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# Inequality and top incomes

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## Abstract

This chapter comprises three main parts. The first part is about data sources, the definitions of income, and the methodologies used to estimate top income shares. Both the standard sources and methods used by the traditional top income studies are described. Further, new developments that employ new sources and estimation approaches are added, a detailed survey of the top-correction methods for surveys including reweighting and replacing top incomes is provided and approaches to align surveys, income tax data, and national accounts are contrasted. The second part of the chapter is a description of the main trends of top income shares that are the result of the previous studies. Different measures discussed in the methods section are presented and compared. The third part of the chapter surveys the literature on the determinants of top income shares. The focus of the third part is on studies that propose new methods to establish links between driving factors and top income shares.

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# 1 Introduction

The evolution of income inequality is attracting considerable attention from researchers and policymakers around the world. Particular attention is paid to the top of the income distribution, namely the evolution of income shares accruing to the top of the distribution. This focus largely stems from a strand in the research literature on economic inequality that emerged in the early 2000s following Piketty (2001), Piketty (2003), Piketty and Saez (2003) and Atkinson (2005).

The top income literature emerged from the ambition to study the evolution of inequality over the path of development (Kuznets, 1953; Feenberg and Poterba, 1993, 2000). To find data sources that are consistent and comparable over time is an inherent problem in the estimation of long-run trends in income inequality. Household survey data and tax-based microdata registers have become available only in recent decades. The innovation came when researchers understood that income tax statistics often contained distributional tables and they have been produced since the introduction of modern tax systems in the early twentieth century. A specific aspect of the early income taxation was that only those with the highest incomes were taxed and required to file tax returns, which means that the longest consistent data series for income distributions available are those that cover the tax-paying top of the income distribution.

Since the early top income share studies, this line of research has moved on to analyzing top incomes' role in the economy as something inherently important. Some papers link top incomes to theories of market concentration and winner-takes-all markets (for example, Rosen 1981, Frank and Cook 1995, Gabaix and Landier 2008), innovation (Aghion et al., 2018), compensation schemes in the financial industry (Phillippon and Reshef 2012), and political influence (Hacker and Pierson 2011).

The top income literature has been surveyed several times, most prominently by Leigh (2009), Atkinson and Piketty (2007) Atkinson and Piketty (2010), Atkinson et al. (2011), and Roine and Waldenström (2015). This chapter adds to these existing top income surveys along several dimensions. First, this chapter reports the most recent evidence on top incomes. By doing so, the geographical scope is expanded to newly covered countries in Africa, Asia, and Latin America. Second, earlier surveys are complemented by extending the concept of income. The conventional income concept is pre-tax top income

shares, which is pre-determined through the use of tax return-based income statistics in the traditional top income share literature. Results from new studies are reported that estimate post-tax income, top-corrected incomes in surveys, and incomes adhering to broader national accounts-based income concepts. These latter series are not directly comparable with the conventional series in all aspects but do help to examine and compare the levels and trends of top income shares within and across countries.

The chapter comprises three main parts. Section 2 is about data sources, the definitions of income, and the methodologies used to estimate top income shares. Both the standard sources and methods used by the traditional top income studies are described. Further, new developments are added that employ new sources and estimation approaches. A detailed survey of the top-correction methods for surveys including reweighting and replacing top incomes is provided. Approaches to align surveys, income tax data, and national accounts are contrasted. The second part of the chapter, Section 3, is a description of the main trends of top income shares that are the result of the previous studies. Different measures discussed in the methods section are presented and compared. The third part of the chapter, Section 4, surveys the literature on the determinants of top income shares. Here, the focus is on studies that propose new methods to establish links between driving factors and top income shares.

## **2 Methods and data to compute top income shares**

This section presents and discusses the different data sources and estimation methods used to compute top income shares. Since the 1990s, many countries started offering micro datasets containing detailed individual-level information about incomes. By contrast, data sources in earlier periods are generally much less detailed when it comes to presenting income earners and their incomes. Definitions of reported incomes in official statistics have often changed along with changes in tax laws. The estimation of top income shares over time is affected by these variations in data. In response, researchers have proposed different methods and data sources to cope with problems of scarce data or the changing nature of sources with the goal of generating consistent and comparable estimates.

All the different income data sources and estimation methods carry their own advantages and disadvantages for the measurement of top income shares. Some approaches rely

on a combination of several data sources, aiming at bringing together their advantages. Traditionally, top income shares are computed by relating top incomes recorded in income tax data to a reference total income, which is usually taken from National Accounts. This method is addressed in Section 2.2. In the 2010s, several approaches to top-correct survey data were developed, thus addressing the misrepresentation of top incomes in survey data. An overview of the emerging literature on top-correction methods is presented in Section 2.3. Finally, two initiatives developed frameworks regarding how to align micro data, like household surveys and income tax data, with aggregate income concepts from national accounts and then uprate the micro data to national accounts. The aim is to understand the distribution of economic growth based on the internationally standardized income definitions of national accounts. Top income shares measured within these frameworks quantify top shares in national income, while the traditional approach estimated top shares in total income that was adjusted to the fiscal definition of income. These two initiatives are explained and contrasted in Section 2.4.

Section 2.1 begins with a brief survey of the definitions of income. This ranges from income concepts that researchers ideally would like to have to income concepts that are recorded in the data sources that are ultimately used for the measurement of top income shares.

## **2.1 Definition of income**

When analyzing top income shares, one can use different concepts of income and units of observation, which ultimately depends on the research question and the availability of data. Pre-tax income shows the result of market forces operating, while post-tax income includes the impact of government redistribution. The traditional top income literature is based on income tax data. Hence, income concepts and income earner units are pre-defined by the nature of the country's income tax system.

Income tax return data document taxable incomes defined as the sum of factor income (labor earnings and capital income) before taxes paid and transfers received by the tax unit. The tax unit may consist of an individual or a married couple (plus their children) depending on the country's income tax legislation. The taxable treatment of **pensions** – related to the variety of pension systems – greatly varies across countries.

Pre-tax income is often net of deductions, mainly interest payments. Similarly, social security contributions paid by employers and employees are generally excluded from pre-tax income because they are not part of the tax base. For an overview of differences in income concepts, tax units and methodological considerations for top income shares estimated in 22 countries, see Atkinson et al. (2011).

Even though pre-tax income may seem like a clear enough definition, there are several income components that may cause comparability problems both over time and across countries. For example, transfers are sometimes included in the tax base (often work-related such as sickness pay, unemployment insurance, and pensions), which applies to the Nordic countries since the 1980s. This is because, "the reason to include them is that they are not viewed as pure transfers but rather part of a collective insurance scheme where you need to work in the first place to get the transfer" (Roine and Waldenström, 2015). **Taxable transfers** have typically become more important over time, but greatly vary in size across countries. Roine and Waldenström (2008) calculated top income shares for Sweden both including and excluding such transfers. They conclude that the difference is small for most of the twentieth century, but the increase in top income shares is notably larger for market income than for total income (including taxable transfers) thereafter. The largest difference is almost 1 percentage point (about 15% of the income share). However, including taxable transfers does not change the main trends (and considering the importance of these systems in the Swedish context, this is likely to be an upper bound of the effect).

**Capital incomes** are a tiny fraction of most people's income, but among top income earners they are more important. A challenge for studying top capital incomes is that many countries have not always included all kinds of capital income. To the extent that such incomes accrue disproportionately to top income groups, this affects the estimation of top income shares. Since the 1990s, many European countries have introduced dual income taxation, taxing capital income at the source. This poses a problem to top income researchers if the two tax records are not or cannot be linked, which is the case for Germany since 2009. For example, Bartels and Jenderny (2015) propose imputing total capital income of German households from external sources and then distribute the total according to the capital income distribution observed before 2009. For the tax authorities, income from interest-bearing bank deposits and corporate dividends are often easy to

observe and include. Other capital incomes, such as the imputed rent of homeownership and realized capital gains, are more difficult to observe. To impute income from **owner-occupied housing** requires information about the housing stock at the household level and this information is usually missing for most historical periods.

Realized **capital gains** are problematic on different levels. Not all income concepts include capital gains. Capital gains are included in the Haig-Simons definition, which is the most commonly used definition in the income inequality literature defining income as consumption plus change in net worth. This income concept goes back to discussions about which items to include in the income tax base, when modern income tax systems were introduced. In late 19th century Prussia, legal scholar Georg von Schanz supported to include capital gains, followed later by the American economists Robert M. Haig and Henry C. Simons in the 1920s and 1930s. Today, capital gains are not part of the income concept used in the national accounts. Conceptually, one would like to measure all capital gains, both realized and non-realized, but the tax statistics only report the realized part. The timing of measurement of the realized capital gains is also problematic. They are observed in relation to the sale of an asset, for example, a house or corporate shares, but the actual capital gain may well have accrued over a long time period. Therefore, realized capital gains give rise to larger transitory noise of incomes and cause large one-time jumps in people's income, and income status. For example, Roine and Waldenström (2012) show that the top 1% income share in Sweden during the 2000s was 20-30 percent higher when realized capital gains was included in income when sorting income earners than it was when sorting earners according to their income excluding realized capital gains and then adding them to the income afterwards.

Household survey based top income shares include incomes before and after taxes as well as transfers. Most taxes, **social security contributions**, and transfers are collected using the questionnaires, while some are estimated by the survey providers using microsimulation. For example, the Socio-Economic Panel (SOEP) collects information on transfers like retirement income or unemployment benefits from the respondents and provides estimates of households' income taxes and social security contributions using microsimulation (Grabka, 2020). Importantly, imputed rent of homeownership is usually included in household survey data. On the one hand, conceptual differences in the recording of capital income pose a challenge when harmonizing income tax and survey

data. Most surveys restrict their recording of capital income to a very general concept of capital income, often not even differentiating between dividends and interest income. Further, capital gains are rarely recorded in surveys. On the other hand, household survey data allow for flexibly adjusting the unit of observation to the individual, the tax unit, or the household. Incomes aggregated at the household level are usually adjusted to differences in households' needs using an **equivalence scale** (see Canberra Group Handbook on Household Income Statistics, 2001 or 2011 for further reading on equivalence scales).

In contrast to income tax data and household surveys, **national accounts'** income definitions are internationally standardized. It should be noted, however, that the Canberra Group Handbook on Household Income Statistics 2001 and 2011 provides international guidelines for the measurement of household income. The **European System of Accounts** (ESA 2010) is the European Union's accounting framework, which is consistent with the worldwide national accounting guidelines set out in the **System of National Accounts** 2008 (2008 SNA). The income concepts are compensation of employees (D.1), taxes on production and imports like VAT (D.2), subsidies (D.3), property income from interest and dividends (D.4), current taxes on income and wealth (D.5), social contributions and benefits (D.6), and other current transfers (D.7). The accounts are based on a wide variety of statistical source data including surveys, administrative data, and census data. However, international standards change over time, so that a researcher interested in long-run comparison of national income must carefully adjust for breaks in the series.

Tax and survey data differ substantially in their definitions of income and unit of observation, which are summarized in Table 1. **Household surveys** usually apply a comprehensive income concept, while tax data contain income subject to taxation. Further, not only do household surveys document a variety of market income sources, they also incorporate private transfers. In contrast, tax incomes ever more frequently exclude capital income due to the introduction of dual income taxation where capital income is taxed separately. This is the case for Germany since 2009. While incomes in survey data are aggregated at the household level, the income-receiving unit in tax data is the tax unit. If household members pool their income, the narrower sharing unit of a tax unit usually produces higher inequality (see, e.g., Bartels and Metzger, 2019). Furthermore, survey and tax data are affected differently by time-variant factors such as survey response and reporting behavior, tax filing behavior, as well as economic, demographic, and legislative



changes. **Undercoverage** and **underreporting** of top incomes may produce a downward-bias for survey-based inequality measures. Tax filing behavior is sensitive to changes in the income tax law creating downward- or upward-bias before or during reform years. Top income earners tend to benefit disproportionately from economic growth (Roine et al., 2009), which in turn produces higher inequality estimates in tax data than in survey data where top income earners are underrepresented. The different observation unit of tax and survey data may reveal diverging inequality trends in countries with joint taxation if couples change their marriage behavior over time, for example, if couples stay unmarried more often. The direction of the effect depends on the degree of assortative mating.

Table 1: Income tax data vs. household survey data

Concept	Income tax data	Household survey data
Unit of analysis	tax unit	household
Income concepts	pre-tax income	pre- and post-tax income imputed rent
Measurement problems	tax avoidance and evasion legislative changes	misreporting non-response
Undercoverage	bottom of the distribution	top (percentile) of the distribution

## 2.2 Income tax statistics and Pareto interpolation

With the introduction of progressive income tax systems in many countries during the late nineteenth and early twentieth centuries, tax authorities and statistical offices started to publish income tax statistics. One important problem with tax-based income data comes from taxpayers' **tax avoidance** and **tax evasion** (Atkinson et al., 2011). Arguably, taxes create incentives and possibilities to minimize taxable income, which can potentially influence the income level reported on tax returns. More importantly, if avoidance and evasion vary over time, across countries, and across the distribution, serious measurement errors may arise. Another problem with tax data is that they are defined and collected by lawmakers and various statistical and tax agencies. Structural breaks in definitions of income or income earner units are not uncommon. Both tax avoidance issues and changing data definitions have been discussed by top income scholars and addressed where possible

(Atkinson et al., 2011), so that even if problems remain, they are often reduced to play a marginal role for top income shares series.

A specific problem with the historical tax-based income distribution statistics is that it typically comes in the form of grouped observations, which list the number of income earners (or, more generally, tax units) between two income thresholds and their aggregate income. However, the number of groups separated by income thresholds varies across countries and within countries over time.

Inequality researchers interested in the income share of a specific top fraction, such as the top decile or the top percentile, of the income distribution face the challenge of how to identify this top fraction, because these fractions almost never correspond to the income thresholds recorded in the grouped income tax statistics. To identify the income threshold of a top fraction and then compute the income share of this top fraction, we need an interpolation method.

The most common **interpolation** procedure in the top income literature since the seminal contribution of Piketty (2001, 2003) builds on the assumption that top incomes follow a Pareto distribution. The **Pareto distribution** goes back to Pareto (1897), who was the first to make systematic observations of the distribution of income, and is characterized as follows

$$F(y) = 1 - (y/k)^{-\alpha} \quad \forall y \geq k \quad (1)$$

$y$  denotes income and  $k$  is the income threshold above which incomes are assumed to follow the Pareto distribution. The **Pareto-coefficient**  $\alpha$  captures the inequality of the distribution. Lower values of  $\alpha$  reflect higher levels of inequality. The parameter  $\beta = \alpha/(\alpha - 1)$ , the inverted Pareto-coefficient, is obtained by dividing the average income above a certain income threshold documented in the tax statistics by the respective income threshold.

Some historical income tax statistics only list the number of tax units per income bracket and are silent about their aggregate income. Piketty and Saez (2007) suggest to impute their incomes assuming a **Pareto distribution** within the income bracket.

In practice, different **Pareto-coefficients** are obtained for different fractiles. For instance, to compute the Pareto-coefficient for the top 1%, the income bracket in which the

top 1% starts is identified, and then the lowest income threshold of that income bracket is used. Empirically,  $\beta$  varies slightly across the top fractiles, which contradicts the basic property of the Pareto distribution that  $\beta$  is a constant. Hence, Pareto-coefficients are computed for different income brackets.

Empirically, the **Pareto interpolation** method provides an extremely good fit when comparing results to those obtained directly from individual tax records, where one can obtain the total income of a fractile by simply adding up individual incomes. See, for example, Feenberg and Poterba (1993) for the United States, Piketty (2001) for France, Bartels and Jenderny (2015) for Germany, and Atkinson et al. (2011) for further examples. Rearranging Eq. 1 and using the estimated  $\beta = \alpha/(\alpha - 1)$ , one can compute the income threshold of the top x%. The income share of the top x% is then obtained by dividing the cumulative income above the income threshold by an external reference total income as follows

$$\text{Income share of top } x\% = \beta \cdot \text{income threshold of top } x\% \cdot \frac{x\% \text{ of total tax units}}{\text{total income}} \quad (2)$$

As can be seen from Eq. 2, the total number of tax units (=total reference population) and the total income are crucial for determining the income share of a fractile. We discuss the choice of total reference population and total reference income in the following Sections 2.2.1 and 2.2.2.

### 2.2.1 Total reference population

As Pareto interpolation is usually applied to income tax statistics, the natural reference population is the total tax unit population of the country, if everyone had filed a tax return. Taxes are filed individually in countries like Australia, Canada, Italy, and Spain, such that the reference group is the adult population defined as all residents above some age cutoff. Taxes are filed per family, which is typically defined as a married couple or a single adult, in countries like France, Germany, and the United States such that the reference group is the number of married couples and single adults (see Atkinson et al. (2011) for an overview).

The **total reference population** is obtained by either the bottom-up approach or

the top-down approach. The bottom-up approach adds the (estimated) number of tax-exempt persons to the number of taxpayers documented in the income tax statistics. The top-down approach draws on official population statistics and computes total tax units as the sum of the number of married couples and singles minus the number of children.

To what extent does the choice of the **age cutoff** and the tax observation unit create differences in the total reference population and, consequently, in the level of top income shares? According to Atkinson (2007), the maximum gap between using an age cutoff at 15 instead of 20 is a 6 percent difference. Atkinson (2007) calculates that a top 1% share of 10% with an age cutoff at 20 would increase to 10.6% with an age cutoff at 15. The tax observation unit creates larger differences. Individual data tend to show a more unequal income distribution than household data (Leigh, 2005). As an example, one can contrast the extreme cases where either both partners earn the same or one partner has zero income. A top 1% share of 10% can be reduced to 8.3%, or increased to 11.8%, respectively, when moving from joint to individual taxation (Atkinson, 2007). All in all, the impact of changing tax units and age cutoffs are not likely to be important for the long-run trends.

### **2.2.2 Total reference income**

As in the case of the total reference population, the **total reference income** can be obtained by either the bottom-up approach or the top-down approach. The bottom-up approach adds (estimated) income of tax-exempt individuals to taxpayers' income as documented in the income tax statistics. The top-down approach draws on **national accounts** and computes reference total income as either a fixed share of household income or deducts all items not included in the legal definition of income. Due to the lack of data, particularly concerning early periods, using a fixed share of GDP based on calibrations in periods when data are available is the predominant practice in the top income share literature. Roine and Waldenström (2010) document that the choice of the total reference income can generate sizable differences in single years or periods, but conclude that overall long-run trends are robust.

## 2.3 Top-correction methods for surveys

Survey data are well-known for misrepresenting top incomes. On the one hand, top income earners may be missing from the sample. On the other hand, **survey incomes may be top-coded** or top income earners included in the sample might not report their income (**item non-response**) or under-report their income. As a result, survey-based inequality measures may turn out to be biased, most likely, downward. For example, it is shown for several countries that top income shares estimated from surveys are lower than top income shares estimated from income tax data (see, e.g., Bartels and Metzger (2019) for Germany, Jenkins (2017) for the United Kingdom, Burkhauser et al. (2012) for the United States). Following this shortcoming of survey data, the official inequality series of the United Kingdom produced by the UK Department for Work in Pension has been top-corrected since 1992 (Burkhauser et al., 2018). This is the only national statistical agency that routinely top-corrects an official inequality series. See Burkhauser et al. (2018) for an explanation and assessment of their **top-correction procedure**. The focus of this section is on the methods to top-correct income distributions documented in survey data.

The reasons for **undercoverage of top incomes** include top-coding, trimming or censoring, under-reporting, unit non-response, and item non-response. For a detailed discussion of the reasons for undercoverage of top incomes in survey data, the interested reader is referred to Jenkins (2017) and Lustig (2020).

The existing top-correction approaches can be classified into two categories: reweighting and replacing. The two categories tackle different problems of undercoverage. **Reweight-*ing*** is applied to correct for coverage error or unit non-response. **Replac*ing*** is applied to correct for top-coding, trimming or censoring as well as under-reporting, unit or item non-response of top income earners. Top incomes of the survey distribution are replaced either using within-survey information or external information.

### 2.3.1 Reweighting top incomes

**Reweight*ing*** is traditionally applied to correct for unit non-response in surveys and is also known as post-survey weight adjustment or poststratification. In the case of top incomes, this method increases population weights for the rich while reducing weights for the non-rich. Importantly, this approach requires at least some top income earners in each

of the relevant income ranges in order to be able to reweight them. Corrected weights are obtained from non-response rates in a population subgroup. These subgroups may be defined by geographic location, age, gender, or family status. In practice, the definition of subgroups depends on the set of respondents' and non-respondents' characteristics that the survey producers provide.

The very basic reweighting method adjusts the weights for differential non-response rates by region and age "grossing-up" the weighted survey sums to official population statistics (see Atkinson and Micklewright, 1983). However, as Atkinson and Micklewright (1983) point out, the assumption that the characteristics of respondents and non-respondents are identical within the category (region or age) is critical. In the case of top incomes, the distribution of non-response across the income distribution may systematically vary from one region/age group to another. Korinek et al. (2006) and Korinek and Ravallion (2007) propose estimating a probabilistic model that takes into account household characteristics while allowing response probabilities to vary within subgroups. Observations are then reweighted according to their inverted estimated response probability.

### 2.3.2 Replacing top incomes

The **replacing method** replaces top income observations with incomes generated from a theoretical distribution. There are three decisions to make when applying this method: a) What proportion of the survey distribution should be replaced with corrected top incomes? b) Should it draw on within-survey information or external information to estimate the parameters? c) Which parametric distribution should be used to generate corrected top incomes?

**Proportion to be replaced.** The proportion of the distribution that should be replaced is often identified by reconciling income tax data with survey data. Income concepts and unit of observations between individual income tax data and survey data are reconciled to detect the **cut-off** above which top incomes are undercovered in survey data. For example, Jenkins (2017) finds that undercoverage of top incomes in UK FRS data varies over the years starting above 95th percentile in the 2000s and above the 99th percentile in the 1990s. This check, however, requires access to income tax microdata, which is limited and difficult to obtain in many countries. Jenkins (2017) recommends making a

”judicious choice” of the cut-off. Thresholds between P95 and P99.5 are commonly used.

**Replacing top incomes using within-survey information.** This approach relies on fitting a parametric model to the survey data at hand and uses the fitted model to predict the upper tail. To ensure that the model fits the top of the distribution, survey observations from the bottom of the income distribution are excluded. For example, Jenkins et al. (2011) fits a generalized beta distribution of the second kind (**GB2**) by Maximum Likelihood to the top 70% after ”balancing goodness of fit with ease of maximization.” Jenkins et al. (2011) and Burkhauser et al. (2012) use GB2 to generate top incomes. For a comparison with the widely used Pareto model, Burkhauser et al. (2012) also fit a **Pareto distribution**. They find that the top 1% income share based on a **Pareto distribution** is larger than the share based on GB2. Using survey information to replace top incomes is both used to address top-coding and under-coverage. However, the ability of this approach to address survey under-coverage at the top is limited because the observed survey distribution does not provide information on the ”true” upper tail (Jenkins, 2017).

**Replacing top incomes using external data.** Another group of methods relies on income tax data as an external data source because it provides a better coverage of the upper tail. This method requires prior ”reconciliation” of survey and income tax data definitions. This means that the analyst must harmonize definitions of income (gross or net; individual or household; equivalized; etc.), reference period (month or year), and the income sharing unit (individual, tax unit or household) across data sources. There are two approaches to replace top incomes using income tax data: combining data and combining inequality measures.

**Combining survey and income tax data** to calculate inequality measures from the combined data is one approach. Burkhauser et al. (2018) replace survey incomes with cell means derived from top quantile groups in the income tax data. Bach et al. (2009) bring together survey data (for the bottom and middle) and income tax data (for the top) before estimating inequality measures on the combined dataset. However, access to unit record income tax data is often restricted and difficult to obtain, which limits a wide application of these approaches, particularly for purposes of cross-country inequality comparisons. Comparably easily available data are the starting point for the approaches developed by

Bartels and Metzing (2019) and Blanchet et al. (2018). They both fit a Pareto model to the top range of the income tax data to impute new top incomes that replace the originally observed survey top incomes. Bartels and Metzing (2019) propose to use top income shares publicly available at the World Inequality Database (WID) for the estimation of the Pareto parameter. The top 1% of the survey income distribution is replaced with Pareto-imputed incomes. Blanchet et al. (2018) developed a Stata command (`bmfcorr`) that combines reweighting and replacing top incomes in survey data using information on the upper tail from tabulated income tax data.

**Combining inequality measures** calculated separately from survey and income tax data is another way to bring together two data sources. Again, it is assumed that the survey covers the bottom  $x\%$  and the income tax data covers the top  $(100-x\%)$ . The most prominent example is the **top-corrected Gini coefficient** developed by Atkinson (2007) and extended by Alvaredo (2011). This approach exploits the properties of inequality indices to be additively decomposable by population subgroup. Here, the two subgroups are the rich (covered by tax data) and the non-rich (covered by survey data). This approach was subsequently applied by Alvaredo and Londoño-Velez (2013) to Colombia, by Jenkins (2017) to the United Kingdom, and by Lakner and Milanovic (2016) and Anand and Segal (2017) to global income inequality. Each of the applications cited uses a Pareto type I model to describe the upper tail of the income distribution.

**Choice of the parametric distribution.** The **Pareto distribution** type I is widely used to fit top incomes. It is generally agreed, that the Pareto distribution quite well approximates the top tail of income distributions (Atkinson et al., 2011). Probably even more importantly, the researcher only has to estimate a single shape parameter and there exist simple formulae for calculating mean income and inequality indices from parameter estimates (Jenkins, 2017). However, the Pareto type I distribution's restriction to a single parameter comes at the expense of the goodness of fit. For example, Jenkins et al. (2011) demonstrate that less restrictive parametric functional forms, like the generalized beta distribution of the second kind (GB2), generate very precise parameter estimates. They also show that **GB2** outperforms the **Singh-Maddala** or the **Dagum distribution**. Jenkins (2017) shows that Pareto II models provide a better fit than Pareto I and that Pareto I only fits as well as Pareto II at very high income thresholds.



Jenkins (2017) provides an extensive discussion on the choice of the Pareto threshold and shows that although different Pareto thresholds have noticeable impacts on estimates of inequality among the rich, the overall inequality trends in the United Kingdom are broadly robust to the choice of the threshold. However, replacing survey incomes with a fixed Pareto fitted value does not account for parameter-estimation error or sampling error. An and Little (2007) and Jenkins et al. (2011) propose drawing multiple random values from the estimated distribution to calculate standard errors of the top-corrected inequality measures.

## 2.4 Aligning surveys, income tax data and national accounts

Following not just the increased attention paid to the development of inequality over time, but also the growing discontent with the fact that important components of national incomes are excluded from surveys or tax returns, a number of scholarly initiatives have developed methods to incorporate distributional estimations in accordance with System of National Accounts. The overall aim is to provide a more comprehensive analysis of the distribution of household income, consumption, and wealth, fully consistent with national accounts aggregates. Since **national accounts** are incorporated in a similar fashion across countries and, with some notable exceptions, over time, a distributional analysis using these income concepts will also be more comparable internationally than is currently the case.

There are several initiatives launched with the two most important ones being the **Expert Group on Disparities in a National Accounts framework (EGDNA)** and the **Distributional National Accounts (DINA)**. The main features of the two initiatives are summarized in Table 2.

The **EGDNA** project is a joint initiative by OECD and Eurostat launched in 2011. It aims to distribute the national accounts' household sector income, consumption, and savings across all individual households. As for incomes, the project begins with the incomes reported at the individual level and adds the items observed in the aggregate by applying distributional assumptions. The allocation of consumption and saving requires cross-matched data on incomes, which is typically scarce and requires additional assumptions. Because of the obstacles to build robust distributions, **EGDNA** reports income

shares for quintiles instead of more fine-grained measures such as the Gini coefficient or top income shares. Results from the **EGDNA** project are presented in Zwijnenburg et al. (2017).

The **DINA** project was developed in the context of the World Inequality Database (WID). Its ambition differs from the **EGDNA** in that it distributes all national income to households, i.e., also the incomes of the corporate sector and the public sector and not only the incomes of the household sector as in **EGDNA**. A key assertion underlying this approach is that households are regarded as the ultimate claimants of the nation's income, which refers to the ownership of both private firms as well as local and central governments. The **DINA** channels corporate sector incomes directly to individual shareholders and, thus, treats this income equally to all other incomes that the households receive; for example, labor earnings and transfer incomes. The public sector incomes and expenditures, which include tax revenues and collective outlays on infrastructure and defense, are distributed to individual households using assumptions about individual drawing rights on the public sector. The **DINA** methodology was established for the case of the United States by Piketty et al. (2018) and has subsequently been applied to China (Piketty et al., 2019), France (Garbinti et al., 2018; Bozio et al., 2018), India (Chancel and Piketty, 2019), the Middle East (Alvaredo et al., 2019), and Russia (Novokmet et al., 2018). Alvaredo et al. (2016) present the concepts and methods of the **DINA** methodology. The methodology is currently being applied to other countries and expanded to also include wealth inequality. The aim is to have **DINA** for all countries in the WID.

Although both the **EGDNA** and the **DINA** project aim to compile distributional results in line with national accounts aggregates, they produce significantly different results because of different concepts and deviations in methodology. Zwijnenburg (2017) provides a detailed overview of the main differences and a discussion on the pros and cons of certain choices in compiling distributional results. The differences between the two approaches are summarized in Table 2.

Table 2: DINA vs. EGDNA

Concept	DINA	EGDNA
Unit of analysis	individuals 20+	households
Income concepts	pre-tax factor income pre- and post-tax national income post-tax disposable income	equivalized disposable income
Other concepts	wealth	consumption
Income adjustments	individualized, equal-split	equivalized
Sector	all sectors	households
Distributional results	percentiles, smaller fractiles at the top	quintiles
Countries	China, France, India, Russia, United States	Australia, Netherlands, United Kingdom

Source: Alvaredo et al. (2016) and Zwijnenburg (2017).

### 3 Evidence on the trends in top income shares

In this section, the main findings from studies of the evolution of top income shares around the world are presented and discussed. The focus is on trends in top income shares both globally and historically. The country coverage varies both in terms of geography and time span. For some countries, data spanning the entire twentieth century and even back to the late nineteenth century are available. These are predominantly the modern-developed Western economies that also represent the bulk of the top income literature. For some countries, mainly developing countries, observed outcomes are restricted to most recent years. The literature on top income shares discusses common and diverging patterns across countries and groups of countries, albeit principally for the rich part of the world. In particular, the experiences in Anglo-Saxon countries relative to continental European countries have been studied intensively, largely because of noticeable differences since the early 1980s. As emphasized by Roine and Waldenström (2015), one should go beyond this dichotomy and examine top income shares in other parts of the world as well. Therefore, a broader categorization of countries is presented, focusing on eight broad country groups around the world.

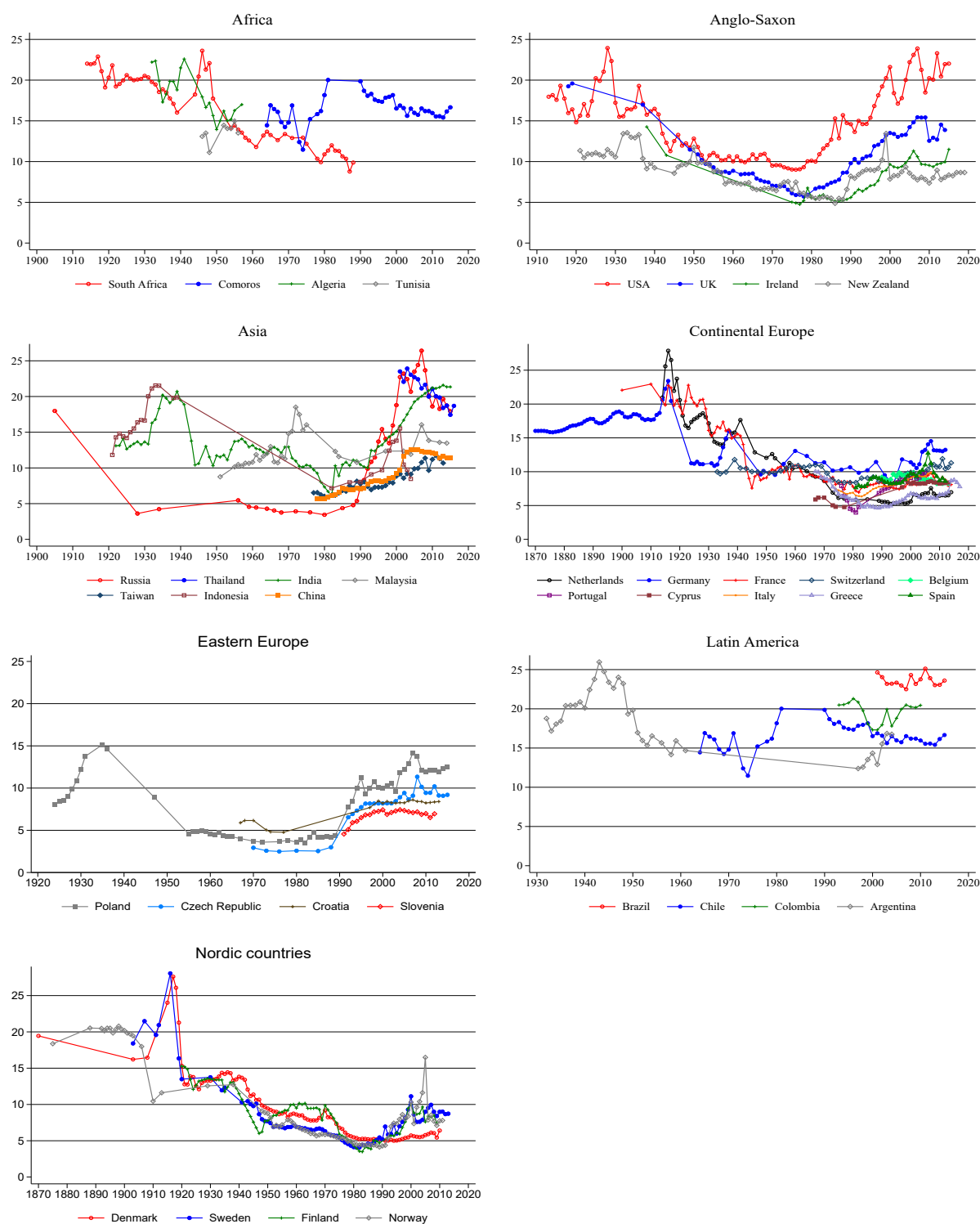
### 3.1 Top income shares using tax-returns statistics

Figure 1 shows the long-run evolution of the income share of the top percentile in the pre-tax total income distribution using official tax returns-based income statistics. Looking at the trends across countries, there are several similarities that appear. The most important common trend is that **top income shares** declined almost continuously over the course of the century. The decline began in the years around **World War I**, then accelerated during **World War II** and continued through the 1970s. From the 1980s onward, experiences are more diverse across countries and country groups. Roine and Waldenström (2011) statistically estimate the existence of common breaks in these top income shares using **structural break estimation** methods. Using basically the same data as in Figure 1, their results suggest that there are two major break points during this era: in 1943 during the Second World War and in 1982.

While the historical equalization pattern is fairly homogeneous among the rich countries, it looks a bit different when turning to former socialist republics or developing economies in **Asia**, **Africa**, and **Latin America**. Note that the evidence is more scattered for these countries, which partly derives from the fact that the series are less credible in several cases due to more problematic source materials. Notwithstanding these issues, these poorer countries mostly show a higher level of income concentration and less of an equalizing trend throughout the twentieth century.

Finally, the last common break point in the early 1980s is visible in the figures only to some degree. While the US top income shares exhibit a stark increase since the 1980s, none of the European countries show such a strong increase or such high levels. Having said this, there are increases in some of these countries as well, but they are smaller than in the US and they also appear later, mainly in the 1990s, and then as a more rapid transition from one level to another rather than as a steady increase. In Eastern Europe, an elevation of top income shares since 1990 is found in many countries, especially in Russia. This development is arguably related to the economic transition from socialism to a market economy. China, Indonesia, and Taiwan also show an upward trend since the 1980s.

Figure 1: Top 1% pre-tax income share



Source: WID.

Note: We display top income shares in both joint and single taxation regimes. Two countries switched from joint to single taxation: Sweden in 1971 and the United Kingdom in 1990.

### 3.2 Top income shares in the distributed national accounts

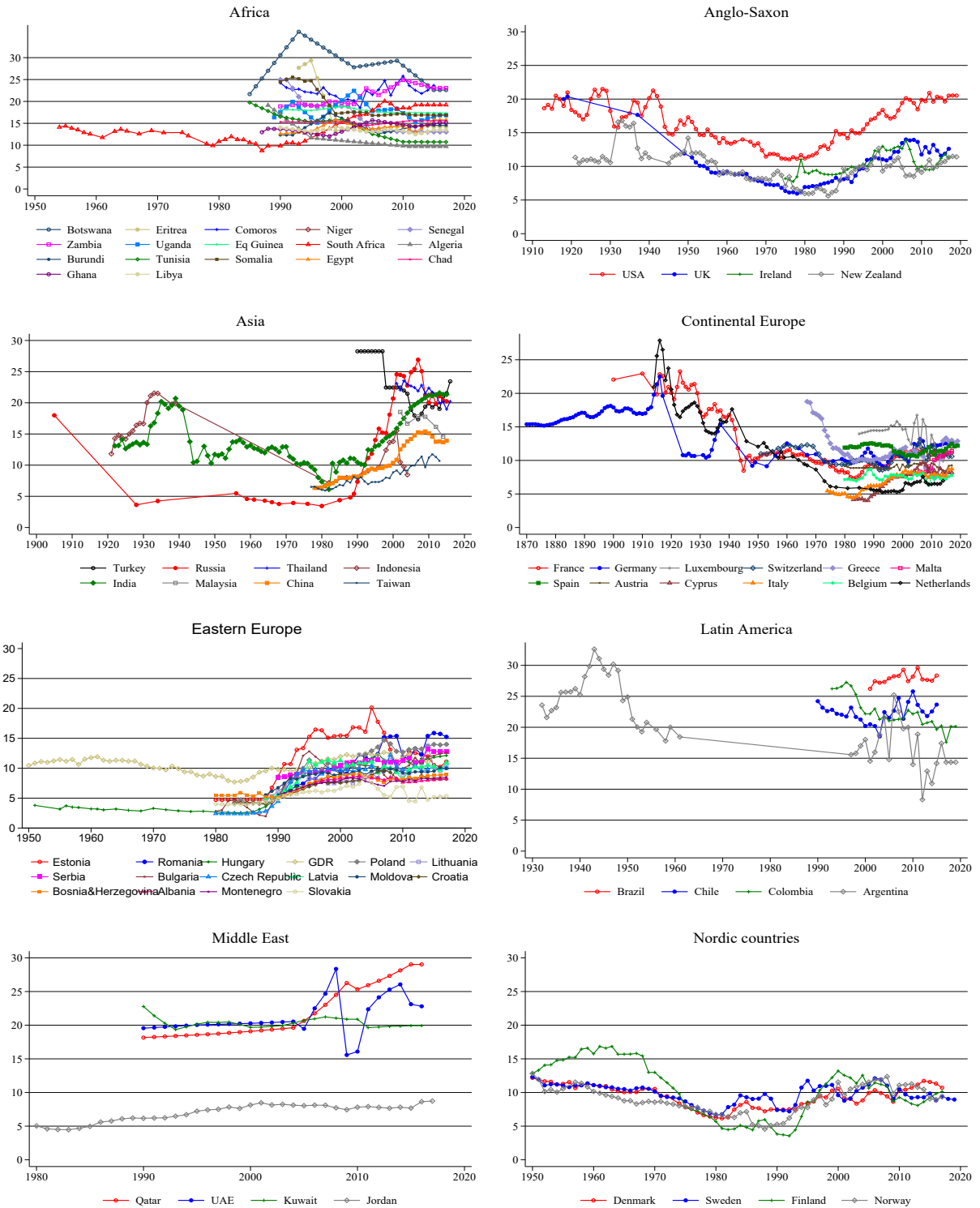
A new set of results in the top income literature emerged in recent years following the estimation of individually-distributed national income, as described in the previous section. Systematically combining household surveys, income tax statistics and national accounts using a common methodology substantially widened the geographical scope of top income shares. While some country series are clearly still under construction, the most recent results of **DINA** top 1% income shares are reported, as of 2020, from WID in Figure 2. Broadly speaking, the **top 1% pre-tax national income shares** confirm the trends found for **pre-tax income shares**, but show higher levels of income concentration. In some African, Latin American, and Middle Eastern countries, the top percentile holds almost 30% of pre-tax national income.

A few studies produced **post-tax national income** series, arguably with a different degree of accuracy. Here, the focus is on the series for France and the United States. Redistribution through tax-benefit systems substantially reduces income concentration. Figure 3 presents results for United States (Piketty et al., 2018) and France (Bozio et al., 2018). In both countries, the top percentile's post-tax income share is substantially lower than the pre-tax income share. In the United States, the top 1% share is reduced by 5%-points from ca. 21% to ca. 16% in 2019. In France, the top 1% share is reduced by 3%-points from ca. 11% to ca. 8% in 2017. In both countries, the absolute gap between pre- and post-tax top 1% share tends to widen. This suggests that, over time, tax-benefit-systems increasingly reduced top 1% income shares.

### 3.3 Top-corrected top income shares

The results from replacing top incomes in surveys using external information on the shape of top of the income distribution is presented in Figure 4. Here, the top 1% incomes recorded in **EU-SILC survey data** are replaced by Pareto-imputed incomes using WID-data following the method developed by Bartels and Metzger (2019). Figure 4 shows trends of Gini coefficients for gross household income in nine European countries, for which both EU-SILC and WID top income shares are available, contrasting Ginis based on unadjusted data and imputed top income data. One should note, that top-corrected Ginis can only be computed for a subset of EU-SILC data years, those when WID top

Figure 2: Top 1% pre-tax national income share (DINA framework)

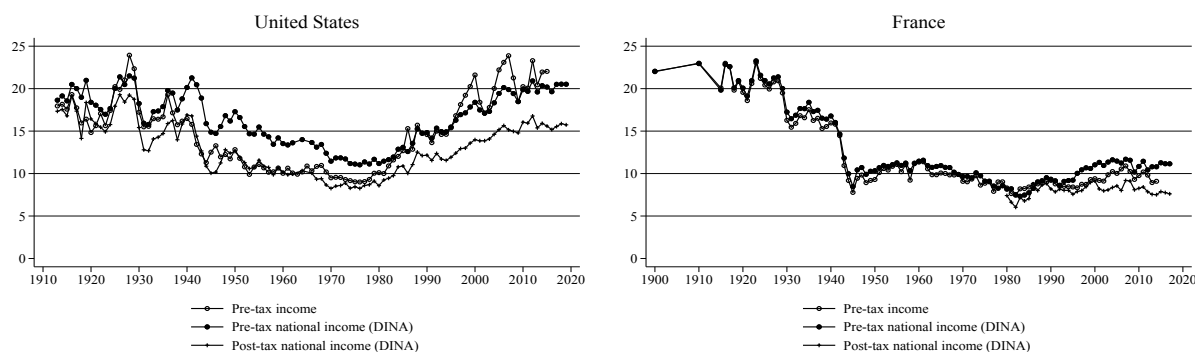


Source: WID.

Note: Equal-split series are included, where available. If not, tax unit series are displayed.

income shares are available. The distance between top-corrected and unadjusted Ginis varies greatly across countries and is mostly explained by the use or non-use of register data for EU-SILC provision.

Figure 3: Top 1% pre-tax, pre-tax national and post-tax national income share

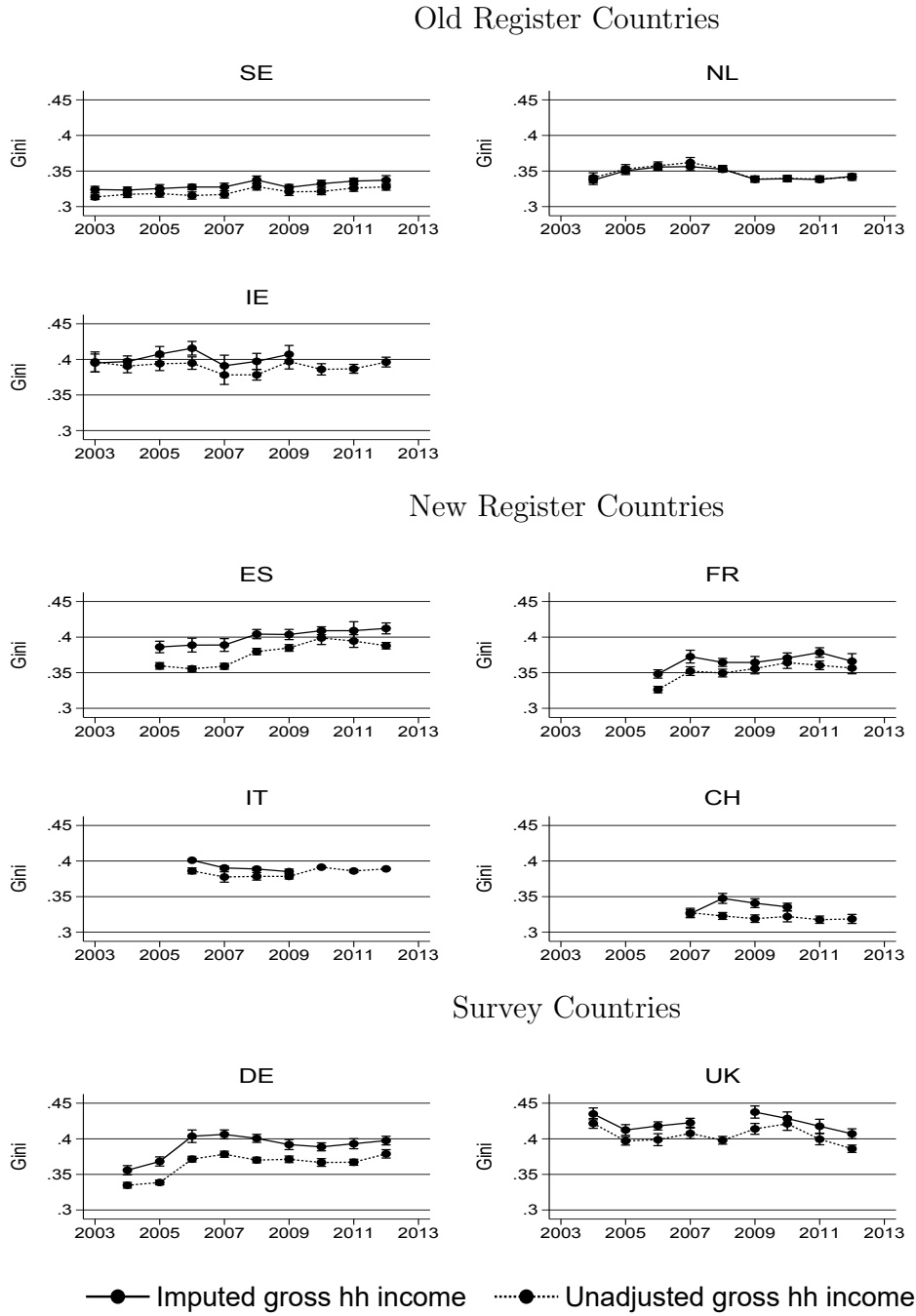


Source: WID.

The gap is very small for countries with a long **register data** tradition (old register countries), like Denmark, Ireland, the Netherlands, Norway, and Sweden. In Denmark and the Netherlands, **top-correcting EU-SILC data** produces virtually no difference. The importance of at least partly using register data is highlighted by the new register countries that only started using income data from registers for EU-SILC provision in the 2000s. The transition improved the representation of top incomes in EU-SILC data. All these new register countries apply a mixed strategy of collecting incomes from both registers and interviews as administrative data cover neither all income types (e.g., pensions are often not fully taxable) nor the whole population. Not surprisingly, the gap between top-corrected and unadjusted Ginis is largest in Germany and the UK, where EU-SILC is based on survey data only.



Figure 4: Top-corrected Gini of gross household income, European countries



Source: Bartels and Metzing (2019).

Note: Imputed gross household incomes are top-corrected EU-SILC incomes using top income shares from WID applying the top-correction method developed by Bartels and Metzing (2019). Vertical lines show bootstrap confidence intervals at the 95%-level based on 200 drawings.

## 4 Potential determinants of top income shares and their trends

A key objective in the analysis of top incomes is to study not only the trends in top income shares but also its **determinants**, both over shorter and longer time spans. In response to

this, several studies examine cross-country panel data as well as within-country variation over time and across regions in order to systematically assess the role of different driving factors.

This subsection discusses these studies and their main results. The presentation centers around the following specific driving factors: finance (which includes broader aspects of financial development and the specific role of financial crises), taxation (which also includes the broader role of government redistribution), trade openness (aiming to capture the different dimensions of globalized economies), political institutions (capturing the importance of deep-rooted institutional conditions), and, lastly, wars (representing a specific type of geopolitical shock to the economic and political system).

A key challenge naturally concerns identification. Several of the studies reviewed use panel data regression techniques that allow for a far-reaching control of simultaneous and confounding factors. A few studies use other approaches, for example, difference-in-difference testing based on synthetic control methods. Although neither of the aforementioned approaches offer conclusive evidence regarding causal links, they might still be informative in rejecting the null hypothesis regarding some factors, thus pointing out which ones do not seem to have been major determinants of top income shares.

## 4.1 The Role of Finance

There are conflicting theoretical predictions concerning the **impact of finance on top income shares**. According to standard theory, **financial development** should decrease income inequality to the extent that a more developed financial system increases the availability of funding for previously credit-constrained individuals (see, for example, Galor and Zeira 1993 and Aghion and Bolton 1997). However, there are other suggested mechanisms working in the opposite direction. For example, if **financial deregulation** spurs financial development, it could be that certain groups are better able to capture the gains from this. These could either be groups already positioned in the financial markets, which allows them to gain disproportionately, or other types of insiders in the economy who block entry into their own markets in order to capture the gains from better financial markets (see Rajan and Zingales 2003).

The study of Roine and Waldenström (2009) examines the links between finance

and top income shares using a large historical cross-country dataset spanning the entire twentieth century and containing different financial variables. Their main identification approach uses first differences to remove the influence of unobserved time-invariant factors as well as common and country-specific trends. **Financial development** is measured as either the total amount of bank deposits (or bank credit for the postwar period) or the stock market capitalization or the sum of these two, always as a share of GDP. Their main results indicate that financial development seems to have been pro-rich over the twentieth century, both in **Anglo-Saxon countries** and elsewhere, regardless of whether it is approximated using bank deposits or stock market capitalization. It should be noted that this finding of finance being pro-rich does not rule out that finance can also be pro-poor (see Beck et al. 2007) and that it could well be groups in the middle that seem to benefit the least from financial development.

In an attempt to identify the causal impact of financial development on top income shares, Tanndal and Waldenström (2017) use the novel **synthetic control methodology** to investigate two "Big Bangs" of **financial deregulation**, the UK in 1986 and Japan in 1997-1999. Their finding is that pre-tax top income shares increased after both deregulation episodes in the two countries. Higher earnings to already well-paid financial employees appear to account for this result, which is supported by occupation-level earnings showing that average earnings increased twice as much for financial specialists in the year after the Big Bang relative to earners in other professions.

**Financial crises** offer a specific opportunity to study the role of finance for top incomes. These crises cause drastic contractions of the financial sector and this suddenness could even open up for a causal interpretation of the estimated effects. Using historical cross-country banking crisis data, Roine et al. (2009) estimate a negative impact of banking crises (measured both as occurrence and in different intensities) on top income shares. The study examines whether the effect differs across countries with either bank-centered or market-centered financial systems but finds no significant difference. Some scholars also propose that top income shares serve as a driver of **credit booms and eventually lead to financial crises**, as exemplified by the financial crisis of 2009, particularly in the US. However, Bordo and Meissner (2012) find no evidence that a rise in top income shares leads to credit booms using data from 14 advanced countries between 1920 and 2000.

## 4.2 The Role of Taxation

Taxation influences top income shares in different ways and the theoretical predictions for inequality are ambiguous. **Top tax rates** are argued to reduce top income shares through three channels: reduced labor supply (real response) (Feldstein, 1995), increased **tax avoidance and evasion** (Auerbach and Poterba, 1988; Slemrod, 1995; Goolsbee, 2000; Saez, 2017), as well as less aggressive wage bargaining by top managers as the marginal return to a pay increase is lower (Piketty et al., 2014). At the same time, the income effect of high taxes on top incomes could lead to an increase in top incomes and eventually gross income inequality (see, for example, Piketty and Saez (2013) and Bastani and Waldenström 2020).

Empirical studies on the role of taxes for top incomes seem to give the most weight to the substitution effect and a negative correlation between taxes on top incomes and pre-tax top income shares. This was first suggested by some early single-country studies (for example Saez (2004) on the United States, Roine and Waldenström (2008) on Sweden, and Atkinson and Leigh (2013) for several Anglo-Saxon countries) and for larger historical cross-country panels by Roine et al. (2009), spanning the entire twentieth century, and Piketty et al. (2014) for the post-1960-period.

However, this negative relationship between top taxes and top income shares is less uniform than what these earlier studies suggested. Analyzing top income shares and top tax rates for **Germany** between 1871 and 2014, Bartels (2019) finds that the correlation is positive during the **industrialization** period and negative starting in the 1990s. Using a larger historical cross-country panel dataset spanning both a long time period, 1900-2014, and more countries (up to 30) than previous studies, Rubolino and Waldenström (2019) show that the relationship varies both across different groups of top income earners and over time. Their results show that top tax elasticities vary tremendously over time. Before 1950, top tax elasticities were medium-to-low. During the postwar era, **top tax elasticities** dropped to almost zero. By contrast, since the early 1980s, top tax elasticities have increased to unprecedented levels. There is also a clear income gradient of increasing tax responsiveness within the income top. Responses are the highest in the highest income group, the 0.1 percentile, while being almost zero in the lower half of the top decile. The study's dataset also allows for an inquiry into specific channels through which these results work. This suggests a combination of labor supply effects and income shifting

from wage to capital income. Furthermore, the study finds that wars, financial crises, and country-specific effects and trends also affect **top tax elasticities**.

In order to approach estimating the causal link between taxation and top income shares, Rubolino and Waldenström (2020) employ the **synthetic control group methodology**. They look at large changes in **tax progressivity** and subsequent changes in pre-tax top income shares in advanced economies since the 1970s. Paying specific attention on the three largest **tax reforms** in terms of changed progressivity, they find that the reduction of tax progressivity has a clear and lasting impact on top income shares.

Other reasons for the decline in top incomes might include **capital flight** and **tax avoidance** before, during, and after large shocks like wars. For example, a part of the decline in top incomes in Germany after World War I might be related to capital flight from Germany to Switzerland among individuals fearing confiscation of property as war reparations, as well as increased tax avoidance activities following the dramatic tax increases in the 1920s (see, e.g., Keynes, 1920, chapter 5, III:1).

### 4.3 The Role of Trade Openness

Trade, or more generally **globalization**, is one of the most challenging driving factors of income inequality and top income shares to estimate. No trade theory has clear predictions of this relationship. For example, standard Heckscher-Ohlin trade theory shows that the **inequality effect of openness** varies depending on relative factor abundance and productivity differences, as well as on the extent to which individuals receive income from wages or capital. At the same time differences stemming from variations in country endowments or productivity also matter (see Easterly 2005 for further discussion).

Examining the role of trade empirically, Roine et al. (2009) and Roine and Waldenström (2015) measure **trade openness** over the long run of history, either *de facto*, as the trade share in GDP (sum of exports and imports divided by GDP), or *de jure*, as the average tariff rate (total tariffs paid divided by traded volume). They cannot find any clear relationship either over time or for different levels of development. Most likely, this result should be interpreted as follows: The channels through which trade exposure affects the income distribution are too complex to be captured in aggregated cross-country panel regressions of this kind. More research examining channels more precisely or using better

measured outcomes is needed in order to reach stronger conclusions regarding the links between trade and top income shares.

#### 4.4 The role of political factors: Institutions and Wars

**Political institutions** are the rules and norms governing **property rights**, **democracy**, and other fundamental political structures in society. It is likely that these institutions matter for the income distribution (Acemoglu and Autor 2011), but to estimate their precise impact on countries' top income shares is highly demanding. A particular advantage of the historic cross-country data on top income shares is that they span a sufficiently long period to include variation in the degree of democracy and other institutional variables. Roine et al. (2009), running panel regressions linking measures of democracy, find that democracy is associated with lower top percentile income shares. However, the income share of the bottom 9% of the top decile is largely unchanged by **democratic transitions**.

Wars represent dramatic episodes that greatly affect the economic and political life of nations and their citizens. As the previous section shows, top income shares fell notably during and after the two World Wars. Some studies argue that the war-related capital destruction could account for some of this, but it is not fully clear how much capital value was actually destroyed or how this would affect the returns to the remaining capital stock (see Piketty and Zucman 2014, Roine and Waldenström 2015 and Bengtsson et al. 2020). The precise channels through which a **wartime effect on top income share** work is also understudied. In a series of analyses in Scheve and Stasavage (2016), it is shown that the rise of **tax progressivity** in the Western world is tied to **wartime mass mobilization**, whereby the bodily sacrifices of the masses forced politicians to compel the rich to sacrifice their money. Rubolino and Waldenström (2019) show that top earners become less sensitive to taxation during wars, something that seems to be true for all wars, not only the two World Wars.

## 5 Summary

This chapter surveys developments in the research on top income shares. A key ambition of the chapter is to present the state of the art in the methods used to estimate top

income shares under differing data conditions, for example, using tax-register data or survey incomes. Pareto interpolation techniques and approaches to handle undercoverage of top incomes in household surveys are discussed.

A new strand of the top income share literature expands the geographical scope, moving beyond the analysis of mainly Western economies to also incorporate a larger sample of countries from Africa, Asia, Eastern Europe, and Latin America. Another novel strand, partly related to the geographical expansion, is an expanded use of household surveys as a main data source to estimate top income shares. These survey data are used primarily in countries where administrative tax records are scarce. In addition, some papers expand the definitions of income, going from analyzing predominantly pre-tax total income (studied earlier largely because this was the only type of income reported in the historical tax statistics) to also study post-tax incomes and even incomes incorporating imputed items from aggregate national income.

The trends and levels of the top income shares presented do not reveal a single pattern, not even within continents. But still some common trends are visible. Looking at Europe, top income shares have been flat in some countries since the 1980s but increasing in others. There was a marked increase in pre-tax top income shares in Eastern Europe after the fall of socialism around 1990, but thereafter they have not increased much and have moved roughly in tandem with Western European countries. In the African and Latin American countries covered by our database, top income shares are at a much higher level than in Europe and there is no strong visible trend in recent decades. By contrast, top income shares appear to be increasing in North America, Russia and parts of Asia, including China.

Looking at the future for top income research, a number of areas are identified that remain largely unexplored and where further research is needed.

First, the variety of top-correction approaches calls for a synthesis of the existing reweighting and replacing methods. Inequality researchers using household surveys would benefit from a procedure that helps to identify the optimal top-correction method given the nature of the data at hand. This conclusion also holds considering advancements in national income-adjusted top income shares that are estimated for a number of countries.

Second, more evidence is needed on post-tax and transfer outcomes. The impact of the historical expansion of redistribution and welfare-state institutions on top incomes re-

mains largely uncertain. Furthermore, an analysis of both cash and in-kind redistribution is needed, which implies an important role for incorporating the role of national accounts into household income definitions.

Third, too little is known about determinants of top income shares. Past studies are mostly concerned with characterizing inequality outcomes, but as the size and quality of datasets continually increase, more effort should be put on linking these outcomes to other economic and political factors in society. More analysis is needed on the role of labor markets, capital returns, inheritance, taxation, globalization, and other potential determinants of top incomes. If possible, emphasis should be put on estimating causal relationships, using both informed instrumental variables estimations and other methods based on historical shocks or structural approaches.

Fourth, mobility aspects are almost entirely absent from the top income literature. This is problematic, since mobility both influences the cross-sectional distributions through the role of transitoriness of income (working through, for example, short-time unemployment spells or one-time realized capital gains) and matters in its own merit by addressing questions about equality of opportunity within careers and across generations (For an extensive treatment of income mobility, see Jäntti and Jenkins (2015); for a more detailed study of mobility at the top of the income distribution, see Björklund et al. (2012)).

Fifth, and finally, the consequences of top incomes, and income inequality more generally, concern both academics and policymakers alike. Although numerous papers estimate the effect of inequality on economic growth, political outcomes, health, crime, and a range of other important outcomes, it is fair to say that there is not a consensus. With richer data on top incomes over time and across countries, the top income literature can make specific contributions to all the strands of literature trying to understand the consequences of inequality for the rest of society.



## 6 Cross References

- Wealth Inequalities
- Inequality Measurement: Methods and Data
- Political Economy of Labour Market Institutions in a Globalised Era

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