The long-run history of income inequality in Denmark

Top incomes from 1870 to 2010

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The long-run history of income inequality in Denmark: Top incomes from 1870 to 2010[1]

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Abstract

We use historical publications and – for more recent years – micro-data from the income tax and wealth tax returns to estimate the development in income inequality in Denmark over the last 140 years. The paper breaks new ground in treating the specific features of the Danish Tax system and in analysing the implications of the switch from joint to individual taxation. We show that income inequality have declined substantially over the last century with an income share for the top 1 per cent dropping from 27.6 per cent from its peak in 1917 to 6.4 in 2010. However the decline is not simply a secular downward trend consistent with the downward part of a Kuznets curve. Instead there seems to be several distinct phases, interleaved with periods of stability.

JEL code: D31; H2; J3; N3;
Keywords: Income inequality; Income distribution; Wealth distribution; Top incomes; Taxation; Denmark;

1 Introduction

The long-run history of income inequality in Denmark is of considerable interest. Denmark is often portrayed as a country that has successfully combined economic performance with social justice. Certainly, in today's terms, Denmark scores well in league tables of income inequality. In the OECD report, *Divided we stand*, Denmark has one of the lowest Gini coefficients at 24.8 per cent, to be compared with 29.5 per cent in Germany and 37.8 per cent in the United States (OECD, 2011, Table A1.1). In the World Top Incomes Database (WTID), the share of the top 1 per cent is currently the lowest recorded. This leads naturally to the question whether this has always been so. Or has Denmark in the past brought about a significant reduction in inequality? If so, when did it take place and how was it achieved?

The study of long-run trends in income inequality in Denmark is aided by the fact that the income and wealth tax data provide a rich historical source. There has long been research based on the data on "assessed" income available in the tax records. The 1928 textbook, *Den økonomiske fordeling*, by Zeuthen contained analyses of the income and wealth distribution in the 1920s. Bjerke examined "the upheavals brought about by the war and the events of the early post-war years" (1957, p. 98) and went on to cover the period 1939-64 (Bjerke, 1965). Later studies included Egmose (1985) covering 1939-80, Pedersen and Smith (2000) covering 1981-96 and the series for top income shares constructed by Kleven and Schultz from micro-data for 1980 to 2005, included in the WTID. This paper benefits from these earlier investigations, and particularly from the long-run perspective taken by Sørensen (1989, 1993), whose study covers a long period from 1903-1986. At the same time, the concept of assessed income used in many of these earlier studies differs from that employed in most countries (in effect, it deducts taxes paid in the previous year), and one of the contributions of the present paper is to estimate distributions for Denmark for taxable income, which is closer to being internationally comparable.

Our overall aim in this paper is to assemble evidence about the long-run evolution of inequality at the top of the distribution in Denmark, with particular emphasis on its comparability over time and across countries. How far can the findings for different sub-periods be joined up? When did top income shares fall? Is Denmark correctly ranked internationally? What can we learn from data from 1870 to 2010 – 140 years spanning two world wars, and the Great Depression as well as the recent Financial Crisis? As such, it provides a long run of data comparable with those for other Nordic countries, and we compare our findings with those for Norway and Sweden.

The estimates of top income shares are based on evidence from the income tax and wealth tax returns, using the historical publications of tabulated data and, for more recent years, micro-data. The sources and methods are described in Section 2, which goes into some detail into the methods used to arrive at taxable income and to deal with the specific, and changing, features of the Danish tax system. In Section 3 we present the results for top income shares. These provide a revised series of top shares based on population coverage and on an income concept closer to the definitions applied for other countries in the WTID. We examine a number of the factors that may have influenced the long-run evolution in Denmark, including the impact of wars, changing labour market participation, the development of the economy, and changes in the tax system. In Section 4, we set these findings for the top shares in the wider context of changes in the rest of the distribution and examine the joint distribution of income and wealth. In Section 5 we compare the results for Denmark with those for other Nordic countries. The conclusions are summarised in Section 6. All the main time series in this paper can be found in appendix A2.

2 Methodology and data

In using income tax data, we are following a line of research that began in the United Kingdom in the nineteenth century (e.g. Baxter, 1868), was taken up in the United States when the present income tax was established, developed further by Kuznets (1953), and which has recently been revived by Piketty (2003). A more or less standard methodology has been established, combining the tax data with external control totals for the total population and total income (see Atkinson and Piketty, 2007 and 2010) in order to facilitate cross-country comparative studies.

In this respect, the construction of the time series for Denmark benefits from a number of advantages:

- A fairly stable tax code over a long time span: Permanent income taxation was established at a national level in Denmark in 1903 and this tax code remained the foundation of the income tax system until the end of the 1960s, (Johansen, 2007, page 12). Since then a number of tax reforms have been passed with the change from family to individual taxation in 1970 as one of the biggest.
- Detailed income statistics have been collected by a single agency: throughout the whole period a single statistical department (DS) – the later Statistics Denmark – was responsible with the collection and reporting of the income data from the tax returns. This ensured a stable format of the publications over long periods of time.
- Although the data for years before 1980 are tabulated, these are quite detailed, especially in the early years, where the reported income distributions are close to micro-data in the top bracket (often down to a single individual), cf. Figure 1. For many years, there are 30 or more intervals. In the tables relating to income year 1920, for example, there are 30 intervals and 12 taxpayers in the top interval. From 1980 the entire population of taxpayers are available as micro-data.

Figure 1
The number of tabulated intervals and individuals in the top interval
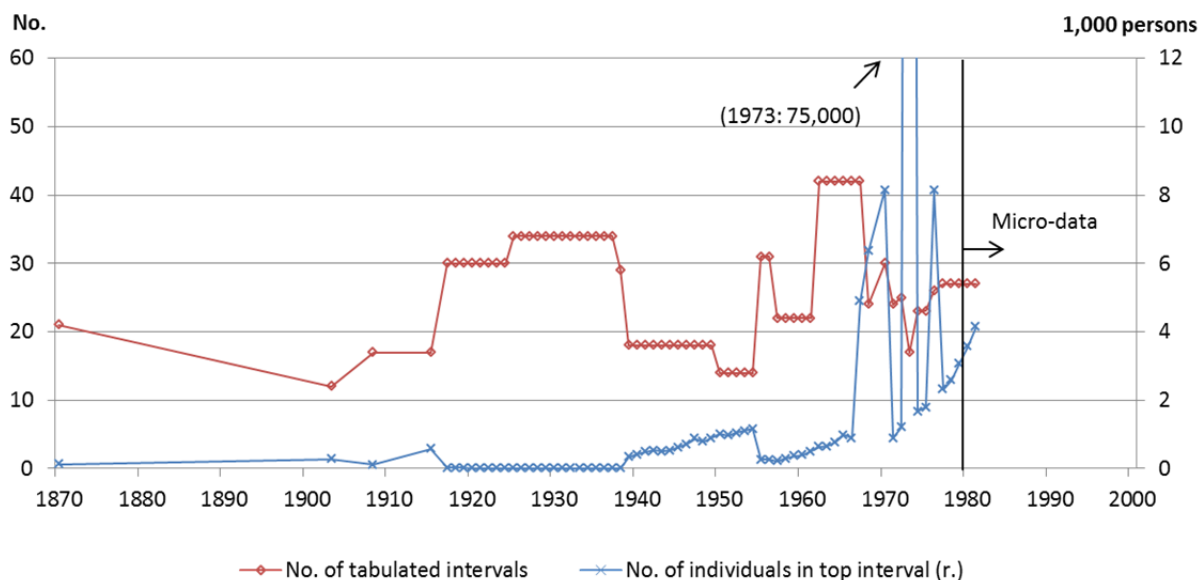
Notes: For the years before 1938 the "residual" interval of the non-filers is counted as an interval.
Sources: Statistics Denmark (see Appendix Table A1) and Sørensen (1989).

At the same time, there are features of the Danish income tax that differ from those in other countries and which complicate the analysis. For this reason, we have to devote considerable space to the definition of income and of the tax unit.

Definition of income

The income concepts applied in determining tax liability, and the income concepts reported in the statistics, have varied over time in a way summarised in Table 1 (drawn from Sørensen, 1989). Up until 1966, the tax was levied on the so-called assessed income, which due to a peculiar rule in the Danish tax legislation was given by gross income minus all direct taxes and rates paid along with more common deductions of certain expenses on life assurance and interest on debt. The deduction of taxes did not involve circularity, since the tax paid in year T was based on income and deductions in year T-1. The deductions included all personal taxes paid to state, municipalities and the church, so that in effect the tax base in year T was very close to the net-of-tax (or disposable) income in year T-1 (see Bjerke, 1957, p. 99).

Table 1
Overview of the income concepts available in the tax statistics

Period	Income concept	Definition
1903-66	Assessed income	Taxable income – personal taxes paid (relating to assessed income in previous year)
1967-	Taxable income	Gross income – common deductions (interest payments, certain types of insurance etc.) = Assessed income + paid personal taxes
1976-	Gross income	Wage income + transfers + interest + stock capital gains and dividends + net business income = Taxable income + common deductions
1980-	Micro-data allowing a variety of definitions in addition to the above.	

Sources: The first three rows are from Sørensen (1989, p. 63).

The deductibility of paid personal taxes up to 1966 complicates the comparison of inequality in Denmark with that in other countries and the construction of a consistent series covering the period as a whole, and correcting for this so-called tax allowance is not trivial, as the individual size of the allowance depends on the assessed income the year before. In what follows, we have treated it by adding back the estimated tax deductions per income range, using information on the tax functions. More specifically we calculate a tax payment for each taxpayer in each income interval based on the interval mean income and the ruling <u>ordinary</u> <u>state</u> tax rates[2]. As far as we know, this is the first time such an adjustment has been made.

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[2] The following tax codes have been applied:

1870-1903: no correction.	1904-1909: law of 1903.
1910-1912: law of 1909.	1913-1914: law of 1912.
1915-1917: law of 1915.	1917-1919: law of 1917 (two laws).
1920-1921: law of 1919.	1922-1939: law of 1922.
1940-1945: law of 1940.	1946-1955: law of 1945.
1956-1965: law of 1955 (taxpayers with dependents).	1966-1966: law of 1965 (taxpayers with dependents).

The calculation of taxable income is only approximate for several reasons. It is based on the average income of the interval in the <u>same</u> year and thus takes no account of changes in income over time; it excludes municipal taxes, church taxes and certain other taxes such as the state wealth taxation. In itself, using the interval average as the tax base is likely to underestimate the average tax payment in a progressive tax system, and hence to understate the degree of inequality. However, operating in the opposite direction is the fact that individuals in the top of the distribution are more likely to have had relatively high income growth compared to the year before in which the tax payment were actually calculated. Not being able to control for income mobility thus overestimates the size of the tax allowance in the top of the distribution and underestimates it in the bottom, giving a more unequal income distribution[3]. Leaving out the wealth tax might somewhat counter this to the extent that income and wealth are correlated.

The exclusion of municipal (and church) taxes affects the income share to the extent that they were not levied proportionally, which was indeed the case in some municipalities. E.g. the capital municipality of Copenhagen, which introduced a modern income tax already in 1861, had in the beginning of the 20th century a degree of tax progression that was as high as at the state level[4]. However the progressivity in some municipalities reflects the large degree of autonomy that the municipalities had at the time to define their own system of taxation, and it is more or less impossible to say something about the overall progressivity at the municipality level[5]. For this reason we have not attempted to add back the municipal taxes.

The resulting totals for taxable income are shown in Figure 2 below, together with the totals for assessed income and for reported income (excluding those below the tax cut-off). As may be seen, the removal of the tax allowance between 1966 and 1967 creates a large jump of around 17-18 percentage points of GFI in the total reported income (switching from assessed to taxable income). However despite the crudeness of our estimates of the tax allowance, the implemented correction is more or less able to remove the jump in the total income, which indicates that the net effect of our correction is broadly correct[6]. The remaining part of the gap is primarily attributed to the tax allowance from the

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For the years 1937-1950 the tax rates from the 1937 Common Municipal Fund law has also been applied. For the years 1951-1955 the tax rates from the 1956 law has been used. The tax payment for each year has further been scaled according to the official scaling factor (udskrivningsprocent) taken from Johansen (2007) or implied from the average tax rates reported in Philip (1965, p. 119). For the laws up to and including the 1919-law a personal allowance of 800 DKK has been applied. For the laws of 1922 to 1945 we have used a personal allowance starting at 1,400 DKK (corresponding to taxpayers with dependents in cities outside the capital). This allowance was phased out, so that taxpayers with an income about 10,000 DKK did not receive it. This schedule has also been applied to the Common Municipal Fund tax. For the laws of 1955 and 1965, the personal allowance was incorporated into the tax schedule by having a zero marginal tax rate in the lowest tax bracket.

[3] Looking at that micro-data from 1980 and onwards indicates that there is indeed a large degree of mobility in the top of the income distribution. From 1980-90 around 23 per cent of the individuals in the top 10 per cent in a given year are not in the group the year after. For the top 1 per cent the number is around 29 per cent. Looking more directly at the changes in tax payments, the individuals in the top 10 per cent increased their average payment around 16 per cent compared to the same individuals the year before. For the top 1 per cent the number was 18 per cent. The increase in average taxable income was on average 6 per cent p.a. from 1980-90.

[4] According to the 1919-law a taxpayer in Copenhagen with an assessed income of 100,000 DKK faced a marginal tax rate of 18 per cent and an average tax rate of 14 per cent, while the corresponding numbers for the state tax were 19 and 6.3 per cent, see Johansen (2007, p. 77).

[5] Even though the government at the time of the introduction of the state income tax in 1903 tried to push the municipalities toward a more uniform system with a proportional income, the local tax authorities still had the possibility of deviating from the assessed income by deducting or adding different amounts based on their knowledge of the situation of the specific taxpayer, see Johansen (2007, p. 71).

[6] Unfortunately there are no years in which DS reports the distribution on both income definitions.

municipal taxes, which we assume to be proportional and thus to not affect the calculated income shares. The possibility of any remaining bias will be discussed in section 3.

Figure 2
Income totals as share of Gross Factor Income
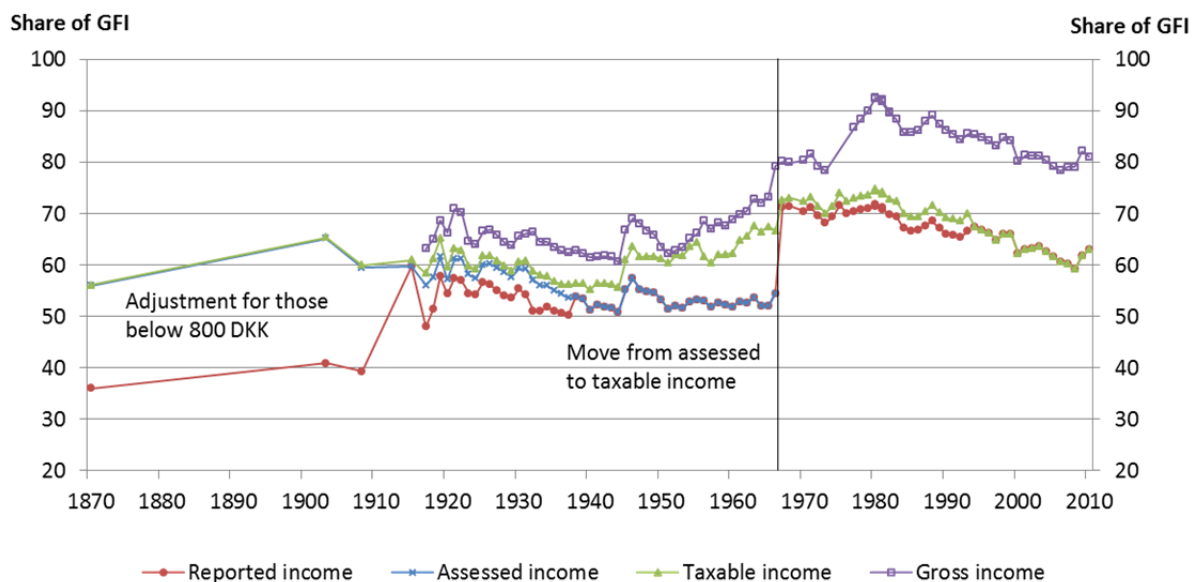
Notes: The income concepts refer to the following:
    1) Reported income: The income total of the legal tax base from the DS tabulated income statistics and the micro-data from 1980.
    2) Assessed income: Reported income plus the DS' estimates of the income below the cut-off of 800 DKK. From 1917-1937 the income below the cut-off has been estimated by Sørensen (1989).
    3) Taxable income: Before 1966, assessed income plus our own estimates of the allowance for ordinary state income taxes (with effect from 1908). Before 1994 the taxable income series have further been adjusted for the grossing up of income transfers in 1994 as descripted below.
    4) Gross income: Before 1970 gross income is given by relatively crude contemporary estimates from DS including also the income of individuals below the cut-off. Hereafter it is given by the legal gross income, which is collected automatically by the tax authorities.
    From 1980 the totals are taken from the micro-data, see appendix A3 for definitions. The years 1980-82 overlap with tabulated totals.
    Expressed as a percentage of Gross Factor Income given by Hansen (1974) (1870-1936) and DS (1937-2010).
Sources: Statistics Denmark, Bjerke and Ussing (1957), Hansen (1974), Sørensen (1989) and own calculations.

Figure 2 also shows total gross income, reported by DS for the years since 1917. This income concept includes adding back all deductions (not just the tax allowance) along with their estimates of the income below the cut-off of 800 DKK, and we should therefore expect taxable income to lie below this amount.

The rest of the general setup of the historical Danish tax system to a large degree followed the international standards at the time[7], allowing deductions of items such as union subscriptions, contributions to pension and insurance schemas (unemployment, sickness, life etc.) and subtracting of personal

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[7] When drafting the original Danish tax legislation from 1903, the Danish government had primarily drawn from the Prussian income tax system (the Miquelian tax law from 1891), see Johansen (2007, p. 25).

allowances before the tax was calculated[8]. However as in many other countries the treatment of capital income deserves particular attention.

Until the introduction of the dual tax system in 1987 the foundation of the income tax system was a net income concept, in which – in principal – all real income streams were to be added along with deductions of all cost associated with "acquiring, securing and maintaining" the income. This meant e.g. that imputed rents, capital gains, positive and negative interest payment and income in kind all were included in assessed/taxable income, while gifts, heritage, lottery premiums etc. were exempt. The only exemption in relations to capital gains was that they were not taxed if they had not accrued by intention. Initially this exemption mainly meant that capital gains on private homes and other personal possessions were exempt: however from 1960 capital gains for ordinary taxpayers were taxed under a special income tax scheme first introduced in 1958, whereas capital gains in relation to a taxpayer's livelihood or speculation are taxed as regular taxable income. It is difficult to assess precisely how the tax authorities made the distinction, but it presumably meant that most taxpayers with capital gains were taxed under the special scheme.

From 1981 the legislation was changed so that capital gains on stocks owned more the 3 years, which had not accrued in relation to a taxpayer's livelihood, were generally exempt[9]. This rule was maintained until 2006, when all capital gains were made taxable, however the precise placement of stock income in the tax legislation changed repeatedly across the period. Until 1991 dividends were generally included in the taxable income, while non-exempt capital gains were taxed under the special income scheme mentioned above until 1993. Hereafter these incomes were taxed as stock incomes, which were not included in taxable income.

As a consequence we generally interpret the series on taxable income as excluding capital gains, while we have a data break in 1991, when dividends were removed from the taxable income. Using the micro-data starting in 1980, which contain the income records of the entire population, we are able to add back the stock income to our income concept, however as shown in appendix A3, the removal of the dividends creates no visible break in the series as the reported dividends were very low before 1991 and the reporting rules for both capital gains and dividends change continuously towards 2006 making it difficult to construct a consistent series over time. Similarly, the introduction of the dual tax system in 1987 does not create a break in the series as the duality was achieved by introducing a new income concept only consisting of labour income (and positive capital income) and taxing this at an extra rate.

Public transfers such as unemployment benefits, sickness benefits and public pensions were all taxable and therefore included in our income concept. However before 1994 some other transfers (cash-benefits and supplement provisions for pensioners) were exempt[10] and recipients of social pensions (disability and old age pension) had an extra personal allowance, which in effect made their pension tax free. We deal with this data break by assuming that the grossing up of transfers only affects the income total (not the top income brackets) and take out the extraordinary growth in the total in this year. We do this by first regressing the growth rates of total taxable income on total labour and capital income (excluding 1994) and scale up the 1993 income total, so that the gross rate from 1993 to 1994 equals the predicted value (2.7 per cent) instead of the actual (7.9 per cent). The implied increase in the 1993 income total of 5.1 per cent is indexed to the development in the income transfers relative to

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[8] See DS Statistiske Meddelelser 1968:9 and Philip (1965 p. 126) for a detailed description of the different deductions and allowances and the developments in these over time. See also Danish Ministry of Taxation (2002).
[9] See Law no 295 of 10/06/1981.
[10] Most of the exempt transfers had the character of former in-kind transfers that had been monetized.

GDP and applied to all years before 1993[11]. In this way the income total in e.g. 1925 and 1970 is scaled up by 0.7 and 2.7 per cent respectively.

With the above we obtain a "comparable" series on taxable income covering the whole century, and in what follows, we take this series (including the corrected assessable income before 1967) as our main series. Although this income concept is affected by changes in tax legislation – such as maximum deductions etc. – and thus not an ideal income concept, the developments in the income shares follow closely what we obtain by using e.g. gross income for the years 1977-2010, where we have overlapping data (see appendix A3, which also gives a summary of the variables used). This gives us some confidence that the development measured by taxable income is also historically a good proxy for the underlying development in gross income.

Tax unit

The tax unit was initially the family, with the incomes of husbands and wives being added together. The data refer to "principal taxpayers", defined as unmarried persons plus married men. From 1970 there was an important change in that the tax unit became individuals aged 15+ (some individuals below 15 years also filed a tax return if they earned a sufficiently high income). However income from wealth was still taxed solely in the hands of the primary income earner in each family until 1983, see Egmose (1985, p. 55).

The required control total for the pre-1970 period is the number of potential principal taxpayers, taken to be the total number of adults minus the number of married women. In the case of Denmark, the Statistical Yearbooks have, in many years, published figures for "skatteforhold" – or "tax condition" – giving the DS estimates of the potential taxpayers. The precise definition of this number varies somewhat across the period, being individuals, age 18+ minus married women before 1955 changing to 16+ minus married women from there until the change to individual taxation in 1970. The figures for total tax units and total individuals are shown in figure 3.

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[11] We use the income transfers as percentage of GDP given by DS' 50 year overview from 2002 back to 1948. From there we index with the state social of expenditures as a share of GFI.

Figure 3
Population totals
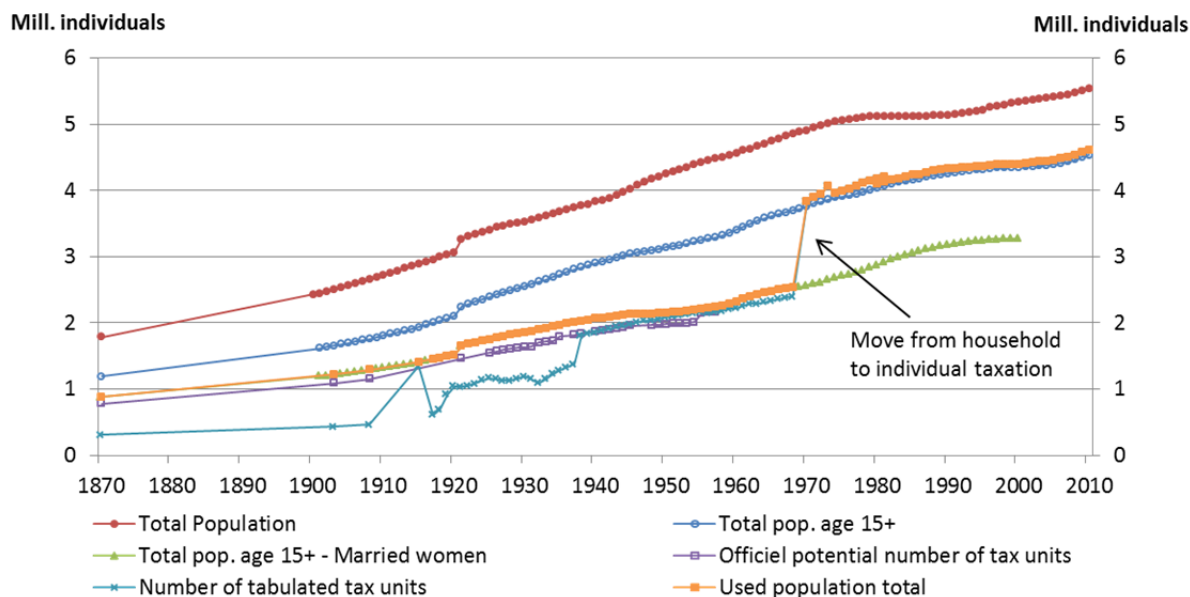
Notes: The population numbers (total and divided into age groups) are taken from DS online database (tables HISB3, HISB4, BEF1). The number of married women from before 1970 has been interpolated based on the populations censuses, which were typically conducted with a 5 year interval.
For the 3 observations 1870, 1903 and 1908 the number of individuals below the cut-off of 800 DKK has been excluded from the number of tabulated tax units, although DS did estimate an income for them and included them in the tabulations. The source of the 1915 observation is the population census that year and therefore covers the whole population.
From 1980 the used population total is taken from the micro-data, see appendix A3 for definitions. The years 1980-82 overlap with the tabulated total.
Sources: Statistics Denmark.

Despite the fact that the estimated number of potential taxpayers from most of the historical period was given by individuals age 18+ minus married women, there were still individuals below 18 with their own income reporting their income to the tax authorities. Most of these were below the 800 DKK cut-off and thus not included in the tabulations before 1938, but an examination by DS in 1939 showed that in this year there were around 53,000 individuals below the age of 18 in the tabulated statistics, see Sørensen (1989, p. 66). Ironically, when DS changed their definition of potential taxpayers to individuals from age 16+, the tax legislation also changed, so that individuals below 18 living at home could apply for joint taxation with the family, which presumably reduced this number.

In order to have a consistent approach over time, we have chosen the slightly broader population total of the age 15+ minus married women that can cover the entire period until 1970. From then on we use the actual number of tax units, which closely corresponds to the population of age 15+, cf. figure 3.

Published data
The sources of the tabulated data are set out in Appendix Table A1. There are a number of gaps, but the series is particularly rich for the first part of the twentieth century. For example, between 1903 and 1939 there are 26 observations, whereas the corresponding number of years for Sweden is 10 and Norway it is 6. The Danish data are less strong than the Norwegian for the nineteenth century, having only the one observation for 1870 (whereas for Norway there are 10 observations). In what follows, we

make use of the data for 1870, but it should be borne in mind that the long gap – a third of a century – means that the figures may be less comparable.

Prior to 1938, DS only collected income assessment for families with an assessed income above 800 DKK (more or less equivalent to the general personal allowance until 1920) leaving out 74 per cent of the population in 1903 decreasing to around 33 per cent from 1917 to 1937. For the years up to 1908 DS made a contemporary estimate of the income below this threshold. For the years 1917 till 1937 we have used the estimates of Sørensen (1989) for the lowest (omitted) interval. The typical amount added per tax unit is around 400 DKK. In Figure 2, the resulting estimated income of the families with an income below 800 DKK is given by the difference between reported and assessed income. It may be seen that the addition is substantial in the years before 1920.

Tax evasion

The extent of tax evasion has been discussed by a number of authors. According to the estimate of Ussing, tax evasion was some 10-15 per cent (1953, page 231). The estimate of Egmose was similar: 10 per cent (1985, page 48). In more recent studies, Kleven et. al. (2011) finds that the tax evasion (which is uncovered by audits) was 1.8 per cent in 2007-08, while tax evasion more broadly is estimated to constitute just below 5 per cent of the GDP, see Mogensen (2003, 2010), who also confirm the declining level of evasion reported by the other authors[12]. Mogensen (2003) estimates that the under-declaration at the beginning of the century was around 25 per cent.

The presence of tax evasion of course gives rise to some caution in term of interpreting the observed income distribution as the real distribution of economic resources, but it only constitutes a problem for our measures of the top income shares, if the evasion is somehow disproportional to reported income[13]. For extensive discussion of the implications of tax evasion for the estimates of top income shares in other countries, see e.g. Alvaredo and Saez (2010).

Interpolation

As the tabulated income statistics in general do not correspond to the income percentiles of interest, it is necessary to derive an estimate of the income distribution within each interval in order to get the desired percentile cut-off. In this study we use the split histogram as the interpolation method, which assumes that the individual incomes within an interval increase linearly from the lower to the upper cut-off with a kink point at the average income in the interval, see e.g. Atkinson (2005) for a description of the method. No extrapolation is made to obtain top income shares within an open upper interval.

The uncertainty implied in using this method to derive a single number for the top income shares can be assessed by calculating the linear upper and lower bound (the global upper and lower bounds). The lower bound assumes no within-interval income inequality, i.e. everyone within the interval earns the interval mean income, while the upper bound is derived by assuming maximum within-interval ine-

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[12] Despite the higher historical levels of tax evasion, one could expect that some tax-payers actually over-reported their income while the tax rates were still low. This due to the fact that the taxable income and tax paid were originally published in the local "tax books", see Johansen (2007, p. 73), and reporting a high income could as such be associated with higher social prestige, easier access to credit etc.

[13] The correlation between income and tax evasion in Denmark has been studied in Mogensen (2003) and Boserup and Pinje (2012). Mogensen (2003, p. 271) finds that, while the share of individuals who had their reported income raised by the tax authorities was an increasing function of income in 1959 and 1980, the relative adjustment was a declining function, so that the overall tax evasion as a share of reported income was more or less constant over the income distribution. Boserup and Pinje (2012) find that evasion is basically uncorrelated with the part of the income that comes from 3nd parties, which imply that evasion is largely uncorrelated with taxable income for most taxpayers in the case of Denmark in the recent years, where 3rd party reporting provides the bulk of the information needed for the tax authorities.

quality (splitting the population within each interval into two groups earning the upper and lower interval cut-off respectively, while ensuring that the total incomes of the two groups still add up to the interval total). As has been found in other studies, with sufficient intervals, the differences between the linear upper and lower bounds on the shares are small: the bounds are practically identical with an average interval around the mean split of [-0.23:+0.13] percentage points for the top 10 per cent and an average interval for the top 1 per cent of [-0.14:+0.07] percentage points, which testifies to the narrowness of the income ranges at the top level. For a comparison of the series created with the mean split method with the linear upper and lower bounds, see appendix A4.

Section summary

Summing up the above description of the data available to our study, we basically have to deal with the following breaks in the data sources:

- prior to 1938 exclusion of those with assessed income below 800 DKK;
- 1967: Change from assessed to taxable income;
- 1970: Change from family to individual based taxation.
- 1994: Grossing up of certain transfers.

In order to deal with these, we have adopted the following strategies:

- Use external information about total income to estimate the incomes of the missing population, building on the work of Sørensen (1989) and DS original estimates for the years 1870-1915;
- Make an estimate of the taxes paid for years prior to 1967, in order to arrive at a distribution of taxable income for those years; this is combined with estimates from 1980 onwards based on the micro-data to give a series for the distribution of taxable income covering the whole period;
- Correct the income total before 1994 for the extraordinary growth created by the grossing up of transfers in 1994.

It should be noted that we have made no adjustment for the shift in the tax unit in 1970, but we discuss below the likely consequences of this break in the series in that year.

The series on taxable income is of course not the ideal series in relation of measuring the underlying development in the income inequality, as the definition of taxable income changes with changes in deductions etc. However, given that the fundamental structure of the Danish tax legislation stayed the same for most of the 20th, we believe that it gives a reasonably accurate description of the development in the underlying income distribution. This can be formally checked from 1977, where DS also publish tabulated data on gross income, and especially from 1980, from where the income records of the entire universe of taxpayers are available as micro-data. As shown in appendix A3 the development in gross income follows closely that of taxable income.

3 Top income shares in Denmark

Analyzing the developments in the Danish income distribution, we begin in Figure 4 with the income share of the top 10, 5 and 1 per cent respectively based on the distribution of taxable income and covering the whole period from 1870 to 2010.

Figure 4
Top income shares 1870-2010
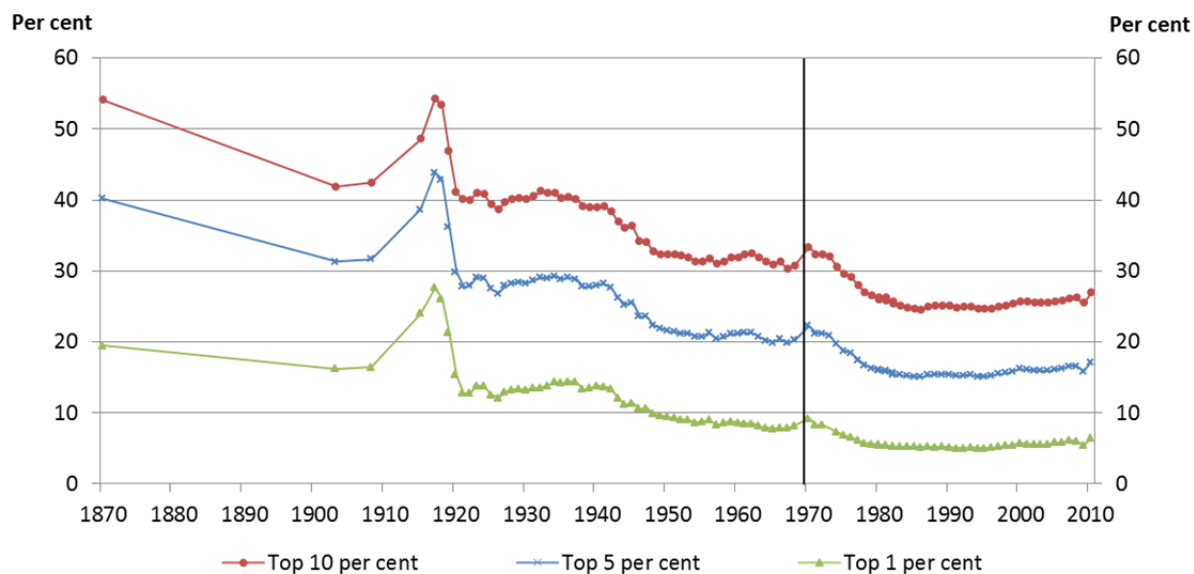
Notes: The vertical line in 1970 indicates the change from family to individual taxation.
Sources: Own calculations.

The figure shows first of all a substantial decline in the top shares between 1870 and 1903. The facts that the 1870 figure was the result of a one-off tax, and that we have no evidence about the intervening years, mean that the fall must be interpreted with caution. However the indication that income was much more unequally distributed before the 20th century is supported by Soltow (1979). He uses data from another one-off tax in 1789 to analyses the distribution of both income and wealth and applying his numbers to the methodology used here gives a lower bound on the top 1 per cent income share of around 30 per cent compared to our estimate of 19.4 per cent in 1870[14].

The indications of high inequality in 1789 and 1870 are interesting because they predate the 1890s that most historians set as the start of the industrialization in Denmark. This speaks against a Kuznets type of explanation for the development in inequality, where high levels of inequality only are a temporary phenomenon resulting from a slow movement of workers from low productive to high productive sectors. It also puts the decline in the 20th century into perspective. If the process to some extent is continuation of the trend from the 19th century, you should also look for driving factors that were present in both centuries.

Going forward from 1870, it is striking that the share of the top 10 per cent fell from 54 per cent to 42 per cent. This fall of 12 percentage points is about the same magnitude as the *rise* in the share of the top 10 per cent that took place in the United States from 1970 to 2003. If we look within the top 10 per cent, then the reduction was larger – around a quarter – for those in percentile groups 90 to 99. The share of the top 1 per cent fell by under a fifth: from 19.4 to 16.2 per cent.

From 1903, we have a – nearly – continuous series for the top income shares of taxable income. This shows a rise in top shares in the First World War, and then a stepwise decline taking place firstly around the Second World War and secondly after the change-over to individual based taxation in 1970.

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[14] Another interesting finding in Soltow (1979) is the close connection between wealth and aristocratic titles with a majority of the wealthiest individuals also holding high titles within the royal court, army or central government.

In between these periods of decline, there seems to have been a tendency to a slight reversal in the shares. Although the top income shares have remained relatively low in the recent years, there has been a tendency to rising inequality at the very top. In 2010 the share of the top 1 per cent was 6.4 per cent, which was its highest level over the past 30 years, although only 1 percentage point higher than in 1980. It is not evident that a rise of 1 percentage point in this share can be regarded as "significant". Certainly the recent increase is very much smaller than in the United States, where the share of the top 1 per cent rose from 8.2 to 17.4 per cent over the same period. To find a share of more than 17 per cent in Denmark, one has to go back to the First World War.

To sum up, the top shares in Denmark today are below those found in many other countries: the top 1 per cent share in 2010 was 6-7 per cent, or under half that found in the United States[15]. The different episodes that have led over the past century to this situation are discussed below.

A contrast between the two world wars

The difference between the changes in top Danish income shares in the First and Second World Wars is striking. During the First World War, the income share of the top 10 per cent increased by 11.8 percentage points, returning it to the 1870 level. This increase can almost entirely be attributed to the top 1 per cent: the share of the top 1 per cent reached a staggering 27.6 per cent in 1917. In 1870, it had been "only" 19.4 per cent. Note also that the increase during the First World War is not a consequence of a collapse of the income total. In contrary, the income total increased on average 10 per cent p.a. from 1908 to 1918 compared to an average increase of 6 per cent p.a. from 1903 to 1960. The development during the Second World War is different in that the shares fell, and that the change was less dramatic. Measured from 1939 to 1946, the share of the top 10 per cent fell by 4.9 percentage points, and the share of the top 1 per cent fell from 13.5 per cent to 10.6 per cent. As this makes clear, the decrease in this case is also borne by the 90-99 percentiles in the distribution.

The contrast between the two World Wars is interesting. It is true that the two situations were different in that Denmark managed to stay neutral during the First World War and was occupied during the Second World War. But during the occupation Denmark was able to maintain its own government with a high level of autonomy over internal affairs until 1943, and economically both episodes meant a large increase in aggregate demand in particular for agricultural products, while imports such as fuel and coal were in short supply. The economic conditions had therefore similarities. The same argument apply to an even larger degree to the case of Sweden, where the development in the top income shares closely followed that of Denmark, as described in section 5.

The difference may lie in the fact that during the First World War the Danish government largely expected that the war would be short and was thus slow to adopt measures such as rationing and price and rent control. Furthermore, the unions and employer organizations had in 1911 settled on a 5 year collective agreement, which more or less dictated the nominal wage growth until 1916 and together with the inflationary pressure from the increased demand; this resulted in a large drop in real wages as documented by Lindberg (1921). In contrast, the potential economic consequences of the Second World War on the Danish economy were much better foreseen by the Danish government, which therefore was faster in implementing rationing, price control etc. Also the unions reacted faster and

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[15] It should be noted that the estimates of top shares for the period from 1980 differ from those of Kleven and Schultz (2011) in two respects: (1) their estimates limit attention to a sub-group of the population (the age group 25-55), and (2) they define income differently by among other things excluding transfers while they include their own estimate of the imputed rental value of private homes. It turns out that both differences reduce the top shares although the age restrictions account for most of the difference. Our calculations suggest that the combined effect is substantial. The share of the top 1 per cent in 1980 rises from 4.0 per cent to 5.5 per cent, and in 2003 from 4.4 per cent to 5.5 per cent

demanded quarterly automatic wage adjustment to inflation in the collective agreement signed in March 1941.

The two wars thus point to the potential distributional consequences of increases in aggregate demand under sticky wage and sticky prices respectively.

The effect of tax unit and women entering the labour market

The next period of markedly declining income shares comes just after the change from family to individual taxation in 1970, which implied that the potential number of tax units changed from the number of individuals age 15+ minus married women to all individuals 15+ (some individuals below 15+ with a sufficient income also filed a tax return.

First, in order to assess the effect of the data break, we show in table 2 the development in the income shares of the top 10 and top 1 per cent around the changeover. There was an increase in the top income shares: rises of 2.6 percentage points for the top 10 per cent (from 30.7 in 1968 to 33.3 in 1970) and 1.0 percentage points for the top 1 per cent (from 8.2 in 1968 to 9.2 in 1970).

Table 2
The effect of the change from family to individual taxation

	Individual		Family	
Per cent	Top 10 per cent	Top 1 per cent	Top 10 per cent	Top 1 per cent
1967	38.4*	9.7*	30.3	7.8
1968	38.8*	10.1*	30.7	8.2
1970	33.3	9.2		
1971	32.3	8.2		

Notes: Families refer to age 15+ excl. married women. Individual refers to all individuals age 15+. 1969 was a "tax free year" and is thus excluded from the table.
* Calculated based on the assumption that all taxpayers in the top income shares were either unmarried or married to someone with zero income.
Sources: Own calculations based on the series for taxable income.

As explained in Atkinson (2007, p. 27), a move from families to individuals could raise or lower top income shares, depending on the joint distribution of the incomes of husbands and wives. If we assume that all individuals in the top income groups are either unmarried or married to someone with zero income, the change only affects the top income shares through a change in the total population, and we should therefore be able to remove the jump in the series by simply changing the population total to all individuals age 15. Doing this for the year 1968 yields an increase in the income share of 8.1 percentage points for the top 10 per cent (from 30.7 to 38.8) and 1.9 per cent for the top 1 per cent (from 8.2 to 10.1), cf. table 2.

The fact that this calculation greatly overestimates the effect of the change in tax units indicates that some of the families in the top income groups in 1968 had a non-negligible income from secondary earners, so that a given total income is now divided, tending to reduce the top shares. Although it could also (partly) be a behavioural response, as the change to individual taxation with progressive taxes gives an incentive to avoid taxation by distributing income more widely within the family, e.g. if a self-employed person "hires" other family members. As such, with no information from the tabulated data on the income distribution within each family – which presumably has changed substantially over the century – there is no easy fix to join the series across the change in tax units. One cannot simply join the two series together by scaling either one of them, as the timing in the change from family to individual taxation can have a big impact on not just the recorded level, but also the development of inequality.

This is in particular the case in connection with women entering into the labour market: see Figure 5. Under a family based system inequality may rise and fall depending on where in the income distribution women enter first and the correlation of potential earnings within the family, whereas inequality will almost always fall under individual taxation (except if the women enter with a very high wages). Simply joining two series by scaling across a change in the tax unit can thus give very misleading results. Sørensen (1989, 1993) does indeed show that the decline in inequality after 1970 is mainly is driven by a decline in inequality among secondary taxpayers (of whom, many were outside the labour market in the beginning of the period), while inequality among primary earners is stable. This implies that the effect of e.g. women entering the labour market depends crucially on the legal unit in the tax system.

Figure 5
The income share of the top 10 per cent and the female employment rate
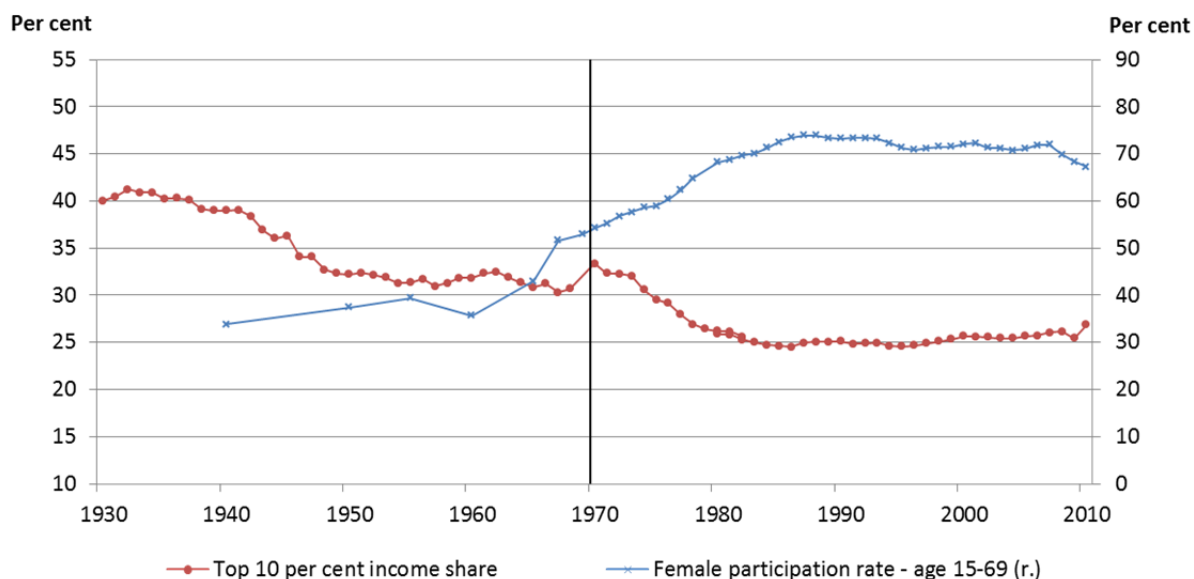
Notes: The vertical line in 1970 indicates the change from family to individual taxation. The participation rate is defined as total participation divided by the number of women between the ages of 15-69. Before 1980 the female participation rate is taken from various Statistical Year Books. After 1980 the series comes from DS online table RAS1. The early observations do for some reason not correspond completely to the number given by DS in their 50 year overview from 2002, but the overall development is the same.
Sources: Own calculations and Statistics Denmark.

From 1980, we can use the micro-data to examine the effect of "marrying-up" couples and thereby creating a tax unit comparable to the family unit from before 1970. Figure 6 shows the resulting top income shares for families in comparison with those from the individual distribution.

Figure 6
Top income shares for families and individuals
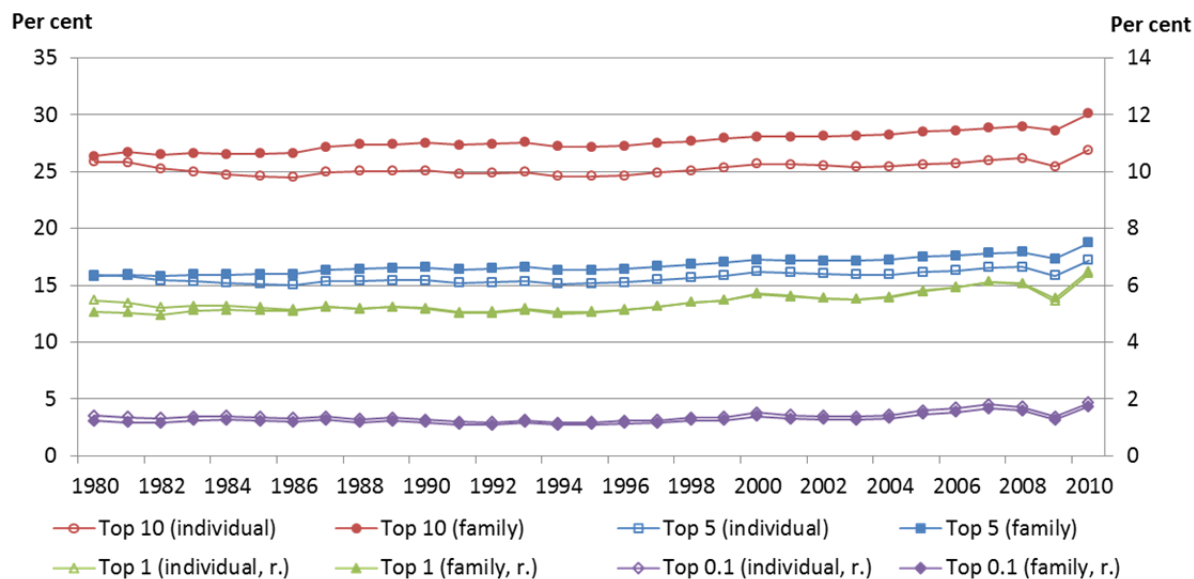
Notes: The family distribution is constructed from the individual distribution with married couples added together.
Sources: Own calculations and Statistics Denmark.

From this, we can draw two important conclusions. The first is that the impact varies across the distribution. The shares of the top 1 and 0.1 per cent are not greatly changed. In 2010, the share of the top 1 per cent is 6.5 per cent on a family basis, compared with 6.4 per cent on an individual basis. In all except the first 3 years between 1980 and 2010, the difference is 0.2 percentage points or less. But the shares of the top 5 and top 10 per cent are higher on a family basis. The share of the top 10 per cent in 2010 is 30.1 per cent, compared with 26.9 per cent on an individual basis. The second finding is that the difference has widened over time for all except the very top shares. This may be seen most clearly from the fact that the top 10 per cent share on a family basis is 3.7 percentage points higher in 2010 than in 1980 compared to an increase of 1.0 percentage point on an individual basis. This demonstrates that the difference in the definition of the tax unit cannot be treated as simply a fixed effect. This is something that potentially is important to take into account when using the World Top Incomes Database to do cross country analyses.

The effect of taxation
In the studies of France (Piketty, 2003) and of the US (Piketty and Saez, 2003) one of the key elements in the analysis was the effect of rising (marginal) taxes and these authors concluded that the rising marginal tax rates were probably one of the reasons why top income shares did not recover after the Second World War, as high marginal tax rates impaired the incentive (or capacity) to accumulate capital at the top, thus preventing the buildup of capital concentration to the same extent as at the beginning of the 20th century.

Something similar is not possible in this study as we in general do not have information on the income composition in the tabulated data. We can therefore only consider the overall development in taxation and inequality along with the direct of taxation given by the difference between assessed income (where taxes have been subtracted) and taxable income.

As a starting point we compare in figure 7 the series on taxable income with that of assessed income – the difference being paid personal taxes to state, municipality and the church. As mentioned in

section 2 the subtraction of paid taxes affects the income shares through two channels. First of all, because the taxes are based on the assessed income the year before, the assessed income in a given year is in effect a weighted sum of the past taxable incomes, where the weights depend on the past average tax rates[16], and as the overall level taxation increases income shares calculated based on assessed income thus become a poorer proxy of the static within-year inequality.

Secondly taxation affects the income shares to the extent that it is not levied proportionally, while proportional taxation in itself does not affect the calculation of income shares. Disregarding the dynamic effects of the tax allowances the difference between assessed income and taxable income in figure 7 thus reflects the progressivity in the tax system.

Figure 7
The top income shares using taxable and assessed income
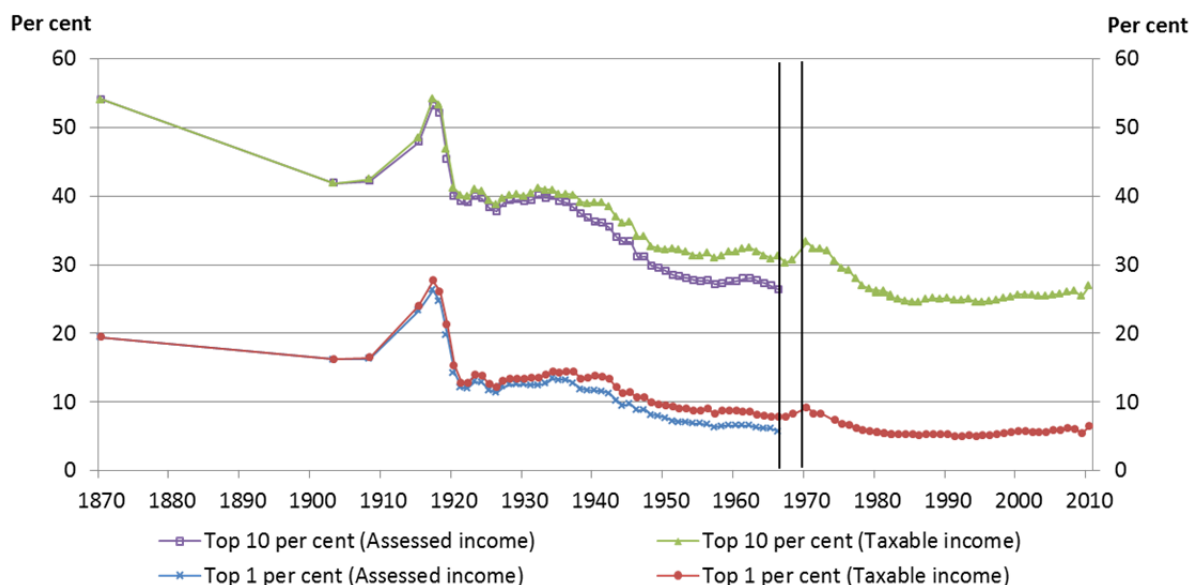
Notes: The pre-1967 taxable income is given by assessed income plus our own estimates of the allowance for ordinary state income taxes (with effect from 1908). The vertical lines indicate the two data breaks of the removal of the tax allowance in 1967 and the change from family to individual taxation in 1970. Both series have been adjusted for the grossing up of transfers as described above.
Sources: Own calculations.

The figure first of all illustrates the effect of our corrections for the tax allowances before 1967. This correction effectively removed the jumps in the series between 1966 and 1967, indicating that the correction – at least at the end of the period – captures the main progressivity of the tax system. Whether or not the corrections also capture the main developments in the progressivity from 1903 to 1966 depends on how the progressivity at the municipal level developed during the same period. It is, as mentioned above, almost impossible to assess the general progressivity at the municipal level in especially the early period; however there are some indications that the rise in state progressivity came as a substitute for municipal progressivity[17]. In this case we would underestimate the income inequality at the beginning of the period and thus the decline towards 1967.

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[16] Assuming a constant average rate (v) the weight on income earned in year s going into assessed income in year $t \geq s$ is $(-v)^{t-s}$. Further assuming a constant income stream, the assessed income converges to $1/(1 + v) \times$ taxable income.
[17] Also the precise timing of the increases in state progressivity should be interpreted with caution as taxation in the period before 1967 was conducted via a number of extraordinary laws outside the ordinary state tax schedule. When these laws

The overall picture in figure 7 is that the tax allowance only affected the income shares marginally before 1935-40 and builds up thereafter, where the effect on the top 1 per cent already from 1940 is stable at around 2 percentage points, while the effect on the top 10 per cent continues to increase to 4-5 percentage points before the tax allowance is removed. This is overall in line with other evidence. Egmose (1985, p. 53) suggests that the effect of taxation on the income distribution was basically zero before 1940, a position which is supported by The Danish Economic Council (DOR) finding in their 1967 report that the difference between measuring the maximum degree of equalization on assessed and gross was stable at 2-3 percentage points from 1950 to 1960 (p. 31), while the redistribution via the tax system were basically zero before 1940. These conclusions are based on the analyses by P. B. Olsen and V. Kampman; surveyed in DOR (1967, p. 43).

A more direct picture of the rise in progressivity is shown in figure 8 that depicts the marginal tax rate at the income cut-off for the top 1 per cent over the last 110 years.

Figure 8
The income share of the top 1 per cent and the (top) marginal tax rate
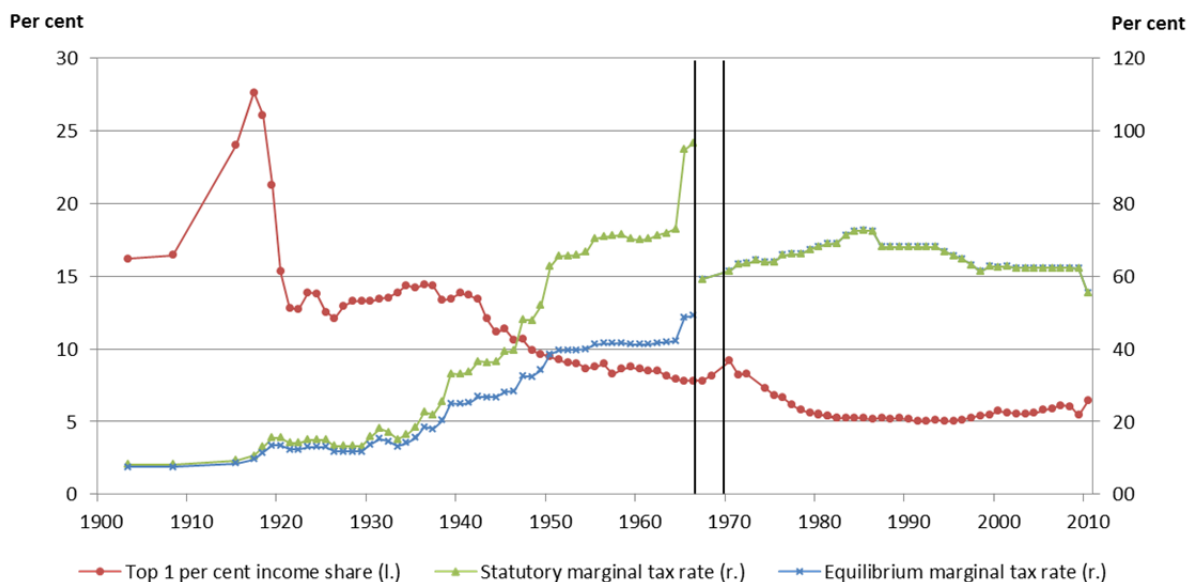
Notes: The marginal tax rate is measured at the income cut-off for the top 1 per cent and before 1970 it takes into account the ordinary state taxation, the common municipal fund law (see footnote 2) and average municipal tax-ation. The municipal average taxation (as per cent of the assessed income to the state) can be found in the statis-tical yearbook back to 1927. These rates have been adjusted by a factor 1.25 to take into account of the fact that the municipalities gave larger deductions before calculating the taxable income (in 1967 and 1968 the municipal income tax base was only 80 per cent of that of the state). Before 1927 the average municipal tax rate has been assumed constant at a level of 6.6 per cent. From 1970 the marginal tax rates are published by the Ministry of Taxation.
The equilibrium marginal tax rate refers to the effective marginal tax rate taking into account the effect of the tax allowance under the assumption of a constant income level. From 1967 the two tax rates are identical, since taxes paid could no longer be deducted. Until 1987 the marginal tax rate applies to basically all income types. After this point capital income is taxed at a lower rate.
The vertical lines indicate the two data breaks of the removal of the tax allowance in 1967 and the change from family to individual taxation in 1970.
Sources: Johansen (2007), Philip (1965), the Ministry of Taxation and own calculations.

turned out to be needed for a long period of time, they were often incorporated into the ordinary tax schedule with some delay.

Looking at the statutory tax rates, the first rise in the marginal tax rate (at this income level) came during the First World War and then leveled off until the mid-1930s from whereon it increased quite substantially until the beginning of the 1950s. However before 1967 the tax allowance created a marked difference between statutory and effective tax rates, because an increase in income in one year – which was initially taxed at the statutory marginal tax rate – reduced the tax liability the following. In effect, the effective marginal tax rates were typical lower than the statutory rates.

A standard method at that time to show the effective tax rates was to calculate so-called equilibrium tax rates assuming a constant income. Under this assumption the marginal tax rate convergences to $1/(1+x)$ with x being the statutory marginal tax rate[18]. A legal marginal tax rate of e.g. 50 per cent thus corresponded to an equilibrium marginal tax rate of 33.3 per cent. This implied that the legal marginal tax rates could be higher than 100 per cent, which they indeed were in the 1950s and 1960s. Measured in this way the marginal tax rate at the top 1 per cent cut-off increased by almost a factor 4 from around 12 per cent in the end 1920s to over 40 per cent around 1960. However it should be noted that the effective marginal tax rate at the individual level in the end depended on the individual expected income in the following years and was thus highly heterogeneous. A further thing to notice is that the marginal tax rate at the top 1 per cent cut-off was far from the top marginal tax rate. In contrary, a general feature of the Danish tax system in particular in the beginning of the 20th century was the large number of tax brackets going high up into the income distribution, as shown in figure 9.

Figure 9
The income distribution and the tax schedule in 1925
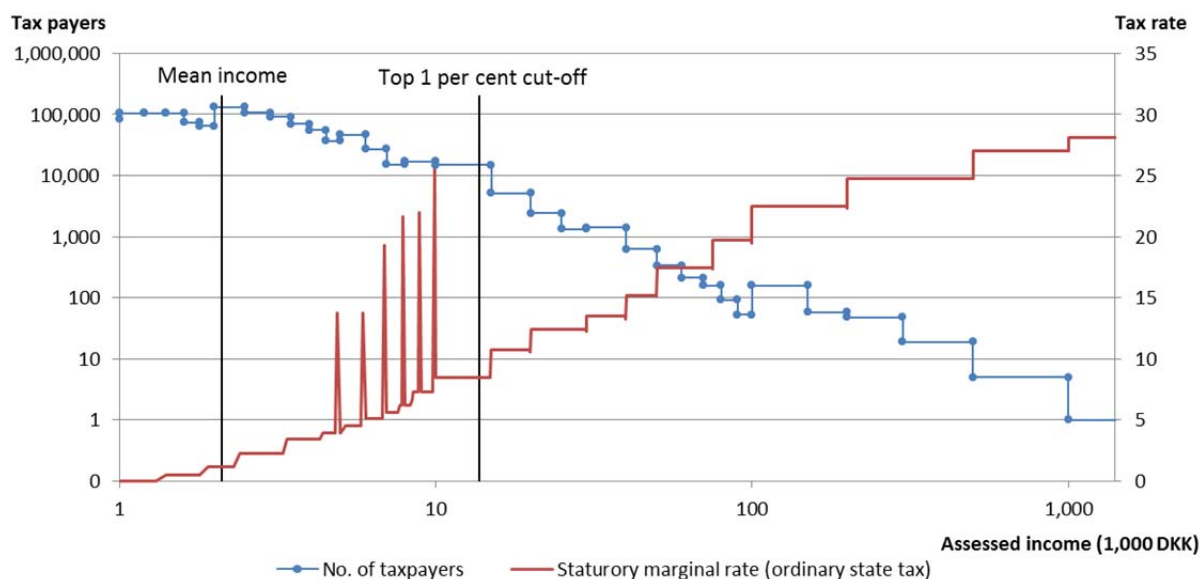
Notes: In 1925 ordinary state taxation followed the 1922 tax law with a scaling factor of 9/8. To arrive at the tax rate at the cut-off for the top 1 per cent in in figure 8, you need to add the municipal tax of 6.6 per cent.
The spikes in the marginal tax rate between 1,000 and 10,000 indicates the phasing out of the personal allowance and implies in principle an infinite local marginal tax rate.
Sources: Johansen (2007) and own calculations.

The figure shows the income distribution and the statutory tax schedule for the ordinary state income tax in 1925. At this time the mean assessed income and the cut-off for being in the top 1 per cent

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[18] To see this, consider an individual with a constant income w. He faces the tax function: $T(\bullet) = T(w – T(\bullet))$, where the effective marginal tax rate x wrt. w is given by: $x = T'(1 – x) \Leftrightarrow x = T' / (1 + T')$.

were was around 2,100 DKK and 13,700 DKK respectively. This implied that taxpayers with an income at the mean were located in the 3rd out of 21 tax brackets with a marginal state tax rate of 1.1 per cent and that the taxpayers at the top 1 per cent cut-off were located in the 11th tax bracket with a marginal tax rate of 8.4 per cent. As a comparison, the top marginal tax rate reached 28.1 per cent for income above 1 mill. DKK – effectively only applying to one taxpayer.

Finally, one of the potential areas, where the World Top Income Database can be used, is the study of the effect of taxation on economic behavior, as pioneered by Piketty et. al. (2011) and although a formal study of this is outside the scope of this paper, the historical development in the marginal tax rate and the income share of the top 1 per cent at least do not contradict the view that marginal tax rates affect economic behavior as measured by the income share of the top 1 per cent. Looking at figure 8, we can see that there is a relatively clear negative co-moment between the marginal tax rate at the top 1 per cent cut-off and their income share. However from a single-country study it is of course difficult to tell whether this is due to changes in real economic behaviour (such as hours worked), which reduces the overall efficiency in the economy or whether it is due to changes in rent seeking at the top, which primarily affects the distribution of income. Further, the negative correlation could be due to other variables correlated with the top marginal tax rate, such as public goods provision and income transfers.

Section summary

In this section we have considered the development of the top income shares in Denmark over 140 years, which might be summarized as follows.

- Today the top shares in Denmark are low by historical standards. Measured at taxable income, the share of top 1 per cent was in the late 2000s around 6-7 per cent compared to around 16 per cent at the beginning of the last century and as high as 28 per cent during the First World War.
- There have therefore been periods with significant falls: possibly in the last 30 years of the nineteenth century, and definitely over the Second World War, and in the 1970s with some tendencies to reversal in between and since the middle of the 1990s.
- We have suggested that economic conditions may contribute to the explanation of the changes in top shares over time, notably the impact of increased labour force participation after 1970, and – more speculatively - the different movements in wages and prices in the First and Second World Wars.
- The choice of unit of analysis – individuals versus couples – can affect measured inequality (although in the case of Denmark not the very top shares) to a differing extent over time, and hence influence the conclusions drawn about trends over time.
- The analysis has highlighted the need to understand the role of taxation when interpreting the results, with the Danish pre-1967 system having the effect of reducing the degree of progression. The impact of marginal tax rates needs to be explored further, but the changes seem consistent with top income shares depending negatively on the top marginal tax rates, which have followed an inverted U-shape over the century.

4 Setting the top shares in context: the evolution of the overall distribution and the joint distribution with wealth

How do the changes in top shares relate to what was happening to the overall distribution? Did the changes reflect the changing composition of overall personal incomes? In this section, we examine which income groups gained as the top income shares fell, and investigate the joint distribution of income and wealth.

The overall income distribution

The recent focus on top income shares – instead of broader measures of inequality – stems from the fact that most early income tax systems only covered the very top of the income distribution. In contrast to these studies, the Danish data have extended well down the income scale for the much of the last century. These data have been employed by earlier researchers to examine overall inequality, and in this section we follow in their footsteps, taking the story up to 2010.

The coverage of the income tax data is summarized in Figure 10 in terms of three variables: (a) the proportion of the population, F, for whom we have effective income data (those above the income cut-off for inclusion in the tabulation), (b) the share, Ω, of income attributable to this group (calculated from the control total), and (c) the starting value of income, y, for those covered, expressed as a fraction of the mean income.

Figure 10
Coverage of the income tax data
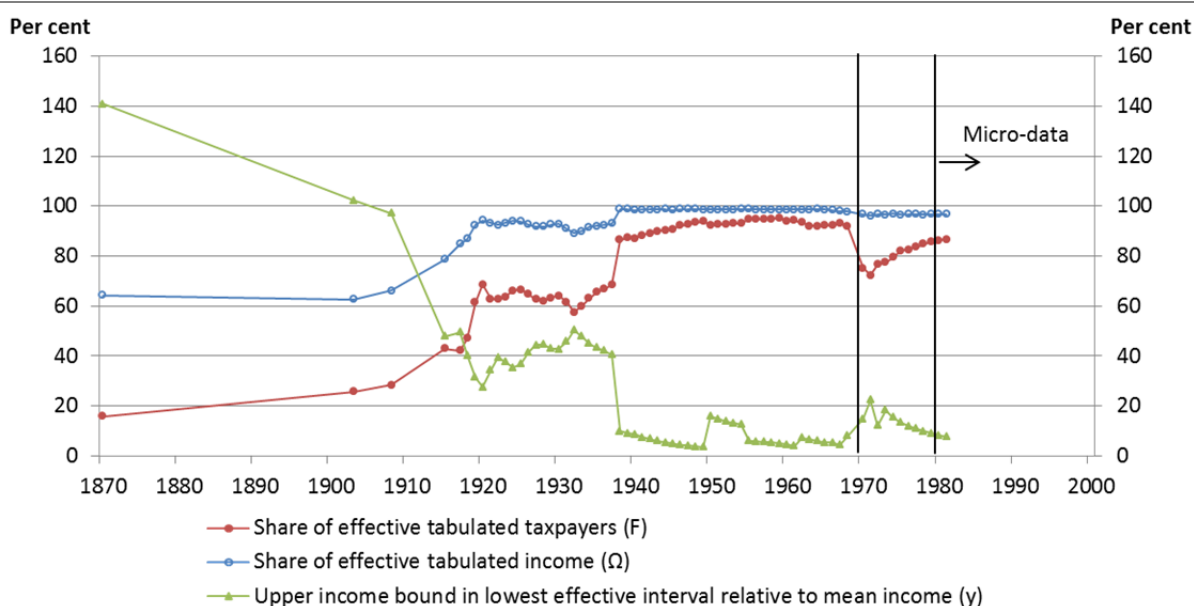
Notes: The vertical line indicates the change from family to individual taxation in 1970.
Sources: Own calculations.

It may e.g. be seen that in 1903 the data covered only 26 per cent of the total tax units in Denmark, even if they received 63 per cent of the total income. The excluded group were essentially those with less than mean income (y was close to 1). This means that any measure of overall inequality is likely to be surrounded by considerable uncertainty. From figure 10 we can further see that we can say nothing about the bottom third before 1938. As a result, we only report the decile shares for those groups covered by the tax data. It should also be noted that from 1938 the statistics are assumed by DS to cover all those with income, so that Ω in the above calculation is zero.

For a broad measure of income equality such as the Gini coefficient a lower bound for the contribution of the excluded group is given by assuming that they all receive the same income, $(1-\Omega)/(1-F)$, expressed relative to the mean, and an upper bound is obtained by assuming that they were divided between two groups, one receiving zero and the other receiving the maximum, y. The difference, equal to $(1-\Omega)\times[1-F-(1-\Omega)/y]$, provides a measure of the maximum possible margin of error. For 1903, this is quite large – around 14.1 percentage points – but from 1915 the difference is generally below 2 percentage points. Using the same technique to calculate the upper and lower bounds for the contribution

to the Gini coefficient from each tabulated interval, one can calculate the overall bounds on the Gini coefficient. In 1903 the difference between the two bounds is 14.2 indicating that the bulk of the uncertainty comes from the excluded group.

Figure 11 shows the Gini coefficients (with upper and lower bounds) for the entire period covered. In considering these figures, it is important to bear in mind the change in 1970 from a family to an individual basis and the grossing up of transfers in 1994 marked by the vertical lines in Figure 11). Even allowing for the break, it is clear that the Gini coefficient has fallen substantially in Denmark over the past century. Moreover, it is clear that there is not a secular downward trend. Denmark is not simply on the downward part of a Kuznets curve. There seem in fact to be several distinct phases, interleaved with periods of stability. There was, for example, little overall change from 1920 to 1939. Nor was there significant change from 1950 to the mid-1960s, where we take as a rule of thumb a 3 percentage point change as "significant". By the same criterion, the rise in the Gini coefficient from 1994 to 2010 of 3.2 percentage points was significant.

Figure 11
The Gini coefficient for taxable income
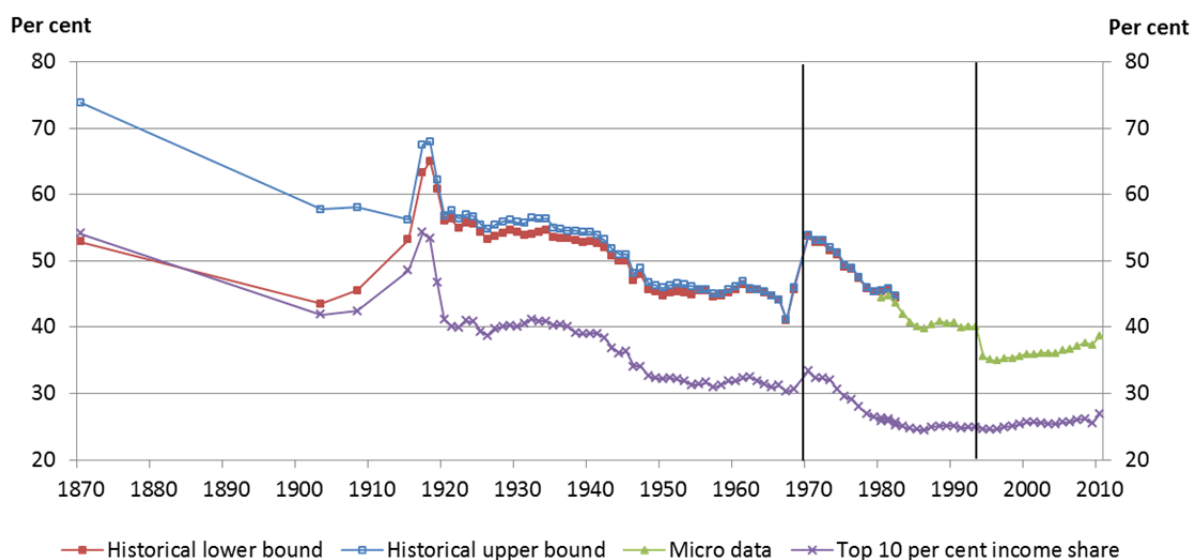
Notes: The first vertical line indicates the change from family to individual taxation in 1970, the second the grossing up of transfers in 1994. The top income series have been adjusted for the latter data break by assuming that the grossing up only affected the income total as described above. Something similar is not possible for the Gini coefficient.
Sources: Own calculations.

The Gini coefficients in Figure 11 may appear high in relation to the 24 per cent for the late 2000s cited at the outset of the paper, an estimate that was also based on register data. It should however be borne in mind that there are three important differences in definition. First, the figures discussed above refer to taxable income, whereas the 24 per cent refers to disposable income; secondly, the 24 per cent figure relates to the combined income of the family, whereas the taxable income estimates since 1970 relate to individual income; thirdly, the 24 per cent refers to income allowing for differences in family size, applying an equivalence scale, whereas the estimates in this paper make no such

adjustment[19]. However the estimated increase of 2.6 percentage points in the Gini coefficient between 2002 and 2010 shown in Figure 11 is very close to the 3 percentage point change shown in the EU-SILC statistics for Denmark[20].

The general picture from this exercise is that the development in the Gini coefficient coincides closely with that of the top income shares. This supports the presumption that the top income shares give a good indication of the development in the overall inequality, when data for broader inequality measured are unavailable. Of course, the Gini coefficient is just an aggregated measure of income inequality and it is thus no more able than the top income shares to shed light on where in the income distribution the equalization took place – e.g. whether the income mass from the decline in the top income shares went to the middle or bottom of the income distribution. We therefore in table 3 show incomes shares for the top six income decile groups along with the sum of the bottom four.

Table 3
Income deciles 1915-2010

Tax unit:	Family					Individual			
	1915	1920	1935	1950	1965	1975	1990	2000	2010
D1-D4	13.5	8.9	10.5	13.6	12.5	11.5	17.1	17.6	15.9
D5	4.5	5.0	5.3	6.7	6.6	6.3	7.7	8.1	8.1
D6	4.8	6.8	6.7	8.5	8.6	8.9	9.6	9.5	9.5
D7	6.4	9.2	8.7	10.4	10.8	11.9	11.4	11.1	11.1
D8	9.1	12.4	11.9	12.6	13.5	14.4	13.3	12.8	13.0
D9	13.1	16.6	16.6	16.1	17.2	17.5	15.8	15.3	15.6
D10	48.5	41.1	40.2	32.2	30.9	29.5	25.1	25.7	26.9

Notes: The income deciles have been calculated based on taxable income. The deciles before 2000 have been corrected for the grossing up of transfers in 1994 assuming that it only affected the D1-D4 deciles. This is of course a stronger assumption than that it only affected the D1-D9 used above.
Sources: Own calculations.

What is interesting in this table is that with the exception of 1915-20 the reduction of the income share in the top was broadly distributed to the rest of the income distribution. As such the income share in the bottom D1-D4 increased by 3.6 percentage points from 1920 to 1965, while the increase for D5-D9 was 6.6 percentage points.

This pattern points to a number of conclusions. First of all it appears to be that the decline in the top income shares is not simply a result of increasing income transfers. You could suspect that because we only have data on taxable income including transfers, the declining inequality simply capture the build-up of the welfare state with increasing transfers. However in this case, you would expect to see that the reduction of the top income primarily went to the bottom of the distribution, which was in general not the case and especially not consistent with the reversal of the increase in the share of the bottom half between 1950 and 1965. This is not to say that there was no effect on the income distribution of increasing transfers, but some of it appears to have been countered by other effects, such as e.g. increases in life expectancy (creating more elderly with relatively low income for a given retirement age)

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[19] Some idea of the possible magnitude of the difference may be seen from the estimates for the UK. For 1970, the UK Gini coefficient for the taxable income of families derived from tax records was 38.5 per cent, for after tax income was 33.9 per cent, and for equalised family disposable income derived from a family survey was 25.9 per cent (source Royal Commission on the Distribution of Income and Wealth, 1979, Tables A.1 and A.3, and website of Institute for Fiscal Studies).
[20] These estimates, which start from 2002, are downloaded from the Eurostat website, where it should be noted that the income year is one year before the survey year.

and increases in enrolment rates into higher education (creating more students with temporary low earnings). Secondly the increase in the income shares of the D5-D9 indicates that the decline in inequality is driven by declining inequality among individuals on the labour market[21].

In the first decade of the 21st century, the top shares increased largely at the expense of decile groups D1-D4. For the groups D5-D8 the changes in income shares were 0.1 percentage points or less. The top decile group gained 1.2 percentage points and D9 gained 0.3, whereas D1-D4 lost 1.7 percentage points.

The joint distribution of wealth and income

Even though the data from before 1980 do not allow us to analysis the income composition within the different income groups, we do have the possibility to analysis the (joint) distribution of wealth and income, which – given some assumptions about the rate of return – can give an indication of the importance of capital income.

In this analysis we start by comparing our series for the income share of the top 1 per cent with the top 1 per cent wealth share (ranked by their wealth) constructed for Denmark by Alvaredo et. al. (forthcoming). This comparison shows that the wealth concentration by and large followed the development in the income concentration, cf. figure 12, with a type of stepwise declines over the 20th century. However it is interesting to note that the large increase in income inequality during the First World War did not result in a subsequent increase in the wealth concentration.

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[21] Various authors (Bjerke, 1957, Sørensen, 1989 have found that there has been a considerable equalization within different industries, while changes in the industry composition have tended to increase inequality (workers have moved from industries with initially low within-industry inequality to industries with initially high inequality).

Figure 12
The top 1 per cent income and wealth share
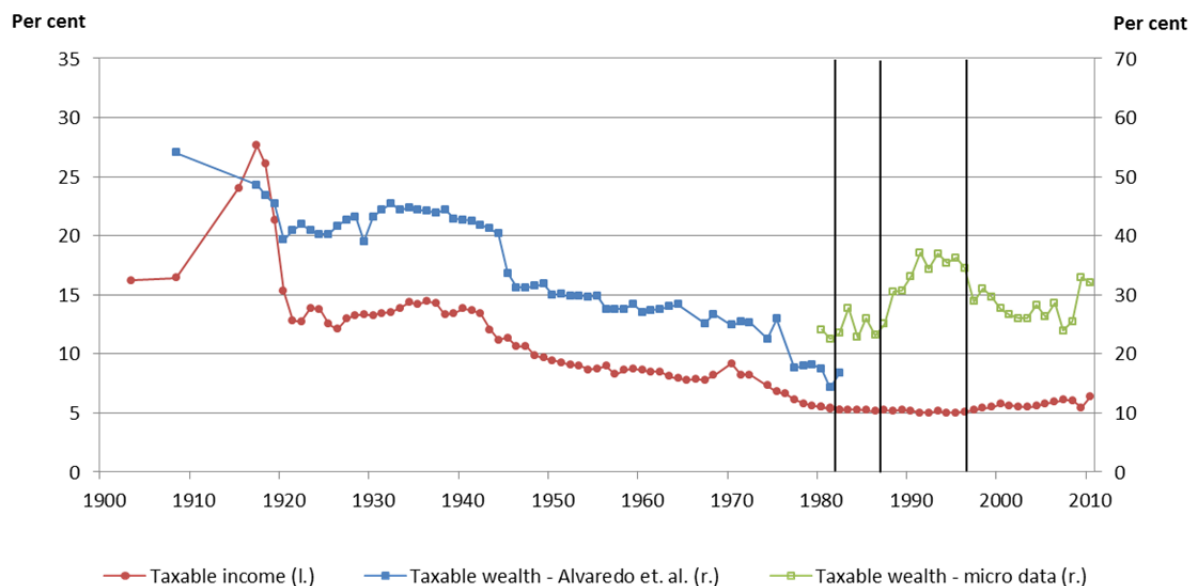
Notes: The top shares for income and wealth are calculated separately, i.e. taxpayers are re-ranked for each calculation. The estimates from Alvaredo et. al. (forthcoming) are family based throughout. The wealth share estimates from the micro-data have three major data breaks:
1983: Change from family to individual taxation.
1987: Firm equity for self-employed is included in the taxable wealth.
1997: The wealth tax is abolished, which affects the reporting of wealth to DS – both because wealth is no longer subject to self-reporting and because the abolition changed the incentive to avoid taxation by placing wealth in special assets.
Note also that the wealth data generally excluded wealth held in pension funds and that real estate is included at the public valuation, which in recent decades in general has been lower than actual estate prices.
Sources: Alvaredo et. al. (forthcoming), Statistics Denmark and own calculations.

One interpretation of this could be that the top income earners during the First World War were taxpayers with relatively low initial wealth and their accumulation thus deflated the wealth share of the top 1 per cent wealth holders. In other words, the war created a new set of rich taxpayers. Some evidence on this can be found by examine the joint distribution of wealth and income shown in figure 13, where the joint distribution is given by wealth-to-income ratios with individuals ranked according to their taxable income. These numbers can be calculated by cross-tabulations of income and wealth available for a number of years in the first half of the 20th century as well as from the micro-data from 1980. Unfortunately the cross-tabulations only cover the very top of the income distribution and we therefore here focus on the top 1 and 0.1 per cent.

Figure 13
The joint distribution of income and wealth
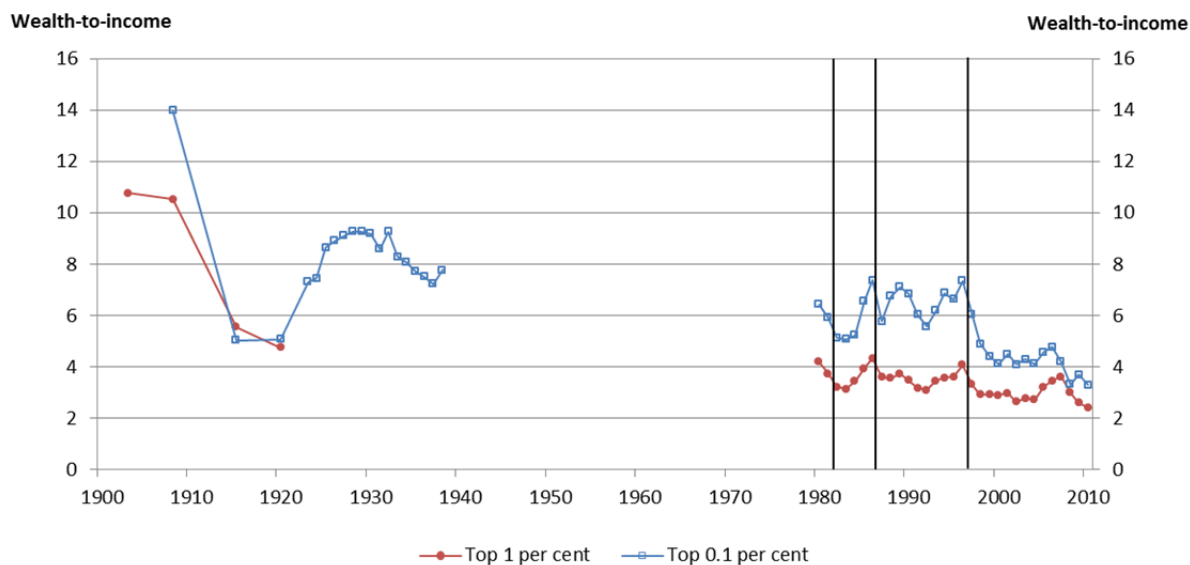
Notes: Taxpayers are ranked according to their taxable income. See figure 12 for a description of the data breaks.
Sources: Statistics Denmark and own calculations

As the figure shows the wealth-to-income ratio for the top 1 per cent is halved from 1908 to 1915 with a drop from ratio 10.5 to 5.6. Of this, the rise in the income share in itself explains around half as the income share of the top 1 per cent increased by 50 per cent from 1908 to 1915. There is in other words some indication that the war brought a new set of people with relatively low wealth to the top of the income distribution.

A second explanation for the lack of translation of the increase in income inequality into wealth inequality is the conduct of tax policy of the time. During the war the government found itself in need of extra funds to fend off some of social problems created by the rapid rise in prices and to maintain a larger army to defend the Danish neutrality. One of the revenue sources for this was the introduction of a tax on income growth with rates as high as 35 per cent[22], cf. Johansen (2007, p. 31). Despite the increases in the ordinary tax in 1915 and 1917, the tax on income growth collected more than double the revenue of the ordinary state tax for most years during the war. In effect this policy made it more difficult for newly high earning taxpayers to accumulate wealth compared to the existing.

After the First World War we have only information on the top 0.1 per cent income taxpayers, but this shows that the wealth-to-income ratio recovered around half of the drop that had accrued during the war and stayed there until the middle of the 1930s. From thereon it declined around 15 per cent towards the Second World War.

From 1938 and until 1980 we have a gap in the data series and we can thus not say anything about the wealth to income ratios in the interim period, besides that the ratio for the top 0.1 per cent drops from around 8 to around 6 over the 40 years. However one has firstly to keep in mind that the income tax system was changed to an individual basis in 1970, while the wealth tax system did not change until 1983. This latter change however does not create a visible break in the series in figure 13.

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[22] Contrary to the ordinary state tax, the tax on income growth was not added to the tax allowance.

Secondly, that real estate is included at the public valuation, which in recent decades in general has been lower than actual estate prices.

5 Comparison with Norway and Sweden

In this section, we compare the top income shares in Denmark with those in Norway and Sweden. For this purpose, we take the series as a whole, making no adjustment for the shift in tax unit in 1970, as the same issue arose for the other countries. In the case of Sweden, Roine and Waldenström (RW) take the adult population aged over 15 minus married women (as here) up to 1950, and from 1971 they take the adult population. These estimates are therefore comparable. The difference lies in that for the intervening period, from 1951 to 1970, RW deduct a proportion of married women, to represent those not in paid work, where this proportion declined over time. In contrast, in the case of Norway, Aaberge and Atkinson (AA) have used throughout the total number of adults. All series exclude capital gains.

The series for the three countries are shown in figure 14 and 15. At first sight, there are remarkable resemblances, however in order to explore this further, it is helpful to consider three sub-periods. The first is the period before 1914, when the data for Denmark and Sweden are relatively sparse: three observations for Denmark, four for Sweden, compared with seventeen for Norway. It is difficult to compare across different years, but for the one year when we have estimates for each country (1903) the share of the top 1 per cent in Denmark at 16.2 per cent is much lower than in Sweden, where it is 27.0 per cent. The estimate for Norway, on the other hand, is fairly close at 19.5 per cent (a difference that may be due to the use of a different control total for population). It is also the case that the 1907 estimate for Sweden is much lower, at 21.5 per cent.

Figure 14
Top 1 per cent income shares in the Scandinavian Countries
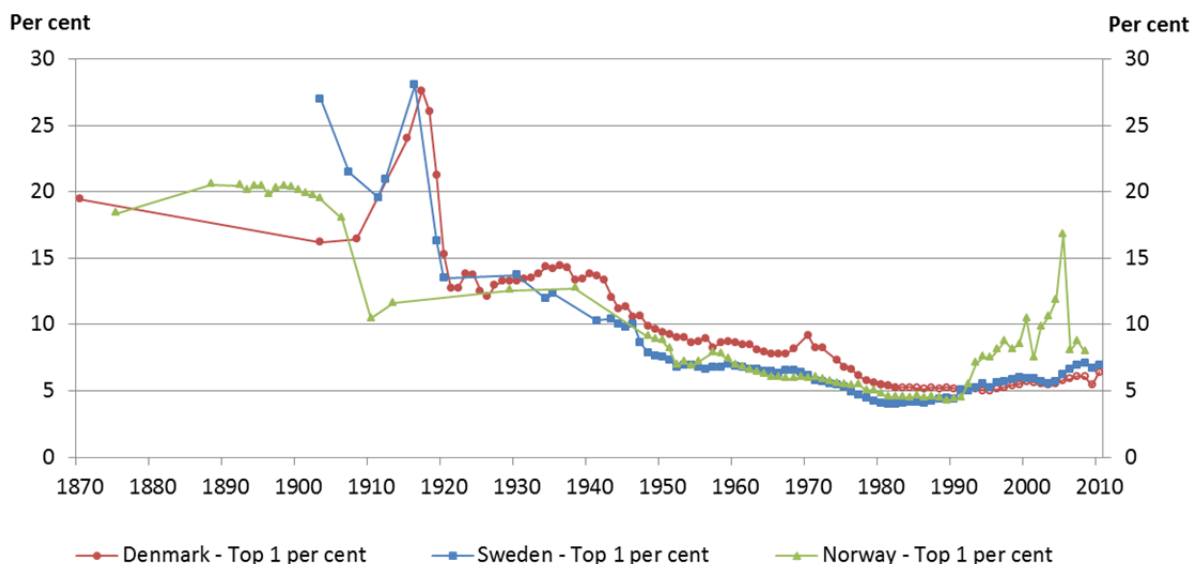
Sources: Own calculations, Aaberge and Atkinson (2010) and Roine and Waldenström (2010) collected from the WTID.

The second period is from 1914 to 1945. Here we can say little about Norway, as we have only two observations. For Sweden and Demark there is now an initial striking similarity, with the top 1 per cent share rising sharply in the First World War to reach 27-28 per cent in both countries. There was then a sharp fall after the war, and, although the Swedish data are sparser, the figures for 1930 are close

at 13-14 per cent. In the beginning of the 1930s, the top shares appear to be falling in Sweden, but rising (by about 1 percentage point for the top 1 per cent) in Denmark. There is more evidence of a fall in Denmark than in Sweden during the Second World War, but there is no sign of a rise in Sweden.

Figure 15
Top 10 per cent income shares in the Scandinavian Countries
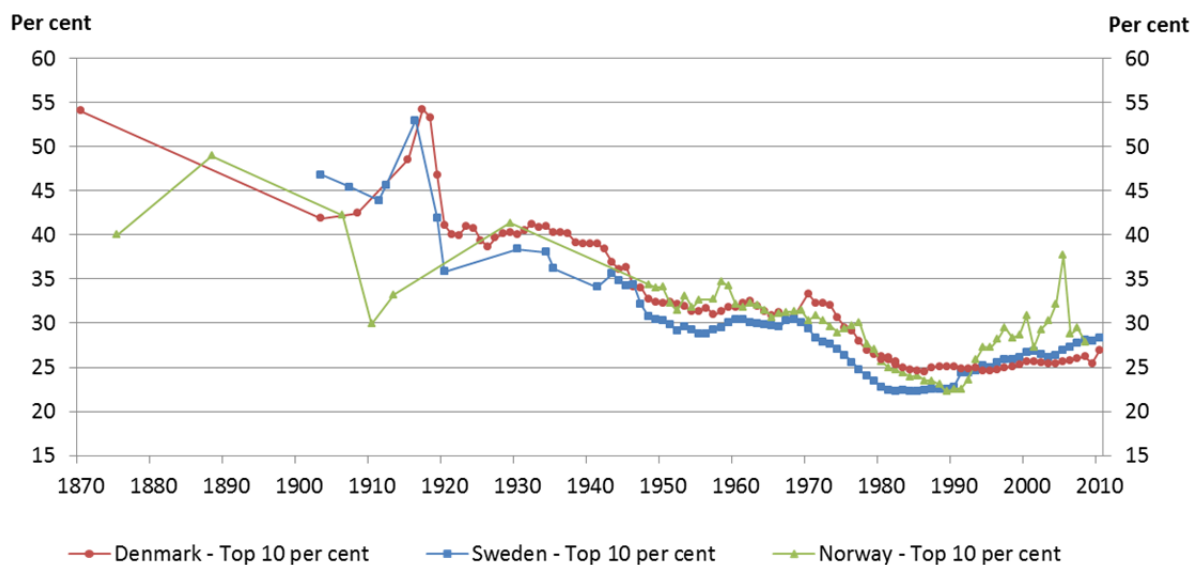
Sources: Own calculations, Aaberge and Atkinson (2010) and Roine and Waldenström (2010) collected from the WTID.

From 1948, there are almost complete series for all three countries. In the late 1940s and early 1950s, the share of the top 1 per cent fell in Sweden and Norway, leaving Denmark with a higher share until around 1990, although the difference began to narrow in the mid-1970s. For the top 10 per cent, the shares were consistently lower in Sweden; Denmark and Norway interchanged positions but by 1990, the share was some 2.5 percentage points higher in Denmark. From 1990, the top shares rose in Norway (where the spikes reflected changes in tax policy) and Sweden, and in recent years the shares of both the top 1 and top 10 per cent are similar in all three countries.

6 Conclusions

This paper has been concerned with the long-run development of income inequality in Denmark with particular reference to top income shares. To this end, we have constructed a new long-run top income series, paying particular attention to the consistency of the estimates over time and to the breaks in the series. We have also considered the overall distribution of income and the relation between income and wealth.

Using the constructed time series, it is possible to give some answers to the questions posed at the outset. There have been periods in the past when Denmark has seen significant reductions in top income shares: (possibly) in the last 30 years of the nineteenth century spanning the start of the industrialization in Denmark, and definitely over the Second World War, and in the 1970s. Where we have evidence covering the rest of the income distribution, it appears that the reduction of the income share in the top was broadly distributed to the rest of the income distribution. The income share in the bottom four decile groups increased by 3.6 percentage points from 1920 to 1965, while the increase for the next five decile groups was 6.6 percentage points. There have also been periods when top shares have increased: notably during the First World War, and in recent years. At the same time, the recent in-

crease is modest (some 1 percentage point) and top income shares in Denmark, which are now similar to those in Norway and Sweden, remain low by international standards. In contrast, the rise in overall inequality, as measured by the Gini coefficient, in recent years is a significant one: more than 3 percentage points from 1994 to 2010, implying that the lower parts of the income distribution have become more unequal.

The causes of the falls and rises in top income shares are open to debate, but we have highlighted notably the impact of increased labour force participation after 1970, and – more speculatively - the effect of differing movements in wages and prices in the First and Second World Wars. There is some indication that the First World War brought a new set of people with relatively low wealth to the top of the income distribution. We have discussed the role of taxation. The impact of marginal tax rates needs to be explored further, but the changes seem consistent with top income shares depending negatively on the top marginal tax rates, which have followed an inverted U-shape over the century. These mechanisms largely apply to the 20th century and we may therefore miss some important points if the declining inequality throughout the 20th century is simple a continuation of a trend from the 19th.

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Appendix A1: Sources of tabulated income tax data

Table A1

Sources of tabulated income tax data

Year	Tax year	Source
1870		SM 11.1873 (main) ST Litra E, No 4, Table I V. Falbe-Hansen og Will. Scharling, DS bind IV
1903*	1904-05	ST Litra E, No 4, Table I + VI
1908	1909-10	ST Litra E, No 7, Table I
1915	Population census	ST Litra A, 14 Table p. 24 + Table 2 in annex
1917*	1918-19	SM 4.57.7 Table 3
1918*	1919-20	SM.4.59.6 Table 3
1919*	1920-21	SM 4.61.6 Table 3
1920*	1921-22	SM 4.65.2 Table 3
1921*	1922-23	SM 4.67.5 Table 3
1922*	1923-24	SM 4.70.2 Table 3
1923*	1924-25	SM 4.72.2 Table 3 + 5
1924*	1925-26	SM 4.75.2 Table 3 + 5
1925*	1926-27	SM 4.77.4 Table 3 + 5
1926*	1927-28	SM 4.79.2 Table 3 + 5
1927*	1928-29	SM 4.82.4 Table 3 + 5
1928*	1929-30	SM 4.84.5 Table 3 + 5
1929*	1930-31	SM 4.87.5 Table 3 + 5
1930*	1931-32	SM 4.90.3 Table 3 + 5
1931*	1932-33	SM 4.92.5 Table 3 + 5
1932*	1933-34	SM 4.95.2 Table 3 + 5
1933*	1934-35	SM 4.97.2 Table 3 + 5
1934*	1935-36	SM 4.99.4 Table 3 + 5
1935*	1936-37	SM 4.103.3 Table 3 + 5
1936*	1937-38	SM 4.106.6 Table 3 + 5
1937*	1938-39	SM 4.108.2 Table 3 + 5
1938	1939-40	SM 4.110.2 Table 3 + 5
1939	1940-41	SM 4.112.4 Table 1 + 2 in annex
1940	1941-42	SM 4.115.2 Table 1 + 2 in annex
1941	1942-43	SM 4.119.2 Table 1 + 2 in annex
1942	1943-44	SM 4.121.4 Table 1 + 2 in annex
1943	1944-45	SM 4.124.3 Table 1 + 2 in annex
1944	1945-46	SM 4.127.2 Table 1 + 2 in annex
1945	1946-47	SM 4.131.3 Table 1 + 2 in annex
1946	1947-48	SM 4.134.2 Table 1 + 2 in annex

Table A1 – continued
Sources of tabulated income tax data

Year	Tax year	Source
1947	1948-49	SM 4.138.2 Table 1 + 2 in annex
1948	1949-50	SM 4.142.2 Table 1 + 2 in annex
1949	1950-51	SM 4.146.2 Table 1 + 2 in annex
1950	1951-52	SM 4.150.2 Table 1 + 2 in annex
1951	1952-53	SM 4.153.2 Table 1 + 2 in annex
1952	1953-54	SM 4.159.2 Table 1 + 2 in annex
1953	1954-55	SM 4.161.2 Table 1 + 2 in annex
1954	1955-56	SM 4.165.2 Table 1 + 2 in annex
1955	1956-57	SM 4.168.2 Table 1 + 2
1956	1957-58	SA 1958 Table 296 + SM 4.171.2, Table 1B + 2B
1957	1958-59	SA 1959 Table 304
1958	1959-60	SA 1960 Table 296
1959	1960-61	SA 1961 Table 307
1960	1961-62	SA 1962 Table 316
1961	1962-63	SA 1963-64 Table 325
1962	1963-64	SM 1968.4 Table 2
1963	1964-65	SM 1969.4 Table 6
1964	1965-66	SM 1969.4 Table 2
1965	1966-67	SM 1970.15 Table 6B
1966	1967-68	SM 1970.15 Table 2A
1967	1968-69	SM 1971.9 Table 2A
1968*	1969-70	SM 1970.2 Table 1 (only frequencies)
1969	**Tax free year**	
1970	1970	ST 1973.3 Table 3 + 4
1971	1971	ST 1974.3 Table 2A + 2B
1972	1972	SA 1976 Table 376 + ST 1975.4 Table 2A + 2b
1973	1973	SA 1977 Table 346 + ST 1975.9 Table 3B+ 4B
1974	1974	SA 1977 Table 346 + ST 1976.4 Table 7A + 7B
1975	1975	SA 1977 Table 346 + ST 1977.6 Table 4A + 4B
1976*	1976	ST 1978.7 Table 10 + ST10 1980 p. 88-89

Table A1 – continued
Sources of tabulated income tax data

Year	Tax year	Source
1977	1977	ST 1979.4 Table 10
1978	1978	ST 1980.6 Table 10
1979	1979	ST 1981.2 Table 10
1980	1980	ST 1982.5 Table 10
1981	1981	I&F 1981 Table 10
1982	1982	I&F 1982 Table 10

Notes: * indicates that we for that year also have relied on estimates by Sørensen (1989). Typically for the income in the lowest interval. However for 1903 we have used his estimates to split the income for the taxpayers with an income above 6,000 DKK into 4 additional subgroups (the cut-off for the top 1 per cent in 1903 was 5,400 DKK). From 1968 the tabulated data only contain the number of taxpayers within each interval and we have instead used Sørensen's estimates for the interval mean income. For 1976 we have used Sørensen's estimates to combine the data from ST10 1980 p. 88-89 with the finer tabulated frequencies in ST 1978.7 Table 10.

Abbreviations:
   DS   Statistics Denmark, Copenhagen, Denmark (www.dst.dk).
   ST   Statistiske Tabelværk (available at DS' library, Copenhagen, Denmark).
   SM   Statistiske Meddelelser (available at DS' library, Copenhagen, Denmark).
   SA   Statistisk Årbog (available online: http://www.dst.dk/aarbogsarkiv).
   I&F   Indkomst og Formue (available at DS' library, Copenhagen, Denmark).
   ST10   Statistisk Tiårsoversigt (available at DS' library, Copenhagen, Denmark).

Appendix A2: Tables of totals and income shares

Table A2
Population totals

	Number of adults	Number of families	Number of tax returns	Used population total
1870	1,189,173	880,991	139,446	880,991
1900	#N/A	#N/A	#N/A	#N/A
1901	1,616,400	1,194,956	#N/A	#N/A
1902	1,636,800	1,208,851	#N/A	#N/A
1903	1,656,100	1,221,647	314,246	1,221,647
1904	1,675,100	1,234,142	#N/A	#N/A
1905	1,694,200	1,246,738	#N/A	#N/A
1906	1,717,200	1,263,233	#N/A	#N/A
1907	1,737,300	1,276,828	#N/A	#N/A
1908	1,757,900	1,290,924	365,968	1,290,924
1909	1,781,700	1,308,219	#N/A	#N/A
1910	1,805,700	1,325,715	#N/A	#N/A
1911	1,829,800	1,343,310	#N/A	#N/A
1912	1,856,100	1,358,580	#N/A	#N/A
1913	1,879,600	1,371,050	#N/A	#N/A
1914	1,905,500	1,385,920	#N/A	#N/A
1915	1,934,600	1,403,990	603,004	1,403,990
1916	1,969,600	1,427,960	#N/A	#N/A
1917	2,002,500	1,449,829	611,865	1,449,829
1918	2,036,300	1,472,599	694,412	1,472,599
1919	2,068,200	1,493,469	916,249	1,493,469
1920	2,104,200	1,518,439	1,042,672	1,518,439
1921	2,246,600	1,649,809	1,037,264	1,649,809
1922	2,284,100	1,676,222	1,050,447	1,676,222
1923	2,318,600	1,699,634	1,083,361	1,699,634
1924	2,353,400	1,723,347	1,138,744	1,723,347
1925	2,390,500	1,749,359	1,165,748	1,749,359
1926	2,428,800	1,776,572	1,149,092	1,776,572
1927	2,461,200	1,797,884	1,125,946	1,797,884
1928	2,491,200	1,816,797	1,127,628	1,816,797
1929	2,521,200	1,835,709	1,162,505	1,835,709
1930	2,550,000	1,853,422	1,188,456	1,853,422
1931	2,582,100	1,871,025	1,153,026	1,871,025
1932	2,620,300	1,894,728	1,088,814	1,894,728
1933	2,656,000	1,915,931	1,148,186	1,915,931
1934	2,694,200	1,939,634	1,225,533	1,939,634
1935	2,729,000	1,959,937	1,286,568	1,959,937
1936	2,770,500	1,987,043	1,328,102	1,987,043

Table A2 – continued

Population totals

	Number of adults	Number of families	Number of tax returns	Used income total
1937	2,805,600	2,007,749	1,377,663	2,007,749
1938	2,836,300	2,024,056	1,807,364	2,024,056
1939	2,868,900	2,042,262	1,838,649	2,042,262
1940	2,903,700	2,062,668	1,859,248	2,062,668
1941	2,926,000	2,071,062	1,885,716	2,071,062
1942	2,955,900	2,087,055	1,911,003	2,087,055
1943	2,985,400	2,102,649	1,938,836	2,102,649
1944	3,015,700	2,119,042	1,958,858	2,119,042
1945	3,039,500	2,128,936	1,982,614	2,128,936
1946	3,060,400	2,134,315	2,014,435	2,134,315
1947	3,075,800	2,134,194	2,030,498	2,134,194
1948	3,093,300	2,136,174	2,045,151	2,136,174
1949	3,113,300	2,140,653	2,054,878	2,140,653
1950	3,137,300	2,149,132	2,089,810	2,149,132
1951	3,155,200	2,157,853	2,097,172	2,157,853
1952	3,174,400	2,167,874	2,110,676	2,167,874
1953	3,197,000	2,181,295	2,127,762	2,181,295
1954	3,224,800	2,199,916	2,147,809	2,199,916
1955	3,249,200	2,215,137	2,161,827	2,215,137
1956	3,271,700	2,228,457	2,153,326	2,228,457
1957	3,291,100	2,238,678	2,165,455	2,238,678
1958	3,318,200	2,256,599	2,181,340	2,256,599
1959	3,356,300	2,285,520	2,213,213	2,285,520
1960	3,402,800	2,322,841	2,220,770	2,322,841
1961	3,447,600	2,356,797	2,256,399	2,356,797
1962	3,498,200	2,396,554	2,288,963	2,396,554
1963	3,543,400	2,430,910	2,287,429	2,430,910
1964	3,581,300	2,457,967	2,310,578	2,457,967
1965	3,613,200	2,479,023	2,335,931	2,479,023
1966	3,641,200	2,495,423	2,355,794	2,495,423
1967	3,668,200	2,510,823	2,380,214	2,510,823
1968	3,698,100	2,529,123	2,395,790	2,529,123
1969	3,724,700	2,544,123	#N/A	#N/A
1970	3,757,300	2,565,123	3,833,346	3,833,346
1971	3,804,135	2,600,358	3,889,483	3,889,483
1972	3,827,988	2,618,333	3,944,423	3,944,423
1973	3,857,935	2,651,757	4,064,136	4,064,136
1974	3,887,730	2,687,390	3,959,514	3,959,514
1975	3,908,751	2,711,956	3,982,830	3,982,830
1976	3,924,109	2,733,669	4,020,502	4,020,502

Table A2 – continued

Population totals

	Number of adults	Number of families	Number of tax returns	Used income total
1977	3,947,383	2,763,048	4,058,633	4,058,633
1978	3,977,050	2,795,870	4,112,026	4,112,026
1979	4,009,135	2,835,326	4,148,024	4,148,024
1980	4,040,634	2,875,270	4,104,271	4,104,271
1981	4,069,119	2,915,640	4,133,937	4,133,937
1982	4,098,841	2,959,315	4,158,752	4,158,752
1983	4,124,161	2,999,081	4,179,597	4,179,597
1984	4,142,755	3,029,489	4,197,772	4,197,772
1985	4,160,393	3,056,611	4,229,858	4,229,858
1986	4,181,143	3,085,278	4,243,392	4,243,392
1987	4,206,840	3,116,986	4,271,674	4,271,674
1988	4,227,970	3,143,803	4,298,507	4,298,507
1989	4,240,474	3,161,858	4,310,761	4,310,761
1990	4,254,852	3,182,671	4,326,341	4,326,341
1991	4,272,839	3,204,705	4,326,943	4,326,943
1992	4,287,181	3,220,252	4,338,304	4,338,304
1993	4,298,051	3,232,659	4,348,857	4,348,857
1994	4,307,391	3,244,962	4,356,649	4,356,649
1995	4,314,802	3,251,991	4,362,788	4,362,788
1996	4,331,347	3,264,485	4,375,910	4,375,910
1997	4,338,174	3,267,298	4,383,441	4,383,441
1998	4,342,672	3,269,929	4,386,982	4,386,982
1999	4,345,934	3,270,766	4,390,883	4,390,883
2000	4,348,872	3,271,310	4,395,071	4,395,071
2001	4,354,699	#N/A	4,401,791	4,401,791
2002	4,363,151	#N/A	4,420,728	4,420,728
2003	4,370,461	#N/A	4,430,778	4,430,778
2004	4,380,062	#N/A	4,442,534	4,442,534
2005	4,393,259	#N/A	4,457,918	4,457,918
2006	4,411,580	#N/A	4,477,839	4,477,839
2007	4,432,931	#N/A	4,502,002	4,502,002
2008	4,465,874	#N/A	4,533,914	4,533,914
2009	4,503,365	#N/A	4,573,664	4,573,664
2010	4,533,420	#N/A	4,603,096	4,603,096

Notes: Number of adults = age 15+, Number of families = age 15+ minus married women.

Sources: The number of adults is taken from DS online database (tables HISB3, HISB4, BEF1). The number of married women from before 1970 has been interpolated based on the populations censuses, which were typically conducted with a 5 year interval. These are available in various DS statistical yearbook. The number of tax returns is taken from the tabulated data, the statistical yearbooks or – from 1980 – the micro-data. The source of the 1915 observation is the population census that year and therefore covers the whole population.

Table A3
Income totals (Mill. DKK)

	Reported income	Assessed income	Taxable income	GFI
1870	241	374	375	669
1900	#N/A	#N/A	#N/A	1,322
1901	#N/A	#N/A	#N/A	1,372
1902	#N/A	#N/A	#N/A	1,396
1903	601	954	956	1,462
1904	#N/A	#N/A	#N/A	1,479
1905	#N/A	#N/A	#N/A	1,558
1906	#N/A	#N/A	#N/A	1,627
1907	#N/A	#N/A	#N/A	1,739
1908	1,054	1,054	1,067	1,773
1909	#N/A	#N/A	#N/A	1,828
1910	#N/A	#N/A	#N/A	1,922
1911	#N/A	#N/A	#N/A	2,051
1912	#N/A	#N/A	#N/A	2,159
1913	#N/A	#N/A	#N/A	2,301
1914	#N/A	#N/A	#N/A	2,529
1915	1,727	1,727	1,767	2,887
1916	#N/A	#N/A	#N/A	3,767
1917	1,922	2,245	2,349	4,003
1918	2,452	2,745	2,934	4,766
1919	3,365	3,585	3,820	5,821
1920	4,027	4,234	4,439	7,396
1921	3,486	3,707	3,856	6,057
1922	3,083	3,309	3,399	5,406
1923	3,288	3,510	3,606	6,030
1924	3,563	3,770	3,886	6,566
1925	3,492	3,696	3,801	6,153
1926	3,107	3,329	3,416	5,529
1927	2,925	3,165	3,237	5,318
1928	2,942	3,187	3,257	5,437
1929	3,113	3,346	3,420	5,802
1930	3,159	3,387	3,463	5,705
1931	2,910	3,181	3,268	5,369
1932	2,611	2,917	3,006	5,112
1933	2,808	3,090	3,201	5,506
1934	3,095	3,342	3,446	5,967
1935	3,263	3,515	3,622	6,380
1936	3,391	3,640	3,770	6,690
1937	3,547	3,779	3,963	7,047
1938	3,938	3,938	4,121	7,312

Table A3 – continued
Income totals (Mill. DKK)

	Reported income	Assessed income	Taxable income	GFI
1939	4,243	4,243	4,478	7,942
1940	4,419	4,419	4,757	8,613
1941	5,089	5,089	5,505	9,736
1942	5,630	5,630	6,112	10,842
1943	6,386	6,386	6,958	12,346
1944	7,132	7,132	7,795	14,015
1945	7,757	7,757	8,567	14,049
1946	8,812	8,812	9,767	15,338
1947	9,340	9,340	10,407	16,891
1948	10,036	10,036	11,230	18,284
1949	10,621	10,621	11,936	19,413
1950	11,736	11,736	13,416	22,041
1951	12,417	12,417	14,508	24,128
1952	13,232	13,232	15,681	25,422
1953	13,860	13,860	16,498	26,785
1954	14,612	14,612	17,471	27,618
1955	15,266	15,266	18,413	28,706
1956	16,266	16,266	18,888	30,634
1957	16,918	16,918	19,719	32,668
1958	17,928	17,928	21,060	33,981
1959	19,553	19,553	23,237	37,435
1960	21,046	21,046	25,251	40,523
1961	24,005	24,005	29,399	45,375
1962	26,722	26,722	33,278	50,768
1963	28,731	28,731	36,146	53,476
1964	31,808	31,808	40,581	61,071
1965	35,514	35,514	46,120	68,291
1966	38,404	38,404	46,937	70,394
1967	54,890	#N/A	56,027	77,050
1968	60,731	#N/A	62,098	84,973
1969	#N/A	#N/A	#N/A	96,754
1970	75,351	#N/A	77,393	106,946
1971	84,339	#N/A	86,711	118,476
1972	94,025	#N/A	96,670	135,126
1973	107,670	#N/A	110,562	157,657
1974	124,506	#N/A	128,327	179,484
1975	143,596	#N/A	148,443	200,427
1976	161,931	#N/A	167,373	231,306
1977	179,727	#N/A	186,024	254,836
1978	199,352	#N/A	206,744	281,384
1979	220,068	#N/A	228,453	309,914

Table A3 – continued
Income totals (Mill. DKK)

	Reported income	Assessed income	Taxable income	GFI
1980	241,137	#N/A	251,037	335,531
1981	261,908	#N/A	273,467	368,076
1982	296,532	#N/A	309,772	424,879
1983	324,826	#N/A	338,912	467,634
1984	346,348	#N/A	361,101	515,226
1985	370,616	#N/A	385,641	555,579
1986	393,118	#N/A	408,350	588,479
1987	421,212	#N/A	438,289	622,104
1988	445,106	#N/A	464,522	648,999
1989	465,060	#N/A	486,301	691,997
1990	481,199	#N/A	503,301	727,658
1991	500,079	#N/A	523,689	758,684
1992	519,176	#N/A	544,354	793,221
1993	529,333	#N/A	556,226	794,968
1994	571,395	#N/A	571,395	847,677
1995	590,743	#N/A	590,743	883,964
1996	611,057	#N/A	611,057	923,196
1997	626,907	#N/A	626,907	966,179
1998	652,734	#N/A	652,734	988,395
1999	681,952	#N/A	681,952	1,032,314
2000	692,150	#N/A	692,150	1,110,791
2001	722,084	#N/A	722,084	1,143,733
2002	743,178	#N/A	743,178	1,174,258
2003	763,349	#N/A	763,349	1,199,055
2004	783,156	#N/A	783,156	1,250,094
2005	808,131	#N/A	808,131	1,311,270
2006	838,057	#N/A	838,057	1,381,275
2007	866,676	#N/A	866,676	1,436,759
2008	885,725	#N/A	885,725	1,497,124
2009	888,854	#N/A	888,854	1,437,186
2010	952,302	#N/A	952,302	1,510,814

Notes: The income concepts refer to the following:
1) Reported income: The income total of the legal tax base from the DS tabulated income statistics and the micro-data from 1980.
2) Assessed income: Reported income plus the DS' estimates of the income below the cut-off of 800 DKK. From 1917-1937 the income below the cut-off has been estimated by Sørensen (1989).
3) Taxable income: Before 1966, assessed income plus our own estimates of the allowance for ordinary state income taxes (with effect from 1908). Before 1994 the taxable income series have further been adjusted for the grossing up of income transfers in 1994 as descripted below.
Expressed as a percentage of Gross Factor Income given by Hansen (1974) (1870-1936) and DS (1937-2010).
Sources: Statistics Denmark, Bjerke and Ussing (1957), Hansen (1974), Sørensen (1989) and own calculations.

Table A4
Income shares

	Top 10	Top 5	Top 1	Top 0.1
1870	54.1	40.2	19.4	7.4
1900	#N/A	#N/A	#N/A	#N/A
1901	#N/A	#N/A	#N/A	#N/A
1902	#N/A	#N/A	#N/A	#N/A
1903	41.9	31.3	16.2	6.1
1904	#N/A	#N/A	#N/A	#N/A
1905	#N/A	#N/A	#N/A	#N/A
1906	#N/A	#N/A	#N/A	#N/A
1907	#N/A	#N/A	#N/A	#N/A
1908	42.4	31.7	16.5	6.3
1909	#N/A	#N/A	#N/A	#N/A
1910	#N/A	#N/A	#N/A	#N/A
1911	#N/A	#N/A	#N/A	#N/A
1912	#N/A	#N/A	#N/A	#N/A
1913	#N/A	#N/A	#N/A	#N/A
1914	#N/A	#N/A	#N/A	#N/A
1915	48.5	38.7	24.0	12.0
1916	#N/A	#N/A	#N/A	#N/A
1917	54.2	43.9	27.6	13.2
1918	53.3	42.9	26.1	11.6
1919	46.8	36.2	21.3	9.8
1920	41.1	29.9	15.3	6.1
1921	40.1	27.8	12.8	4.5
1922	40.0	27.9	12.8	4.1
1923	41.0	29.1	13.9	4.8
1924	40.8	29.0	13.8	4.8
1925	39.3	27.5	12.5	4.1
1926	38.7	26.8	12.1	3.8
1927	39.7	27.9	13.0	4.3
1928	40.1	28.3	13.3	4.4
1929	40.3	28.4	13.3	4.4
1930	40.0	28.3	13.3	4.3
1931	40.5	28.6	13.4	4.4
1932	41.2	29.0	13.5	4.4
1933	40.9	29.0	13.9	4.7
1934	40.9	29.3	14.4	4.9
1935	40.2	28.8	14.2	5.0
1936	40.3	29.0	14.4	5.1
1937	40.1	28.9	14.3	5.0
1938	39.1	27.8	13.3	4.5

Table A4 – continued
Income shares

		Top 10	Top 5	Top 1	Top 0.1
1939		39.0	27.8	13.5	4.6
1940		39.0	28.0	13.8	4.9
1941		39.0	28.2	13.7	4.7
1942		38.4	27.6	13.4	4.4
1943		36.9	26.2	12.1	3.7
1944		36.1	25.3	11.2	3.3
1945		36.3	25.5	11.4	3.4
1946		34.1	23.6	10.6	3.4
1947		34.0	23.6	10.7	3.5
1948		32.7	22.3	9.9	3.1
1949		32.3	21.9	9.7	3.1
1950		32.2	21.5	9.4	3.0
1951		32.3	21.4	9.3	2.9
1952		32.2	21.2	9.0	2.8
1953		31.9	21.2	9.0	2.8
1954		31.3	20.8	8.7	2.6
1955		31.3	20.7	8.8	2.8
1956		31.7	21.3	9.0	2.8
1957		30.9	20.4	8.3	2.4
1958		31.3	20.7	8.6	2.6
1959		31.8	21.1	8.7	2.6
1960		31.8	21.2	8.6	2.6
1961		32.3	21.3	8.5	2.5
1962		32.5	21.3	8.5	2.4
1963		31.9	20.7	8.1	2.2
1964		31.3	20.2	7.9	2.2
1965		30.9	19.9	7.8	2.1
1966		31.2	20.4	7.8	2.0
1967		30.3	19.9	7.8	#N/A
1968		30.7	20.2	8.2	#N/A
1969		Change from family to individual taxation			
1970		33.3	22.3	9.2	#N/A
1971		32.3	21.2	8.2	2.2
1972		32.3	21.2	8.2	2.3
1973		32.0	20.9	#N/A	#N/A
1974		30.6	19.6	7.3	1.9
1975		29.5	18.8	6.8	1.7
1976		29.1	18.4	6.6	#N/A
1977		27.9	17.5	6.1	1.5
1978		26.9	16.7	5.8	1.4
1979		26.4	16.3	5.6	1.4

Table A4 – continued
Income shares

		Top 10	Top 5	Top 1	Top 0.1
1980		25.9	15.9	5.5	1.4
1981		25.8	15.8	5.4	1.3
1982		25.3	15.4	5.2	1.3
1983		25.0	15.3	5.3	1.4
1984		24.7	15.2	5.3	1.4
1985		24.6	15.1	5.2	1.3
1986		24.5	15.0	5.2	1.3
1987		24.9	15.3	5.2	1.4
1988		25.1	15.4	5.2	1.3
1989		25.1	15.4	5.2	1.3
1990		25.1	15.4	5.2	1.3
1991		24.8	15.2	5.0	1.2
1992		24.9	15.2	5.0	1.2
1993		24.9	15.4	5.1	1.3
1994		24.6	15.1	5.0	1.2
1995		24.6	15.1	5.0	1.2
1996		24.7	15.2	5.1	1.2
1997		24.9	15.5	5.2	1.2
1998		25.1	15.7	5.4	1.3
1999		25.3	15.8	5.5	1.4
2000		25.7	16.2	5.7	1.5
2001		25.6	16.1	5.6	1.4
2002		25.5	16.0	5.5	1.4
2003		25.4	15.9	5.5	1.4
2004		25.4	16.0	5.6	1.4
2005		25.7	16.2	5.8	1.6
2006		25.7	16.3	5.9	1.7
2007		26.0	16.5	6.1	1.8
2008		26.2	16.6	6.1	1.7
2009		25.4	15.8	5.4	1.4
2010		26.9	17.2	6.4	1.9

Sources: Own calculations

Appendix A3: Description of the micro data from 1980-2010

Our analysis of the micro-data from 1980 and onwards is conducted on the server of the Kraka Foundation (www.kraka.org) managed by Statistics Denmark (DS)[1]. This server contains a number of rich register data sets organized by DS and from these we draw the yearly income data sets (*indk*) augmented with the age variable from the family and population data sets (*fabe*). This age variable is measured at the beginning of the year, and we therefore add 1 in order to bring it in line with the age used by the tax authorities, which is measured at the end of the year.

From these data sets we start by collecting the legal taxable income (DS variable: *qsplindk*) and legal gross income defined as taxable income before deductions (*brutto*), which were the only definitions available in the tabulated data before 1980[2]. These concepts are naturally affected by changes in the tax code and legislation more broadly, with the most important for this study since 1980 being:

- From 1987 self-employed are able to retain profits in the company, so that these first enter taxable income at a later stage[3].
- In 1990 and especially in 1994 some formerly tax exempt transfers are raised and made taxable.
- From 1991 stock income (capital gains and dividends) are taxed under a separate scheme and it no longer included in taxable income.
- From 2000 imputed rents are taxed under a separate scheme and are no longer included in taxable income.

It should further be kept in mind that capital gains in general were not included in both income concepts, as they were taxed under a special income scheme before 1993 and as stock income (together with dividends) hereafter.

Of these changes it is only the grossing up of transfers in 1994 that seems to have a visible effect on the distributions of taxable and legal gross income. As shown in figure A1, the Gini coefficients for both concepts drop around 4 percentage points. The effect on the income share of the top 10 per cent is of an order of 1-1.5 percentage points.

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[1] A precise description of all variables is available at the DS homepage:
www.dst.dk/da/TilSalg/Forskningsservice/Dokumentation.aspx. See also www.dst.dk/en/TilSalg/Forskningsservice.aspx.
[2] A consistent tabulation of legal gross income was not available in the tabulated data before 1977.
[3] While the 1987-reform also introduced the dual tax system, the definition of taxable income was not affected. The duality was achieved by introducing a new income concept consisting only of labour income and taxing this at an extra rate.

Figure A1
The Gini coefficient and the top 10 per cent income share without the 1994 correction
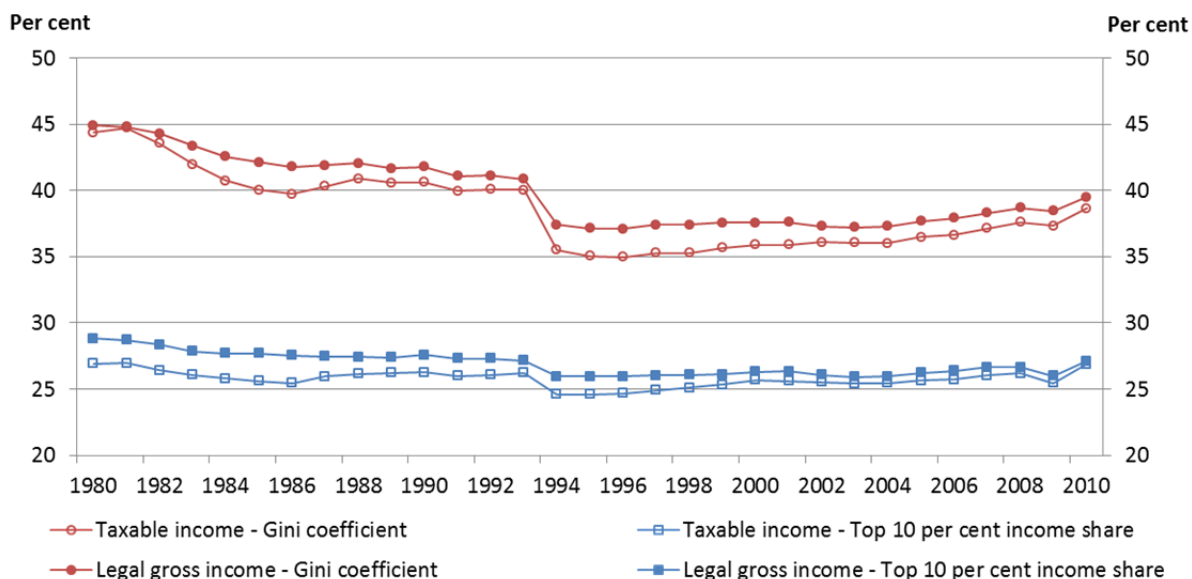
Notes: Compared with the income shares used in the paper, the ones we use here have not been corrected for the grossing up of transfers in 1994.
Sources: Statistics Denmark

None of the other data breaks create visible breaks in the series. However we return to the issue of dividends (and capital gains) below.

What is further evident from figure A1 is that there are no systematic differences in the development in the inequality measures based on taxable and legal gross income[4], which indicates that changes in deduction rules have not affected the distribution significantly. This gives us some confidence in that inequality measured in taxable income also historically is a good proxy for the development in gross income.

DS have also computed a more standardized gross income concept (*perindkialt*), which is in principle unaffected by the changes in tax code (i.e. what income types that are taxed). However given that reporting rules are often tied to the tax code, this income concept is indirectly affected. This is in particular true for stock income (dividends and capital gains), where the reporting to the tax authorities and thus DS have changes systematically since 1980. Furthermore, the development in the top income shares from this income concept closely follows those in figure A1[5], when we exclude stock income (*aktieindk*).

One way of assessing the impact of stock income on the top income shares is to add *aktieindk* to the taxable income *qsplindk* from 1991 and onwards. This has been done in figure A2, which shows that the inclusion of stock income increases the top 10 per cent share from the beginning of the 1990s to 2000 by around 1.5 percentage points.

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[4] This is also the case for the period 1977-1982, where the legal gross income is available in tabulated data.
[5] Before 1991 the variable *aktieindk* only contains dividends (from Danish companies), while non-tax exempt capital gains generally were placed in the residual income variable (resuink_gl) along with a range of other "hard-to-classify" income variables. Subtracting this variable from *perindkialt* along with *aktieindk* does not change the above conclusion.

Figure A2
Total stock income and the top 10 per cent income share
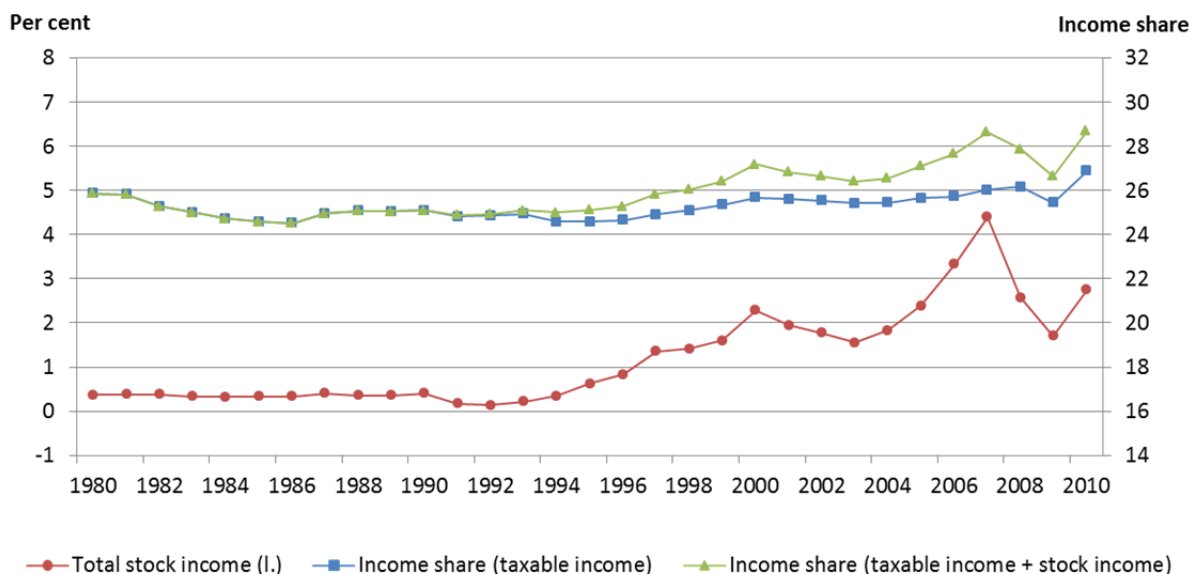
Notes: Total stock income (*aktieindk*) is measured in per cent of taxable income + stock income (*qsplindk* + *aktieindk*).
         The series have been adjusted for the grossing up of transfers as description in section 2 in the paper. The same
         scaling factor has been used for both income totals.
Sources: Statistics Denmark

However, what is also evident from figure A2 is that this may simple reflect that changes in re-porting rather the changes in the real income distribution. This is indicated by the fact that the total stock income reported to DS increases from almost nothing in the beginning of the period to around 2 per cent of taxable income (plus stock income) from 2000 and onwards. This implies that, while the levels of inequality using stock income presumably are more accurately measured in the end of the pe-riod, the increase over the period is likely to be exaggerated. Figure A2 further gives a reason for why the removal of dividends from taxable income in 1991 did not create a visible break in the time series. The level of reported dividends was simply negligible.

For the analysis of wealth-to-income shares in section 4 we have used reported wealth for the wealth taxation (*form*) until 1996, and the variable *formrest_ny05* after the wealth tax were abolished. Among other things this imply that the value of certain consumer durables (such as cars) are excluded from the measure along with the firm equity for self-employed.

Appendix A4: Upper and lower bounds on the income shares

In the paper we focused solely on the income shares calculated by the mean split histogram method described in e.g. Atkinson (2005). This method assumes that the individual incomes within an interval increase linearly from the lower to the upper cut-off with a kink point at the average income in the interval. In this section we assess the uncertainty around this estimate by calculating the global (linear) upper and lower bounds by assuming that individuals within each interval either earns the interval mean (no within-equality) or is split in two groups earning the lower and upper income cut-off respectively (maximum within-equality).

The results of these calculations for the top 10 and top 1 per cent are shown in figure A3, from where it is evident that the uncertainty on the top 1 per cent throughout the whole period lies between +/- 0.5 percentage points. For the top 10 per cent the uncertainty is virtually zero before 1940, while it is more substantial in the 1940s and 50s with bounds going up to +/- 1 percentage point.

Figure A3
Deviations from the mean split interpolation of the income shares
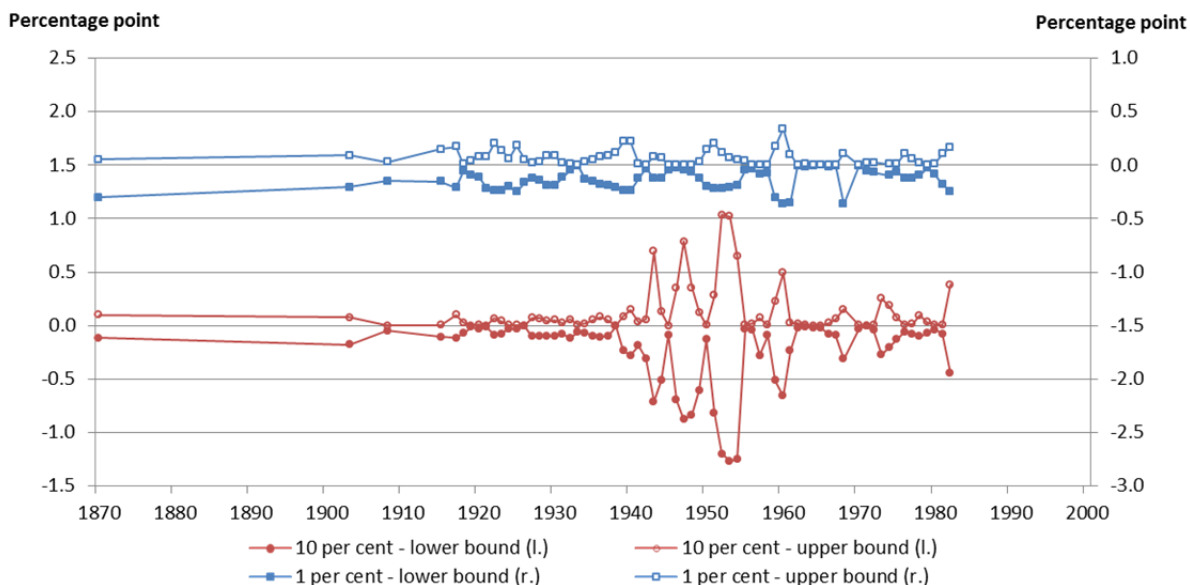
Sources: Own calculation

From 1980 the shares are calculated using micro data and there is thus no interpolation uncertainty in the estimates.