice. Alternatively, if the individual saves inside a retirement account, the after-tax payoff after N years equals:

$$P = \left[100(1 + r)^N\right] \times (1 - \tau_w). \quad (2)$$

Contributions to the retirement account can be made with pre-tax money, investment returns accrue tax free, and distributions are taxed at rate τ_w. Hence, savings inside the retirement account are taxed only once.

Equations (1) and (2) are equal and the individual is indifferent between saving outside or inside a retirement account if $\tau_0 = \tau_w$ and $\tau_i = 0$. This implies that pension savings inside a retirement account offers two potential tax benefits. First, the individual can benefit from income smoothing when the tax schedule is progressive and $\tau_0 > \tau_w$, i.e., the individual can reduce his life-time tax burden by saving when income is high and withdrawing when income is low. Second, investment returns inside the retirement account accrue tax free, $\tau_i = 0$.[9] If we extend the model with uncertainty and assume that individuals are risk averse, pension savings inside a retirement account offers the additional advantage of risk sharing with the government: if realized returns are high, the individual can afford to pay the tax, and if realized returns are low, the tax obligations are reduced. In other words, a risk-averse investor prefers an uncertain future loss to a certain loss today.[10]

For the various reasons outlined above, households have a tax incentive to switch from direct to indirect ownership. Households do not have to make an active decision on their own. Retirement

[9] When pension liabilities are unfunded as in France, the individual can benefit from income smoothing, but not from tax-free investment returns. Under the book reserve systems in Germany, Japan, and Sweden, actuarial methods are used to replicate funded pension plans, so both benefits to saving inside a retirement account apply.

[10] In addition, interest rate uncertainty increases the advantage of indirect ownership because P and H are convex functions.

benefits are often negotiated between the employer and labor unions, so private pension plans are offered as standard contracts to all employees of a company, an industry, or the entire country (e.g., Sweden). The tax theory of pensions does not say anything about the speed by which direct ownership is replaced by indirect ownership, but there are good reasons to believe that the process is slow and may take a half century to complete as suggested by the evidence in Section 2 above. First, households can access the tax-advantaged retirement account through payroll deduction, which by construction is a slow process of building retirement wealth. Since 1975, US households can also access individual retirement accounts and sell directly-held stocks to finance IRA contributions, but contribution amounts are limited and, with the exception of a short period in 1982–1986, high-income households are not eligible. Second, assets in a retirement account are illiquid as they cannot be used for other purposes than retirement. Early withdrawal or borrowing against the retirement account are subject to penalty. Nor does the tax theory of pensions say that direct ownership is irrational. There are many other reasons to save than to provide for retirement, and households may hold stocks for speculation or for incentive reasons (insider ownership). Furthermore, there are investment restrictions and stocks that the investor desires may not be available inside a retirement account. For example, the Employee Retirement Income Security Act of 1974 (ERISA) states that pension funds are subject to the prudent-man rule, which may limit investment options.

3.2 Empirical Measures

First, we construct a measure of the benefit of avoiding tax on investment income. Equations (1) and (2) are not directly suitable for empirical testing because they approximate the taxation of bonds rather than stocks. Therefore, to derive an empirical measure, let d be the expected dividend yield, g the expected capital gain, and τ_d and τ_g the effective marginal tax rates on dividends and capital gains, respectively. The expected rate of return from holding stocks inside a retirement account is:

$$r = (1 + d)(1 + g) - 1 \approx d + g, \tag{3}$$

and the expected rate of return from direct stock ownership outside a retirement account is:

$$r^{\tau} = [1 + d(1 - \tau_d)] \times [1 + g(1 - \tau_g)] - 1 \approx (1 - \tau_d)d + (1 - \tau_g)g. \tag{4}$$

Inflation is central to our analysis and we therefore work with real rates of return. Let i denote the expected inflation rate. A simple measure of the relative tax advantage of holding stocks inside a retirement account is the difference between the real rate of return from holding stocks inside and outside a retirement account:

$$\text{GAP} = \frac{\tau_d d + \tau_g g}{1 + i}. \tag{5}$$

Expected inflation enters the equation in the denominator. It also enters in the effective marginal tax rates τ_d and τ_g (bracket creep) and in the capital gains growth rate g because nominal capital gains are taxed.[11] Since GAP has a dividend and a capital gains term, we also examine the explanatory power of each term as well as the effective marginal tax rate on dividends τ_d and capital gains τ_g.

Next, we construct a measure of the benefit to income smoothing. For simplicity, we assume certainty, zero risk-free interest rate, and constant life-time income. An individual works N years and needs retirement income for M years. Let Y denote annual income, and $T(Y)$ tax liability on this income. The life-cycle hypothesis implies that the individual chooses the same consumption rate $\phi = N/(N + M)$ throughout his life time. If the individual makes regular savings outside a retirement account, life-time tax liability equals $N \cdot T(Y)$. If instead the individual saves inside a retirement account, he can save pre-tax income and reduce life-time tax liability on earned income to $(N + M) \cdot T(\phi Y)$. Tax liability is lower when the individual saves inside a retirement account when the tax code is progressive. We construct three measures of the benefit to income smoothing:

$$\text{SMOOTH} = \begin{cases} 1 - \frac{T(\phi Y)/\phi}{T(Y)}. & \text{Reduced tax bill.} \\ \frac{(\phi Y - T(\phi Y))/\phi}{Y - T(Y)} - 1. & \text{Increased disposable income.} \\ \bar{\tau}(Y) - \bar{\tau}(\phi Y). & \text{Reduced average tax rate.} \end{cases} \tag{6}$$

[11] To neutralize the latter problem, capital gains are indexed in the United Kingdom from 1982-1998.

The first row measures life-time tax savings from income smoothing as a fraction of life-time income taxes, the second row measures the corresponding increase in disposable income, and the third row measures the decrease in the average tax rate $\bar{\tau}(\cdot)$. SMOOTH quantifies the maximum benefit to income smoothing if implemented optimally over a life time. SMOOTH is larger with a more volatile income stream (we assume constant income), while saving motives other than minimizing tax liability reduce SMOOTH.

3.3 Parameters

The empirical variables derived above require parameter estimates for effective marginal tax rates, expected stock returns, and inflation. Details about country-specific tax regulations are provided in the Appendix.

3.3.1 Effective Marginal Tax Rates

We are interested in constructing a proxy for the effective marginal tax rate of a representative household that chooses between holding stocks inside or outside a retirement account. We think of the representative as a middle class household. It has high enough income that Government-provided, public pensions are insufficient to cover consumption needs during retirement years. Also, the representative's income is low enough that the maximum retirement benefits from private pension plans are a significant portion of consumption during retirement years. As our base case, we assume that the representative household has an annual income of five times Gross Domestic Product (GDP) per capita. The marginal tax rate of this household on dividend income can be computed from tax tables and GDP-per-capita time series. While the choice of the multiple five is somewhat arbitrary, we examine the robustness of our results to alternative income multiples.

Capital gains taxation is markedly different from dividend taxation. First, the statutory tax rate on long-term capital gains is usually lower than the statutory rate on short-term gains and it is often zero. Second, capital gains tax can be postponed until the stock is sold. The value of deferral of capital gains has been subject to much debate. Miller (1977) refers to conventional folk wisdom that 10 years of tax deferral is almost as good as exemption from tax. Bailey (1969) estimates the

value of deferral to 50% of the statutory rate, Protopapadakis (1983) finds estimates in the order of 25%, and Chay, Choi, and Pontiff (2006) find it to be 55%. Green and Hollifield (2003) model the advantage of deferral and find numerically that the effective tax rate on capital gains amounts to approximately 50-60% of the statutory rate. We assume that the effective capital gains tax rate is 50% of the long-term statutory rate evaluated at the annual income five times GDP per capita.

3.3.2 Expected Stock Returns and Inflation

Estimation of expected dividend yield and capital gains rate are intrinsically noisy. We make simple first-order approximations and pursue a number of robustness checks. We assume that the expected dividend yield is $d = 4\%$, and that the expected capital gains rate is 2% plus expected inflation measured as the three-year moving average. The inflation estimate is based on the Consumer Price Index. These assumptions can be supported by estimates based on data from Global Financial Data and International Historical Statistics. The pooled cross-section and time-series average dividend yield in our sample is 3.6%. The constant-dividend assumption ignores both cross-country variation and the time-series trend in the data. The pooled average dividend yield series begins at 5.3% in 1950 and ends at 2.3% in 2006. In Japan, average dividend yield is less than 1% in the post-1980 period.[12] The geometric average real GDP growth rate in our sample is 2.9%. The average is influenced by the high real growth after World War II, especially in Germany and Japan, so we assume that investors expect lower real future growth. Our assumptions imply that the expected real rate of return on stocks is approximately 6% before tax, which is within the range reported by Fama and French (2002) between 1951 and 2000: 4.74% using the dividend growth model and 6.51% using the earnings growth model.

3.3.3 Demographic Parameters

The numerical value of the tax benefit to income smoothing depends on demographic parameters. We assume that an individual begins contributing to a pension plan at the age of 25 and retires at

[12]Substantially lower dividend yields in the United States and United Kingdom after 1982 can partially be explained by a dramatic increase in popularity of share repurchases following changes in regulation favoring these repurchases. Since share repurchases are taxed differently from dividends, we do not include them in our calculations.

the age of 65. Retirement at 65 has long been the norm in the countries we study. It was chosen in the social security system of the United Kingdom in 1925 and in the United States in 1935. We also assume that the individual uses life-expectancy statistics to predict the number of years in retirement. Life-expectancy statistics are available from the Human Mortality Database.[13] For each country in our sample, we collect life-expectancy conditional on the age of 25 and compute the cross-country average. The time-series of average life expectancy begins at 70.4 years in 1950 and ends at 81.4 years in 2006. Hence, the number of work years is $N = 40$ and the number of retirement years $M \in [6.4, 16.4]$. The number of retirement years is an approximately linearly increasing function of time. Therefore, saving for retirement becomes increasingly important over time.

4 Household Taxation of Stocks

Dividends are taxed as ordinary income, but many tax codes offer a dividend-tax relief to reduce the effects of double taxation of corporate income. Canada introduced a dividend-tax credit in 1949, Japan in 1950, France in 1965, United Kingdom in 1973, Germany in 1977, and Finland in 1993 under tax codes which are often referred to as reduced-rate or imputation-tax systems. Furthermore, the tax codes of Sweden 1991, Finland 1993, United Kingdom 1999, and United States 2003 differentiate between ordinary income and investment income and subject investment income to lower marginal tax rates. These tax systems are usually referred to as dual-income systems. The tax code of Japan 1965 combines all of these features.

The United States begins taxing capital gains on stocks in 1916. Some other sample countries begin taxing capital gains on stock relatively late: the United Kingdom in 1965 and Canada in 1972. Sweden begins taxing short-term capital gains in 1910 and Finland in 1920, but long-term capital gains are tax exempt before 1967 in Sweden and 1986 in Finland. In Germany, France, and Japan, long-term capital gains on stocks are effectively tax exempt throughout the time period we study.

[13] University of California, Berkeley (USA), and Max Planck Institute for Demographic Research (Germany). Available at www.mortality.org or www.humanmortality.de.

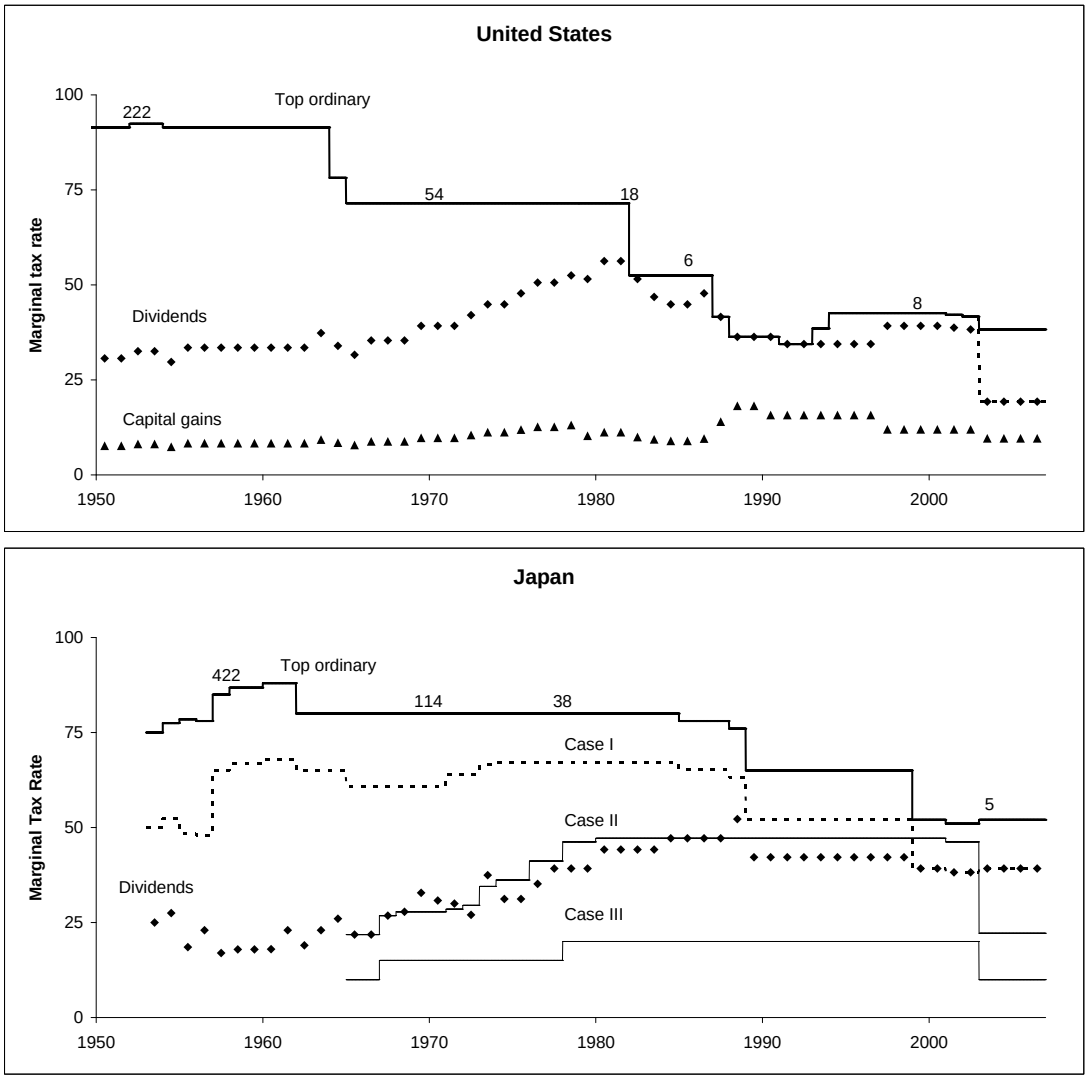
4.1 Evolution of Marginal Tax Rates

The sequence of plots contained in Figure 5 show the evolution of marginal tax rates. In all plots, the solid line above is the top statutory rate on ordinary income and the dashed line below is the top statutory rate on dividends. The numbers adjacent to the top statutory tax rate (solid line) are the top income tax brackets expressed as multiples of GDP per capita. Below the top statutory rates, we plot our proxies for the effective marginal tax rate on dividends (diamonds) and capital gains (triangles).

The top panel of Figure 3a shows the evolution of marginal tax rates in the United States. We assume that local tax is a constant 5%. The top statutory rate on ordinary income equals the top statutory rate on dividends between 1950 and 2002. Since 2003, dividends are taxed at a lower top statutory rate. This change in the tax code is represented by the dashed line. Top statutory income rates decrease from above 90% in the 1950s to below 40% in 2006. In 1950, the GDP-per-capita multiple is 222 and thus relevant to few households. The multiple decreases rapidly to 18 in 1980. After TRA 1986, the income multiple stays around eight. The effective marginal tax rate on dividends as measured by DIVTAX5 (diamonds) stays around 30% in the 1950s and 1960s, it increases rapidly in the 1970s, and drops back to the 30% level after TRA 1986. These changes occur because tax tables are fixed and nominal growth pushes many households into higher tax brackets. The bracket creep of the 1970s becomes an important part of Ronald Reagan's presidential campaign and results in TRA 1986 with the formal indexation of tax tables. The effective capital gains tax rate as measured by GAINTAX5 is approximately constant around 10%.

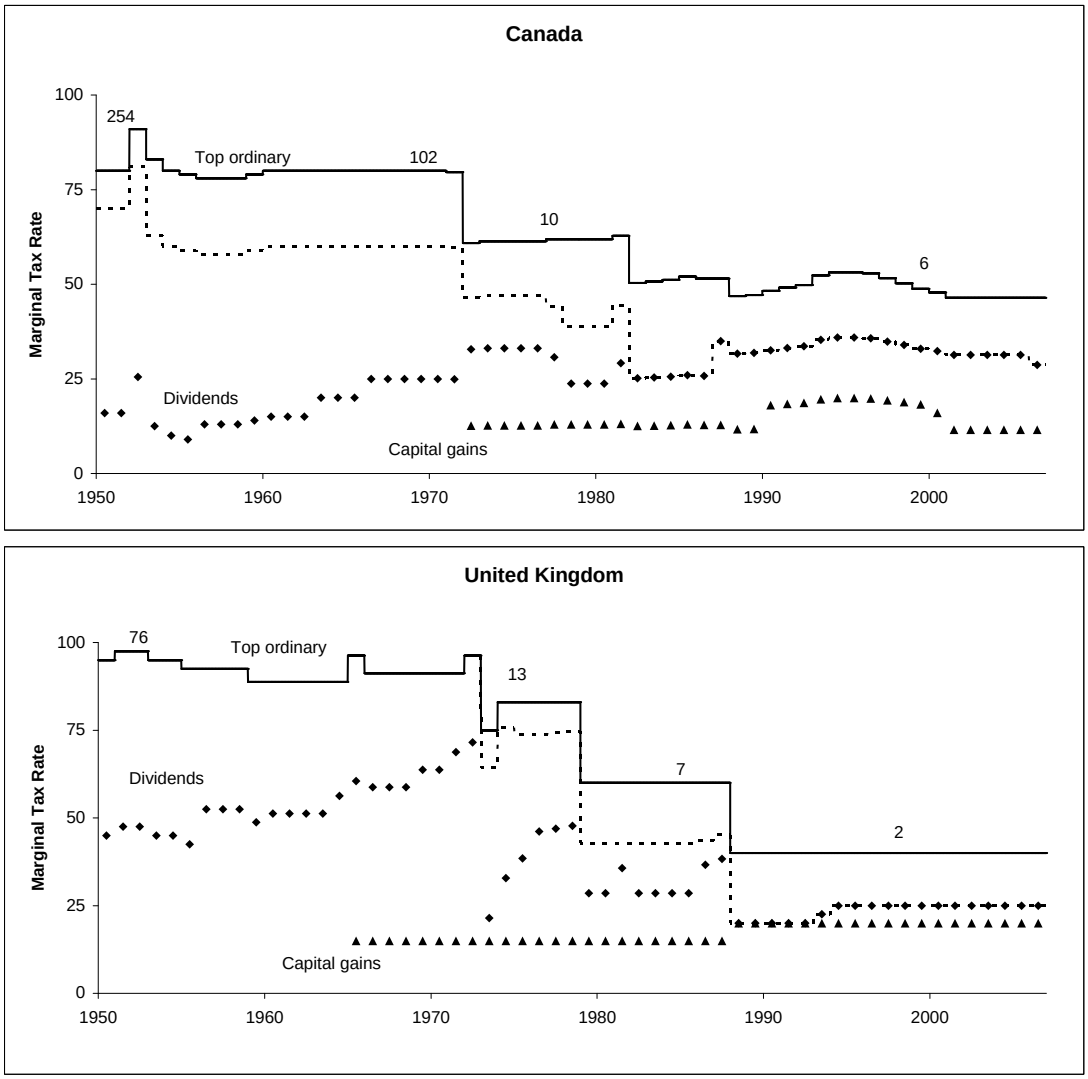
The eight tax plots share several common features. In the first decade after World War II, high statutory rates on personal income are coupled with low effective marginal tax rates. In the subsequent decades, effective marginal tax rates drift upwards (bracket creep), and the GDP-per-capita multiple at the top statutory rate decreases from an average well above 100 in 1950 to around 10 in 1980. In the extreme cases of Sweden and Finland (Figure 3c), the effective marginal tax rates are equal to the top statutory rates in the 1970s and 1980s, and the top statutory rate applies to an income multiple of only two. The bracket creep ends with TRA 1986 and similar tax reforms

Figure 3a: Evolution of Marginal Tax Rates



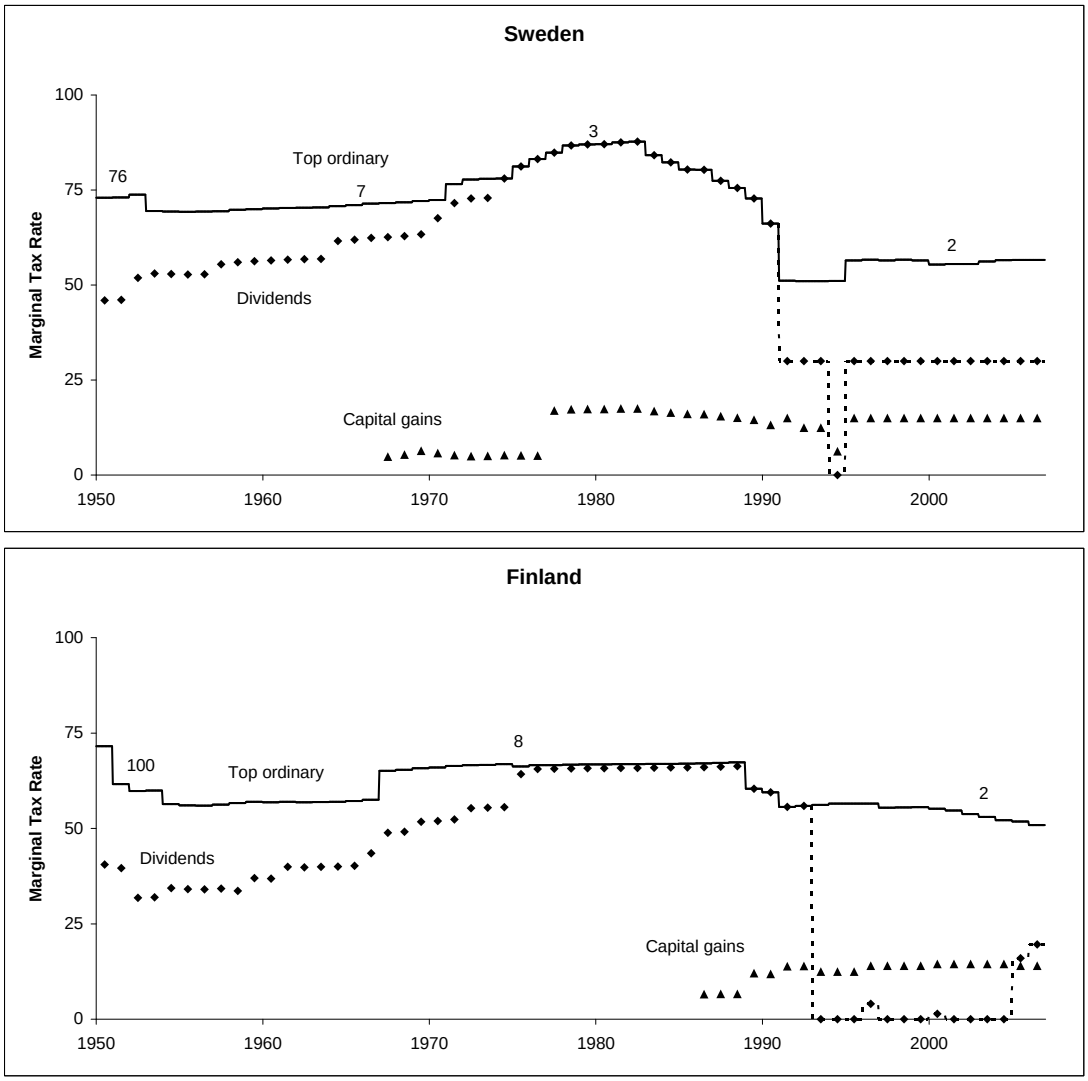
The figure shows the top statutory tax rate (solid line), the top statutory rate on dividends (dashed line), the effective marginal tax rate on dividends (diamonds), and the effective marginal tax rate on long-term capital gains (triangles). The effective marginal tax rates have been evaluated at an income equal to five times GDP per capita. The numbers adjacent to the top statutory rate are the top income tax brackets expressed in multiples of GDP per capita. In Japan, the marginal tax rate depends on the size of the dividend from each company. Case I, II, and III refer to a large, an intermediate, and a small dividend, respectively.

Figure 3b: Evolution of Marginal Tax Rates



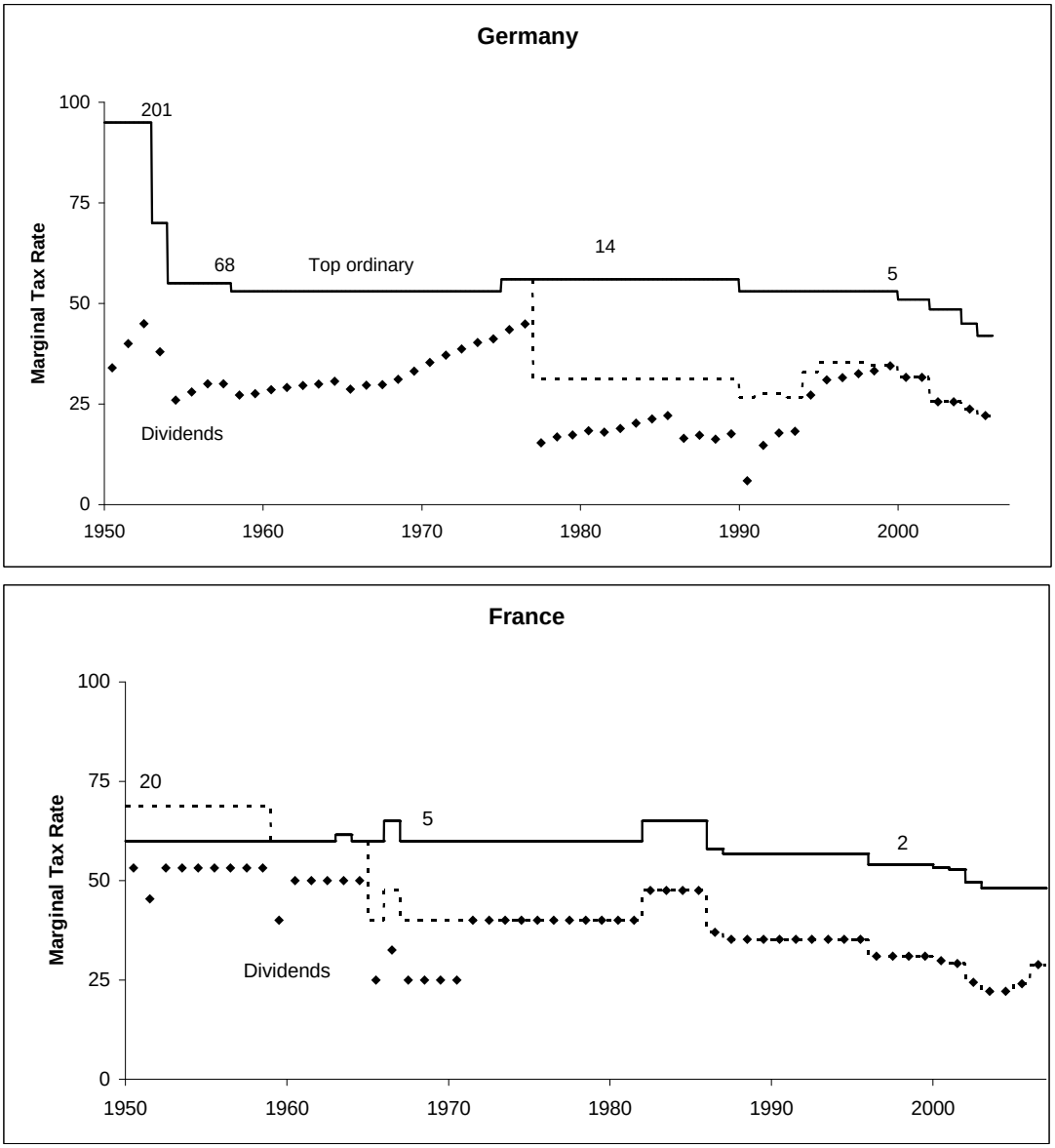
The figure shows the top statutory tax rate (solid line), the top statutory rate on dividends (dashed line), the effective marginal tax rate on dividends (diamonds), and the effective marginal tax rate on long-term capital gains (triangles). The effective marginal tax rates have been evaluated at an income equal to five times GDP per capita. The numbers adjacent to the top statutory rate are the top income tax brackets expressed in multiples of GDP per capita.

Figure 3c: Evolution of Marginal Tax Rates



The figure shows the top statutory tax rate (solid line), the top statutory rate on dividends (dashed line), the effective marginal tax rate on dividends (diamonds), and the effective marginal tax rate on long-term capital gains (triangles). The effective marginal tax rates have been evaluated at an income equal to five times GDP per capita. The numbers adjacent to the top statutory rate are the top income tax brackets expressed in multiples of GDP per capita.

Figure 3d: Evolution of Marginal Tax Rates



The figure shows the top statutory tax rate (solid line), the top statutory rate on dividends (dashed line), the effective marginal tax rate on dividends (diamonds), and the effective marginal tax rate on long-term capital gains (triangles). The effective marginal tax rates have been evaluated at an income equal to five times GDP per capita. The numbers adjacent to the top statutory rate are the top income tax brackets expressed in multiples of GDP per capita.

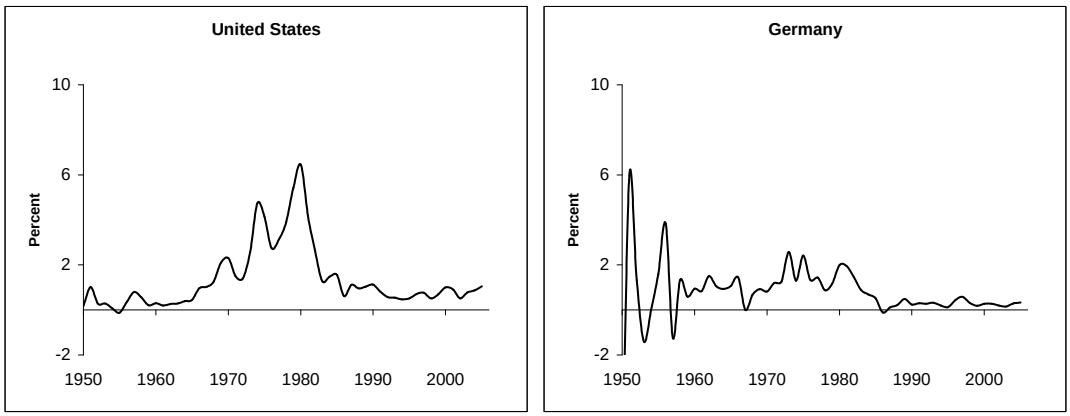
in other countries: the United Kingdom 1988, Japan 1989, Sweden 1991, and Finland 1993. In all countries, effective marginal tax rates become equal to top statutory rates after TRA 1986, but top statutory rates are much lower than in the past.

A simple measure of bracket creep equals real tax liability on nominal income as a fraction of tax liability on real income:

$$\text{CREEP} = \frac{T(Y(1+i))/(1+i)}{T(Y)} - 1. \tag{7}$$

The measure assumes that households and governments are passive. In particular, governments do not index tax tables. Figure 4 plots the time-series of CREEP5 for the United States and Germany.

Figure 4: Bracket Creep



The figure shows the annual bracket creep measured as real tax liability on nominal income over tax liability on real income in percent. It is evaluated at the income level five times GDP per capita (CREEP5).

The plots for the United Kingdom and Japan resemble that of the United States, and the plots for Canada, France, Sweden, and Finland are similar to that for Germany. CREEP5 increases in the 1970s in the United States, United Kingdom, and Japan. In the United States, CREEP5 peaks at approximately 6%, which means that real tax liability increases by six percentage point in a single year. The cumulative real tax increase to a passive household between 1973 and 1982 amounts to the stunning amount of 40%. Discrete adjustments of income brackets begin in 1977, and with

formal indexation from TRA 1986 the problem is largely eliminated.[14] Bracket creep is relatively small in Germany where inflation is kept under tight control. Bracket creep is less pronounced also in Canada, France, Sweden, and Finland because the GDP5 investor pays the top marginal tax rate on most of his income, i.e., average tax rates are close to top marginal rates.

4.2 Tax Advantage of Pensions

The sample average GAP5 is about two percent. It ranges from 1% in Germany to 2.8% in the United Kingdom. A two percent expected return difference matters over long investment horizons. For example, suppose one dollar per year is put into a savings account over 40 years. The future value of the savings account at 2% interest rate is \$60 compared to \$40, which is the future value of a savings account that accrues without interest.

Figure 5 shows the evolution of GAP5 in each of the eight sample countries. GAP5 varies both over time and cross-sectionally. GAP5 reaches particularly high levels in the United Kingdom and Sweden with high inflation and extreme levels of dividend income taxation, but the level of GAP5 does not fall far behind in the United States. In the United Kingdom, GAP5 peaks at nearly 6%, which implies that, under our assumptions, the expected real rate of return on stocks after tax is approximately zero.[15] Shareholders in Canada, France, Germany, and Japan are partly protected from rising income taxes by the dividend tax credit. In countries with tax on long-term capital gains, notably the United States, Sweden, and United Kingdom, GAP5 peaks during the high-inflation period of the 1970s. In Canada and Finland, GAP5 peaks when tax on long-term capital gains is introduced. In countries where long-term capital gains are exempt from tax, notably France, Germany, and Japan, GAP5 is relatively low over time. A visual comparison of the GAP5 plots with those of household ownership in Figure 2a and 2b suggests a strong correlation between changes in stock ownership structure and GAP5. In the United States, United Kingdom

[14] Personal tax tables change infrequently from World War II to the 1970s. Regular adjustments of personal tax tables begins in France 1969, Canada 1972, United Kingdom and Finland 1977, and Sweden 1979. Germany and Japan do not follow the general pattern and change their personal tax tables infrequently throughout the post-war period.

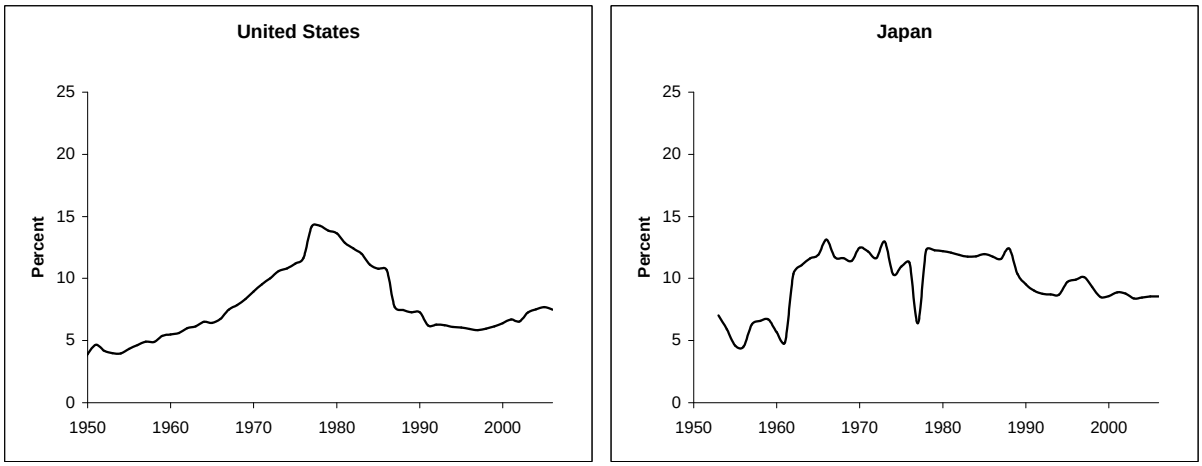
[15] Expected real rates of return outside the retirement account are not negative under the assumed parameter values in Figure 5 because real stock price growth is high ($g = 2\%$) and the effective marginal tax rate on capital gains is low as a result of deferral and low statutory rates on long-term capital gains.

Figure 5: Evolution of GAP5

The figure shows the real rate of return difference between saving inside and outside a retirement account for a household with an income multiple of five times GDP per capita. The numbers are expressed in percent. We assume that the expected dividend yield is $d = 4\%$, expected real growth is $g = 2\%$, and that expected inflation equals the three-year moving average. We also assume that the effective capital gains tax rate equals 50% of the long-term statutory rate.

and Sweden, the fraction of household ownership decreases particularly fast when GAP5 climbs to high levels in the 1970s, while in Japan and Germany, there is not much time-series variation in either the fraction of household ownership or GAP5.

Figure 6: Evolution of SMOOTH5



The figure shows the tax benefit to income smoothing for a household with an income multiple of five times GDP per capita. The numbers are expressed in percent.

The averages of the three measures of SMOOTH5 are positive because personal tax tables are generally progressive. The average annual reduction in the tax bill is 7.3%, the increase in disposable income is 4.8%, and the reduction in the average tax rate is 2.7%. These numbers are quite small given that they are derived under the assumption that income smoothing is implemented optimally over the individual's life time. More carefully calibrated parameters with income growth and borrowing constraints do not raise SMOOTH5 much above the numbers we have presented here. Figure 6 shows the evolution of SMOOTH5, measured as the reduction of the tax bill, in the United States and Japan. In the United States, the benefit from income smoothing increases during the 1970s and peaks near 15%, while it is relatively stable in Japan. The paths of SMOOTH5 in the other six countries are also relatively flat. Accordingly, the correlation coefficient between GAP5 and SMOOTH5 is relatively small.

5 Household Ownership and the Tax Advantage of Pensions

Our objective is to study households' aggregate response to the tax incentive to save inside a retirement account. The response variable is the change in the aggregate fraction of household ownership Δy and the incentive variables are GAP5 and SMOOTH5. Hence, we estimate the pooled cross-section and time-series regression model:

$$\Delta y_{it} = a + b \cdot \text{GAP5}_{it} + c \cdot \text{SMOOTH5}_{it} + e_{it}, \tag{8}$$

and test whether the slope coefficients are negative: $b, c < 0$. We do not include lagged variables because the incentives to save inside a retirement account are slow-moving variables. Any delayed response is likely to be highly correlated with the current values of the incentive variables. The regression can be estimated with the seven-country panel data set. The estimation procedure corrects for first-order autocorrelation and heteroscedasticity.[16]The time series of ownership are incomplete for the United Kingdom, Sweden, and Finland, particularly in the beginning of the sample period. Missing values are replaced by linearly interpolated data.

Table 2 reports our main results. SMOOTH5 is measured as the reduction in the tax bill (the top row of (6)). Specification (1) ignores the tax variables and reports only the average annual change in household ownership across the seven countries. It shows that the average annual decline in the fraction of household ownership is 0.92%. Specifications (2)–(4) include the proxy variables for the relative tax advantage of holding stock inside a retirement account. We can see that the coefficients of GAP5, its two components, and DIVTAX5 are significantly different from zero in all specifications, while the coefficient of GAINTAX5 and SMOOTH5 are not. Furthermore, once we include the tax variables, the intercept term is not statistically different from zero. The magnitude of the regression coefficient of GAP5 means that a three percentage point difference between saving inside and outside a retirement account results in an annual reduction of the fraction of household ownership by one percentage point. The result that both the dividend and the capital gain component of GAP5 are statistically different from zero suggests that both dividend tax and

[16]In Table 2, we allow the autocorrelation coefficient to be country specific, while in Table 3 we use the same autocorrelation coefficient for all countries. The pooled autocorrelation coefficient is 0.133.

Table 2: Pooled Regressions

	(1)	(2)	(3)	(4)
Constant	–0.92 (–11.3)***	–0.28 (–1.4)	–0.21 (–0.9)	0.19 (0.7)
GAP5		–32.2 (–6.1)***		
Dividend term			–36.8 (–3.7)***	
Capital gain term			–26.3 (–2.2)**	
Dividend tax rate				–1.9 (–5.3)***
Gains tax rate				–1.6 (–1.7)*
SMOOTH5		1.6 (0.7)	1.4 (0.6)	–2.5 (–1.0)
R^2	0.000	0.036	0.036	0.031
#Obs	395	392	392	392

The table reports the results of regressing the households' annual percentage ownership change on proxy variables for the relative tax advantage of saving inside a retirement account defined by equations (5) and (6). The proxy variables are functions of effective marginal tax rates which are evaluated at he income five times GDP per capita. The regressions are estimated with generalized least squares and take into account within-country autocorrelation and heteroscedasticity, and cross-country heteroscedasticity. t-statistics are reported in parentheses below the coefficients. Asterisk *** denotes significance level 1% or better.

capital gains tax matter.

Table 3 shows the results of estimating the regression model (8) decade by decade. We report only the results for GAP5 and SMOOTH5 as regressors. The coefficient of GAP5 is statistically different from zero in the three regressions covering the 1960s, 1970s, and 1980s, but not otherwise. These regression results demonstrate that significant explanatory power of the regression model is due to cross-section variation in effective marginal tax rates. The regression results also emphasize the interaction between tax and inflation before TRA 1986. The lack of explanatory power in the 1990s suggests that TRA 1986 and related tax reforms in other countries successfully responded to bracket creep.

Table 3: Decade-by-Decade Regressions

	1950-59	1960-69	1970-79	1980-89	1990-99
Constant	–0.25 (–0.3)	–0.46 (–1.0)	0.24 (1.1)	–0.43 (–0.8)	–1.90 (–2.5)**
GAP5	12.2 (0.3)	–27.9 (–2.0)*	–36.8 (–5.6)***	–30.7 (–3.4)***	28.8 (0.9)
SMOOTH5	–11.9 (–0.9)	6.7 (1.6)	–0.1 (0.0)	3.3 (0.8)	8.7 (2.2)
R^2	0.182	0.212	0.087	0.091	0.029
#Obs	37	68	72	80	80

The table reports the regression results decade by decade. The dependent variable is the households' annual percentage ownership change and the independent variables are proxy variables for the relative tax advantage of saving inside a retirement account. The proxy variables are functions of effective marginal tax rates which are evaluated at he income five times GDP per capita. The regressions are estimated as in Table 2. t-statistics are reported in parentheses below the coefficients. Asterisk ** and *** denotes significance level 5% and 1% or better, respectively, against the null hypothesis that the coefficient is zero.

We carry out several robustness checks. First, the pooled regression (8) assumes that the underlying time trend is equal in all countries. When we allow the underlying time trend to vary (i.e., country-fixed effects), we get similar regression coefficients.[17] Second, the tax variables in regression (8) have been evaluated at the income multiple of five times GDP per capita. Alternatively, we evaluate the tax variables at (i) each GDP-per-capita-income multiple from one to 15, (ii) the average statutory rate, (iii) the top statutory rate on dividends and capital gains, and (iv)

[17]Out of all eight countries, only the coefficient of the dummy variable for Canada is statistically different from zero.

the top statutory rate on ordinary incoming (dividends). The last experiment ignores all information about dividend-tax reliefs. None of these alternatives change the ordering of high-tax versus low-tax countries. The fraction of household ownership decreases fast in the United States, United Kingdom, and Sweden, where marginal tax rates are relatively high, and the fraction of household ownership decreases slowly in Germany and Japan where marginal tax rates are relatively low. Since the country ordering is preserved, only the magnitude of the regression coefficients, and not the statistical significance, changes across the alternative specifications.

6 Discussion and Extension

TO BE COMPLETED.

7 Conclusions

This paper analyzes the long-term decreasing trend in household direct ownership of stocks and the corresponding long-term increase in intermediated stock ownership. We have provided panel-data evidence from eight countries that the change in household ownership is related to proxy variables for effective marginal tax rates. Notably, the sample countries follow different paths depending on features of the tax code and exposure to inflation. As inflation increases in the 1970s, the fraction of household ownership decreases fast in the United States, United Kingdom, and Sweden where effective marginal tax rates are high and long-term capital gains are taxed. At the same time, the fraction of household ownership decreases slowly in Germany with tight monetary policy and Japan with low effective marginal tax rates and zero tax on long-term capital gains. These findings lead to a number of important research and policy implications.

The current ownership structure with mostly intermediated stock ownership and little direct ownership is a consequence of tax policy. The ownership shares of pension funds, mutual funds, and life insurance companies would have been much smaller without the tax benefits granted to pensions. Under the tax explanation, the role of financial intermediaries is to make payroll deductions and to economize on execution costs. We conclude from the evidence that tax policy

has been successful. The intention of the Revenue Act of 1921 was to stimulate private savings on a before-tax basis. Presumably, stock prices would have been much lower without the tax benefits awarded to pensions. This conclusion follows immediately from the assumptions of the Capital Asset Pricing Model extended with proportional investor-level taxes (Brennan (1970)).

We have argued that inflation matters to stock ownership through its impact on effective marginal tax rates and by imposing tax liability on nominal capital gains. The two effects seem to be equally important. In retrospect, we conclude that the United Kingdom, Canada, Sweden, and Finland poorly timed the introduction of capital gains tax on stocks, while Canada, Germany, and United Kingdom successfully timed the introduction of dividend-tax credits. In Canada and United Kingdom the effects of the two tax reforms partly offset each other. We also conclude that the TRA 1986 and subsequent tax reforms in other countries have been successful in combatting the effects of inflation on tax by reducing effective marginal tax rates and indexation of personal tax tables.

John Maynard Keynes writes: *There is no subtler, no surer means of overturning the existing basis of society than to debauch the currency. The process engages all the hidden forces of economic law on the side of destruction, and it does it in the manner which not one man in a million is able to diagnose.* Much has been said about the effects of the inflation of the 1970s. We want to add the decrease of households' direct ownership of stocks to the list of unanticipated consequences of inflation.

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8 Appendix: Personal Taxation of Stocks

This appendix explains the principles of personal taxation of income from stocks in the United States, United Kingdom, Canada, Japan, Germany, Sweden, and Finland. We do not cover the taxation of corporate income except where it is needed to understand personal taxation of dividends. The following general notation is useful:

$$
\begin{aligned}
\tau_d &= \text{personal tax rate on dividend income.} \\
\tau_r &= \text{reduction rate on dividend income.} \\
\tau_i &= \text{imputation rate on dividend income.} \\
\tau_g &= \text{personal tax rate on capital gains.} \\
\tau_p &= \text{personal tax rate on ordinary income.} \\
\tau_{pi} &= \text{personal tax rate on investment income.} \\
\tau_{pc} &= \text{central personal tax rate.} \\
\tau_{ps} &= \text{sub-central personal tax rate.} \\
\tau_{sc} &= \text{central surtax rate on personal tax.} \\
\tau_{ss} &= \text{sub-central surtax rate on personal tax.}
\end{aligned}
$$

The precise meaning of each tax rate is explained in its context below. Many tax systems are covered in this appendix and additional notation is introduced as needed. The statutory tax rates are not reported here, but can be requested from the authors.

8.1 United States

Personal income is subject to federal, state, and city taxes. When there is a choice (since 1949), we choose the federal tax tables for a married couple filing jointly. We adjust for state tax by assuming it is a time-series constant $\tau_{ps} = 5\%$, but we ignore city tax. The assumption for the state tax rate is based on the equally-weighted average top statutory state tax rates in 1950, 1987, and 2006. The information is taken from the Tax Foundation.

8.1.1 Dividends

From 1913–2002, dividends are taxed as ordinary income. State taxes are deductible at the federal level, so the marginal tax rate on dividend income equals:

$$\tau_d = \tau_{pc}(1 - \tau_{ps}) + \tau_{ps}. \tag{9}$$

In 2003, the United States switches to a dual-income system, where ordinary income and investment income are taxed as separate income classes. The federal tax schedule on dividends is simpler, it involves only two steps, and peaks well below the top personal rate:

$$\tau_d = \tau_{pi}(1 - \tau_{ps}) + \tau_{ps}. \tag{10}$$

8.1.2 Capital Gains

Capital gains taxation of stocks begins in 1916. From 1916–1933, realized capital gains on stocks are taxed as ordinary income. From 1922–1933, the capital gains tax rate is capped at 12.5%. From 1934–1986, a portion π of long-term capital gains is taxed:

$$\tau_g = \pi \times \left[\tau_{pc}(1 - \tau_{ps}) + \tau_{ps}\right]. \tag{11}$$

The federal capital gains tax rate is capped at 30% (1938–1941) and 25% (1942–1969). The cap is removed in 1972–1986. There is a Vietnam war capital gains surtax τ_{gs} in 1968–1970:

$$\tau_g = \pi \times \left[\tau_{pc}(1 + \tau_{sc})(1 - \tau_{ps}) + \tau_{ps}\right]. \tag{12}$$

Since 1987, long-term capital gains are taxed as a separate income class:

$$\tau_g = \tau_{pi}(1 - \tau_{ps}) + \tau_{ps}. \tag{13}$$

8.2 Canada

A distinguishing feature of the Canadian tax system is that provincial (sub-central) tax rates are defined as proportions of federal (central) taxes. Hence, central and sub-central tax rates are multiplied with each other, which means that the provincial tax is a tax on the federal tax. We approximate the provincial tax with the rates from Ontario. Our data sources include Taxation Statistics, National Finances, Ontario Ministry of Finance, Perry (1989), and Perry (1990).

8.2.1 Dividends

We begin with the Canadian tax system in 1949–1971. A tax credit is provided at the central level for sub-central taxes. Let τ_{rs} denote the sub-central reduction rate. The personal tax rate net of the sub-central tax credit equals:

$$\tau_p = \tau_{pc} + (\tau_{ps} - \tau_{rs})\tau_{pc}. \tag{14}$$

Dividends are taxed as personal income, but Canada offers a dividend-tax relief at rate τ_r. Dividend income is taxed at the rate:

$$\begin{array}{rcll} \tau_d & = & \tau_{pc} - \tau_r & \text{(central tax)} \\ & + & (\tau_{ps} - \tau_{rs}) \times (\tau_{pc} - \tau_r) & \text{(sub-central tax)} \end{array} \tag{15}$$

This expression corrects Lakonishok and Vermaelen (1983) and Booth and Johnston (1984), who include the sub-central tax credit, but fail to include the sub-central tax.

We proceed with the tax system in 1972–1999. There are two important changes. First, an imputation-tax credit at rate τ_i replaces the dividend-reduction rate τ_r. The dividend tax and the imputation-tax credit are levied on the grossed-up dividend $1 + g$. Second, the sub-central tax credit is abandoned and, later, surtaxes are added at both the central and the sub-central level.

The surtaxes are defined as proportions of other taxes. Dividend income is taxed at rate:

$$\begin{aligned}
\tau_d &= [(1+g)\tau_{pc} - (1+g)\tau_i] && \text{(central tax)} \\
&+ [(1+g)\tau_{pc} - (1+g)\tau_i] \times \tau_{sc} && \text{(central surtax)} \\
&+ [(1+g)\tau_{pc} - (1+g)\tau_i] \times \tau_{ps} && \text{(sub-central tax)} \\
&+ [(1+g)\tau_{pc} - (1+g)\tau_i] \times \tau_{ps} \times \tau_{ss} && \text{(sub-central surtax)}
\end{aligned} \tag{16}$$

This expression can be simplified to:

$$\tau_d = (1+g)(\tau_{pc} - \tau_i)\left[1 + \tau_{ps}(1+\tau_{ss}) + \tau_{sc}\right]. \tag{17}$$

The personal tax rate is simpler as there is no imputation-tax credit:

$$\tau_p = \tau_{pc}\left[1 + \tau_{ps}(1+\tau_{ss}) + \tau_{sc}\right]. \tag{18}$$

Next, we explain the Canadian tax system as of 2000–2005. This tax reform changes the sub-central tax. Instead of a tax on tax, the sub-central tax becomes a tax on income. Surtaxes remain to be tax on tax. A new sub-central dividend credit at rate τ_{rs} is also introduced:

$$\begin{aligned}
\tau_d &= [(1+g)\tau_{pc} - (1+g)\tau_i] && \text{(central tax)} \\
&+ [(1+g)\tau_{pc} - (1+g)\tau_i] \times \tau_{sc} && \text{(central surtax)} \\
&+ [(1+g)\tau_{ps} - (1+g)\tau_{rs}] && \text{(sub-central tax)} \\
&+ [(1+g)\tau_{ps} - (1+g)\tau_{rs}] \times \tau_{ss} && \text{(sub-central surtax)}
\end{aligned} \tag{19}$$

Essentially, the federal and provincial taxes are calculated separately and then summed together. The expression simplifies to:

$$\tau_d = (1+g)\left[(\tau_{pc} - \tau_i)(1+\tau_{sc}) + (\tau_{ps} - \tau_{rs})(1+\tau_{ss})\right]. \tag{20}$$

Again, the personal tax rate is simpler:

$$\tau_p = \tau_{pc}(1 + \tau_{sc}) + \tau_{ps}(1 + \tau_{ss}). \tag{21}$$

Finally, there is a change in the taxation of dividends in 2006 that we ignore because stock ownership data and GDP per capita are not yet available for 2006.

8.2.2 Capital Gains

Capital gains taxation of stocks begins in 1972. The principles have not changed as of 2006. A proportion of long-term capital gains π is taxed as ordinary income:

$$\tau_g = \pi \times \tau_p. \tag{22}$$

From 1986–1989, households earn a life-time capital gains exemption for the sale of all property including real estate. Although the exemption amount is quite large, we ignore this provision.

8.3 United Kingdom

Income taxes are collected at the central level only, so we do not need to worry about sub-central taxes. The main information and data sources are Orhnial and Foldes (1975), King (1977), and HM Revenue & Customs.

8.3.1 Dividends

From 1947–1964, the United Kingdom has a tax system which can be characterized as a hybrid of two business taxation models. One component conforms to the classical model of corporate taxation with double taxation except that there are different tax rates for distributed and retained profits. Specifically, the corporation pays corporate tax at rate τ_{cd} on distributed profits and rate τ_{cr} on retained profits, where $\tau_{cd} \geq \tau_{cr}$. Shareholders in higher income brackets pay personal tax on dividends at rate $\tau_p - \tau_{pst}$, where τ_{pst} is the standard rate of income tax. The other component of the hybrid system conforms to the standard model of partnership taxation, where business income

passes through and is taxed as personal income. Specifically, shareholders pay tax on corporate income at the standard rate of income tax τ_{pst} irrespective of whether corporate income is paid out or retained. This tax is paid in addition to personal tax on dividends.

In the hybrid system, the marginal tax rate on dividend income equals the personal rate. To see this, we decompose pre-tax corporate income Y into after-tax dividend D, after-tax retained earnings RET, paid corporate taxes on dividends, and paid corporate taxes on retained earnings:

$$Y = D + \tau_{cd}D + RET + \tau_{cr}RET. \tag{23}$$

From 1947–1951, an individual shareholder is liable for personal tax in the amount:

$$(\tau_p - \tau_{pst})D + \tau_{pst}D + \tau_{pst}RET. \tag{24}$$

The first term is personal income tax on dividends (first component of the hybrid system). The second and the third terms are personal tax on corporate income (second component). From this expression, we can see that the marginal tax rate on dividend income equals:

$$\tau_d = (\tau_p - \tau_{pst}) + \tau_{pst} = \tau_p. \tag{25}$$

From 1952–1964, the corporate tax deductability is removed and shareholders are also liable for personal tax on paid corporate taxes:

$$(\tau_p - \tau_{pst})D + \tau_{pst}D + \tau_{pst}RET + \tau_{pst}(\tau_{cd}D + \tau_{cr}RET). \tag{26}$$

We can see that the marginal tax rate on dividend income equals the marginal tax rate on personal income as in (25).

In 1965–1972, the United Kingdom switches to a classical tax system. Dividends are taxed as personal income at rate $\tau_d = \tau_p$. A few years later, in 1973–1998, the United Kingdom switches to an imputation-tax system with a significant dividend-tax relief. The tax and the imputation-tax credit is levied on the grossed-up dividend $1/(1 - \tau_i)$, so the marginal tax rate on dividend income

equals:

$$\tau_d = \frac{\tau_p - \tau_i}{1 - \tau_i}. \tag{27}$$

The imputation rate is defined as the standard rate of income tax, which means that only households in higher income brackets pay tax on dividends. From 1973–1984, dividend income above an exclusion amount is subject to investment income surcharge at rate 15% on top of the ordinary income tax rate for high-income earners. We ignore the surcharge in our calculations because the exclusion amount is large.

Since 1999, the United Kingdom combines the imputation-tax system with a dual-income system where dividends are taxed as a separate income class at a proportional rate below ordinary income:

$$\tau_d = \frac{\tau_{pi} - \tau_i}{1 - \tau_i}. \tag{28}$$

8.3.2 Capital Gains

Capital gains taxation of stocks begins in 1965. From 1965–1987, the United Kingdom practices a dual-income system where realized capital gains are subject to a proportional rate after an initial exempt amount. From 1988–2006, realized capital gains are taxed as ordinary income except for an initial exempt amount. From 1982–1997, the cost basis is indexed for inflation. The gap plot for the United Kingdom in Figure 5 is corrected for indexing.

8.3.3 Pensions

From 1973–1997, untaxed investors also earn a tax refund on dividends (see Bell and Jenkinson (2002)). This means that equation (3) for the expected rate of return on a pension fund changes to:

$$r \approx \left(1 + \frac{\tau_i}{1 - \tau_i}\right) d + g, \tag{29}$$

and equation (5) becomes:

$$\text{GAP} = \left(\frac{\tau_p}{1 - \tau_i}\right) d + \tau_g g. \tag{30}$$

8.4 Japan

Taxes are collected at the central level, but the revenues from specific taxes are reserved for the sub-central administration. The central tax is referred to as national tax and the sub-central taxes as prefectural tax and municipal tax, respectively. From 1953–1961, municipalities are offered the choice among three different tax schedules. We focus on option b which becomes the standard from 1962. The main data sources are Ishi (2001) and the Tax Bureau of the Ministry of Finance. We are missing the tax tables from 1949–1952.

8.4.1 Dividends

Dividend income is taxed as personal income subject to central tax rate τ_{pc} and sub-central tax rate τ_{ps} (prefectural and municipal tax). Both the central and the sub-central tax schedules are progressive. From 1950–2006, Japan offers a dividend-tax credit in the form of a rate reduction. The central reduction rate is τ_{rc} and the sub-central reduction rate τ_{rs}. The marginal tax rate on dividend income equals:

$$\tau_d = \tau_{pc} + \tau_{ps} - \tau_{rc} - \tau_{rs}. \tag{31}$$

The reduction rates are lower for higher dividend income (two income brackets). In our calculations, we choose the reduction rate for the lower income level because the higher income tax bracket is high (annual dividend income above JPY 10 million). The marginal tax rates on personal income $\tau_{pc} + \tau_{ps}$ is capped from 1961–1988:

$$\tau_d = \min\left[\tau_{pc} + \tau_{ps}, \tau_{cap}\right] - \tau_{rc} - \tau_{rs}, \tag{32}$$

i.e., the dividend-tax reduction is earned in full after the cap is imposed.

From 1965–2006, the marginal tax rate on dividends depends on the dividend amount earned from each stock in the portfolio. Therefore, the marginal tax rate does not only depend on household income but also on portfolio composition and dividend yield. The dividend is small, intermediate, or large depending on whether the dividend on the stock falls below, between, or exceeds JPY 50,000 and 250,000, respectively. In 1973, the cutoffs are doubled. From 1965–1988, large dividends are

taxed according to (31). This tax treatment referred to as Case I in Figure 3a and the text above. For intermediate dividends, the shareholder can choose between personal taxation (31) and the following simplified procedure:

$$\tau_d = \tau_{pi} + \tau_{ps} - \tau_{rs}. \tag{33}$$

Under the option, a proportional investment tax τ_{pi} replaces the central tax schedule τ_{pc} and reduction τ_{rc}. The option is referred to as Case II above. Finally, for small dividends, the shareholder can choose between personal taxation (31) and not reporting the dividend income on the tax return. In the latter case, the shareholder ends up paying the proportional withholding tax collected at source. This is referred to as Case III above.

8.4.2 Capital Gains

Before 1953, capital gains on stocks are taxed as ordinary income. From 1953–1988, stocks are exempt from capital gains tax. Capital gains tax on stocks is reintroduced in 1989. For long-term capital gains defined by the minimum holding period of one year, shareholders are given a choice. First, the investor can choose to not report the capital gain. In this case, the capital gains tax equals the withholding tax of 1% of the sales price. Second, if the investor chooses to report the capital gain on the tax return, it is subject to a proportional investment income tax (national tax and local inhabitants tax). We ignore capital gains tax in our calculations.

8.5 Germany

Personal income is taxed at the central level only. We choose the tax schedule for a married couple filing jointly. From 1958–2006, there is only one tax schedule. Then, the tax for a married couple equals two times the tax on half the income, so the marginal tax rate for a married couple with income equal to GDP5 equals the marginal tax rate of a single filer with income equal to GDP2.5. The main data sources are Börsch-Supan (1994), Corneo (2005), and Statistical Yearbook of Germany. We use the 1954 tax table for 1955 and 1956.

8.5.1 Dividends

Dividends are taxed as personal income. A special feature of the German tax code since 1958 is that the marginal tax rate is determined by a combination of a step function and a continuous function. The marginal tax rate is a constant in the lowest and the highest income brackets, and it is determined by a polynomial function in the intermediate income brackets:

$$\tau_p = a + 2b_1 \left(\frac{Y-c}{d}\right)^1 - 3b_2 \left(\frac{Y-c}{d}\right)^2 + 4b_3 \left(\frac{Y-c}{d}\right)^3, \tag{34}$$

where Y denotes taxable income and $\{a, b_1, b_2, b_3, c, d\}$ are parameters which vary over time. The polynomial function has three terms in 1958–1974, four terms in 1975–1989 (as shown), and two terms in 1990–2006 (linear function).

From 1977–2001, Germany has an imputation-tax system that works as in the United Kingdom (27). From 2002–2006, Germany switches to a partial-inclusion system, where a proportion π of the dividend is taxable income:

$$\tau_d = \pi \times \tau_p. \tag{35}$$

Following the unification of West and East Germany, personal income is also subject to a multiplicative surtax:

$$\tau_d = \begin{cases} \left(\frac{\tau_p - \tau_i}{1-\tau_i}\right)(1+\tau_{sc}) & \text{, in 1990–2001,} \\ \pi\tau_p(1+\tau_{sc}) & \text{, in 2002–2006.} \end{cases} \tag{36}$$

From 1950–2006, there is also a church tax which also enters like a multiplicative surtax. We ignore this tax. The church tax is optional (one can opt out of the church), the effective tax rate is relatively small in the order of 1-2%, and it varies geographically.

8.5.2 Capital Gains

Long-term capital gains defined by a minimum holding period of six months before 1998 and 12 months from 1998 are exempt from capital gains tax.

8.6 France

Taxes are collected at the nation level. We ignore surtaxes in our calculations. The main data sources are Fougère (1994) and Piketty (2001) .

8.6.1 Dividends

From 1950-1959, dividends are taxed at source at rate τ_w. The net dividend is taxed as personal income:

$$\tau_d = 1 - (1 - \tau_p)(1 - \tau_w). \tag{37}$$

From 1960-1964, dividends are taxed as personal income. The withholding tax is fully deductible:

$$\tau_d = \tau_p. \tag{38}$$

From 1965-2004, France has a standard imputation-tax system that offers a partial credit for corporate taxes on distributed profits:

$$\tau_d = \frac{\tau_p - \tau_i}{1 - \tau_i}. \tag{39}$$

In 2005-2006, France replaces the imputation-tax system with a partial-inclusion system where a proportion π of the dividend is taxed as personal income:

$$\tau_d = \pi \times \tau_p. \tag{40}$$

8.6.2 Capital Gains

Capital gains taxation of stocks begins in 1976. Capital gains are taxed as a separate income class subject to a low proportional rate. A relatively large amount is exempt, so we assume that the capital gains tax is effectively zero.

8.7 Sweden

Personal income is subject to national tax (central), prefectural tax, municipal tax, and church tax (sub-central). We approximate the sub-central tax rate with the average municipal tax rate, but we ignore the prefectural tax and the church tax, which are relatively small. We also ignore a social security tax (Folkpensionsavgift, 1936-1973), which is based on ordinary income including investment income. The social security tax is capped and rather small at higher income levels. When there is a choice (1953–1970), we use the national tax rates for a married couple filing jointly. The main data sources are Söderberg (1996) and Tax Statistical Yearbook of Sweden.

8.7.1 Dividends

Dividends are taxed as personal income. Sub-central taxes are deductible before 1971 and not deductible from 1971:

$$\tau_d = \begin{cases} \tau_{pc}(1-\tau_{ps})+\tau_{ps} & \text{, in 1948–1970,} \\ \tau_{pc}+\tau_{ps} & \text{, in 1971–1990.} \end{cases} \tag{41}$$

The combined marginal tax rate is capped in 1980–1985. In 1991, Sweden introduces a dual-income system, where ordinary income is subject to a progressive schedule and dividend income is taxed as investment income subject to a lower proportional rate:

$$\tau_d = \tau_{pi}. \tag{42}$$

8.7.2 Capital Gains

Capital gains taxation of stocks begins in 1910. From 1910–1951, short-term capital gains as defined by a holding period of less than five years are taxed as ordinary income, while long-term capital gains are exempt. From 1952–1966, a portion π of short-term capital gains is taxed as ordinary income:

$$\tau_g = \pi \times \tau_p. \tag{43}$$

The portion depends on the holding period:

$$\pi = \begin{cases} 100\% & \text{, if 0–2 years,} \\ 75\% & \text{, if 2–3 years,} \\ 50\% & \text{, if 3–4 years,} \\ 25\% & \text{, if 4–5 years,} \\ 0\% & \text{, if >5 years.} \end{cases} \tag{44}$$

From 1967–1976, 10% of the sales price of a security held more than five years is taxed as ordinary income. From 1977–1990, the formula for the inclusion proportion changes to:

$$\pi = \begin{cases} 100\% & \text{, if 0–2 years,} \\ 40\% & \text{, if >2 years.} \end{cases} \tag{45}$$

From 1991–2006, all capital gains are taxed as investment income:

$$\tau_g = \tau_{pi}. \tag{46}$$

The tax rule in effect 1967–1976 removes the basis from the calculation of the long-term capital gain. As above, let g denote nominal stock price growth rate. The statutory marginal tax rate on long-term capital gains equals:

$$\tau_g = 10\%\tau_p \left(\frac{(1+g)^N}{(1+g)^N - 1} \right). \tag{47}$$

This expression shows that the effect on the marginal tax rate from the loss of the basis is small over long investment horizons, especially when expected stock price growth is high. The value of the basis protection disappears in the limit as N goes to infinity. In the analysis above, we assume that $N = 15$, $g = 2\% + i$, where i equals three-year moving average inflation.

8.7.3 Pensions

From 1991–2006, imputed income from pension asset management defined as the average treasury rate during the previous year times the value of the pension assets in the beginning of the year is taxed at the proportional rate 15%. We denote the expected treasury rate with r_f and measure it as 1% plus moving average inflation. Equation (5) becomes:

$$\text{GAP} = \tau_d d + \tau_g g - 15\% r_f. \tag{48}$$

8.8 Finland

Income taxation in Finland resembles Sweden in many ways. Personal income is subject to national tax (central), municipal tax, and church tax (sub-central). We approximate the sub-central tax rate with the average municipal tax rate, but we ignore the relatively small church tax. We use the national tax tables for a married couple filing jointly with no dependents (1950–1975). The main data sources are Kukkonen (2000), the Finnish Tax Administration, and Statistics Finland.

8.8.1 Dividends

From 1950–1992, dividends are taxed as ordinary income. The marginal tax rate on dividends equals the sum of central and sub-central tax rates:

$$\tau_d = \tau_{pc} + \tau_{ps}. \tag{49}$$

From 1993–2004, Finland uses a dual-income system with full imputation. Dividends are subject to investment income tax at rate τ_{pi} and corporate tax is credited back through imputation as in the United Kingdom:

$$\tau_d = \frac{\tau_{pi} - \tau_i}{1 - \tau_i}. \tag{50}$$

Most years, the investment income rate equals the imputation rate so that $\tau_d = 0$. Recently, in 2005–2006, Finland replaces the imputation system with a partial-inclusion system such that a

proportion π of the dividend is taxed as investment income:

$$\tau_d = \pi \times \tau_{pi}. \tag{51}$$

8.8.2 Capital Gains

Capital gains taxation of stocks begins in 1920. From 1920–1985, short-term capital gains as defined by a holding period of less than five years are taxed as ordinary income, while long-term capital gains are exempt. From 1986–1992, the rules change gradually towards the new system in place since 1993. An initial (large) amount is tax exempt. A portion π of the capital gain above the tax-exempt amount is taxed as ordinary income:

$$\tau_g = \pi \times \tau_p. \tag{52}$$

The portion depends on the holding period. From 1986–1988 it is:

$$\pi = \begin{cases} 100\% & \text{, if 0–5 years,} \\ 20\% & \text{, if >5 years,} \end{cases} \tag{53}$$

from 1989–1990:

$$\pi = \begin{cases} 100\% & \text{, if 0–4 years,} \\ 80\% & \text{, if 4–5 years,} \\ 40\% & \text{, if >5 years,} \end{cases} \tag{54}$$

and from 1991–1992:

$$\pi = \begin{cases} 100\% & \text{, if 0–4 years,} \\ 80\% & \text{, if 4–5 years,} \\ 50\% & \text{, if >5 years.} \end{cases} \tag{55}$$

From 1993–2006, all capital gains on stocks are taxed as investment income:

$$\tau_g = \tau_{pi}. \tag{56}$$

Since 1986, a long-term investor has the option to define the capital gain as 50% of the sales price from 1986–1992 and 30% from 1993–2006. In our calculations, we ignore this option and the initial tax-exempt amount because the difference is small.