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ABSTRACT

The Evolution of Aggregate Stock Ownership---A Unified Explanation

Since World War II, direct stock ownership by households has largely been replaced by indirect stock ownership by financial institutions. We argue that tax policy is the driving force. Using long time-series from eight countries, we show that the fraction of household ownership decreases with measures of the tax benefits of holding stocks inside a pension plan. This finding is 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.

JEL Classification: G10, G20, H22 and H30
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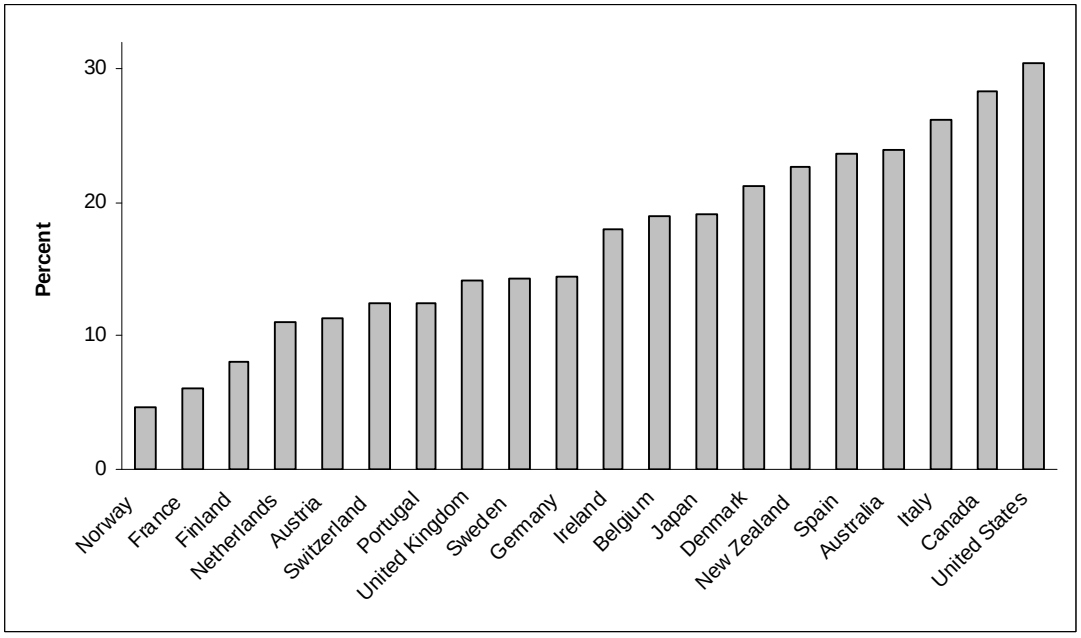
1 Introduction

A well-known fact in finance is the long-term 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 less than 30% in 2006. A large portion of households' ownership shares has migrated to financial intermediaries which manage private pension plans such as pension funds, mutual funds, and life insurance companies. A similar shift of ownership shares from households to carriers of retirement assets has taken place in all countries for which long time-series of stock ownership data exist. 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.

Traditional theory emphasizes that financial intermediaries exist to economize on transaction costs or to solve information problems. In the context of the stock market, professional asset man-

agement allows households to diversify at low cost, to earn abnormal returns from stock picking, and to benefit from corporate governance services. Therefore, one would expect that ownership migrates from households to financial intermediaries because transaction costs or information problems have increased over time. However, brokerage commission and bid-ask spread have decreased (e.g., Jones (2002)), and there are reasons to believe that information-related costs have also decreased along with computers, internet, and globalization. Hence, traditional theories seem unable to explain the disappearing household ownership.

With these observations in mind, Allen and Gale (1994), Allen and Santomero (1998), and Allen and Gale (2000), in a sequence of works, explore the idea that the costs of effectively participating in the financial markets have increased over time. Professional asset managers use complex and sophisticated financial instruments to reduce risk premia below what households can attain trough simple diversification. Hence, better risk sharing may explain why shares migrate from households to financial intermediaries. The explosion of financial innovations since 1970 and the trading volume of derivative securities since 1990 suggest that the benefits of intermediated stock ownership has increased in recent years. However, pension funds grow after World War II, and mutual funds are small as late as 1980. If improved risk sharing is responsible for the shift of ownership from households to financial intermediaries, one would expect that mutual funds grow and not pension funds. Most of the ownership shift from households to pension funds takes place from 1960–1980 before the trading in derivatives securities begins. In fact, the timing suggests that the change in aggregate stock ownership structure may be the cause of financial innovation rather than its consequence.

A decade earlier, economists often looked for tax-based explanations of economic behavior and debated whether any non-tax explanation had merit. In this environment, Ippolito (1986) proposes the hypothesis that the growth of pension funds is the result of tax policy. The principles for the taxation of pensions date back to the Revenue Act of 1921 (TRA 1921), which states that employers and employees can contribute pre-tax dollars for retirement purposes and that personal income tax is paid upon withdrawal of funds. These tax rules imply two tax benefits over direct stock ownership. First, investment returns accrue tax free inside a pension plan whereas dividends

and capital gains on directly held stocks are subject to personal income tax. Second, by contributing pre-tax dollars into a pension plan, households shift taxable income from high-income work years to low-income retirement years. Smoothing income reduces tax liability in a progressive tax system. As a result of these two tax benefits, indirect stock ownership through pension plans gradually replaces direct household ownership. The process is slow because contributions into pension plans are subject to statutory limits and there is no incentive to invest after-tax dollars into a pension plan as these dollars would be taxed a second time upon withdrawal.

The objective of our paper is to test the tax theory of pension funds. We compile aggregate stock ownership data and construct proxy variables for the tax benefits of pensions from a detailed decomposition of eight countries' tax codes over sixty years. We find that proxy variables that capture the benefit from tax-free investment returns are strongly correlated with changes in the fraction of household ownership, while proxy variables for the benefit from income smoothing have no explanatory power. For calibrated parameters, the compound-interest effect of tax-free returns appears large enough to justify the gigantic shift in aggregate stock ownership that has taken place since World War II. The tax benefits from income smoothing are surprisingly small, however.

Our empirical investigation rests on important time-series variation. Personal income taxes are relatively small before World War II and the tax benefit of pensions is insignificant. However, personal income taxes jump in the beginning of World War II and create a strong tax incentive to save inside a pension plan. Interestingly and important for the argument, income taxes remain at high levels after World War II and, in fact, rapidly increase through the combination of nominally-fixed tax tables and inflation (bracket creep). By the 1970s, the US upper-middle class is exposed to effective tax rates that approach the statutory maximum of 70%. The Tax Reform Act of 1986 (TRA 1986) cuts marginal tax rates in half and tax tables are indexed, but by this point in time, direct ownership of stocks has largely been replaced by intermediated ownership and reached the low levels we see in Figure 1. The institutional shift from pension funds to mutual funds also supports the tax argument. Pension funds grow rapidly after World War II and peak with an ownership share of 28% of the stock market in 1985. Mutual funds grow after the enactment of 401(k) and peak at the end of our time-series with an ownership share of 20% of the stock market.

Mutual funds become important when they are granted the tax status of pension funds.

The empirical investigation also exploits important cross-country variation. Personal income tax influences stockholders in two ways. First, dividends are taxed as personal income and are, therefore, subject to the general bracket creep before TRA 1986. Second, capital gains taxation is nominal and stockholders must pay personal income tax on inflationary gains. In our data, the combined effects of tax and inflation appear to have the strongest impact on the stock ownership structures in the United States, United Kingdom, and Sweden, three countries with high effective tax rates, bracket creep, and taxation of long-term capital gains. At the other end of the spectrum, the combined effects of tax and inflation appear to be relatively mild in Germany with tight monetary policy and in Japan with low effective tax rates. In addition, neither Germany nor Japan taxes long-term capital gains.

Previous empirical tests of the tax theory of pension funds have used micro-level household data. A reference list of unpublished working papers can be found in the survey by Bernheim (2002). The idea is to correlate households' savings decisions with marginal tax rates. One limitation of this approach is that the marginal tax rate is a function of the savings decision. We use macro-level data. Our statistical results are robust to a range of proxy variables for the marginal tax rate including the average statutory rate and the top statutory rate, which are immune to the endogeneity problem mentioned above.

We conclude that the proliferation of financial intermediaries in the stock market is the consequence of tax policy. Standard textbooks of financial intermediation largely neglect the role of intermediaries as carriers of tax benefits. We also conclude that personal tax has become increasingly less relevant for tax policy and research in financial economics as ownership shares have migrated from taxed households to tax-deferred pension plans. Nevertheless, personal tax on dividends and capital gains appear regularly in the policy debate, and textbooks in corporate finance present theories of capital structure and payout policy under the assumption that households own all shares. Finally, within the ramifications of Tax-CAPM (Brennan (1970)), we conclude that stock prices would have been much lower without the dynamic tax clientele shift that we have observed. Sialm (2008) explores this proposition in time-series data from the United States.

The rest of the paper proceeds as follows. Section 2 shows the main stylized facts. Section 3 presents the hypothesis and the methodology. Section 4 discusses personal income tax systems in the eight sample countries. Section 5 presents our empirical results. Alternative explanations are discussed in Section 6, and 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.

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 listed and non-listed stocks. The data are constructed by the Federal Reserve, which 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, including non-profit organizations, and 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. 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.[1] In the statistical analysis below, we use the original numbers from the Flow

[1] According to Statistics of Income, 1960-2007, non-financial corporations receive 9% of taxable dividends over the

of Funds.[2]

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 book value of listed and non-listed stocks exceeds the market value of listed stocks by 26 percent over the 1980–2005 period. Therefore, we adjust the fractions from Statistics Canada by the overshooting 26 percent. Specifically, for households, we subtract 0.26 from the observed fraction of household ownership and divide by 0.74 and, for all others, we divide the observed fraction of ownership by 0.74. The adjusted fraction of household ownership in 2006 is 29% as shown in Figure 1.

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 from Sweden and Finland are compiled using a variety of methods.[3]

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

period 1960-2007. We do not use this estimate because we do not know the proportion of inter-corporate dividends that are paid by fully-owned subsidiaries.

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

[3]Sweden: the 1950 data are 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.

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 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)).[4] Foreign ownership decreases between 1961 and 1990 in Canada when the country gains political independence from the United Kingdom.

[4]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.

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).

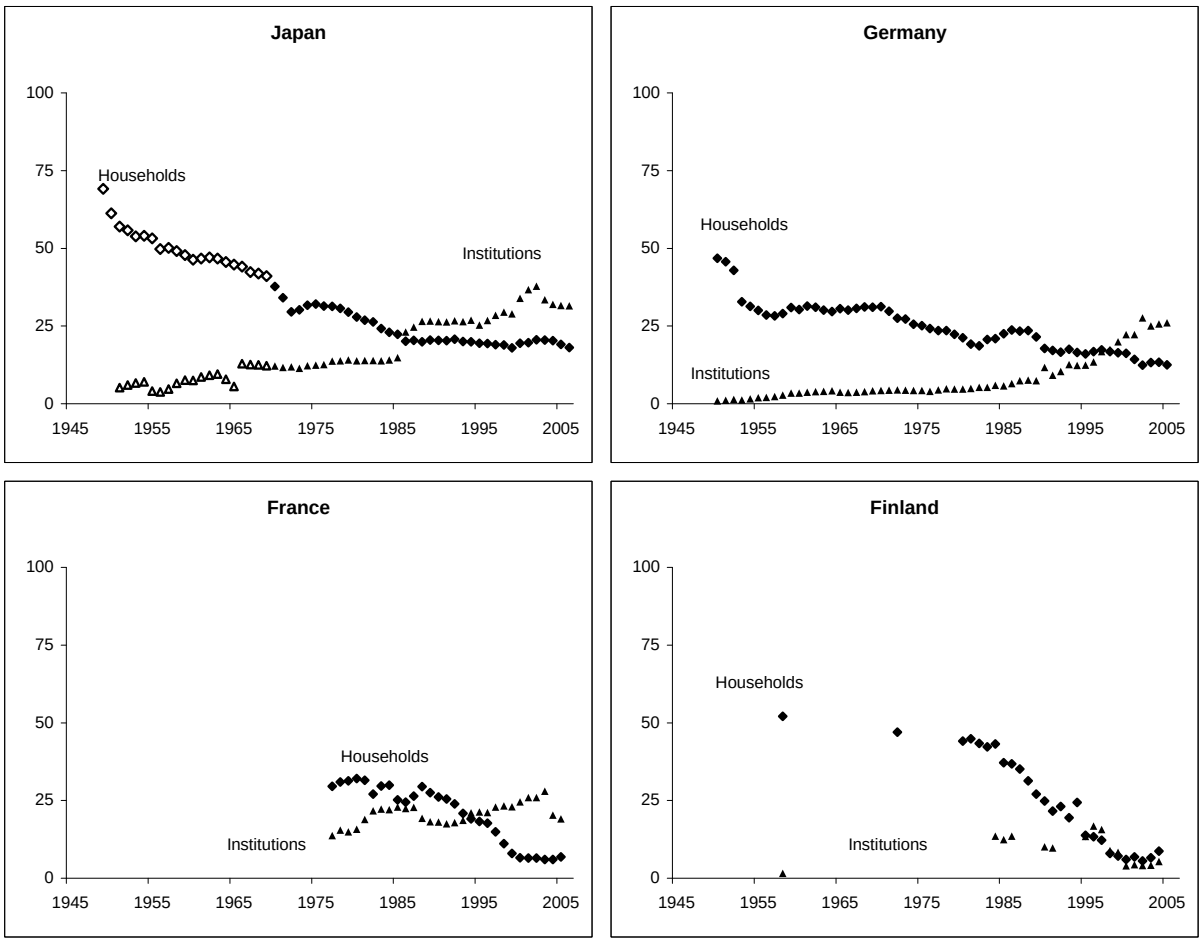
Figure 2a: Evolution of Stock Ownership

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

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, non-financial corporations pick up the residual (not shown). The plots illustrate 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. In Canada, the fraction of household ownership 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 two percentage points per year.

Figure 2b: Evolution of Stock Ownership

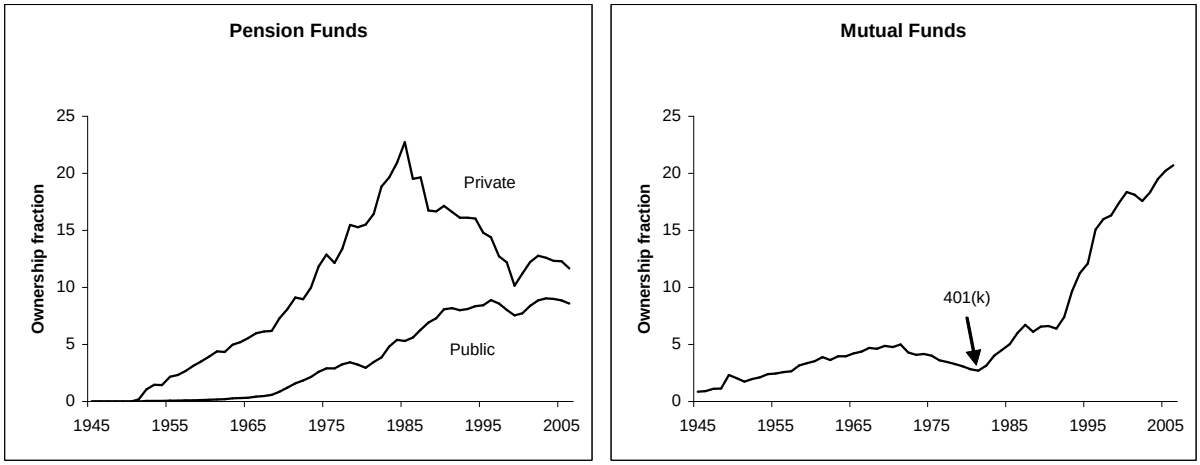


The figure shows the aggregate ownership fraction of households and financial institutions (pension funds, mutual funds, and insurance companies) in percent.

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 to mark the merger of two time-series with different qualities. The four plots emphasize interesting cross-country variation relative to the countries in Figure 2a. 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. We do not know much about ownership structure before World War II. Small-sample evidence by Franks, Mayer, and Wagner (2005) suggests that the transformation from direct ownership by households to intercorporate ownership takes place in Germany in the 1920s and the 1930s.

Figure 3: Stock Ownership of U.S. Mutual Funds and Pension Funds



The two figures show the stock ownership fractions of private and public pension funds and of mutual funds in percent of all stocks. The figure for mutual funds also marks the introduction of 401(k) plans in 1982. Source: Flow of Funds.

Figure 3 plots the time-series of stock ownership shares of U.S. pension funds and mutual funds, respectively. Pension funds grow after World War II. Their ownership share peaks in 1985. Mutual funds are initially small and do not begin to grow before the contribution limits for employer-sponsored 401(k) plans have been specified by the Economic Recovery Tax Act of 1981 (ERTA 1981).[5] We see a sharp decline in the ownership share of private pension funds after 1985. These ownership patterns suggest that retirement assets move from defined benefit plans managed by pension funds to defined contribution plans managed by mutual funds.

[5]Time-series of bond ownership shares show similar traits. Mutual funds hold less than 2% of the taxable bond market in 1981 and increase their holdings to approximately 10% in 2006.

3 Hypothesis and Methodology

3.1 Tax Theory of Pension Funds

As stated in the Introduction, the principles for the taxation of private pensions date back to TRA 1921. Employer and employee contributions to private pension plans 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 a pension liability is backed by off-balance sheet assets held by a financial intermediary. 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 (IRAs) that allow households to hold stocks directly are relatively recent additions.[6]

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, and life insurance companies. Pension funds and life insurance companies dominate the United Kingdom and Canada, and trust banks play the role of pension funds in Japan. Life insurance companies offer funded pension plans in Germany, Sweden, and Finland, where company pension funds are small. Book reserves play an important role in Germany, Japan, and Sweden. Many private pension plans in France are unfunded (pay as you go). Public pension plans such as the US social security system tend to be unfunded and are not part of our analysis.

The following stylized setting illustrates the argument. Suppose an individual chooses between saving inside or outside a pension plan. 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.

[6]IRAs can be found in Canada from 1957, United States 1975, France 1990, Sweden 1994, and Germany 2002. Using data from the Investment Company Institute (ICI), we estimate that 3% of US equities are held directly in IRAs.

Investment returns outside the pension plan are taxed at rate $\tau_i, i = 1, ..., N$. All taxes and the horizon are known at time 0. Consider an individual who decides to set aside \$100 pre-tax money for retirement. If he invests outside the pension plan, the after-tax payoff after N years equals:

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

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

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

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

Equations (1) and (2) are equal and the individual is indifferent between saving outside or inside the pension plan if $\tau_0 = \tau_w$ and $\tau_i = 0$ for all i. This implies that pension savings inside the pension plan offers two potential tax benefits. First, the individual benefits from income smoothing when the tax schedule is progressive and $\tau_0 > \tau_w$, i.e., the individual reduces his life-time tax burden by saving when income is high and withdrawing when income is low. Second, investment returns inside the pension plan accrue tax free, $\tau_i = 0$. If we extend the model with uncertainty and assume that individuals are risk averse, saving inside a pension plan 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 obligation is reduced. In other words, a risk-averse investor prefers an uncertain future tax liability to a certain tax payment today.[7]

For the various reasons outlined above, households have a tax incentive to switch from direct to indirect ownership. Is it a plausible explanation for the evolution of aggregate stock ownership? First, households do not have to make an active decision on their own. Retirement benefits are

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

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). This means that information about the tax benefits spread fast to a broad population. Second, 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. Households contribute to their pension plans through payroll deduction, which by construction is a slow process of building retirement wealth. Moreover, households do not want to shift after-tax money into a pension plan as this would subject this money to a second round of income taxation. Third, we do not expect ownership to migrate entirely to financial institutions because there are costs associated with holdings stocks in a pension plan. Assets held inside a pension plan are illiquid, there are many other reasons to save, and households may hold stocks for speculation or for incentive reasons (insider ownership).[8] In addition, there are investment restrictions and stocks that the investor desires may not be available inside the pension plan. 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.

Equations (1) and (2) have been derived for the private pension system of the United States, but the equations apply to other institutional environments. For example, under the book reserve systems in Germany, Japan, and Sweden, actuarial returns on investments are used instead of market returns. Actuarial returns also accrue tax free. When private pension plans are unfunded as many plans are in France, the individual benefits from income smoothing, but not from tax-free investment returns. The pay-as-you-go plan is, therefore, a special case. Equations (1) and (2) ignore some institutional details. Social security taxes are levied on wages, but not on employer contributions to pension plans. Escaping social security tax is, therefore, an additional tax benefit of saving inside a pension plan. Social security taxes are capped and, therefore, irrelevant at higher income levels that matter more for contributions to private pension plans. There are exceptions. In the United States, the cap on payments into the public health system (medicare) is removed

[8] Early withdrawal or borrowing against the assets in the pension plan are subject to penalty, if at all possible.

in 1990 and, in Sweden, where social security tax rates are quite high, the cap on social security contributions is removed in 1968. Equations (1) and (2) also ignore corporate tax because wages and contributions to private pension funds are tax deductible expenses for the firm. In countries where pension liabilities are held on the books, contributions are also made before tax, but corporate tax must be paid, when the book reserves are dissolved. Hence, corporate tax is deferred along with personal tax. We ignore this feature because off-balance sheet pension plans are also available in countries where book reserves are used.

3.2 Empirical Measures

First, we construct a measure of the benefit of avoiding tax on investment income. Equations (1) and (2) 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 gains rate, and τ_d and τ_g the marginal tax rates on dividends and capital gains, respectively. The expected rate of return from holding stocks inside the pension plan is:

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

and the expected rate of return from direct stock ownership outside the pension plan 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 the empirical analysis and we therefore work with real rates of return. Let i denote the expected inflation rate. A simple measure is the difference between the real rate of return from holding stocks inside and outside the pension plan:

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

Expected inflation enters the equation in the denominator. It also enters in the marginal tax rates τ_d and τ_g (bracket creep) and in the capital gains growth rate g because the taxation of capital

gains is nominal.[9]

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 the pension plan, life-time tax liability equals $N \cdot T(Y)$. If instead the individual saves inside the pension plan, 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 the pension plan and the tax code is progressive. We construct three closely-related measures of the benefit to income smoothing:

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

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 effective 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 for other reasons than minimizing tax liability reduces SMOOTH.

3.3 Parameters

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

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

3.3.1 Marginal Tax Rates

We construct a proxy for the marginal tax rate of a representative household that chooses between holding stocks inside or outside a pension plan. 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 retirement income. As our base case, we assume that the representative household has an annual income of five times Gross Domestic Product per capita (GDP5). 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) calculates 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

Estimates 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 a three-year moving average. The inflation estimate is based on the Consumer Price Index. The 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. Our approach means that we treat payout policy as exogenous and do not allow for supply-side adjustments to changes in tax policy (e.g., Black (1976), Chetty and Saez (2005)). The parameter 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 time-series begins at 5.3% in 1950, and it ends at 2.3% in 2006.[10] The geometric average real GDP growth rate in the pooled sample is 2.9%. The average is influenced by high real growth rates after World War II, especially in Germany and Japan, so we assume that investors expect lower real stock price growth.

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 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.[11] 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. These assumptions imply that the number of work years is $N = 40$ and the number of retirement years is $M \in [6.4, 16.4]$. The number of retirement years is an approximately linearly increasing function of time. The importance of saving for retirement increases over time.

[10] 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.

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

4 Evolution of 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.

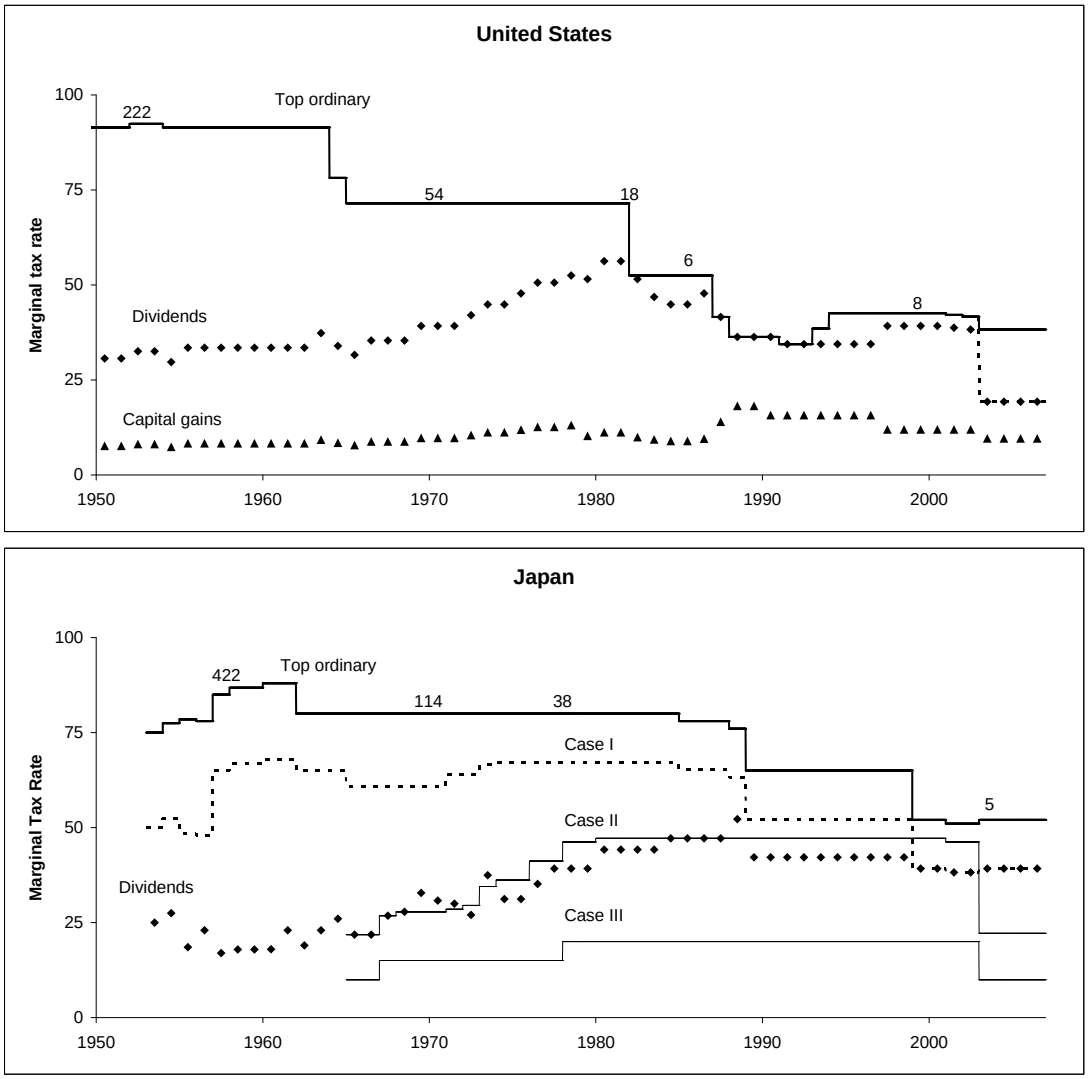
The United States begins taxing capital gains on stocks in 1916. Some other sample countries begin taxing capital gains on stocks relatively late: the United Kingdom in 1965 and Canada in 1972. Sweden begins taxing short-term capital gains in 1910 and Finland in 1920, but long-term capital gains are 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.

4.1 Marginal Tax Rates

The sequence of plots contained in Figure 4 shows 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 marginal tax rate on dividends (diamonds) and capital gains (triangles) of our representative GDP5 household.

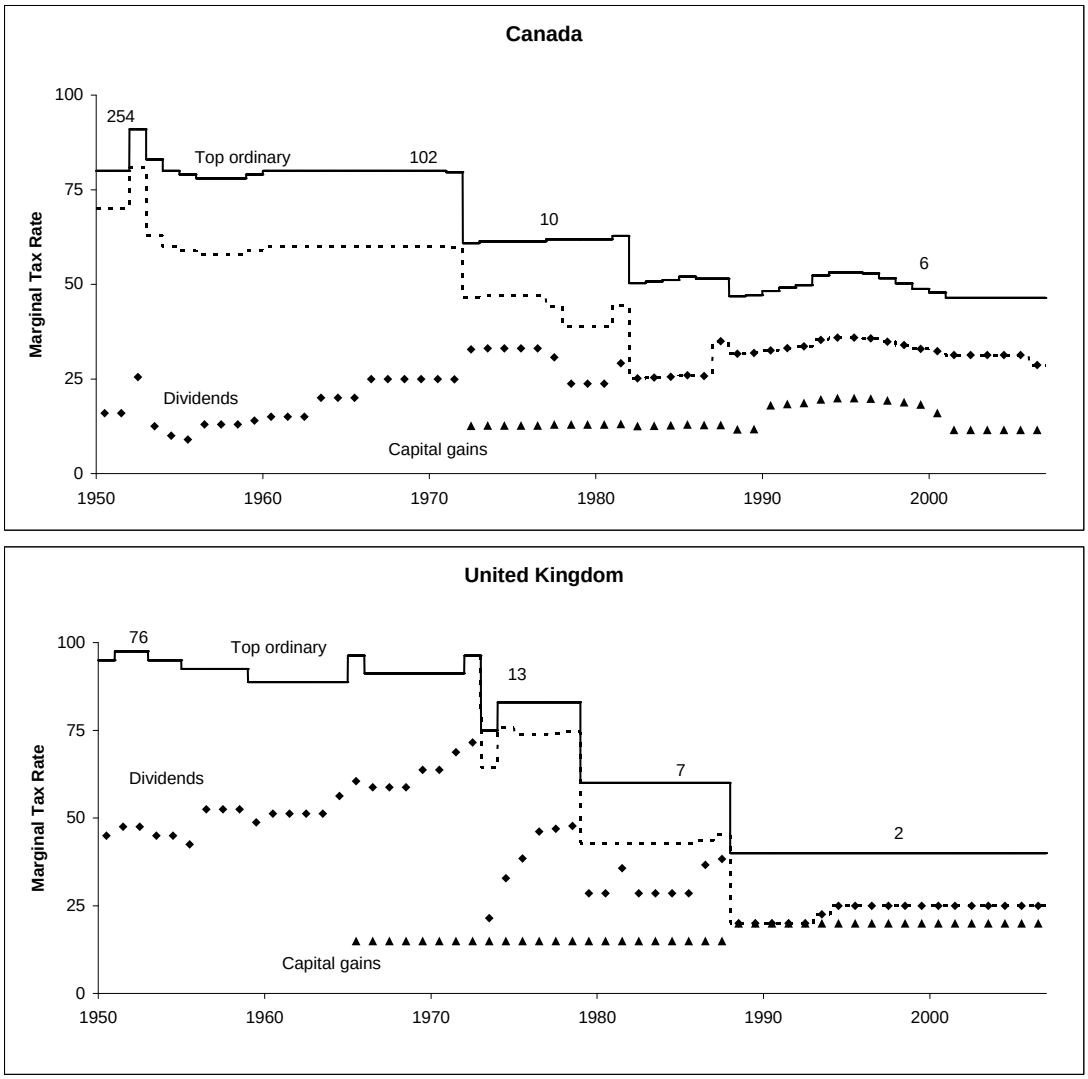
The top panel of Figure 4a shows the evolution of marginal tax rates in the United States. We assume that state tax is a constant 5%, which is close to the average top statutory rate. The top statutory rate on ordinary income equals the top statutory rate on dividends between 1950 and 2002. Since 2003, 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

Figure 4a: Marginal Tax Rates



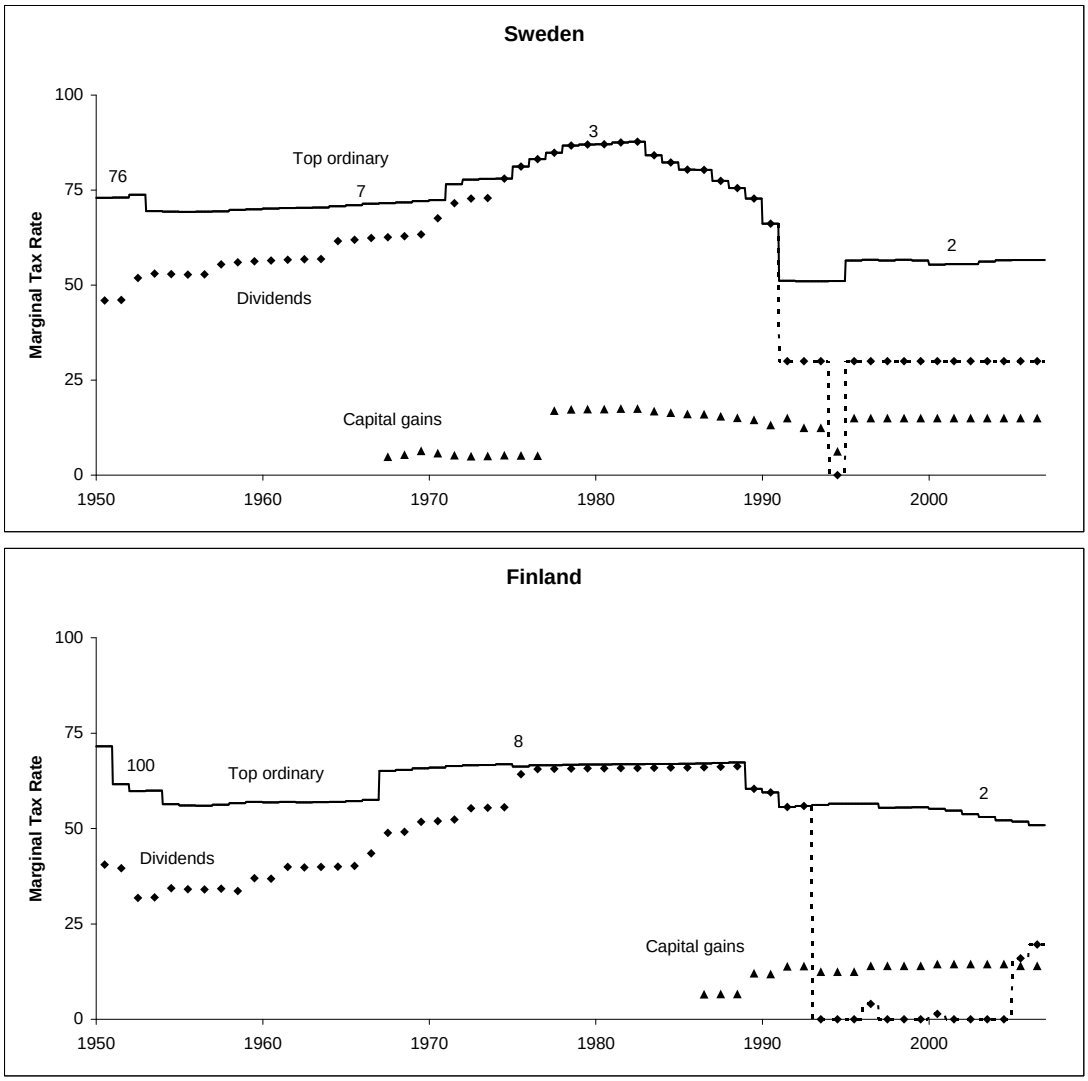
The figure shows the top statutory tax rate (solid line), the top statutory rate on dividends (dashed line), the marginal tax rate on dividends (diamonds) and long-term capital gains (triangles) of the representative GDP5 household. The numbers adjacent to the top statutory rate are the top income tax 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 4b: Marginal Tax Rates



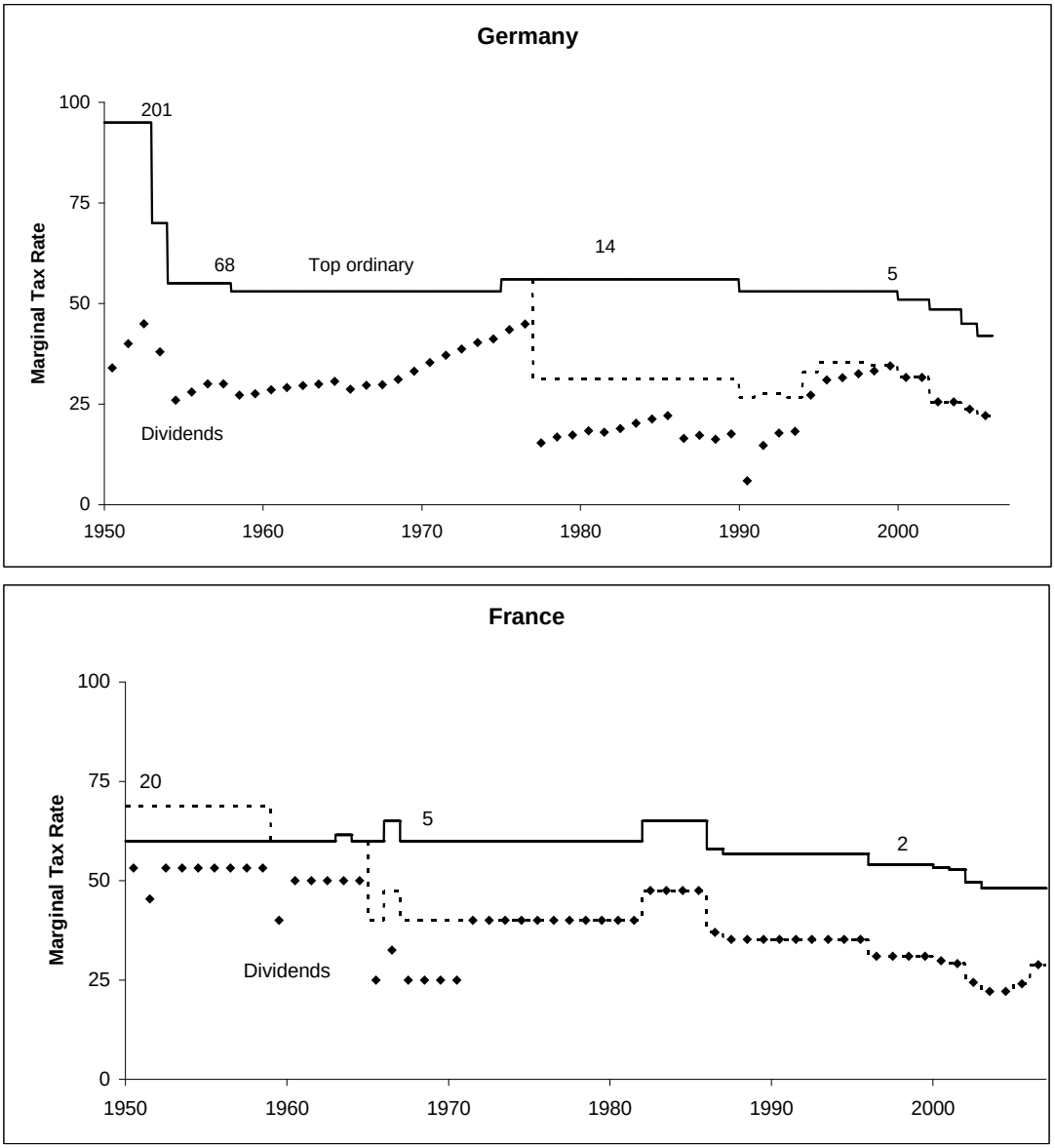
The figure shows the top statutory tax rate (solid line), the top statutory rate on dividends (dashed line), the marginal tax rate on dividends (diamonds) and long-term capital gains (triangles) of the representative GDP5 household. The numbers adjacent to the top statutory rate are the top income tax brackets expressed in multiples of GDP per capita.

Figure 4c: Marginal Tax Rates



The figure shows the top statutory tax rate (solid line), the top statutory rate on dividends (dashed line), the marginal tax rate on dividends (diamonds) and long-term capital gains (triangles) of the representative GDP5 household. The numbers adjacent to the top statutory rate are the top income tax brackets expressed in multiples of GDP per capita.

Figure 4d: Marginal Tax Rates



The figure shows the top statutory tax rate (solid line), the top statutory rate on dividends (dashed line), the marginal tax rate on dividends (diamonds) and long-term capital gains (triangles) of the representative GDP5 household. The numbers adjacent to the top statutory rate are the top income tax brackets expressed in multiples of GDP per capita.

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 marginal tax rate on dividends for the GDP5 household (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 income growth pushes 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 capital gains tax rate (triangles) is approximately constant around 10%.

The eight tax plots share several common features. In the first decade after World War II, high top statutory rates on personal income are coupled with low marginal tax rates for the GDP5 household. In the subsequent decades, 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 4c), the marginal tax rates of the GDP5 household 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 in other countries: the United Kingdom 1988, Japan 1989, Sweden 1991, and Finland 1993. In all countries, the marginal tax rates of the GDP5 household become equal to top statutory rates after TRA 1986, but top statutory rates are much lower than in the past.

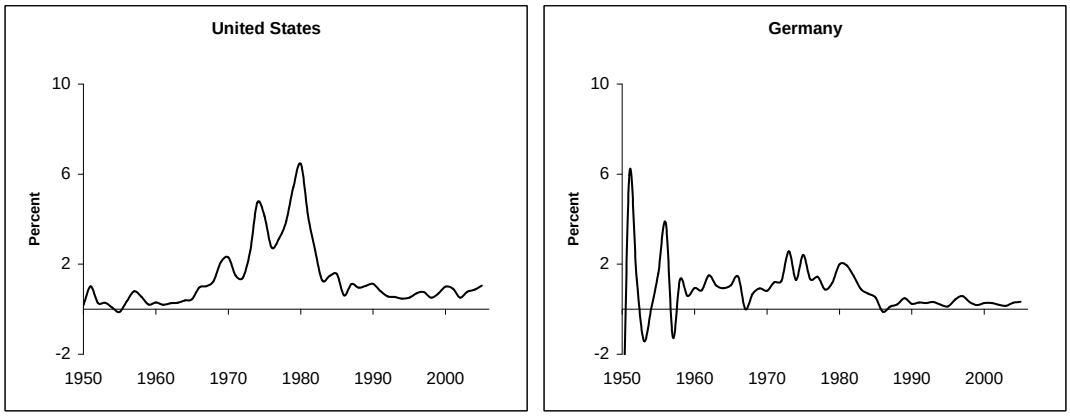
4.2 Bracket Creep

A quantitative measure of bracket creep can be constructed as 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. The left of Figure 5 plots the time-series of CREEP5 for the United States. The measure peaks at approximately 6%, which means that real tax liability increases by six percentage point in a single year. The cumulative real

Figure 5: 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).

tax increase between 1973 and 1982 amounts to the stunning amount of 40% of personal income. Of course, an implicit tax increase of this order of magnitude does not materialize. Tax tables are adjusted in 1977-1979 and 1982, and formal inflation indexation is adopted with TRA 1986.[12] Households do not stay passive either. They respond by bargaining for pensions over wages, selling stocks to finance consumption, buying municipal bonds, increasing tax-deductible mortgages, etc. The time-series for Germany are seen to the right of Figure 5. Bracket creep is relatively mild in Germany because inflation is kept under tight control. Consequently, German tax tables are never indexed. The CREEP plots for the United Kingdom and Japan resemble United States, and the plots for Canada, France, Sweden, and Finland are similar to Germany. Bracket creep is less pronounced in Canada, France, Sweden, and Finland because, at the time of the inflation of the 1970s, the GDP5 household already pays the top statutory rate on most of his income, i.e., effective tax rates are close to top statutory rates.

[12]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.

4.3 Tax Benefits 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 6 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.[13] Shareholders in Canada, France, Germany, and Japan are partly protected from bracket creep 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 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 and Sweden, the fraction of household ownership decreases 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.

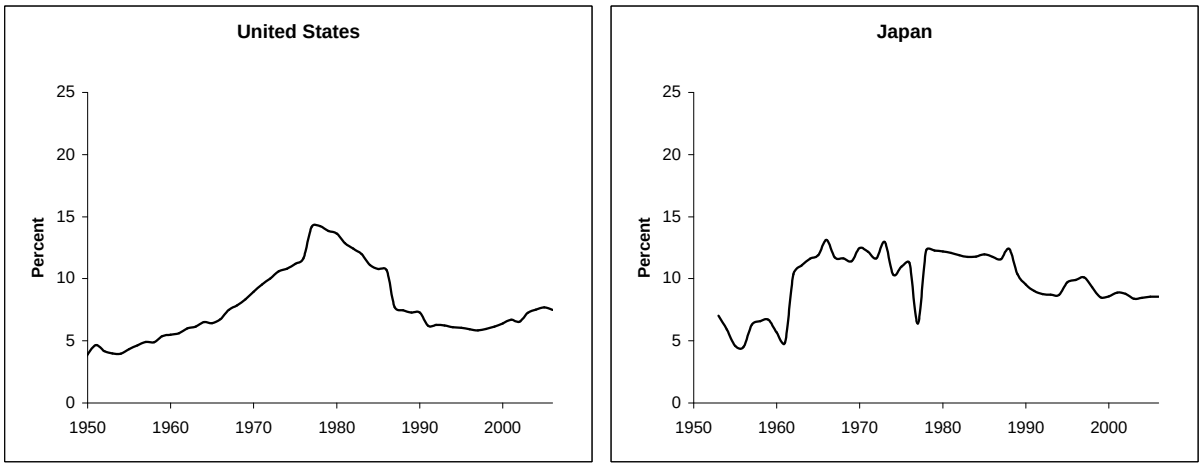
The averages of the three measures of SMOOTH5 are positive because personal tax tables are progressive. The average annual reduction in the tax bill is 7.3%, the increase in disposable income is 4.8%, and the reduction in the effective tax rate is 2.7%. These numbers are quite small given that they are 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 7

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

Figure 6: Benefit of Tax-Free Returns

The figure shows the real rate of return difference between saving inside and outside a pension plan for a household with an income multiple of five times GDP per capita (GAP5). 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.

Figure 7: Tax Benefit of Income Smoothing



The figure shows the tax benefit to income smoothing for a household with an income multiple of five times GDP per capita (SMOOTH5). The numbers are expressed in percent.

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 relatively flat. The correlation coefficient between GAP5 and SMOOTH5 is small.

5 Household Ownership and the Tax Benefits of Pensions

Our objective is to estimate households' aggregate response to the tax incentives to save inside a pension plan. The response variable is the change in the fraction of household ownership Δy. The incentive variables are GAP5 and SMOOTH5. 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 pension plan are slow-moving variables. Any delayed response is likely to be highly correlated with the current values of the incentive variables. Life expectancy and, therefore, the need to save for retirement increases at a steady rate over time. The effect of

this trend variable is captured by the regression intercept. The regression can be estimated with the eight-country panel data set. The estimation procedure corrects for first-order autocorrelation and heteroscedasticity.[14] 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: Pooled Regressions

	(1)	(2)	(3)	(4)
Constant	–0.92 (–11.3)***	–0.25 (–1.3)	–0.20 (–0.9)	0.19 (0.7)
GAP5		–32.2 (–6.3)***		
Dividend term			–36.5 (–3.7)***	
Capital gains term			–29.3 (–2.5)**	
Dividend tax rate				–1.9 (–5.3)***
Capital gains tax rate				–1.6 (–1.7)*
SMOOTH5		1.5 (0.7)	1.3 (0.6)	–2.5 (–1.0)
R^2	0.000	0.037	0.038	0.032
#Obs	395	392	392	392

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

Table 2 reports our main results. SMOOTH5 is measured as the reduction in the tax bill (the top row of Equation (6)). Specification (1) ignores the tax variables and reports only the average annual change in household ownership across the eight countries. The average decline in the fraction of household ownership is 0.92% per year. Specifications (2)–(4) include the tax variables. The coefficient of GAP5 is significantly different from zero, while the coefficient of SMOOTH5 is not.

[14] 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.

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 pension plan results in an annual reduction of the fraction of household ownership by one percentage point. When we break down GAP5 into its components (Specifications (3) and (4)), we see that both terms and the marginal tax rates on dividends and capital gains have explanatory power. These results suggest that both dividend tax and capital gains tax matter.

Table 3: Decade-by-Decade Regressions

	1950-59	1960-69	1970-79	1980-89	1990-99
Constant	–0.64 (–0.7)	–0.59 (–1.3)	0.21 (0.9)	–0.31 (–0.6)	–1.80 (–2.5)**
GAP5	32.9 (0.8)	–23.6 (–1.7)*	–38.2 (–5.4)***	–32.9 (–3.5)***	25.6 (0.8)
SMOOTH5	–12.3 (–1.0)	7.6 (1.8)	0.8 (0.2)	2.7 (0.6)	8.5 (2.1)
R^2	0.165	0.210	0.090	0.100	0.027
#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 tax benefits of saving inside a retirement account. The proxy variables are functions of marginal tax rates that are evaluated at the 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.

Table 3 reports the results of estimating the regression model (8) decade by decade. We report only the results using 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 results demonstrate that the explanatory power of the regression model (8) is due to cross-section variation in marginal tax rates during the high-inflation period 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.

We carry out many robustness checks. The pooled regression model (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.[15] We also examine the regression model's sensitivity to varying the model parameters of GAP and SMOOTH. The results are summarized in Table 4. In Specifications (1) and (2), we evaluate the tax variables at the income level GDP1 and the top statutory rate, respectively. Evaluating the tax variables at other income multiples from GDP2 to GDP15 or at the average statutory rate produce regression coefficients that fall between these two extremes. The explanatory power of GAP is not affected, while the coefficients of SMOOTH remain insignificant. We also vary the financial parameters keeping the tax parameters constant (evaluated at GDP5). Specification (3) assumes that both the dividend yield and the capital gains yield are zero. The stripped-down GAP variable measures the impact of capital gains tax on inflation. Intermediate combinations of positive dividend yields and capital gains growth rates generate similar results. Specification (4) models expected dividend yield as a three-year moving average keeping all other assumptions the same. Again, the explanatory power of GAP is unaffected.

The regression results are robust to varying the model parameters because none of the alternatives change the ordering of high-tax versus low-tax countries during the high-inflation period before TRA 1986. The fraction of household ownership decreases fast in the United States, United Kingdom, and Sweden, where marginal tax rates are high, and the fraction of household ownership decreases slowly in Germany and Japan where marginal tax rates are low. Since the country ordering is preserved, only the magnitude of the regression coefficients, and not the statistical significance, changes across the alternative specifications. The regression to the far right in Table 4 supports this interpretation. Specification (5) is a regression where the dummy variable for each country is interacted with an indicator variable which equals one for 1970–1989 and zero otherwise. The fraction of household ownership decreases in all countries. However, the fraction of household ownership decreases faster in Sweden and the United Kingdom in 1970–1989 than in other countries or other time periods. The tax variable GAP5 picks up this time-series and cross-country correlation. Any non-tax explanation must account for this particular pattern.

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

Table 4: Robustness Checks

	Tax parameters		Financial parameters		No parameters
	GDP1	Top rate	Zero yield	Moving average	Dummy variables
	(1)	(2)	(3)	(4)	(5)
Constant	–0.28	–0.13	–0.90	–0.54	–0.74
	(–2.1)**	(–0.9)	(–5.1)**	(–2.8)***	(–8.9)***
GAP	–41.2	–23.7	–57.1	–21.1	
	(–6.0)***	(–5.5)***	(–4.6)***	(–5.3)***	
SMOOTH	–1.1	–1.7	2.5	1.7	
	(–1.5)	(–1.0)	(1.0)	(0.7)	
Sweden					–0.98
					(–5.2)***
United Kingdom					–0.60
					(–2.9)***
United States					–0.41
					(–1.2)
Finland					–0.30
					(–0.8)
Japan					–0.15
					(–0.3)
Germany					0.31
					(0.6)
Canada					0.58
					(1.4)
France					0.58
					(0.9)
R^2	0.040	0.036	0.022	0.031	0.049
#Obs	391	392	392	361	395

The table reports the results of varying the model parameters or GAP and SMOOTH. (1) The tax variables are evaluated at an income multiple of one times GDP per capita. (2) The tax variables are evaluated at the top statutory rate. (3) The tax variables are evaluated at zero dividend yield and zero capital gains yield. (4) The tax variables are evaluated at the three-year moving average dividend yield. (5) Country dummy variables interacted with an indicator variable for 1970–1989.

6 Alternative Explanations

Allen and Santomero (1998) hypothesize that households respond to increasing participation costs by shifting from direct to indirect stock ownership. Possible proxy variables for participation costs include stock market turnover, idiosyncratic volatility, cross-border ownership, and the opening of stock options and stock futures markets. Stock market turnover may be a consequence of dynamic risk management strategies, the level of idiosyncratic volatility measures the number of stocks that are required to diversify a stock portfolio, cross-border investing requires more expertise than purchasing domestic stocks, and the use of derivatives for risk management requires a certain level of sophistication. The four proxy variables for participation costs reach their time-series high in the 1990s and 2000s after most shares have already shifted from households to financial institutions. Time-series of stock market turnover in the United States, United Kingdom, and Sweden begin a long-term increase starting around 1980 with the fastest increase taking place recently. For example, in the United States, annual stock market turnover is 20% from 1950–1980, 50% from 1980-1989, and 100% from 1990-2006 (French (2008)). Idiosyncratic volatility is a slow-moving variable which increases at a constant rate over time (Campbell, Lettau, Malkiel, and Xu (2001)). The foreign ownership fraction increases rapidly in all countries after 1990 (see Table 1). Markets for standardized stock options open in the United States 1973, United Kingdom 1982, France and Sweden 1985, and Germany 1990.

Commentators of earlier versions of this paper have suggested a learning explanation of the observed evolution of aggregate stock ownership. Suppose that directly-held stock portfolios are undiversified, and that professionally-managed portfolios are well diversified. Then, stock ownership shares migrate from households to financial intermediaries as households learn about the low-cost diversification alternative offered by financial intermediaries. Ownership data from the Survey of Consumer Finances, brokerage accounts, and the Swedish share registry verify that directly-held stock portfolios are undiversified,[16] and institutional ownership data from 13(f) filings suggest that institutional stock portfolios include many stocks. We want to raise a few objections. First, the argument requires that the amount invested in directly-held stocks is large relative to total

[16]See, e.g., Polkovnichenko (2005), Goetzman and Kumar (2008), Dahlquist, Robertsson, and Rydqvist (2009).

household wealth including human capital, residential real estate, retirement accounts, and claims on the social security system. Otherwise, shifting a small amount into a mutual fund portfolio has a negligible effect. Second, learning may contribute to the underlying time trend in the aggregate stock ownership data, but it does not explain the different country paths, or why pension funds grow after World War II and why mutual funds grow after the enactment of 401(k). The first mutual fund was offered to the U.S. market in 1924 as a low-cost diversification vehicle. Sixty years is a long time to learn.

Labor economist have proposed a number of non-tax benefits of defined benefit plans that may contribute to the growth of pension funds. Defined benefit plans may affect productivity, since defined benefit formula makes it costly for workers to leave employment too early or to quit employment too late. Moreover, private annuity markets are believed to suffer from adverse selection because people who expect to live long choose to purchase life annuity contracts and thereby raise the insurance cost for people with shorter life expectancy. A mandatory defined benefit plan such as the social security system can offer fairly priced life annuities. Given these potential effects on labor productivity and risk sharing in the economy, Bernheim (2002) concludes that the tax benefits of private pensions do not imply that "the growth of the pension system is exclusively, or even primarily attributable to the tax system." We notice that the moral hazard and adverse selection arguments apply to defined benefit plans and cannot explain the growth of defined contribution plans post-401(k). Also, there is no reason to believe that moral hazard and adverse selection suddenly become important after World War II (Ippolito (1986)). Life annuities appear in the United States in 1772, and the legislation of annuities dates back to the late 1930s after the beginning of the social security system in 1935.

7 Conclusions

This paper has analyzed 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 changes in the fraction of household ownership is correlated with proxy variables for marginal tax rates. Ownership in the eight sample countries

follow different paths depending on features of the tax code and exposure to inflation in the 1970s and the 1980s. As inflation takes off, the fraction of household ownership decreases fast in the United States, United Kingdom, and Sweden where 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 and Japan with tight monetary policy and no tax on long-term capital gains.

The implications of these results for tax policy, research, and teaching are outlined at the end of the Introduction. We conclude the paper with suggestions for future research. The tax theory of pension funds may explain the growth and prevalence of inter-corporate ownership in many countries. For example, we see in Table 1 above that inter-corporate ownership increases in Sweden when marginal tax rates increase. Do firms in Germany and Japan hold stock portfolios to hedge pension liabilities on the books? Furthermore, we have argued that households respond to tax incentives by shifting from direct to indirect stock ownership. Do we see similar portfolio adjustments in aggregate ownership data of bonds and real estate? The cross-country panel approach used in this paper may provide a useful tool to study these and related tax questions that otherwise are restricted to studying the effects of a handful tax reforms.

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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 6 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 4a 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.