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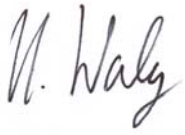

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The Evolution of Aggregate Stock Ownership*

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Abstract:
Since World War II, direct stock ownership by households has largely been replaced by indirect stock ownership by financial institutions.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, H30

Keywords: Capital Gains Tax, Income Tax, Stock Ownership, Bond Ownership, Inflation, Bracket Creep, Pension Funds

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1 Introduction

More than $100 billion a year is contributed to tax-deferred private pension plans in the United States. Cash flows of this magnitude ought to leave a visible trace in the economy. In this paper, we investigate how the taxation of private pensions has shaped the ownership structure of the stock market. At the end of World War II, households own most stocks directly. Sixty years later, the fraction of household ownership has decreased to 30 percent. Households' ownership shares have largely migrated to private pension plans managed by pension funds, mutual funds, and life insurance companies.

Private pensions are favorably taxed. Employers and employees can contribute pre-tax dollars for retirement purposes and investment returns grow tax free inside a pension plan. Shifting pre-tax income from high-income work years to low-income retirement years reduces tax liability in a progressive tax system. In the tax environment right before the Tax Reform Act of 1986 (TRA 1986), when effective tax rates and tax progressivity were considerably higher than today. Ippolito (1986) estimates as much as a 40 percent reduction in lifetime tax liability from optimal pension use, about equally divided between tax-free returns and the tax benefit of income smoothing.

Such large potential tax savings hardly go unnoticed by labor market participants. We picture a labor union that bargains with management over wages versus pensions taking into account how much total compensation increases, if deferred compensation (pensions) is offered in lieu of current compensation (wages). As an illustration, the bargaining between the United Automobile Workers (UAW) and management of General Motors, Ford, and Chrysler resulted in a tenfold increase of pensions from 1950 to 1980 compared to a four-fold increase of wages (see Kryvicky (1981) and Loewenstein (2008)). Increased life expectancy certainly contributes to the increased demand for pensions in this time period, but the tax benefits of pensions over wages also appear large enough to play an important role.

Pension funds gradually increase from a negligible stock ownership share at the end of World War II to about 30 percent of the stock market in the mid 1980s, and the fraction of household direct ownership decreases by approximately the same proportion. Mutual funds are insignificant shareholders until they are granted the tax status of pension funds following the enactment of 401(k)

in 1982.[1] Subsequently, mutual funds increase their ownership share from less than 3 percent in 1981 to more than 20 percent of the stock market today. The process of shifting stock ownership shares from households to financial institutions is slow because retirement wealth is built through payroll deduction.[2] When the old generation of shareholders divests their directly-held stock portfolios, the new generation of shareholders purchases stocks through a pension plan.

The evolution of aggregate stock ownership of the United States reflects the experience of one country with its specific tax policy. Therefore, to gain statistical power, we compile aggregate 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 determine the decline in household ownership (sell side) and ignore the increase in private pensions plans (buy side) because the institutional variation across countries and over time makes it difficult to identify which institutions carry pension assets on their balance sheets. With this in mind, we provide statistical evidence for the hypothesis that tax policy has shaped the ownership structure of stock markets. In particular, we find that proxy variables capturing the benefit from tax-free investment returns are correlated with changes in the fraction of household ownership, while proxy variables for the benefit of income smoothing have no explanatory power. For calibrated parameters, the compound-interest effect of tax-free dividends and capital gains appears large enough to justify the gigantic shift in aggregate stock ownership that has taken place since World War II.

In the United States, the principles for the taxation of pensions date back to the Revenue Act of 1921 (TRA 1921), but at this point of time personal income taxes are relatively small. Personal income taxes jump in the beginning of World War II, and pension funds begin to grow a few years later. 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). Shareholders are affected through income taxation of dividends and through capital gains taxation of nominal price increases. By the 1970s, the US upper-middle class

[1]The 401(k) plan is enacted by the Revenue Act of 1978 (TRA 1978), but the plan does not become effective before the contribution limits are specified by the Economic Recovery Tax Act of 1981 (ERTA 1981).

[2]There is no incentive to invest after-tax dollars into a pension plan which would subject such income to a second round of personal income tax upon withdrawal. In recent years, growth is also restricted by statutory contribution limits (see Jagadeesh, Kotlikoff, and Warshawsky (2004)) for the history of contribution limits).

is exposed to marginal tax rates above 50 percent. The Tax Reform Act of 1986 (TRA 1986) cuts marginal tax rates in half, and tax tables become inflation protected, but by this point in time, pension funds have become the largest shareholders of the US stock market.

The evolution of stock ownership and effective tax rates in the United Kingdom and Sweden are similar to that of the United States except that income taxes climb to even higher levels in the 1970s. In Sweden, for example, the fraction of household ownership decreases by two percentage points per year from 1970–1990 when marginal tax rates on dividends exceed 80 percent for middle-income households. In the United Kingdom and Sweden, the correlation between the decrease in household ownership and the proxy variables for tax-free returns is statistically significant within the time-series of each country. Stock ownership and effective tax rates of the other countries in our sample, notably Finland, France, Germany, and Japan, follow a different path. The time-series of household ownership begin at a lower level with significant inter-corporate ownership, probably as the result of transactions right before and during World War II. Income tax tables are subject to the same inflationary pressure, but unlike the United States, United Kingdom, and Sweden, shareholders are protected by dividend-tax credits and exemptions of long-term capital gains from personal income tax. The explanatory power of the panel regression comes from the different paths taken by the two groups of countries through the inflation period of the 1960s, 1970s, and 1980s.[3]

One would expect that the same tax policy that has shaped stock ownership structure has also shaped bond ownership structure. Our analysis of bond ownership structure is significantly less elaborate than for stocks due to the lack of international data. In the beginning of the 20th century, households are the dominant bondholders, similar to stocks (Guthman (1950)). However, in order to finance World War II, massive amounts of government debt is sold to financial institutions whose bond ownership share dwarfs that of households. By the end of the war, the fraction of household ownership has dropped to 10 percent of the taxable bond market (excluding savings bonds and municipal bonds). After the war, when banks unwind their treasury bond portfolios and return to their traditional role as providers of business loans, households do not rebuild their taxable

[3]Notice that Finland, France, Germany, and Japan, unlike the other countries, the United States, United Kingdom, and Sweden, experienced severe inflation during or right after World War II (for more analysis on this correlation, see Perotti and Schwienbacher (2009)).

bond portfolios through direct ownership. Instead, households purchase bonds through pension funds and, following the 401(k), through mutual funds. Pension funds accumulate 20 percent of the taxable bond market (mid 1980s) and mutual funds 10 percent. Foreign institutions, many of which are central banks and not subject to United States taxation, are the largest bondholders today.

Establishing a link between tax policy and ownership structure is important for numerous reasons. First, stock prices would have been much lower without the dynamic tax clientele shift from households to pension funds. Sialm (2009) provides supporting evidence of the relation between stock prices and effective tax rates. The stock price level matters to investors who hold stocks in their portfolios, to corporations that issue securities, and to governments which give up tax revenues. Second, stock ownership structure may have implications for corporate governance (see, e.g., Friedman (1996) and Blackburn (2002)). If large tax subsidies are given to the financial intermediation industry, it is pertinent that financial institutions hold efficient portfolios and act responsibly in corporate governance matters. Third, the time-series evidence suggests 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.

Our paper is related to a large literature on tax clienteles in the stock and bond markets. Important theoretical contributions include Brennan (1970) (stock market), Miller (1977) (bond market), and Auerbach and King (1983) (stock and bond market together). The empirical search for tax clientele effects has examined cross-sections of stock returns (Black and Scholes (1974), Litzenberger and Ramaswamy (1979)), abnormal stock returns around the ex-dividend day (Elton and Gruber (1970)), direct stock ownership data (Dahlquist, Robertsson, and Rydqvist (2009)), and household portfolio data from the Survey of Consumer Finances (Poterba and Samwick (2003)). Tax clientele effects are hard to detect in cross-section data. Our paper suggest that the main piece of evidence can be found in the time-series. Ippolito (1986) labels the dynamic tax clientele shift

"the tax theory of pension funds". We contribute supportive statistical evidence of this theory.

The rest of the paper proceeds as follows. Stylized facts about the evolution of aggregate ownership structure of stocks and bonds are provided in Section 2 and Section 3. The rest of the paper constructs the panel regression. Section 4 presents the tax theory of pension funds and the empirical methodology. Section 5 discusses personal income tax systems in the eight sample countries. Section 6 presents the panel regression results, and Section 7 concludes. The appendix provides details on the tax rules in each of the sample countries.

2 Evolution of 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 Stock Ownership Data

Annual ownership statistics exist for the United States since 1945, Japan 1949, Germany 1950, Canada 1961, and France 1977. Time-series of ownership data for Sweden begin 1950, United Kingdom 1957, and Finland 1958, but data 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. 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 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.[4]

In the regression analysis below, we analyze changes rather than levels of ownership. Different data construction methods do not influence the statistical inference, if the level is uncorrelated with changes in ownership. However, in this section, we are interested in comparing levels of ownership across countries. The methodology used by the Federal Reserve means that the US household sector is upward biased relative to the fraction of household ownership in the other sample countries. The bias arises from including non-listed stocks and non-profit organizations, and from eliminating inter-corporate ownership. The bias from non-listed stocks can be estimated from the difference between the Flow of Funds total and stock market capitalization, and the ownership of non-profit organizations is available from 1987–2000 (Table L.100a). Non-listed stocks and non-profit organizations account for approximately four percentage points each of the household sector. Correcting for these biases, the fraction of household ownership in the United States is 30 percent as of 2006. We have no methodology to estimate inter-corporate ownership.[5] The Canadian household sector is also upward biased. 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. For all others sectors, we divide the observed fraction of ownership by 0.74. The adjusted fraction of household ownership in 2006 is 29 percent.

[4]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.

[5]Poterba and Samwick (1995) and French (2008) make further attempts to adjust the household sector.

2.2 Common Stock Ownership Patterns

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

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

Financial institutions ownership increases. The ownership fractions of pension funds, investment funds, and insurance companies are shown in columns (2)–(4). Many of these institutions are engaged in the retirement business. [6] The growth in financial institutions is large. To get a quantitative measure of the 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 percent.

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 percent. 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)).[7]

[6] U.S. pensions are managed by pension funds, mutual funds, and life insurance companies. In Canada and United Kingdom, pension funds and life insurance companies dominate the retirement business. Life insurance companies offer funded pension plans in Germany, Sweden, and Finland, where pension funds are small. In Japan, trust banks are large providers of private pensions. Finally, in Germany, Japan, and Sweden, pension liabilities also appear as reserves on the company's books.

[7] 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

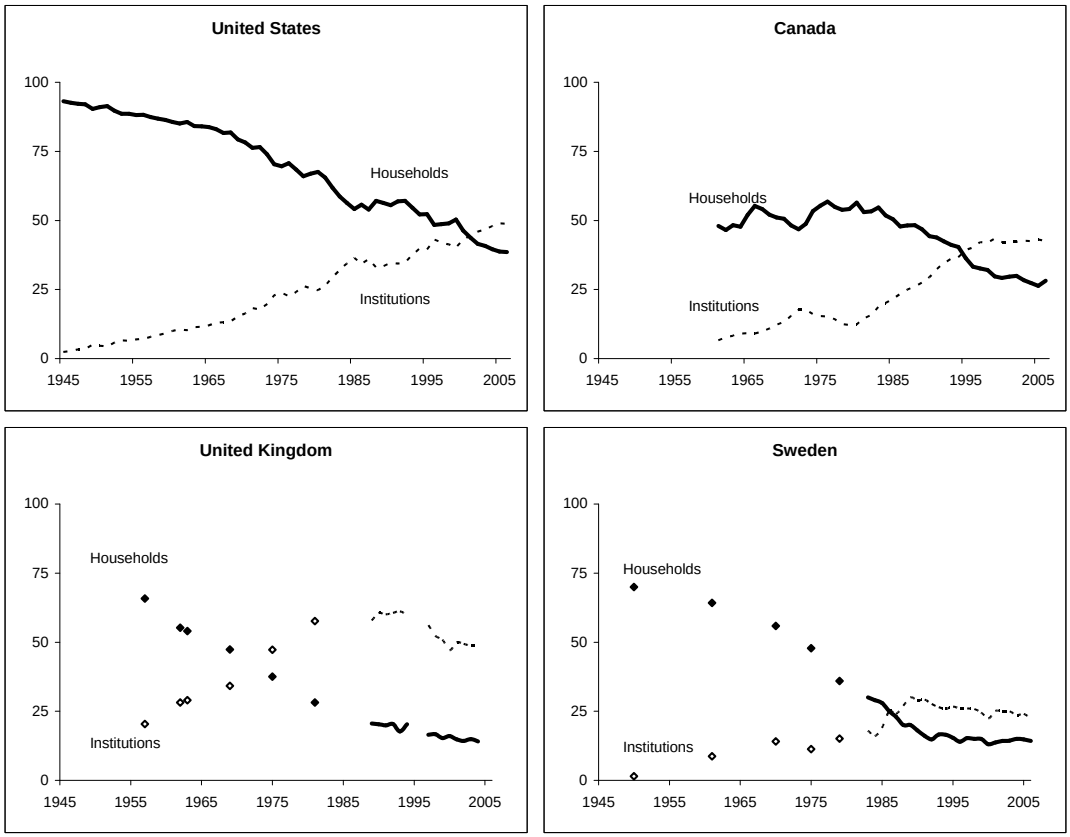
Table 1: Evolution of Stock Ownership

	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 percent. 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).

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

Figure 1a: Evolution of Stock Ownership



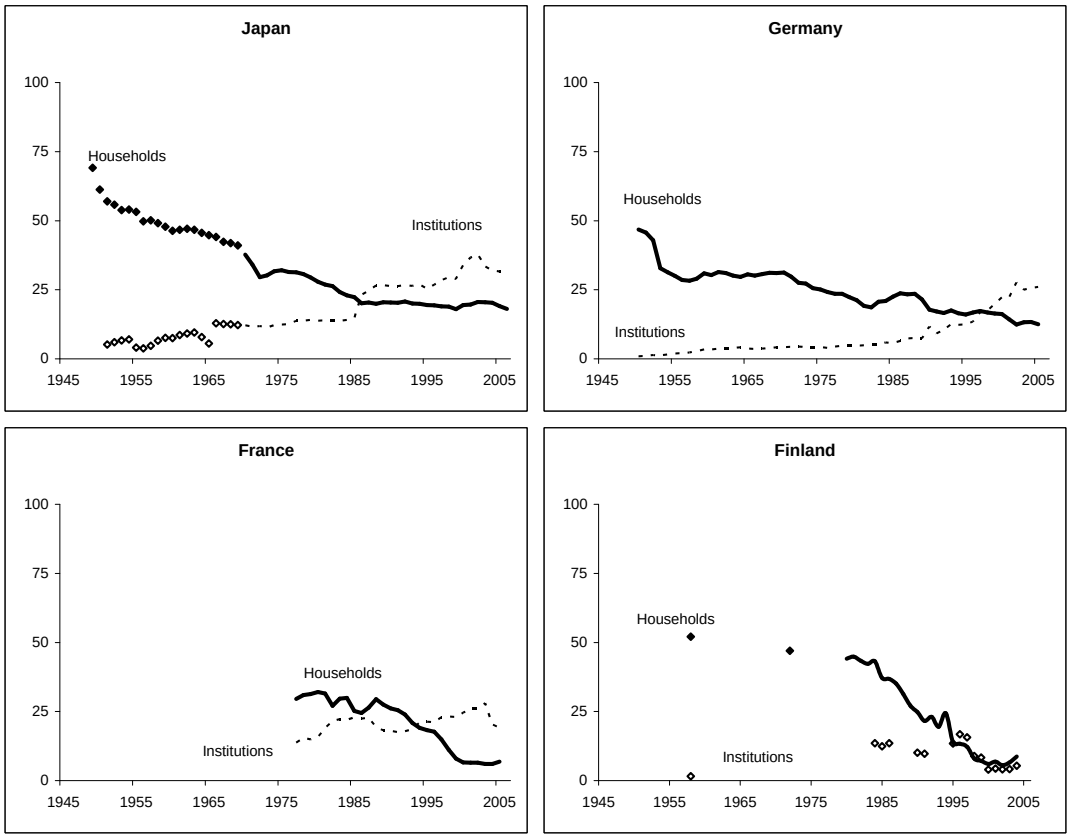
The figure shows the percentage aggregate ownership fraction of households (solid diamonds and lines) and financial institutions (open diamonds and dashed lines) defined as pension funds, mutual funds, and insurance companies.

Figure 1a plots the complete time-series of household and institutional ownership (pension funds, investment funds, and insurance companies) in the United States, Canada, United Kingdom, and Sweden. We use different symbols, diamonds versus lines, to mark the merger of time-series with different qualities. Households are represented by solid diamonds and solid lines, and financial

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.

institutions by open diamonds and dashed lines. 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

Figure 1b: Evolution of Stock Ownership



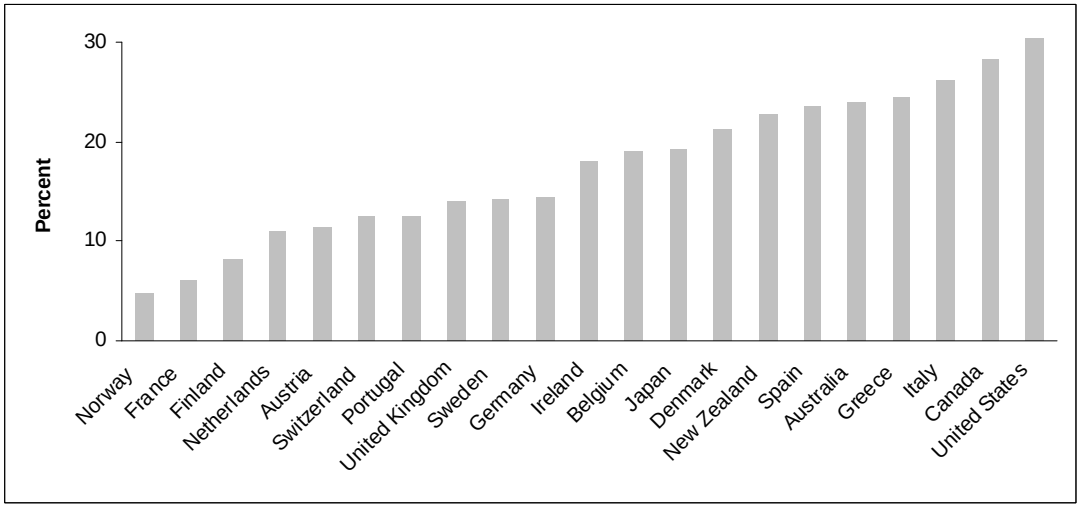
The figure shows the percentage aggregate ownership fraction of households (solid diamonds and lines) and financial institutions (open diamonds and dashed lines) defined as pension funds, mutual funds, and insurance companies.

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 1b plots the time-series of household and institutional ownership in Japan, Germany, France, and Finland. The four plots emphasize interesting cross-country variation relative to the countries in Figure 1a. Household ownership decreases slowly in Japan in 1970–2006 when ownership shares are based on market values (portion represented by the solid line), 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 1a. 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 2: Households' Direct Ownership Fraction of Stocks



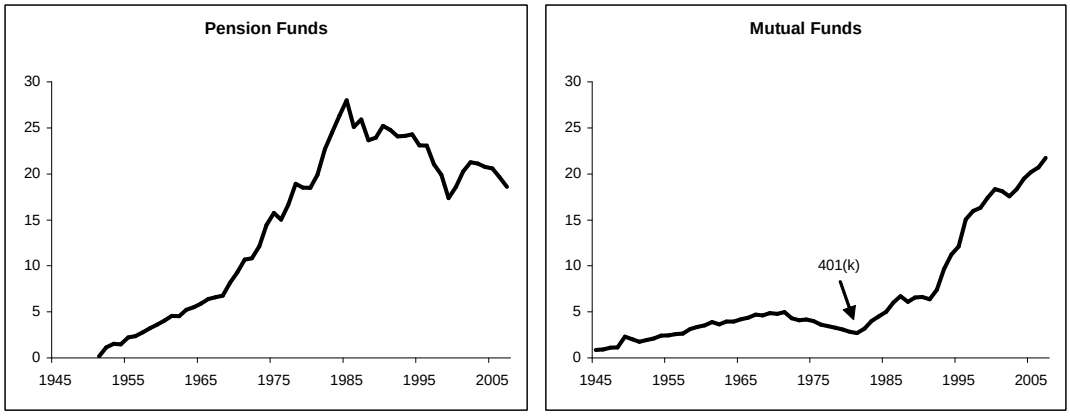
The figure shows the aggregate fraction of household direct ownership of equity in 20 countries. The data are the most recently available between 2004 and 2006. Data sources: Flow of Funds (United States), Statistics Canada, Australian Bureau of Statistics, FESE (2007), Goldman & Sachs (New Zealand), 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. The number for Canada has been adjusted for closely-held equity as explained in the text below.

In Figure 2, we summarize the fraction of household ownership in recent years for countries with developed stock markets. There is not a single country where households own more than half of the equity market directly, with the average across countries being just 17 percent. In the former

Eastern Europe, where stock markets reopened recently, the fraction of household ownership ranges from 3.9 percent (Hungary) to 18.1 percent (Slovenia) (FESE (2007)).

2.3 U.S. Mutual Funds

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



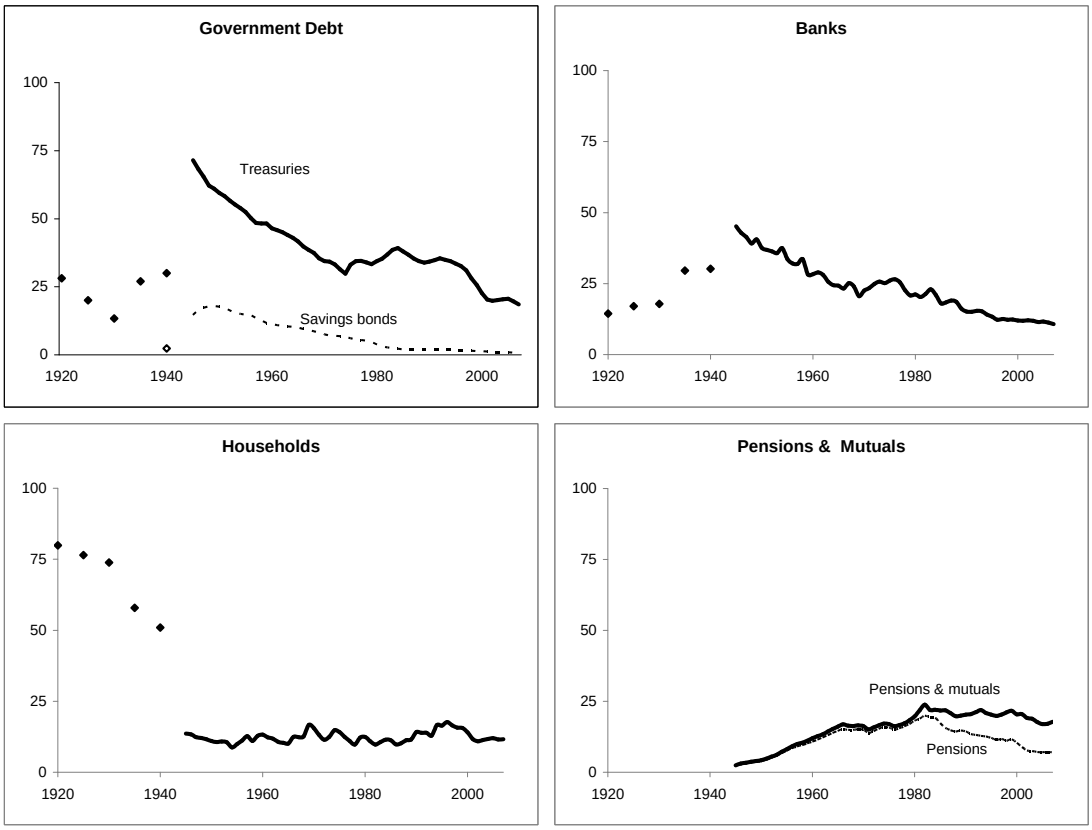
The two figures show the stock ownership fractions of private and public pension funds and of mutual funds in percent of all stocks. The figure for mutual funds also marks the introduction of 401(k) plans in 1982. Source: Flow of Funds.

Figure 3 plots the complete time-series of stock ownership shares of U.S. pension funds and mutual funds, respectively (see Table 1). 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). We see a decline in the ownership share of pension funds after 1985 when retirement assets move from defined benefit plans managed by pension funds to defined contribution plans managed by mutual funds. Mutual funds manage both taxed and tax-deferred investment accounts. The split is not known. Data from the Investment Company Institute suggest that the tax-deferred portion is somewhere between 40 and 80 percent.

3 Evolution of Bond Ownership

In this section, we report the evolution of aggregate bond ownership in the United States. We argue that the financing needs of World War II exceed the lending capacity of the household sector (crowding out). After the war, when Government borrowing needs decrease, households rebuild their bond portfolios inside pension funds and not through direct bond ownership.

Figure 4: U.S. Bond Market Composition and Ownership



The top left figure shows US Government debt as a percent of marketable debt (treasury, agency, corporate, municipal, and savings bonds). The other three figures show ownership in percent of fully taxable debt (excluding municipal and savings bonds). The first five data points from 1920–1940 are taken from Guthman (1950) (Table 1, 3, and 5). The data from 1945–2007 are from Flow of Funds (Table L.209–L.212).

Annual bond ownership data are constructed by the Federal reserve. The household sector is defined as the residual after subtracting the ownership shares of financial institutions. Five-annual data points are also provided by Guthman (1950) from 1920–1945. He reports the ownership frac-

tions of insurance companies, commercial banks, savings banks, and the Federal Reserve. The residual is composed of households and foreign (institutional) investors, but we label it the household sector. The top left plot of Figure 4 reports Government debt as a percent of marketable debt including treasury, agency, corporate, municipal, and savings bonds. In the other three plots, we report ownership shares of fully taxable debt (treasury, agency, and corporate), but we eliminate municipal bonds with tax-exempt interest and savings bonds with taxation deferred to redemption. Several clear patterns emerge:

Government debt crowds out private debt during World War II. The US Government issues treasury securities to financial institutions and savings bonds to households to finance World War II. At the end of the war, treasury securities (70 percent) and savings bonds (15 percent) dominate the public debt market. Government borrowing subsequently falls back to its pre-war level.

Households vanish during World War II. The fraction of household ownership reaches a long-term equilibrium already during World War II. Today, it is less than 10 percent if we subtract the ownership shares of non-profit organizations and bonds held in Individual Retirement Accounts (IRAs).[8]

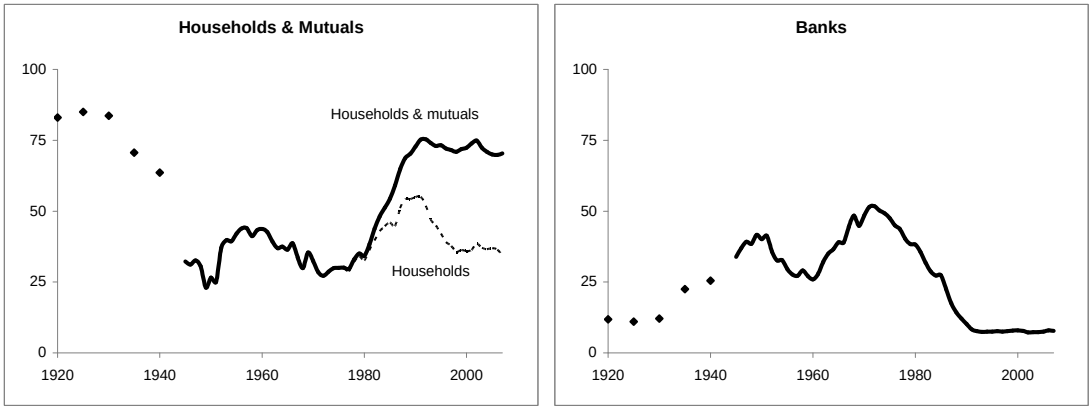
Banks peak during World War II. Banks purchase treasury securities to finance the war. After World War II, banks unwind their Treasury bond portfolios and return to their traditional role as providers of business loans.

Pension funds and mutual funds grow after World War II. Households rebuild their bond portfolios inside pension funds and not through direct ownership. Mutual funds grow after 401(k). The ownership share of mutual funds can be seen as the difference between the solid line above (pension funds and mutual funds together) and the dashed line below (pension funds alone). Pension funds and mutual funds reach together 20 percent of the bond market at the end of the

[8]The average ownership share of non-profits from 1987-2000 is 3 percent. Using data from the Investment Company Institute, we estimate that bonds held in IRAs average to approximately 3 percent from 1992-2006.

time-series.

Figure 5: Evolution of US Municipal Bond Ownership



The figure shows ownership of US state and municipal bonds in percent of the outstanding stock. The first five data points from 1920–1940 are taken from Guthman (1950) (Table 4). The data from 1945–2007 are taken from Flow of Funds (Table L.211).

We close the bond ownership section with a brief look at the municipal bond market. Municipal bonds constitute 15 percent of the US bond market (including municipal bonds and savings bonds). Like private borrowing, municipal bonds are crowded out during the war, when the municipal bond fraction drops to 5 percent. During the 1980s, households and mutual funds increases their ownership share by approximately 50 percentage points at the expense of banks. Banks leave the municipal bond market after TRA 1986 eliminates a tax arbitrage.[9] As with other marketable securities, mutual funds grow post-401(k) but, in the case of municipal bonds, mutual fund growth cannot be tax motivated. We see the mutual fund ownership share as the difference between the solid line above (households and mutual funds combined) and the dashed line below (households only). The mutual fund share increases particularly after the Orange County default in 1994. Diversification is the likely explanation for the increased demand for municipal bonds held through mutual funds. Consistent with tax incentives, however, pension funds, insurance companies, and foreign investors do not hold low-yield municipal bonds.

[9]Interest expense on debt that is used to finance municipal bond portfolios is no longer deductible from corporate income after TRA 1986.

4 Hypothesis and Methodology

4.1 Tax Theory of Pension Funds

The principles for the taxation of pensions date back to the Revenue Act of 1921 (TRA 1921), which states that employer and employee contributions to private pension plans are made before tax, investment returns grow tax free, and distributions are taxed as personal income.[10] 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.[11] 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.

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. 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

[10] The consumption-tax treatment of funded pension schemes appears to be the general principle across countries. The unfunded pension plan in France (pay as you go) constitutes an exception.

[11] Individual retirement accounts (IRAs) that allow households to hold stocks directly are relatively recent additions. 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 percent of US equities are held directly in IRAs. Even then, there is a transaction cost advantage of pooling small contributions (payroll withdrawals) into a large purchases, and most stock IRAs are invested in mutual funds.

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 grow 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 saving 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 lifetime tax burden by saving when income is high and withdrawing when income is low. Second, investment returns inside the pension plan grow tax free, $\tau_i = 0$. Equations (1) and (2) do not explicitly account for corporate tax because wages and contributions to private pension funds are both tax deductible expenses for the firm.[12] [13]

4.2 Empirical Measures

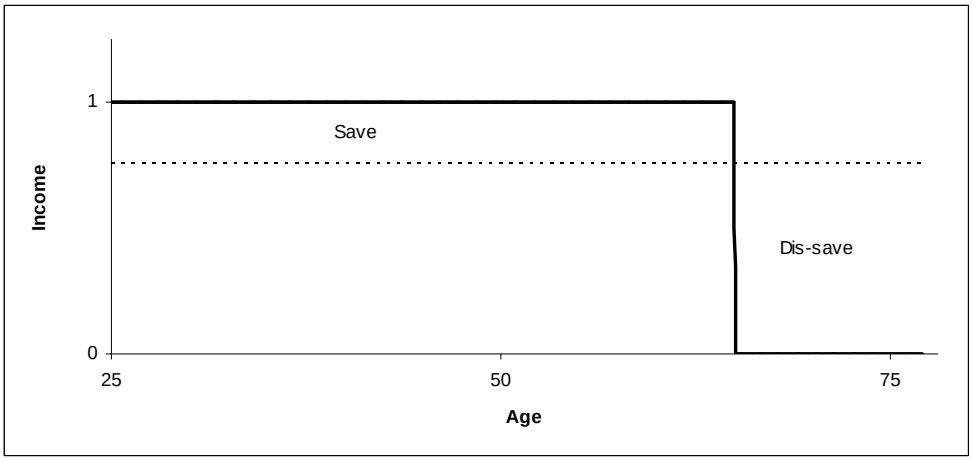
First, we construct a measure of the tax benefit of income smoothing. Following Ippolito (1986), we assume certainty, zero risk-free interest rate, and constant lifetime income. An individual works N years and needs retirement income for M years. Let Y denote annual income and $T(Y)$ tax liability on this income. The life-cycle hypothesis implies that the individual chooses the same consumption rate $\phi = N/(N+M)$ throughout his lifetime. See Figure 6 for an example where the number of work years is $N = 40$ and time in retirement $M = 13$ years. Annual income during work years is $Y = 1$. Smoothed over lifetime, annual income decreases to $\phi Y = 13/53 \approx 0.75$.

If the individual makes regular savings outside the pension plan, lifetime tax liability equals $N \cdot T(Y)$. If instead the individual saves inside the pension plan, he can save pre-tax income and

[12] In Germany, Japan, and Sweden, where pension liabilities are held on the books, contributions are made before tax, but corporate tax must be paid, when the book reserves are dissolved. Hence, corporate tax is deferred along with personal tax. This is a feature that we ignore.

[13] Contributions to the Social Security system are levied on wages, but not on employer contributions to private pension plans. Escaping social security tax is, therefore, an additional tax benefit of saving inside a pension plan that we ignore. 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 in 1990 and, in Sweden, where social security tax rates are quite high, the cap on social security contributions is removed in 1968.

Figure 6: Life-Cycle Consumption Model



The figure shows annual pre-tax income (solid line) during work years and annual pre-tax income if smoothed over work and retirement years (dashed line).

lifetime tax liability on earned income becomes $(N+M)\cdot T(\phi Y)$. We measure lifetime tax savings from income smoothing as a fraction of lifetime income taxes:

$$\text{SMOOTH} = 1 - \frac{T(\phi Y)/\phi}{T(Y)}. \tag{3}$$

Tax liability is lower when the individual saves inside the pension plan and the tax code is progressive. SMOOTH quantifies the maximum benefit to income smoothing if implemented optimally over lifetime. It is larger with a more volatile income stream (we assume constant income), while saving for other reasons than minimizing tax liability reduces it.

Next, we construct a measure of the benefit of avoiding tax on investment income. 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:

$$r = (1+d)(1+g) - 1 \approx d + g, \tag{4}$$

and the expected rate of return from direct stock ownership outside the pension plan is:

$$r^{\tau} = [1 + d(1-\tau_d)] \times [1 + g(1-\tau_g)] - 1 \approx (1-\tau_d)d + (1-\tau_g)g. \tag{5}$$

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 of the benefit of tax-free returns is the difference between the real rate of return from holding stocks inside and outside the pension plan:

$$\text{GAP} = \frac{\tau_d d + \tau_g g}{1+i}. \tag{6}$$

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 capital gains taxation is nominal.

4.3 Asset Location Problem

Black (1980) and Tepper (1981) argue that it may be tax inefficient to hold both stocks and bonds inside the pension plan. Suppose that the tax-minimization problem can be separated from the portfolio investment problem. Then, a tax-minimizing pension plan is entirely invested in either bonds or stocks. Specifically, swapping one dollar of stock investment for one dollar of bond investment inside the pension plan renders the additional real rate increase:

$$\text{SWAP} = \frac{\tau_r r}{1+i} - \frac{\tau_d d + \tau_g g}{1+i}, \tag{7}$$

where r is the interest rate and τ_r the associated marginal tax rate. The first term on the right hand side is the real rate difference between holding bonds inside or outside the pension plan (GAP for bonds). The second term is the corresponding real rate benefit of holding stocks inside the pension plan (GAP for stocks). Allowing investment returns to grow at the before-tax rate inside the pension plan raises after-tax income. Investing the pension fund entirely in the higher taxed security, i.e., bonds if SWAP is positive and stocks otherwise, raises disposable income further.

Choosing parameters from the United States, Black (1980) and Tepper (1981) argue that pension plans should be entirely invested in bonds with the desired stock portfolio held on the firm's balance sheet financed with debt. A similar argument can be developed for self-directed household accounts

such as 401(k) and IRAs.[14] If pension fund managers and households would act this way, the tax theory of pension funds cannot be true. However, the prescription of Black (1980) and Tepper (1981) is not supported by the data. Some pension fund managers tilt their investments towards bonds (Frank (2002)), but, in the aggregate, pension funds are 70 percent invested in stocks, and many households hold stock portfolios inside their pension plans (Poterba and Samwick (2003)). The critical assumption of Black (1980) and Tepper (1981) is that the tax-minimization problem can be separated from the portfolio investment problem, which in turn requires that: *(i)* the plan sponsor can borrow and lend at the same rate, *(ii)* interest grows tax-free inside the pension plan and is fully deductible outside the plan, and *(iii)* the sponsor has sufficient operating income to service the long-term debt financing of the stock portfolio. Judging from the portfolio behavior of pension funds and households, at least one of these conditions is violated, and we will continue our empirical investigation of the tax theory of pension funds under the assumption that the bond-stock arbitrage is not doable.

4.4 Parameters

The empirical variables SMOOTH and GAP require parameter estimates for marginal tax rates, expected stock returns, inflation, and demographics. Tax rates are collected from a variety of sources listed in the Appendix. GDP per capita is taken from International Monetary Fund (2009), dividend yields from Global Financial Data, and the Consumer Price Index (CPI) from International Historical Statistics (Mitchell (2007)). Life-expectancy statistics are available from the Human Mortality Database.[15]

4.4.1 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 assume that the representative household has the following two features: First, it has high enough income that government-provided, public pensions

[14] See Shoven (1999), Shoven and Sialm (2003), Dammon, Spatt, and Zhang (2004), Huang (2008).

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

are insufficient to cover consumption needs during retirement years. Second, 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 GDP 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. 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, and 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 percent of the statutory rate, Protopapadakis (1983) finds estimates in the order of 25 percent, and Chay, Choi, and Pontiff (2006) find it to be 55 percent. 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 percent of the statutory rate. In spite of no consensus, we assume that the effective capital gains tax rate is 50 percent of the long-term statutory rate evaluated at the annual income five times GDP per capita.

4.4.2 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 $d = 4$ percent, and that the expected capital gains rate is 2 percent plus expected inflation measured as a three-year moving average of changes in CPI. 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)). Our rough parameter assumptions are somewhat in line with the data. The pooled cross-section and time-series average dividend yield in our sample is 3.6 percent. The time-series of cross-country average dividend yields begins at 5.3

percent in 1950 and ends at 2.3 percent in 2006.[16] Stock price growth can be linked to GDP growth. The geometric average real GDP growth rate in the pooled sample is 2.9 percent. 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. The assumptions on dividend yield (4 percent) and capital gains yield (2 percent plus inflation) imply that the expected real rate of return on stocks is approximately 6 percent before tax, which is within the range reported by Fama and French (2002) between 1951 and 2000: 4.74 percent using the dividend growth model and 6.51 percent using the earnings growth model.

4.4.3 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.[17] We assume that households use life-expectancy statistics to predict the number of years in retirement. For each country in our sample, we collect life-expectancy conditional on age 25 and compute the cross-country average. Across countries, the time-series of average life expectancy begins at 70 years in 1950 and ends at 81 years in 2006. These numbers 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. Accordingly, the importance of saving for retirement increases over time. For simplicity, in our calculations of SMOOTH, we ignore expected growth in life expectancy, i.e., we assume that a household that starts saving for retirement in 1950 uses the life expectancy of 1950 to plan for retirement that begins forty years later in 1990. Ignoring growth in life expectancy, downward biases the numerical value of SMOOTH.

[16] 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 regulations. Since share repurchases are taxed differently from dividends, we do not include them in our calculations.

[17] 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.

5 Evolution of Household Taxation of Stocks

In this section, we study the time-series and cross-country properties of the two empirical measures of the taxa benefit of pensions, SMOOTH and GAP. Since they are functions of tax rates, we begin with an examination of the evolution of personal income tax.

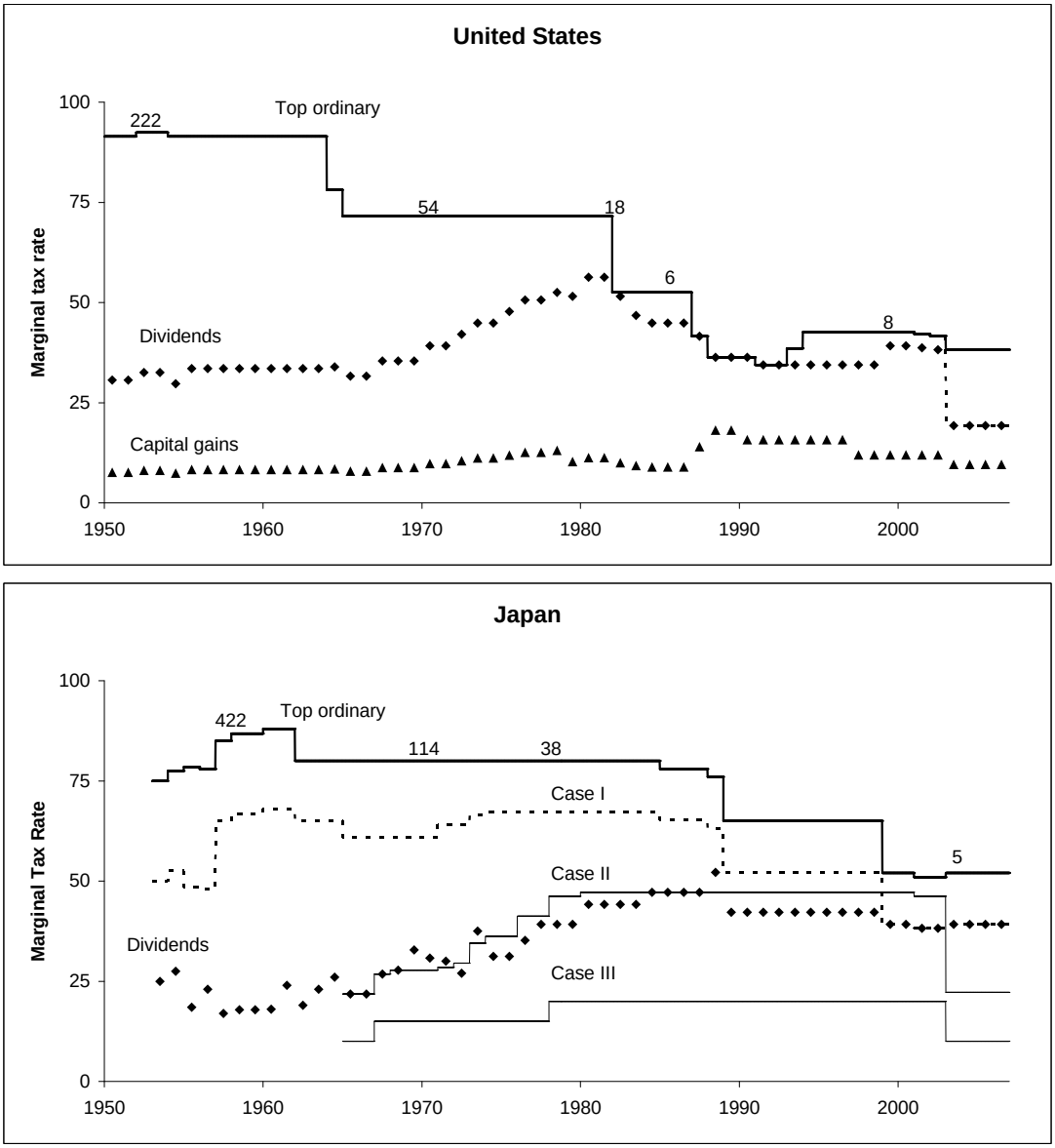
5.1 Personal Income Tax on Stocks

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 1949, Japan 1950, France 1965, United Kingdom 1973, Germany 1977, Sweden 1991, Finland 1993, and the United States 2003. The United States begins taxing capital gains on stocks in 1916, but elsewhere taxation of long-term capital gains is relatively recent: United Kingdom 1965, Sweden 1967, Canada 1972, and Finland 1986. In Germany, France, and Japan, long-term capital gains on stocks are effectively tax exempt throughout the time period we study.

The sequence of plots contained in Figure 4a–d 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.

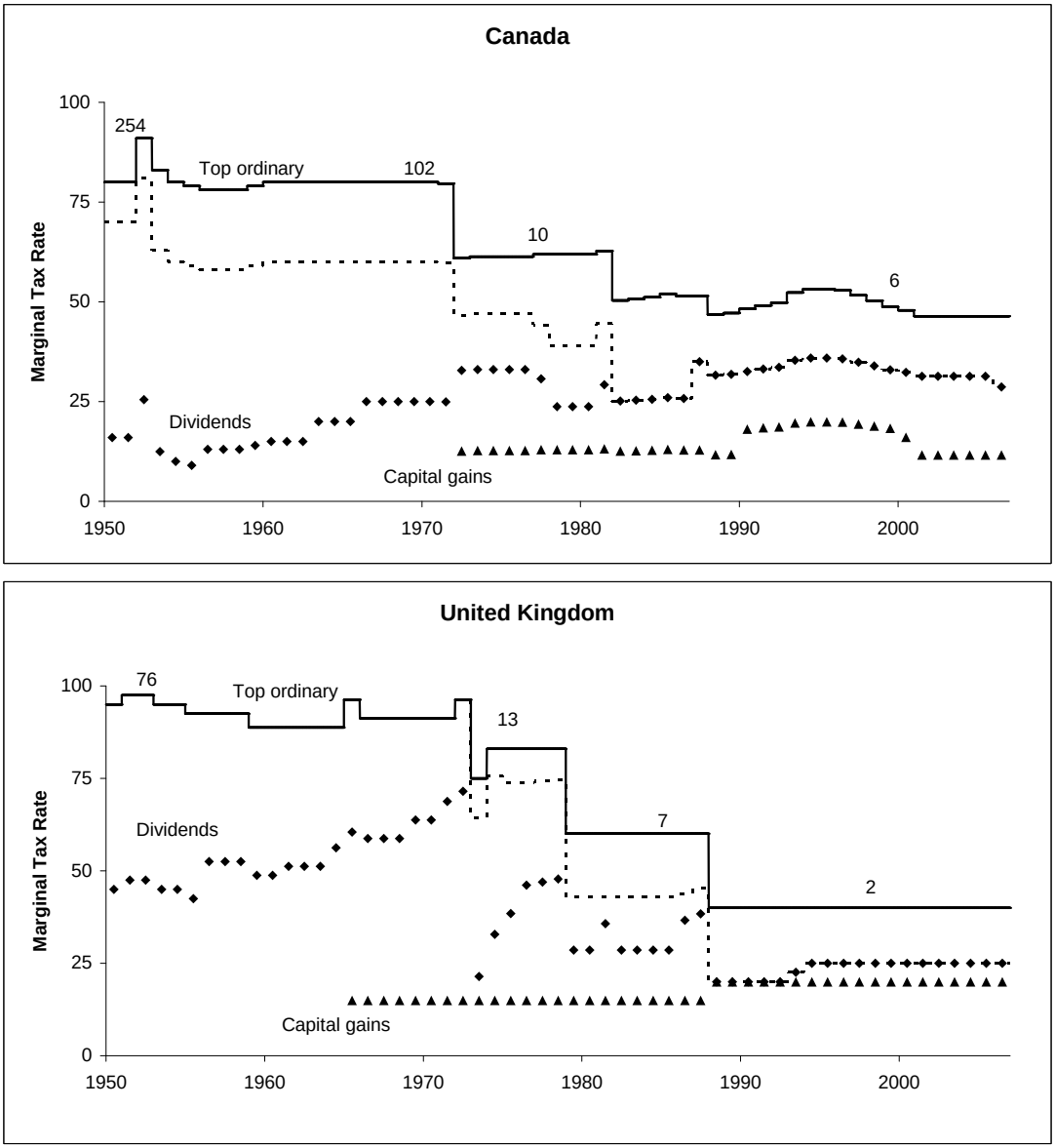
The top panel of Figure 7a shows the evolution of marginal tax rates in the United States. We assume that state tax is a constant 5 percent. The top statutory rate on ordinary income equals the top statutory rate on dividends between 1950 and 2002. Since 2003, dividends are taxed at a lower rate. This change in the tax code is represented by the dashed line. Top statutory income rates decrease from above 90 percent in the 1950s to below 40 percent 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 percent in the 1950s and 1960s, it increases rapidly in the 1970s, and drops back to the 30 percent level after TRA 1986.

Figure 7a: Marginal Tax Rates



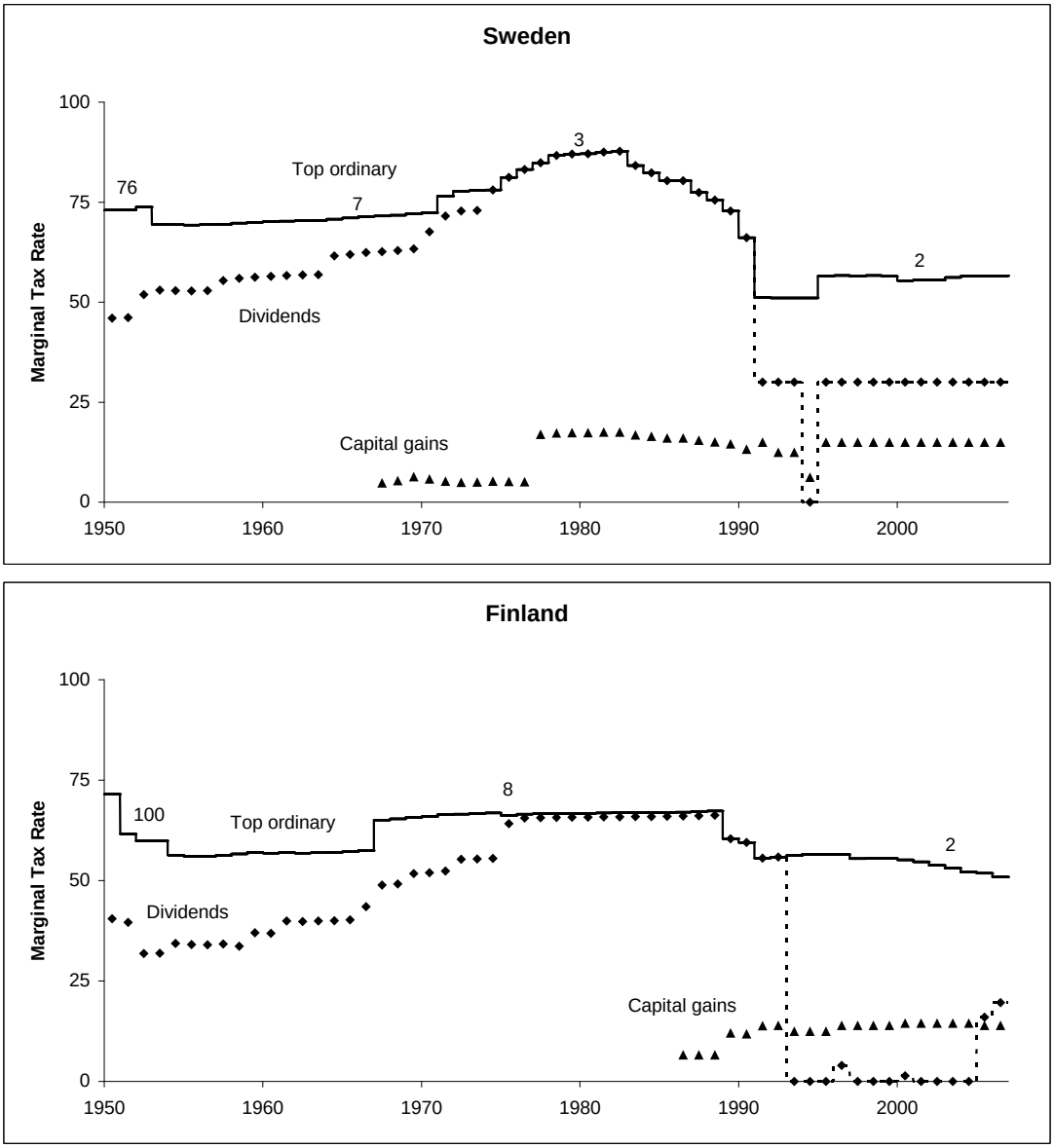
The figure shows the top statutory tax rate (solid line), the top statutory rate on dividends (dashed line), the marginal tax rate on dividends (diamonds) and long-term capital gains (triangles) of the representative GDP5 household. The numbers adjacent to the top statutory rate are the top income tax 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 7b: Marginal Tax Rates



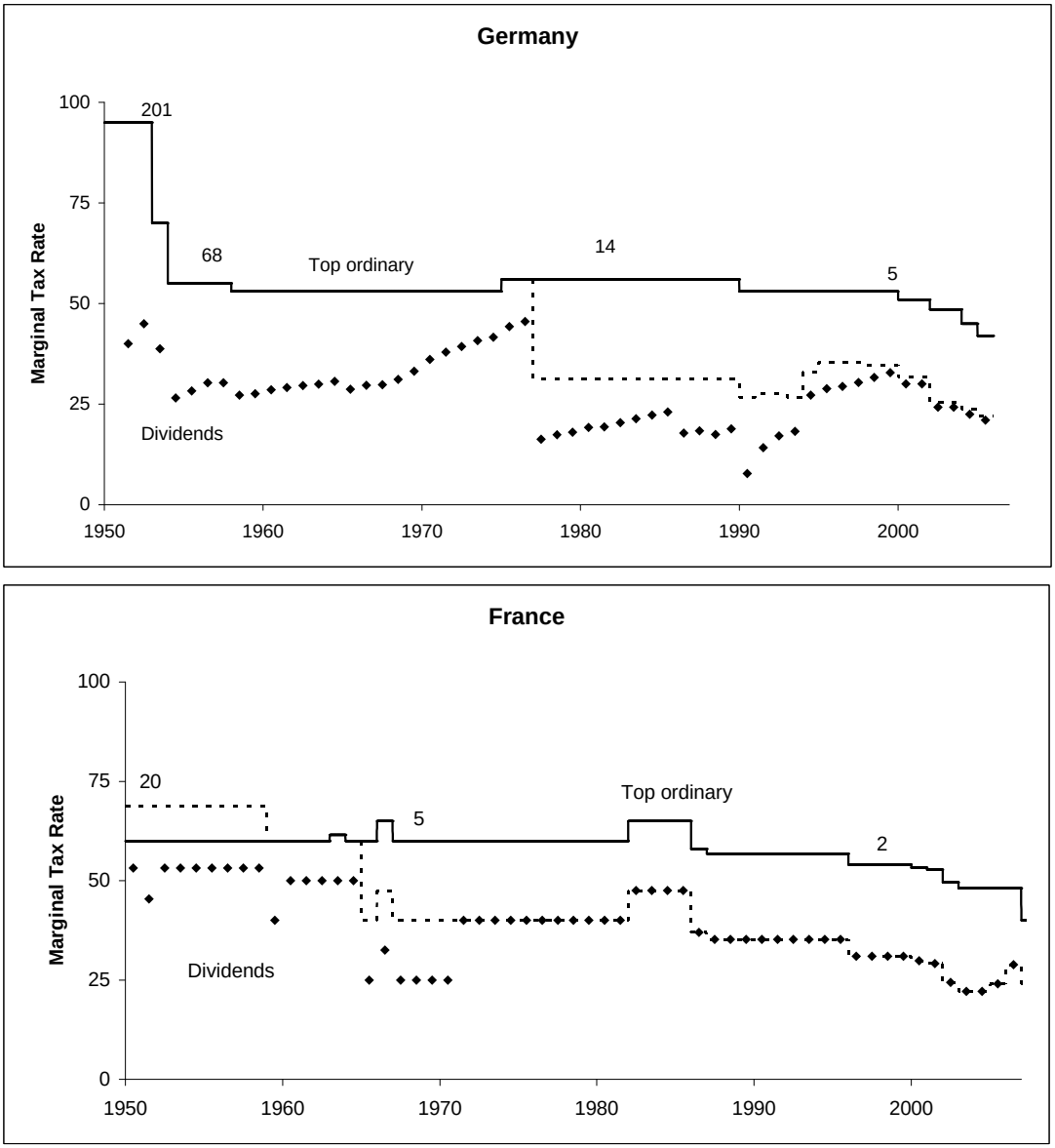
The figure shows the top statutory tax rate (solid line), the top statutory rate on dividends (dashed line), the marginal tax rate on dividends (diamonds) and long-term capital gains (triangles) of the representative GDP5 household. The numbers adjacent to the top statutory rate are the top income tax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

Figure 7c: 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 7d: 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.

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 percent.

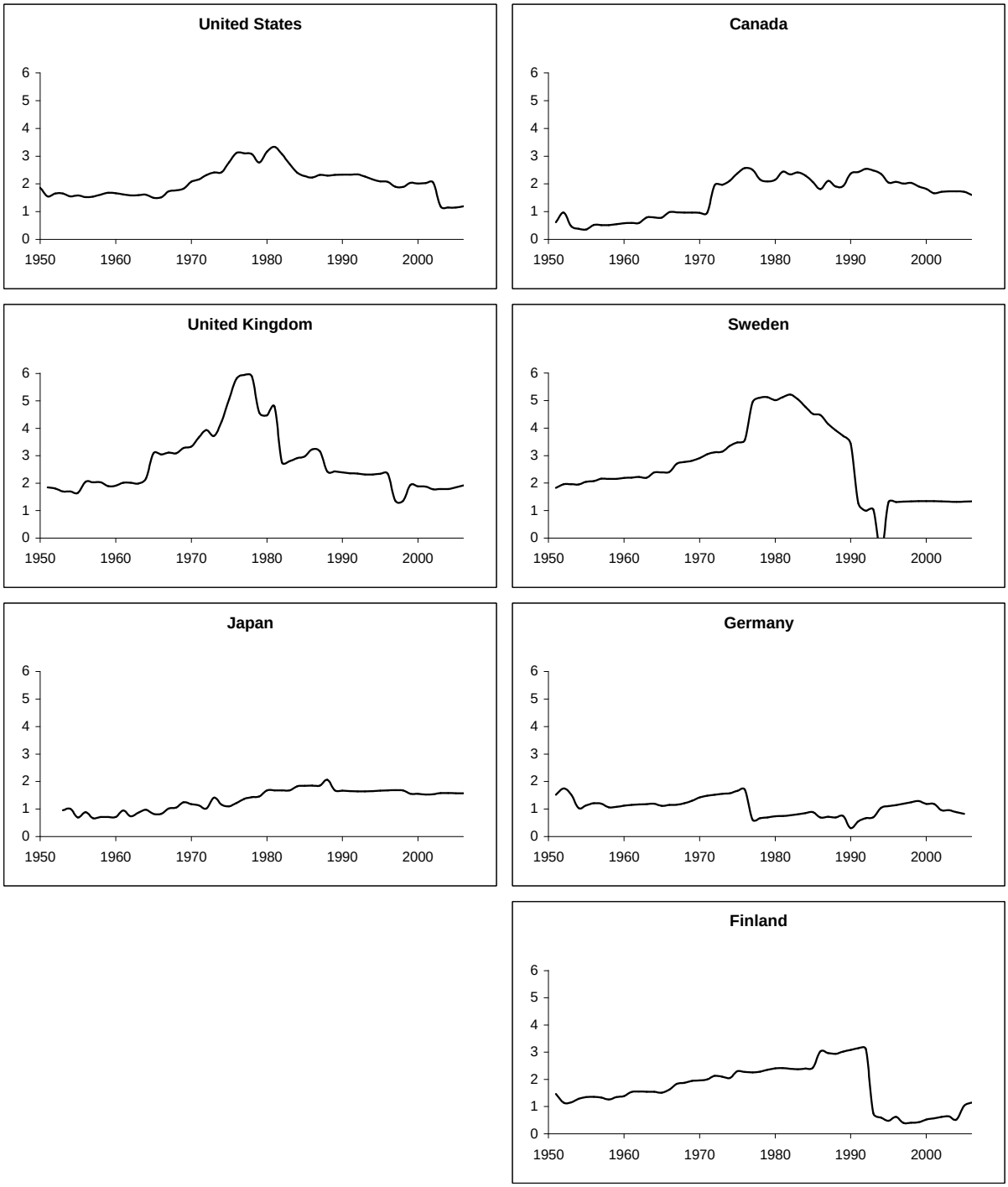
The eight tax plots share several common features. In the first decade after World War II, high top statutory rates on personal income are coupled with low marginal tax rates for the GDP5 household. In the subsequent decades, marginal tax rates drift upwards (bracket creep), and the GDP-per-capita multiple 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 7c), 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.

5.2 Tax Benefits of Pensions

We begin with the tax benefit of tax-free returns. The sample average GAP5 is about two percent. It ranges from 1 percent in Germany to 2.8 percent 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 percent interest rate is \$60 compared to \$40, which is the future value of a savings account that grows without interest.

Figure 8 shows the evolution of GAP5 in each of the eight sample countries. In the United States, United Kingdom, and Sweden, the path is hump shaped. GAP5 peaks in the 1970s together with the increasing taxation of dividends (bracket creep) and capital gains taxation of purely inflationary price increases. For example, in the United Kingdom, GAP5 peaks at nearly six percent, which implies that, under our assumptions, the expected real rate of return on stocks after

Figure 8: 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 $d = 4$ percent, expected real growth is $g = 2$ percent, and that expected inflation equals the three-year moving average. We also assume that the effective capital gains tax rate equals 50 percent of the long-term statutory rate.

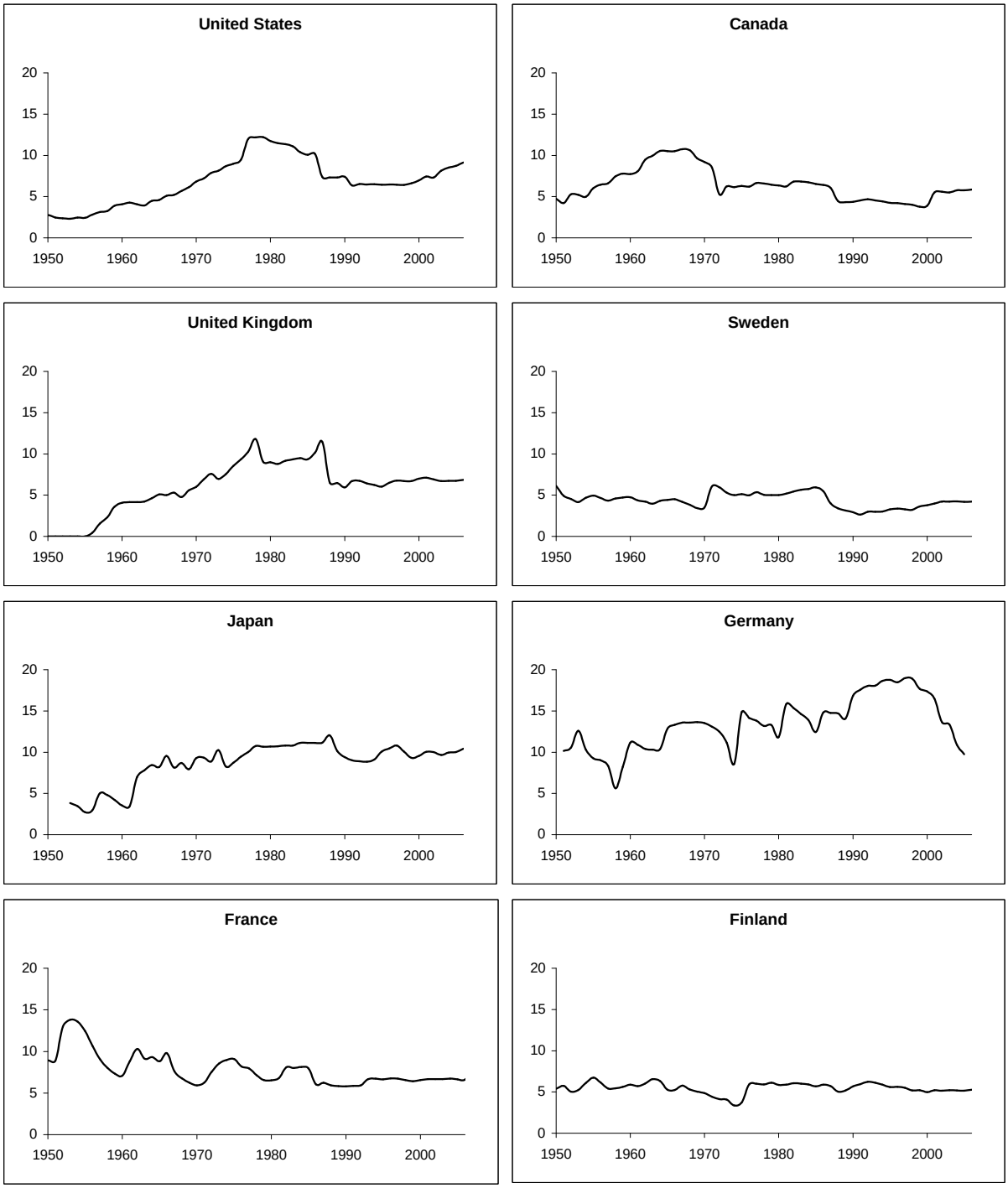
tax is approximately zero.[18] The other countries do not respond to the inflation shock of the 1970s. Shareholders in France, Germany, and Japan are protected from bracket creep by the dividend tax credit, and capital gains are exempt from taxation. The importance of capital gains taxation can also be seen in Canada and Finland, where GAP5 increases after the introduction of capital gains taxation in 1972 and 1986–1992 (gradual increase), respectively, as well as in the United Kingdom, where GAP5 drops in 1982 after capital gains are protected against inflation through indexation. A visual comparison of the GAP5 plots with those of household ownership in Figure 1a and 1b suggests a strong correlation between changes in stock ownership structure and GAP5. In Sweden, United Kingdom, and United States, 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.

Next, we look at the tax benefit of income smoothing. Averages SMOOTH5 is positive because personal tax tables are progressive. The average annual reduction in the tax bill in the pooled sample is 7.3 percent. Our estimate is significantly less than 20% (Ippolito (1986)). Our estimate is also quite small. It translates into an average reduction of the effective tax rate by only 2.7 percentage points.[19] Figure 9 shows the evolution of SMOOTH5 in the eight countries. In the United States and the United Kingdom, the time-series of SMOOTH5 display the same hump-shaped path as GAP5, which peaks in the 1970s when tax progressivity is high. However, the correlation coefficient between GAP5 and SMOOTH5 in the pooled sample is small. In Sweden and Finland, the time-series of SMOOTH5 is flat because marginal tax rates equal top statutory rates at the GDP5 income level, and in Germany SMOOTH5 is high as a result of the unusual way the marginal tax rate is determined (see the Appendix).

[18] 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.

[19] See Rydqvist, Schwartz, and Spizman (2010) for further analysis of the magnitude of the tax benefit of income smoothing.

Figure 9: 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.

6 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, and the incentive variables are GAP5 and SMOOTH5. We estimate the following 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 report the results of our main regression model first and discuss robustness checks afterwards. In our main regression model,

Table 2: Pooled Regressions

	(1)	(2)	(3)	(4)
Constant	–0.92 (–11.3)***	–0.21 (–1.1)	–0.15 (–0.6)	0.27 (1.0)
GAP5		–34.5 (–6.6)***		
Dividend term			–39.2 (–4.1)***	
Capital gains term			–28.2 (–2.4)**	
Dividend tax rate				–2.0 (–5.8)***
Capital gains tax rate				–1.7 (–1.8)*
SMOOTH5		1.4 (0.6)	1.3 (0.6)	–2.8 (–1.1)
R^2	0.000	0.043	0.044	0.039
#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 (6) and (3). 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 *, **, and *** denote significance level 10 percent, 5 percent, and 1 percent or better, respectively, against the null hypothesis that the coefficient is zero.

we do not include lagged independent 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. If there is an underlying time trend in the fraction of household ownership such as the effect of increased life expectancy, then the time trend is captured by the regression intercept. We estimate the regression with the eight-country panel data set. The estimation procedure corrects for first-order autocorrelation and heteroscedasticity following the procedure of Parks (1967).[20] The time series of ownership are incomplete for the United Kingdom, Sweden, and Finland, particularly in the beginning of the sample period. Missing values are replaced by linearly interpolated data.

Table 2 reports our main results. 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 percent 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. 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 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 intercept is statistically different from zero in the 1990s regression. It suggests that non-tax variables reduce the fraction of household ownership in recent years.

We carry out many robustness checks. The results of varying the model parameters of GAP and

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

Table 3: Decade-by-Decade Regressions

	1950-59	1960-69	1970-79	1980-89	1990-99
Constant	–0.38 (–0.4)	–0.59 (–1.3)	0.21 (0.9)	–0.31 (–0.6)	–1.80 (–2.5)**
GAP5	20.1 (0.4)	–23.6 (–1.7)*	–38.2 (–5.4)***	–32.9 (–3.5)***	25.6 (0.8)
SMOOTH5	–13.5 (–1.0)	7.6 (1.8)	0.8 (0.2)	2.7 (0.6)	8.5 (2.1)
R^2	0.158	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 *** denote significance level 10 percent, 5 percent, and 1 percent or better, respectively, against the null hypothesis that the coefficient is zero.

SMOOTH 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 capital gains are taxed. On the contrary, the fraction of household ownership decreases slowly in Germany and Japan where marginal tax rates are low and capital gains are not taxed. Since the country

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	–0.27 (–2.0)**	–0.14 (–0.9)	–0.90 (–5.1)**	–0.54 (–2.8)***	–0.77 (–8.9)***
GAP	–42.1 (–6.0)***	–23.5 (–5.6)***	–57.1 (–4.6)***	–21.1 (–5.3)***	
SMOOTH	–1.1 (–1.5)	–1.8 (–1.0)	2.5 (1.0)	1.7 (0.7)	
Sweden					–1.07 (–4.2)***
United Kingdom					–0.64 (–3.0)***
United States					–0.63 (–1.9)**
Japan					–0.42 (–0.9)
Finland					0.10 (0.2)
France					0.18 (0.2)
Germany					0.39 (0.7)
Canada					0.54 (1.2)
R^2	0.044	0.035	0.022	0.031	0.046
#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. The countries have been sorted from most negative coefficient to most positive. Asterisk *, **, and *** denote significance level 10 percent, 5 percent, and 1 percent or better, respectively, against the null hypothesis that the coefficient is zero.

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 the United States, United Kingdom, and Sweden in 1970–1989 than in other countries or other time periods. The tax variables pick up this time-series and cross-country correlation. Any non-tax explanation must account for this particular pattern.

Finally, we experiment with the model specification. The fraction of household ownership is bounded between zero and one, which implies that a reduction in the fraction of household ownership must be smaller as the ownership level approaches the lower boundary. We see such an effect in the most recent data after 1990 but, overall, the level is so far away from the lower boundary that including the lagged fraction of household ownership makes no difference to the regression results. We also allow the underlying time trend to vary across countries (i.e., country-fixed effects) with similar regression coefficients. Out of all eight countries, only the coefficient of the dummy variable for Canada is statistically different from zero.

7 Conclusions

In this paper, we have investigated the hypothesis that tax policy has shaped aggregate stock ownership structure. There are three pieces of supporting evidence. First, we find that the fraction of household ownership decreases relatively fast during the high-inflation period of the 1960s, 1970s, and 1980s in countries with high effective taxation of dividends and nominal stock price increases (the United States, United Kingdom, and Sweden). The evolution of household ownership in those countries stands in sharp contrast to the slow decrease in the fraction of household ownership during the same time period in countries with low tax on dividends and untaxed capital gains on stocks (Finland, France, Germany, and Japan). Second, mutual funds are small institutional investors until they get included in the private retirement system through the 401(k). Third, households are crowded out from the bond market during World War II. When households rebuild

their bond portfolios after the war, they do so in tax-favored pension funds rather than through direct ownership.

We have not studied alternative explanations and have, therefore, not attempted to develop any control variables to be included in the regression model. There are alternative theories of the growth of intermediated stock ownership. In a sequence of works, Allen and Gale (1994), Allen and Santomero (1998), and Allen and Gale (2000) argue that professional asset managers can use complex and sophisticated financial instruments to improve risk sharing beyond that of simple diversification. Developing proxy variables for the risk sharing benefits of intermediated stock ownership is an avenue for future research. A problem for arguments based on risk sharing is to explain why mutual funds that specialize in risk sharing are small before they become part of the retirement system. Another challenge is to explain why the stock ownership structures of high-tax countries and low-tax countries follow different paths during the high-inflation period of the 1960s, 1970s, and 1980s.

We have seen in Table 1 that inter-corporate ownership in Sweden increases as effective tax rates reach higher levels. Do firms in Sweden, Germany, and Japan purchase stock portfolios to hedge pension liabilities on the books? That is, to what extent can tax policy explain the prevalence of inter-corporate ownership? The cross-country panel approach used in this paper may provide a useful tool to study this and related tax questions that otherwise are restricted to studying the effects of a handful major 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, Canada, United Kingdom, Japan, Germany, France, 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 used:

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

The precise meaning of each tax rate is explained in its context below. Many tax systems are covered 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 $\tau_{ps} = 5 percent$, 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 Sagoo (2005).

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 percent. 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 percent (1938–1941) and 25 percent (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 main data sources are Revenue Canada (1950–2006), 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 lifetime 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 the HM Revenue & Customs website.

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 percent 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 8 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 (4) 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 (6) becomes:

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

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 Tax Bureau of Finance (1953–2005). 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 7a 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 percent 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 the German Tax Administration. We use the 1954 tax table for 1955 and 1956, which are missing.

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 percent, 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 central level only. 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 as in (27). 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 as in (35).

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), municipal tax, and church tax (sub-central). We use 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), Statistics Sweden, and the Swedish Tax Administration.

8.7.1 Dividends

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

$$\tau_d = \begin{cases} \tau_{pc}(1-\tau_{ps})+\tau_{ps} & \text{, in 1948–1970,} \\ \tau_{pc}+\tau_{ps} & \text{, in 1971–1990.} \end{cases} \tag{39}$$

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:

$$\tau_d = \tau_{pi}. \tag{40}$$

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 1952–1976, a portion π of short-term capital gains is taxed as ordinary income as in (22). The portion depends on the holding period:

$$\pi = \begin{cases} 100\% & \text{, if 0–2 years,} \\ 75\% & \text{, if 2–3 years,} \\ 50\% & \text{, if 3–4 years,} \\ 25\% & \text{, if 4–5 years,} \\ 0\% & \text{, if >5 years.} \end{cases} \tag{41}$$

From 1967–1976, 10 percent of the sales price of a security held more than five years is taxed as ordinary income. From 1977–1989, the formula for the inclusion proportion changes to:

$$\pi = \begin{cases} 100\% & \text{, if 0–2 years,} \\ 40\% & \text{, if >2 years.} \end{cases} \tag{42}$$

In 1990, the proportion increases to $\pi = 50\%$. From 1991–2006, all capital gains are taxed as investment income:

$$\tau_g = \tau_{pi}. \tag{43}$$

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:

$$\tau_g = 10\%\tau_p \left(\frac{(1+g)^N}{(1+g)^N - 1} \right). \tag{44}$$

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 percent. We denote the expected treasury rate with r_f and measure it as 1 percent plus moving average inflation. Equation (6) becomes:

$$\text{GAP} = \frac{\tau_d d + \tau_g g - 15\% r_f}{1+i}. \tag{45}$$

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) and the Finnish Tax Administration.

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:

$$\tau_d = \tau_{pc} + \tau_{ps}. \tag{46}$$

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 (27). 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:

$$\tau_d = \pi \times \tau_{pi}. \tag{47}$$

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 as in (22). The portion depends on the holding

period. From 1986–1988 it is:

$$\pi = \begin{cases} 100\% & \text{, if 0–5 years,} \\ 20\% & \text{, if >5 years,} \end{cases} \tag{48}$$

from 1989–1990:

$$\pi = \begin{cases} 100\% & \text{, if 0–4 years,} \\ 80\% & \text{, if 4–5 years,} \\ 40\% & \text{, if >5 years,} \end{cases} \tag{49}$$

and from 1991–1992:

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

From 1993–2006, all capital gains on stocks are taxed as investment income as in (43). Since 1986, a long-term investor has the option to define the capital gain as 50 percent of the sales price from 1986–1992 and 30 percent from 1993–2006. In our calculations, we ignore this option and the initial tax-exempt amount because the difference is small.

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