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# ABSTRACT

Over the past two decades, the United States federal income tax revenue has shown periods of increased volatility. Throughout the 1990s the growth rate of individual income taxes was between 5 and 10 percent, it has swung between -12 and +12 percent from 2000 to 2006. Meanwhile wage income has been relatively stable during this period while capital income annual growth has swung from -20 to +50 percent between 2000 and 2006. Looking deeper into the income composition of taxable sources, we find that tax revenue has increased its dependence on volatile capital gains income, due in part to an increasing dependence on high-income taxpayers. In the decade ending 1976, capital and business income represented about 17.1 percent of gross income, including about 3.1 percent for capital gains and losses. While the share of capital and business incomes have been relatively stable over time, the share of net capital gains or losses has increased to about 5.8 percent of gross income, on average the decade ending 2006, an almost twofold compared to four decades ago. Using a database on individual tax files from 1966 to 2006 from the Internal Revenue Service Public Use Files, we estimate the sources of tax revenue volatility over time and by income groups. We find strong evidence that since 1966, the growth rate of tax revenue has become increasingly dependent on the growth rate of capital income, while its dependence on wage income has decreased. Before 1986, both capital income growth and wage income growth were negatively related with income tax growth, suggesting a smoothing effect of taxation. However, after 1986, capital income growth has been positively related to income tax revenue growth, and this positive relationship has increased more than tenfold in 20 years. We also find that this increased dependence of tax revenue growth on capital income is essentially related to top income earners. The results show evidence that capital income growth and tax revenue growth almost continuously increased from the bottom to the top quintile.

# Introduction

The Great Recession and accompanying financial crisis in the United States in 2008 and 2009 opened up large deficits. The combination of increased spending and declining tax revenue has created federal deficits in excess of 10 percent of GDP. The large growth in outlays has drawn significant research and public concern about the Keynesian multiplier and the sustainability of increased government spending (Conley and Dupor 2011). However, the yawning deficits have been exacerbated by a precipitous drop in tax revenue. Still, there has been decidedly less interest in the drivers of rapidly falling tax revenue.

A facet of the large structural deficits revealed in the Great Recession that has received less attention than fiscal stimulus is the design of federal government revenue collection. From 2008 to 2009 while GDP and personal income experienced a drop of close to 2 percent, federal government personal income tax receipts dropped by 20 percent.[1] Part of this is an outcome of the built-in flexibility (BIF) of the tax system, where taxes act as an automatic stabilizer over the course of the business cycle. During periods of growth (downturns), the percent change in tax revenue is larger than the percentage change in income. However, this flexibility has demonstrated unprecedented changes in the past decade, partly due to the increased use of options or stock grant incentives from corporations (Goolsbee 2000). From 1969 to 2001, the ratio of the percent change in personal income taxes over the percent change in personal income has followed a long term trend around one, and has stayed between -0.3 and 2.2 until the end of the 1990s (Figure 1). However, during the first decade of the 21st century, this ratio began to swing wildly, reaching values of -7.5 in 2002 and 11.9 in 2009. Even more striking however, is the fact that those two extremes were years during which personal income taxes have been decreasing, while personal income was either increasing (2002) or decreasing (2009). When we exclude those two years, the ratio has varied between -1.4 and 2.8 since the late 1990s, which while closer to the previous trend is still well above historical norms.

**<INSERT FIGURE 1 HERE>**

Federal government expenditures tend to follow a steady state for consumption smoothing reasons. For example, the ratio of federal government expenditures over federal government receipts—or the amount of federal government expenditures per dollar of receipts—was very close to one from 1969 to 2001, with values between 0.9 and 1.3. However, this ratio has taken off in the past ten years, and has remained above 1 since 2001, with values as high as 1.7 in 2009 and 1.6 in 2010.[2] In sum, government expenditures vary little over the long run while revenue collection has evolved more due to policy designs such as the composition of individual income sources towards more volatile sources. In this paper, we claim that this can dampen the manageability of public finances by potentially increasing debt in an unsustainable manner. In other words, even if public revenue and expenditures increase over the long run at similar rates, asymmetric volatility of public revenue can cause long run increases in debt due to the structural finance of steady state consumption. The increased progressivity of United States federal income tax coupled with federal income tax revenue reliance on volatile sources of income, as high income earners receiving a greater percentage of their income from capital gains and business

[1] Bureau of Economic Analysis (Tables 1.1. and 1.2); Office of Management and Budget, Historical Tables (Table 2.1).
[2] Bureau of Economic Analysis (Table 3.2).

income, and the increased volatility of these sources has presented new challenges (Picketty and Saez, 2007). This shift in the structure of the taxable income has increased the volatility and risk of the United States government portfolio of taxable assets.

Economists have recognized that despite their importance to stabilize the economy, very little work has been done on economic stabilization (Blanchard, 2006). Fuest et al. (2010) highlight the special importance of better understanding the impact of economic stabilizers in time of crisis. In this paper, we start to fill this gap by investigating the structural sources of the changes in federal individual income tax receipts over time and by income groups. We find that over the past forty years, changes in federal income tax receipts have not only become increasingly dominated by top income earners but more importantly by changes in volatile capital income, at the expense of changes in more stable wage income.[3] Although we define capital income broadly, including business income, and show that the volatility of more capital income sources has increased over time, a significant part of the variation in capital income is dues to capital gains. While some economists have argued that lower capital gains tax rates should increase revenue due to highly sensitive capital gains realization to tax rates (Feldstein et al. 1980), others have shown that the lower taxation of long term capital gains is likely to increase asset price volatility and may reduce rather than increase tax revenue in the long run (Stiglitz 1983). Investors seeking to minimize their tax liability offset short-term losses with long-term gains, thereby reducing their expected payment, inducing additional asset price movements (Badrinath and Lewellen 1991). The increased dependence of federal government tax revenue on high-income earners which receive a greater percentage from volatile but faster growing capital sources has consequently increased the volatility of tax revenue.

In this paper, we use 41 years of individual tax return data from the United States' Internal Revenue Service Public Use Files (PUF), aggregated into income percentile groupings, and combined with macro-economic data to provide evidence of the increased up and down swings of individual income tax revenue over time. Our evidence is both graphical and empirical. We find that the changes in individual income tax revenue growth are essentially explained by the changes in high-income group income growth. We also find that the relationship between tax revenue collection from high-income groups and capital income sources increased over time and tax regimes. From 1966 to 2006, while the dependence of tax revenue growth on wage income growth has decreased for all income groups, the riskiness of the United States federal tax portfolio has increased more than 1100% since 2000 due to greater reliance on capital income and greater volatility on the financial markets.

[3] In a companion paper (Balding and Dauchy 2011b), we investigate recent issues in the design of the federal income tax receipts in more details. Balding and Dauchy (2011b) measures the volatility of federal income taxes in multiple ways to find that it has been strongly increasing in just a few years, according to some measures, and explains the main sources for this increasing volatility, as well as the potential risks associated to it, suggesting importance of bringing this issue to the public awareness. We further look at a fundamental issue of built-in flexibility since the past 10 to 20 years which is that the of sensitivity of the personal income tax with respect to personal income is increasingly asymmetric across groups and across sources of income. However, contrary to Fuest et al (2010) we find that the source of this asymmetry is not the bottom of the income distribution, but the top of the distribution, where capital income has taken an increasingly large share of income.

This paper is organized as follows. The next section provides a graphical evidence of the increasing dependence of tax revenue growth on capital income growth and high-income individual's income growth and reviews the existing literature on the changing structure of individual income tax revenue, with a special focus on its seeming dependence on stock markets. We motivate the paper by showing the shortcomings of the literature to investigate further the relationship between tax revenue and stock markets. The third section describes the empirical strategy and the data. The fourth section discusses the results and their implication for public policy, and the last section concludes.

## The structural changes in individual tax revenue growth

The structural rigidity of tax assets will determine the variability of public revenue available for government services, redistribution, or debt repayment. Increases in the volatility of the income sources being taxed affect long-term tax revenue and the ability to raise required funds for public expenditures commitments on a timely basis. While wage income growth is small, and with long run volatility approaching zero, capital sources like capital gains and business income have higher growth rates and volatility. To our surprise, research has largely omitted studying the volatility of income sources. From 2000 to 2009, the growth rate of federal individual income tax revenue was larger than 12 percent in absolute value for 5 years, larger than 10 percent for 6 years, and larger than 7 percent for 8 years out of ten, including 5 years of tax revenue decrease and 5 years of increase.[4] However, the overall annualized growth rate over this decade was negative at -0.89%. By contrast, the previous 40 years starting in 1960, have only experienced two years of negative growth, one in 1983 and one in 1971, both of them less than -5 percent—compared to 18 years of high positive growth greater than 10% in that period. The annualized growth rate was positive and above 8% in each of the four decades from 1960 to 1999.

Figure 2 shows the year-to-year growth of aggregate taxable wages and a broad measure of taxable capital income growth, obtained from Internal Revenue Service Public Use Files (PUF).[5]

**<INSERT FIGURE 2 HERE>**

Figure 2 shows that while nominal wage income growth has remained relatively constant over time, capital income has always been more volatile than wage income with even larger year-to-year changes since 1984. Between 1966 and 2006, while nominal aggregate wage income grew at an average annual rate of 5.1percent, aggregate capital income grew at a higher rate of 7.1 percent. However, the variance of wage income growth at .0005 was tiny compared to the variance capital income growth at .023, a 46-fold difference in the implied risk level compared to only a 38 percent higher growth rate. This implies that tax policy is assuming substantially more risk for minimal increase in expected return. To extend this analysis, between 1966 and 2006, there is no year where nominal aggregate wage income declines,

[4] Source: Office of Management and Budget, Historical Tables, Table 2.1.

[5] Capital income includes net short-term and net long-term capital gains, net small business income, net partnership income, net business income from sole-proprietorship, taxable interests, taxable dividends, net rental income, net royalty income, and net estate or trust income.

while capital income suffers 9 non-consecutive years of negative growth throughout the same period. This implies that tax revenue from capital income is significantly more risky than wage income.

The divergence between income sources and tax revenue however has not received much attention. Research has begun to consider the potential for increased variability due to the non-stationarity of tax revenue sources but failed to link it to specific sources of income and the diverging variability between capital and labor (Sobel and Holcombe 1996). Others have highlighted the impact of diverging tax rates on capital and labor on tax revenue and proposed that taxing capital gains and dividends at the same rate would end income shifting between income sources while maintaining a progressive structure (Altshuler et al. 2010). This proposal while reducing the incentive to shift income overlooks the underlying impact on tax revenue volatility.

The tax base concentration on capital income has increased government revenue volatility due to the underlying asset volatility. Tax policy in the United States over the past 20 years has suffered from large upward and downward swings in federal income tax revenue growth due to the structurally changing design of its collection of revenue generating tax assets. The implicit distribution of the federal individual income tax revenue collection between capital and labor sources has significantly changed over time, showing an increasing reliance on volatile capital assets at the expense of low volatility and slower growing labor income assets. In 1966 wages and salaries represented 81 percent of adjusted gross income, compared to 19.5% for our broad measure of capital income. The wage share had increased to more than 85 percent in 1983, after which it decreased most years to 68.8 percent in 2006. By contrast, the capital income share increased to 24.9 percent in 2006.[6] The resulting effect on federal tax revenue has been to increase the correlation between public revenue and the stock market.

This unique outcome has been prompted by numerous long-term policy trends. First, tax policy has narrowed the effective tax base to depend heavily on high-income earners. For instance, the top decile of income earners paid 71 percent of total federal individual income taxes in 2006, a 22 percentage point increase from 1966 (Figure 3).

**<INSERT FIGURE 3 HERE>**

As shown in the Figure 3, more than 80 percent of this increase in tax share was due to the highest income earners.[7] This is true even though the largest reductions in marginal tax rates in the past 40 years were for top income earners. Public revenue has concentrated the portfolio risk of taxable assets into a very narrow sub-population of taxpayers. When the income of the wealthy is growing tax revenue increases rapidly. However, when the income of the wealthy is declining, tax revenue falls rapidly and remains depressed for an extended period of time due to loss allocation provisions associated with capital gains income.

[6] Public Use Files (PUF), Internal Revenue Service.

[7] This trend in the share of federal individual income taxes paid by high-income earners is also evidenced in Picketty and Saez (2007).

The political consensus agrees upon the acceptability of a progressive tax system. This political consensus, however, has overlooked the important implication for the economy of an indirect link between tax system progressivity, revenue collection, and the stock market, through returns to capital, at the expense of the traditional link with broader economic activity. The political and research focus on optimal progressive taxation system has overlooked the implied income source shift accompanying the evolution of tax policy (Consea and Krueger 2006, Sorensen 1999, Slemrod 1990, and Suits 1977). In particular, from 1966 to 2006 the taxable share of total individual income has increased for the top quintile of income earners, but decreased for all lower quintiles of income earners (Figure 4).

**<INSERT FIGURE 4 HERE>**

Figure 4 shows that the share of aggregate gross income captured by the top 1 percent of income earners has significantly increased over time. The top decile and the top 1 percent earners share of pretax income was 56.5 percent and 28 percent of total pretax income in 2006, compared to 40 percent and 12 percent in 1966.This shows that the pre-tax income share has increased significantly for the top 20 percent of taxpayers and decreased for the remaining 80 percent. The largest growth in the share of national income occurs for the top 1 percent. For all percentiles below the top decile, their share of aggregate gross income captured has decreased. The tax base, as measured by the ratio of pretax income to adjusted gross income, has increased faster at the top of the distribution than for other groups, further demonstrating the increased dependence of the tax system on high-income earners to generate public revenue.[8] One study in 1991 found that taxpayers with income greater than $100,000 enjoyed 70 percent of all capital gains income (Auten and Cordes 1991). The trend in the share of total capital gains earned by high-income earners has increased. Today the top 10 percent of income earners capture nearly 100 percent of declared capital gains income. Furthermore, from 1966 to 2006, while aggregate capital gains income has grown at the approximate long run rate of stock market appreciation of 7.5 percent, declared business income has grown at an average of 3.8 percent.[9] The capital gains growth rate nearly twice that rate of business income has significantly increased its importance to overall revenue collection as it is one of the most volatile sources of capital income.

Second, in parallel to the narrowing of the tax base, the nature of income has evolved, especially for higher income earners. In 2006, wages and salary income comprised 68 percent of total income, 13 percentage points lower than in 1966. This trend is mirrored in high-income earners in the United States where non-wage income has increased from 37.5 percent of income in 1966 to 42.4 percent of income in 2006 for the top decile. The impact on tax revenue of differences in marginal income tax rates across types of taxable income, as has been noted in previous research, indicates the importance of shifting across income sources by arbitraging tax rates between wages and capital (Feldstein 1995). As one study notes"[…] taxing income from other sources at a higher rate than long-term capital gains

[8] The major change occurred after the Tax Reform Act of 1986, when the broadening of the tax base and the reduction of average tax rates mostly affected top income earners. For example, tax shelters such as the deduction of passive activity losses were significantly reduced or eliminated. These tax advantages were more likely to be used by high-income earners.

[9] From 1966 to 2006, the annual growth rate of the S&P 500 index was 8.7 percent, and increased from 6.5 percent to 10.6 percent before and after 1985.

provides incentives for individuals to choose investment assets on the basis of minimizing taxes and divert income to capital gains forms (Auerbach and Poterba 1988)." One micro-level study found large variance in the shares of income sources based upon the different tax rates implying taxpayers were shifting income to minimize their tax burden especially prevalent with capital based income sources (Bach and Buslei 2009). In addition, the nature of capital income at the top is composed of more volatile income sources. For example, while net capital losses and gains represented 37 percent of capital income of all taxpayers in 2006, it was 48 percent for the top income percentile only (figure 5).

**<INSERT FIGURE 5 HERE>**

Total net capital gains also represent a higher share of capital income for the whole population. In 1966, net capital gains represented 17 percent of capital income on average for the population, and 21 percent for the top decile. In 2006, they represented 36 percent of capital income for the whole population and 42 percent for the top decile (figure 6).

**<INSERT FIGURE 6 HERE>**

To the extent net capital gains and losses are more volatile sources of income, this shift in the composition of capital income represents a major shift in the underlying volatility of government revenue. The income of the wealthy, for whom public revenue depends heavily, has become highly correlated with the stock market and corporate profits both notoriously volatile. An unintended consequence of narrowing the tax base to depend heavily on high-income earners is the implication that the government will receive revenue more revenue from higher volatility sources.

The specific division however, between capital and labor income for high-income earners is difficult to ascertain with great accuracy. One study found a significant tax induced increase in travel and entertainment reducing taxable income for business through the shifting of business costs that are difficult to identify as personal or business (Clotfelter 1983). Furthermore, there is a specific accounting problem between the division between labor and capital income among high-income earners with greater ability to shift their sources and arbitrage tax rates (Feenberg and Poterba 2000). High income earners with multiple types of income will be the most able to shift income arbitraging, tax rates to maximize their after tax income. Research simulations indicate that aligning capital and ordinary income taxation for individuals would limit income shifting, and could bring significant gains (Keuschnigg and Dietz 2007 and Keuschnigg and Nielsen 2004).

Even with this simpler tax treatment, business income and capital gains income, the two primary sources of capital income for the wealthy, would be highly correlated with corporate profits and the stock market, both of which are more volatile than wages and salaries. According to our calculations, the variance of the growth of aggregate capital gains income was .27 in the period 1967 to 2006, increasing to .34 after 1985. The increased reliance on a narrow and volatile base has changed the variability of federal income tax revenue.

The narrowing of the tax base coupled with the increase in capital as a share of income has shifted the revenue collection framework for the United States. The numerous intricacies of capital income

taxation are not a new policy issue, with one economist noting that "reform of the capital gains tax has occupied a central place in recent tax policy discussion…(Auerbach 1992)." Little research however has considered capital gains tax reform from the perspective of minimizing the portfolio tax risk of the federal government. Between the narrowed tax base, the growth of capital income, and the change in the nature of capital income towards more volatile sources, the United States tax revenue has significantly increased its exposure to upper-income taxpayers and capital based income.

Among the various provisions that govern capital gains taxation, the net loss carry forward for capital income creates additional tax revenue variability. Allowing investors to reduce their tax liability from capital losses by spreading them out both forward and backward dampens government revenue until loss reserves are exhausted. This flexibility, by allowing taxpayers to spread losses over time, reducing past or future tax liabilities, causes large movements in taxable income by providing income recognition flexibility. Research has found that if capital loss offset rules are restricted this may result in a dead weight loss as high as 45 cents of every related tax dollar (Ahsan and Tsigaris 2009). Conversely, the reduction in capital gains tax rates may have increased volatility as it reduces the lock-in effect and taxpayers are more willing to realize gains and losses. Research has found that increases in capital gains tax rates reduce the realization of capital gains as a tax avoidance strategy (Daunfeldt et al. 2010). In 2003, aggregate net capital gains income turned negative due to three straight previous years of double-digit losses in broad indexes despite the fact that 2003 witnessed a 26 percent increase in the S&P 500. Taxpayers appear to be availing themselves of tax minimization strategies that increase the variance of the federal government income tax revenue. Figure 7 illustrates the increased correlation between tax revenue and a 50/50 total return portfolio.[10]

**<INSERT FIGURE 7 HERE>**

Figure 7 shows the growth rate of individual income tax revenue and the annual return from a balanced portfolio composed of 50 percent high quality fixed income and 50 percent United States stocks. As can be seen in Figure 7, though the losses from the balanced 50/50 portfolio were small during the 2001 recession, spreading out capital losses helped reduce individual income tax liabilityby a total of nearly 25 percent over three years from its 2000 peak, before returning to positive growth in 2004. The flexible loss allocation decision process available to taxpayers increases the variability of government revenue from individual income sources, depressing individual income tax revenue for numerous years after stock market indexes declined, until tax revenue increases after loss carry forward reserves have been exhausted. One public finance specialist recently noted that "by granting preferential tax treatment, the capital gains preference thereby further encourages relatively risky activities (Slemrod 2009)."

The changes in tax policy and the underlying structure of individual income tax base, dampen the individual income tax revenue collection framework, inducing systematic booms and busts public revenue cycles. Tax revenue projections have been based upon macroeconomic business cycle fluctuations, however due to changes in tax policy and in the underlying dependence on volatile income

[10] See appendix for a description of the capital returns variable.

sources, tax revenue growth is increasingly based upon asset price movements rather than economic activity. Figure 8 demonstrates the increased reliance on capital income since 1966.

**<INSERT FIGURE 8 HERE>**

Due to the higher reliance on high income earners and their increased reliance on capital income, the tax base has shifted to rely heavily on financial assets rather than the real economy. In 1966 72.9% of taxable income weighted by taxpaying revenue dollar came from wages and salary while in 2006 that number had declined to 64.6%. Given the significantly higher volatility of capital income to wage income, the only moderately higher growth rate, and ability to spread gains and losses over time, this significantly impacts the growth of tax revenue. The true shift of tax revenue collection however can be seen in the portfolio of taxable asset risk as seen in Figure 9.

**<INSERT FIGURE 9 HERE>**

As figure 9 demonstrates, given the increased reliance on capital income and higher volatility of declared capital income since 1984, the portfolio riskiness of the United States federal income has jumped dramatically. With the booming stock market of the late 1990's, taxable asset portfolio riskiness reaches a recent low in 2000 but has since increased dramatically. From 1966 to 1984, capital income volatility was low with only moderate fluctuations over time. Even from its previous modern peak in the mid and late 1980's, tax asset portfolio riskiness is four times higher.

While the use of tax revenue stabilizers aid automatic tax revenue adjustment, increases in their procyclicality and volatility prompts increased public tax revenue fluctuations (Baunsgaard and Symansky 2009). Because government expenditures are much more stable than the economy, although a degree of flexibility in the tax system is desired for stabilizing purposes, policy-makers should make ensure that tax revenue does not bear the risk of being increasingly less manageable due to a growing dependence on volatile underlying income sources.

## Data and Methodology

The primary data resource is the Internal Revenue Service Public Use Files (PUF). IRS PUF is a yearly sample of individual tax returns comprising most information submitted on each tax return, which provides detailed information on American income sources and tax payments. We combine these data with a range of macroeconomic and financial market controls such as GDP growth, inflation, unemployment, and return on capital income. The macroeconomic controls are from US government sources including the Bureau of Economic Analysis, the Bureau of Labor Statistics, and the Census Bureau. Return on capital income is calculated based on data downloaded from Global Financial Data using total returns of major asset markets including the S&P 500 and the Dow Jones Corporate Bond total returns.

Our dataset covers the years from 1966 to 2006, the latest year available as IRS tax data are released three years after the current tax year. We made a number of adjustments to individual tax files. First, to control for the impact of high-income earners and the shift in the tax base, we aggregated each year

by income percentile, based on adjusted gross income (AGI), by applying user weights to individual observations. This transformation into percentile groupings rather than individual observations, enables us to follow the impact of changes in the sources of income on tax revenue from specific income percentiles over time while conserving a large population size so that each years has one hundred observations. This gives us a total dataset of 4,100 observations, with 41 years for each income percentile. In various regressions presented later, we test the sensitivity of grouping the data by decile, quintile, and median income. Each observation contains the percentile mean of each variable.

Second, to test the impact of changes in wage and capital income on tax revenue we separate out income sources by type. We group income types into wages and salaries, capital, and other income. PUF data include only taxes directly paid by individuals. However, individual taxpayers indirectly pay other income taxes. The most important ones are half of payroll taxes paid by employers, and corporate taxes paid on corporate profits before those are distributed in wages and salaries. An accurate measure of taxable income and tax payments would include them. We also ignore untaxed income such as employer-provided health insurance and homeowners' imputed rental income.

This follows a clear economic rational of lumping the factors of production into capital and labor which account for almost all individual taxable incomes. The "other" sources of income are economically small when aggregated at the percentile level and include pension, social security, alimony, unemployment, and farm incomes. We then create three different measures of capital income, capi0, capi2, and capi3, using a broad definition of capital income that includes business income (sole-proprietorship, partnership, and S corporation profits), net recognized capital gains (short-term and long-term), rental and royalty incomes, interests, dividends, and estate and trust income. For instance, even though capital gains, interest, and dividend income are all reported as different sources of income, in economic terms all qualify as capital income.[11] Capi0 is the simple weighted sum of these capital income sources. Capi2 and Capi3 are corrected for the amount of net capital losses carry forward from the current year based on the applicable regulatory limitation.[12] It should be noted that we define capital income broadly to include business, partnership, trust and estate, as well as other forms of income. The economic rationale for calculating and defining capital income broadly in this manner is straightforward: all these income types are risky incomes and more likely to be dependent on financial markets. Financial capital receives income from its share of increased economic productivity as a factor of production whether this is in the form of business income, corporate profits, or holding financial assets.[13]

[11] See appendix for a table listing the different capital income compilations and correlation table.

[12] The Internal Revenue Code limits the amount of net capital losses that can be recognized against ordinary income to $3,000 every year ($1,500 for single taxpayers). In separate regressions not presented here, we alternatively include and exclude pension income in the capital income variables. Capi3 is capital income including pension income. The main results are not affected, and are available on demand.

[13] While most sources of income are easily grouped into wage, capital, or other income, pension and annuity income presented a difficult case. Pension income could feasibly be considered capital income as it provides income to a recipient from indirectly held capital assets. However, as the recipient of pension income does not bear the risk of capital market fluctuations, there is also sound economic rationale for not counting pension income as capital income. This matters as more than economic accounting because high-income earners own their financial capital, while low income earners receive a disproportionate share of pension income. To account for this

Finally, we also calculate a proxy for the amount of net capital loss carry forward at the percentile level for each year. Capital losses carry forward can significantly reduce taxable capital income. Given the imperfection of this proxy, we do not attempt to offset future net capital gains of a given percentile based on the proxy for capital losses carry forward in preceding years. Instead, we directly include the proxy as a separate variable in our regressions.[14] Nevertheless, current taxable capital income is corrected for net capital losses carry-forward

Third, due to our interest in the sources and changing patterns of federal income tax revenue, we transform the dollar amount variables into annual percentage change. The growth rate of tax revenue captures the sensitivity of tax revenue to income sources, and in particular the speed with which the tax system stabilizes the economy (Pechman, 1956; Cohen 1959; Auerbach and Feenberg, 2000). It also permits us to investigate government individual income tax revenue swings over time and its sources. For variables that are not in dollar amounts, we do not transform them in percentage changes. For instance, we use the unemployment rate, the rate of GDP growth, the inflation rate, which are already expressed in percentage terms. It is worth noting that most variables, with the exclusion of capital incomes, have low variances over time.[15] As has already been noted in the previous section, the variance of wage growth is very small, but much higher for capital income growth.

When transformed into percentage changes, the dataset comprises 4,000 observations, equivalent to a balanced panel.[16] We add fixed year and group dummies to control for unobserved effects that are invariant within groups over time and between years for all groups. We also include dummies that capture each tax regimes, defined below.

We start from a baseline regression including income variables and macroeconomic variables. We then add fixed effects for income percentiles, years or tax regimes. We suspect that the relationship between income sources and tax liability is not the same across income groups, and may also vary across tax regimes. Therefore we run separate regressions for five income quintiles, as well as for the pooled quintiles where all the independent variables are interacted with quintile dummies. We also run separate regression for specific decades and/or tax regimes as well as a pooled regression over all tax regimes/periods in which all independent variables are interacted with dummies for decades and/or tax regimes.[17]

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disparity, in separate regressions not presented here, we alternatively include and exclude pension income in the capital income variables. The main results are not affected, and are available on demand.

[14] See appendix for details on the empirical methodology and data.

[15] See descriptive statistics in appendix for a complete list of the variables and summary statistics.

[16] Although PUF data are based on different individuals every year, when aggregated at the percentile level with the use of sampling weights, we obtain a time series of cross-sections of the population divided into percentiles, which is equivalent to a balanced panel.

[17] Stata dataset, DO files, and log files are available for review by interested readers. Please contact the corresponding author to receive electronic copies. Two important points should be noted. First, not all regression results are presented in this paper for the sake of space. We run various regressions to test the robustness of the variable definition or the specification used. Second, due to the shift from level to first difference and percentage change, we are able to avoid managing non-stationary data. Though this applies to a limited number of variables, it is important to note especially when regressions results in levels are considered.

A number of econometric issues ought to be mentioned. Due to the focus of the study on tax revenue and the sources of income by groups of taxpayers based on income, we first suspect that the variance of the independent variables differs between panels, resulting in heteroskedasticity. For instance, while the average taxpayer in a lower percentile receives most of her income from wage with little variation of income sources over time, the average high income tax payers receives frequently more than fifty percent of their income from capital income sources with much higher variation in sources of income. Consequently, we re-run the pooled regressions by quintile but this time we re-weight the data based on the variance of predicted standard errors, within each quintile, of the unweighted pooled regression. This re-weighting strategy calculates the correct standard errors of the estimated coefficients, as if the regression were run separately for each quintile. The advantage of this weighted pooled regression is that it not only calculates the correct standard errors of the coefficients estimated, but also enables us to test whether the coefficients—for example the coefficients on capital income--are significantly different between quintiles. Second, we suspect that the variances of independent variables also vary across time periods or tax regimes. A key assumption in standard ordinary least squared regressions is that observations are a random walk around a trend. However, especially for tax revenue by percentile and capital income and as we saw earlier, the variance of key variables varies over time. Therefore, we also re-run the pooled regressions by tax regimes and/or time periods based on the predicted standard errors within each period. Third, due to certain provisions of the United States tax code that link tax liability over periods--such as capital losses carry forwards—we suspect that autocorrelation is present. If the error terms of previous periods were correlated with the error terms in the current period, the results would be biased. However, we run various tests for autocorrelation and find that when the model is fully specified with year and group dummies, the error terms are not correlated with the previous five lags. Various heteroskedasticity tests between panels and autocorrelation tests are presented in tables 1 and 2.

***Tax Regimes***

In some regressions we either directly control for tax regimes with the use of dummies for major tax changes or interact the independent variables with tax regimes dummies. The first tax regime encompasses the Kennedy-Johnson period from 1966 to 1980, during which the top marginal tax rate remained as high as 70 percent.[18] The second and third regimes cover years from 1981 to 1986, and from 1987 to 1989, following two of the most dramatic changes in the US tax system, both of which happened in the 1980s under President Reagan. The second regime that follows the Economic Recovery Tax Act (ERTA) reduced the top individual marginal tax rate from 70 percent to 50 percent, and cut tax rates in all other brackets by about 23 percent of their former level in a three-year period. It also provided automatic adjustments of tax brackets for inflation, to prevent bracket creep, beginning in

[18] In 1964, the top marginal tax rate was slashes for the first time since the large tax increase of 1932 that followed the Great Depression from 91 percent to 70 percent.

1984 for the first time in the history of the individual tax system.[19] The third regime covers the period following the TRA, which for the first time in the history of the federal tax system was aimed at simplifying the federal tax system to increase efficiency. The TRA, signed into law in 1986, not only significantly reduced the top marginal income tax rate to 28 percent, but also increased the tax base by curtailing several previous deductions.[20] It is also worth noting that capital gains were increased for one year to the exact same rate as the top marginal rate, resulting in a one-time jump in redemptions to avoid the higher rate.

The fourth and fifth tax regimes cover two less dramatic acts that aimed at reducing budget deficits that had persisted since 1981. This regime starts in 1990, following the 1990 act passed under President Bush, which increased the top marginal rate from 28 percent to 31 percent. The fifth tax regime covers the period 1994-1996, following the Omnibus Budget Recovery Act of 1993 (OBRA-93) passed under President Clinton, when the top marginal tax rate was increased again to 39.5 percent, increased the corporate tax rate by 1 point to 35 percent, and expanded the earned income tax credit. Both the 1990 and the 1993 acts affected mostly taxpayers at the top and bottom of the income distribution while the vast majority in middle-income groups were unaffected.

The sixth regime covers years that follow the Taxpayer Relief Act of 1997 (TRA 97), and covers 1997-2002. While individual income tax rates were not changed at the top, the 15 percent bracket reduced to 10 percent. The top tax rate on long-term capital gains was reduced from 28 to 20 percent, most capital gains from the sales of homes were excluded, and the estate tax was increased. It also generated or expanded a handful of new tax deductions and tax credits.[21]

The seventh regime starts with President Bush era of tax cuts, encouraged by the emergence of budget surpluses in the previous years. This regime starts in 2002, following the Economic Growth Tax Relief and Reconciliation Act (EGTRRA) enacted that year, and featuring large reductions in marginal income tax rates and the creation of a new tax bracket of 10 percent for low-income families. Those provisions were supposed to sunset in 2011, at which time the tax law would revert to what it had been in 2001.[22] This regime covers the Job and Growth Tax Reconciliation Act of 2003 (JGTRA) was passed, reducing tax

[19] By 1980, many people who did not have high income had started to face unusually high tax rates because inflation had gradually pushed many taxpayers towards higher tax brackets. This phenomenon has been referred to as the *bracket creep.*

[20] While the tax cuts included in the TRA mostly benefited high-income individuals, many of the deductions and exclusions that were curtailed had benefited the same groups. See Slemrod and Bakija (2008) for more details. In particular, tax rates on "long-term" capital gains, received largely by high-income taxpayers, were increased to match other incomes' rates. Meanwhile, aspects of the tax system that generally favors low-income groups, such as personal exemptions and the standard deduction, were increased. Other limitations affected deductions for certain tax favored savings accounts, medical expenses, business meals, entertainment, and certain business losses.

[21] Incidentally, this came after a republican majority won congress in 1994, while fundamental tax reform that would clean the tax system started to raise attention, the TRA97 complicated it even further. Among the largest changes were the introduction of multiple new tax favored saving plans and expansion of existing ones, new tax credits for higher education, and a new tax credit for dependent children.

[22] Purely for technical reasons, so that phase-in and –out would reduce the ten-year revenue cost of the bill.

rates and increasing standard deductions, child credits, and tax bracket sizes. Moreover, tax rates on dividends and capital gains were significantly reduced to 15 percent.[23]

We test the null that the relationship between capital income volatility increases over time in the same way across groups. However, testing this hypothesis for five quintiles and seven tax regimes would significantly reduce the degrees of freedom. Therefore we test the equality of the relative changes in the coefficients over time across quintile by dividing the period into two periods (pre- and post-1986) or four decades (1966-77, 1977-86, 1987-96, 1997-2006).

***Model***

Our baseline specifications are shown in equations (1) and (2)

$$\%\Delta Tax_{it} = \alpha\%\Delta W_{it} + \beta\%\Delta K_{it} + \gamma X_t + \varepsilon_{it} \quad (1)$$

Where $\%\Delta Tax_{it}$ is the annual percent change in personal income tax liability of percentile i in year t. The annual percent change of wages and salary and capital income are represented by $W_{it}$ and $K_{it}$. Tax revenue should also depend on macroeconomic variables. In fact, it is also our purpose to evaluate to which extent the annual growth rate of tax revenue depends on the economy, as compared to the stock market. We expect that the increasing dependence of individual income tax liability on volatile sources of income has reduced its dependence on the economy. Therefore, in all regressions we include the inflation rate, the unemployment rate, and the real growth rate of GDP.[24]

Because our data take the form of a balanced panel, we include a test of a random effect model against a fixed effect model, and adopt a fixed effect model with year and percentile dummies, as shown in equation (2).

$$\%\Delta Tax_{it} = \alpha\%\Delta W_{it} + \beta\%\Delta K_{it} + \gamma X_t + \sum_i D_i + \sum_t D_t + \varepsilon_{it} \quad (2)$$

We run equation (2) on the whole panel and for each quintile. However, we are interested in comparing coefficients across quintiles. Therefore, we also run a full interacted model with quintile dummies interactions, as presented in equation (3). We allow the standard errors of the error term to vary across quintiles. For this we use a weighted least square where each weights are equal to the within quintile variance. As we will see later, we use the same weighted least square strategy for other fully interacted models.

$$\%\Delta Tax_{ijt} = \sum_j \alpha_j \%\Delta W_{ijt} + \sum_j \beta_j \%\Delta K_{ijt} + \sum_j \gamma_j X_{jt} + \sum_j D_j + \sum_t D_t + \varepsilon_{ijt} \quad (3)$$

We expect that the growth rate of tax liability has increased its dependence on volatile sources of

[23] Note: capital gains had long benefited from preferential rates, but this was the first time since 1935 that dividends benefited from a special low rate compared to ordinary income. The provisions under the EGGTRA and JGTRA were extended in 2004, and another bill in 2005 extended them through 2010.

[24] Macroecomic variables are from the Bureau of labor and the Bureau of Economic Analysis.

income over time. To test this, we use two types of specifications. In the first, presented in equation (4), we interact all variables with a simple dummy in the middle of our sample. Because the last tax reform that significantly impacted the tax liability of Americans was the Tax Reform Act of 1986, we chose a dummy equal to one if the percentile is observed after 1986, and zero otherwise $I_{post86}$.

$$\%\Delta Tax_{ijt} = \sum_j \alpha_{1j} \%\Delta W_{ijt} I_{post86} + \sum_j \alpha_{2j} \%\Delta W_{ijt} + \sum_j \beta_{1j} \%\Delta K_{ijt} I_{post86} + \sum_j \beta_{2j} \%\Delta K_{ijt} + \sum_j \gamma_{1j} X_{jt} I_{post86} + \sum_j \gamma_{2j} X_{jt} + I_{post86} + \sum_j D_j + \sum_t D_t + \varepsilon_{ijt} \quad (4)$$

The second strategy to test the increasing dependence of the variability of taxes on capital income is torun our baseline model separately for each of the seven tax regime described above. This specification is shown in equation (5), where I(R=r) is a dummy equal to one id the data is observed during tax regime r.

$$\%\Delta Tax_{it} = \sum_{r=1}^{R-1} \alpha_r \%\Delta W_{it} I(Taxreg = r) + \alpha_7 \%\Delta W_{it} + \sum_{r=1}^{R-1} \beta_r \%\Delta K_{it} I(Taxreg = r) + \beta_7 \%\Delta K_{it} + \sum_{r=1}^{R-1} \gamma_r X_t I(Taxreg = r) + \gamma_7 X_t + \sum_{r=1}^{R-1} I(Taxreg = r) + \sum_i D_i + \varepsilon_{it} \quad (5)$$

## Results

We begin by running numerous diagnostic tests in order to analyze the data and justify our econometric approach. In tables 1-3 we run diagnostic tests for heteroskedasticity, autocorrelation, and stationarity. First, all of our tests reject homoskedasticity between panels. This fits our expectation that the relationship between the growth of income sources and the growth of individual income tax liability varies across income groups. In other words, there is evidence of non-constant variances across panels. Figures 10 and 11 plot the growth rate of individual income tax liability against the growth rate wages and salaries (figure 10), or the growth rate of capital income (figure 11), aggregated at the quintile level, from 1966 to 2006.

**<<INSERT FIGURE 10 HERE>>**

**<<INSERT FIGURE 11 HERE>>**

They clearly show that the linear relationship between the variables of interest and individual income tax liability growth varies across panels. Second, we find mixed evidence of autocorrelation across panels. When excluding panel (or percentiles) fixed effects, there is clear autocorrelation. However, when including panel fixed effects, there is no autocorrelation. While this may seem contradictory, we believe that this pattern is due to the nature of the data. As IRS PUF data does not track individual tax filers, it is not surprising that the effects of previous years would not follow a specific percentile, as there is movement into and out of a specific group. However, on an aggregate level, it is not surprising that the effects of previous years will carry over to current time periods. Third, the stationarity tests on tax revenue growth reveal a clear declining relationship between the non-stationary of the data and income percentiles, with the top twenty percentiles non-stationary and other percentiles stationary. This means that while the bottom 80 percentiles of taxpayers maintain constant variances and averages of individual income tax liability growth over time, the variances and averages of tax liability growth of the top 20 percentiles of taxpayers vary over time. Given that the top twenty percentiles of taxpayers are responsible for a majority of individual income tax liability, this relationship becomes fundamental to our understanding of the evolution of the growth of tax revenue from individual income in the United States over the past forty years.[25]

Tables 4 and 5 present the baseline regressions without and with fixed year effects for the entire population at the percentile level (Models 1 and 2) and by income quintile (Models 3 to 7).[26] While the regressions present results without and with fixed year effects, the results are strikingly similar for the overall population. First, the significance of baseline specifications without fixed group effects and then with and without year effects is very small and yields insignificant coefficients for the variables of interest—wage growth, capital income growth, inflation growth, GDP growth, and the rate of unemployment. When regressing the entire sample without controlling for heteroskedasticity across panels of income percentiles, the baseline results are insignificant. Second, in the sub-population regressions by quintile there is an upward trend in the r-square and general significance of the variables of interest. Regressions by quintiles normalize the variance within groups and the heteroskedasticity between groups is reduced because income groups within quintiles are more homogenous. Therefore the significances of both the specifications and the variables increase. The initial diagnostic tests and the results of the baseline regression demonstrate the existence of heteroskedasticity across panels.

An interesting result of tables 4 and 5 is the fact that the effect of capital income growth on personal income tax liability growth increases with income quintiles. For example, in the regressions without year effect, the relationship between capital income growth and tax liability growth is .046 for the middle quintile, .074 for the next quintile, and .139 for the top quintile. When we add year effects, the relationship is also increasing with income quintiles, but the coefficients are less significant.

[25] In 2006, the top quintile was responsible for 82.5 percent of individual income tax payments, including 39.4 percent for the top percentile, and 70.8 percent for the top decile. This compares to 64.1 percent for the top quintile in 1966, including 21.6 percent for the top percentile and 48.7 percent for the top decile

[26] Currently, we will not correct for many of the econometric issues which we have detailed preferring to demonstrate the importance of correcting for the data issues and most importantly how they skew understanding of the United States tax framework.

We further test whether the coefficients of the variables of interest—wages and capital income growth—are significantly different across income groups. For this, we pool all quintiles in a single regression and interact all regressors, including the macroeconomic variables, with five dummies for income quintiles. This is done without year fixed effects in tables 6 and with year fixed effects in table 7. Tables 6 and 7 show  models. Model 1 constrains the error term to have the same variance across groups, which we already know is wrong because of the presence of heteroskedasticity. Models 2 to 5 correct for heteroskedasticity across panels of income percentiles based on various weighting strategies. To control for the presence of heteroskedasticity, we reweight the data based on variables that are correlated with the variance of the errors. Model 2 reweight the data with the average within quintiles of the inverse of the predicted variance of the errors terms predicted from model 1. This method is the most standard as it should provide results that are very similar to the regressions performed separately for each quintiles and presented in tables 4 and 5. Models 3, 4 and 5 are generalized least squares assuming constant panels variance across groups (model 3), heterogeneous panel variance across percentiles (model 4), and heterogeneous variance across quintiles (model 5). There are a number of results worth noting.  First, in the absence of correction for heteroskedasticity as shown in model 1, the model returns both very similar results to the baseline model and a large degree of insignificance. Second, correcting for the differential residual variance across income groups reduces the heteroskedasticity of the data.  Third, GLS regressions under numerous variance assumptions make only moderate improvements on the baseline model when interacted by quintile.  Similar to the results about autocorrelation, weighting by a group specific variable is important, as the variance appears to significantly vary across quintiles. Last, but not least, the same pattern of increasing coefficients on capital income growth from the bottom to the top quintiles appear, providing evidence that tax liability variance is largely explained by the variance of capital income for high quintiles, but much less so for low quintiles.

We also expect that the relationship between the volatility of capital income and the volatility of tax liability increase over time and within quintiles. Tables 8 and 9 address the change in the relationship between tax liability growth and the sources of income growth over time and by quintiles. Table 8 looks at the change in this relationship from the period before to the twenty years after the Tax Reform Act of 1986. Models 1 and 2 are across all groups, while models 3 to 7 are separate regressions for each quintile. The results are much more significant when the regressions are separated for each quintiles, for the overall specifications and the coefficients. Moreover, there is strong evidence that the relationship between tax liability growth and capital income growth significantly increased from before to after the TRA 1986 for all quintiles except the top quintile. However, we suspect that the lack of significance for the top quintile is due to the presence of non-stationarity within this group, as evidenced previously in table 3. Table 9 interacts each variable with both the dummy for before and after the TRA 1986, but also with the five income quintiles, in order to be able to test whether the coefficients on the variables of interest are significantly different across groups. Model 1 assumes homogenous variance across groups, which we know is wrong because of the presence of heteroskedasticity. Model 2 corrects for heteroskedasticity across quintiles. The results provide evidence that the relationship between tax liability growth and capital income growth increased from

the bottom to the top quintiles, as shown in previous tables. The change over time is weak but positive and increasing.

We further test our prediction that the variability of tax liability has increased over time by dividing the data into 7 tax regimes. We compare the baseline regression with 7 separate regressions by tax regimes. The results are shown in table 10.[27] The results confirm our prediction. The first column shows the baseline regression, which we already know is mis-specified because of a high degree of heterogeneity across panels. The next seven columns present the result by tax regime. During the first two tax regime, the variability of tax liability does not depend significantly on the variability of wages and salaries, and depends negatively on the variability of capital. During the third tax regime, which starts in 1987, the coefficients on both wages and capital are significant, and the effect of the variability of capital is positive. The next four tax regime show an increase in the effect of the variability of capital, except in 1994-96, and the coefficient are large and significant in the last two tax regimes.

As shown in table 3, we cannot reject that the data are trend stationary or difference stationary under several tests.[28] Nevertheless, in the case of tax revenue and capital income, the Levin-Lin-Chu tests can not reject that at least one panel is non-stationary in most deciles, except for the second and top deciles in the case of tax revenue, and for the second, third, and top two deciles in the case of capital income. Most tests cannot reject that wage and macroeconomic series are stationary.[29] Given these findings, we have opted not to utilize other econometric techniques such as cointegration and Hodrick-Prescott filtering for business cycle smoothing (Ravn and Uhlig, 2002; Hodrick and Prescott, 1997). While, such techniques are frequently utilized in macroeconomic studies to smooth business cycle fluctuations, given our usage of percentile averaging which smoothes most variables in question such as tax revenue, wages, and capital income, there is no technical reason to believe that these techniques are either needed or useful.

## Discussion and Concluding Remarks

Over the past two decades, the United States federal income tax revenue has shown periods of increased volatility. While in most of the 1990s the growth rate of individual income taxes was between 5 and 10 percent, it has swung between -12 and +12 percent from 2000 to 2006. Meanwhile wage income has been relatively stable during this period while capital income annual growth has swung from

[27] We did not run a fully interacted model by tax regime and quintile because this would have significantly reduced the degrees of freedom.

[28] The Hadri test is performed on all panels as a whole, and across panels within deciles. The tests cannot reject that the data are trend stationary. We use several version of the Fisher test on all panels and by deciles across panels (the adjusted Dickey-Fuller unit root test is shown in Table 3). We cannot reject that the data are difference stationary. We use several other stationarity tests including the Harris-Tzavalis test and the Levin-Lin Chu test. The Harris-Tzavalis is most relevant when performed on all percentiles because it assumes that the number of panels tends to infinity while the number of periods if fixed. The Levin-Lin-Chu test assumes that the ratio of number of periods to group tends to infinity, and therefore is more relevant when performed across a limited number of panels.

[29] We also run unit-root test for macroeconomic variables (growth rate of GDP, unemployment rate and inflation) and find no evidence of a unit root.

-20 to +50 percent between 2000 and 2006. After looking deeper into the income composition of taxable sources, we find that tax revenue from the personal income tax has become increasingly dependent on volatile capital income, due primarily to an increasing dependence on high-income taxpayers and income sources that are highly volatile.

The increase in tax revenue volatility has been prompted by a number of factors. First, the tax system shifted over time to rely much more on high-income earners. While the marginal rates on high-income earners have decreased over time, the tax base has shrunk to exclude or receive minimal tax revenue from middle and low-income earners. Second, the reliance on high-income earners for the United States tax base has increased the implied exposure to capital income and its underlying volatility. High-income earners receive a much higher percentage of their income, increasing the risk to large swings in tax revenue to the US Treasury. Third, capital income volatility in the past two decades has increased. Not only are high-income earners and the US Treasury more dependent on volatile capital income, capital volatility has increased when measured across decades.

Using a database on individual tax files from 1966 to 2006 from the Internal Revenue Service Public Use Files, we estimate the relationship between the volatility of personal income taxes and the volatility of major income sources—wages and salaries income and capital income-- over time and by income groups. The volatility of the personal income tax is defined as the percentage change in tax liability by group.[30]

We find that annual changes in the individual income tax significantly depend on the growth of capital income over the 40 years up to 2006, and that this relationship increases across income groups, with a strong relationship for the top quintile. Interestingly we find that the growth of capital income and wages and salaries have less explanatory power to explain personal income tax revenue growth after 1986. This suggests that the explanatory power of both those income sources to explain tax revenue growth has significantly decreased over time, even if those income sources represent together more than 90 percent of adjusted gross income. However, more research is needed. IN particular, we suspect that the non-stationarity of tax liability for high percentiles of income may bias these results.

Moreover, we find that personal income tax revenue growth has increased its dependence on the capital income growth of high-income groups, but decreased its dependence on the growth of wage income from middle- and low-income groups. Personal income tax revenue from wages and salaries for middle- and low-income earners is either statistically insignificant or even negative indicating a tax base shift towards high-income earners. Interestingly, for the top quintile, we find that the growth rate of tax payments is large and statistically dependent on both wage and capital income sources. More research is needed in order to evaluate the volatility of wage income for smaller income groups.

Our research also appears to support the idea that the tax system has become increasingly detached from larger macroeconomic activity and more dependent on capital income to drive tax revenue growth. With the exception of unemployment, the range of macroeconomic variables are largely insignificant to

[30] In this draft we only use tax revenue growth to approximate tax revenue volatility. Future drafts will extend to other definitions of volatility, such as moving average standard deviations over time (transversal volatility) and between group standard deviation (horizontal volatility).

tax revenue growth and more importantly the primary tax base of the top 20 percent of income earners. It would seem a risky tax collection strategy to separate economic growth from changes in tax revenue.

## References


Ahsan, Syed and Panagiotis Tsigaris. "The Efficiency Loss of Capital Income Taxation under Imperfect Loss Offset Provisions." Public Finance Review 37(6). November, 2009. 710-731

Altshulher, Rosanne, Benjamin Harris, and Eric Toder. "Capital Income Taxation and Progressivity in a Global Economy." Tax Policy Center, Urban Institute, and Brookings Institution Working Paper. May 12, 2010

Auerbach, Alan J. and Daniel Feenberg. "The Significance of Federal Taxes as Automatic Stabilizer." The Journal of Economic Perspectives 14(3). Summer, 2000. 37-56.

Auerbach, Alan J. "On the Design and Reform of Capital Gains Taxation." The American Economic Review 82(2). 1992. Pp. 263-267.

Auerbach, Alan and James Poterba. "Capital Gains Taxation in the United States: Realization, Revenue, and Rhetoric." Brookings Papers on Economic Activity. 1988(2). 595-637

Auten, Gerald and Joseph Cordes. "Cutting Capital Gains Taxes." The Journal of Economic Perspectives. 5(1). Winter 1991. 181-192

Bach, Stefan and Hermann Buslei. "Evidence from Microsimulation Using Tax Statistics for Germany." DIW Berlin Discussion Paper 950. November 2009.

Badrinath, S.G. and Wilbur Lewellen. "Evidence on Tax Motivated Securities Trading Behavior." The Journal of Finance.46(1). March 1991. 369-382

Baunsgaard, Thomas and Steven Symansky. "Automatic Fiscal Stabilizers." IMF Staff Position Note SPN/09/23. September 28, 2009.

Blanchard, O. (2006). "Comments on The Case Against the Case Against Discretionary Policy."By Alan Blinder. In R. Kopcke, G. Tootell and R. Triest (eds), "The macroeconomics of Fiscal policy". MIT Press. Boston. 2006. 62-67.

Bohn, Henning. "Tax Smoothing with Financial Instruments." The American Economic Review 80(5). December 1990. 1217-1230

Clotfelter, Charles. "Tax Induced Distortions and the Business Pleasure Borderline: The Case of Travel and Entertainment." The American Economic Review. 73(5). December 1983. 1053-1065

Cohen, Leo. "An empirical Measurement of the Built-in Flexibility of the Individual Income Tax." American Economic Review 49(2), Papers and Proceedings of the 71st Annual Meeting. May, 1959. 532-541.

Conley, Timothy and Bill Dupor. "The American Recover and Reinvestment Act: Public Sector Jobs Saved, Private Sector Jobs Forestalled", working paper. 2011.

Consea, Juan Carlos and Dirk Krueger. “On the Optimal Progressivity of the Income Tax Code.” Journal of Monetary Economics 53(7). October 2006.1425-1450.

Daunfeldt, Sven-Olov, Ulrika Praski-Stahlgren, and Niklas Rudholm. “Do High Taxes Lock-in Capital Gains? Evidence from a Dual Income Tax System.” Public Choice. 145.2010. 25-38

Feenberg, Daniel R. and James M. Poterba. “The Income and Tax Share of Very High-Income Households, 1960-1995.” The American Economic Review 90(2). May 2000.264-270

Feldstein, Martin. “The Effect of Marginal Tax Rates on Taxable Income: A Panel Study of the 1986 Tax Reform Act.” The Journal of Political Economy 103(3). June 1995. 551-572.

Feldstein, Martin, Joel Slemrod, and Shlomo Yitzhaki. “The Effects of Taxation on the Selling of Corporate Stock and the Realization of Capital Gains.” The Quarterly Journal of Economics. 94(4). June 1980. 777-791

Goolsbee, Austan. “Taxes, High Income Executives, and the Perils of Revenue Estimation in the New Economy.” American Economic Review. 90(2). 2000.271-275

Gordon, Roger. “Taxation of Corporate Capital Income: Tax Revenue Versus Tax Distortions.” The Quarterly Journal of Economics. 100(1). February 1985.1-27

Hodrick, R. and Prescott, E.“Postwar U.S. Business Cycles: An Empirical Investigations.” ,Journal of Money, Credit and Banking, 29(1). 1997. 1-16.

Keuschnigg, Christian and Martin Dietz. “A Growth Oriented Dual Income Tax.” International Tax and Public Finance. 14(2). 2007. 191-221

Keuschnigg, Christian and Soren Bo Nielsen. “Start-ups, Venture Capitalists, and the Capital Gains Tax.” Journal of Public Economics. 88(5). April 2004. 1011-1042

Pechman, Joseph A. “Yield of an Individual Income Tax During a Recession.” In Policies to Combat Depression. 1956. 123-145.

Picketty, Thomas and Emmanuel Saez. “How Progressive is the U.S. Federal TaxSystem? A Historical and InternationalPerspective.” Journal of Economic Perspectives 21(1). 2007, 3–24.

Ravn, M. and Uhlig, H. 2002. “On Adjusting the Hodrick-Prescott Filter for theFrequency of Observations.” Review of Economics and Statistics, 84. 2002. 371-380.

Sobel, Russell S. and Randall G. Holcombe. “Measuring the Growth and Variability of Tax Bases over the Business Cycle.” National Tax Journal 49(4). December 1996. 535-52

Slemrod,Joel. “Lessons for Tax Policy in the Great Recession.” National Tax Journal. September 2009.387-397

Slemrod, Joel, and Jon Bakija. “Taxing ourselves: a citizen's guide to the debate over taxes.” The MIT Press; 4th edition. April 30, 2008.

Slemrod, Joel. “Optimal Taxation and Optimal Tax Systems.” The Journal of Economic Perspectives 4(1). Winter 1990. 157-178.

Sorensen, Peter Birch. “Optimal Tax Progressivity in Imperfect Labour Markets.” Labour Economics 6(3). September 1999. 435-452.

Stiglitz, Joseph. “Some Aspects of the Taxation of Capital Gains.” Journal of Public Economics. 21. 1983. 257-294

Suits, Daniel B. “Measurement of Tax Progressivity.” The American Economic Review 67(4). September 1977. 747-752.

## Appendix: Data description and summary statistics: *Data Description*

| Variable name* | Variable | Description |
|---|---|---|
| Capi0 | Capital Income | Summation of dividends, interest, business income (sole proprietorship), partnership, small corporations, net long term and short term capital gains, rental, royalty, and estate or trust income |
| Capi2 | Capital Income with Used Net Loss Carry Forward | Summation of all sources of capital income in Capi0 *minus* applied net loss accrued in previous tax year |
| Capi3 | Capital Income including pension and annuity income | This sums all sources of capital income in Capi0 but also includes pension and annuity income |
| C | Total Capital Return Index | A 50/50 portfolio using the Dow Jones Corporate Bond Total Return and the S&P 500 Total Return Index |
| wage | Wages and Salary income | As reported by taxpayers |
| netclcf | Net capital loss carry forward | Approximated at the income percentile level. See below for details on the calculation. |
| unemprate | Unemployment rate | Yearly unemployment rate from the United States Bureau of Labor Statistics |
| ngdpg | Growth rate of nominal gross domestic product | Nominal GDP of the United States Bureau of Economic Analysis |
| rgdpg | Growth rate of real gross domestic product | Real GDP of the United States Bureau of Economic Analysis |
| inf | Inflation rate | Year-to-year percent change in consumer price index (CPI-U) from the United States Bureau of Labor Statistics |

***Correlation table for wage and for capital income by sources, 1966-2006***

| | Wages | Dividends | Interest | Business | Partnership | Small Business | Rental | Royalty | Windfall | Estate | Short Term Capital Gain | Long Term Capital Gain | Capital Gain |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wages | 1.00 | | | | | | | | | | | | |
| Dividends | 0.80 | 1.00 | | | | | | | | | | | |
| Interest | 0.81 | 0.94 | 1.00 | | | | | | | | | | |
| Business | 0.88 | 0.88 | 0.86 | 1.00 | | | | | | | | | |
| Partnership | 0.71 | 0.88 | 0.78 | 0.79 | 1.00 | | | | | | | | |
| Small Business | 0.73 | 0.89 | 0.82 | 0.76 | 0.94 | 1.00 | | | | | | | |
| Rental | 0.64 | 0.77 | 0.69 | 0.77 | 0.86 | 0.86 | 1.00 | | | | | | |
| Royalty | 0.69 | 0.92 | 0.87 | 0.76 | 0.78 | 0.80 | 0.62 | 1.00 | | | | | |
| Windfall | -0.09 | -0.22 | -0.23 | -0.11 | -0.01 | -0.01 | -0.01 | -0.40 | 1.00 | | | | |
| Estate | 0.76 | 0.96 | 0.90 | 0.81 | 0.89 | 0.93 | 0.81 | 0.92 | -0.20 | 1.00 | | | |
| Short Term Capital Gain | 0.10 | 0.22 | 0.11 | 0.13 | 0.37 | 0.30 | 0.20 | 0.16 | 0.07 | 0.20 | 1.00 | | |
| Long Term Capital Gain | 0.69 | 0.92 | 0.84 | 0.71 | 0.87 | 0.91 | 0.74 | 0.84 | -0.12 | 0.93 | 0.27 | 1.00 | |
| Capital Gain | 0.45 | 0.27 | 0.26 | 0.36 | 0.21 | 0.19 | 0.21 | 0.15 | -0.02 | 0.21 | 0.05 | 0.22 | 1.00 |

**Table 1 – Testing for Heteroskedasticity**

| | White Test for Homoskedasticity | Cameron and Trivedi Decomposition of IM Test | Breusch-Pagan and Cook Weisberg Test for Heteroskedasticity with i.i.d. | Breusch-Pagan and Cook Weisberg Test for Heteroskedasticity with F statistic |
|---|---|---|---|---|
| **Chi-squared** | 400.23<br>(.00) | 400.23<br>(.00) | 162.97<br>(.00) | |
| **F-Statistic** | | | | 169.90<br>(.00) |
| **Degrees of Freedom** | 122 | 122 | | |
| **Stata Command** | Estat imtest, white | Estat imtest | Estat hettest, iid | Estat hottest, fstat |
| | | | | |
| **Null** | Rejected | Rejected | Rejected | Rejected |
| **Data** | Heteroskedastic | Heteroskedastic | Heteroskedastic | Heteroskedastic |

**Table 2 – Testing for Autocorrelation**

| | Error Regression | Error Regression | Error Regression | ARCH Test |
|---|---|---|---|---|
| **Lagged Error Term** | -.002*<br>(.001) | -.002**<br>(.001) | -.001<br>(.02) | |
| **Specification** | No fixed group or year effects | Fixed year effects | Fixed year and group effects | |
| **Lags** | | | | 5 |
| **Percentile** | | | | 100 |
| | | | | |
| **Autocorrelation** | Yes | Yes | No | No |

Standard error in parentheses *Significant at the 10% level **Significant at the 5% level *Significant at the 1% level

**Table 3 – Unit-Root Tests for Stationarity**

| | Levin-Lin | Levin-Lin | Levin-Lin | Levin-Lin | Levin-Lin |
|---|---|---|---|---|---|
| **Variable** | Tax Liability | Tax Liability | Tax Liability | Tax Liability | Tax Liability |
| **Unadjusted t** | 13.2 | -1.29 | 0.773 | 3.91 | 4.39 |
| **P-value** | 1 | 0.261 | 0.963 | 1 | 1 |
| **Percentile** | 100 | 11-20 | 21-30 | 31-40 | 41-50 |
| **Years** | 41 | 41 | 41 | 41 | 41 |
| **Stationary 1/** | Yes | Yes | Yes | Yes | Yes |

| | Levin-Lin | Levin-Lin | Levin-Lin | Levin-Lin | Levin-Lin |
|---|---|---|---|---|---|
| **Variable** | Tax Liability | Tax Liability | Tax Liability | Tax Liability | Tax Liability |
| **Unadjusted t** | 5.47 | 4.29 | 4.15 | 6.64 | 8.18 |
| **P-value** | 1 | 1 | 1 | 1 | 1 |
| **Percentile** | 51-60 | 61-70 | 71-80 | 81-90 | 91-100 |
| **Years** | 41 | 41 | 41 | 41 | 41 |
| **Stationary 1/** | Yes | Yes | Yes | Yes | Yes |

**1/ At the 10% level.**

| | Fisher - Dickey Fuller | Fisher - Dickey Fuller | Fisher - Dickey Fuller | Fisher - Dickey Fuller | Fisher - Dickey Fuller |
|---|---|---|---|---|---|
| **Variable** | Wages | Wages | Wages | Wages | Wages |
| **Inversed Chi-2** | 10.8 | 3.07 | 0.899 | 0.123 | 0.069 |
| **P-value** | 1 | 1 | 1 | 1 | 1 |
| **Percentile** | 100 | 11-20 | 21-30 | 31-40 | 41-50 |
| **Years** | 41 | 41 | 41 | 41 | 41 |
| **Stationary 1/** | Yes | Yes | Yes | Yes | Yes |

| | Fisher - Dickey Fuller | Fisher - Dickey Fuller | Fisher - Dickey Fuller | Fisher - Dickey Fuller | Fisher - Dickey Fuller |
|---|---|---|---|---|---|
| **Variable** | Wages | Wages | Wages | Wages | Wages |
| **Unadjusted t** | 0.047 | 0.077 | 0.104 | 0.045 | 0.032 |
| **P-value** | 1 | 1 | 1 | 1 | 1 |
| **Percentile** | 51-60 | 61-70 | 71-80 | 81-90 | 91-100 |
| **Years** | 41 | 41 | 41 | 41 | 41 |
| **Stationary 1/** | Yes | Yes | Yes | Yes | Yes |

**1/ At the 10% level.**

**Table 3 – Unit-Root Tests for Stationarity cont.**

| | Levin-Lin | Levin-Lin | Levin-Lin | Levin-Lin | Levin-Lin |
|---|---|---|---|---|---|
| **Variable** | Tax Liability | Tax Liability | Tax Liability | Tax Liability | Tax Liability |
| **Unadjusted t** | -10.65 | -1.57 | -3.05 | -5.42 | -5.76 |
| **P-value** | 0.001 | 0.698 | 0.164 | 0.001 | 0.001 |
| **Percentile** | 100 | 11-20 | 21-30 | 31-40 | 41-50 |
| **Years** | 41 | 41 | 41 | 41 | 41 |
| **Stationary 1/** | No | Yes | Yes | No | No |

| | Levin-Lin | Levin-Lin | Levin-Lin | Levin-Lin | Levin-Lin |
|---|---|---|---|---|---|
| **Variable** | Tax Liability | Tax Liability | Tax Liability | Tax Liability | Tax Liability |
| **Unadjusted t** | -5.71 | -4.68 | -3.72 | -2 | -0.034 |
| **P-value** | 0.005 | 0.019 | 0.037 | 0.461 | 0.997 |
| **Percentile** | 51-60 | 61-70 | 71-80 | 81-90 | 91-100 |
| **Years** | 41 | 41 | 41 | 41 | 41 |
| **Stationary 1/** | No | No | No | Yes | Yes |

**1/ At the 10% level.**

| | Fisher - Dickey Fuller | Fisher - Dickey Fuller | Fisher - Dickey Fuller | Fisher - Dickey Fuller | Fisher - Dickey Fuller |
|---|---|---|---|---|---|
| **Variable** | Capital income | Capital income | Capital income | Capital income | Capital income |
| **Inversed Chi-2** | 103 | 3.54 | 8.16 | 17.7 | 20.9 |
| **P-value** | 1 | 1 | 0.991 | 0.606 | 0.399 |
| **Percentile** | 100 | 11-20 | 21-30 | 31-40 | 41-50 |
| **Years** | 41 | 41 | 41 | 41 | 41 |
| **Stationary 1/** | Yes | Yes | Yes | Yes | Yes |

| | Fisher - Dickey Fuller | Fisher - Dickey Fuller | Fisher - Dickey Fuller | Fisher - Dickey Fuller | Fisher - Dickey Fuller |
|---|---|---|---|---|---|
| **Variable** | Capital income | Capital income | Capital income | Capital income | Capital income |
| **Unadjusted t** | 18.13 | 13.1 | 7.1 | 2.99 | 0.782 |
| **P-value** | 0.579 | 0.873 | 0.996 | 1 | 1 |
| **Percentile** | 51-60 | 61-70 | 71-80 | 81-90 | 91-100 |
| **Years** | 41 | 41 | 41 | 41 | 41 |
| **Stationary 1/** | Yes | Yes | Yes | Yes | Yes |

**1/ At the 10% level.**

**Table 4 – Group Regressions Without Fixed Year Effects**

| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 | Model 7 |
|---|---|---|---|---|---|---|---|
| **Wages** | 3.059<br>(2.47) | 2.28*<br>(1.25) | 3.09<br>(2.00) | .789***<br>(0.10) | .489***<br>(0.06) | .529***<br>(0.07) | .664***<br>(0.04) |
| **Capital Income** | -.231**<br>(10.98) | -.219*<br>(0.11) | -0.029*<br>(0.16) | 0.05<br>(0.03) | .046***<br>(0.02) | .074***<br>(0.01) | .139***<br>(0.02) |
| **Inflation** | 0.266<br>(0.24) | 0.289<br>(0.25) | 1.465<br>(1.29) | .02***<br>(0.00) | .016***<br>0.00 | .014***<br>0.00 | .01***<br>(0.00) |
| **Unemployment Rate** | -0.11<br>(0.12) | -0.152<br>(0.14) | -0.761<br>(0.71) | -0.022***<br>(0.00) | -.019***<br>0.00 | -.016***<br>0.00 | -0.015***<br>(0.00) |
| **Real GDP Growth** | 0.147<br>(0.11) | 0.162<br>(0.12) | 0.796<br>(0.64) | .002***<br>(0.00) | .016***<br>0.00 | .011***<br>0.00 | .011***<br>0.00 |
| **Constant** | -0.771<br>(0.60) | -0.642<br>(0.79) | -2.88<br>(-2.88) | -0.039***<br>(0.01) | -0.003<br>(0.01) | .014***<br>(0.00) | .015***<br>(0.00) |
| **R-Square Within** | n/a | 0 | 0.01 | 0.36 | 0.51 | 0.58 | 0.6 |
| **R-Square Between** | n/a | 0.05 | 0.59 | 0.47 | 0.29 | 0.7 | 0.84 |
| **R-Square Overall** | 0 | 0 | 0.01 | 0.36 | 0.51 | 0.58 | 0.6 |
| **F-Statistic** | 2.06 | 1.84 | 1.42 | 566.84* | 721.80* | 1916.24* | 1169.69 |
| **Observations** | 3,950 | 3,950 | 750 | 800 | 800 | 800 | 800 |
| **Fixed effects** | No | Percentile | Percentile 0-20% | Percentile 21-40% | Percentile 41-60% | Percentile 61-80% | Percentile 81%+ |

Note: Regressions based on 100 percentiles from 1966 to 2006. The dependent variable is the growth rate of tax liability. Robust standard errors in parenthesis. * p<.1; ** p<.05; *** p<.01.

**Table 5 – Regressions With Fixed Year Effects, Overall and by Quintiles**

| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 | Model 7 |
|---|---|---|---|---|---|---|---|
| Wages | 3.121 | 2.078 | 2.437 | .446*** | .239*** | 0.062 | .44** |
| | (2.581) | (1.486) | (2.702) | (0.109) | (0.059) | (0.072) | -0.162 |
| Capital Income | -.207** | -.195** | -.204* | -0.008 | 0.000 | 0.014 | .081* |
| | (0.092) | (0.090) | (0.106) | (0.024) | (0.013) | (0.011) | -0.041 |
| Inflation | 0.051 | 0.032 | 0.109 | .014*** | .017*** | .016*** | .015*** |
| | (0.040) | (0.040) | (0.224) | (0.002) | (0.001) | (0.001) | -0.002 |
| Unemployment Rate | -0.019 | -0.094* | -0.390 | -0.022*** | -0.024*** | -.019*** | -.024*** |
| | (0.027) | (0.049) | (0.253) | (0.003) | (0.002) | (0.002) | -0.002 |
| Real GDP Growth | -0.003 | -0.024 | -0.128 | .008*** | .009*** | .004** | .008*** |
| | (0.014) | (0.032) | (0.175) | (0.003) | (0.001) | (0.001) | -0.001 |
| Constant | -0.144 | .641* | 3.230 | .117** | .08** | .074*** | .081*** |
| | (0.180) | (0.360) | (1.912) | (0.030) | (0.026) | (0.018) | -0.014 |
| R-Square Within | n/a | 0 | 0.01 | 0.36 | 0.51 | 0.58 | 0.6 |
| R-Square Between | n/a | 0.05 | 0.59 | 0.47 | 0.29 | 0.7 | 0.84 |
| R-Square Overall | 0 | 0 | 0.01 | 0.36 | 0.51 | 0.58 | 0.6 |
| F-Statistic | 2.06 | 1.84 | 1.42 | 566.84* | 721.80* | 1916.24* | 1169.69 |
| Observations | 3,950 | 3,950 | 750 | 800 | 800 | 800 | 800 |
| Fixed effects | No | Percentile | Percentile 0-20% | Percentile 21-40% | Percentile 41-60% | Percentile 61-80% | Percentile 81%+ |

Note: Regressions based on 100 percentiles from 1966 to 2006. The dependent variable is the growth rate of tax liability. Robust standard errors in parenthesis* p<.1; ** p<.05; *** p<.01.

**Table 6 – Regressions with Quintile Interactions with Uncorrected and Corrected Standard Errors**

| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 |
|---|---|---|---|---|---|
| **Wages** | 3.09 | 3.09 | 3.76 | -0.49 | 3.72 |
| **Wagesx2** | -2.31 | -2.31 | -2.64 | 1.28 | -2.95 |
| **Wagesx3** | -2.60 | -2.60 | -2.78 | 0.99 | -3.23 |
| **Wagesx4** | -2.56 | -2.56 | -3.02 | 1.03 | -3.18 |
| **Wagesx5** | -2.43 | -2.43 | -2.77 | 1.18 | -3.03 |
| **Capital Income** | -0.288* | -.288* | -0.29 | -0.12* | -0.29 |
| **Capital Incomex2** | .338** | .338** | 0.38 | .189** | 0.34 |
| **Capital Incomex3** | .334** | .334** | 0.35 | .172** | 0.34 |
| **Capital Incomex4** | .362** | .362** | 0.36 | .199** | 0.36 |
| **Capital Incomex5** | .427** | .427** | 0.38 | .261*** | 0.43 |
| **Inflation** | 1.46 | 1.46 | 1.32*** | 0.12** | 1.31** |
| **Inflationx2** | -1.44 | -1.44 | -1.29*** | -0.10* | -1.29** |
| **Inflationx3** | -1.45 | -1.45 | -1.30*** | -0.10* | -1.29** |
| **Inflationx4** | -1.45 | -1.45 | -1.30*** | -0.11* | -1.30** |
| **Inflationx5** | -1.45 | -1.45 | -1.31*** | -0.11* | -1.31** |
| **Unemployment Rate** | -0.76 | -0.76 | -.899*** | -0.08 | -0.97* |
| **Unemployment Ratex2** | 0.74 | 0.74 | .942** | 0.05 | 0.94* |
| **Unemployment Ratex3** | 0.74 | 0.74 | .948** | 0.06 | 0.95* |
| **Unemployment Ratex4** | 0.74 | 0.74 | .953** | 0.06 | 0.95* |
| **Unemployment Ratex5** | 0.75 | 0.75 | .954** | 0.07 | 0.96* |
| **Real GDP Growth** | 0.80 | 0.80 | .568* | 0.11 | 0.53 |
| **Real GDP Growthx2** | -0.78 | -0.78 | -0.51 | -0.09 | -0.51 |
| **Real GDP Growthx3** | -0.78 | -0.78 | -0.52 | -0.09 | -0.52 |
| **Real GDP Growthx4** | -0.78 | -0.78 | -0.52 | -0.10 | -0.52 |
| **Real GDP Growthx5** | -0.79 | -0.79 | -0.52 | -0.10 | -0.52 |

**Table 6 – Regressions with Quintile Interactions with Uncorrected and Corrected Standard Errors cont.**

| | | | | | |
|---|---|---|---|---|---|
| **Constant** | -0.05 | 0.01 | -0.61 | 0.00 | 0.00 |
| **Fixed Effects** | Group | Group | Group | Group | Quintile |
| **Standard Errors** | Uncorrected | WLS -- weights are inverse of predicted within quintile variance from Model 1 | Weighted GLS assuming constant panel variance by percentiles | Weighted GLS assuming different panel variance by percentiles | Weighted GLS assuming different panel variance by quintile |
| **R-squared** | 0.05 | 0.49 | | | |
| **Chi-squared** | | | 57.58* | 688.14*** | 684.56* |
| **F-Statistic** | 117.1* | 117.2*** | | | |
| **Observations** | 3,950 | 3,950 | 3,950 | 3,950 | 3,950 |
| **Groups** | 100 | | 100 | 100 | 100 |

Note: Regressions based on 100 percentiles from 1966 to 2006. The dependent variable is the growth rate of tax liability. Robust standard errors in parenthesis. * p<.1; ** p<.05; *** p<.01.

**Table 7 – Regressions with Quintile Interactions, Fixed Year Effects, Uncorrected and Corrected Standard Errors**

| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 |
|---|---|---|---|---|---|
| **Wages** | 2.99 | 3.09 | 3.73 | -0.606 | 3.72 |
| **Wagesx2** | 2.82 | -2.42 | -2.60 | 1.28 | -3.06 |
| **Wagesx3** | -2.58 | -2.74 | -1.90 | 0.966 | -3.36 |
| **Wagesx4** | -0.995 | -2.93 | 2.50 | 0.750 | -3.54 |
| **Wagesx5** | -0.751 | -2.76 | 1.15 | 0.978 | -3.32 |
| **Capital Income** | -.272* | -.287* | -0.276 | -0.129* | -0.289 |
| **Capital Incomex2** | 0.551 | .316* | 0.723 | 0.158 | 0.317 |
| **Capital Incomex3** | 0.579 | .305* | 0.737 | 0.146 | 0.308 |
| **Capital Incomex4** | 0.944 | .317* | 1.12 | 0.156 | 0.32 |
| **Capital Incomex5** | 1.01 | .343** | 1.00 | 0.185 | 0.348 |
| **Inflation** | 1.12 | 1.46 | 0.09 | 0.110 | 1.30** |
| **Inflationx2** | -1.44 | -1.44 | -1.29* | -0.101 | -1.29* |
| **Inflationx3** | -1.45 | -1.45 | -1.30* | -0.103 | -1.29* |
| **Inflationx4** | -1.48 | -1.45 | -1.34* | -0.104 | -1.29* |
| **Inflationx5** | -1.48 | -1.45 | -1.33* | -0.108 | -1.30* |
| **Unemployment Rate** | -0.673 | -0.766 | -2.23 | -0.117 | -1.01*** |
| **Unemployment Ratex2** | 0.729 | 0.74 | .941* | 0.051 | .943*** |
| **Unemployment Ratex3** | 0.736 | 0.743 | .952* | 0.057 | .949*** |
| **Unemployment Ratex4** | 0.746 | 0.745 | .96* | 0.062 | .953*** |
| **Unemployment Ratex5** | 0.741 | 0.748 | .953* | 0.064 | .956*** |
| **Real GDP Growth** | 0.619 | 0.787 | 0.090 | 0.14 | 0.567 |
| **Real GDP Growthx2** | -0.775 | -0.775 | -0.510 | -0.088 | -0.512 |
| **Real GDP Growthx3** | -0.788 | -0.78 | -0.525 | -0.09 | -0.515 |
| **Real GDP Growthx4** | -0.815 | -0.783 | -0.558 | -0.092 | -0.517 |
| **Real GDP Growthx5** | -0.814 | -0.783 | -0.546 | -0.092 | -0.517 |

**Table 7 – Regressions with Quintile Interactions,Fixed Year Effects, Uncorrected and Corrected Standard Errors cont.**

| | | | | | |
|---|---|---|---|---|---|
| **Constant** | 0.544 | .086*** | 11.7 | 0.136 | 0.148 |
| **Fixed Effects** | Group and Year | Group and Year | Group and Year | Group and Year | Quintile |
| **Standard Errors** | Uncorrected | WLS -- weights are inverse of predicted within quintile variance from Model 1 | GLS assuming constant panel variance by percentile | GLS with different panel variance by percentile | GLS with different panel variance by quintile |
| **R-squared** | 0.05 | 0.06 | | | |
| **Chi-squared** | | | 88.33** | 24.38 | 22.9 |
| **F-Statistic** | 0.59 | 131.82* | | | |
| **Observations** | 3,950 | 3,950 | 3,950 | 3,950 | 3,950 |
| **Groups** | 100 | 100 | 100 | 100 | 100 |

Note: Regressions based on 100 percentiles from 1966 to 2006. The dependent variable is the growth rate of tax liability. Robust standard errors in parenthesis. * p<.1; ** p<.05; *** p<.01.

**Table 8: Regressions Without Fixed Year Effects, With Interaction with After TRA 1986 Tax Regime, Overall and by Quintile**

| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 | Model 7 |
|---|---|---|---|---|---|---|---|
| Wages | 2.95 | 0.903 | 1.46 | .80*** | 0.159 | .354*** | .537*** |
| | (2.38) | (2.68) | (5.88) | (0.135) | (0.097) | (0.112) | (0.176) |
| WagesxAfter86 | 0.66 | 2.46 | 2.02 | -0.054 | .462*** | 0.144 | 0.092 |
| | (4.03) | (3.14) | (6.18) | (0.15) | (0.12) | (0.11) | (0.18) |
| Capital Income | -0.239 | -0.250* | -0.324* | 0.035 | -0.003 | 0.044*** | 0.120** |
| | -0.115 | -0.128 | -0.187 | -0.046 | -0.022 | -0.015 | -0.046 |
| Capital IncomexAfter86 | 0.192 | 0.592*** | 0.591*** | 0.057 | 0.069** | 0.052*** | 0.025 |
| | (0.218) | (0.155) | (0.133) | (0.049) | (0.024) | (0.018) | (0.036) |
| Inflation | 0.350 | 0.351 | 1.77 | 0.02*** | 0.015*** | 0.012*** | 0.010*** |
| | (0.313) | (0.305) | (1.58) | (0.002) | (0.006) | (0.001) | (0.001) |
| InflationxAfter86 | -0.314 | -0.322 | -1.68 | 0.008*** | 0.013*** | 0.012*** | 0.005*** |
| | (0.314) | (0.304) | (1.58) | (0.002) | (0.002) | (0.001) | (0.001) |
| Unemployment Rate | -0.089 | -0.170 | -0.820 | -0.02*** | -0.02*** | -0.02*** | -0.02*** |
| | (0.112) | (0.157) | (0.838) | (0.001) | (0.001) | (0.001) | (0.001) |
| Unemployment RatexAfter 1986 | 0.016 | 0.110 | 0.476 | 0.019*** | 0.016*** | 0.015*** | 0.013*** |
| | (0.145) | (0.182) | (0.969) | (0.003) | (0.002) | (0.001) | (0.001) |
| Real GDP Growth | 0.235 | 0.233 | 1.18 | 0.019*** | 0.012*** | 0.01*** | 0.01*** |
| | (0.184) | (0.178) | (0.940) | (0.017) | (0.001) | (0.007) | (0.001) |
| Real GDP GrowthxAfter86 | -0.255 | -0.259 | -1.30 | 0.017*** | 0.014*** | 0.007*** | 0.008*** |
| | (0.189) | (0.183) | (0.936) | (0.003) | (0.002) | (0.001) | (0.001) |
| After 86 | 2.16 | 1.34 | 7.70 | -0.18*** | -0.22*** | -0.17*** | -0.13*** |
| | (1.57) | (0.992) | (5.07) | (0.020) | (0.018) | (0.011) | (0.010) |
| Constant | -1.82 | -1.09 | -5.68 | -0.023 | 0.076*** | 0.069*** | 0.05*** |
| | (1.43) | (1.12) | (5.76) | (0.016) | (0.011) | (0.007) | (0.011) |
| Fixed Effects | No | Group | Group | Group | Group | Group | Group |
| R-Square Within | n/a | 0.004 | 0.015 | 0.370 | 0.540 | 0.610 | 0.620 |
| R-Square Between | n/a | 0.09 | 0.66 | 0.520 | 0.030 | 0.680 | 0.840 |
| R-Square Overall | 0.003 | 0.003 | 0.013 | 0.370 | 0.540 | 0.610 | 0.620 |
| F-Statistic | 8.48** | 54.1** | 67.3*** | 661*** | 2029** | 7609*** | 2859** |
| Observations | 0 | 3950 | 3950 | 750 | 800 | 800 | 800 |
| Groups | No | Percentile | Percentile 0-20% | Percentile 21-40% | Percentile 41-60% | Percentile 61-80% | Percentile 81-100% |

Note: Regressions based on 100 percentiles from 1966 to 2006. The dependent variable is the growth rate of tax liability. Robust standard errors in parenthesis. * p<.1; ** p<.05; *** p<.01.

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**Table 9: Regressions Without Fixed Year Effects, With Interaction with After TRA 1986 Tax Regime and with Quintiles, Uncorrected and Corrected Standard Errors**

| | Model 1 | Model 2 |
|---|---|---|
| **Wages** | .876 | .155 |
| **Wagesx2** | .467 | .647 |
| **Wagesx3** | .344 | .023 |
| **Wagesx4** | 2.11 | .198 |
| **Wagesx5** | 2.30 | .361 |
| **WagesxAfter86** | 2.88 | 2.40 |
| **WagesxAfter86x2** | .467 | -2.46 |
| **WagesxAfter86x3** | .344 | -1.97 |
| **WagesxAfter86x4** | 2.11 | -.224 |
| **WagesxAfter86x5** | 2.30 | -2.27 |
| **Capital Income** | -.317* | -.297* |
| **Capital Income x2** | .452* | .332* |
| **Capital Income X3** | .443* | .296* |
| **Capital Income x4** | .596* | .340* |
| **Capital Income x5** | .706* | .411** |
| **Capital Income xAfter86** | .625 | .746 |
| **Capital Income xAfter86x2** | -.760 | -.689 |
| **Capital Income xAfter86x3** | -.756 | -.683 |
| **Capital Income XAfter86x4** | -.86 | -.693 |
| **Capital Income xAfter86x5** | -.821* | -.718 |
| **After 86** | 1.356 | -.169*** |
| **Macroeconomic variables and interactions** | YES | YES |
| **Constant** | -1.03 | .052*** |
| **Fixed Effects** | Group | Group |
| **Standard Errors** | Uncorrected | WLS --weights are inverse of predicted variances within quintiles from Model 1 |
| **R-squared** | 0.05 | 0.412 |
| **F-Statistic** | 18.4*** | 71.2*** |
| **Observations** | 3,950 | 3,950 |
| **Groups** | 100 | 100 |

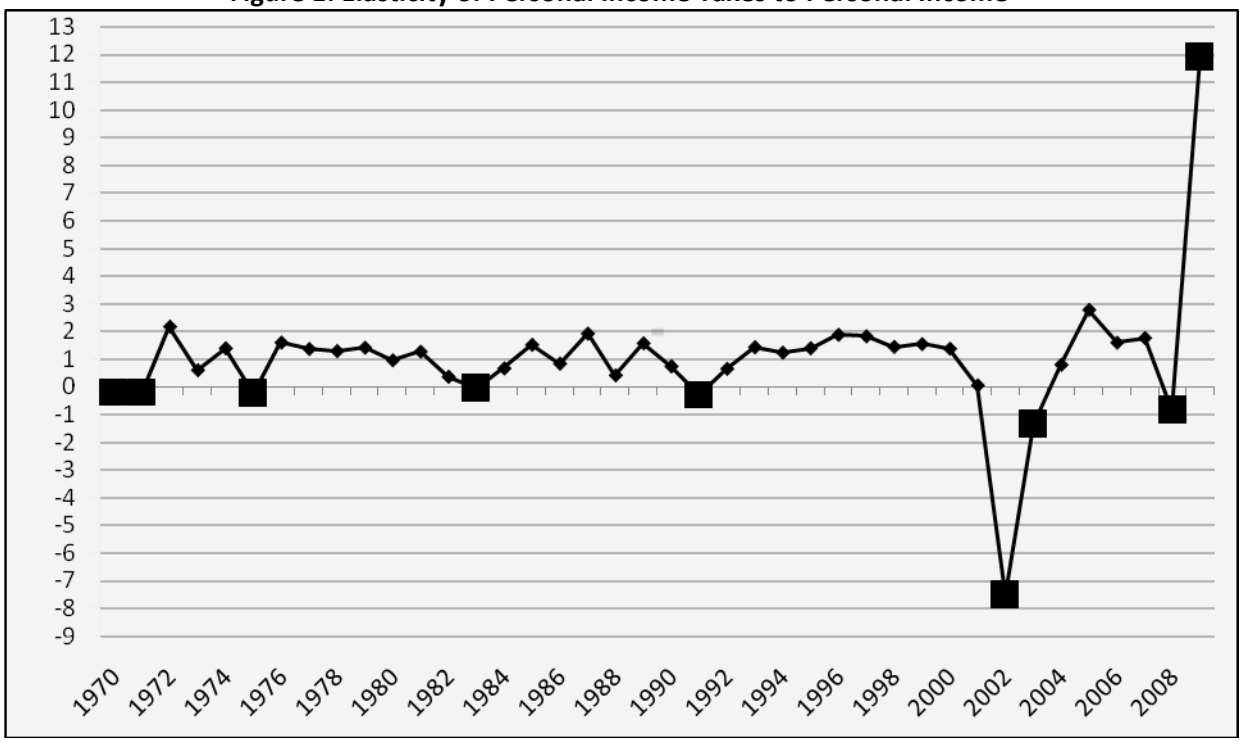
Note: Regressions based on 100 percentiles from 1966 to 2006. The dependent variable is the growth rate of tax liability. Robust standard errors in parenthesis. * p<.1; ** p<.05; *** p<.01.

**Table 10: Regressions With Fixed Year Effects, With Interaction with Seven Tax Regimes, Overall and by Quintile**

| Independent variables: % changes of wages and capital | No tax regime effect | Tax regime 1966-80 | Tax regime 1981-86 | Tax regime 1987-89 |
|---|---|---|---|---|
| Wages | 2.078 | -0.013E+03 | 3.54 | -3.49*** |
| Capital | -.195 | -.486 | -.189*** | .191*** |
| Macro variables | Yes | | | |
| Const. | .642 | .189 | .693 | .382 |
| Fixed effect | Percentile and year | | | |
| R-2 Within | 0.01 | 0.01 | 0.16 | 0.2 |
| R-2 Between | 0.001 | 0.06 | 0.006 | 0.01 |
| R-2 Overall | 0.01 | 0.008 | 0.09 | 0.13 |
| F-Statistic | 93.6*** | 2.25*** | 67.7*** | 3,83*** |
| Observations | 3950 | 1351 | 599 | 300 |

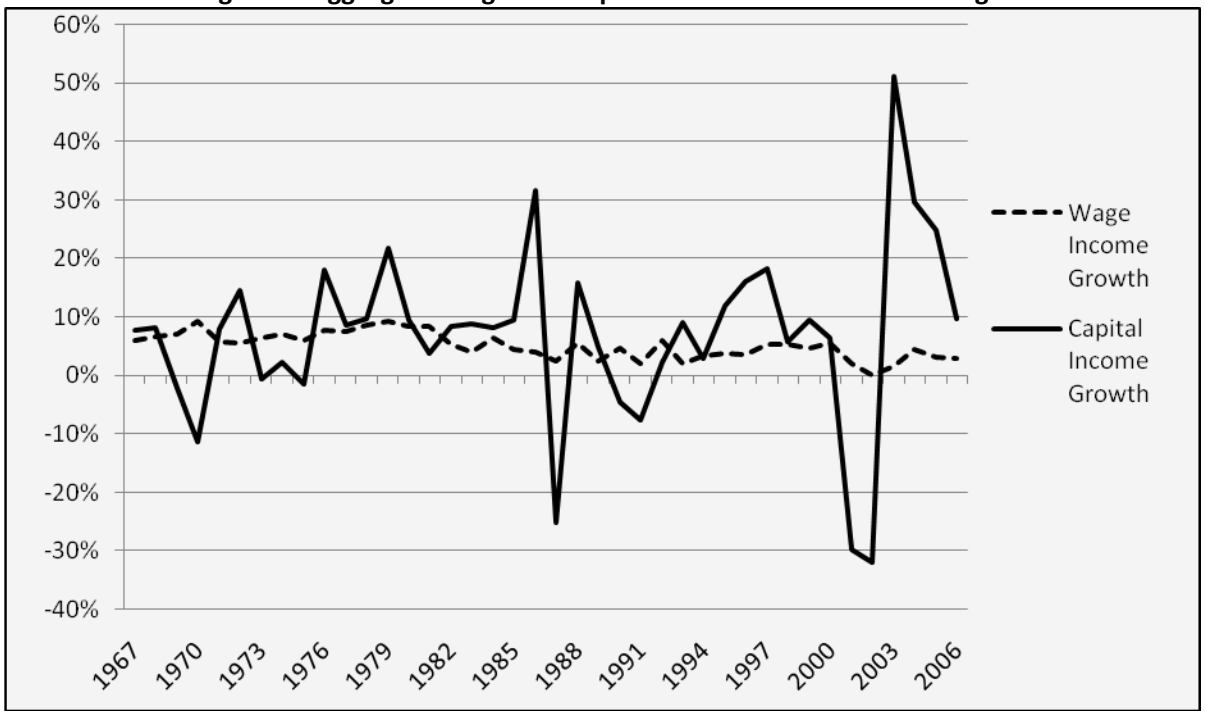
| Independent variables: % changes of wages and capital | Tax regime 1990-93 | Tax regime 1994-96 | Tax regime 1997-01 | Tax regime 2002-06 |
|---|---|---|---|---|
| Wages | 2.071 | .442 | 7.69*** | -16.1 |
| Capital | .253 | .089 | .612** | 2.221* |
| Macro variables | Yes | | | |
| Const. | -.0364 | .035 | -.289* | -.316 |
| | Percentile and year | | | |
| R-2 Within | 0.12 | 0.01 | 0.85 | 0.07 |
| R-2 Between | 0.026 | 0.23 | 0.97 | 0.78 |
| R-2 Overall | 0.11 | 0.05 | 0.87 | 0.007 |
| F-Statistic | 1.53** | 0.31 | 20.6*** | 2.35** |
| Observations | 400 | 300 | 500 | 500 |

**Figure 1: Elasticity of Personal Income Taxes to Personal Income**



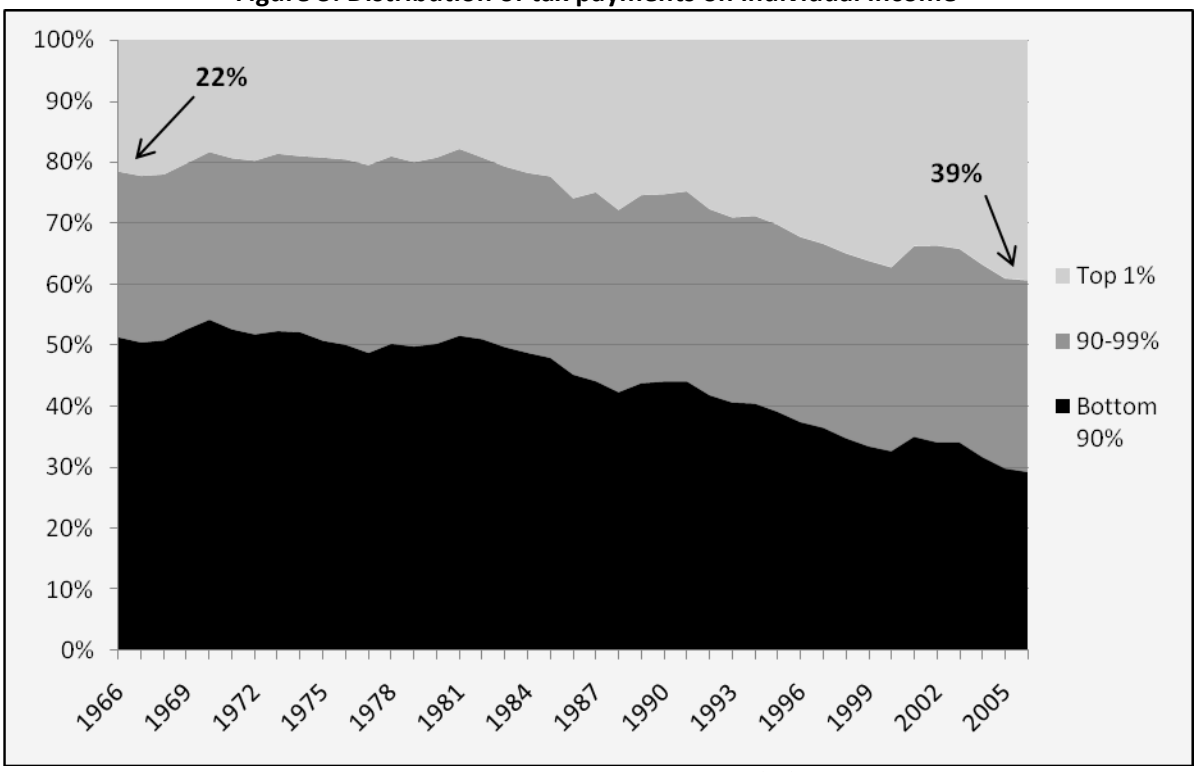

Source: Bureau of Economic Analysis and authors' calculation. The elasticity is defined as the annual percent change in personal income taxes over the annual percent change in personal income. The smaller diamonds markers refer to years when personal income taxes were increasing, while the larger square markers are years when the percent change in taxes was negative.

**Figure 2: Aggregate Wage and Capital Income Year to Year Change**



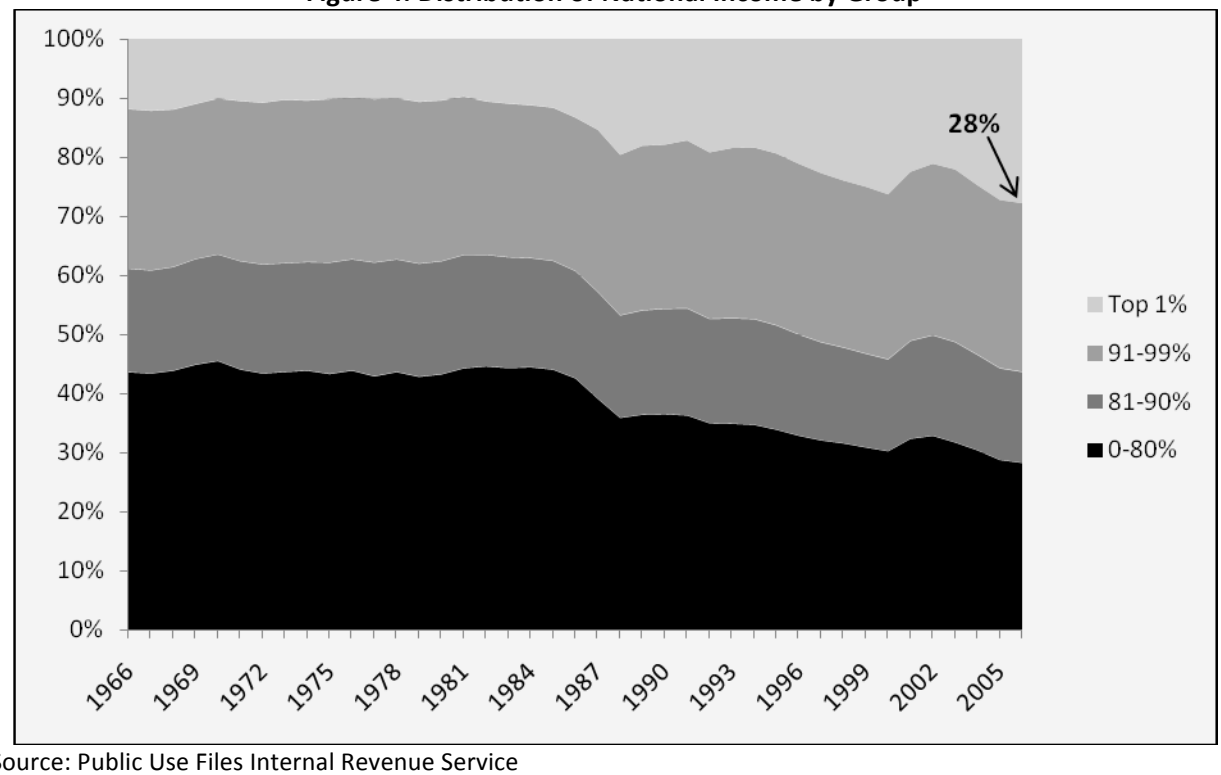

Source: Internal Revenue Service Public Use Files and authors calculation

**Figure 3: Distribution of tax payments on individual income**



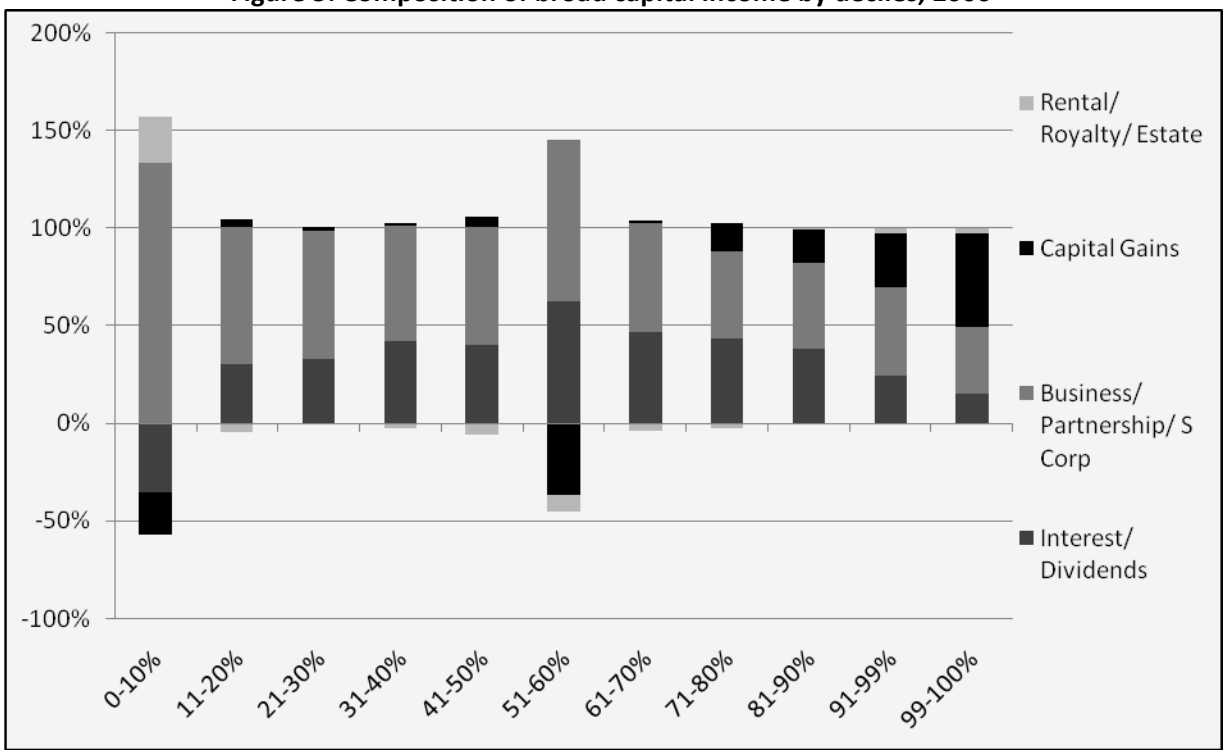

Source: Public Use Files, Internal Revenue Service. Taxes exclude one half of payroll taxes directly paid by employers.

**Figure 4: Distribution of National Income by Group**



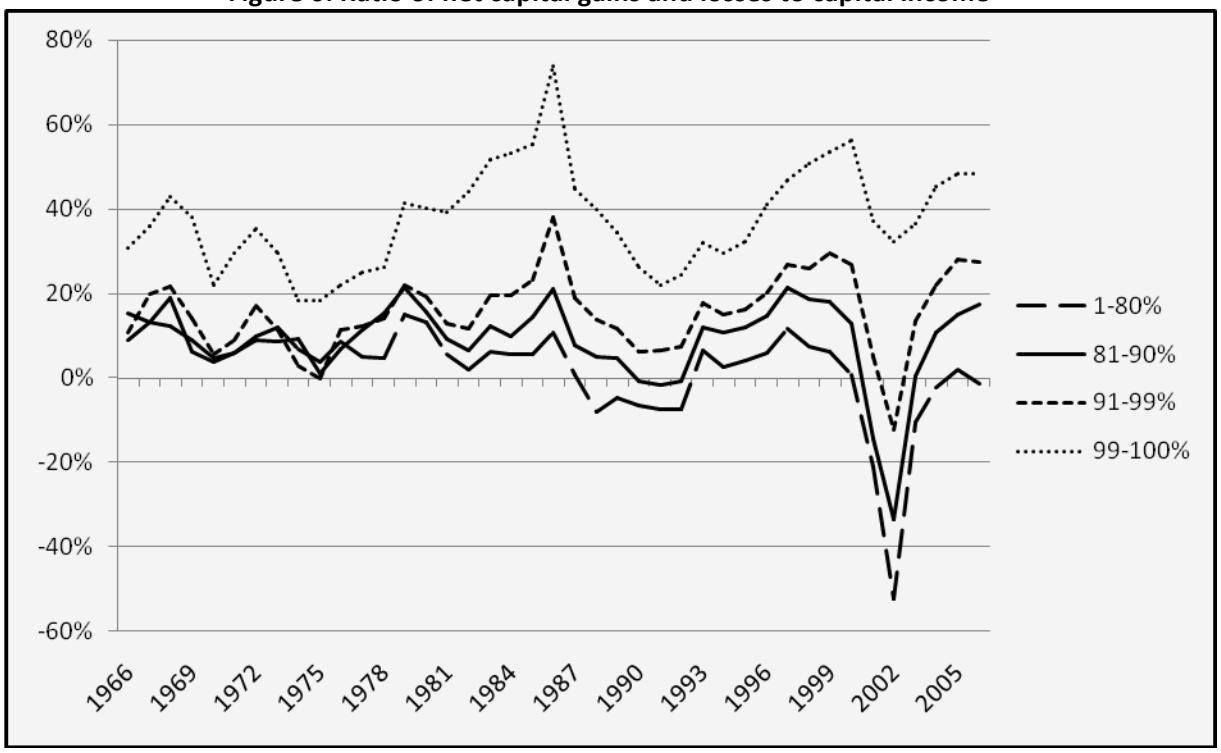

Source: Public Use Files Internal Revenue Service

**Figure 5: Composition of broad capital income by deciles, 2006**




Source: Internal Revenue Service Public Use Files

**Figure 6: Ratio of net capital gains and losses to capital income**




Source: Internal Revenue Service Public Use Files, averaged for groups of percentiles. Capital income is broadly defined as the sum of net business income, net partnership income, net income from small corporations, taxable interests, dividends, total net capital gains and losses, net rental and royalty incomes, and net estate and trust income. It does not include pension income, farm income and non-schedule D capital gains. The categories on the x-axis are income deciles from deciles 2 to 9. Decile 10 excludes the top 1 percent or income earners, which is represented by category 11. The first decile is excluded because for this category positive net capital gains tend to compensate large losses from business-related income, inducing large values of the ratio in certain years.

**Figure 7: Aggregate Individual Tax Revenue and a 50/50 Portfolio**

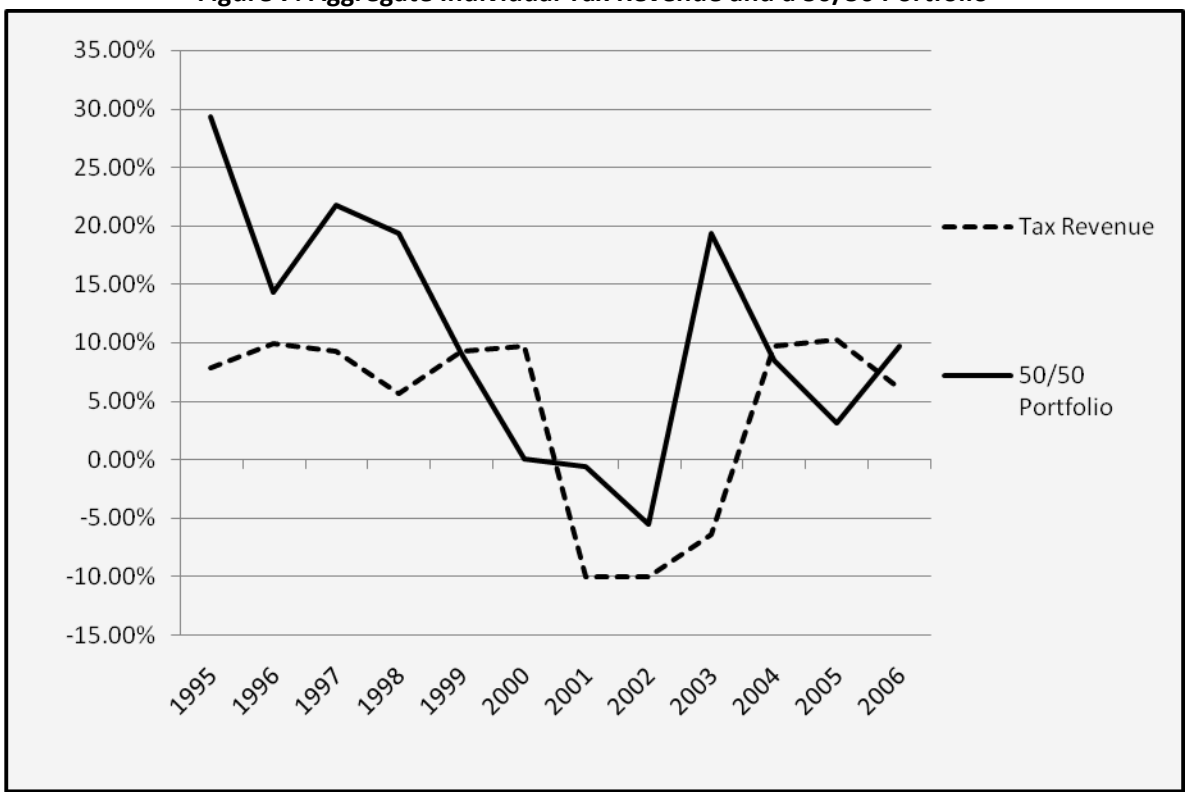


**Figure 8: National Income Weighted by Taxpayer Dependence**

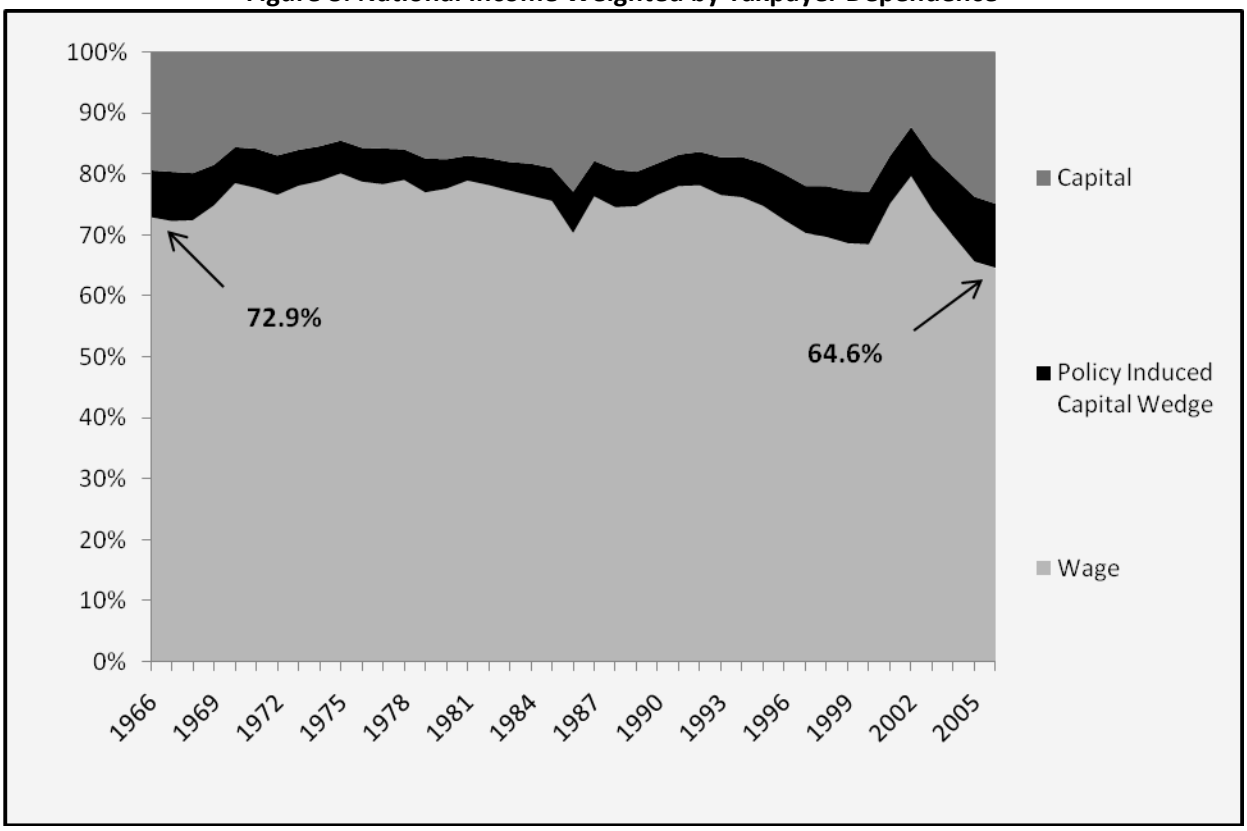
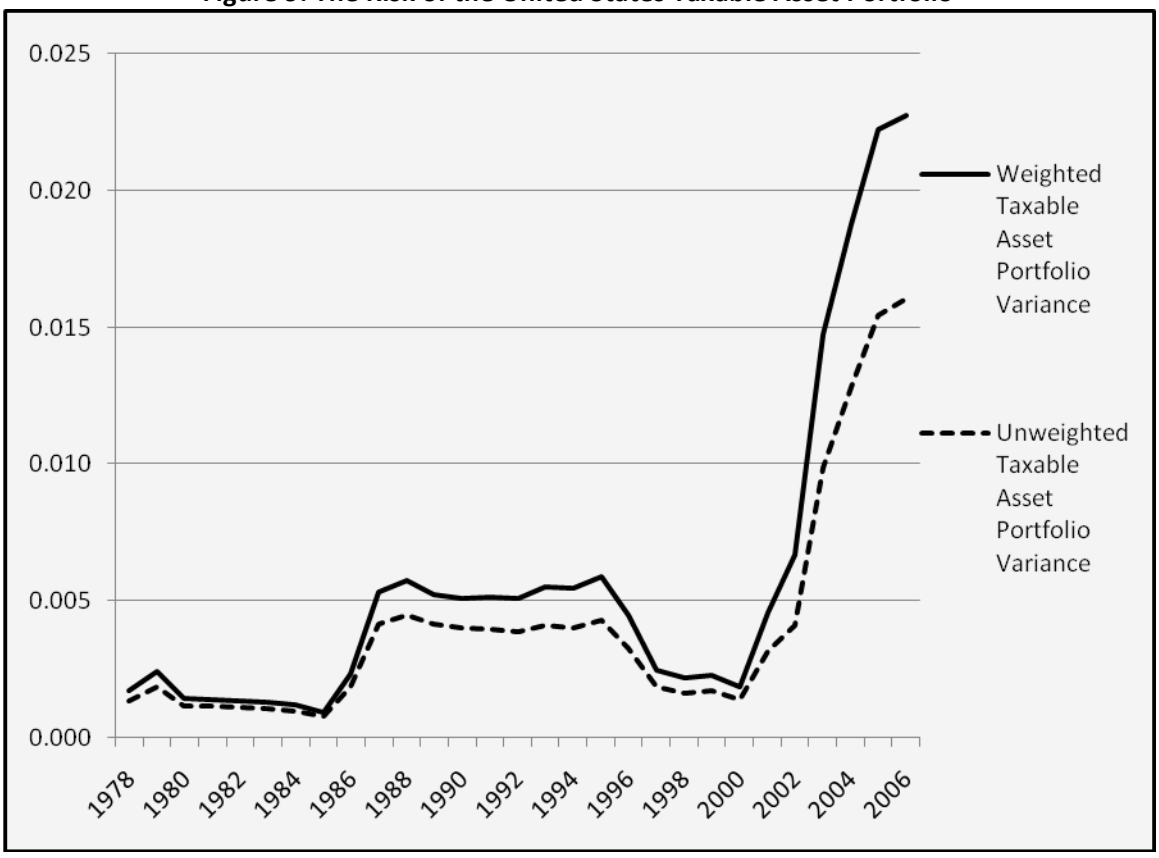


**Figure 9: The Risk of the United States Taxable Asset Portfolio**




Source: IRS Public Use Files with 10 year rolling variance

**Figure 10: Tax liability growth (y-axis) and wage growth (x-axis), by income quintiles, 1966-2006**

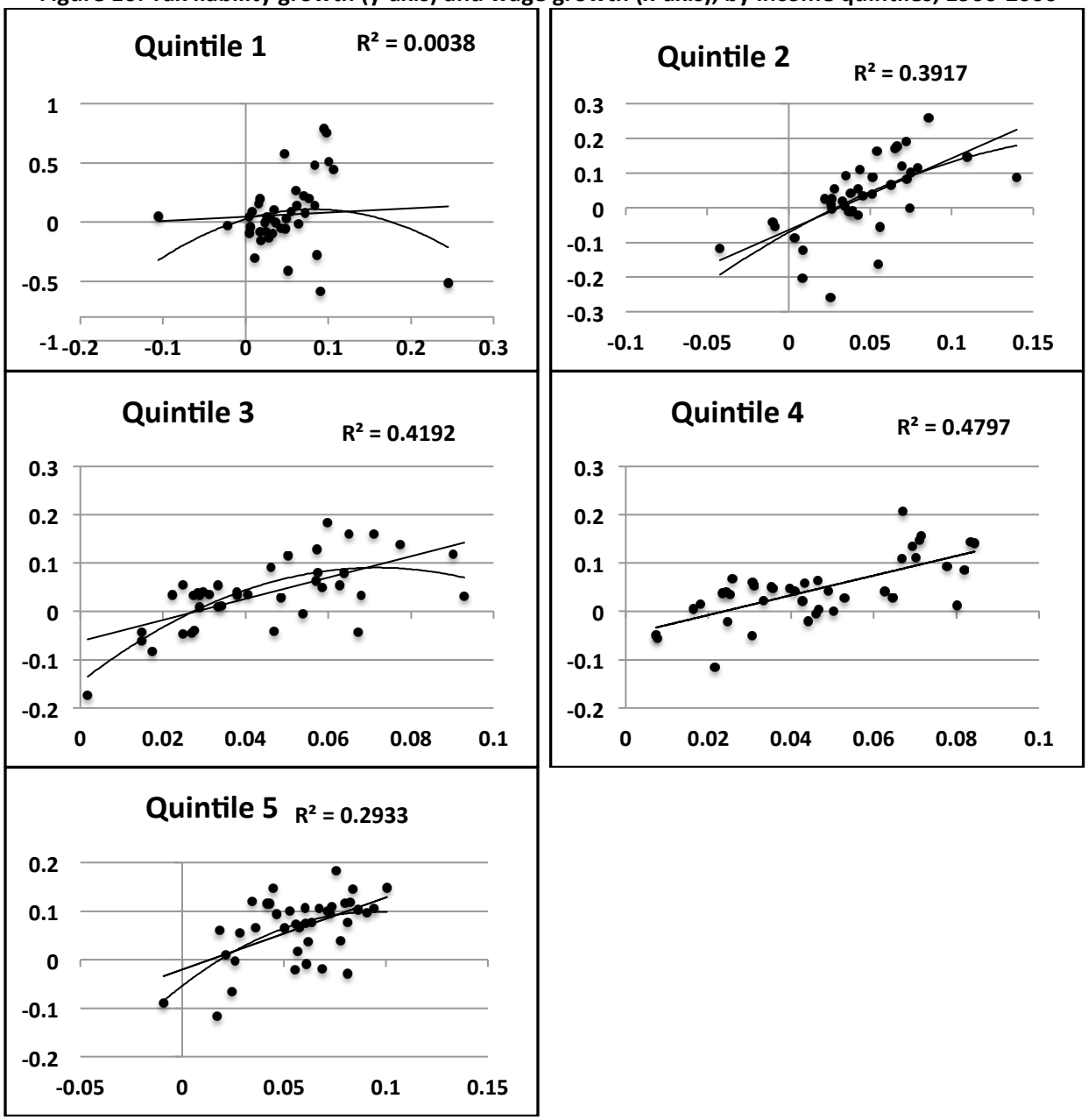


**Figure 11: Tax liability growth (y-axis) and capital income growth (x-axis), by income quintiles, 1966-2006**