What Determines Top Income Shares? Evidence from the Twentieth Century*

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Abstract

This paper examines the long-run determinants of the evolution of top income shares. Using a newly assembled panel of 16 developed countries over the entire twentieth century, we find that financial development disproportionately boosts top incomes. This effect appears to be particularly strong during the early stages of a country's development. Economic growth is strongly pro-rich which is inconsistent with globalized labor markets determining the incomes of elites. Furthermore, international trade is not associated with increases in top incomes on average, but is so in Anglo-Saxon countries. Finally, tax progressivity has a significant negative effect on top income shares whereas government spending has no such clear impact on inequality.

Keywords: Top incomes, income inequality, financial development, trade openness, government spending, economic development

JEL: F10, G10, D31, N30

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1 Introduction

The relationship between inequality and development is a central issue in the study of economics. From fundamental concerns about whether markets forces have an innate tendency to equalize or increase differences in economic outcomes, to much debated questions about the effects of "globalization", distributional concerns are always present: Does economic growth really benefit everyone equally or does it come at the price of increased inequality? Is the effect perhaps different over the path of development? Is it the case that increased openness benefits everyone equally, is it perhaps especially the poor that gain, or is it the case that it strengthens the position only of those who can take full advantage of increased international trade? Does financial development really increase the opportunities for previously credit constrained individuals or does it only create increased opportunities for the already rich? What is the role of the state in all this? Theoretically such questions are difficult to resolve as there are plausible models suggesting equalizing effects of these developments, as well as models suggesting the opposite.[1] Empirically problems often arise because typically these effects should be evaluated over long periods of time and data is typically only available for relatively short periods.

This paper empirically examines the long-run associations between income inequality and financial development, trade openness, the size of government, and economic growth. The main novelties of our study lie in the uniquely long time period for which we have data and in the focus on top income shares. We use a newly compiled dataset for 16 countries, mostly developed economies, over the whole of the twentieth century.[2] While previous studies have only had comparable data from the 1960s (at best),

[1] Just to give some examples: one may distinguish between theories that predict markets to be innately equalizing, disequalizing or both (depending on initial conditions). Mookherjee and Ray (2006) give a useful overview of the literature on development and endogenous inequality based on such a division. Winters et al. (2004) give an overview of evidence on the relation between trade and inequality, Cline (1997) summarizes different theoretical effects of trade on income distribution, while Claessens and Perotti (2005) provide references for the links between finance and inequality, presenting theories which suggest both equalizing effects as well as the opposite. We will discuss some of the suggested mechanisms in more detail in Section 2 below.

[2] Even though the choice of countries is mainly a result of data availability it has some positive side effects. We are, for example, able to trace a fixed set of relatively similar countries as they develop rather than letting different countries represent stages of development. Having similar countries is also important especially when thinking about theoretical predictions from openness which are often diametrically different for countries with different factor endowments, technology levels etc.

our series start at the end of the "first wave" of globalization (1870–1913), continues over the interwar de-globalization era (1913–1950), the postwar "golden age" (1950–1973) and ends with the current "second wave" of globalization.[3] Hence, in contrast to relying on shorter periods of broader cross-country evidence, our dataset allows us to study how inequality has changed over a full wave of shifts in openness as well as several major developments in the financial sector. In terms of the role of government, our long period of analysis implies that we basically cover the entire expansion of the public sector and the same is true for the role of income taxation, which was non-existent or negligible at the beginning of the twentieth century.[4] Furthermore, by focusing on the top income earners (and concentration within the top) we can address a particular subset of questions regarding the extent to which economic development is particularly pro-rich.[5] This angle is of interest partly because there are theoretical arguments for why some effects should be particularly beneficial for the rich, but also because recent studies of long-run inequality suggest that large parts of changes in top income shares are driven by changes in the very top of the income distribution.[6]

Our empirical analysis exploits the variation within countries to examine how changes in top income shares are related to changes in economic development, financial development, trade openness and government size. As some theories suggest that the effects may be different depending on the level of economic development we also study this in more detail, allowing the effects to vary between different levels of per capita income. Furthermore, using a panel data approach allows us to take all unobservable time-invariant factors, as well as country specific trends into account.[7]

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[3] As variously classified by, e.g., O'Rourke and Williamson (2000) and O'Rourke (2001). All of these studies discuss various aspects of globalization and inequality over these periods but they did not have sufficient data to analyze developments in detail. Cornia (2003) discusses differences in within-country inequality between the first and second globalization.

[4] In fact, the introduction of a modern tax system is typically what limits the availability of data on income concentration.

[5] Most of the previous work has focused on broader inequality concepts, in particular the Gini-coefficient, or (to a lesser extent) on the particular effects on the poor (e.g., Harrison, 2006; Beck et al. 2007).

[6] Examples include, models of how aspects of these developments creates extreme returns to "superstars", or models of capitalists and workers where capitalists benefit disproportionately would, when taken to the data, translate to isolated effects for a small group in the top of the income distribution. For evidence on much of changes in top income concentration stemming from the very top, see Piketty (2003), Piketty and Saez (2003, 2006), and Atkinson and Piketty (2007).

[7] As suggested by Piketty (2005), the new data coming out of the recent research on top incomes enables more rigorous testing of mechanisms at play, and as he points out, even if this kind of analysis will always suffer from a severe identification problem the new data will allow testing of relationships which we have not been able to address before.

Several findings come out of the analysis. First, we find that financial development, measured as the relative share of the banking and stock market sectors in the economy seems to increase top income shares. When interacted with the level of economic development it turns out that the result derives from a strong effect in the early stages of development. This result is in line with the model suggested by Greenwood and Jovanovic (1990) where financial markets initially benefit only the rich but as income levels increase (and with them the development of financial markets) the gains spread down through the distribution. It is also of particular interest since a recent study by Beck, Demirguc-Kunt and Levine (2007) finds that financial development disproportionately benefits the poor.[8]

We also study the effect of various aspects of globalization on top incomes. When measuring globalization as the trade share of GDP we find no relationship on average, but we do find a strong association between increased trade and increased top incomes in Anglo-Saxon countries. The difference between the two groups is substantial: an estimated 50 percent of the difference in the development of top incomes since 1980 – a difference which has been emphasized in the top income literature – can be explained by the different responses to international trade.

Another aspect of globalization that our results shed light on is the suggestion that the incomes of the elite is set on a global labor market, while all others have their incomes set locally. Our results suggest that this is not the case (at least not in any simple form of the argument). Assuming that domestic development determines wages on the local labor market while global growth determines the compensation for the elite, domestic economic growth (above the World average) should decrease inequality between the two groups.[9] By contrast, our results suggest that increasing GDP per capita is strongly pro-rich. As we find this relation to be similar at different stages of economic development, it could indicate that recent findings of high productivity growth mainly

[8] Note, however, that these findings are not necessarily conflicting. For example, both the poor and the richest group can benefit at the expense of the middle class.

[9] Gersbach and Schmutzler (2007) as well as Manasse and Turrini (2001) emphasize the distribution of incomes within the elite group (rather than the average) predicting that globalization leads to an increased spread in incomes for the elite. Others such as Gabaix and Landier (2007) emphasis the firm size effect, while Kaplan and Rauh (2007) stress technological change, superstar effects (Rosen, 1981), and scale effects as plausible explanations for increasing top incomes.

benefiting the rich in the U.S. postwar era (Dew-Becker and Gordon, 2005, 2007), is a general phenomenon both across countries and across time.[10]

Finally our results indicate that government size only marginally lowers top income shares. Specifically, higher top marginal taxes have a robust, but fairly small negative effect on top income shares.[11] Government spending as share of GDP, however, has no clear effect.

The remainder of the paper is organized as follows. Section 2 outlines some common theoretical arguments linking the incomes of the rich and the variables included in the study. Section 3 describes the data and their sources while Section 4 provides a brief inspection overview of the relationships between the different variables. Section 5 presents the econometric framework and Section 6 presents the main results and a number of robustness analyses. Section 7 concludes.

2 Potential determinants of trends in top income shares

A number of recent contributions to the study of income inequality have increased the availability of comparable top income data over the long-run. Following seminal contributions by Piketty (2001, 2003) on the evolution of top income shares in France, series on top income shares over the twentieth century have been constructed for a number of countries using a common methodology.[12] The focus in this literature has mainly been on establishing facts and to suggest possible explanations for individual countries. To the extent that general themes have been discussed these have focused on accounting for some common trends such as the impact from the Great Depression and World War II (on countries that participated in it) and on the differences between Anglo-Saxon countries and Continental Europe since around 1980. Broadly speaking the explanations for the sharp drop in top income shares in the first half of the twenti-

[10] Note that what find is that stronger than average growth increases top income shares, not that growth in general has this effect.
[11] Atkinson and Leigh (2007c) find stronger negative effects of marginal taxation on top income shares in their study focusing on Anglo-Saxon countries.
[12] Other recent studies include Australia (Atkinson and Leigh, 2007), Canada (Saez and Veall, 2005), Germany (Dell, 2005), Ireland (Nolan, 2007), Japan (Moriguchi and Saez, 2006), the Netherlands (Atkinson and Salverda, 2005), New Zealand (Atkinson and Leigh, 2007), Spain (Alvaredo and Saez 2006), Sweden (Roine and Waldenström, 2007) and Switzerland (Dell, Piketty and Saez, 2007). Much of this work is summarized and discussed in Atkinson and Piketty (2007).

eth century have revolved around shocks to capital ownership, leading to the top income earners losing much of the wealth that provided them with much of their income, thus decreasing their income share substantially. High taxes after World War II (and the decades thereafter) prevented the recovery of wealth for these groups. After roughly 1980 top income shares have increased substantially in Anglo-Saxon countries but not in Continental European countries. However, this has not been due to increases in capital incomes but rather due to increased wage inequality (see Piketty and Saez, 2006 for more details on the proposed explanations for the developments).

Even though a number of plausible explanations have been suggested in this literature it is fair to say that so far no attempts at exploiting the variation across countries and across time in an econometrically rigorous way has been made. In fact, in overviews (Piketty 2005 and Piketty and Saez 2006) of this literature it is suggested that – even though there will always be severe identification problems – cross country analysis seems a natural next step. A first question when contemplating such an analysis is, of course, what variables that could be expected to have a clear relationship to top income shares. Beside variables suggested in the top income literature, such as growth, taxation and the growth of government, we think variables capturing financial development and openness to trade, are especially interesting.

The next question is; what should we expect these relationships to look like? When it comes to the impact of financial development, it is fair to say that standard theory typically predicts that financial development should decrease inequality, at least if we think of financial development as increasing the availability for previously credit constrained individuals to access capital (or that financial markets allow individuals with initially too little capital to "pool their resources" to be able to reach a critical minimum level needed for an investment).[13] This is the standard mechanism in growth theories where a country can be caught in a situation where badly developed financial markets make it impossible for much of the population to realize projects that would increase growth (as, for example, in Galor and Zeira, 1993 and in Aghion and Bolton, 1997). The situation would be one of low growth (compared to the country's potential), high inequality and badly developed financial markets. With the development of

[13] Recent evidence for financial development being pro-poor is given in Beck et al. (2007).

financial markets, increased growth goes hand in hand with less inequality as the financial markets improve the allocation of resources. A larger fraction of individuals are then given the possibility to realize profitable projects.

There are, however, a number of suggested mechanisms that could turn this prediction around. In an overview of the links between finance and inequality, Claessens and Perotti (2005) give a number of references (e.g. Rajan and Zingales, 2003 and Perotti and Volpin, 2004) to theory, as well as evidence, of financial development, which benefits insiders disproportionately (consequently leading to increased inequality). The idea, in various garbs, is that understanding the potential threat to their position from certain types of development of capital markets, the political elites (implicitly the top income earners) would block such developments, possibly to the detriment of the economy. Hence, these theories agree that *in principle* the development of financial markets could have an equalizing effect but *in practice* only developments that disproportionately benefit the elite will materialize.

Beside theories suggesting either increased equality or increased inequality from financial development there are also a number of theories suggesting that financial development, much like the classic Kuznets curve, leads to increased inequality in early stages of development but at later stages also benefits the poor, leading to increased equality. An influential article suggesting precisely this is Greenwood and Jovanovic (1990). Their idea is that at low levels of development when capital markets are non-existent or at an early stage of development only relatively rich individuals can access the benefits of these (as there are certain fixed costs involved). At this stage further developments of financial markets increase growth but disproportionately benefit the rich. However, as the economy grows richer, a larger and larger portion of the population will be able to access the capital market and more and more individuals will benefit. Consequently resource allocation improves even more, growth continues to increase, but now accompanied by decreasing inequality. Eventually the economy reaches a new steady state where financial markets are fully developed, growth is higher and inequality has gone through a cycle of first increasing and then decreasing over the path of development.

When it comes to standard trade theory the inequality effect of openness varies depending on relative factor abundance and productivity differences, and also on the extent to which individuals get income from wages or capital. Easterly (2005) provides a good overview of the arguments, stressing the importance between differences (between countries) stemming from variations in endowments or productivity. Assuming, which seems realistic, that our sample contains countries that (over the whole of the twentieth century) have been relatively capital rich compared to the global average and are places where capital owners coincide with the income rich, we should, in general, expect trade openness to increase the income shares of the rich in our sample.[14] Even if theory is far from clear cut in its predictions, the basic argument that trade openness may "naturally" benefit the rich underlie calls for political intervention whereby a "loosing majority" could be compensated given that the total gains are large enough (as shown in Rodrik, 1997 and as recently forcefully argued in Scheve and Slaughter, 2007).

Overall, the conclusion we draw from reviewing the literature on possible determinants of top income shares is that theory provides us with many plausible alternatives. The main contribution we can make lies in using the uniquely long period for which we have data to test whether there are robust relationships over time as well as to address issues of changing relationships along the path of development (such as testing whether financial market development has a different effect in early stages of development compared to later stages).

3 Data description

This section outlines the data and their sources. Further details can be found in the appendix. The following variables are included in the analysis.

Top income shares. In traditional income inequality research, top income earners have typically been defined as everyone in the top decile (P90–100) of the income distribu-

[14] An example of when this is not the case would be if differences between countries are due to productivity differences that are so large that the richer countries (the ones in our sample) can export labor intensive goods (productivity advantage offsets labor scarcity). Then trade would reduce inequality in the rich countries. Another potentially important point is the fact that these countries have largely traded with each other, and therefore the predictions could still be different for different countries in our sample.

tion. The recent studies of Piketty (2001) and others have shown, however, that that the top decile consists of several highly heterogeneous groups of income earners that should be analyzed separately in order to reach as accurate conclusions as possible. In particular, the long-run evolution of the income share of the bottom nine percentiles of the top decile (P90–99) suggests a remarkably stable pattern over time whereas the the share earned by the top percentile (P99–100), by contrast, has fluctuated considerably over the same period. Moreover, while labor incomes dominate in the lower group of the top decile, capital incomes are relatively more important to the top percentile. In order to analyze the determinants of top income shares in detail we will hence differentiate between the groups of income earners within the top decile.

Our top income data come from a new international panel dataset over top income shares for 16 countries covering most of the twentieth century. These series are constructed by several researchers as parts of a joint methodological framework where the main source is the income statements in personal tax returns collected for different income classes, following Piketty (2001, 2003) and others.[15] The income reported in these sources is typically *gross total income*, which includes income from labor, business and capital (and sometimes realized capital gains) before taxes and transfers. Top income shares are then computed by dividing the observed top incomes by the equivalent total income earned by the entire (tax) population, had everyone filed a personal tax return. In most countries only a minority of the people filed taxes before World War II and the computation of reference totals for income regularly include both tax statistics and various estimates from the national accounts. For this reason the reference total income is likely to be measured with some error. Despite the efforts made to make the series as consistent and comparable as possible, one should be aware of that there are some known discrepancies in the data that could still create problems.[16]

[15] See the Table B2 in the Appendix for specific references and Atkinson and Piketty (2007) for details.

[16] Some differences in both income and income earner (tax unit) definitions remain. For example, realized capital gains are excluded from the income concept in all countries except for Australia, New Zealand and (partly) the UK. Tax unit definitions vary even more. In Argentina, Australia, Canada, China, India and Spain they are *individuals* but in Finland, France, Ireland, the Netherlands, Switzerland and the United States they are *households* (i.e., married couples or single individuals). Moreover, in Japan, New Zealand, Sweden and the United Kingdom the tax authorities switched from household to individual filing. In Germany there is a mixture of the two, with the majority of taxpayers being household tax units whereas the very rich filing as individuals. For a longer and more detailed discussion of these problems, see Atkinson and Piketty (2007, ch. 13).

We employ three measures of top income share in order to mitigate some of these measurement problems. Our preferred measure is *Top10_1*, defined as the top percentile income share (P99–100) divided by the income share of the next nine percentiles in the top decile (P90–99), i.e., P99–100/P90–99. We prefer this shares-within-shares measure since it cancels out the reference total income and hence eliminates the above mentioned measurement error associated with it.[17] Since the P90-99 income share has been relatively stable over time, the shares-within-shares measure is highly informative of the evolution of incomes in the top percentile. We also use *Top1*, the top percentile income share, since it is the most commonly used measure of income concentration in the literature. Lastly, we compute a shares-within-shares measure for the absolute income top: *Top10_01*, i.e., the top 0.1 percentile income share (P99.9–100) divided by the rest of the top decile's income share, P99.9–100/P90–99.9.

Financial development. The challenge in estimating financial sector development over the whole twentieth century is to find variables that are available and comparable for all countries for such a long period. We therefore use three different measures aimed at capturing the relative importance of private external finance: *Bank deposits* (deposits at private commercial and savings banks divided by GDP), *Stock market capitalization* (the market value of listed stocks and corporate bonds divided by GDP), and *Total market capitalization* (the sum of the first two, which is also our preferred measure). The variable *Bank deposits* is closely related to the measure of *Private credit*, used for example by Beck et al (2006), but is available for a longer time period.[18] By using these three different measures, we are able to address possible distributional differences between bank-based and market-based financial development.

Our sources for bank deposits are Mitchell (1995, 1998a, 1998b) for the pre-1950 period and International Financial Statistics (IFS) and Financial Structure Database (FSD) for the post-1950 period. Data on stock market capitalization before 1975 come from Rajan and Zingales (2003), who present data for the years 1913, 1929, 1938, 1950, 1960 and 1970. We linearly interpolate between these years (but not over the world wars) to get 5-year averages which we then link to post-1975 data from FSD.

[17] To see this, note that P99–100 = Inc_{Top1}/Inc_{All} and P90–100 = Inc_{Top10}/Inc_{All}, which implies that *Top10_1* = $Inc_{Top1}/Inc_{All}/(Inc_{Top10}/Inc_{All} - Inc_{Top1}/Inc_{All}) = Inc_{Top1}/(Inc_{Top10} - Inc_{Top1})$.

[18] For the country-years with overlapping data, the correlation between *Private credit* and *Bank deposits* is 0.82.

One problem with the stock market capitalization measure is its potentially close connection to our income measure, which includes capital income (although not realized capital gains), i.e., the rate of return on stocks and bonds owned by the rich. Hence, there could be a mechanical relation between top income shares and financial development if, for example, dividends tend to be high when stock market capitalization is high. This potential problem is, however, considerably smaller in the case of bank deposits, which hence works as a robustness check in our analysis.

Openness. Our measure of trade openness is standard and defined as the sum of exports and imports as a share of GDP. We use data on trade from Mitchell (1995, 1998a, 1998b), Rousseau and Sylla (2003) and López-Córdoba and Meissner (2005) for the pre-1960 period and from IFS thereafter.

Central government spending. In order to account for the activity and growth of government over the period, we include a measure of *Central government spending*, defined as central government expenditure as a share of GDP. Data are from Rousseau and Sylla (2003). Ideally we would have liked to include both central and local governments since the spending patterns at these two administrative levels may both vary systematically across countries and within countries over time. For example, the Swedish municipalities and counties has gradually taken over the state's responsibility for the provision of traditional public sector goods such as health care and schooling, thereby potentially causing a decrease in central government spending but not in total government spending. However, lacking a measure of total government spending, we think that our chosen alternative is the best available measure for capturing the growth of government over time.[19]

Top marginal tax rate. We use statutory top marginal tax rates as our main source for measuring the impact of tax progressivity, and in a broader sense government activity, on top income shares. Ideally we would like to have data on actual marginal tax rates paid by top income earners instead of the statutory rates which have been binding to

[19] Rousseau and Sylla (2003) use this variable in their study of the determinants of economic growth in an historical context. Central government spending to GDP is also the variable that is available in databases such as the *Penn World Tables*, the World Bank's *World Development Indicators*, and the IMF:s *International Financial Statistics*.

varying degrees both across countries and within countries over time.[20] For a few countries such data are available thanks to previous efforts of researchers to calculate actual tax rates for different levels of incomes over time (Bach et al., 2005 for Germany, Roine and Waldenström, 2007 for Sweden, and Kristian Rydqvist for Canada, Sweden, the UK, and the US). For this reason, we employ two variants of the marginal tax measure. First, *topmtax1* consists of the statutory top marginal tax rates (except for Germany and Sweden) and is our main concept because of the homogeneity in the measure across countries. Second, *topmtax2* is based on the same data except for Canada, UK, Sweden and US in the postwar period where tax rates are calculated by Kristian Rydqvist for incomes equal to five times GDP per capita. Data on tax rates come for the most part from the different top income studies reported in Table A2, with a few complements drawn from OECD:s tax database.

GDP per capita and Population. For the variables *GDP per capita* and *Population size* we use data from Maddison (2006). However, the shares of GDP calculated for most of the other explanatory variables use nominal GDP from Bordo et al. (2001), Mitchell (1995, 1998a, 1998b) and Rousseau and Sylla (2003).

4 A first look at the data

To get a sense of the relationships between our variables of interest it is useful to just look at the trends over time. After all, when it comes to some of the main findings in the individual country studies on top incomes, such as the effects of the Great Depression and World War II, these are apparent just from looking at the development. *Figure 1* shows the development of our main dependent variable, *Top10_1*, over the Twentieth Century for all countries in our sample.

Besides clearly showing the impact of the depression and World War II for many countries, another striking feature of the series is the strong common trend. With the exception of a few countries the development is remarkably similar over time, at least until around 1980. The same is, in varying degree, true for the main right-hand-side

[20] For example, Roine and Waldenström (2007) shows for Sweden that over the entire century the top income percentile only paid a marginal tax rate equal to the statutory top rate in the years around 1980. More generally, the statutory top rates have been relatively more binding to larger groups of income earners in Scandinavia and the U.K than in, e.g., Japan or the U.S.

variables (at least for the development of GDP/capita, top marginal tax rates and central government spending). The panels in *Figure 2* show the development of these since 1900.

These signs of interdependencies are perhaps not so surprising given our focus on economies that been relatively closely interconnected through events such as the Great Depression affecting top incomes in many of these countries in similar ways. One may also think of broad policies (taxation, liberalization etc) or changes in technology (financial innovation, factor flows etc) to be reflected in common trends of top income shares across countries. In the extreme this could be a problem for our econometric approach since we rely on within country changes in the relevant variables to identify effects, holding common trends constant. If there are changes across time in the explanatory variables but these are exactly the same everywhere, we would not find any effect even if there may be a relation. In other words, by taking out common trends, we run the risk of falsely rejecting a hypothesis because the patterns are too similar across countries. However, since no two countries are affected in exactly the same way by the developments throughout the 20th century, there should be enough variation in the data to disentangle the effects (see section 5 below). This problem is not unique to our study; exploiting the residual variation after having controlled for common effects is the standard way of approaching cross-country data.

Can we by just looking at the data find any clear patterns between the top income shares and the proposed explanatory variables over time? The short answer would have to be no. As can be seen in *Figure 2* the level of financial development is quite volatile up until the middle of the postwar period when it starts to increase. Trade openness, on the other hand, exhibits a more monotonic increase (except for the drastic drop in the Netherlands during World War I), and a similar pattern goes for GDP per capita. Government spending is increasing in all countries, with the well-known war-related spike in the 1940s. Top marginal taxation increases before World War II, but continues to be high throughout the postwar period up to its peak around 1980 when it mostly starts to decrease. Overall, there are no obvious links between any of these variables and the top income shares, although there is quite notable cross-country variation to use in a more sophisticated analysis of the panel. Piketty (2005) makes a similar simple eyeballing exercise to provide some suggestive evidence on

the inequality-growth links in the specific case of France, but in the end he concludes that "Using all countries in the database might allow to produce more convincing results".[21] The natural next step, therefore, is to study these relationships more rigorously.

5 Panel estimations: Econometric method

The theoretical discussion concerning the potential determinants of top income shares is suggestive, but inconclusive. Financial development has been suggested to increase as well as to decrease top income shares and the same goes for trade openness and the effect of economic growth. We do, however, expect to find that a larger government and higher tax rates (especially higher top marginal taxes) are associated with lower top income shares.[22] When it comes to finding possible relations between variables based on simply eye-balling the time series, we have concluded that there are no obvious links to be suggested. We therefore proceed with panel estimates of the effects on these variables on top income shares. Panel estimations allow us to take all unobservable time-invariant factors into account. Further, it allows us to control for both common and country specific trends. Thus, we can test for specific hypotheses regarding the relation between different variables on top income shares.

When estimating the determinants of top income shares using a long and narrow panel of countries, the assumptions underlying the standard fixed effects model are likely to be violated. In particular, serial correlation in the error terms can be expected. We therefore apply the less demanding first difference estimator which relies on the assumption that the first differences of the error terms are serially uncorrelated. This means that we start with the following regression:

$$\Delta y_{it} = \Delta \mathbf{X}'_{\mathbf{it}} b_1 + \gamma_t + \mu_i + \varepsilon_{it} \qquad (2)$$

This is a standard first difference regression including fixed time effects γ_t and country specific trends (here captured by a country specific effect μ_i). Further, $\Delta \mathbf{X_{it}}$ is the

[21] Piketty (2005), p. 8.
[22] This is assuming that disincentive effects dominate. Some of the individual country studies on top incomes have found that higher marginal taxes have indeed lowered top income shares.

vector of (first-differenced) variables that we are interested in as well as other control variables. Of course, the assumption of no serial correlation in the error terms does not necessarily hold, even after first-differencing. Indeed, some preliminary tests suggest that serial correlation is a problem in this setting.[23]

To account for serial correlation, we follow two different strategies. First, we include the lagged dependent variable, thereby explicitly allowing for the dynamics that give rise to serial correlation. This means that we estimate the following regression:

$$\Delta y_{it} = b_0 \Delta y_{it-1} + \Delta \mathbf{X}'_{\mathbf{it}} b_1 + \gamma_t + \mu_i + \varepsilon_{it} \qquad (3)$$

Applying the same test as above shows that serial correlation is no longer a problem when using a dynamic specification. However, the inclusion of the lagged dependent variable is not unproblematic since it is correlated with the unobserved fixed effects. Thereby, we could get biased estimates. This bias is reduced when *T* is large (Nickell, 1981). *T* does in this case depend on the actual time horizon on which the data is based. In other words, in our case where *T* is 100 years, the bias is not likely to be a major problem even if we only use 20 periods based on 5-year averages. Furthermore, the standard way of dealing with the dynamic panel data problem is to use GMM-procedures along the lines of Arellano and Bond (1991) or Arellano and Bover (1995).[24] But these GMM-procedures are not appropriate in a setting with small *N* and large *T* such as ours (Roodman, 2007). For these reasons we run regression (3) without any adjustments or instrumentation.

The second approach we use is to estimate (2) using GLS and thereby directly allowing for country specific serial correlation in the error terms. Both when using dynamic first differences and first differenced GLS, we allow for heteroskedasticity in the error terms.

[23] The test procedure follows Wooldridge (2002, Chapter 10.6): We run regression (2) and keep the residuals. We then rerun the regression and include the lagged residuals in the estimation. Since the coefficient on the lagged residual is positive and significant, we can conclude that serial correlation is a problem even after taking first differences.

[24] Lagged levels and differences of the endogenous variable/s are used as instruments.

The fact that we control for trends and time invariant country factors does not mean that we have fully addressed potential endogeneity problems. First of all, we could have direct reverse causality from top income shares to our explanatory variables. This would be the case if, for example, top income shares would have a direct effect on economic growth, rather than the other way around. Similarly, high top income shares could affect financial development positively if individuals in the top of the income distribution are relatively prone to make use of the financial markets for saving and investment. It is more difficult to see a problem of reverse causality from top incomes to trade and government spending, but a high income concentration can of course affect the political trade-offs facing a government. This, in turn, can affect trade policies, government spending and how the tax system is structured. Second, it is possible that some uncontrolled factor affects both top income shares and the respective control variables. This would then give rise to an omitted variable bias of our estimates.

The ideal way of dealing with these endogeneity problems is to find some credible instrument for each respective explanatory variable. Since our approach here is to take an agnostic view on several potential explanations for top incomes over a long period, instrumentation is not feasible. Therefore, we will be analyzing partial correlations between top incomes and a set of explanatory variables, and we do not claim to establish causality. Rather, we regard our contribution as a first systematic take on the various explanations of top income shares that have been proposed in the literature.

6 Results

In this section, we report the results from panel regressions using the above estimation methods. Throughout, we use both dynamic first differences (DFD) and first differenced GLS (FDGLS). As mentioned above, we include both country specific trends and time effects that control for common shocks across all countries. By first differencing, we automatically control for all time-invariant country specific effects. We begin by looking at average effects over the whole period for all countries using different measures of financial development. We then allow for different effects across levels of development, differences between Anglo-Saxon and other countries, and fi-

nally we show that our results are robust to using alternative measures of top incomes as well as restricting the sample in a number of ways.

6.1 Main results

Table 1 presents the results from our baseline regressions. The dependent variable is our preferred measure of income concentration, *Top10_1*, the ratio between the income shares of the top percentile and the income shares of the top 90-99 percentiles. Odd numbered columns, (1), (3), (5) and (7) show results for the dynamic first difference (DFD) specification and the even numbered columns (2), (4), (6), and (8) the results for the first differenced GLS (FDGLS).

In the first columns (1) and (2), the combined measure of financial development, *Total capitalization*, is used and we also control for GDP per capita, population size, central government spending, and openness to trade. In columns (3) and (4) we use *Bank deposits* and in columns (5) and (6) *Stock market capitalization* to measure financial development. We use these alternatives partly due to the potential problem of there being a rather mechanical relationship between the capital incomes of the rich and stock market capitalization, but mainly because of the fact that Anglo-Saxon countries tend to have more stock market based financial systems, while most of continental Europe is more bank based (see for example Boot and Thakor, 1997, Allen and Gale, 2000, and Levine, 2005). Hence, differences between these measures would indicate a possible reason for the different developments of top incomes in Anglo-Saxon and continental European countries respectively.[25]

These results show the existence of two clear relationships across all specifications. First, there is a strong positive relation between GDP per capita and top income shares suggesting that growth (in the developed world) has been "pro-rich" over the 20th century. The average 5-year change in per capita GDP is about 10 percent over the relevant time period. The point estimates of about 0.3, then indicate that the average change in per capita income is associated with a 0.03 increase in the income share of the top percentile. Given that the average value of *Top10_1* is 0.38, this is a modest,

[25] As mentioned above, this difference is one of the main findings in the recent research on top incomes. Indeed, the title of the recent volume edited by Anthony Atkinson and Tomas Piketty, collecting much of this work is "*Top Incomes over the Twentieth Century: A Contrast between European and English-Speaking Countries*".

but non-negligible increase. The most plausible explanation for this finding is perhaps simply that the high income groups in society have a larger share of their income tied to the actual development of the economy. This means that in countries where growth is faster than the average, the rich get a larger than proportional share of this development, thus causing growth to be pro rich.

Second, we find that financial development on average is also quite strongly pro-rich. The average increase in *Total capitalization* in our data is about 0.1. An increase in *Total capitalization* of this size is according to our estimates associated with an increase in top income shares by approximately 0.04. This is about a ten percent increase from the mean top income share (0.38). [26]

While both economic growth and financial development are robustly related to increases in top income shares across the specifications, the other variables seem equally robust in showing no significant relationship at all. Contrary to what is often asserted *openness*, i.e. the trade to GDP-ratio, is if anything negatively related to top income shares (significant only in the DFD specification in column 3). As we by including time fixed effects control for any general changes in globalization it is of course still possible that "general globalization" increases income inequality, but country specific trade openness does not. However, the mechanism behind such a result would be quite difficult to spell out. Furthermore central government spending does not appear to have an impact on top income shares. One possibility is that government spending is not strongly related to marginal taxes, especially top marginal taxes, at the same time as top marginal taxes could be what matters for top incomes.[27] In columns (7) and (8), we therefore include statutory top marginal income taxes for the 11 countries that we have data for. While the point estimate of this variable is negative, it is not statistically significant. It should be noted that this is not due to the simultaneous inclusion of taxes and government spending: dropping government

[26] Using *Bank deposits*, the size of the coefficients may look slightly lower but the average change in *Bank deposits* is much smaller than the changes in *Total capitalization*: 0.02 compared to 0.1. Thus, the size of the estimated effects is actually quite similar between the two variables. To be precise, the standardized coefficient is 0.25 for *Total capitalization* and 0.21 for *Bank deposits* in the DFD specifications

[27] Steinmo (1993) is an interesting account of how differences in not only the general tax level but the composition may matter especially for the rich. In particular he notes that the US and the UK had as high (or higher) top marginal taxes as Sweden in the 1950s and 1960s.

spending from the regression does not result in statistically significant effects of top marginal taxes.

6.2 Different effects depending on the level of economic development

As discussed in the theoretical discussion, the effect of several variables on top income shares can be expected to depend on the level of economic development. In order to analyze this possibility, we allow the effects to vary depending on the level of economic development. More precisely, we split the sample into three similar sized groups based on per capita GDP and then interact group indicators with the respective variable of interest. The results from this exercise are presented in Table 2.[28]

First, as can be seen in columns (1) and (2), there is little evidence that the effect of GDP growth on top incomes depends on the level of development. The point estimates are only significant for the lowest income groups, but F-tests cannot reject the hypothesis that the estimated coefficients are equal for the different groups.

When it comes to the effect of financial development depending on the level of economic development this exercise indicates something interesting. According to the basic idea in Greenwood and Jovanovic (1990), financial development should benefit the rich relatively much when the level of economic development is low, but not when it is high. In columns (3) and (4), we see that this argument appears to be supported by the data. Using our preferred measure of top income shares, *Top10_1*, it seems that the positive impact of financial development on top income shares is due to its effect at low levels of economic development. In fact, F-tests reject both the hypothesis of similar coefficients between the low- and middle income groups, as between the low- and high income groups.

Standard trade theory suggests that the effect of trade openness should vary depending on relative factor abundance. Basically, the relatively abundant factors of production are expected to benefit from increased openness, while the scarce factors are expected to lose. Since factor abundance is likely to be related to the level of economic devel-

[28] It should be noted that all countries that are included in this analysis are now at relatively high levels of economic development, while India, China and Argentina are not included. This exclusion prevents a comparison between countries that are at the same level of economic development at very different time periods.

opment, it is natural to analyze if the effect of openness on top income shares depends on the level of development. In columns (5) and (6), we find some indication of such a pattern. The point estimates of *Openness* are significantly larger in the low income group than in the high income group. This would indicate that increased trade tends to be generating relatively larger income disparities in poor countries than in rich, which goes against the predictions from the basic Heckscher-Ohlin trade models, but is compatible with other trade based explanations. However, these effects are not statistically significant and should hence not be emphasized.

6.3 Are Anglo-Saxon countries different?

Based on the different developments from 1980 and onwards, it has been suggested that the evolution of top income shares in Anglo-Saxon countries differs from that of continental Europe.[29] Empirically speaking, there are two possibilities: Anglo-Saxon countries may have had a different development in the underlying determinants of top income shares, or the response to the underlying determinants differs – for some reason – between the two groups of countries. In Table 3, we address this issue by interacting a dummy variable indicating that a country is Anglo-Saxon with the main variables of interest.[30] We can then directly answer the question if the slope coefficients differ between Anglo-Saxon and other countries.

As can be seen in columns (1)-(4), there is no indication that economic growth or financial development have a different relations to top income shares in the two country-groups. Again, this is evidence against the possibility that the type of financial system (bank based or market based) has different distributional consequences.

Openness to trade does, however, have a different impact on top incomes in the Anglo-Saxon countries compared to the rest of the sample. While increased trade on average is not significantly related to top incomes, it is associated with a significant increase in top income shares among the English speaking countries and the estimated difference is quite substantial. Consider the following back-of-the-envelope calculation. The average increase in *Top10_1* since 1980 has been 0.15 among Anglo-Saxon countries, while it has been close to zero in the other group of countries. During the

[29] Atkinson and Piketty (2007).
[30] Anglo-Saxon countries are Australia, Canada, New Zealand, UK and the US.

same time period, trade has increased by about 0.25 on average (there is no difference between Anglo-Saxon and other countries). As the slope coefficient is 0.3 on the interaction term, approximately 0.3×0.25=0.075, that is about 50 percent, of the total difference between the groups can be accounted for by the different responses to international trade. The underlying cause of these differences is beyond the scope of this paper, but the size of this effect certainly calls for further research.

Another possibility that has been discussed in the literature is that the different groups of countries differ in their acceptance of inequality.[31] One, admittedly quite weak, way to test this hypothesis is to analyze if government spending is relatively pro-rich in Anglo-Saxon countries. In columns (7) and (8), we therefore interact government expenditures with the Anglo-Saxon indicator, but the interaction term is not statistically significant. We can therefore not see any indication that the distributional impact of government spending is different in the two country groups.

6.4 Alternative measures and sample restrictions

In this section, we analyze the robustness of the main result in three dimensions. First, we use alternative measures of top income shares. Second, we use various sample restrictions to make sure that our results are not driven by extreme observations. Finally, we use a somewhat different measure of top marginal taxes.

We prefer the use of *Top10_1* to measure top income shares because it is immune to the problems of correctly estimating the reference total for income. It is, however, not the only possible measure of top incomes. In Table 4, we therefore repeat the main analysis from above using the *Top1* (columns 1-4) and *Top10_01* (columns 5-8) as the dependent variables. *Top1* has the advantage of relating top incomes to total incomes, (though this may come at the expense of measurement error). It also increases the number of observations. *Top10_01*, gives us the results for an even more extreme group in the uppermost tail in the income distribution.

In columns (1) and (2) we see that using *Top1* as our measure of top incomes, the results are essentially the same as before: there is a strong positive relation both be-

[31] See, for example the discussion in Piketty and Saez (2003).

tween GDP per capita and financial development (*Total capitalization*) and top income shares.[32] The estimated coefficient on financial development is roughly unity, which means that increasing financial development by one standard deviation is associated with an increase in top income shares by about 0.5 percentage points (the mean of *Top1* is around 9 percent).[33] The relation between openness to trade and top income is negative, and the coefficient is statistically significant in FDGLS-specification. Again, the evidence thus points against trade being associated with increased inequalities on average. The relation between central government spending and top income shares is insignificant is like before. However, adding top marginal taxes (columns 3 and 4) to the above specification we now find a statistically significant negative relation between marginal taxes and top incomes. The coefficient indicates that an increase in top marginal taxes by 10 percentage points (about one standard deviation) is associated with a 0.25 percentage point reduction in the top income shares. Since the average value of *Top1* is about 9, this is a relatively small effect.[34]

Columns (5) to (8) reports the results when using the income shares of the top tenth of a percentile scaled by the income share of the 90–99.9 percentiles (*Top10_01*). The main results in columns (5) and (6) are similar to the ones before: the positive relation between economic growth and top incomes appear robust, as does the relation between financial development and top incomes. Using *Top10_01* as the dependent variable, the partial correlation between top incomes and government spending is negative and marginally statistically significant. In the final two columns (7) and (8), we add top marginal taxes and find that the effect of this variable is negative and statistically significant, but the estimated coefficient is now very small.

In Table 5, we conduct a different set of robustness tests, based on various sample restrictions. In the first two columns we focus on the post World War II-period, and drop the observations prior to 1945. The main reason for this restriction is that this period included the great depression era, during which the volatility of growth rates

[32] The results are similar when using *Bank deposits* or *Stock market capitalization* as proxies for financial development.
[33] Using *Bank deposits* rather than *Total capitalization* increases the sample size even further. The results are the same
[34] One oddity is that the partial effect of government spending on top incomes is positive when holding marginal taxes constant. The effect is of considerable size: increasing the share of government to GDP by 10 percentage points is associated with a 1.5 percentage point increase in top income shares.

and changes in the income distribution were quite extreme. Further, top income shares declined rapidly during the Second World War, possibly for reasons unrelated to the economic forces we are analyzing. The main results are unchanged by this sample restriction.[35] Economic growth is robustly related to increases in top incomes, as is financial development. In columns (3) and (4), we drop Japan. One reason behind this exclusion is that we do not have *Top10_1* data for Japan, but only *Top05_1*. Another reason is that Japan integrated with the world economy quite late compared to the other countries in the sample. It is therefore possible that the evolution of top incomes were affected by other factors than in other countries. However, excluding Japan does not change the main results.

Measuring top marginal taxes is not unproblematic and we here mainly rely on the series collected by researchers studying the evolution of top income shares. For a few countries – Canada, Sweden, UK and the US – we use more unified series of top marginal income taxes annually for the period 1950-2005. The correlation between the two series of top marginal taxes is 0.64 (in first differences). This is quite high, but we nevertheless replace the original tax data with the new series for the four countries where the new data is available, and re-run the regressions for the post WWII-period. In the first two columns of Table 6, we report the results for this time period using the original data and see that there is a negative relation between top marginal taxes and top income shares. In columns (3) and (4), we use the new series and see that the estimates are both larger and more statistically significant. A point estimate of about 0.13 suggests that increasing top marginal taxes by 10 percentage points reduces the income share highest income earners (the income share of the top percentile relative to the income share of the 90^{th} – 99^{th} percentiles) by 1.3 percent. This is quite a small effect considering that the average income share of the Top1 group is 45 percent of the Top90-99 group.

7 Conclusions

This paper set out to empirically analyze the long-run relationships between top income shares and financial development, trade openness, the size of government, and

[35] The change in the umber of observations between the two samples is larger when using *Bank deposits* to measure financial development. The results are, however, similar using this measure.

economic growth. While these relationships, of course, have been extensively studied before, the unique contribution of this paper lies in the long time period for which we have data. Combining findings from a number of recent studies on top incomes with other historical data, our results are based on developments over the whole of the twentieth century. Using a panel data approach allows us to take all unobservable time-invariant factors, as well as country specific trends into account.

Two findings stand out as being significant and robust across all specifications. First, economic growth seems to have been pro-rich over the Twentieth Century. More precisely, in times when a country has grown faster than average, top income earners have benefited more than proportionally. A likely reason for this result is simply that, top incomes are (and have been) more closely related to actual performance than incomes on average. This result is similar at different levels of development and is not different between Anglo-Saxon and other countries. Second, we also find financial development to have been pro-rich over the twentieth century. This effect is also similar in Anglo-Saxon countries and elsewhere, it does not depend on whether financial development is proxied using bank deposits or stock market capitalization (often said to be a difference between Continental Europe and Anglo-Saxon countries), *but* it seems to depend on economic development. In line with the model in Greenwood and Jovanovic (1990) we find that the effect is strongest at relatively low levels of economic development.

When it comes to the much debated distributional effects of trade openness we do not find any evidence of this being disproportionately beneficial for top income earners on average. If anything the relationship is negative in some specifications. However, here there is a difference across groups of countries. Increased trade is associated with increased top incomes in Anglo-Saxon countries; but not in continental Europe. The difference is large enough to explain a substantial part of the different development of top incomes in the two country groups since 1980. While we can only speculate about the causes behind these different responses to trade, it is possible that labor market institutions might play a role.[36]

[36] As has been documented by Botero et al (2004), countries of English legal origin have weaker employment protection, weaker trade unions, and weaker social security laws. All of these can affect the impact of trade on the distribution of income.

Finally, government spending has no clear effect on inequality but the degree of tax progressivity in the top of the distribution seems to have a significantly negative effect on top income shares. The size of the effect is, however, fairly small. This suggests that government policies are relatively ineffective in reducing inequality by lowering the income shares of the top income earners.

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Table 1. The determinants of top income shares

	(1) Δtop10_1 DFD	(2) Δtop10_1 FDGLS	(3) Δtop10_1 DFD	(4) Δtop10_1 FDGLS	(5) Δtop10_1 DFD	(6) Δtop10_1 FDGLS	(7) Δtop10_1 DFD	(8) Δtop10_1 FDGLS
Δgdppc	0.293***	0.284***	0.242***	0.184***	0.303***	0.275***	0.328***	0.327***
	(0.098)	(0.052)	(0.080)	(0.040)	(0.10)	(0.054)	(0.104)	(0.052)
Δpop	–0.681*	–0.232	0.0886	0.106	–0.634	–0.203	–0.815	–0.574**
	(0.35)	(0.22)	(0.22)	(0.11)	(0.38)	(0.22)	(0.37)	(0.22)
Δcgov	0.0257	–0.101	–0.116	–0.207	0.0215	–0.135	0.26	0.133
	(0.27)	(0.18)	(0.27)	(0.17)	(0.27)	(0.18)	(0.35)	(0.18)
Δtopmtax							–0.0007	–0.0005
							(0.0007)	(0.0003)
Δopen	0.0414	–0.00704	–0.130**	–0.0660	0.0665	0.0174	0.005	–0.049
	(0.13)	(0.085)	(0.065)	(0.048)	(0.082)	(0.086)	(0.14)	(0.09)
Δtotcap	0.0447**	0.0333***					0.067***	0.056***
	(0.019)	(0.011)					(0.019)	(0.012)
Δbankdep			0.132**	0.0982***				
			(0.051)	(0.028)				
Δsmcap					0.0307*	0.0276**		
					(0.017)	(0.013)		
Δtop10_1(lag)	0.0616		0.0263		0.0620		0.0404	
	(0.14)		(0.13)		(0.14)		(0.17)	
Country trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs	106	109	130	140	108	109	90	92
No countries	14	13	14	14	13	13	11	11
R-squared	0.71		0.63		0.69		0.72	

The dependent variable is the income share of the top percentile divided by the income share of the 90th to 99th percentiles. DFD stands for dynamic first differences, while FDGLS stands for first differenced GLS. FDGLS estimations allow for country specific AR(1) processes. Both DFD and FDGLS allow for heteroskedasticity in the error terms. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 2. The effects at different levels of economic development

	(1) Δtop10_1 DFD	(2) Δtop10_1 FDGLS	(3) Δtop10_1 DFD	(4) Δ top10_1 FDGLS	(5) Δtop10_1 DFD	(6) Δtop10_1 FDGLS
	Level of development × ΔGDP per capita		Level of development × ΔTotal capitalization		Level of development × ΔOpenness	
low inc × *X*	0.329**	0.321***	0.211***	0.161***	0.399	0.213
	(0.12)	(0.056)	(0.056)	(0.036)	(0.55)	(0.16)
med inc × *X*	0.271***	0.236***	0.0301*	0.0263*	0.219	0.0905
	(0.096)	(0.067)	(0.018)	(0.015)	(0.16)	(0.12)
high inc × *X*	0.162	0.143*	0.0300	0.00791	–0.0753	–0.110
	(0.14)	(0.084)	(0.024)	(0.016)	(0.12)	(0.092)
Δpop	–0.665*	–0.255	–0.948**	–0.553**	–0.619*	–0.252
	(0.37)	(0.22)	(0.37)	(0.24)	(0.33)	(0.21)
Δcgov	–0.0418	–0.185	0.184	0.0143	–0.143	–0.177
	(0.30)	(0.18)	(0.27)	(0.17)	(0.29)	(0.18)
Δtotcap	0.0466**	0.0350***			0.0471**	0.0373***
	(0.020)	(0.012)			(0.019)	(0.011)
Δgdppc			0.276***	0.258***	0.286***	0.262***
			(0.090)	(0.051)	(0.098)	(0.053)
Δopen	0.0284	–0.0115	0.0947	0.0426		
	(0.13)	(0.084)	(0.13)	(0.086)		
Δtop10_1(lag)	0.0509		0.0592		0.0643	
	(0.16)		(0.12)		(0.16)	
Test Low=Medium	0.18	1.87	9.95***	12.56***	0.11	0.53
Test Low=High	1.38	4.39**	10.14***	16.30***	0.80	3.84**
Test Medium=High	1.13	1.51	0.00	0.82	4.37**	3.11*
Country trends	Yes	Yes	Yes	Yes	Yes	Yes
Time effects	Yes	Yes	Yes	Yes	Yes	Yes
Obs	106	109	106	109	106	109
No of countries	14	13	14	13	14	13
R-squared	0.71		0.74	.	0.72	

Interactions between low, medium and high GDP per capita and ΔGDP per capita, Δtotcap, and Δopenness. DFD stands for dynamic first differences, while FDGLS stands for first differenced GLS. FDGLS estimations allow for country specific AR(1) processes. Both DFD and FDGLS allow for heteroskedasticity in the error terms. Tests are F-tests of equality of coefficients. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 3. Are Anglo-Saxon countries different?

	(1) Δtop10_1	(2) Δtop10_1	(3) Δtop10_1	(4) Δ top10_1	(5) Δtop10_1	(6) Δtop10_1	(7) Δtop10_1	(8) Δtop10_1
	DFD	FDGLS	DFD	FDGLS	DFD	FDGLS	DFD	FDGLS
	Anglo-Saxon × ΔGDP per capita		Anglo-Saxon × ΔTotal capitalization		Anglo-Saxon × ΔOpenness		Anglo-Saxon × ΔCgov	
Δgdppc	0.279**	0.259***	0.291***	0.286***	0.262***	0.281***	0.296***	0.282***
	(0.12)	(0.058)	(0.099)	(0.052)	(0.094)	(0.051)	(0.100)	(0.053)
Anglo-Saxon × Δgdppc	0.0519	0.0504						
	(0.12)	(0.067)						
Δtotcap	0.045**	0.034***	0.029	0.016	0.042**	0.032***	0.046**	0.033***
	(0.019)	(0.012)	(0.023)	(0.016)	(0.018)	(0.011)	(0.020)	(0.012)
Anglo-Saxon × Δtotcap			0.0245	0.0231				
			(0.022)	(0.016)				
Δopen	0.0621	0.00701	0.0611	0.0186	-0.0401	-0.0621	0.0208	-0.00151
	(0.13)	(0.087)	(0.13)	(0.085)	(0.14)	(0.092)	(0.14)	(0.088)
Anglo-Saxon × Δopen					0.317**	0.265**		
					(0.15)	(0.11)		
Δcgov	0.0321	-0.0819	-0.00379	-0.125	-0.0273	-0.0357	-0.0309	-0.0830
	(0.27)	(0.17)	(0.27)	(0.17)	(0.26)	(0.17)	(0.28)	(0.20)
Anglo-Saxon × Δcgov							0.244	-0.0440
							(0.38)	(0.27)
Δpop	-0.681*	-0.283	-0.686*	-0.267	-0.583*	-0.100	-0.685*	-0.229
	(0.35)	(0.22)	(0.35)	(0.22)	(0.34)	(0.22)	(0.35)	(0.22)
Δtop10_1(lag)	0.0819		0.0567		0.0740		0.0614	
	(0.18)		(0.14)		(0.14)		(0.14)	
Country trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs	106	109	106	109	106	109	106	109
No of countries	14	13	14	13	14	13	14	13
R-squared	0.71		0.71	.	0.72		0.71	

Interactions between a dummy for Anglo-Saxon countries and ΔGDP per capita, Δtotcap, Δopenness, and Δcgov. The dependent variable is the income share of the top percentile divided by the income share of the 90th to 99th percentiles. DFD stands for dynamic first differences, while FDGLS stands for first differenced GLS. FDGLS estimations allow for country specific AR(1) processes. Both DFD and FDGLS allow for heteroskedasticity in the error terms. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 4. Alternative measures of top income shares

	(1) Δtop1 DFD	(2) Δtop1 FDGLS	(3) Δtop1 DFD	(4) Δtop1 FDGLS	(5) Δtop10_01 DFD	(6) Δtop10_01 FDGLS	(7) Δtop10_01 DFD	(8) Δtop10_01 FDGLS
Δgdppc	6.026***	5.766***	6.691***	6.27***	0.0572**	0.0713***	0.071***	0.076***
	(1.85)	(1.03)	(1.59)	(1.31)	(0.026)	(0.016)	(0.027)	(0.016)
Δpop	–14.15	–4.619	–5.552	–4.356	–0.147	–0.0574	–0.169*	–0.132*
	(8.99)	(5.03)	(8.14)	(5.25)	(0.10)	(0.069)	(0.099)	(0.074)
Δcgov	5.290	5.767	15.66**	13.001***	–0.133*	–0.110**	–0.041	–0.006
	(7.63)	(4.62)	(7.42)	(4.97)	(0.078)	(0.056)	(0.10)	(0.06)
Δtopmtax			–0.028**	–0.021**			–0.0003*	–0.0002**
			(0.013)	(0.009)			(0.0002)	(0.0001)
Δopen	–7.187	–8.833***	–8.385	–8.395***	0.0141	0.0209	0.0211	0.006
	(4.57)	(2.26)	(5.21)	(2.51)	(0.036)	(0.028)	(0.039)	(0.03)
Δtotcap	1.045*	0.985***	1.608***	1.276***	0.0101**	0.0081**	0.012**	0.012***
	(0.56)	(0.32)	(0.55)	(0.32)	(0.0049)	(0.0037)	(0.005)	(0.004)
Lagged dep. variable	–0.0262		–0.0904		0.238**		0.253*	
	(0.12)		(0.11)		(0.11)		(0.135)	
Country trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs	123	126	101	103	106	109	90	92
No of countries	15	14	12	12	14	13	11	11
R-squared	0.54		0.62		0.75		0.76	

The dependent variable in columns (1)–(4) is the income share of the top percentile. In columns (5)-(8) it is the share of the top 0.1 percentile relative to the income share of the top 90-99.9 percentiles. DFD stands for dynamic first differences, while FDGLS stands for first differenced GLS. FDGLS estimations allow for country specific AR(1) processes. Both DFD and FDGLS allow for heteroskedasticity in the error terms. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 5. Sample restrictions

	(1) Δtop10_1 DFD	(2) Δtop10_1 FDGLS	(3) Δtop10_1 DFD	(4) Δtop10_1 FDGLS
	Pre 1945 excluded		Japan excluded	
Δgdppc	0.294**	0.265***	0.456***	0.402***
	(0.12)	(0.057)	(0.12)	(0.060)
Δpop	–0.683*	–0.309	–0.559	–0.135
	(0.35)	(0.23)	(0.41)	(0.23)
Δcgov	0.0161	–0.194	0.0303	0.0447
	(0.26)	(0.18)	(0.28)	(0.18)
Δopen	0.0322	0.00474	0.0592	–0.0160
	(0.13)	(0.090)	(0.13)	(0.091)
Δtotcap	0.0450**	0.0348***	0.0463**	0.0369***
	(0.019)	(0.012)	(0.019)	(0.012)
Δtop10_1(lag)	0.0539		0.123	
	(0.18)		(0.14)	
Country trends	Yes	Yes	Yes	Yes
Time effects	Yes	Yes	Yes	Yes
Obs	102	103	96	99
No of countries	14	13	13	12
R-squared	0.63		0.75	

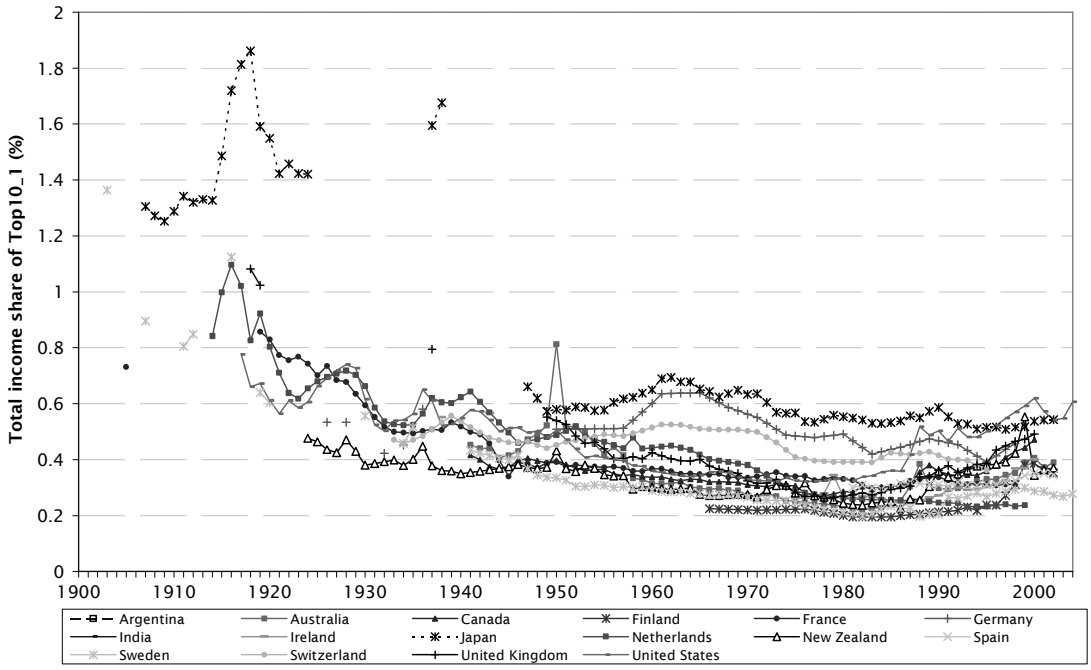
The dependent variable is the income share of the top percentile divided by the income share of the 90th to 99th percentiles. DFD stands for dynamic first differences, while FDGLS stands for first differenced GLS. FDGLS estimations allow for country specific AR(1) processes. Both DFD and FDGLS allow for heteroskedasticity in the error terms. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 6: Alternative measure of top marginal taxes

	(1) Δtop10_1 DFD	(2) Δtop10_1 FDGLS	(3) Δtop10_1 DFD	(4) Δtop10_1 FDGLS
	topmtax1		*topmtax2*	
Δgdppc	0.353***	0.346***	0.357***	0.357***
	(0.12)	(0.061)	(0.12)	(0.062)
Δpop	–0.803**	–0.601***	–0.887**	–0.654***
	(0.36)	(0.22)	(0.36)	(0.22)
Δcgov	0.227	0.0700	0.237	0.115
	(0.35)	(0.19)	(0.34)	(0.19)
Δtopmtax1	–0.0908	–0.0860**		
	(0.072)	(0.037)		
Δtopmtax2			–0.138*	–0.146***
			(0.079)	(0.045)
Δopen	–0.0359	–0.0725	–0.0445	–0.0622
	(0.14)	(0.094)	(0.14)	(0.093)
Δtotcap	0.0694***	0.0589***	0.0707***	0.0623***
	(0.020)	(0.012)	(0.019)	(0.012)
Δtop10_1(lag)	–0.0012		–0.0144	
	(0.20)		(0.20)	
Country trends	Yes	Yes	Yes	Yes
Time effects	Yes	Yes	Yes	Yes
Obs	86	87	86	87
No of countries	11	11	11	11
R-squared	0.64		0.64	

Notes: The dependent variable is the income share of the top percentile divided by the income share of the 90th to 99th percentiles. DFD stands for dynamic first differences, while FDGLS stands for first differenced GLS. FDGLS estimations allow for country specific AR(1) processes. Both DFD and FDGLS allow for heteroskedasticity in the error terms. *topmtax1* consists of mainly statutory top marginal tax rates while *topmtax2* uses marginal tax rates on incomes equal to five times GDP per capita (data collected by Kristian Rydvist) for Canada, Sweden, UK and US. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

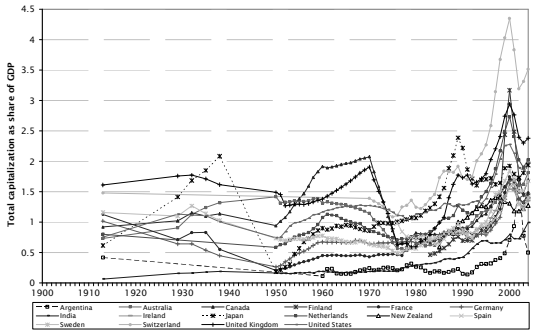
Figure 1: Top 10_1 for 16 countries over the twentieth century.



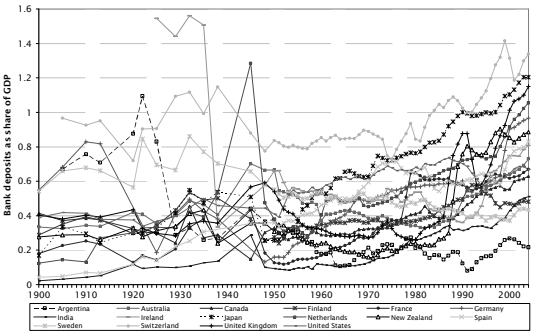
Source: See Table A2.

Figure 2: Variables included in the regression analysis, all countries, 1900–2000.

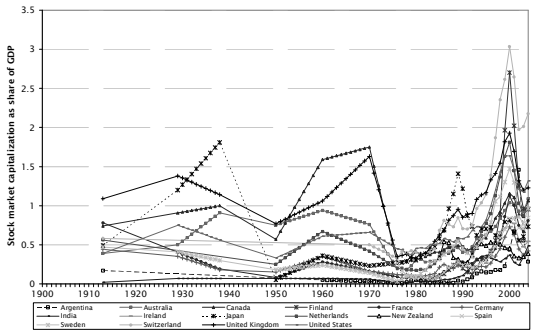
a) Total capitalization



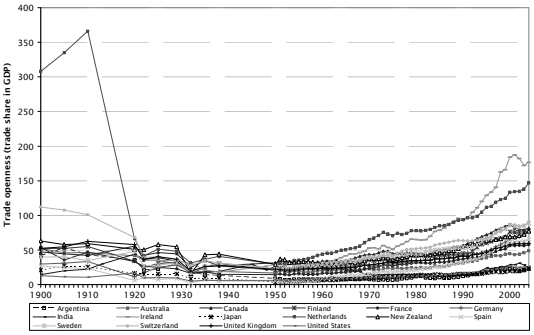
b) Bank deposits



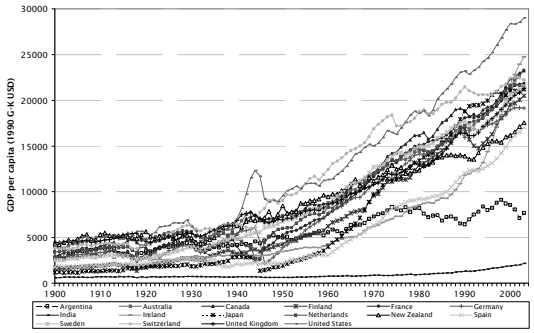
c) Stock market capitalization



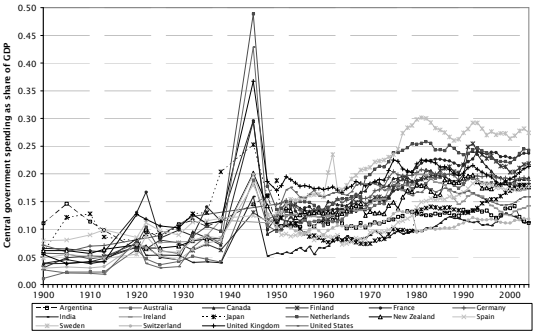
d) Trade openness



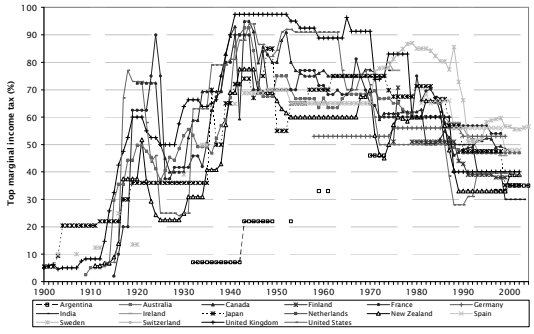
e) GDP per capita



f) Government spending



g) Top marginal tax rate



Appendix

Table A1: Variable definition

Variable	Variable definition	Source
Top10_1	Share of top 10% income share earned by those with the 1% of highest incomes.	See Table A2.
Top1	Share of total income earned by those with the 1% highest incomes.	See Table A2.
Top10_01	Share of top 10% income share earned by those with the 0.1% of highest incomes.	See Table A2.
totcap	Total capitalization: Sum of Bank deposits and Stock market capitalization	-1950: Mitchell, RZ, Bordo; 1950-: IFS, FSD, RZ.
bankdep	Bank deposits: Share of commercial and savings bank deposits in GDP.	-1950: Mitchell, Bordo; 1950-: IFS, FSD.
smcap	Stock market capitalization: Market value of publicly listed stocks divided by GDP.	-1975: RZ; 1975-: IFS, FSD.
open	Trade openness: Share of imports plus exports in GDP.	-1950: Mitchell, LM, Bordo; 1950-: IFS, FSD.
cgov	Government expenditure: Central government expenditure divided by GDP.	-1950: Mitchell, RS, Bordo; 1950-: IFS, FSD.
topmtax1	Top marginal tax (statutory)	Table A2, OECD tax database
topmtax2	Top marginal tax (statutory) and marginal tax rate for incomes = 5 × GDP/cap (Rydqvist).	Table A2, OECD tax database, Bach et al. (2005) and Rydqvist.
gdppc	GDP per capita	Maddison (2006)
pop	Population	Maddison (2006)

Note: Bordo = Bordo, Eichengreen, Klingebiel and Martinez-Peria, (2001), FSD = Financial Structure Database, IFS = International Financial Statistics, LM = López-Córdoba and Meissner (2005), Mitchell = Mitchell (1995, 1998a, 1998b), RS = Rousseau and Sylla (2003), RZ = Rajan and Zingales (2003).

Table A2: Income inequality data*

Country	Source	Full sample period	No. of 5-year periods in...		
			Top10_1	Top1	Top10_01
Argentina	Alvaredo (2006)	1932-73[a],1997-2004	0	9	0
Australia	Atkinson and Leigh (2007a)	1921-2002	13	17	13
Canada	Saez and Veall (2005)	1920-2001	13	17	13
Finland	Riiehlä et al. (2005)	1966-85[a],1990-2002	8	8	7
France	Piketty (2003)	1915-1998	18	18	18
Germany	Dell (2007)	1925-38,1944-98	13	13	13
India	Banerjee and Piketty (2005)	1922-1999	0	16	0
Ireland	Nolan (2007)	1938,-43,-65,1973-2000	8	8	8
Japan	Moriguchi and Saez (2007)	1886-2002	17[b]	21	17[b]
Netherlands	Atkinson and Salverda (2005)	1914-1999	17	17	17
New Zealand	Atkinson and Leigh (2007b)	1921-2002	17	17	17
Spain	Alvaredo and Saez (2006)	1981-2002	5	5	5
Sweden	Roine and Waldenström (2007)	1903-35[a],1941-2004	20	20	20
Switzerland	Dell et al. (2007)	1933-1996	14	14	14
United Kingdom	Atkinson and Salverda (2005)	1908-1999	14	14	14
United States	Piketty and Saez (2003)	1913-2002	18	19	18

[a] There are years with missing values in this subperiod

[b] The shares-within-shares data for Japan is based on the top five percent (P95–100).

[*] Due to data limitations for some of the variables, the actual country coverage for the main specifications is shown in Table A3.

Table A3. Actual country sample for main regressions

	Top10_1		Top 1		Top 10_1 (w/ taxes)[b]	
	DFD	FDGLS	DFD	FDGLS	DFD	FDGLS
Argentina[a]			X	X		
Australia	X	X	X	X	X	X
Canada	X	X	X	X	X	X
Finland	X	X	X	X	X	X
France	X	X	X	X	X	X
Germany	X	X	X	X	X	X
India			X	X		
Ireland	X		X			
Japan	X	X	X	X	X	X
Netherlands	X	X	X	X		
New Zealand	X	X	X	X	X	X
Spain	X	X	X	X	X	X
Sweden	X	X	X	X	X	X
Switzerland	X	X	X	X		
UK	X	X	X	X	X	X
US	X	X	X	X	X	X

[a] Argentina is included in the non-reported regressions using Top 1 as the dependent variable and *Bank deposits* as the measure of financial development.

[b] Sample of countries for which top marginal taxes data are also available.