Who Bears Aggregate Fluctuations and How? Estimates and Implications for Consumption Inequality*

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As we write in late December 2008, the economy is mired in a year-long recession, the US stock market is down 40% for the year, the US government is lending hundreds of billions of dollars to keep financial institutions and some large industrial firms afloat, and the unemployment rate stands at 6.7 percent. Real per capita consumption of nondurables and services has fallen roughly one percent over the last year. Most economists predict growth rates below average for the next several years. The welfare costs of these declines depend significantly on their allocation across households.

In this paper we study differences in exposure to aggregate fluctuations across households. In doing so, we bring together two somewhat disparate literatures. One line of research has documented increases in income and consumption inequality over the past 25 years (e.g. David Cutler and Lawrence Katz (1991), Georgio E. Primiceri and Thijs van Rens (2008), Dirk Krueger and Fabrizio Perri (2003)). This work, typically framed within a basic permanent income model, focuses on the extent to which income shocks are insured and pays less attention to differential exposure of income to aggregate shocks across households.

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This stands in contrast to the literature in asset pricing that studies the extent to which households that own equity are more exposed to the risk of the stock market. Parker (2001) and Christopher Malloy, Tobias J. Moskowitz, and Vissing-Jørgensen (2008), for example, have documented that the risk of equity is born disproportionately by households with large stock market wealth, a finding which has first-order implications for equilibrium asset pricing conditions and their evaluation.[1] However, this literature has focused mainly on the covariation of consumption growth with equity returns, and not considered covariation with other sources of risk to standard of living such as risks to human capital wealth. For our purposes, this is significant since human rather than physical capital risk is likely to be the dominant driver of aggregate consumption risk since the share of aggregate income that comes from labor income is roughly double the share coming from capital. As with the literature on consumption inequality, this research is limited by the omission (or under-representation) of high-consumption households from standard consumption datasets.

In this paper, we study differential household exposure to aggregate consumption fluctuations, which embodies risk from both financial assets and human capital. We focus on the exposure of the consumption of the rich, defined based on consumption levels, and the implications for the evolution of consumption inequality during the present crisis. We further provide evidence on the channels through which this exposure is borne and the implications for the consumption of the extremely high-consumption households, whose consumption is not

[1] As Mankiw and Zeldes (1991) first elucidates, if aggregate shocks are concentrated on few households, then many observed risk premia that are too large to match the predictions of the canonical calibrated representative-agent asset pricing model are in fact consistent with more reasonably parameterized equilibrium conditions for the investors who bear most risk.

observed in household-level datasets.[2]

We find first that the consumption growth of high-consumption households is significantly more exposed to aggregate shocks than that of the typical household in the Consumer Expenditure (CEX) Survey data covering the period since 1982. Quantitatively, the exposure to aggregate consumption growth of the consumption growth of households in the top ten percent of the distribution of consumption in the CEX is five times as high as that of the average household.

Where does this exposure come from and might it be even greater if we were able to observe the consumption of the very rich? To answer this, we study the dynamic properties of the incomes of high-income groups using the tax return data assembled by Piketty and Saez (2003) in which they document trends in US income inequality since 1917. During the period covered by the CEX, we find extremely high exposure of high-incomes to aggregate fluctuations, suggesting that the CEX figures significantly understate exposure for high-consumption households. We also observe that while households with high incomes excluding capital gains earn a disproportionate fraction of proprietary income, interest and dividends, even the top 1 percent of households earn more than half of their non-capital gains income from wage income during the period covered by the CEX. Further, the wage income of very high income groups is far more exposed to aggregate fluctuations. Therefore, differentially-exposed income is likely a central driver of differentially-exposed consumption, although there are also possible differences across groups in the relation between cash-flow risk and wealth risk (via differences in

[2] Malloy et al. (2008) sort households based on stock market wealth finding higher sensitivity of the consumption growth of wealthy stockholders to both the stock market and to aggregate consumption growth. Here, we sort households by consumption levels and, more importantly, consider the role of income risk -- including labor income risk -- in driving the higher sensitivity of the rich to aggregate consumption growth, as well as analyzing (income) data for the very rich and considering implications for inequality.

revaluation risk) and in the relation between consumption and wealth (via differences in preferences).

Given these patterns, which indicate that aggregate income and consumption fluctuations are disproportionately borne by high-consumption and high-income households, we would expect recent shocks to fall more heavily on high-income or high-consumption households. Based on the evolution of consumption inequality in-sample, we predict a significant decline in consumption inequality during the past year. Assuming real aggregate per capita consumption growth 3 percent less than its historical mean (of 2 percent), the ratio of consumption of the top 20 percent to the bottom 80 percent is expected to fall by about 9 percentage points, relative to its evolution under trend growth.

Finally, we find that the stochastic process of the income of very high-income households has evolved significantly over time. Prior to the last twenty five years, the income of very high income households was not more exposed to aggregate consumption or aggregate income fluctuations. Over time, wages have risen as a share of high incomes and both the wage and non-wage income of the high-income households has become more sensitive to aggregate income and consumption. Thus, while high-income households currently bear an inordinately large share of aggregate fluctuations now, this is a recent occurrence.

I. The exposure of high-consumption households to aggregate consumption fluctuations

To begin we use the CEX surveys from 1982 to 2004 to study whether the consumption of high-consumption households is more exposed to aggregate fluctuations. Ideally we would measure the average utility of a constant set of households and study its exposure to an aggregate measure of utility. Instead of utility, we use a measure of consumption expenditures for

nondurables and a subset of services from the CEX, deflated by the CPI for nondurables.[3] Since the CEX is a rotating panel, we mimic tracking a constant set of households as follows. To reduce the impact of households exiting and entering, we first construct the log change in quarterly consumption for each household and then take a CEX-weighted average across growth rates within a group to construct average consumption growth for a group for that quarter. A household's percentile in the consumption distribution is defined based its expenditures in the first period of the change and the (weighted) cross-sectional distribution in that period. We use the sum of four quarterly log growth rates to obtain a series of annual growth rates, defined as the growth rates from a three-month period to the same three-month period the following year. These annual growth rates are available at the monthly frequency.[4]

Panel A in Table 1 shows the extent of consumption inequality across percentile groups in the CEX. The first row of Panel B in Table 1 show the results of regressing a group's average (across households) log consumption growth on contemporaneous aggregate real per capita log consumption growth, defined based on real chain-weighted NIPA nondurables and services (deflated as described in Parker (2001)) and constructed starting from monthly data to obtain the same timing for annual growth rates as the CEX data. The growth rate of those in the top ten percent of households in the distribution of consumption typically changes by about 5 percentage points when the growth rate of aggregate consumption per capita changes by 1 percent, while the

[3] The expenditure definition and CEX sample period follows Malloy et al. (2008). Since we cannot adjust for family size or changes in family size in the income data used in the section below on income, we do not adjust consumption for family size effects in the CEX. All CEX levels and growth rates are thus to be interpreted as per household.

[4] Sorting on initial consumption leads to non-standard measurement error when analyzing consumption growth rates of percentile groups. We show in an unpublished appendix posted on our web pages that using log growth rates ensures consistent estimates of the sensitivity of group consumption growth to aggregate consumption growth if the primitive measurement error is classical. For consistency across data sets we use log growth rates in all tables.

change in the growth rate of the bottom 80 percent is only about a half percent.[5] The second row in Panel B change the left hand side to be calculated from the change in the log of mean group consumption (as opposed to the mean of the log change in consumption), with the change for a given 3-month period relative to the prior 3-months again calculated based on households present in the CEX in both periods. This will lead to a different time series if consumption growth rates within a given percentile group tend to be systematically higher or lower for households who initially had higher than average consumption levels for the group. The resulting sensitivities of growth rates to aggregate consumption growth rates are again higher for higher-consumption groups. It is unclear which of the two sets of sensitivities should be preferred since a dependence of consumption growth rates within a given percentile group on initial consumption levels could reflect both true dependence and mechanical dependence driven by measurement error. We return to the last row of Panel B below.

Panel C shows that exposure to aggregated CEX consumption instead of NIPA consumption per capita is somewhat less concentrated on high-consumption households. The top ten percent of households are estimated to be about 4.5 (=2.51/0.56) times more exposed to changes in CEX consumption that those in the bottom 80 percent. Panel D shows the implication of these differential exposures for the share of aggregate consumption fluctuations borne by each group. If consumption changes were proportional (i.e. if the sensitivities in Panel B had all been one), the share borne by the top 10 percent would be its share of initial consumption, i.e. the fraction the group constitutes of the population times the average ratio of group consumption to average consumption in Panel A (e.g. 0.10*2.15=0.215 for the top 10 percent). The actual fraction borne by a group is estimated as the regression coefficient from regressing [(Dollar change in mean

[5] At a quarterly frequency there is a smaller difference across households, at lower frequencies, there is a larger difference across households.

group consumption per household)*Group share of population/Lagged mean aggregate consumption per household] on the growth rate in mean aggregate consumption per household Since, across subgroups of households, the numerators sum to the total dollar change in real per household consumption, the coefficients sum to one. The fraction borne by the top 10 percent of household is 45 percent -- driven by a combination of the top 10 percent having higher average consumption and being more sensitive to aggregate shocks.

We conclude that in the CEX data, the consumption of high-consumption households is more exposed to aggregate booms and busts than that of the typical household. But we also see the exposure rising significantly only quite high in the distribution, and, according to BLS statisticians, the CEX data do not seem to measure the expenditures of the top 5 to 10 percent of households in the distribution of expenditures (implying that what we denote the top 10 percent actually more likely represents those in the second highest decile). So might the differential consumption growth sensitivities in Panel B significantly understate the extent to which inequality relative to those at the very top of the distribution typically rises with high aggregate growth? And what are the channels through which high-consumption households are more exposed?

II. The exposure of the income of high-income households to aggregate fluctuations

To address these questions, we use information from the IRS's Sources of Income reports based on US tax return information, as compiled by Piketty and Saez (2003), to study properties of the income of high income and very high income households during the period since 1982 (to match the CEX period with the exception that IRS data are available up to 2006 as opposed to only 2004 for the CEX). This data has the advantage of being based on large samples of high

income households and giving information on the composition of taxable income. It has the disadvantage of not tracking the same households over time and not much information on the bottom 90 percent of households. We show that the first disadvantage probably biases down the extent to which high-incomes are exposed to aggregate fluctuations, and we account for the second by using NIPA data (NIPA Table 2.1) to measure national totals (similarly to Piketty and Saez (2003)).

For two reasons, we focus on income excluding capital gains. First, since the timing of capital gains realizations is endogenous to the household, a capital gain may represent not high income but low income as a household sells assets to support consumption. Second, and more importantly, we observe only wage income rather than revaluation of human capital. Since we study the cash flow from human capital, for comparability we study only the cash flow from investments, i.e. dividends, interest, rental and proprietor income, rather than also the underlying assets generating these cash flows.

Panel A of Table 2 shows the extent of income inequality in the Piketty-Saez data. Panels B and C show that very high income individuals still have substantial wage income. Even the top tenth of a percent have nearly half their income from wage earnings (panel B). A lower share of their income comes from interest income and more comes from dividends (roughly double the population average) and proprietors income (roughly triple the population average). Panel C shows that high-income households hold more than their share of capital income, but that the concentration of stock market wealth (and thus dividend income), is not extreme when households are ranked by non-capital gain income.

Turning to the stochastic properties of income, we regress the log growth rate in real group per tax unit income onto the log growth rate of aggregate real consumption per tax unit

(calculated from NIPA consumption data and the IRS number of tax units) and aggregate real income per tax unit (calculated from NIPA total income across the five sub-categories of income and the IRS number of tax units). Panels D and E show two main points. First, high income groups have larger estimated growth rate sensitivities to aggregate growth rates. The scale of this is quite dramatic, with the incomes of the top 0.01 percent of tax units having a sensitivity of about 9 to aggregate consumption growth rates and of about 4 to aggregate income growth rates.[6] The strikingly different cyclicality across groups is displayed in Figure 1, which simply plots annual growth rates of average real incomes per tax unit for the full set of tax units as well as for several of the sub-groups of tax units.

Second, we can dig deeper into what drives the difference in sensitivities across groups. One might expect that the labor income of high-income households is less exposed to aggregate fluctuations than that of low-income household; in fact it is more exposed. The high sensitivities for the very rich (top 1 percent or higher) are to a large extent driven by these households having wage income that is very sensitive to changes in aggregate consumption and aggregate income. These is also some tendency for the non-wage income of higher-income households to be more exposed to aggregate consumption and income fluctuations relative to the non-wage income of the average household.

An obvious concern in using the IRS data is that the percentiles upon which groups are defined are updated each year, so the groups are not tracking the same households over time (in the CEX data we could avoid this problem by using the panel dimension of that data set). What is the impact of this? First, if household transitions across percentile groups are uncorrelated with the aggregate changes, then the estimates in Table 2 measure actual differences in exposure,

[6] Results are similar if we omit the two years after the 1986 tax reform which have unusually large income growth.

although not for the same households over time. But, since high-consumption households are more exposed to aggregate fluctuations, it is likely that some of them fall to lower groups when aggregates fall and rise through the distribution again when aggregates rise. In this case, the exposure that we measure understates the relative exposure of the high-income groups. The measured decline in bad times is reduced by initially lower income, less-exposed households entering the high-income group, and the measured rise in good times is reduced by these same households leaving the high-income group. The reverse happens for the low-income groups: high-income households fall into the group in bad times, lowering their average incomes and making the group appear more exposed to aggregate fluctuations.

To judge the significance of this bias, we introduce it artificially into our analysis of consumption in the CEX where we can examine the difference it makes relative to an analysis that constructs changes across a fixed set of households from a given period to the next. The last row of Panels B of Table 1 reports the exposure to aggregate consumption of the consumption of a changing population of households in the CEX constructed analogously to the tax data. Relative to the sensitivities based on the two unbiased (fixed-group) series in Panel B, the series that do not focus on a fixed set of households show greater exposure to aggregate growth rates for the low-consumption groups and lower exposure for the high-consumption groups. We conclude that the estimates of Table 2 are likely downward biased estimates of the extent to which high-income households are more exposed to aggregate income fluctuations.[7]

The exposure of the income of very high-income households (who are largely excluded from the CEX) to aggregate consumption and aggregate income growth is consistent with the consumption of very high-income households being even more exposed to the aggregate state

[7] The three different approaches to constructing group level growth rates also affect the average growth rates of the series. For brevity we do not study that issue here.

than implied by our estimates for high-consumption households in the CEX data in Table 1. That is, given income exposure described in this section, Table 1 probably significantly understates the consumption exposure of the top 1 percent of households. However, we cannot conclude this with certainty since differences in consumption exposure across groups may be driven not only by differences in income exposure but also potentially by differences between cash-flow exposure and wealth risk (revaluation risk) across groups or differences in the relation between wealth and consumption across groups.

III. The impact of the 2007 crisis and 2008 recession on inequality

Given the large exposure of high-income or high-consumption households to movements in aggregate income or consumption, we expect recent poor aggregate economic performance to fall more heavily on them. We now quantify the expected decline in inequality based on the historical patterns of the previous sections. Based on recent statistics, we consider the effect of a decline in the growth rate in aggregate real per capita consumption of nondurables and services from 2 percent to minus 1 percent, i.e. a 3 percentage point growth rate decline (for one year).

Based on the first row of Panel B in Table 1, a 3 percentage point in the growth rate of aggregate real per capita consumption of nondurables and services will lead to a decline of about 1.5 percentage points in the growth rate of real per household consumption for those in the bottom 80 percent, a decline of around 11 percentage points for those on the top 20 percent, and a decline of around 17 percentage points for those in the top 10 percent – all relative to trend. Thus, the consumption of the typical household in the top 20 percent (top 10 percent) will decline by about 9 percent (15 percent) relative to the consumption of the average household in the bottom 80 percent. We expect this decline in consumption inequality to be a downward-

biased estimate due to high-consumption households being under-represented in the CEX data.

IV. Changes in income exposure for high-income households

While the previous sections show the significant extent to which aggregate fluctuations impact the consumption (income) of high consumption (income) groups more than low consumption (income) groups, the previous sections consider only the period since 1982, when the CEX data is available. In the income data, we find significantly different patterns in prior data.

Table 3 shows the same statistics as Table 2 but over the period from 1929 to the availability of the CEX data sample (with roughly similar conclusions if we focus on the post-war period up to 1982). First, over this older period, high-income households have less of their income from wages and much more of their income from dividends, relative to the more recent period. This suggests a higher exposure of the very high-income households to stock market fluctuations in the earlier period and lower exposure to changes in wage income. Second, Panel D and E show that in the earlier period the incomes of the very high-income households have about the same sensitivity to aggregate consumption as the income of all households, and a lower sensitivity to aggregate income. This is due mainly to lower exposure of the wage income of the rich to changes in aggregate income in the earlier period but also to lower exposure of non-wage income (disproportionately earned by rich households) to changes in aggregate income in the earlier period.

Might the changing patterns be due to changes in the bias from transitions into and out of percentile groups? It seems unlikely, since the bias as discussed above reduces cyclicality but should not change relative rankings of cyclicality across groups. Thus, it appears that there is a

striking change across periods.

V. Conclusion

High-income households are highly exposed to aggregate booms and busts. This implies large effects of the current recession on consumption inequality. We document that this exposure represents a significant break from the past. Prior to the last 25 years, high-income households were less exposed to aggregate fluctuations. As high-income households have changed from being rentiers to workers, dividends and so probably stock market risk has become less concentrated on high-income households. But at the same time, aggregate income changes have become more concentrated on high income households. We find this fact – high-income households becoming more exposed to aggregate changes in income – tantalizing. It begs further study, both in terms of better measurement and in terms of understanding the underlying labor and capital market mechanisms.

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Table 1. Exposure of group consumption growth to aggregate consumption growth

	Household consumption group			
All CEX households	Bottom 80 Percent	Top 20 Percent	Top 10 percent	Top 5 Percent
Panel A. Average consumption to total average consumption				
1	0.79	1.83	2.15	2.52
Panel B. Sensitivity of consumption to NIPA consumption				
Sensitivity of mean growth rate				
1.10	0.54	3.36	5.29	5.33
[3.66]	[1.47]	[5.62]	[4.02]	[3.55]
Sensitivity of growth rate of mean				
1.68	0.41	3.64	5.68	5.54
[5.38]	[0.95]	[6.80]	[4.82]	[3.80]
Biased sensitivity of growth rate of mean with group entry/exit				
1.33	1.15	1.59	1.86	2.25
[3.28]	[3.42]	[2.54]	[2.38]	[2.21]
Panel C. Sensitivity of consumption growth to total CEX consumption growth				
1	0.56	1.69	2.01	2.51
	[7.92]	[13.50]	[8.29]	[6.02]
Panel D. Fraction of total CEX fluctuation borne by group				
1	0.39	0.62	0.45	0.34
	[7.40]	[11.53]	[7.97]	[6.09]

Notes: t-statistics based on Newey-West standard errors in brackets. All regressions use annual changes from the three-month period one-year ago. Annual growth rates are available at the monthly frequency and regressions include monthly dummies to account for seasonality. All calculations use CEX weights.

Table 2. Exposure of group income growth, 1982-2006

Type of income	All tax units	Top 10 percent	Top 1 percent	Top 0.1 percent	Top 0.01 percent
	Household income group				
Panel A. Average income in group to average for all tax units					
Total	1	3.2	10.7	41.3	157.9
Panel B. Average percent of income from source					
Total	100	100	100	100	100
Wage	68.0	77.5	60.7	49.0	40.3
Proprietors	9.8	12.7	22.4	27.6	32.0
Dividend	4.8	3.7	6.7	9.7	12.0
Interest	15.8	5.2	7.8	10.2	12.2
Rental	1.7	1.0	2.4	3.5	3.5
Panel C. Percent of aggregate income of each type					
Total	100	32.0	10.7	4.1	1.6
Wage	100	36.4	9.5	3.0	1.0
Proprietors	100	41.3	25.0	12.0	5.1
Dividend	100	26.0	15.1	7.9	3.6
Interest	100	10.0	4.9	2.5	1.2
Rental	100	24.2	18.9	10.0	3.8
Panel D. Aggregate consumption growth beta					
Total	1.98	2.60	4.69	7.30	8.62
	[5.14]	[3.32]	[2.62]	[2.64]	[2.59]
Wage	1.86	2.53	5.44	9.86	15.22
	[6.08]	[4.08]	[3.08]	[2.55]	[2.71]
Prop.+Div.+	2.25	2.03	2.80	3.51	2.71
Int.+Rental	[3.09]	[2.30]	[1.44]	[1.42]	[0.87]
Panel E. Aggregate total income growth beta					
Total	1	1.26	2.22	3.23	3.71
		[5.34]	[3.70]	[3.36]	[3.16]
Wage	0.82	1.07	2.28	4.37	5.96
	[12.67]	[5.28]	[3.69]	[3.24]	[2.90]
Prop.+Div.+	1.38	1.92	2.11	1.95	1.52
Int.+Rental	[10.04]	[3.01]	[2.48]	[1.87]	[1.34]
Panel F. Fraction of aggregate income change borne by group					
Total	100	40.30	23.90	13.40	5.80
		[5.34]	[3.86]	[3.52]	[3.17]

Notes: t-statistics in parenthesis. Percentiles refer to tax units. Total income excludes capital gains and transfers and does not subtract taxes. Panel D and E report the regression coefficients from regressing the percentage change in group-type income on the percentage change in aggregate real per tax unit consumption growth (Panel D) or on the percentage change in aggregate real per tax unit total income growth (Panel E). Panel F is similar to Table 1 Panel E except for being based on income rather than consumption.

Table 3. Exposure of group income growth, 1929-1982

Type of income	All tax units	Top 10 percent	Top 1 percent	Top 0.1 percent	Top 0.01 percent
	Household income group				
Panel A. Average income in group to average for all tax units					
Total	1	2.9	8.9	27.6	83.6
Panel B. Average percent of income from source					
Total	100	100	100	100	100
Wage	69.8	66.0	42.0	30.1	18.0
Proprietors	14.3	18.3	27.9	21.3	13.5
Dividend	4.0	8.8	20.3	37.6	57.6
Interest	7.8	3.9	5.3	5.9	6.0
Rental	4.1	3.0	4.5	5.1	4.9
Panel C. Percent of aggregate income of each type					
Total	100	29.3	8.9	2.8	0.8
Wage	100	27.5	5.3	1.1	0.2
Proprietors	100	36.7	16.5	3.8	0.7
Dividend	100	63.8	45.8	25.6	11.5
Interest	100	14.1	6.1	2.1	0.6
Rental	100	21.7	10.5	3.7	1.1
Panel D. Aggregate consumption growth beta					
Total	1.62	1.55	2.01	1.85	1.98
	[7.22]	[10.87]	[7.25]	[4.74]	[4.31]
Wage	1.49	0.71	0.65	0.42	0.32
	[5.66]	[4.55]	[2.97]	[1.30]	[0.45]
Prop.+Div.+	1.83	2.61	2.86	2.29	2.22
Int.+Rental	[8.65]	[8.72]	[7.42]	[4.76]	[4.38]
Panel E. Aggregate total income growth beta					
Total	1	0.62	0.84	0.82	0.75
		[8.45]	[6.60]	[4.83]	[3.54]
Wage	1.03	0.33	0.07	-0.04	-0.37
	[31.10]	[4.91]	[0.65]	[-0.29]	[-1.20]
Prop.+Div.+	0.91	1.02	1.30	1.10	0.93
Int.+Rental	[12.71]	[6.77]	[8.02]	[5.45]	[4.09]
Panel F. Fraction of aggregate income change borne by group					
Total	1	20.5	9.9	3.7	1.3
		[8.55]	[6.61]	[5.21]	[4.33]

See notes for Table 2.
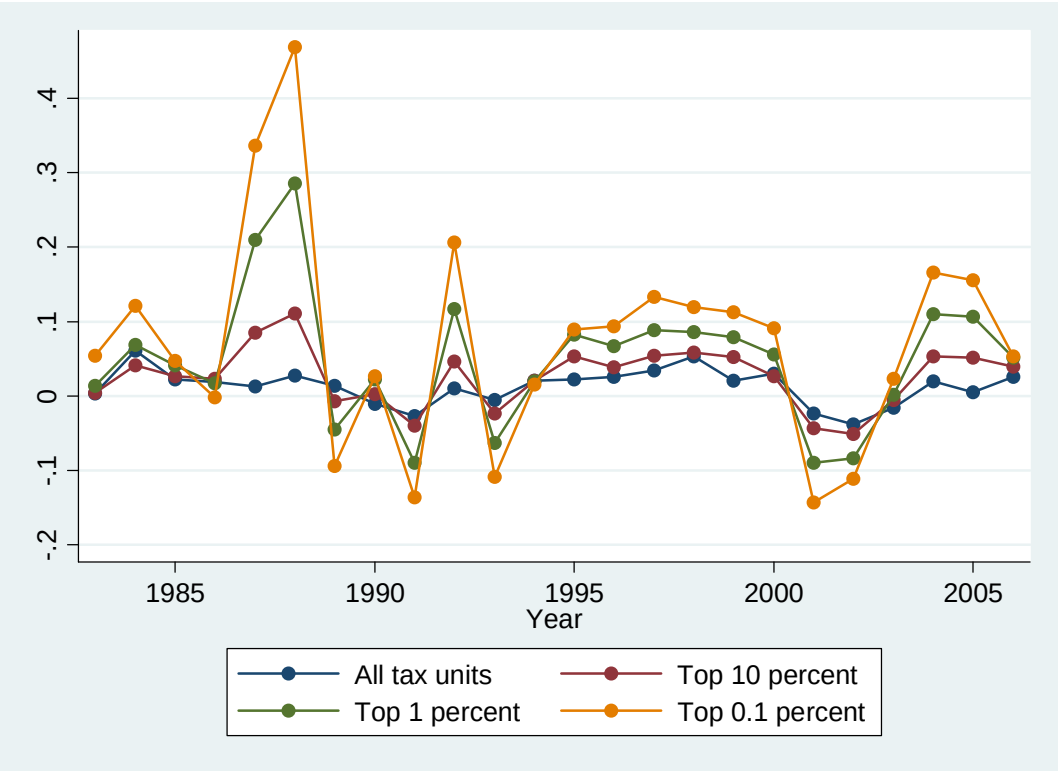
Figure 1. Annual growth rates of non-capital gain income by income group, 1982-2006