

Top incomes' growth and cyclicity

Michael Bordo¹
Agnieszka Markiewicz²
and Christopher Meissner³

Abstract

We study the relationship between income inequality changes and underlying top incomes' volatility. We find that the increase in top income shares was associated with increased top incomes' volatility and procyclicality. In North American countries the compensation for a unit of risk is much higher than in continental Europe or Japan. We find that, since the beginning of the 1990s, the wage share of top incomes has become procyclical and the business share has become countercyclical. The income from dividends displays stronger procyclicality since the 1990s. Interest and rent incomes display however stronger countercyclicality, at least for the richest tax units in the top 0.1% and 0.01%. These results suggest that although the labor income of the top incomes has become more procyclical, their additional income sources partially counterbalance this extra volatility.

¹ Rutgers University

² Erasmus University Rotterdam

³ University of California Davis

1. Introduction

Many developed economies experienced large increases in income inequality during the last three decades. Top incomes and top income shares have become more volatile and experienced greater cyclicity as the share of total incomes accruing to the top income percentiles increased.⁴ This paper studies the relationship between changes in income inequality and dynamics of top incomes' variability.

We first seek to identify the nature of the increased variability for top incomes, its relationship to the rise in income inequality and increased sensitivity to business cycle fluctuations. For this purpose, we use the top incomes dataset assembled by Thomas Piketty and Emmanuel Saez (2003) for 8 countries. We first estimate the trend and cyclicity coefficients for each of the countries individually testing for simultaneous structural changes in their values. We find that the increase in top income shares was associated with their increased average volatility. However, in North American countries the compensation for a unit of risk (measured as volatility here) appears to be much higher than in continental Europe or Japan. Our findings thus indicate that the previously identified differences in income inequality patterns persist even if one adjusts top incomes' gains by their volatility.

We explore the nature of the top incomes' risk more in detail using the decomposition of top incomes into their sources: wage income, capital income and business income for three economies, for which the top incomes dataset provides such series: Canada, the US and France.

We find that the wage share of income was significantly countercyclical before 1991. We also note that wages of higher fractiles tend to experience stronger cyclicity. Since the beginning of the 1990s, the wage share of income has become procyclical for the top 0.1 % and top 0.01 %. The change in the business cycle fluctuations of wage share of income could thus be the reason for increased procyclicity of the total top incomes as suggested by Parker and Vissing-Jorgensen (2009).

In contrast to the wage income shares, the business shares of income became countercyclical after 1990 thus providing a hedge for top incomes. More specifically, we find positive and significant cyclicity coefficients in the first part of the sample for all the top incomes. After 1991, the business income shares of top 1%, 0.1% and 0.01% have moved in the opposite direction to the GDP per capita growth and in case of top 1% and 0.1% significantly so.

⁴ See Parker and Vissing-Jorgensen 2009 and 2010 and Geuvenen (2014)

Capital income is not a homogenous category as its components display different business cycle fluctuations. We find that since the 90s, investment income became countercyclical for the top 10 % and top 1 % but became procyclical for top 0.1 % and top 0.01% income shares. The income from dividends displays stronger procyclicality in the second part of the sample. Interest and rent incomes display however stronger countercyclicality, at least for the richest households in the top 0.1% and 0.01%.

These results suggest that although the labor income of the richest households has become more procyclical, their additional income sources partially counterbalance this extra volatility. In particular, the business income and some components of capital income have been acting since the 90s as hedges to additional wage income variability. The richer the households are, the higher are the shares of these additional sources of income in their total income thus decreasing the overall borne risk. The diversification effect present in the richest households' income portfolios could therefore partially explain the increasing large volatility adjusted income gains.

This paper is related to the growing empirical literature studying cross-country differences in income inequality dynamics enabled by recently created top incomes database. Using this relatively new data set, Atkinson, Piketty and Saez (2011) and Roine and Waldenström (2011) study the income inequality trends observed across the globe. In this paper, instead of studying income inequality dynamics alone, we analyze their link to the income volatility and cyclicity.

This paper is closely related to Parker and Vissing-Jorgensen (2009) and Guvenen et al (2014). In particular, we extend work by Parker and Vissing-Jorgensen (2009) in two dimensions. First, we use the data for all the countries available in the top incomes database to test for structural breaks in the relationships we are interested in. Parker and Vissing-Jorgensen (2009) compare changes for two periods 1970-1982 and 1982-2007. This allows us to extend their finding of recent increase procyclicality of top incomes in the US and Canada to a larger set of countries. Second, we study in detail the dynamics of the sources of top incomes so that we shed light on the potential drivers of the rise in top incomes' cyclicity. More recently, Guvenen et al (2014) study business cycle variations in income risk of household from entire income distribution. While the authors have access to individual income data and they decompose systematic and idiosyncratic risk components, our data limits us to study average top incomes' volatility. Similarly to Guvenen et al (2014) and Parker and Vissing-Jorgensen (2009) we find that the cyclicity of the richest households increased only in the last decades of the 20th century. The novelty of this paper is that we study in detail the potential drivers of this shift.

2. Data

We use the Top Incomes Database constructed by several authors including Atkinson, Piketty and Saez (2011) which is available on the Paris School of Economics website: <http://topincomes.gmond.parisschoolofeconomics.eu/>. This dataset has been constructed using country tax files in a manner similar to the original methodology implemented by Kuznets (1953). These tax statistics report the number of taxpayers for a large number of income brackets, as well as their total income and tax liability. The number of households in top fractile groups is computed using population census data. Top income shares series are obtained by dividing top income series by total personal income which is computed using aggregate income sources and national accounts.

The top incomes database is a yearly dataset and it currently covers 28 countries. For many of them, the series are incomplete and interrupted, mainly due to the change in the national definition of the tax unit. In addition to these issues, the time series analysis, carried out in this paper requires a relatively long series. These constraints leave us with a set of 8 countries: Australia, Canada, France, Japan, Netherlands, Norway, Sweden and the US. We use the average incomes and income shares for the following fractiles: top 10%, top 5%, top 1 %, top 0.1%, top 0.01%. When available, we also use the average income for the remaining 90% of countries' income distribution.

One of the natural critiques of the Top Incomes Database is that it is not panel data but instead represents a repeated cross-section. In effect, the database does not take into account the potential mobility of the top earners in and out of the top fractiles. If this is the case, the dynamics of the top income shares displayed by this dataset could lead to inaccurate inference about trends in income inequality and underestimate the income risk. Kopczuk et al (2010) find however that mobility at the top of the earnings distribution in the US has been very stable since 1978. Parker and Vissing-Jorgenson (2009) explore this issue with Canadian panel data and find that using top incomes data does not significantly alter their inferences. Of course, in countries where mobility rates vary substantially from those in North America due to cultural and institutional factors, our inferences could be misleading. We have no reason to believe that this is a major issue however.

In addition to the average top incomes and their shares in total income, we use data on the decomposition of incomes. The sources of income are also given in the Top Incomes Dataset. Sufficiently long time series for these components are available for only three countries: US, Canada and France.

We classify the components into three main categories: wage income, business income and capital income. Wage income represents wages, salaries and other remuneration payments and in the US data it includes stock options and bonuses granted by companies to their employees.

Business income includes all revenues realized as a result of business activity. Capital income consists of income receipts on real and financial assets including dividends, interests and rents. We measure business cycle fluctuations by growth rates in the real GDP per capita series provided by Maddison project and described in Bolt and van Zanden (2013). Ideally, we would like to use the total GDP growth rates as measures of the business cycle fluctuations; however, they are not available for a long time span.

3. Stylized facts

3.1. Income inequality and income volatility

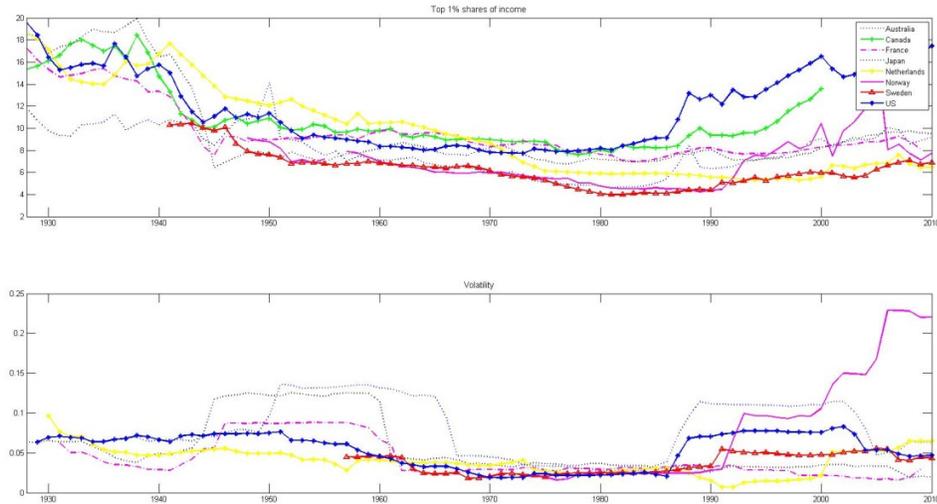
Top income shares experienced large increase in the closing decades of the 20th century. The magnitude of this increase was very different across the globe. Atkinson, Piketty and Saez (2007) and Roine and Waldenström (2011) show that in the English speaking countries the income inequality increase was the largest while in some regions of continental Europe and Japan the observed increase was the smallest.

The upper panel of Figure 1 plots the evolution of the shares of income of the top 1% of the income distribution in each country. The figure displays a well documented pattern: the income inequality measured by the share of income of the richest tax units was high in the beginning of the 20th century, dropped around the Second World War time and remained low in the immediate postwar decades. Over the last thirty years, top income shares have increased again. Today, income inequality, measured as the share of income garnered by the top 1% is roughly at the same level as it was in the beginning of the 20th century. The highest increases in the top 1% income shares were observed in the US, Canada, and Norway. In Sweden and the Netherlands, the increase was the smallest.

While the increase in income inequality around the globe has been largely documented in the literature, the *increase* in the variability of top incomes has been somewhat understudied. It turns out that coincident with the rise in top income shares, the shares and incomes of the top percentiles have become more volatile and more procyclical. It would appear that the rise in procyclicality and variability is greatest in countries that have seen the largest rises in top income shares.

The lower panel of Figure 1 plots the volatility of the growth rates of the shares of income of the richest 1% in each country. The time-varying figures are obtained using 15 years rolling windows.

Figure 1. Top 1% income share and its volatility



While the upper panel clearly shows that the richest tax units increased their share of income in the total GDP of economy, the lower panel suggests that this increase was accompanied by higher income risk. In most countries, we observe an increase in the variability of income from the second half of the 1980s. In the Netherlands, France and Japan, we find that the top incomes volatility did not increase in last three decades. In those countries the increase in top income shares was also very low. The joint examination of both panels of the figure thus suggests that the increase in income inequality observed during the last three decades (measured by top income shares) could reflect a compensation for additional income volatility.

3.2. Trends in cyclicality

We first seek to identify the link of the increased top incomes' volatility to the business cycle. For that purpose, we estimate the following specification for each country separately:

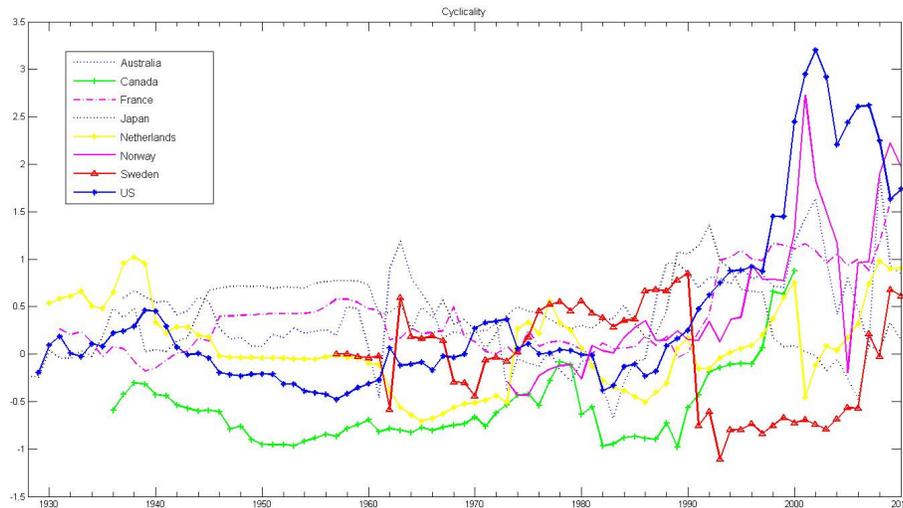
$$y_{i,t}^p = \alpha_i + \beta_i^p y_{i,t} + \epsilon_{i,t} \quad (1)$$

where $y_{i,t}^p$ is the growth rate in the income share of the top fractile p , and $y_{i,t}$ is the real GDP growth per capita in country i . In this case, β_i^p thus represents the elasticity of the top income share with respect to the changes in income per capita. Although the length of a business cycle is longer than one year, we use yearly changes to keep as many data points as possible.

A positive and significant β_i^p indicates that the top incomes' share is procyclical and a negative value would suggest the counter-cyclical.

Figure 2 below shows the evolution of cyclicity over time. The time-varying coefficients β_i^p were estimated for top 1% income share using a rolling window of 15 observations.

Figure 2. Cyclicity of top 1% shares of income

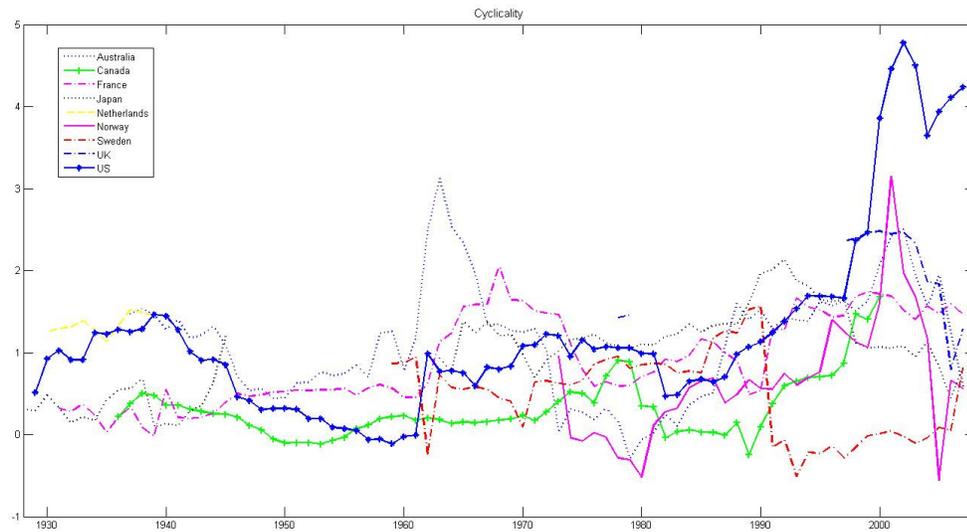


First, the figure suggests that there has been a general increase in cyclicity of top income shares, starting in the 80s. This is consistent with the pattern displayed in the lower panel of Figure 1 where, in many countries, the variability of top incomes increased in the second half of the 1980s.

A closer look at the evolution of the coefficients shows that there are large differences between countries. In the US and Norway for instance the income shares of top 1% became highly procyclical starting in the beginning of the 90s' while in Sweden the reverse occurred. Specifically, the cyclicity of the top 1% income shares became counter-cyclical in Sweden.

Figure 3 plots the time-varying coefficients β_i^p where, in the regression, instead of income shares we use average income of top percentile. This is the specification used by Parker and Vissing-Jorgenson (2009). Since the figures on average top incomes are not always available, Figure 3 displays fewer countries' series. Results are qualitatively similar to those in Figure 2.

Figure 3. Cyclicity of top 1% average incomes



The picture presented in Figure 3 is largely similar to Figure 2. There is a general increase in the cyclicity of top incomes starting at the end of the 80s with the US top 1% displaying recently the highest procyclicality and Sweden showing the highest acyclicity.

4. Empirical analysis

We first formally test for the presence of structural breaks in cyclicity of top incomes. Second, we test if the change in the cyclicity occurred at the same time as income inequality started to increase. Third, we study the dynamics of top income sources in order to shed some light on the potential drivers of their recent increased cyclicity.

4.1. Structural breaks in cyclicity of top incomes

In order to formally identify the changes in the trends in cyclicity, we run a set of structural break tests. We test for the existence of structural breaks in the value of β_i^p for each country separately. Recently Qu and Perron (2007) developed tests for joint structural breaks in a group of countries and Roine and Waldenström (2011) implemented them in the context of global income inequality trends. These procedures require the panels to be balanced and in our dataset several

countries have short data series and numerous missing values. In addition, since countries in our sample display different income inequality trends, as demonstrated by Roine and Waldenström (2011) for instance, there is no reason to believe that the breaks would occur at the same time. We therefore test for structural breaks for individual countries separately and implement the tests developed by Bai and Perron (1998 and 2003).

Their sequential procedure is applied to the value of the cyclicity coefficient β_i^p and is as follows. First, we estimate up to five breaks in the sample considered. Second, we apply the test, which is designed to detect the presence of $(j + 1)$ breaks conditional on having found j breaks ($j = 0, 1, \dots, 5$). The statistical rule is to reject j in favor of a model with $(j + 1)$ breaks if the overall minimal value of the sum of squared residuals (over all the subsamples where an additional break is included) is sufficiently smaller than the sum of squared residuals from the model with j breaks. The dates of the selected breaks are the ones associated with this overall minimum.

Table 1 shows the results of these tests. The first column of the table reports the country in question and the nature of the independent variable in our regression. In particular, we test for structural shifts in the cyclicity of growth rates in top income shares and in average incomes of these households. The tests are carried out for the following top fractiles: top 10 %, top 1 %, top 0.1 % and top 0.01 %. In addition, in the last column of the table, we report the results for the cyclicity changes in the remaining 90 % of households. When the series are not available, it is denoted in the table as NA.

We report the date of the significant shift in the cyclicity coefficient along with the values of the coefficient before and after the break in brackets. The reported values are significant at least at the 5 % level, otherwise we include zero in brackets. Even if we do not find structural breaks, it is still informative to report in brackets the values of significant cyclicity coefficients during the entire sample.

Table 1. Structural breaks in the cyclicity of top incomes.

Country					
Australia	Top 10 %	Top 1 %	Top 0.1 %	Top 0.01 %	Bottom 90 %
Shares	[0]	[0]	[0]	[0]	
Average Incomes	[0.76]	[1.14]	[1.27]	NA	[0.51]
Canada	Top 10 %	Top 1 %	Top 0.1 %	Top 0.01 %	Bottom 90 %
Shares	1988 [-0.61,0]	1987 [-0.74,1.14]	1987 [-0.65,2.37]	1984 [0,3.12]	
Average Incomes	None	1988	1987	1987	1977

		[0,1.73]	[0,3.14]	[1.55,4.08]	[1.4,0.79]
France	Top 10 %	Top 1 %	Top 0.1 %	Top 0.01 %	Bottom 90 %
Shares	1949 [0.13,0]	1949 [0.34, 0]	1949 [0, 0]	1949 [-0.31, -0.67]	
Average Incomes	1949 [0, 1.09]	1949 [0.44, 1.4]	1949 [0.63, 1.28]	1949 [0.79, 1.42]	1948 [0,1.07]
Japan	Top 10 %	Top 1 %	Top 0.1 %	Top 0.01%	Bottom 90 %
Shares	[0]	1942, 1960 [0, 0.95, 0]	1941 [0, 1.13]	1941 [0, 1.49]	
Average Incomes	[0.97]	1942, 1962 [0, 2.18, 0.86]	1941 [0, 2.3]	1941 [0, 2.68]	NA
Norway	Top 10 %	Top 1 %	Top 0.1 %	Top 0.01 %	Bottom 90 %
Shares	[0]	[0]			
Average Incomes	[0]	[0]	NA	NA	[0.67]
Sweden	Top 10 %	Top 1 %	Top 0.1 %	Top 0.01 %	Bottom 90 %
Shares	1994 [0, 0]	1994 [0, 0]	1996 [0, 1.74]	1983 [0, 0]	
Average Incomes	[0.52]	[0]	1996 [0, 2.12]	1982 [0, 1.54]	[0.63]
US	Top 10 %	Top 1 %	Top 0.1 %	Top 0.01 %	Bottom 90 %
Shares	1983 [-0.32, 0.38]	1941, 1987 [0, -0.41, 2.06]	1987 [0, 3.48]	1983 [0, 3.43]	
Average Incomes	1941 [0.79, 0.19]	1942, 1987 [0.91, 0, 3.66]	1987 [0.63, 4.89]	1987 [0.55, 5.36]	1944 [1.22, 0.48]

We find that only in Norway top incomes are not cyclical. This result is surprising given the pattern initially observed in Figure 2. When we look again at Figure 2 we see that the rise in cyclicity coefficient observed around 2000 is followed by its huge drop which might be the reason why the second part of the sample has not been found to be more procyclical in the statistical analysis. In contrast, the income of households in the bottom 90 % of income distribution in Norway is procyclical.

In 6 out of 8 countries, we find a change in the cyclicity dynamics of the top incomes in the 1980s. In addition to Norway, the cyclicity of top income shares did not experience any structural

shift in Australia. In countries which took part in WWII, we find a change in the cyclicity in the first half of the 20th century. Specifically, in Japan and France we find an increase in the cyclicity in the 1940s. The observed increase is large. In France, for instance, the income of the top 1 % became more than three times more procyclical after 1949. It is unlikely that the drivers of these changes in the 1940s are the same as those in the 1980s and afterwards. The 1940s were a period of declining shares of income from capital and an overall decline in income concentration at the top.

In other countries, we see that the change in cyclicity occurred later; in Canada and the US the change occurred in the 1980s and in the 1990s in Sweden. We observe the same pattern of a large increase in cyclicity: in the US, for instance, the income of top 0.1% responds almost 8 times more to average per capita income changes after 1987 than before that date.

In addition to the trend of increased cyclicity over the last century, we find that the cyclicity is positively related to the fractile of the income distribution. The highest fractiles experience greater increases in their sensitivity to income fluctuations. In the US case for instance, the elasticity of top 1% incomes with respect to per capita income change is 3.66, the one of top 0.1% is almost 50% and the one of 0.01% is even higher than 50%. Finally, we find that in countries where the income inequality increase was large, namely the US and Canada, the increase in income cyclicity was large and significant as well. In countries where the increase in income inequality was much smaller, for instance France and Japan, we do not find changes in the cyclicity behavior of top incomes.

4.2. Are higher income gains a compensation for additional income risk?

Given that the variability of top income shares seems to rise in proportion to their levels, one possibility is that the recent increase in income inequality reflects a compensation for additional volatility. If this hypothesis is true, there should be a change in behavior of top incomes and their variability around the same time. We investigate this hypothesis formally by testing for the presence of common breaks in the inequality trend and its cyclicity. We test if there were joint structural breaks in the coefficients of cyclicity β_i^p and the trend α_i in equation (1). The results of these tests are displayed in Table 2.

Table 2. Joint break dates in the mean top incomes change and their cyclicity

	Top 10 %	Top 1 %	Top 0.1 %	Top 0.01 %
Australia	None	None	None	None
Canada	1952,1988	1988	1987	1984
US	1983	1987	1987	1983

France	1942	1942, 1983	1948	1948
Japan	None	1940,1977	1940, 1973, 1993	1940, 1973, 1993
Sweden	1983	1982	1981	1981
Norway	None	None	None	None

Table 2 reports the dates of joint structural breaks in trend and cyclicity, significant at least at the 5 % level. Joint shifts occur in all countries with the exception of Australia and Norway.

In Canada, the US and Sweden, we find the change in the dynamics of top income shares and their cyclicity in the 80s, when both, the share and the cyclicity of top incomes increased (see Table 1 for comparison). In France and Japan, we find structural changes in top incomes around the war time and then again in the late 1970s and early 1980s. This result is consistent with the findings by Roine and Waldenström (2011) who demonstrate that countries which took part in the WWII experienced at that time a downward shift in income inequality.

The findings presented in Table 2 show that there was a coincident change in the top income gains and their business cycle fluctuations suggesting that the observed income inequality trend could reflect compensation for increased income volatility. If this is the case, is the observed compensation for volatility appropriate? While we do not know what an adequate compensation for risk is, we do observe the evolution of the top incomes risk's compensation and that of other tax units in our sample.

We use here the simplest measure of income gain per unit of risk, in the spirit of a Sharpe Ratio, from the finance literature. We compute the income gain as average growth rate in mean incomes by fractile and divide by the standard deviation in this growth rate. We use the break dates reported in Table 2 to define the samples for the computation of risk adjusted returns. For comparison purposes, we also report the risk adjusted income gains for the bottom 90% of the distribution and average per capita incomes. For these households, we split the sample at the break dates estimated for top incomes. Table 3 thus contains the information on risk adjusted income gains across different types of households and different periods of time for each country. The two dimensional comparison makes it easier to judge the adequacy of the increased compensation for top income risk. Australia and Norway, where the top incomes behavior does not experience any changes, are omitted from the table.

Table 3. Risk adjusted income gains

Country	Top 10 %	Top 1 %	Top 0.1 %	Top 0.01 %	Bottom 90 %	Per capita
Canada	1952,1988 [0.55, 1.05, 0.61]	1988 [0.57,0.60]	1987 [0.29,0.61]	1984 [0.18,0.51]	1988 [0.56,-0.35]	1988 [0.78,0.60]

US	1983 [0.23,0.51]	1987 [0.13,0.37]	1987 [0.08,0.35]	1983 [0.05,0.44]	1983 [0.23,-0.01]	1983 [0.33,0.91]
France	1942 [-0.05,0.54]	1942, 1983 [-0.22,0.41,0.47]	1948 [-0.27,0.60]	1948 [-0.32,0.51]	1942 [0.16,0.86]	1942 [0.04,0.48]
Japan	None	1940,1977 [0.36,0.12,0.30]	1940, 1973, 1993 [0.32,0.11,0.01,0.23]	1940, 1973, 1993 [0.25,0.14,0.03,0.08]	1977 [1.56,-0.19]	1940,1977 [0.39,0.45,0.79]
Sweden	1983 [0.27,1.19]	1982 [-0.01,0.82]	1981 [-0.16,0.64]	1981 [-0.12,0.58]	1983 [0.56,0.98]	1983 [1.31,0.75]

Table 3 shows that, over the last century, there has been an increase in risk adjusted top income gains in most of the countries. The only exception to this trend is Canada where we observe stable Sharpe Ratios for the top 1% and lower Sharpe Ratios for the top 10 % after 1988. In all other countries, in the later samples, each unit of top incomes' risk was rewarded more generously. In France and Sweden the Sharpe Ratios of top incomes moved from negative to positive figures, mainly reflecting their drops in the first part of the sample due to the Great Depression and the WWII.

Average per capita Sharpe Ratios increased also in the US, France and Japan suggesting an improvement in the average income conditions in these economies. These figures are not however informative about the evolution of the tails of the income distribution. The bottom 90 % of the income distribution experienced a deterioration in risk adjusted returns in Canada, the US, and Japan. Note that the households in the bottom 90% of the income distribution are worse off in the US by this measure as not only did they experience negative income gains but also large variability, reflected by small negative value of Sharpe Ratios. In both European countries, Sweden and France, the Bottom 90% seem to be better off than in the beginning of the previous century, as measured by risk adjusted pre-tax/pre-transfer income gains. This is in line with previous findings by Saez and Veall (2007) that the continental European countries display different income inequality dynamics. Their finding holds when top income growth is adjusted by income risk measured by a simple standard deviation.

The changes in the Sharpe Ratios over time vary across the countries and fractiles. In Canada, even the highest reported fractile, top 0.01%, increased 'only' three times but the average per capita return dropped. In the US, the surge in the risk compensation is the largest as top 0.01% for instance earn 9 times more after 1983 than they did before that date. Perhaps surprisingly, in Sweden, we observe similar changes in the top income gains. Specifically, in the first part of the sample, the top incomes' returns dropped while in the second part the richest earned Sharpe Ratios of the order of 0.7. It is important to note however that the risk adjusted returns for the bottom 90 % reached even higher ratios in the second part of the sample namely 1. In contrast, the average per

capita income gains dropped suggesting that the risk adjusted income gains were concentrated in the tails of Swedish income distribution while the middle was left out.

The results reported in Table 3 indicate that the differences in income inequality patterns persist even if one adjusts top incomes' gains by their risk. In particular, we find that in North American countries in our sample, namely Canada and the US, the surge in the top income returns remains extreme even when corrected for their risk. In continental Europe, represented by France and Sweden, the changes in risk adjusted top incomes' returns seem much more moderate relative to the bottom 90 %.

While the empirical literature focused so far on documenting and trying to explain the surge in income inequality, few studies have attempted at analyzing the income risk dynamics.⁵ In what follows we focus on the latter, namely, we try to recognize the drivers of the shifts in top incomes' cyclicity which accompanied recent increase in income inequality.

Of course several possible alternative explanations for these findings exist. The first is related to data issues. Since the top incomes database is a repeated cross-section, we know that the tax units are not 100% identical from period to period. The notion of income variability for a top fractile with a constant constituency is quite different from the notion when the identity of those tax units in the top fractile is constantly changing. However, assume an extreme and implausible case when the identity of the top fractile is completely different from one year to the next say because the entire fractile was pushed into a lower fractile while the top fractile is re-populated from those previously below it. In this case, where idiosyncratic shocks determine the fractile form period to period the variability of fractile incomes with respect to aggregate incomes is zero. In the opposite, but equally unlikely case assume all the individuals in the top fractile remain in the fractile and experience positive idiosyncratic shocks that are positively correlated with shocks to average income. Here we would over-state the relationship between top income shares and movements in aggregate GDP per capita.

Parker and Vissing-Jorgenson (2010) proposed a simple partial equilibrium model of heterogeneous workers to explain the rise in pro-cyclicality of top incomes in the US since 1982. They assume that new technologies since the 1980s have decreased the diminishing marginal returns especially to certain occupations – notably those in finance, other high-end services and managerial occupations. New technologies have allowed many types of workers, especially those which are highly paid already, to expand the scale of operations without running into diminished marginal returns. If this is

⁵ A few examples of studies of recent income inequality increase are Atkinson, Piketty and Saez (2011), Roine and Waldenström (2009), Roine, Vlachos and Waldenström (2009).

true then the earnings/profit function for these top fractiles shows greater sensitivity to aggregate fluctuations.

4.3. Sources of changes in the trend and cyclicality of top incomes.

We find that top incomes became significantly more procyclical during the last century. This finding could be because of higher shares of total income coming from sources that are generally more cyclical and variable and because variability of the various components has increased. Again, Parker and Vissing Jorgenson (2010) study this issue for the US.

We also explore this question using the top incomes dataset and in particular the components of incomes. While it would have been ideal to extend this idea to a large number of countries, only 3 countries have a sufficiently long time series of sources of income: Canada, France and the US. Figures 4-6 plot the evolution of top incomes in each of the countries, divided into 3 categories: wage income, capital income and business income. Each figure includes three panels. The top panels show the share of income generated by wages. The middle panels plot capital share of top incomes and the bottom panels show the business share of income.

Figure 4. The sources of top income shares in Canada

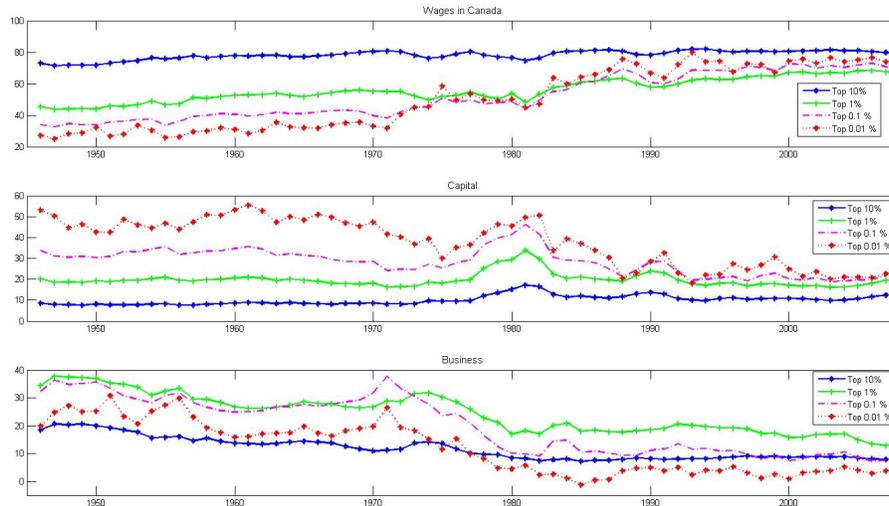


Figure 5. The sources of top income shares in the US

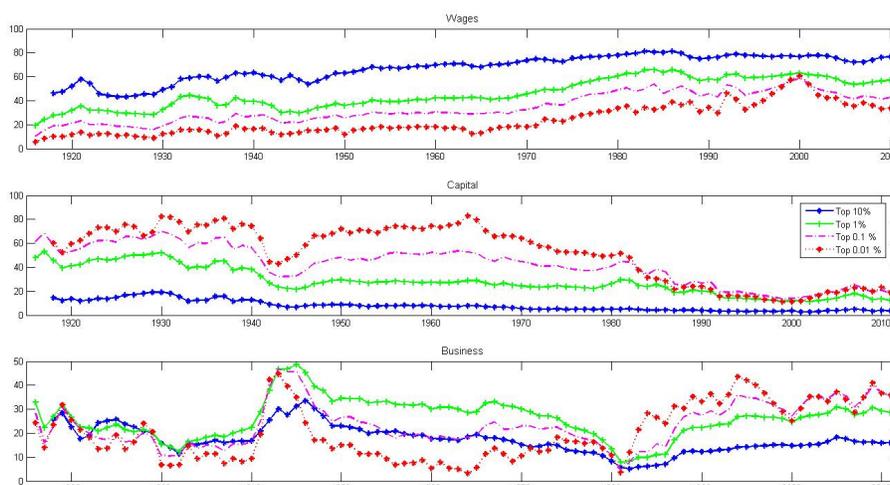
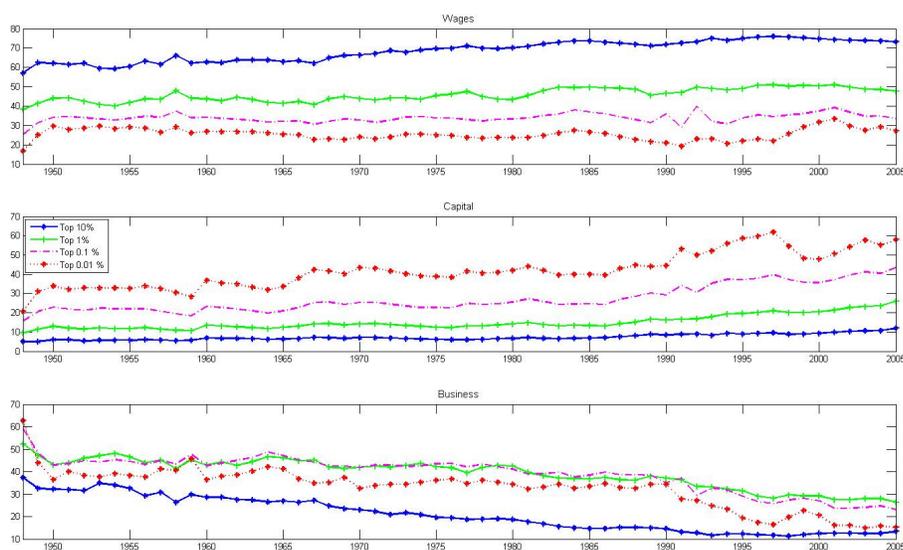


Figure 6. The sources of top income shares in France



In all the three countries, top labor incomes increased during last decades of the 20th century. As a result, the fraction of labor income in the top percentile is much higher today than in the beginning of the twentieth century. The wages constitute the highest share of income of the top 10 % and their share decreases when the higher fractiles of income distribution are considered. The share of wages increased for all the top income fractiles at the expense of capital income; this is a fact previously documented in the literature (see Piketty and Saez, 2003 and Atkinson, Piketty and Saez, 2011). The drop in the capital income is mainly due to a reduction in top wealth concentration.

The exception here is France where both wage and capital shares of income increased during the last century at the expense of the business share of income which dropped considerably, as shown in the bottom panel of Figure 6.

Capital income, composed of rents, interests and dividends represents the highest share in income of the richest households. Finally, the share of business income dropped during the last century in Canada and France but it increased in the US, especially for the highest incomes.

In the beginning of our sample which starts in 1920, the US business income represented roughly equal shares for all top incomes. Currently, it is by far the highest source of income for the richest Americans in our sample: top 0.01 % and top 0.1 %.

In order to understand the cyclical behavior of the sources of income and identify its potential changes we again estimate the cyclicity coefficients in the following regression:

$$y_{i,t}^{p,c} = \alpha_i + \beta_i^p y_i + \epsilon_{i,t}$$

where $y_{i,t}^{p,c}$ stands for one of the income sources: wages, capital and business income.

Figures 7-9 plot the evolution of the rolling cyclicity coefficients β_i^p for three income categories for the top 0.1 % richest households in each country. The top panel plots the cyclicity coefficients series for wages, the middle one for capital and the bottom one for business income. The coefficients and 95% significance intervals are computed using rolling windows of 15 years.

Figure 7. Cyclicity of top 0.1 % in Canada

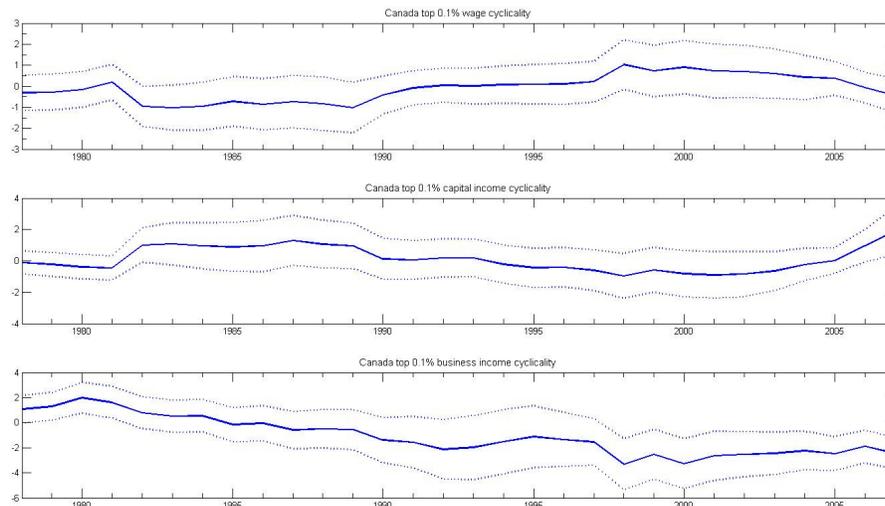


Figure 8. Cyclicity of top 0.1 % in the US

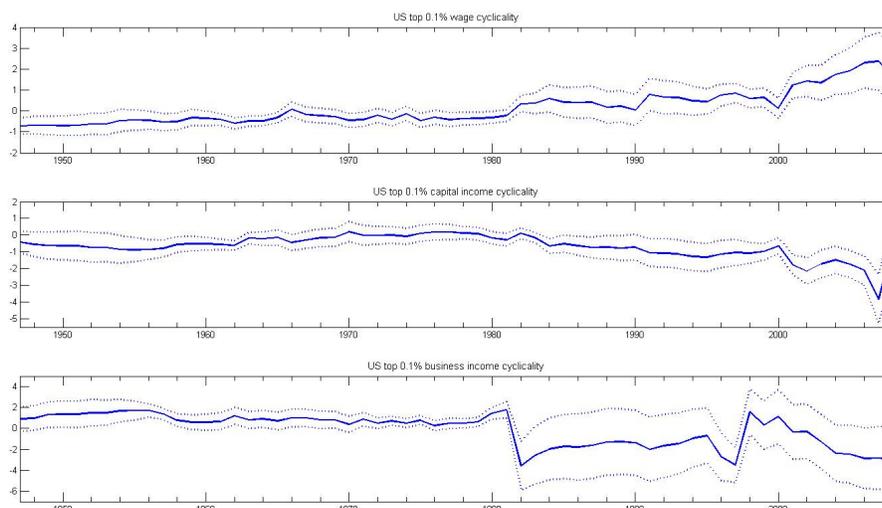
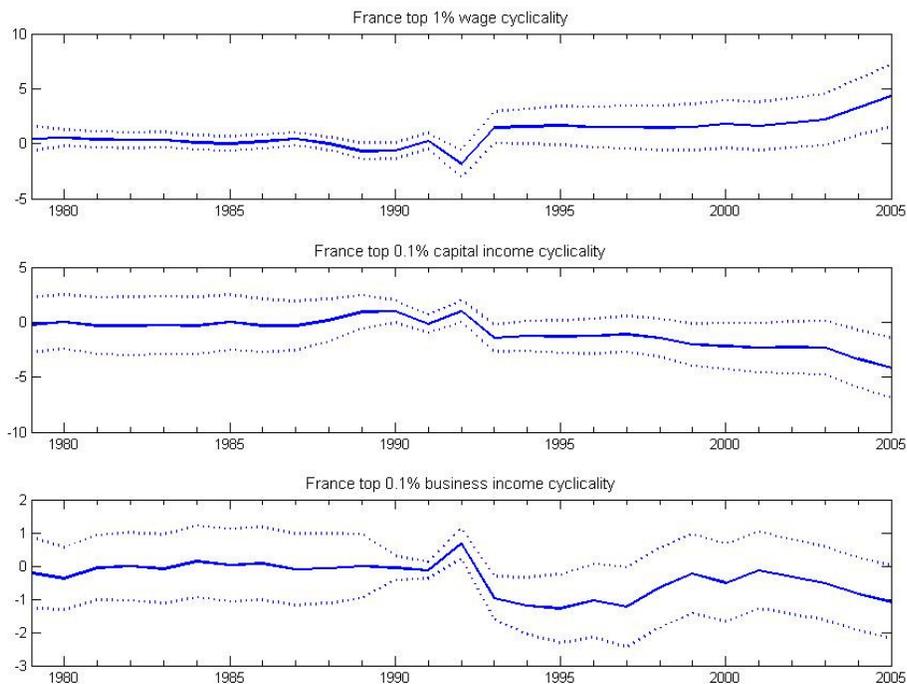


Figure 7. Cyclicity of top 0.1 % in France



The figures suggest that there has been a significant increase in cyclicity of wage shares at the end of 80s in the US and in the beginning of the 90s in France. In Canada, we do not immediately see any increase in the sensitivity of wages of top 0.1% to the business cycles fluctuations. An

increase in the cyclicity of the wage shares was accompanied by the significant increase in countercyclicity of the capital income shares in the US and in France. Thus, these figures suggest that, since the 1990s, the top 0.1 % incomes in France and in the US experience higher wage incomes fluctuations which can however be somewhat hedged by capital income sources. In addition, the plots suggest that in all three countries, the business income shares became an additional hedge for the top incomes' risk since the 90s.

Since the top incomes dataset provides relatively short series for the components of income for individual countries, we pool the available data for three countries and estimate a panel with country fixed effects. Since in all the countries the shifts in cyclicity occurred at the end of the 80s or the beginning of the 90s, we simply split the sample in 1990 and estimate the cyclicity coefficients in two subsamples.

Table 4 below reports the values of the estimated coefficients β_i^p for three income categories: wage income, business income and capital income. In addition, because the dynamics of components of capital income are different, we report the results for 3 categories: investment, dividends, interests and rents. The rents category is reported only for France and the US and interest income exist only for the US and Canada. All the regressions are carried out for top 10%, top 1 %, top 0.1 % and top 0.01 %. The top panel of Table 4 includes the results for to 10 % and top 1 % of country's income distribution and the lower panel reports the findings for top 0.1 % and top 0.01.

Table. 4. Cyclicity of top incomes' sources

		Top 10 %		Top 1%	
		1919-1990	1991-2010	1919-1990	1991-2010
Wages		-0.1887***	-0.1473***	-0.7979***	0.0260
Business Income		0.5911***	0.6029**	0.7214***	-0.8643***
Capital Income		-0.2453**	1.8842***	-0.0967*	0.9910**
	Investment	0.0761	-1.0422**	-0.0107	-0.3978
	Dividends	-0.0167	2.8233***	-0.0575	1.0895***
	Interests	-0.5410**	2.3821***	-0.6019***	1.6489**
	Rents	-0.5192**	-0.0324	-1.1580*	-1.1137*
		Top 0.1 %		Top 0.01 %	
		1919-1990	1991-2010	1919-1990	1991-2010
Wages		-0.6585***	0.7186*	-0.7504***	1.3770**
Business Income		0.5824***	-2.0706***	0.7036*	-1.3601
Capital Income		-0.3220***	0.7863*	-0.3128**	0.0718
	Investment	-0.3266	2.7299**	-0.1019	8.3238**
	Dividends	-0.2838	0.5736	-0.4065**	-0.7960

	Interests	-0.7489***	0.8549	-0.5095**	-1.7550**
	Rents	-0.5095*	-1.7560*	-0.6586**	-5.0055**

The first important result is that the wage share of income was significantly countercyclical before 1991 for all the top incomes considered here. We also note that wages of higher fractiles tend to experience stronger cyclicity. In the second part of the sample, starting in 1991, the wage share of income is procyclical. This is the case of the top 0.1 % and top 0.01 %. The change in the business cycle fluctuations of the wage share of income could thus be the reason for increased procyclicality of the total top incomes both because the share of income garnered as wages has increased and because the cyclicity has increased as suggested by Parker and Vissing-Jorgensen (2009).

Since we analyze here the behavior of wage share of income, the obtained result could be driven either by changes in the remuneration of top incomes or by their hours worked. Our finding is consistent with the argument of Castro and Coen-Pirani (2008) that skilled labor's hours have become more procyclical since the mid-1980s in the US because of the decrease in the capital-skill complementarity. Of course, their argument can be used in our context, if we assume that the top incomes represent skilled labor. Parker and Vissing-Jorgensen (2009) report the professional composition of top 1 % in the US between 1998 and 2001. They show that two skilled labor categories together represent more than 65 % of the top percentile: (i) executive, administrative or managerial and (ii) professional specialty including, lawyers, medical doctors and investment bankers. Higher percentiles of income distribution tend to include even higher shares of skilled labor so that we can comfortably assume that top incomes represent mainly skilled labor.

While the wage income shares became more procyclical, the business shares of income became countercyclical after 1991 thus providing a hedge for top incomes. More specifically, we find positive and significant cyclicity coefficients in the first part of the sample for all the top incomes. After 1991, the business income shares of top 1%, 0.1% and 0.01% move in the opposite direction to the GDP per capita growth and in case of top 1% and 0.1% significantly so. The business income shares of the top decile again do not change its cyclical behavior indicating that these incomes are somewhat different from higher fractiles. It is important to note that top decile income shares are composed of very heterogeneous households including higher middle class represented for instance by lawyers and medical doctors but also superstars in the sports and entertainment industries, investment bankers and CEOs (see Gordon and Dew-Becker, 2007). Since top 10 % richest also include higher middle class households, their income fluctuations rather reflect the average business cycle behavior than the highest incomes movements.

In contrast with the observations of the plots in Figures above, we find that capital income category is more procyclical after 1991. In order to understand better the cyclical behavior of underlying components, we also carry out the empirical analysis for the sources of capital income shares which vary among the three countries. First, we find that in the second part of the sample, investment income became countercyclical for the top 10 % and top 1 % but became procyclical for top 0.1 % and top 0.01% income shares. The income from dividends displays stronger procyclicality in the second part of the sample. Interest and rent incomes display however stronger countercyclicality, at least for the richest households in the top 0.1% and 0.01%.

These results suggest that although the labor income of the richest has become more procyclical their other income sources *partially* counterbalance this additional risk. In particular, the business income and some components of capital income have been acting since the 90s as hedges to additional wage income risk. The richer the households are the higher are the shares of these additional sources of income in their total income thus decreasing the overall borne risk.

Conclusion

This paper studies the relationship between income inequality changes and income volatility dynamics. We identify the nature of the increased volatility for top incomes, and then investigate its relationship both to the rise in income inequality and to business cycle fluctuations. For this purpose, we use the Top Incomes Dataset for 8 countries for which long-run series exist. We find that the rise in top income shares was associated with increased top incomes' risk. However, in North American countries the compensation for a unit of risk was much higher than in continental Europe or Japan. Our findings thus indicate that the previously identified differences in income inequality patterns persist even if one adjusts top incomes' gains by their risk.

We then explore the nature of top incomes' cyclicity more in detail using the decomposition of top incomes into their sources: wage income, capital income and business income for three economies, for which the Top Incomes Dataset provides consistent series: Canada, the US and France.

We find that the wage share of income was significantly countercyclical before 1991. Since the beginning of the 1990s, the wage share of income has become procyclical. In contrast to the wage income shares, the business shares of income have become countercyclical after 1990 thus providing a hedge for top incomes. Capital income is not a homogenous category as its components display different business cycle fluctuations. We find that since the 1990s, investment income has become

countercyclical for the top 10 % and top 1 % but has become procyclical for top 0.1 % and top 0.01% income shares. The income from dividends displays stronger procyclicality in the second part of the sample. Interests and rents however display stronger countercyclicality, at least for the richest households in the top 0.1% and 0.01%.

These results suggest that although the labor income of the richest households (tax units) has become more procyclical, their additional income sources partially counterbalance this extra volatility. In particular, the business income and several components of capital income have been acting since the 1990s as hedges to additional wage income risk. The richer the households are the higher are the shares of these additional sources of income in their total income thus decreasing the overall risk.

References

- Atkinson, Anthony B., Thomas Piketty, and Emmanuel Saez. 2011. "Top Incomes over a Century or More." *Journal of Economic Literature* 49: 3-71.
- Bai, Jushan, and Pierre Perron, 1998. "Estimating and Testing Linear Models with Multiple Structural Changes," *Econometrica* 66, 47–78.
- Bai, Jushan, and Pierre Perron. 2003. "Computation and Analysis of Multiple Structural Change Models," *Journal of Applied Econometrics* 18, 1–22
- Bolt, J. and J. L. van Zanden. 2013. The First Update of the Maddison Project; Re-Estimating Growth Before 1820. Maddison Project Working Paper 4.
- Castro, Rui and Daniele Coen-Pirani, 2008. "Why Have Aggregate Skilled Hours Become So Cyclical Since the Mid-1980s?," *International Economic Review* 49,135–184.
- Gordon, Robert J. and Dew-Becker, Ian 2007. "Selected Issues in the Rise of Income Inequality," *Brookings Papers on Economic Activity* 38:2, 169-92.
- Güvenen, Fatih, Greg Kaplan, and Jae Song. 2014 "How Risky Are Recessions for Top Earners?" *American Economic Review: Papers & Proceedings* 2014, 104(5): 148–153.
- Güvenen, Fatih, Greg Kaplan, and Jae Song. 2014. "The Nature of Countercyclical Income Risk.," *Journal of Political Economy* 122, 621-660.
- Kopczuk, Wojciech, Emmanuel Saez, and Jae Song. 2010. "Earnings Inequality and Mobility in the United States: Evidence from Social Security Data since 1937." *Quarterly Journal of Economics* 125 (1): 91–128.
- Kuznets, Simon. 1953. *Shares of Upper Income Groups in Income and Savings*. New York: National Bureau of Economic Research.
- Parker, Jonathan A., and Annette Vissing-Jorgensen. 2010. "The Increase in Income Cyclical of High-Income Households and Its Relation to the Rise in Top Income Shares." *Brookings Papers on Economic Activity*: 1–55.
- Piketty, Thomas, and Emmanuel Saez. 2003. "Income Inequality in the United States, 1913-1998." *Quarterly Journal of Economics* 118, no. 1: 1-39.
- Qu, Zhongjun, and Pierre Perron, 2007. "Estimating and Testing Multiple Structural Changes in Multivariate Regressions," *Econometrica* 75 , 459–502.
- Roine, Jesper, Vlachos, Jonas and Waldenström, Daniel, 2009. "The long-run determinants of inequality: What can we learn from top income data?," *Journal of Public Economics*, 93, 974-988.
- Roine, J., and D., Waldenström. 2011. Common trends and shocks to top incomes: a structural breaks approach, *Review of Economics and Statistics* 93, 832-846.

Saez, E., and M. R. Veall. 2007. "The Evolution of High Incomes in Canada, 1920-2000." In *Top Incomes over the 20th Century: A Contrast between Continental European and English-Speaking Countries*, edited by A. B. Atkinson and T. Piketty. Oxford University Press.