Top incomes in Germany, 1871-2013

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Abstract

This study provides new homogeneous series on top income shares in Germany from the early phase of industrialization until present. German income tax statistics offer the unique possibility to go back as far as 1871 and produce series for eight German states ranging from heavily industrializing Prussia or Saxony to mostly agrarian Baden or Wurttemberg. Top income earners in Germany are mostly business owners who benefit from global demand for their goods. High income concentration of the industrialization period temporarily dropped in the 1920s, when hyperinflation eroded financial assets and exorbitant wage increases curtailed business profits, but then reached new heights under the Nazi regime. The German development is in contrast to other industrialized countries like France, the UK, and the US, where World War II brought a strong and lasting reduction in income concentration at the top. Since the turn of the millennium, top income shares in Germany are on the rise catching up with the levels of the UK and the US.

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1   Introduction

The dramatic increase of the top percentiles income share in the United Kingdom and the United States has generated a revival of interest in the evolution of top incomes. Since the seminal contribution of Piketty (2001, 2003), a succession of studies construct top income share series over the 20th century for countries around the world.[1] These studies use income tax statistics to measure the concentration of income within the topmost part of the distribution. Since most countries introduced modern income tax systems at the beginning of the 20th century, these series can be built for a time horizon of about 100 years.

This paper provides a new top income share series for Germany from 1871 to 2013. Series from the eight biggest states are merged to produce a single German series for the pre-war period of 1871-1918, when income was taxed at the state-level. Although there are individual studies of German states, no German-wide series all the available data in a single place. The longest top income share series covering Germany from 1891 to 1998 is by Dell (2007), but the series is restricted to Prussia before World War I, and thus excludes about 40% of the German population.[2] The new series improves the series from Dell (2007) along several dimensions, which includes an extended period length both backwards and forwards, greater regional coverage before World War I, and a more consistent reference total construction.

Top income shares in Germany have remained surprisingly stable over the past 130 years. The top decile's income share is 40% in 2013 and in 1913. About 2% of household income accrued to the top 0.01% throughout the entire period. At all times, business income is the most important income source at the top, even

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[1]Amongst many others, Piketty (2007) estimated the series for France, Aaberge and Atkinson (2009) for Norway, Roine and Waldenström (2009) for Sweden, Atkinson (2007) for the United Kingdom, and Piketty and Saez (2007) for the United States. Dell (2007) provided the series a Germany 1891-1998, whereas the series 1891-1917 only covers Prussia. The estimated shares are collectively available at the World Wealth and Income Database (WID).

[2]Top income share series for Baden, Saxony, Hesse and Wurttemberg are included in Dell's unpublished PhD thesis (Dell, 2008). Other previous estimates of income concentration using German income tax statistics include Procopovitch (1926) (1875,1896,1913,1919), Grumbach (1957) (1820-1938), Geisenberger and Müller (1972) (end of 19th century until World War I), Tilly (2010) (1852-1875) and Dell (2007) (1891-1998). See Appendix Figures F.1 to F.7 for a comparison of previous estimates with this paper's estimates.

though top wage earners increasingly enter the top since the 1980s.[3] The post-war drop of top income shares in Germany is not a first-time event, but a return to low levels already seen in the 1920s. This is in contrast to the other war-participating countries such as France, the United Kingdom and the United States, where World War II brought the strong and lasting decline in top incomes. Further, the post-war drop in Germany was not as pronounced as in other countries, such that income concentration in post-war Germany was high in international comparison. Although the United Kingdom's and the United States' top percentile's income share overtook the German top percentile's share in the 1980s, top income shares in Germany are on the rise since the turn-of-the-millennium catching up with the levels of the United Kingdom and the United States.

The length of the period under consideration allows us to investigate explanatory factors for up- and downswings of top income shares over five quite different eras: (1) from an essentially rural economy to one of the world's most advanced industrial economies on the eve of World War I; (2) from the first democracy of the Weimar Republic expanding social security and labor market regulation, economic upheaval, hyperinflation and the Great Depression to; (3) the takeover by the nazis and World War II; (4) the *Golden Age* of the post-war era with the expansion of welfare state and education; and (5) German unification, its rise to the export world champion and the recent rise in inequality. While a higher capital share in national income is associated with higher top income shares, average tax rates, trade, union density and technological change are associated with lower income shares. However, relationships do not act uniformly across periods. More recently, trade and technological change tends is enriching the German elite. Average tax rates increased along with top income shares in the early years of progressive income taxation.

One should note that top income share series suffer from important limitations. First, top income shares document income concentration at the top and do not capture changing inequality elsewhere in the distribution. Second, income tax data record gross incomes before taxes subject to changes in the tax law. The redistribu-

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[3]This conclusion is shared by Bach et al. (2009) who integrate German income tax data and survey data in order to analyze changes in the bottom, middle and top of the income distribution for the period 1992-2003.

tive role of the government is neglected. Frequent changes in the tax legislation pose a challenge to create homogenous series. The introduction of dual income taxation with a separate withholding tax on dividends and interest in Germany in 2009 is a recent example. We devote special effort to correct for such changes. If tax avoidance and tax evasion change over time, we might obtain biased results. Finally, our fiscal top income shares by definition exclude the part of national income that is not captured by income taxation, which is approximately 10% of national income. Piketty et al. (2018) and Garbinti et al. (2017) are the first two attempts to construct long-run distributional national accounts (DINA) for the United States and France, respectively, combining tax, survey, and national account data. Thereby, they can construct inequality measures for the entire population, since tax data micro-files became available in 1962 in the United States and 1970 in France. In Germany, such micro-files are only available since 1992. As the aim of this paper is to provide a consistent long-run top income share series for Germany, we leave DINA measures for the entire distribution in Germany since 1992 for future work.

The paper is organized as follows: Section 2 briefly describes the method to construct top income shares and provides details on the data employed. The new top income share series 1871-2013 is presented and discussed in Section 3. A discussion of underlying forces behind changing income concentration is given in Section 4. Section 5 concludes.

2 Data and Methodology

We use income tax statistics as the main data source to estimate top income shares. Income tax statistics are both available in many countries of the world for more than a century and, to a large extent, comparable across countries. The series covers Germany as defined by the prevailing borders.[4] Over the course of the 19th century, German states subsequently introduced a modern income tax, where the amount of taxes depends on the income level of the household or the individual,

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[4]We refrain from estimating a series within constant borders, e.g. territory of the BRD, because it can hardly be argued that we would include a homogenous population and its children in such a series given the large number of displaced persons, particularly after World War II.

respectively: 1869 in Hesse, 1874 in Bremen, 1874 in Saxony, 1881 in Hamburg, 1884 in Baden, 1891 in Prussia, 1905 in Württemberg and 1912 in Bavaria. At the same time, the statistical offices of these states started publishing tabulations with the number of taxpayers per income bracket and aggregated taxable income per income bracket. In total, 27 income tax systems were introduced in the 39 German states, but only the states mentioned above regularly published tax statistics. In Prussia, income taxation for top income earners was introduced in 1851. However, the coexistence of a consumption tax in bigger cities with income taxation in rural areas (*urban-rural-dualism*) makes income tax statistics of limited use of estimating of top income shares before 1874. In 1874, the consumption tax was abolished and income taxation was extended to the entire population (see Appendix Section A for details on Prussian income tax regimes). We use income tax statistics of eight German states altogether including 90% of the German population in 1871 and covering almost the entire German territory of the newly founded German Reich as illustrated by Figure 1. Not included is about 10% of the population living in Mecklenburg-Schwerin (1.3%), Sachsen-Weimar, Mecklenburg-Strelitz, Oldenburg, Braunschweig, Sachsen-Meiningen, Sachsen-Altenburg, Sachsen-Coburg-Gotha, An-halt, Schwarzburg-Rudolstadt, Schwarzburg-Sondershausen, Waldeck, Reuß ältere Linie, Reuß jüngere Linie, Schaumburg-Lippe, Lippe, Lübeck and Elsaß-Lothringen (3.5%). We merge these eight series into a single German series covering the period from 1871 to 1918. Appendix Table B.1 provides a list of the sources by state and year. Appendix Section E describes the merging procedure for the German series.

In 1920, a Federal German income tax was introduced. However, the Statistical Office did not compile income tax statistics between 1919 and 1924. During the hyperinflation years of 1923 and 1924, income tax legislation was temporarily suspended. From 1925 to 1938, income tax statistics mostly cover a smaller territory than before World War I, excluding the provinces of Poznan, part of West Prussia, Katowice (part of Silesia), Alsace-Lorraine, and North of Flensburg (part of Schleswig-Holstein) lost after the war. From 1936 to 1938, income tax statistics again include Saarland, which was occupied and governed by the United Kingdom and France under a League of Nations mandate from 1920 to 1935. In 1938, income

Figure 1: German territory covered by the series, 1871-2013
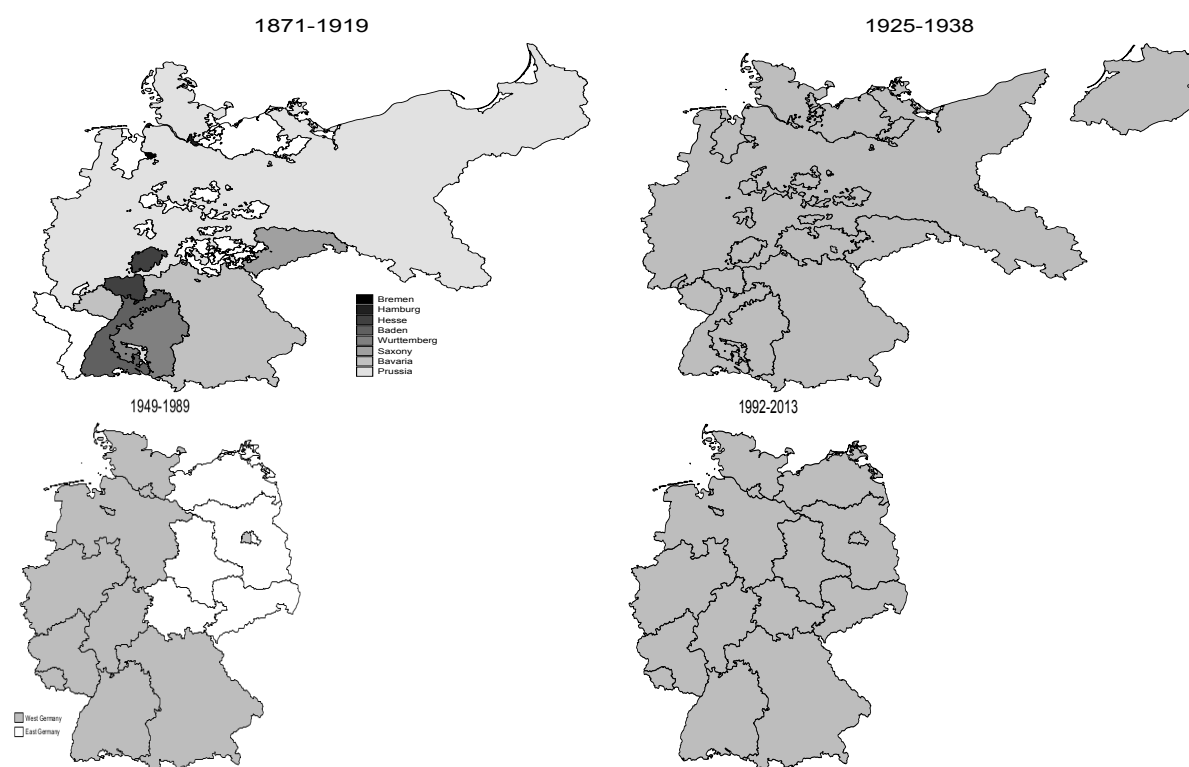
Note: Grey shaded areas are covered by the series and white areas are excluded as either no income tax statistics were published (1871-1919) or the area was not part of the (West) German territory.

tax statistics include Austria after its annexation into Nazi Germany.

The major tax reform in 1920 also included the introduction of a payroll tax on wages withheld at source. This payroll tax abolishes the obligation to file a tax return for large fractions of the population, where wages are the only income source. Consequently, the bottom half of the top decile is no longer captured in income tax statistics. Payroll tax statistics and income tax statistics cannot be merged *ex post* for two reasons. First, tax units are sorted by different income concepts (wages vs. overall income). Second, payroll tax statistics recorded the individual as the tax unit and income tax statistics record the household as the tax unit. However, the statistical office published synthetic tabulations of both income and payroll tax statistics for 1926, 1928, 1932, 1934, 1936 and 1950, which we use to estimate top income shares in these years. We can estimate the top percentile's share between 1925 and 1960, when only income tax statistics are available. Appendix Figure A.2 shows that income tax tabulations produce almost identical results up from the top percentile, but underestimate the share of the top decile. Starting in 1961,

the statistical office published statistics that include both payroll tax and income taxpayers in one table.

From 1949 to 1989, income tax statistics include the Federal Republic of Germany (FRG). Hence, the about 18 million Germans living in the German Democratic Republic (GDR) are excluded, this is a fifth of the German population in 1950. On the other hand, about 7 million people fled from the former eastern territories of the German Reich (Silesia, Pomerania and East Prussia) to the FRD between the end of World War II and 1950. Statistics include West-Berlin and Saarland after 1960. Saarland joined the FRG in 1957. In 1990, Germany was unified such that income tax statistics in 1992 cover 4 million additional taxpayers and 5 million non-filers.

Using income tax statistics, thresholds and average incomes of top income groups are obtained by applying the Pareto interpolation method commonly used in the top income share literature since the seminal contribution of Piketty (2001, 2003). Dividing the cumulative income above the income threshold of a fractile by an external reference total income gives the share of income accruing to the fractile. Source and construction of the reference total income and total population are described in Appendix Sections C and D, respectively. Applying the Pareto interpolation method to tabulated income tax statistics in Germany yields almost identical top income shares as obtained from individual tax records.[5] Incomes are Pareto imputed where only the number of taxpayers per income bracket are available following (Piketty and Saez, 2007, p.222).

3 Trends in top income shares

3.1 Top income shares in German states, 1871-1918

The level of income concentration between 1871 and 1918 varies greatly across German states. Figure 2 shows the evolution of income shares accruing to the top 1% of

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[5]Bartels and Jenderny (2015) compare German top income shares using both tabulated income tax statistics and all individual tax returns which are available as microdata since the 1990s. Top income shares based on tabulated statistics deviate from those based on microdata by about one decimal point. Using microdata, top 1% incomes are obtained by simply accumulating incomes moving downwards the income distribution until reaching the fractile threshold.

the population within German states. The independent cities of Hamburg and Bremen exhibit the highest level of income concentration. In contrast, mostly agrarian states like Hesse and Baden appear more egalitarian. The top percentile's income share in the independent cities fluctuates around 30%, which is more than twice the share of the same group in Hesse or Baden. It is worth noting that the magnitude of income concentration observed in the independent cities as well as in Prussia and Saxony before World War I is also quite high from a long-term perspective over the 20th century. Currently, about 13% of total income accrues the top percentile in Germany.

The trend of increasing income concentration over the industrialization period similarly applies across German states. The income share accruing to the top 1% increases from 13% to 17.5% in Baden between 1890 and 1913, from 15.5% to 17.5% between 1873 and 1913 in Prussia and from 15% to 17% between 1904 and 1912 in Wurttemberg. In Saxony, the gains in top incomes mostly went to entrepreneurs in industry and trade and only marginally to the more traditional professions such as large landowners, higher officials, doctors, lawyers, professors, and higher clerks, which is shown to have applied similarly to Prussia (Kaelble and Volkmann, 1986, p.175).

During World War I, income concentration sharply rises in Prussia and Saxony. Most other states refrain from publishing income tax statistics during the war. This increase, however, is almost offset by the drop in 1918. Increasing business profits in the armament industry and, more generally, businesses benefitting from the particular demands of a war economy are behind the rise in income concentration during the war (Preussisches Statistisches Landesamt (ed.), 1920, p.71). In addition, rich private investors bought war bonds on a large scale earning high interest income (Hardach, 2017). The nominal income growth of middle income earners (3000 to 9500M) in the wake of inflationary pressures toward the end of the war contributed to reduce top income shares in 1918. In addition, by 1918, authorities managed to restrict extraordinarily high profits from military spending. Regardless, income concentration at the end of World War I is well above the levels of the 1870s.

There are some former attempts to analyze income inequality using income

tax data from German states before 1918. The results of these studies, which either computed Pareto coefficients or top income shares as a measure of inequality, are displayed in Appendix Figures F.1 to F.6.[6] Most find slight signs of rising income concentration prior to World War I. The Soviet economist Procopovitch (1926) concludes that "tendencies towards plutocratic development are certainly in evidence in Germany" between 1875 and 1919. It is worth noting that Procopovitch (1926) provide the empirical support for the inequality increasing part of the Kuznets curve (Kuznets, 1955). Grumbach (1957), who estimated Pareto coefficients for the period of 1822-1939 for various German states, speculates that growing, but unequally distributed business incomes contributed to the increase in income concentration at the top. He confirms our finding that income concentration was particularly high in the independent cities of Hamburg and Bremen. The diagnosis of increasing income concentration was shared and intensively discussed by contemporary economists such as Gustav von Schmoller (Schmoller, 1895), Werner Sombart (Sombart, 1919) and Adolph Wagner.[7]

The degree of industrialization might explain part of the difference in income concentration across states. It is widely agreed that easy access to large coal deposits determined the regional pattern of industrialization in Germany and other industrialized countries (Sombart, 1919; Pollard, 1981; Holtfrerich, 1973; Fremdling, 1985; Tilly, 1991) According to Gutberlet (2012), access to coal mattered not only for the location of metallurgy in late 19th century Germany, but also for cotton textiles production. Higher economic growth in Saxony and the Prussian Ruhr area

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[6]This paper's series includes (1) more datapoints; (2) Pareto imputed top incomes, where only the number of taxpayers per income class is available; and (3) consistent adjustments, where corporate taxpayers are tabulated jointly with personal income taxpayers. Consequently, resulting trends are less volatile than the top income share estimates by Dell (2008) and Geisenberger and Müller (1972), particularly for Baden, Hesse, and Wurttemberg. Consistently excluding corporate taxpayers generates lower top income shares. E.g., this paper's top decile's share for Saxony is 4%-points lower than the estimate of Dell (2008) (see Appendix Figure F.5) and is 2%-points lower for Baden (see Appendix Figure F.2). For Saxony, tables recording personal income taxpayers separately from corporate taxpayers are provided in the review (*Zeitschrift*) rather than the yearbook of the statistical office used by Dell (2008). See Appendix Section A for the adjustment procedure applied to the Baden income statistics.

[7]This group of economists was also referred to as "socialists from the teacher's desk" (*Kathedersozialisten*) for their support of social reforms. Wagner postulated that "a new large economic (money-)aristocracy has arisen, which far supersedes the old one in numbers in income and wealth, next to an elevated laboring class and a depressed class." (Wagner, 1907, p.467)

made top incomes possible that could not be matched in agrarian areas. On the other hand, the growing importance of big cities for commercial trade (Hamburg, Bremen) and financial trade (Berlin) might have boosted top incomes disproportionately. According to Sombart (1919), banks acted as the pacemaker for German industrial production and trade, which were also mostly located in bigger cities such as Hamburg, Frankfurt, and Berlin. Finally, comparably higher enforcement of tax collection might be another reason for higher income concentration in the independent cities as income tax was the main source of fiscal revenue in these cities (Ketterle, 1994, p.144).

Figure 2: The top 1% income share in German states, 1871-1918
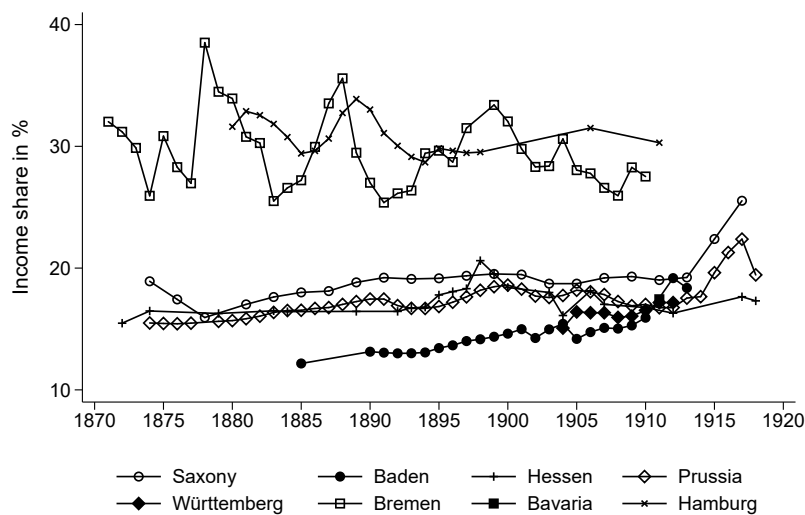
Source: Appendix Table A1.

3.2 Top income shares in Germany, 1871-2013

We now turn to the top income share series for Germany from the foundation of the German Reich in 1871 until 2013. Figure 3 displays how the top decile's and top percentile's share developed over time. Five periods should be distinguished over which the German territory, the population living in this territory, and the political system changed quite radically. The industrialization period of the German Reich from 1871 to 1918 was characterized by high and increasing top income shares. During Weimar Republic from 1920 to 1933, inequality was low, but it sharply increased when the Nazis came to power in 1933. Over the post-war period from

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1949 to 1989, the top decile's income share quite steadily increased from a low-point in 1950. The top percentile's income share quickly recovered from the slump immediately after the war. In most years of the post-war period, their income share is even higher than in the 1920s, which contrasts with many other industrialized countries at that time. German unification in 1990 initially resulted in a decrease in top income shares, but by the mid-2000s, the top decile's share crossed the pre-World War I level and the top percentile's share the post-World War I level. As most of the capital gains were tax exempt in Germany, excluding capital gains from the series does not greatly reduce the top decile's or top percentile's income share. In the following, each period is discussed separately and we focus on series including capital gains.

Figure 3: Top decile and percentile income shares in Germany, 1871-2013
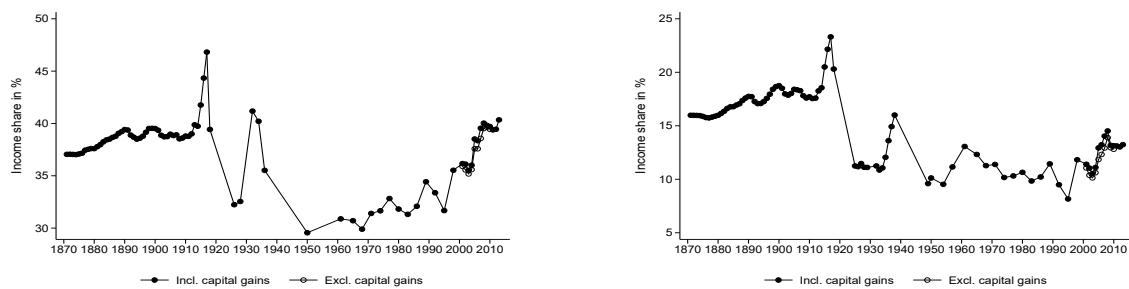
In order to shed light on the distribution of income gains within the top decile, Figure 4 displays the income share of bottom half of the top decile (P90-95), the next 4% (P95-99) and the top 1%. Before 1918, most of the changes in the top decile are driven by changes in the top percentile. Even though the top 1% is a small share of the population, it captures about a sixth of total income before World War I and a seventh throughout the second half of the 20th century. The top percentile lost relative to the bottom 9% after both World Wars. This pattern is also observed for the United States by Piketty and Saez (2003). In Germany, the top percentile's share was far higher before World War I and fluctuated around the share of the bottom 5% and the next 4% in the post-war period. In the United States, it was only slightly higher before World War I and quite below the share of the bottom 5% and the next 4% in the post-war period. This indicates a comparably high income

concentration at the top in Germany. Germany's trends in international comparison are discussed in more detail in Section 3.3.

The industrialization period from 1871 to 1918 marks a phase of moderately increasing income concentration at the top in Germany as discussed in Section 3.1. The top percentile overproportionately benefitted from the industrialization period in Germany, whereas incomes of the lower 9% of the top deciles kept up with overall income growth. The top percentile's income share moderately increased from 16% in 1871 to 18% in 1913. In contrast, the income share of the bottom half (P90-95) stagnated at about 9% and the next 4% (P95-99) even lost out relative to the other fractiles. Income shares of all fractiles of the top deciles dropped in 1918 compared to the preceding years, but not below the pre-war levels of the industrialization period. World War I did not act as the great leveler in Germany, but rather exacerbated tensions between workers, business owners, and the government. The war brought a large-scale redistribution from labor to capital which the November revolution of 1918 intended to reverse (Kocka, 1978, p.136). The aggregated German series shows a lower share of the top 0.01% than the Prussian series. Taking the Prussian series as representative for Germany, as done by Dell (2007), overestimates income concentration at the very top. E.g., the income share of the top 0.01% would be overestimated by 20% when only considering Prussia (see Appendix Figure F.7). German top incomes before World War I were mostly earned on the Prussian territory.[8]

The second period covers the years of the Weimar Republic[9] from 1919 to 1933. However, cabinets changed frequently depending on the support of the elites, but also the voting masses. This opened the door for a "laboratory of inequality reducing policies" (Kaelble, 2017, p.61). The top marginal tax rate was raised from 5% (in Prussia) to 60%, unemployment insurance was introduced, as well as employment law and employment protection. In the aftermath of the revolution of 1918, employer's organizations accepted the unions as equal partners and met many

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[8]Almost two-thirds of the German millionaires included in the famous Yearbook of Millionaires (*Jahrbuch der Millionaere*) of 1913, produced by former ministry civil servant Rudolf Martin, lived in Prussia. A fifth of the Prussian millionaires lived in the Rhineprovince, 15% in Berlin, and 10% in Silesia. In contrast, 15% live in Bavaria, 9% in Saxony, and 8% in Hamburg.

[9]The constitution of the new republic was created in the city of Weimar.

of their sociopolitical demands including large wage increases. In return, the unions cooperated with the employer's organizations and renounced the class war (Kocka, 1978, p.137). Both wage increases and hyperinflation contributed to reducing inequality.[10] The income share of the top percentile almost halved to 11% in the 1920s and remained virtually stable until 1933. However, according to the controversial *Borchardt-hypothesis* (Borchardt, 1982, p.176), it was exactly the sharpening distributional conflict between the organized interest groups of labor and capital along with the large scale redistribution beyond means that made the economy of the Weimar Republic "sick". Excessive wage raises in the second half of the 1920s by far exceeded productivity growth, thus curtailing business profits and limiting the scope for new investments.[11] Fast rising unemployment was another consequence. The inoperable political and economic system of this period of exceptional low inequality found its end in the Nazi "seizure of power" in 1933.

The third period is from the Nazi "seizure of power" in 1933 until the eve of World War II in 1938. After 1938, the statistical office stopped publishing income tax statistics, so we do not know how the income distribution changed during World War II. The Nazi-period is marked by an extraordinary increase in the top percentile's income share from 11% in 1934 to 17% 1938. In contrast, the P95-99 gained only moderately. As in most industrialized countries, economic recovery after the Great Depression started in 1932 in Germany. The following boom until 1936 was driven by a rebound effect and predictable from late 1932 according to Ritschl (2002). Fiscal and monetary policy of the Nazis were immaterial for the upswing. Industrial firms saw their profits rise sharply between 1933 and 1939 with an average return on equity of 10.4% (Spoerer, 1996). Ferguson and Voth (2008) find that firms "betting on Hitler" outperformed comparable unconnected firms in

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[10]Hyperinflation in the first half of the 1920s eroded financial assets, greatly reduced capital incomes and thereby induced a redistribution from nominal to physical capital (Holtfrerich, 1980, p.273). Capital flight to Switzerland fearing confiscation for war reparations or increased tax avoidance activities following the exorbitant tax increases might be another reason for reduced top incomes. Piketty and Zucman (2014) point out that Swiss data show a large increase in foreign fortunes managed by Swiss banks in the 1920s and, in all likelihood, a sizable fraction of these belonged to German households. Further, capital flight of foreign securities from Germany after World War I is acknowledged by contemporaries such as Keynes (1920) (chapter 5, III:1).

[11]The large increase of the wage share can be seen from the inverse of the capital share presented in Figure ??, which sharply decreased in the second half of the 1920s. Spoerer (1996) finds that the return on equity between 1925 and 1929 was only 2.5%.

their stock market value by 5% to 8%. The effect of Nazi-connections probably contributed to further concentrate incomes at the top.[12] Larger firms were more likely to form connections with the Nazi government including firms across all sectors, i.e., firms with rearmament relevant skills and without.[13] Some large family fortunes originated during this period, for example that of the Quandt family, who bought BMW after the war. In contrast, unions were dissolved in 1933 and wage controls enacted such that average hourly wages in 1938 were lower than in 1928.

The fourth period from 1949 to 1989 depicts the Federal Republic of Germany (FRG), excluding about a fifth of the German population, which was living in the German Democratic Republic (GDR). Top income shares in post-war Germany are remarkable in three ways. First, income shares of the bottom half of the top decile and the next 4% were not significantly below the levels of either the pre-war industrialization period or the interwar-period. In the 1950s and 1960s, the top percentile's share is even higher than in the interwar period.[14] This means that income concentration in post-war Germany is high in historical perspective, thus colliding with the general view that the Social Market Economy of the post-war period was characterized by comparably low inequality. Several studies suggest a striking continuity in post-war Germany along many dimensions. It was the same people at the helm of German big business and its associations in the 1950s, who had organized the war economy in the early 1940s, except for a few of the most compromised collaborators with the Nazi regime (Grunenberg, 2006). Rather than embarking on radical reform, German policymakers in the 1950s quickly reinstalled institutions inherited from the Weimar Republic and the mid-1930s, thus creating a tightly regulated economy with corporatist organization. Institutional changes

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[12]Tendencies of economic concentration also become evident from the steadily decreasing number of corporations between 1925 and 1938. The number of limited liability companies decreased from 64,398 in 1925 to 25,662 in 1938. The number of stock companies decreased from 13,010 in 1925 to about 9,634 in 1932 and then almost halved to 5,518 in 1938.

[13]Part of income increase recorded in tax statistics might be due to improved enforcement of the tax authorities since 1937 (Statistisches Reichsamt, 1939). However, we can only speculate if this improved enforcement disproportionately affected the rich, thereby contributing to an increased income share of this group.

[14]Dell (2007) obtains even higher top income shares in the 1950s, as can be taken from Appendix Figure F.7, which is puzzling as we use the same data source and almost the same reference total population and total income.

were only adopted as needed to avoid a rupture with the Allies (Eichengreen and Ritschl, 2009). Eichengreen and Ritschl (2009) argue that the institutional continuity provided accountability and predictability in the 1950s and enabled the German economy to grow back to its historical trend after heavy disruptions in the aftermath of World War II. Second, the top percentile's income share in post-war Germany is also higher than in other industrialized countries like United States, United Kingdom, France and Sweden, which we discuss in more detail in Section 3.3. Third, the post-war drop in top income shares in Germany is not a first-time event, but a return to the low levels already seen in the 1920s. This is in contrast to the other countries involved in the war such as United States, France and United Kingdom, where first great decline in top income shares occurred after World War II.

The fifth and last part of the series covers reunified Germany. Political unification on October 3, 1990, brought the Eastern states of Berlin, Brandenburg, Mecklenburg-Western Pomerania, Saxony, Saxony-Anhalt, and Thuringia into the Federal Republic of Germany. The first years after reunification are marked by exceptionally high GDP growth rates for the reunified German economy. GDP grew by about 8% per year from 1990 through 1992 even though industrial production quickly collapsed in the East and unemployment jumped. Those keeping their jobs benefited from an unprecedented jump in real wages bargained by the Western German labor unions that aimed to reach parity with West German wage levels by 1994 (Burda and Hunt, 2001). Accordingly, the inclusion of East Germans into the West German income tax system brought an over-proportional increase in the number of unemployed non-filers. At the same time, wages of the still employed East Germans kept up with West German wages up to the highest percentile. Taking these effects together, the income share of the top percentile sharply fell, whereas the share of the bottom 9% of the top decile remained almost unchanged between 1989 and 1992. In 1995, top percentile's incomes fell, whereas the economy was still growing, although at a slower pace. Consequently, the share of the top percentile declines even further, in contrast to the P90-95 and P95-99 who held their share. Growth slowed even further after 1996. By 1998, the top percentile's income share reached the pre-reunification level as business and capital income continued to grow; just like

unemployment. From then on, the top 5% (P95-99 and top 1%) experience an enormous growth in their income share, which was only briefly interrupted by the burst of the new economy bubble in 2003. The income share accruing to the top percentile rose from about 12% in 2000 to a post-war high of more than 14% in 2008. In 2009, Germany was hit by the largest output drop of the post-war era in the wake of the Great Recession; GDP declined by more than 5%. Unfortunately for researchers, the recession coincided with the introduction of dual income taxation in the form of a separate withholding tax on dividends and interest income (*Abgeltungssteuer*) after which income tax statistics no longer capture these incomes systematically. The shares presented include an imputed capital income share after 2009, which is explained in detail in Bartels and Jenderny (2015). Hence, the remaining drop in the top percentile's income share is largely attributable to the economic crisis.

All in all, the top percentile did not recover from the shocks between 1914 and 1945 until 2013. But the bottom 9% of the top decile have gained substantially in the second half of the 20th century surpassing the prewar levels in the first decade of the 2000s. This means that income concentration at the top decile in Germany today is even greater than it was during the industrialization period of 1871-1913.

Figure 4: The income share of fractiles P90-95, P95-99 and P99-100, 1871-2013
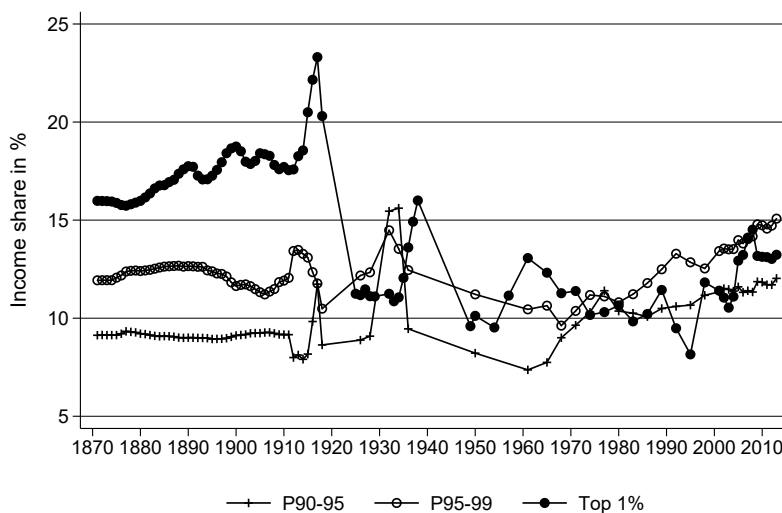
Source: Appendix Table A1.

The income shares of the top 0.01% are displayed in Figure 5. Despite high volatility between adjacent years, their income share is at a remarkably stable level of

about 2% for more than 130 years. In the years where we have microdata, excluding capital gains shows that even at the very top taxable capital gains are comparably small.

Figure 5: The income share of the top 0.01% in Germany, 1871-2013
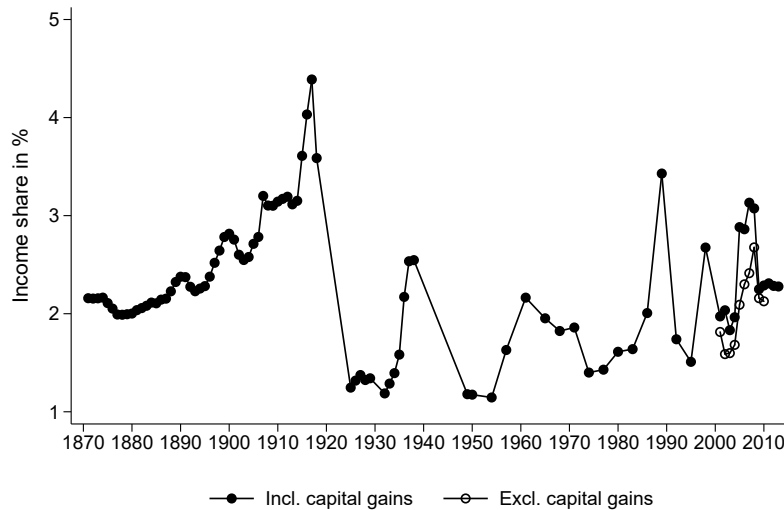
Source: Appendix Table A1.

The bottom 50% lost out against the upper half of the distribution over the post-war period, as shown in Figure 6. In the years of the German *Wirtschaftswunder*, strong labor demand and high GDP growth rates coincided with powerful unions, low unemployment and a rather compressed wage distribution. The bottom 50% received a third of total income. With the oil crises and the onset of mass unemployment the share of the bottom 50% collapsed to less than a quarter. In the 1970s, the share of employees in the service sector surpassed the share employed in the industrial sector. The fall of the bottom half is mirrored by an increase of the middle 40% who receive slightly more than 40% of total income since the 1970s. However, the middle 40%'s share has remained quite stable ever since, while the top decile gained since the mid-1990s. However, with the growth of the low-income sector at the end of the 1990s, the share of the bottom half declined significantly from 22% in 2001 to 17% in 2013.

Figure 6: The income share of the bottom 50% and middle 40% in Germany, 1961-2013
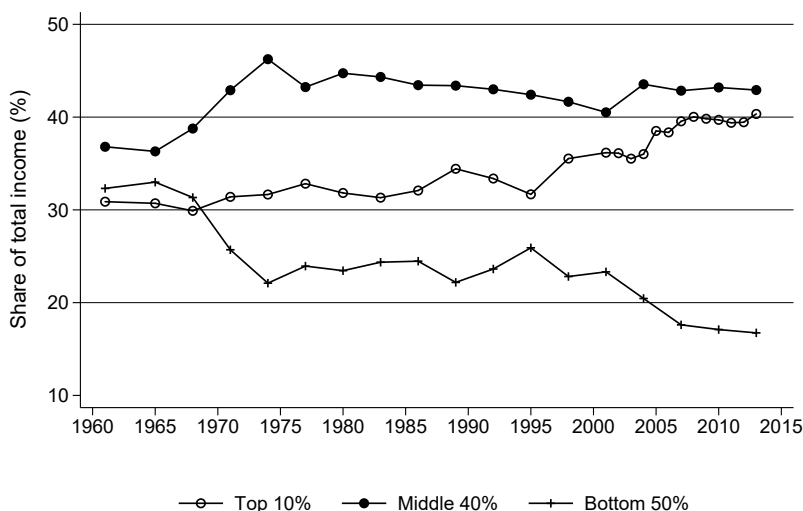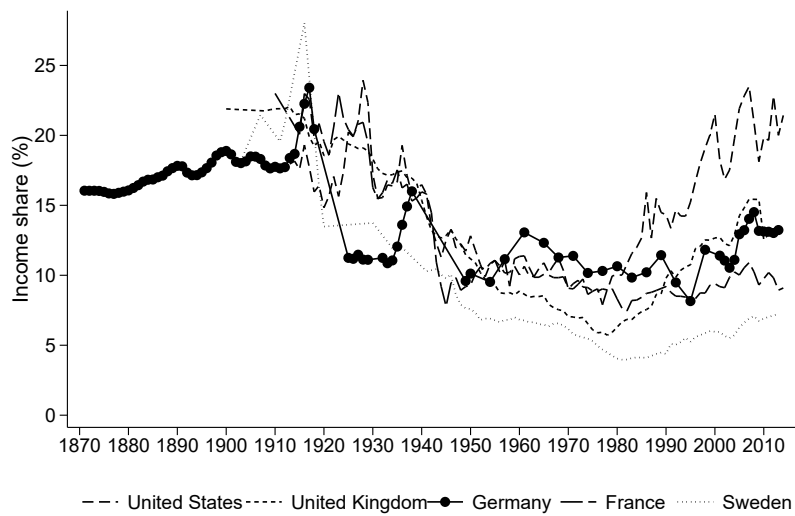

Source: Appendix Table A1.

3.3 International comparison

Comparing income concentration in Germany to other countries reveals a strikingly stable income concentration in Germany over the 20th century. Figure 7 shows the evolution of the top 1% income share in Germany in comparison to the trends observed in France, Sweden, the United Kingdom, and the United States. Although the German top percentile also experienced a U-shape pattern over the 20th century, like other countries (Atkinson et al., 2011), the U-shape is rather flat and interrupted by the exploding shares before and during the two World Wars. The top percentile's share in Germany was comparably low in the first half of the 20th century. As in Sweden, the decline in income concentration in Germany happened toward the end of World War I and in the 1920s. In the France, the United Kingdom and the United States, by contrast, the large drop occurred during World War II. These contrasting developments for United Kingdom and Germany are also found by Gómez-León and de Jong (2017). Even though they use a different data source – social tables consisting of 78 income groups 1900-1950, they also find exploding inequality in Germany during World War I, a large inequality decline thereafter, and an inequality increase during the Nazi regime. Their findings for the United Kingdom are also in line with the evolution of top income shares, documenting a drop during World War

I, an inequality increase in the 1920s, all followed by a rather steady decline until the end of World War II. In the post-war period, the top percentile's income shares in Germany are exceptionally high. This is astonishing as this period is internationally viewed as a phase of low inequality. Since the mid-1990s, Germany is on a path of increasing income concentration, resembling more and more the Anglo-Saxon countries.

Figure 7: Top 1% income share in international comparison

Source: WID.world and Appendix Table A1.

3.4 Composition of top incomes

In order to understand the source of top incomes in Germany, Figure 8 displays the composition of top incomes within fractiles of the top decile moving toward the very top of the income distribution. Three basic conclusions similarly apply to the four exemplary years presented: First, business income from unincorporated firms is always the most important income source of top income earners in the top percentile and among those at the top of the top. In contrast, P90-95 and P95-99 incomes are mostly composed of wages. Second, capital income, i.e., dividends, interest income and rents, is of minor importance across the distribution in Germany compared to other countries like France or the US. Even for the top 0.01%, capital income never comprises more than 20%. This is not surprising as most German firms are unincorporated generating business income and often held by a few family members. Accordingly, Germany did not experience the dramatic decline in capital incomes from dividends and interest income after World War II as it is witnessed in the United States. One should note, however, that business income includes both a labor and capital income component. It is unclear how much effort business owners invest to gain their business income or if they did not work for it at all. Third, the self-employed, i.e. lawyers, physicians, auditors, earn top incomes, but do not belong do the very top group.

Fluctuations in business incomes are indeed a major force behind the dynamics of top income shares. Figure 9 displays the composition of top 0.1%'s income from 1928 to 2013. Peaks of the top 0.1%'s income share are associated with 60% business income (1938, 1961) or 50% business income (2001, 2008). This pattern is even more pronounced for the top 0.01% for which we can compute the income composition after 1961. This group generates 80% of their income from business in 1961 and 1965 and roughly 70% in 1989, 1998 and 2007. The rise in income concentration during rearmament before World War II is a rise in business incomes at the top. The fall in income concentration in the late 1960s and following reunification in the 1990s also coincides with falling business incomes at the top. The declining portion of business income at the very top is mirrored by an increase in the portion of capital income. While income from dividends, interest as well as renting and leasing was

Figure 8: Income composition of top groups within the top decile in Germany
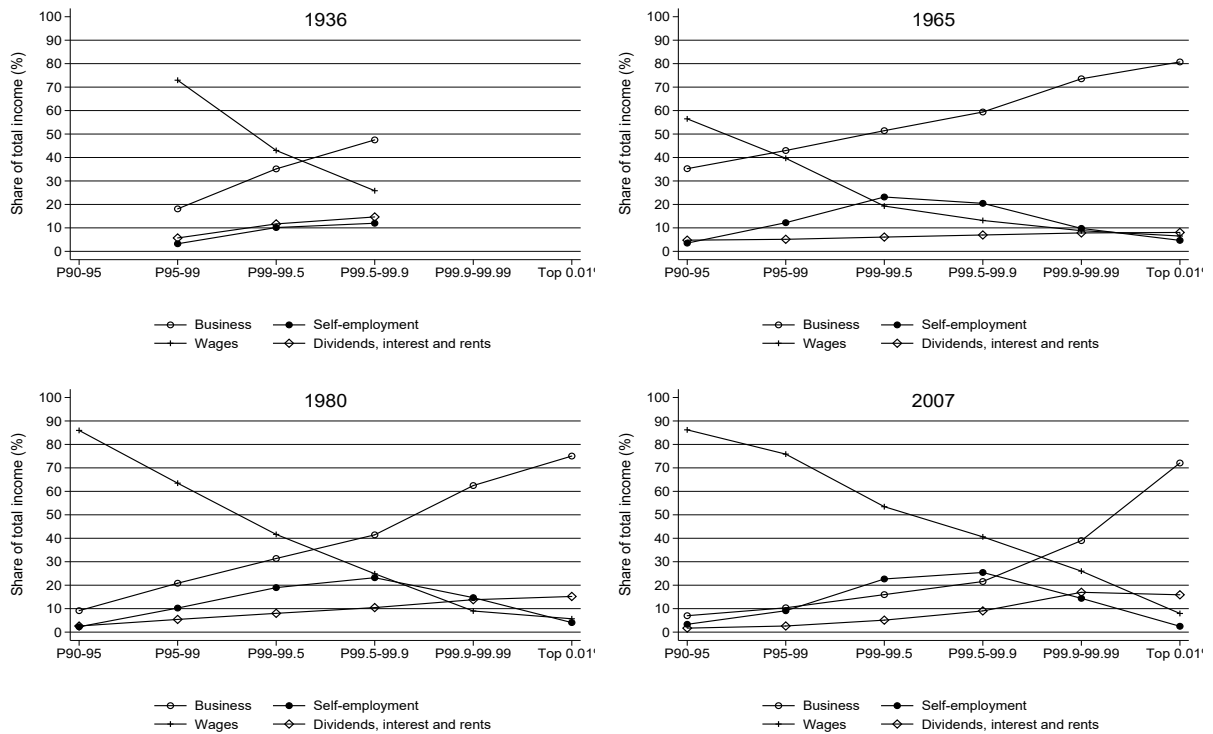
7% for the top 0.1% and top 0.01% in 1961, this portion quite steadily increased, reaching about a quarter for both top groups in the late 2010s.

Top managers and highly qualified self-employed increasingly entered top income groups since the 1980s. Whereas wages are less than a tenth of the top 0.1%'s income in the 1960s, the wage share increases to almost 30% in the first decade of the 2000s. The surge of top wage incomes in the second half of the 20th century is a common phenomenon also found for Italy, the Netherlands, Spain, and the United States. This experience is in contrast with rising importance of capital income at the top in Finland, Sweden, and the United Kingdom (Atkinson et al., 2011). It remains an open question to what extent these *working rich* are CEO and business owner at the same time, disbursing part of their business income as wage income. Rubolino and Waldenström (2017) find that income shifting between wages and capital income in response to tax differentials is substantial at the top of the income distribution.[15]

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[15]The analysis is based on Australia, Canada, France, Italy, Japan, Korea, the Netherlands, Spain, Taiwan and the United States due to data availability.

Figure 9: Composition of top incomes in Germany - Top 0.1%
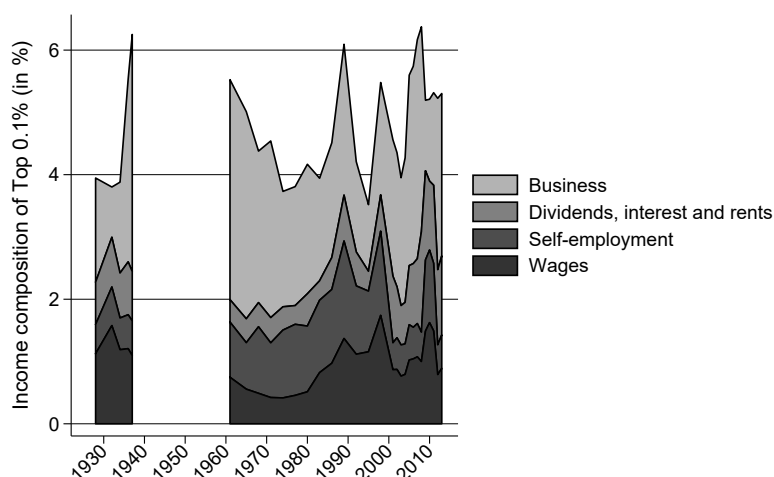
If owning a business is the time-invariant key to earn top incomes in Germany, the question arises of how business ownership is achieved and maintained, possibly across generations. Kaelble (1990) studies the owners and top managers of large German companies both in the German Reich before World War I and in the Weimar Republic. He finds that intergenerational persistence of business ownership was high in both periods. Increasingly sons did not work in the family business they inherited, but rather became top managers of another business. Already during the industrialization phase, noble families as entrepreneurs played a minor role in Germany. Indeed, inherited business wealth might still be of central importance for top incomes. Korom et al. (2017) investigate how likely the richest Americans are to remain on the Forbes list between 1982 and 2013, and finding that lasting fortunes are likely embedded in families as they erode less easily, if professionally managed, than self-made fortunes. According to Schröder and Westerheide (2010), about 90% of all German companies are family-controlled companies generating more than half of the cash flow of German companies.

4 Seeking Explanations

Despite two World Wars, a variety of political regimes including constitutional monarchy, dictatorship, and democracy, as well as rapidly changing technological frontiers during periods of industrialization and digitalization, top income shares in Germany remained both remarkably high and stable. There were temporary upswings over the industrialization period, during the Nazi regime, in the immediate post-war period and, recently, since the turn-of-the-millennium. On the other hand, both World Wars were followed by a substantial decline in top income shares. In the following, we investigate to what extent macroeconomic processes, globalization, technological change, labor market institutions like powerful trade unions, and redistribution via income taxation are associated with changes of the top percentile's income share.

Focusing on Germany for a period of almost 150 years enables us to investigate, if the relationship between top income share and specific potential drivers indeed operates uniformly across periods. We argue that relationships are likely to change over time. Moreover, if inequality regimes shift over time, the role of some factors may increase, while others lose importance. For example, trade unions may become powerful and achieve high wage increases when a high-inequality regime collapsed, thereby reducing distributed profits in a new low-inequality regime. Figure 10 shows the development of our main variables from 1871 to 2013.

Capital share in national income is expected to be positively correlated with top income shares as capital ownership is concentrated at the very top of the income distribution. Bengtsson and Waldenström (2017) study the correlation of functional and personal income distributions for a larger number of countries, finding that the correlation is 0.5 or higher and highly statistically significant in 13 of the 16 countries. According to their results, the correlation is declining in Continental European and Nordic countries in recent decades. We use their capital share figures.[16]

Globalization, as measured by the degree of trade integration is generally expected to increase inequality in advanced economies. Following the predictions of

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[16]Erik Bengtsson kindly provided an extended series for Germany starting in 1871.

the Heckscher-Ohlin (HO) model, trade will increase relative wages of high-skilled in advanced economies as they will export goods that use intensively the factors they are more endowed with. However, increased competition may also reduce the monopoly power of national champions, and thereby reducing top income shares. We measure the degree of globalization by the share of exports in GDP.

Technological progress is often identified as one of the main drivers for increased inequality, particularly at the upper part of the distribution (IMF, 2007; OECD, 2011). However, a growing number of studies find indication of trade-induced technological progress (see, e.g., Bloom et al. (2016)). We use patent applications per capita provided by Madsen (2007) as a measure for technological progress.[17]

Trade unions are expected to have an equalizing effect not only by increasing earnings of their members or others, but also indirectly by creating awareness for a fair income distribution or by establishing pay norms among employers. Most studies find that higher union density is associated with a more compressed wage distribution (Förster and Tóth, 2015). We construct our own time series of trade union density defined by the share of employees who are members of a trade union, because the longest available series from OECD only begins in 1960.

Top tax rates are suggested to reduce top income shares through three channels: reduced labor supply (real response) (Feldstein, 1995), increased tax avoidance and evasion (Auerbach, 1988; Slemrod, 1995; Goolsbee, 2000; Saez, 2017) or less aggressive wage bargaining of top managers as the marginal return of a pay increase is lower (Piketty et al., 2014). To create measures of income taxation at the top, we compute the marginal tax rate and the average tax rate that would apply to the top percentile's average income according to the prevailing income tax legislation. Figure 10 shows that top statutory tax rates in German states before World War I were small with top tax rates mostly lower than 5%. States with the highest level of income concentration – Hamburg and Bremen – also charged the highest tax rates.

Table 1 shows that all of these variables strongly correlate with the income

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[17]Jakob Madsen kindly provided an extended series of patents in Germany covering our entire period.

Figure 10: Main variables

share of the top 1%. As developments of top income groups are largely driven by the top percentile, we restrict this analysis to the top percentile. While a higher capital share is associated with a higher income share of the top 1% when considering all periods jointly, average tax rates, trade, union density and technological change are associated with lower income shares. However, the sign of the correlation changes for some factors across the periods. The correlation matrices also show that the explanatory variables are (strongly) correlated with each other such that a regression

including all these variables jointly would suffer from multicollinearity.[18]

The capital share in German national income shows a strong positive correlation with the top percentile's income share in all four periods. The correlation is higher than 0.8 in all periods, except the post-war period 1949-1989.

Trade measured by the share of exports in GDP is associated with lower top income shares in three of the four periods. Only in the most recent period does trade seem to be associated with higher top income shares. This suggests that the benefits from exporting to the global economy were shared more broadly from the industrialization phase until the post-war era, while they tend to enrich the elite in recent years. Cross-country studies also remain inconclusive about the long-run role of trade.[19] Among others, Roine et al. (2009) find no clear distributional impact from international trade.

Average tax rates of the top 1% show a strong negative correlation with the income share of the top 1%, when all periods are considered jointly. However, splitting the periods reveals that this correlation was indeed positive until World War II and slightly negative in the post-war period. Only the most recent period shows a significantly negative correlation of -0.78. Income tax rates during the industrialization period were low and often increased in years when top income shares increased as well (see Figure 10). The same applies to the Nazi-period, when rising top tax rates coincided with rising income concentration. This hints at virtually no response to taxation during this period which is in line with the finding of Rubolino and Waldenström (2017) that top tax elasticities for 1900-1950 were very low in a set of 30 countries. In contrast, the top percentile's share growth after the turn-of-the-millennium coincides with decreasing marginal and average tax rates. According to Rubolino and Waldenström (2017), top incomes in Anglo-Saxon countries became more responsive to taxation over 1981-2014, with tax elasticities

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[18]We refrain from regressing a set of potential causes on our top income shares, as this very simple approach is judged unsatisfactory for several reasons. First, unobserved time-invariant factors may force the error term to be correlated over time. Second, causality may very well be reverse. Thirdly, the timing of effects is unclear. While some factors may impact inequality immediately, others may take longer to show an effect. Fourth, inequality measures are typically bounded and non-stationary. Statistical inference that mistakenly uses standard asymptotic results leads to erroneous conclusions (Jäntti and Jenkins, 2010).

[19]See Förster and Tóth (2015) for an overview.

increasing to unprecedented levels of 0.92 among the top 0.1%. In contrast, they find that taxpayers in Nordic countries and continental Europe respond much less to tax changes.[20]

Trade union density is negatively correlated top income shares in three of the four periods. During the industrialization era, trade union density was small with less than 5% of employees being member of a trade union, but quite steadily increasing. One might speculate to what extent increasing income concentration contributed to increasing trade union membership. Trade union membership and bargaining power substantially increased in the Weimar Republic when top income shares fell dramatically. After the Nazi takeover unions were banned and top income shares increased quickly. In the most recent period, declining union membership is strongly correlated with increasing top income shares.

Technological change measured by the number of patent application per capita is negatively correlated when considering all periods jointly. Splitting the periods reveals that technological change is only associated with lower income concentration in the middle of the 20th century. Both in the industrialization period and since reunification of Germany, technological change is associated with higher top income shares.

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[20]The estimated tax elasticity in Germany is 0.18 for the top 1% and 0.1 for the top 0.1%.

Table 1: Correlation matrices by period

All	Top 1%	Cap.share	ATR	Trade	Union	Patents
Top 1%	1					
Cap.share	0.219*	1				
ATR	-0.848***	-0.00175	1			
Trade	-0.375***	0.428***	0.581***	1		
Unions	-0.779***	-0.129	0.820***	0.414***	1	
Patents	-0.494***	0.426***	0.418***	0.126	0.455***	1
1871-1919						
Top 1%	1					
Cap.share	0.818***	1				
ATR	0.683***	0.844***	1			
Trade	-0.385**	0.412**	0.0392	1		
Unions	0.609***	0.869***	0.894***	0.311*	1	
Patents	0.529***	0.881***	0.871***	0.368*	0.910***	1
1925-1938						
Top 1%	1					
Cap.share	0.836***	1				
ATR	0.885***	0.849***	1			
Trade	-0.629*	-0.543*	-0.599*	1		
Unions	-0.587*	-0.589*	-0.612*	0.950***	1	
Patents	-0.449	-0.464	-0.481	0.954***	0.946***	1
1949-1989						
Top 1%	1					
Cap.share	0.529***	1				
ATR	-0.0474	-0.134	1			
Trade	-0.148	0.0114	0.839***	1		
Unions	-0.202	-0.362*	0.295	0.421**	1	
Patents	-0.153	-0.113	-0.515***	-0.677***	-0.292	1
1992-2013						
Top 1%	1					
Cap.share	0.897***	1				
ATR	-0.781***	-0.849***	1			
Trade	0.899***	0.918***	-0.904***	1		
Unions	-0.890***	-0.907***	0.847***	-0.946***	1	
Patents	0.881***	0.869***	-0.747***	0.887***	-0.953***	1

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: See Note below Figure 10 for sources of regressors, independent variables are from own calculations.

5 Conclusions

This paper provides a new homogeneous series on top income shares in Germany from the early phase of industrialization until present. Constructing a homogeneous

long-run series for Germany is particularly challenging. The German territory, the population living in this territory, the political system, and, to some extent, the tax legislation has changed quite radically over time.

Eight series ranging from heavily industrializing Prussia and Saxony to mostly agrarian Hesse and Baden document the evolution of top income shares over the industrialization period until World War I. Top income shares in industrializing Prussia and Saxony lie between very high shares in the independent cities of Hamburg and Bremen and comparably low shares in Hesse and Baden. As many of the superrich of Imperial Germany lived in Prussia, we overestimate income concentration at the top when only looking at Prussia. The state's series were merged into a single German series incorporating 90% of the German population.

In 2013, the share of total income received by the bottom half of the population was 17%, while the share of the top decile was 40%. In 1913, the share of the top 10% was also 40%. The top 1% is, however, lower today than in 1913 (18% versus 13%). The top 1% increased sharply between the creation of the Reich in 1871 and the establishment of the Weimar Republic in 1918. It then decreased dramatically when social policies were implemented by the Weimar Republic. The Nazi prewar period is associated with economic recovery and favorable policies for large businesses, and saw temporary surges in top incomes. The top 1% share was then reduced to 10-12% during the 1950-1990 period, when the bottom 9% of the top decile quite steadily gained. Since the turn of the millennium, the top percentile's income shares is on the rise catching up with the levels of the UK and the US. By the mid-2000s, the top decile's income share in Germany exceeded the prewar level.

In Germany, high income concentration of the industrialization period dropped as soon as the 1920s and fluctuated around this level throughout the postwar period. This contrasts with other rich countries like United States, the United Kingdom, and France, where the Second World War brought strong and lasting reductions in income concentrations at the top. The top percentile's income share in Germany in the post-war period is high in international comparison. This collides with the general view, that this was a period of low inequality.

Top income earners in Germany have been business owners throughout the

twentieth century and up to the present. Consequently, growth in top income shares in Germany is closely related to increasing profits from unincorporated firms and to a higher capital share in national income. As most German firms are family owned, with some family members more involved than others, it is difficult to judge how much of top incomes from business profits are labor incomes and which part is "pure" capital income (with limited labor input). Starting in the 1980s, however, highly qualified employees have increasingly entered top-income groups.

Higher average tax rates, trade openness, union density, and technological change are associated with lower top income shares. However, relationships do not act uniformly across periods. Currently, trade and technological change tend to enrich the German elite. Average tax rates increased along with top income shares in the early years of progressive income taxation, but show a strong negative correlation since the early 2000s, when top statutory tax rates were reduced substantially.

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A   Income tax regimes and the definition of income

In the following, the evolution of income tax regimes in German states from the second half of the 19th century until 1919 and in Germany 1920-2012 are briefly sketched. Special emphasis will be given to the Prussian tax system which comprised the biggest part of the German population in the 19th century. Further, the Prussian income tax system not only served as a role model for the introduction of similar systems in other German states, but also for the first federal German income tax introduced in 1920 (Ketterle, 1994). In the second part of this section, we describe how incomes recorded in tax statistics were modified to estimate top incomes that are consistently defined over time.

The Prussian income tax legislation can be ordered into four phases: class taxation from 1821 to 1850 (1), class taxation and classified income taxation coexisting with a consumption tax (grind and butcher tax) in bigger cities from 1851 to 1873 (2), class tax and classified income tax from 1874 to 1890 (3), and modern income tax from 1891 to 1918 (4).

The class tax introduced in Prussia in 1820 is only of limited use for the estimation of income concentration because the assignment into a class hinges on the social class and not on income. Still, some contemporary authors argue that the class assignment was strongly related to the income position or earnings ability.[21] 12 subclasses were distinguished into which authorities of the municipality assigned all households[22] according to their social class. The second important drawback of the class tax is the fact, that inhabitants of the biggest cities were not subject to the class tax, but instead had to pay grind and butcher tax (*Mahl- und Schlacht-steuer*) on flour and meat consumption.[23] We might thus worry to underestimate the concentration at the top (1) if the class membership does not perfectly reflect the position in the income distribution, (2) if more top income earners lived in the biggest cities than on the country side, and (3) if top income earners transferred their residence to a bigger city subject to grinder and butcher tax in order to evade the class tax. Figure A.1 shows that the distribution of the taxed population over the four main classes remained rather stable between 1821 and 1848.

In 1851, a new classified income tax (*klassifizierte Einkommensteuer*) replaced both the class tax as well as the grind and butcher tax for all tax units with incomes above 3.000 Mark. The new classified income tax roughly applied to the top 2% of

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[21]Engel (1868), director of the Prussian statistical office, states that the four classes of the class tax encompassed the very rich, the rich, less wealthy townsmen and peasants and the lowest class servants and day labourer. His predecessor Dieterici (1849) refers to the four classes as *patricians, bourgeoisie, petty bourgeoisie, secondary citizens* in the city and *landlords, landowners with allodial title, peasants* and *landless farm workers* on the country-side. The tax was judged to be regressive by contemporary authors: The tax of highest class paid 48 times the tax of lowest class, even though top class citizens probably earned more than 100 times more than the lowest class (Dieterici, 1849).

[22]Tax units were mostly close family members including other relatives in the household without own income. Tax units in the lowest class were individuals, but not more than two tax units per household (Geisenberger and Müller, 1972).

[23]In 1820, the grind and butcher tax applied in 132 bigger cities which was reduced to 83 cities in 1851 (Ketterle, 1994). urban-rural-dualism

Figure A.1: Prussian population by class, 1821-1848
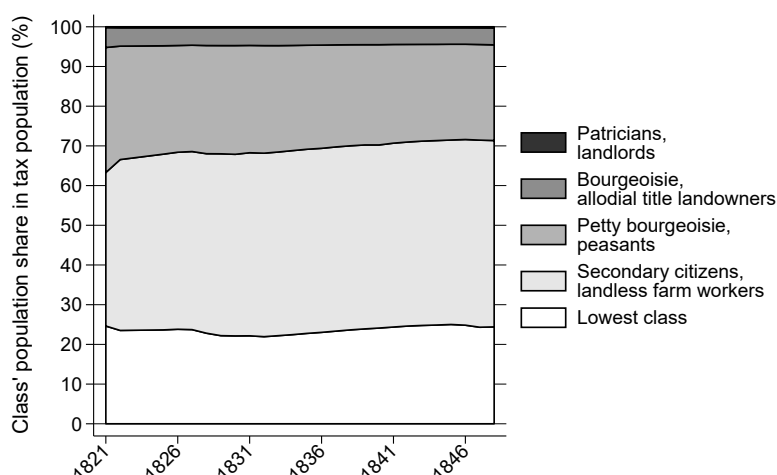
the tax units (or 1% of the population) and was levied on income from real estate, business, wages, interest rates and other capital income. However, incomes were estimated by a local committee such that top incomes are most likely to be systematically underestimated.[24] The class tax now also incorporated explicit income bands, but the assignment to a class was under the responsibility of the Prussian administration and not revised annually, thereby potentially neglecting annual income fluctuations (Grant, 2002). In income year 1874, the grind and butcher tax is abolished and income taxation (classified and class tax) equally applies to cities and rural areas. Therefore, Prussian tax statistics are used for top income shares as of 1874.

In 1891, a far-reaching income tax reform finally abolished the class tax. All households with incomes higher than 900 Mark were subject to a progressive income tax, which applied to 23% of the tax units or 31% of the population. The share of the population taxed steadily increased and reached 63% in 1913. Most importantly, the obligation to file a tax return is introduced for incomes above 3,000 M (about 3% of tax units) which the authorities cross-checked with their own information. As a consequence, the recording of top incomes was greatly improved. E.g., the income share of the top 1% jumps by almost 4% between 1890 and 1891. We take the observed jump in income shares between 1890 and 1891 as an indicator for the disproportional underestimation of the respective top group and adjust our Prussian series 1871-1890 upwards with this share difference.

Hesse introduced a modern income tax in 1869, Bremen in 1874, Saxony in 1874, Hamburg in 1881, Baden in 1884, Württemberg in 1905 and Bavaria in 1912.[25].

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[24]Taxpayers brought before court in the Prussian city Bochum in 1891 admitted to have earned incomes more than twice as high than estimated by the local authorities for the tax collection (Wagner, 1891, p.587).

[25]Bavaria with a large and rich population unfortunately only introduced income taxation in 1912 and published income tax statistics only once for the tax year 1912. Before, income sources were

All these income tax systems share some basic common characteristics. First, the tax burden is levied on the aggregate of different income sources, i.e. business income, capital income, income from employment, pensions, income from renting and leasing. Capital gains were tax exempt in Prussia and Saxony, but taxable in Württemberg, Hamburg and Bremen. Second, income is aggregated at the household level, except for Saxony, where individual taxation is applied. Third, the ducal (Hesse and Baden) or royal (Prussia, Bavaria, Saxony and Württemberg) family as well as parts of the military were tax exempt. Fourth, all taxpayers are obliged to declare their income (Baden, Bremen, Hamburg) or if it exceeds a threshold of 1,600 M (Saxony), 2,000 M (Bavaria), 2,6 Mark (Hesse since 1895, Württemberg) (Ketterle, 1994). This means that the top 10% were obliged to declare in Saxony and Bavaria and the top 5% in Hesse and Württemberg.

The share of the population included in the tax statistics varies across states. In Prussia, the increased tax allowance in 1891 reduces the share of the taxed population from about 70% to about 30%, but then steadily increases to almost 70% before World War I. In 1918, Prussian income statistics already exclude Poznan and Bromberg.[26] In Saxony, about 70% of the adult population is taxed. In Württemberg, about 30% of the population is subject to income taxation in 1909. The importance of income taxation as a fiscal revenue also varied greatly. Whereas Saxony, Prussia, Württemberg, Baden and Bavaria mostly relied on profits from state-owned enterprises in agriculture, forestry and, most importantly, railway (Ullmann, 2005, p.42), income taxation was indeed the central fiscal revenue for the Hanse cities Hamburg and Bremen (Ketterle, 1994, p.144).

In sum, income recorded in German states' income tax statistics 1871-1918 was based on a broad definition of income. Different levels across regions might be explained by the two following factors to some extent: First, the inclusion of capital gains in Württemberg, Hamburg and Bremen may produce more volatile top income share estimates. Second, higher tax enforcement in the Hanse cities, where income taxation represents the main fiscal revenue, may also lead to higher and more volatile top income shares.

The federal German income tax, which was introduced in 1920 after the revolution and the establishment of the Weimar republic, abolished the privileges for the governing noble elite and the military who had been tax exempt in many German states. The income recorded in the income tax statistics was broader defined compared to the pre-war period as capital gains from speculation were now taxable. Starting in 1932, income from agriculture and forestry is not taxable if below 6,000 M and only partly if between 6,000 and 12,000 M. This means that almost all income from agriculture and forestry was tax exempt which reduced the number of taxpayers. However, the top percentile generated only 2% of their income from agriculture and forestry as compared to about 40% from business and wages in 1928.

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taxed separately in Bavaria: income from academic and artistic profession, from mining industry and leasing were taxed jointly (group II), income from salaries, pensions and life annuities were taxed jointly (group III) and, last, capital income was taxed separately (*Kapitalrentensteuer*). As a result, the joint distribution of the three tax income types in Bavaria cannot be reconstructed.

[26]Checking the diffference for 1917, where tabulations both including and excluding Poznan and Bromberg are available, shows that differences in top income shares are negligible.

Exemption rules were relaxed again in the following years.

From 1919 to 1924, the Statistical Office did not compile any income tax statistics. During the hyperinflation years 1923 and 1924, the new income tax legislation was temporarily suspended and taxes were collected according to emergency decrees. Income tax statistics are available for 1925-1929 and 1932-1938. The introduction of a payroll tax for wage incomes and a capital income tax withheld at source presumably mark the two most radical novelties. Both could be credited against the income tax liability. Employees with wages lower than 8,000 M whose other incomes did not exceed a minimum allowance of 500 M did not have to file a tax return and, consequently, were not included in income tax statistics. The introduction of the payroll tax poses a problem for the estimation of top income shares because the distributions of income tax and payroll tax cannot be merged *ex post* for several reasons. First, the income distributions are ranked by different income concepts. While the payroll tax statistics is ranked by wages, the income tax statistics is ranked by total income which includes wages, business income, capital income etc. Second, the definition of the tax unit differs. The tax unit for payroll tax is the individual, while it is the household for the income tax. There are about 4 million households recorded in income tax statistics and about 24 million individuals included in payroll tax statistics. Third, some tax units are double-counted between 1925 and 1933, i.e., they appear in both statistics, if their wage did not exceed 8,000 Mark, but their income from other sources than wages is above a minimum allowance. The number of double-counted tax units is 272,137 in 1928 and 300,204 in 1932 according to the Statistical Office. Using income tax statistics, we can compute the top percentile's share whose income threshold lies well above 8,000 Mark throughout the period above which a tax declaration was obligatory. For the top decile and top twentieth, we use synthetic tabulations provided by the Statistical Office for 1926, 1928, 1932, 1934, 1936 and 1950. Even though it remains unclear, how the issues raised above were addressed in these synthetic tabulations, we decided to rather present tentative estimates than no estimates at all. Dell (2007) put the income tax distribution on top of the payroll tax distribution to estimate the shares of fractiles below the top percentile. Appendix Figure A.2 compares top income shares based on income tax statistics, synthetic tabulations from the Statistical Office and estimations from Dell (2007). First, income shares of the top 1% and 0.01% are almost identical when using income tax statistics or synthetic tabulations. Second, shares of the top 10% and 5% are strongly underestimated when relying on income tax statistics only. Third, estimates from Dell (2007) are close to those based on synthetic tabulations of the Statistical Office, but strongly deviate in 1950.

For particular tax units, incomes recorded in income tax statistics are understated: If wage income did not exceed 8,000 M, but income from other sources than earnings was above a minimum allowance, income tax statistics between 1925 and 1932 only recorded incomes other than wages. Since these tax units most likely to do not belong to the top 1%, the effect on our estimated income shares of the top 1% and above is likely to be small.

Recorded income in income tax statistics 1925-1938 is defined as

total income from income sources (business, wage etc.)

- professional expenses (*Werbungskosten*)

= total amount of income (*Gesamtbetrag der Einkünfte*)

- special expenses (*Sonderausgaben*)

= <u>recorded income</u>

Incomes recorded in payroll tax statistics include both professional expenses and special expenses so that we deduct twice the legislative lumpsum for these items (2x240 M) for incomes below 8,000 M in order to harmonize the two income concepts.

In post-1949 Germany, the total amount of income (*Gesamtbetrag der Einkünfte*) defined by the German Income Tax Act is the income concept documented in the income tax statistics, which is the sum of the seven income categories (agriculture and forestry, business, self-employment, employment, capital income, renting and leasing, as well as other), plus tax-relevant capital gains less income type-specific income-related expenses, savings allowances, and losses. A share of pensions (*Ertragsanteil*) is also included which amounts to about 30% of the pension. For the cohort receiving their first pension in 2005 or after, the taxable share is gradually increased from 50% in 2005 to 100% in 2040. Old-age lump-sum allowance and exemptions for single parents are deducted. Since a number of large tax-deductible items, such as special expenses for social security contributions, are not deducted at that stage, the total amount of income is considerably higher for most tax units than the eventual taxable income to which the tax rate is applied.

Recorded income in income tax statistics since 1949 is defined as

total income from income sources (business, wage etc.)

- professional expenses (*Werbungskosten*)

= <u>recorded income</u> = total amount of income (*Gesamtbetrag der Einkünfte*)

We now turn to the modifications of the income tax data in order to harmonize data over time and across countries. The construction of the tabulations published by the Statistical Offices varies greatly over time. In order to harmonize tabulations both between states and over time, several adjustments have to be undertaken. First, years with tabulations containing both the number of tax units and aggregated incomes per income bracket are sometimes followed by years containing the number of tax units only. This applies to tax years 1886-1905 and 1911-1913 in Baden, 1873-1919 in Hesse, until 1891 in Prussia, 1896-1910 in Saxony, and 1905-1913 in Württemberg (indexed by *b* in Appendix Table B.1). Aggregate income per income bracket is then imputed under the assumption that incomes are Pareto distributed following (Piketty and Saez, 2007, p.222).

Second, some publications tabulate personal and corporate taxpayers jointly. Apart from the fact that we are interested in the distribution of personal income, this poses a problem to the estimation of top income shares because the distribution of corporate taxpayers' income is more skewed than the distribution of personal

taxpayers' income. For Baden, the share of personal taxpayers in total taxpayers per income bracket in 1911 is used to adjust the number of total taxpayers downwards in the preceding and following years where only total taxpayers are given. The 1911 publication lists personal and corporate taxpayers split into more than 300 income brackets. It is assumed that the tax exempt are all personal taxpayers. This assumption seems reasonable as the share of personal taxpayers in the lowest income bracket is 99.992% in Baden in 1911 and corporate taxpayers are mostly present in the top of the joint distribution. For Bavaria, income tax statistics are published only in 1912 such that the distribution of personal and corporate taxpayers cannot be separated. There are, however, 2,112,000 personal taxpayers and only 20,000 corporate taxpayers whose share in total taxable income is 4.3% (Hoffmann and Müller, 1959).

Third, the number of recorded income brackets ranges from less than 10 to more than 200. In some cases, a large increase or reduction in the number of income brackets from one year to another, which makes the top income estimate either more or less precise, may lead to an abrupt change in the income share of a top group. However, this only applies to Saxony 1895-1903 and to Württemberg 1904-1906 and 1911. We correct the shares upwards by the differential between the last year with few brackets and the first year with many. In Saxony, 1876 is replaced by the mean of the two adjacent years as an unusual high number of tax unit in a very broadly defined income class leads to outliers of the top 1% and top 5% income share.

Fourth, capital income, i.e., dividends and interest income, is taxed separately at a flat rate since the introduction of dual income taxation in Germany in 2009 and, hence, is no longer systematically recorded by income tax statistics. While it is still beneficial for some tax units to declare capital income in their income tax declaration, e.g., if the flat rate exceeds their personal income tax rate, the size of reported capital income in income tax statistics since 2009 is negligible. Additionally, between 2001/2002 and 2008 only half of the cash dividend (dividends net of the corporation tax) was taxable. The top income shares reported in this paper are based on the full amount of capital income since 2001 following the methodologies developed by Bartels and Jenderny (2015). We can recover the full amount of dividends from microdata for 2001 to 2008. Starting in 2009, capital income is imputed using dividends from firms included at the most comprehensive German stock index, CDAX, as proxy for dividends and the tax flow of the withholding tax on interest income as proxy for interest income. Bartels and Jenderny (2015) provides a detailed description of the methods and of the tax reforms.

Table A.1: Thresholds

| year	Top 10%	Top 5%	Top 1%	Top 0.5%	Top 0.1%	Top 0.01%
1961	23,641	31,939	77,349	120,957	332,149	1,457,842
1965	27,523	37,905	91,844	141,699	375,897	1,572,498
1968	32,344	45,209	93,352	145,498	378,092	1,476,943
1971	43,397	60,140	118,580	182,170	460,289	1,918,127
1974	48,739	65,747	120,867	176,661	440,140	1,647,610
1977	48,723	65,413	123,412	183,393	462,299	1,714,055
1980	53,336	71,934	135,341	200,766	495,928	2,054,530
1983	49,792	65,912	124,133	180,197	431,615	1,813,377
1986	52,255	67,907	137,932	199,158	454,321	2,089,812
1989	57,055	77,340	163,644	198,029	528,957	2,588,949
1992	58,437	76,795	159,953	203,244	502,698	2,128,692
1995	56,941	75,923	147,390	180,378	420,177	1,721,127
1998	57,191	79,390	149,292	208,052	510,438	2,553,744
2001	59,681	81,380	149,039	207,048	503,694	2,150,154
2002	59,182	80,001	145,756	198,354	451,586	1,834,018
2003	58,264	78,477	142,875	204,028	422,690	1,657,740
2004	58,101	78,760	146,561	198,690	444,971	1,736,906
2005	57,764	79,681	153,275	211,755	500,794	2,134,406
2006	57,451	79,815	157,831	219,755	524,485	2,246,383
2007	57,880	79,782	165,782	233,048	545,367	2,399,775
2008	57,637	80,441	169,936	240,399	572,489	2,450,380
2009	58,784	75,615	160,961	222,714	555,266	1,833,025
2010	58,612	75,342	159,847	220,086	547,937	2,014,839
2011	61,848	79,288	166,273	230,758	604,078	2,157,594
2012	62,056	80,784	182,732	215,581	596,113	2,124,771
2013	63,607	82,563	186,055	218,588	611,473	2,129,600

Source: Appendix Table A3. *Note:* All figures in 2010 Euros. Fractile thresholds after the introduction of the withholding tax in 2009 are approximated from the corrected share (including a capital income proxy) using Pareto interpolation.

Table A.2: Average Incomes

year	Top 10%	Top 5%	Top 1%	Top 0.5%	Top 0.1%	Top 0.01%
1961	49,728	75,738	210,395	323,974	889,705	3,484,470
1965	59,026	88,266	236,815	361,142	963,403	3,754,693
1968	62,574	87,463	235,960	356,220	916,458	3,816,800
1971	81,991	113,623	297,314	449,440	1,185,648	4,854,277
1974	85,787	115,725	275,549	409,827	1,011,283	3,794,025
1977	91,678	119,670	287,979	427,942	1,063,602	3,992,220
1980	93,829	126,548	313,954	465,722	1,228,581	4,753,283
1983	85,471	114,967	268,502	389,768	1,075,965	4,472,492
1986	92,175	126,436	293,446	423,702	1,296,348	5,764,213
1989	105,664	146,913	351,112	603,845	1,870,168	10,500,000
1992	103,419	141,141	293,976	489,550	1,304,266	5,389,384
1995	97,369	129,158	250,736	412,483	1,081,541	4,639,663
1998	107,420	147,303	357,492	553,402	1,656,772	8,086,624
2001	110,841	152,167	349,495	523,182	1,418,507	6,045,178
2002	107,708	146,752	329,613	489,806	1,327,819	6,070,253
2003	105,853	143,357	314,058	460,292	1,211,499	5,460,218
2004	106,160	145,201	327,337	484,994	1,296,665	5,789,937
2005	112,694	157,504	378,455	578,947	1,678,839	8,436,229
2006	113,722	160,321	392,136	602,124	1,749,705	8,483,927
2007	117,792	167,662	418,079	645,118	1,886,065	9,329,425
2008	120,035	172,081	435,312	673,713	1,952,469	9,218,106
2009	115,189	161,739	381,076	568,709	1,514,030	6,507,104
2010	114,786	161,141	379,635	567,081	1,518,248	6,613,667
2011	121,531	170,813	404,618	608,654	1,653,263	7,127,819
2012	122,220	171,921	403,517	589,618	1,636,732	7,075,679
2013	124,498	174,740	408,418	595,663	1,649,958	7,028,674

Source: Appendix Table A2. *Note:* All figures in 2010 Euros.

Figure A.2: Income tax tabulations vs. synthetic tabulations
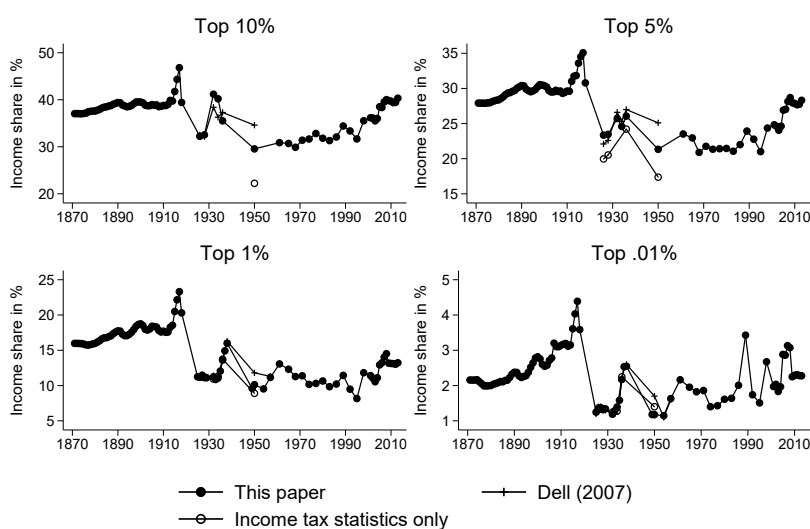
Note: Series of this paper is based on synthetic tabulations of the Statistical Office in 1926, 1928, 1932, 1934, 1936 and 1950, while the other datapoints between 1925 and 1957 are based on income tax statistics only. Accordingly, series only differ in the years where synthetic tabulations are used.

B Sources of income tax statistics

Statistical Offices regularly published tabulations with the number of taxpayers per income bracket and aggregated taxable income per income bracket. These tables are the source of information for the distribution of top incomes. So-called statistical yearbooks contain most of the income tax tabulations, but for some years, tabulations are found in additional publications such as the review (*Zeitschrift*) or notification (*Mittheilung*) of the respective Statistical Office. Sources for income tax tabulations used for the estimation of top income shares in German states until 1918 and in Germany, 1925-2012, are given in Table B.1.

Table B.1: **Sources of Income Tax Statistics for German States and Germany**

Year	Source
Baden	
1886, 1891, 1892, 1893, 1894, 1895	Statistik der badischen Einkommensteuer, 1896[a]
1896, 1897, 1898, 1899, 1900	Statistik der badischen Einkommensteuer, 1901[a]
1901	Statistik der badischen Einkommensteuer, 1906[a]
1902, 1903	Statistisches Jahrbuch für das Großherzogtum Baden, 1903, Vol. 34[a]
1904, 1905	Statistisches Jahrbuch für das Großherzogtum Baden, 1905, Vol. 35[a]
1906, 1907, 1908 1909, 1910	Statistisches Jahrbuch für das Großherzogtum Baden, 1910 und 1911, Vol. 38[b]
1911	Statistik der Einkommens- und Vermögensteuer im Großherzogtum Baden, 1911[b]
1913	Statistisches Jahrbuch für das Großherzogtum Baden, 1913, Vol. 40[a,b]

Continued on next page

44

Table B.1 – continued from previous page

Year	Source
1914	Statistisches Jahrbuch für das Großherzogtum Baden, 1915, Vol. 41[a,b]

Bavaria

Year	Source
1912	Statistisches Jahrbuch für das Königreich Bayern, 1915, Vol. 13[a]

Bremen

Year	Source
1872, 1873	Jahrbuch für Bremische Statistik, 1882
1874, 1875, 1876	Jahrbuch für Bremische Statistik, 1891
1877, 1878, 1879	
1880, 1881	
1882, 1883, 1884	Jahrbuch für Bremische Statistik, 1888
1885, 1886	
1887, 1888	Jahrbuch für Bremische Statistik, 1892
1889, 1890, 1891	Jahrbuch für Bremische Statistik, 1894
1892, 1893	
1894, 1895, 1896	Jahrbuch für Bremische Statistik, 1899
1897, 1898	
1900	Jahrbuch für Bremische Statistik, 1905
1901, 1902, 1903, 1904	Jahrbuch für Bremische Statistik, 1906
1905, 1906	Jahrbuch für Bremische Statistik, 1910
1907, 1908, 1909	Jahrbuch für Bremische Statistik, 1912
1910, 1911	

Hamburg

Year	Source
1881, 1882	Statistik des Hamburgischen Staats 1886, Vol. 13
1883-1892	Statistik des Hamburgischen Staats 1895, Vol. 17
1893-1899	Statistik des Hamburgischen Staats 1902, Vol. 20
1907	Jahresbericht der Verwaltungsbehörden der Freien und Hansestadt Hamburg 1909
1912	Jahresbericht der Verwaltungsbehörden der Freien und Hansestadt Hamburg 1914

Hesse

Year	Source
1870, 1873, 1875 1880, 1884, 1885 1890	Statistisches Handbuch für das Großherzogtum Hessen, 1909, Vol. 2[b]
1893	Mittheilungen der Großherzoglich Hessischen Centralstelle für die Landesstatistik 1893, Vol. 23[b]
1894	Mittheilungen der Großherzoglich Hessischen Centralstelle für die Landesstatistik 1894 Vol. 24[b]
1895	Mittheilungen der Großherzoglich Hessischen Centralstelle für die Landesstatistik 1895 Vol. 25[b]
1896	Mittheilungen der Großherzoglich Hessischen Centralstelle für die Landesstatistik 1897 Vol. 27[b]
1897	Mittheilungen der Großherzoglich Hessischen Centralstelle für die Landesstatistik 1898 Vol. 28[b]
1898, 1899	Mittheilungen der Großherzoglich Hessischen Centralstelle für die Landesstatistik 1899 Vol. 29[b]
1900	Mittheilungen der Großherzoglich Hessischen Centralstelle für die Landesstatistik 1900 Vol. 30[b]

Table B.1 – continued from previous page

Year	Source
1901, 1904, 1905 1907, 1908	Mittheilungen der Großherzoglich Hessischen Centralstelle für die Landesstatistik 1909 Vol. 39[b]
1911	Mittheilungen der Großherzoglich Hessischen Centralstelle für die Landesstatistik 1911 Vol. 41[b]
1913	Mittheilungen der Großherzoglich Hessischen Centralstelle für die Landesstatistik 1913 Nr. 945[b]
1918	Mittheilungen der Großherzoglich Hessischen Centralstelle für die Landesstatistik 1919 Nr. 994[b]
1919	Mittheilungen der Großherzoglich Hessischen Centralstelle für die Landesstatistik 1920 Nr. 1[b]

Prussia

Year	Source
1821 -1848	Mittheilungen des statistischen Bureau's in Berlin, Vol. 1, 1849[b,c]
1852 -1866	Zeitschrift des Königlich Preußischen Statistischen Bureaus, Vol. 8, 1868[b]
1867, 1870, 1873	Zeitschrift des Königlich Preussischen Statistischen Bureaus, Vol. 44, 1904[b]
1874	Anlagen zu den Stenographischen Berichten über die Verhandlungen des Hauses der Abgeordneten, 1875[b]
1875	Anlagen zu den Stenographischen Berichten über die Verhandlungen des Hauses der Abgeordneten, 1876[b]
1876	Anlagen zu den Stenographischen Berichten über die Verhandlungen des Hauses der Abgeordneten, 1877[b]
1877	Anlagen zu den Stenographischen Berichten über die Verhandlungen des Hauses der Abgeordneten, 1877/78[b]
1878, 1880	Zeitschrift des Königlich Preussischen Statistischen Bureaus, Vol. 44, 1904[b]
1881	Anlagen zu den Stenographischen Berichten über die Verhandlungen des Hauses der Abgeordneten, 1882[b]
1882	Anlagen zu den Stenographischen Berichten über die Verhandlungen des Hauses der Abgeordneten, 1882/83[b]
1883	Anlagen zu den Stenographischen Berichten über die Verhandlungen des Hauses der Abgeordneten, 1883/84[b]
1884	Anlagen zu den Stenographischen Berichten über die Verhandlungen des Hauses der Abgeordneten, 1885[b]
1885	Anlagen zu den Stenographischen Berichten über die Verhandlungen des Hauses der Abgeordneten, 1886[b]
1886	Anlagen zu den Stenographischen Berichten über die Verhandlungen des Hauses der Abgeordneten, 1887[b]
1887	Anlagen zu den Stenographischen Berichten über die Verhandlungen des Hauses der Abgeordneten, 1888[b]
1888	Anlagen zu den Stenographischen Berichten über die Verhandlungen des Hauses der Abgeordneten, 1889[b]
1889	Anlagen zu den Stenographischen Berichten über die Verhandlungen des Hauses der Abgeordneten, 1890[b]
1890	Anlagen zu den Stenographischen Berichten über die Verhandlungen des Hauses der Abgeordneten, 1890/91[b]
1891	Anlagen zu den Stenographischen Berichten über die Verhandlungen des Hauses der Abgeordneten, 1892[b]
1892	Statistisches Jahrbuch für den Freistaat Preußen, Vol. 17, 1921

Table B.1 – continued from previous page

Year	Source
-1919	

Saxony

1875, 1877	Zeitschrift des Königlich Sächsischen Statistischen Bureaus, 1877, Vol.23
1879	Zeitschrift des Königlich Sächsischen Statistischen Bureaus, 1889[b], Vol.35
1882, 1884	Zeitschrift des Königlich Sächsischen Statistischen Bureaus, 1885, Vol.31
1886	Zeitschrift des Königlich Sächsischen Statistischen Bureaus, 1889, Vol.35
1888, 1890	Zeitschrift des Königlich Sächsischen Statistischen Bureaus, 1891, Vol.37
1892, 1894	Zeitschrift des Königlich Sächsischen Statistischen Bureaus, 1894, Vol.40
1896, 1898, 1900	Statistisches Jahrbuch für das Königreich Sachsen, 1906[b], Vol.34
1902, 1904	
1906, 1908, 1910	Statistisches Jahrbuch für das Königreich Sachsen, 1912[b], Vol.40
1912	Statistisches Jahrbuch für das Königreich Sachsen, 1913, Vol.41
1914	Statistisches Jahrbuch für das Königreich Sachsen, 1916/1917, Vol.43
1916, 1918	Statistisches Jahrbuch für den Freistaat Sachsen, 1918/20, Vol.44

Württemberg

1905, 1906, 1907	Statistisches Handbuch für das Königreich Württemberg, 1910/11[b]
1908	Württembergische Jahrbücher für Statistik und Landeskunde, 1909[b]
1909	Württembergische Jahrbücher für Statistik und Landeskunde, 1910[b]
1910	Württembergische Jahrbücher für Statistik und Landeskunde, 1911[b]
1911	Württembergische Jahrbücher für Statistik und Landeskunde, 1913[b]
1912	Statistisches Handbuch für das Königreich Württemberg, 1912/13[b]
1913	Württembergische Jahrbücher für Statistik und Landeskunde, 1914[b]

Germany

1920	Statistik des Deutschen Reichs, Vol. 312, Table 14
1925	Statistik des Deutschen Reichs, Vol. 348 (income tax)
1926	Statistisches Reichsamt (1939): Die Einkommenschichtung im Deutschen Reich, Wirtschaft und Statistik, 660-664. *Statistik des Deutschen Reichs, Vol. 375 (income tax), Vol. 359 (payroll tax)*
1927	Statistik des Deutschen Reichs, Vol. 375 (income tax)
1928	Statistisches Reichsamt (1939): Die Einkommenschichtung im Deutschen Reich, Wirtschaft und Statistik, 660-664. *Statistik des Deutschen Reichs, Vol. 391 (income tax), Vol. 378 (payroll tax)*
1929	Statistik des Deutschen Reichs, Vol. 430 (income tax)
1932	Statistisches Reichsamt (1939): Die Einkommenschichtung im Deutschen Reich, Wirtschaft und Statistik, 660-664. *Statistik des Deutschen Reichs, Vol. 482 (income tax), Vol. 492 (payroll tax)*
1933	Statistik des Deutschen Reichs, Vol. 482 (income tax)
1934	Statistisches Reichsamt (1939): Die Einkommenschichtung im Deutschen Reich, Wirtschaft und Statistik, 660-664. *Statistik des Deutschen Reichs, Vol. 499 (income tax), Vol. 492 (payroll tax)*
1935	Statistik des Deutschen Reichs, Vol. 534 (income tax)
1936	Statistik des Deutschen Reichs, Vol. 534 (income tax), Vol. 530 (payroll tax)
1937, 1938	Statistik des Deutschen Reichs, Vol. 580 (income tax)
1949	Statistisches Jahrbuch füer die Bundesrepublik Deutschland 1953, p.454
1950	Statististisches Bundesamt (1954): Zur Frage der Einkommenschichtung, Wirtschaft und Statistik 6, 265-273. *Statistik der Bundesrepublik Deutschland, Vol. 125, Table 22*

Table B.1 – continued from previous page

Year	Source
1954, 1957	Fachserie L, Finanzen und Steuern, Series 6.1, p.74 and p.141
1961	Fachserie L, Finanzen und Steuern, Series 6.1, p.51, Table 2
1965	Fachserie L, Finanzen und Steuern, Series 6.1, p.45, Table 2
1968	Fachserie L, Finanzen und Steuern, Series 6.1, p.29, Table 3
1971	Fachserie 14, Finanzen und Steuern, Series 7.1, p.18
1974	Fachserie 14, Finanzen und Steuern, Series 7.1, p.20
1977	Fachserie 14, Finanzen und Steuern, Series 7.1, p.22
1980	Fachserie 14, Finanzen und Steuern, Series 7.1, p.25
1983	Fachserie 14, Finanzen und Steuern, Series 7.1, p.25
1986	Fachserie 14, Finanzen und Steuern, Series 7.1, p.25
1989	Fachserie 14, Finanzen und Steuern, Series 7.1, p.30
1992	Fachserie 14, Finanzen und Steuern, Series 7.1, p.16
1995	Fachserie 14, Finanzen und Steuern, Series 7.1, p.14
1998	Fachserie 14, Finanzen und Steuern, Series 7.1, p.1
2001	Fachserie 14, Finanzen und Steuern, Series 7.1.1, Table 3
2002	Fachserie 14, Finanzen und Steuern, Series 7.1.1, Table 3
2003	Fachserie 14, Finanzen und Steuern, Series 7.1.1, Table 3
2004	Fachserie 14, Finanzen und Steuern, Series 7.1.1, Table 3
2005	Fachserie 14, Finanzen und Steuern, Series 7.1.1, Table 3
2006	Fachserie 14, Finanzen und Steuern, Series 7.1.1, Table 3
2007	Fachserie 14, Finanzen und Steuern, Series 7.1.1, Table 3
2008	Fachserie 14, Finanzen und Steuern, Series 7.1.1, Table 3
2009	Fachserie 14, Finanzen und Steuern, Series 7.1.1, Table 3
2010	Fachserie 14, Finanzen und Steuern, Series 7.1.1, Table 3
2011	Fachserie 14, Finanzen und Steuern, Series 7.1.1, Table 3
2012	Fachserie 14, Finanzen und Steuern, Series 7.1, Table A3
2013	Fachserie 14, Finanzen und Steuern, Series 7.1, Table A3

Note: Year refers to tax year. a. Personal and corporate persons are tabulated jointly. b. Only number of tax units available and no information on incomes. c. Only class tax.
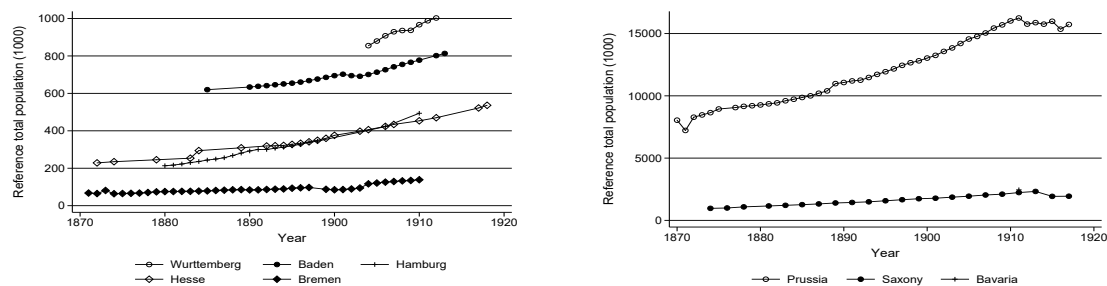
C Reference total population

There are two approaches to derive the reference total population. The bottom-up approach adds the (estimated) number of tax exempt to the number of taxpayers documented in the income tax statistics. The top-down approach draws on population statistics and obtains total tax units as the sum of married couples and bachelors reduced by the number of children. The top-down approach is applied from 1925 onwards. For the period 1871-1918, annual information on population by age and marital status is not consistently available in German states. Therefore, the bottom-up approach is applied and the reference total population 1871-1918 is obtained as

> number of tax units recorded in tax statistics
>
> + tax exempt
>
> = reference total population

The number of tax exempt is documented in income tax statistics in Hesse (until 1883), Prussia and Saxony. For the other German states, we take the number of tax exempt estimated by Hoffmann and Müller (1959).[27] In Bavaria, only joint tabulations of personal and corporate taxpayers are available such that corporate taxpayers are included in the population control. Particular social groups such as military or the ruling noble family were exonerated from taxation. Since their income is unknown, the number of these exonerated persons is not added to total tax units. Figure C.1 presents reference total population by state from 1871 to 1918.

Figure C.1: Reference total population by state, 1871-1918

Source: Appendix Table A2.

From 1925 to present, we adopt the top-down approach and the reference total population is given by

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[27]In Baden, Bremen, Hamburg, Hessen and Württemberg, Hoffmann and Müller (1959) estimate the number of tax exempt as difference between the workforce as documented by occupation census data and the number of taxpayers. This method is also used by Statistisches Reichsamt (1932). On the one hand, this residuum potentially underestimates the number of tax exempt by not accounting for unemployed persons. On the other hand, the residuum potentially overestimates tax exempt tax units if households consist of more than one earner. In the first step, a too low number is substracted from the workforce. In the second step, the resulting number gives earners and not tax units....

Married Couples/2

+ Bachelors

- Children (up to 19 years)

= <u>reference total population</u>

Reference total population is displayed in Figure C.2. The evolution of both reference total population and total adults reflects the frequent changes of the German border over the 20th century. The population jump in 1938 is due to the annexation of Austria whose population was immediately included in the German income tax system. Figures after 1949 exclude the population of the GDR (about 18 million), but include about 7 million refugees from the former Eastern territories. In 1990, Germany was reunified adding a population of 16 million living in the former GDR to a population of 64 million in the FRG. The population census in 2011 brought to light a smaller population size than estimated by the Statistical Office. Furthermore, the number of married spouses was larger than estimated before. These two effects produce a one-time reduction of our reference total population in 2011.

The number of taxpayers recorded in tax statistics also fluctuated over time as shown by Figure C.2. These fluctuations are mostly explained by the introduction of a payroll tax on wage incomes withheld at source and to a comparably smaller extent by the changing population that was subject to the income tax legislation. Therefore, we display figures including the sum of income and payroll taxpayers and income taxpayers only. Tabulated payroll tax statistics are available in 1926, 1928, 1932, 1934, 1936, but cannot be merged with income tax statistics by the researcher (see Appendix SectionA). Only after 1961, the Statistical Office started to merge the two distributions into a single income distribution. Therefore, only 6% to 14% of the reference total population is captured by income tax statistics from 1925 to 1960, but about 70% thereafter. From 2001 to 2012, the Statistical Office provided annual income tax statistics that again excluded payroll taxpayers who did not file a tax return. However, in 2001, 2004, 2007, 2010, 2013, there are also joint statistics available including both payroll and income taxpayers.

Figure C.2: Reference total population and total taxpayers in tax statistics in Germany, 1925-2013
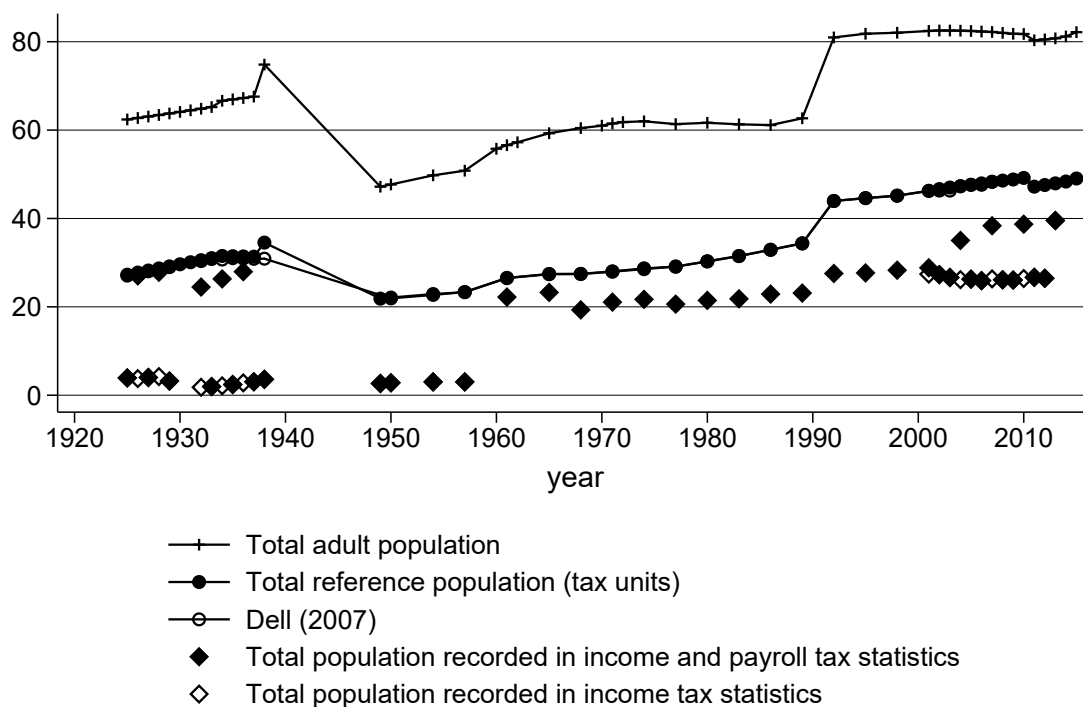
Source: See Appendix Table Germany.

D   Reference total income

There are two approaches to derive the reference total income. The bottom-up approach adds the (estimated) income of tax exempt to the taxpayers' income documented in the income tax statistics. The top-down approach draws on national accounts and obtains reference total income as a fixed share of private household income documented in national accounts. National accounts provide a useful benchmark both regarding consistency over time and comparability across countries via the United Nations' System of National Accounts (SNA) first charted in 1947 and the European System of Accounts (ESA) which is a modification of SNA. German national accounts follow ESA 1995 over the period 1970-1990 (sectoral accounts only since 1980) and ESA 2010 since 1991. The bottom-up approach is applied for German states 1871-1918, when national accounts were not yet produced. The top-down approach is applied for Germany from 1925 onwards.

For the period 1871-1918, incomes recorded in income tax statistics represent the most reliable source for national income (Helfferich, 1917, p.91). The most consistent series of national income (*Volkseinkommen*) in Germany and German states is the series of Hoffmann and Müller (1959). Their numbers are based on tax incomes augmented by estimated non-filer income and cover Baden, Bavaria, Bremen, Hamburg, Hesse, Prussia, Saxony and Wurttemberg as well as Germany as a whole over the period 1851 to 1957. Despite recurring criticism of this series,

no attempt of replacing it has been undertaken.[28] In order to compute household income, Hoffmann and Müller (1959) estimate non-filers' income in German states. Applying the bottom-up approach, the reference total income 1871-1918 is obtained as

Tax income recorded in tax statistics (1)

+ Income of non-filers with income beneath the tax allowance (from Hoffmann and Müller (1959)) (2)

= Reference total income

Tax income (1) is taken directly from income tax statistics. In Bavaria, only one joint tabulation of personal and corporate taxpayers is available in 1911 such that income of corporate taxpayers is included in (1) and, hence, in reference total income for Bavaria. Average income of non-filers (2) in each state in 1913 is provided by the Statistical Office (Statistisches Reichsamt, 1932, p.24). Hoffmann and Müller (1959) deflate the 1913 figures with the wage index for average gross wages in the industrial and agricultural sector from 1870 to 1914 from Kuczynski (1947). Figure D.1 displays the evolution of total reference income per capita in German states.

Figure D.1: Reference total income per capita by German state, 1870-1918
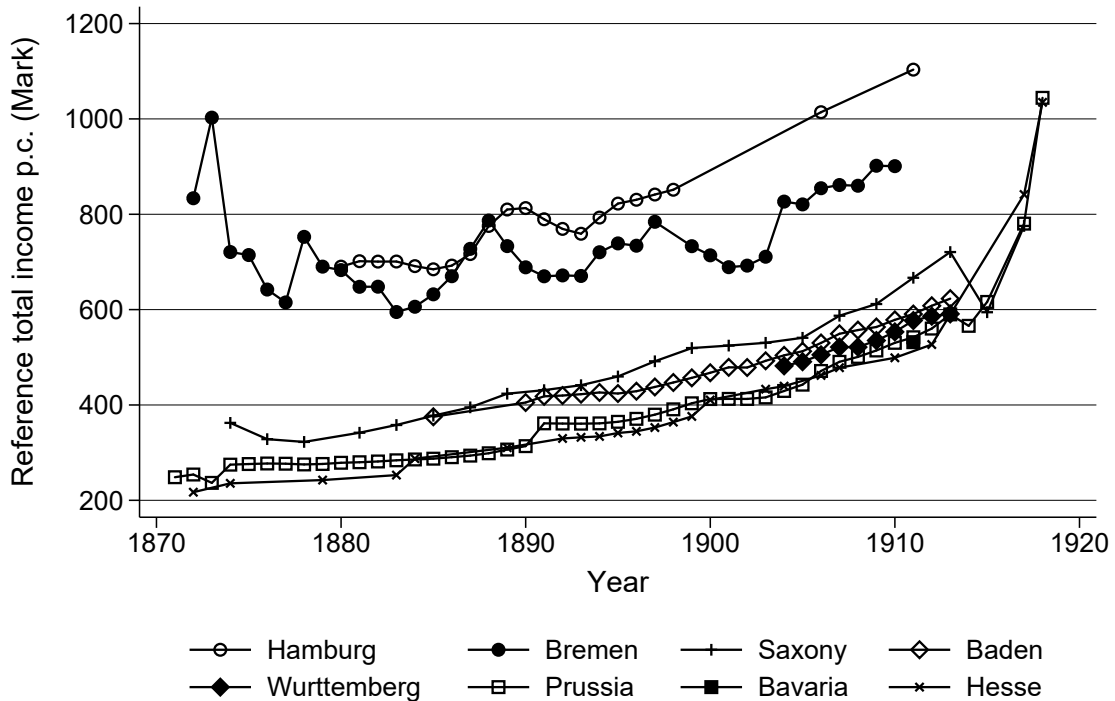
Source: See Appendix Table Germany.

For 1925-2013, the top-down approach is used and reference total income is obtained as a fixed share of household income documented in national accounts.

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[28]See, e.g., Fremdling (1988).

Household income in national accounts exceeds total income recorded in tax statistics. The difference is explained by income of non-filers (1) and incomes or part of incomes not covered by tax statistics (2). A fixed share of national accounts' private household income is used because we want to include (1) but not (2) in our reference total income (Atkinson, 2007).

National accounts' household income is an overestimate of our reference total income for three reasons. First, business and property income in national accounts is much higher than the aggregate documented in income tax statistics. This item is calculated as a residual in national accounts since there are no representative primary statistics on business income in Germany. This introduces a substantial amount of measurement error.[29] Also, tax avoidance might occur at a larger scale for business and property income as opposed to employment income understating business and property income in tax statistics. Second, retained earnings from corporations (undistributed profits) and imputed rents are included in national accounts, but do not show up in income tax data. Third, income from non-profit institutions serving private households (NPISH) are included in the household sector in Germany augmenting household income in national accounts.[30] However, national accounts' household income also exclude income types that are included in tax data. Pensions increasingly became taxable in recent years and are thus included in our income measure from income tax statistics.

In order to determine the fixed share of national accounts' household income, a reference point is needed. The only attempt to estimate both non-filers' and filers' income using income tax definitions - to the knowledge of the author - is the study by Bach et al. (2009) who construct an integrated database of both household survey data covering the bottom of the distribution and income tax data covering the middle and the top for the years 1992 to 2003. Their estimate of gross market household income of both filers and non-filers is between 80.9% and 84.4% of the national accounts' household income. We decide to take 90% of total household income of private households and, thereby, follow Dell (2007). We take a higher share than 84.4% because pensions are not included in national accounts' household income, but are included in our tax income. The remaining gap may be seen as income missing from tax statistics such as retained earnings, undeclared business and property income and imputed rent (assuming that these are distributed proportionately to recorded incomes) and to differences in the income definition or the income recipient such as NPISH. Additionally, a higher reference income generates lower income shares so that we can interpret our results as a lower bound for income concentration levels. Roine and Waldenström (2010) use 89% of national accounts' household income for the Swedish top income share series, Aaberge and Atkinson (2010) use 72% for the Norwegian series and Piketty and Saez (2007) use 80% for the US series 1913-1943.

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[29]The German Federal Statistical Office (Destatis, 2009) acknowledges that "balancing differences" with respect to the production and expenditure approach of GDP calculation amount to about 1% of GDP. Bach (2013) estimates that the gap between adjusted national accounts' business income and tax recorded business income is about 90 billion Euro in 2004, which is more than 4 % of GDP in that year.

[30]However, Schwarz (2008) estimates that income of NPISH amounts to only 2% of the household sector's income.

For 1925 to 1938, we use the figures from the Statistical Office's publications which are assembled by Hoffmann and Müller (1959) in Table 24 on p.56. Social contributions are given in Table 15 on p.43. It should be noted, that tax income statistics still formed the "main pillar" of national accounts at that time (Statistisches Bundesamt, 1972, 40). We rely on the Hoffmann and Müller (1959) series for our preferred reference total income because they deduct government transfers such as unemployment benefits and social assistance from the original figures from the Statistical Office. These transfer incomes are not part of tax incomes and should therefore be excluded from our reference total income. Reference total income in 1935 is adjusted downwards substracting national income from Saarland as Saarland is included in the tax statistics only as of 1936. Reference total income in 1938 is upscaled using the share of national income including Austria (*Grossdeutsches Reich*) in national income without Austria as Austria is included in the tax statistics in 1938. Total household income is the sum of

Salaries and wages (*Lohn und Gehalt*)

- Employers' social security contributions (*Sozialbeiträge der Arbeitgeber*)

+ Civil servant pensions (*Beamtenpensionen*)

+ Income from renting and leasing (*Vermietung und Verpachtung*)

+ Business and self-employment income (*Handel, Gewerbe, freie Berufstätigkeit*)

+ Income from agriculture and foresty (*Land- und Forstwirtschaft*)

+ Capital income (*Kapitalvermögen*)

= Total household income

x 0.9

= <u>Reference total income</u>

For 1949 to 2013, we rely on figures published as part of the national accounts by the Federal Statistical Office. Total household income is the sum of

Compensation of employees (Residents) (*Arbeitnehmerentgelt (Inländer)*)

- Employers' social security contributions (*Sozialbeiträge der Arbeitgeber*)

+ Property income (*Vermögenseinkommen*)

+ Operation surplus (*Betriebsüberschuss*)

+ Income of self-employed (*Selbständigeneinkommen*)

= Total household income

x 0.9

= <u>Reference total income</u>

Compensation of employees is from Statistisches Bundesamt (1955) Table 2 in Chapter 23 for 1949, from Statistisches Bundesamt (2016a) Table 12.1 in Chapter 12 for 1950-1969 and from Statistisches Bundesamt (2016b) Table 1.3 for 1970-2012. Employers' social contributions are from Statistisches Bundesamt (1955) Table 2 for 1949, result from the difference between compensation of employees (*Arbeitnehmer-entgelt (Inländer)*) and gross wages (*Bruttolöhne und -gehälter*) given in Statistisches Bundesamt (2016a) Table 12.1 for 1950-1969 and are from Statistisches Bundesamt (2016b) Table 1.8 for 1970-2012.

Property income, operation surplus and income of self-employed is from Statistisches Bundesamt (1991) Table 2.3.5 for 1950 to 1979 and from Statistisches Bundesamt (2016b) Table 1.10 for 1980-2012. In 1949, we take the residual from national income (*Volkseinkommen*) reduced by compensation of employees given in Statistisches Bundesamt (1955) Table 1 and 2 for 1949. However, a major revision of the series up from 1980 in the wake of the introduction of ESA 1995 generates a break in the series.[31] For the years 1980 to 1990, we have both revised and unrevised figures. Unrevised figures are, on average, 85% of the revised figures. Therefore, we adjust the unrevised figures 1950-1979 from Statistisches Bundesamt (1991) upwards by 17% ($100/85 \approx 1.17$).

We deduct the sum of capital gains observed in income tax microdata from the income control when we estimate shares excluding capital income.[32]

In order to check the robustness of the selected reference total income, we constructed several alternative total income measures which are displayed in Figure D.2. Total household income estimated by Bach et al. (2009) for the years 1992 to 2003 is about 53% of GDP. Hence, Figure D.2 shows different measures of total income compared to 53% of GDP. GDP is taken from Ritschl and Spoerer (1997) for 1925 to 1938 and from Statistical Office in the post-war years. Our preferred reference total is 90% of total household income. We follow Roine and Waldenström (2010) and construct to alternative measures based on incomes recorded in tax statistics. For the first measure, we add 25% of taxpayers' average income multiplied by the number of non-filers to incomes recorded in tax statistics. For the second measure, we add 80% of the income tax threshold multiplied by the number of non-filers to the incomes recorded in tax statistics.

For 1925 to 1938, two points are worth mentioning. First, both total personal income from the Statistical Office and our reference total income increase in the crisis years in the early 1930 relative to GDP German GDP shrinks massively from more than 80 billion Reichsmark in 1930 to less than 60 billion Reichsmark in 1933. However, the figure from the Statistical Office increases much more which is due to

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[31]Property income, operation surplus and income of self-employed jumps from 131 in 1979 to 160 billion Euro in 1980. One explanation for the break in 1980 is the addition of so-called Financial Intermediation Services Indirectly Measured (FISIM) which estimates the value of financial intermediation services which financial institutions do not charge explicitly. FISIM is 17 billion Euro in 1980.

[32]This strategy enables us to easily interpret the difference between the series including and excluding capital gains. However, one should note that the income total in the national accounts does not include capital gains.

the inclusion of government transfers that increase in crisis years. As these incomes are not part of tax incomes and should therefore be excluded from our reference total income, we rely on the Hoffmann and Müller (1959) series for our preferred reference total income. Second, in 1938, both total personal income measures increase relative to GDP as they were upscaled to include Austria to match the population recorded in tax statistics.

For 1949 to 2013, our reference total covers a declining share of GDP. This is at least partly due to the growth of the public and private sector in the post-war period. The measure that adds 25% of average taxpayer income to the incomes recorded in tax statistics fluctuates around 53% of GDP. In contrast, adding 80% of the income tax allowance yields even lower levels in most years.

Figure D.2: Different reference total incomes as shares of GDP in Germany, 1925-2013
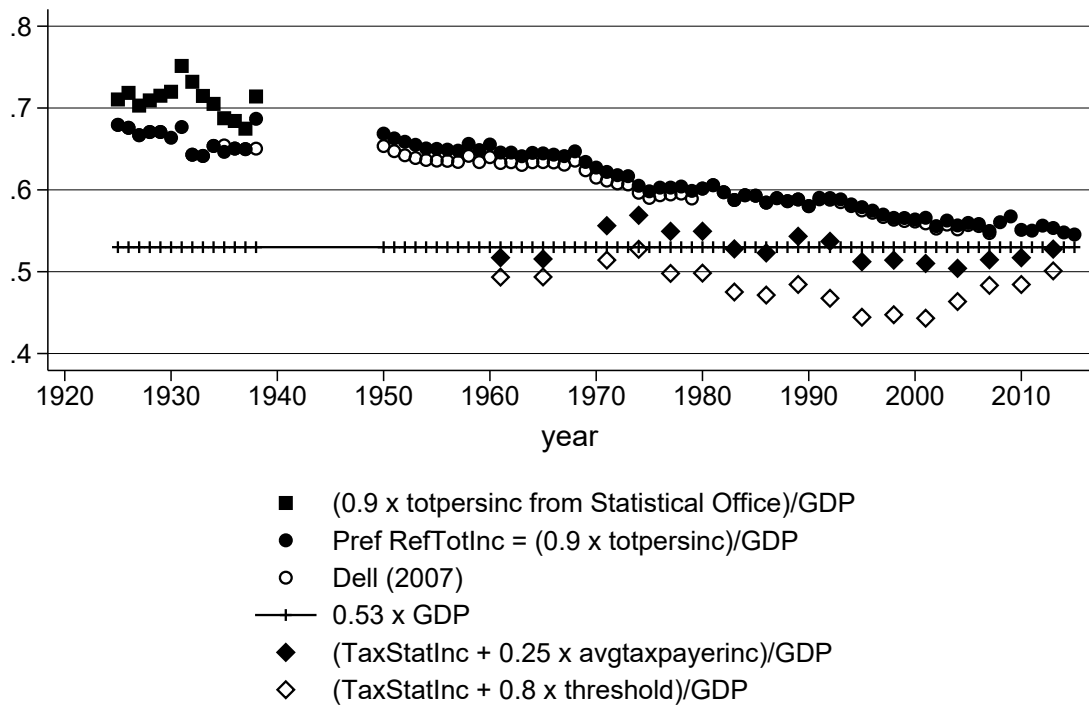
Source: See Appendix Table Germany.

E   Estimation of German series, 1871-1918

The aggregated top income share series for Germany is computed in a two-step procedure. First, a point estimate for 1909 is constructed where data are available in most of the eight states. The top income share in each state i is weighted by the state's fraction in German total income or German total population, respectively. The German top income share in 1909 is thus given as

$$share_{Germany,1909} = \sum_{i=1}^{n} w_{i,1909} \cdot share_{i,1909}$$

where $w_{i,1909}$ is the fraction of state i in German total income or total population, respectively, in 1909. 1909 is the year, when the highest number of state-specific point estimates of top incomes shares is available. For Bavaria, 1911 estimates are taken for 1909 estimates since income taxation in Bavaria is only introduced in 1912 taxing incomes from 1911. The series is extended backwards to 1871 and forwards to 1918 by multiplying the aggregated point estimate of 1909 with the average growth rate of top income share over n states. This can be written as

$$share_{Germany,t} = \sum_{i=1}^{n} w_{i,t}(1 + g_{i,t}) \cdot share_{Germany,1909}$$

where $g_i = \frac{share_{i,t+1}-share_{i,t}}{share_{i,t}}$ is the growth rate of a fractile's top income share in state i between year t and $t+1$.

Figure E.1 displays the income- and population-weighted German series in comparison to the Prussian series. The overall trend is driven by the Prussian series as Prussia includes the majority of the German population. But the level of income concentration turns out rather different. Looking at Prussia only, we would underestimate income concentration at the top decile. The picture reverses moving further to the top of the distribution. The income share of the top 0.01% in Prussia exceeds the share of this group in the entire Germany. Since many of the superrich at that time lived in Prussia, particularly the heavily industrialized Ruhr area, we would overestimate income concentration at the very top relying on Prussian data only.

As a reference point in 1912, we can merge a joint tabulation of German states with the same income brackets for all states for the year 1912 (1910 in Bavaria, 1911 in Wurttemberg) (Statistisches Reichsamt, 1932, p.126). The joint tabulation includes all of our eight states but Bremen. The datapoint of the merged series is slightly above our income- or population-weighted aggregate series. The comparably higher level is partly explained by the inclusion of legal persons in the statistics from Saxony, Baden and Bavaria in the joint tabulation. In sum, the estimate from the joint distribution is very similar to our aggregate series. This means that the estimation error from not taking between-state inequality into account is likely to be small.
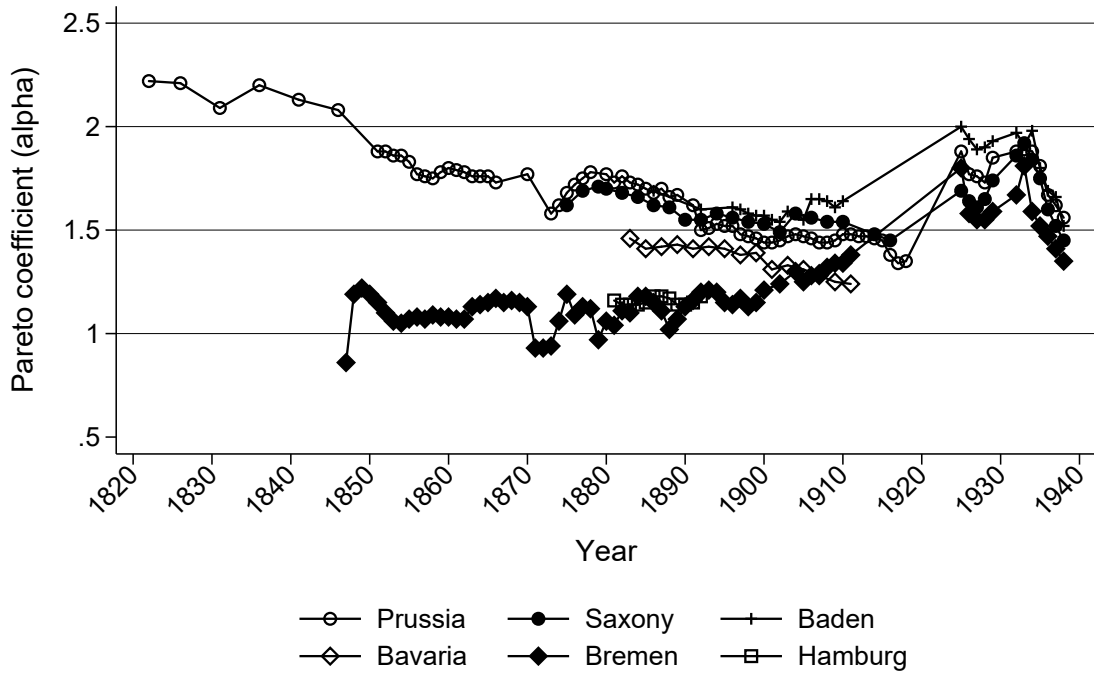
Figure E.1: Top income shares Germany, 1871-1918
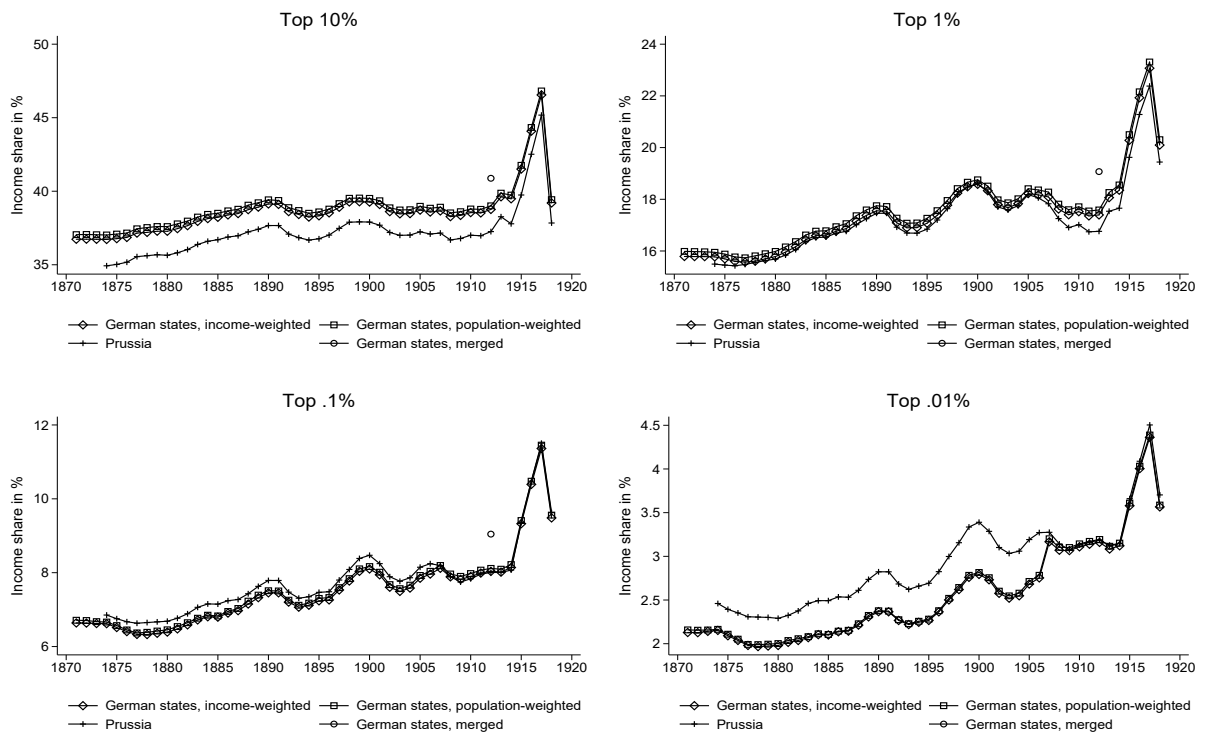
Source: Appendix Table x.

Note: German states, merged, are obtained from a joint tabulation (Statistisches Reichsamt, 1932, p.126).

F   Comparison with previous estimates

Figure F.1: Pareto coefficient α, previous estimates, 1822-1938

Source: Grumbach (1957)
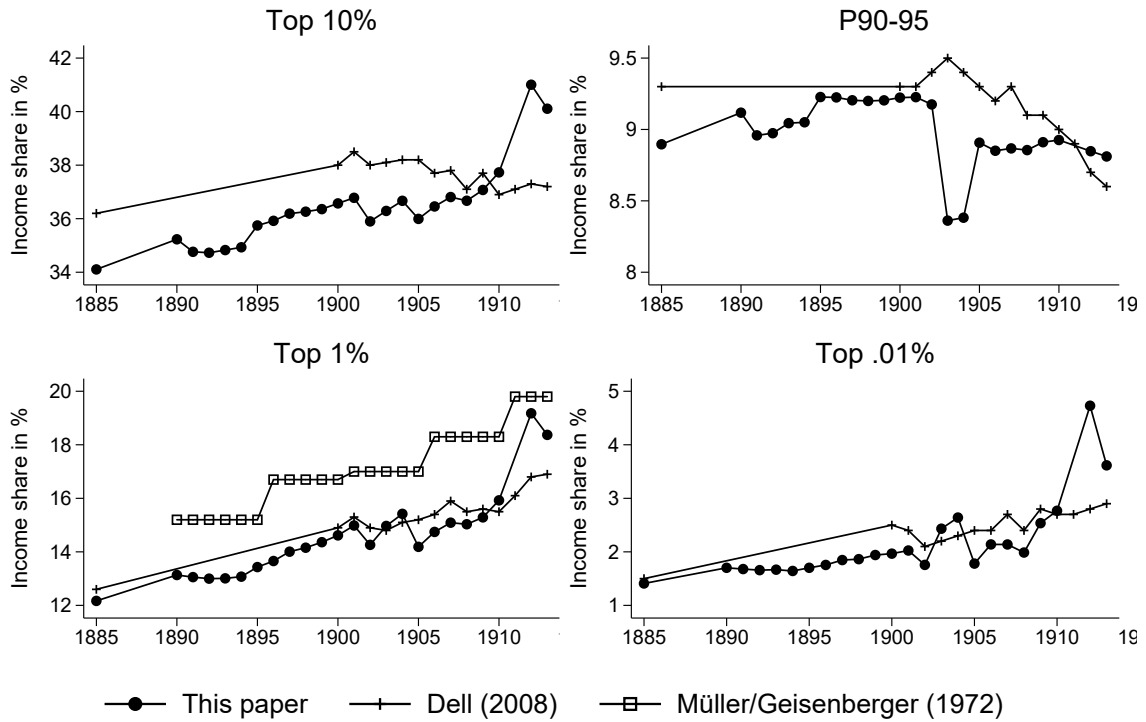

Figure F.2: Top income shares in Baden, 1885-1913

59
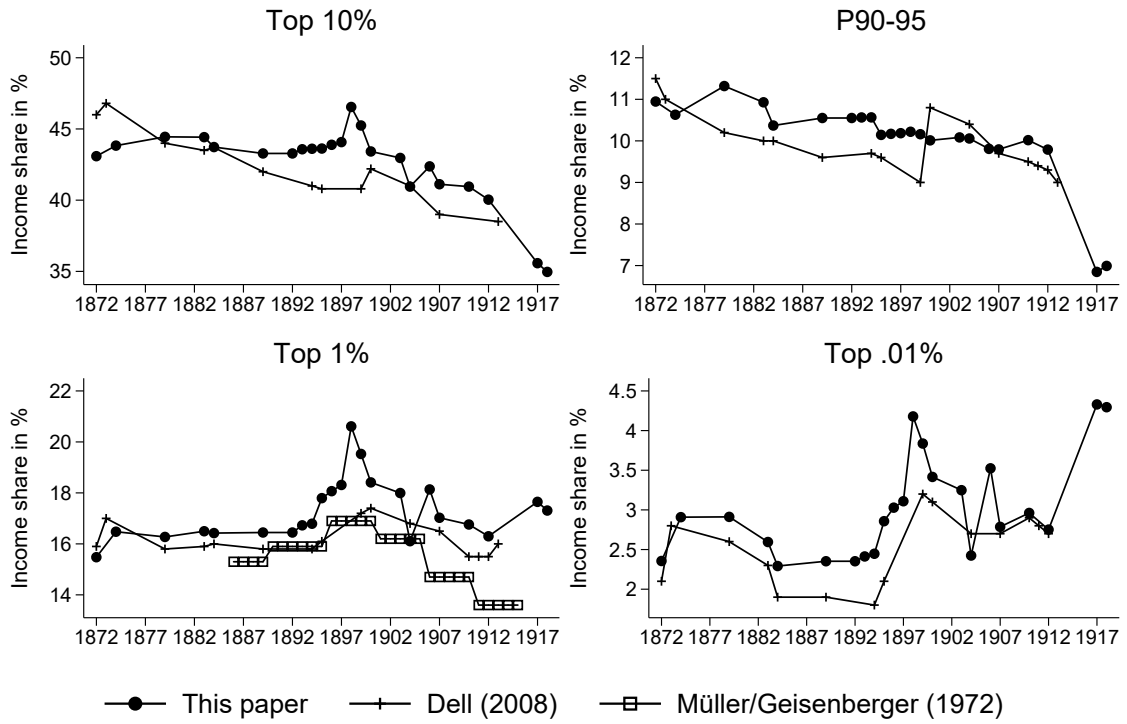
Figure F.3: Top income shares in Hesse, 1872-1918
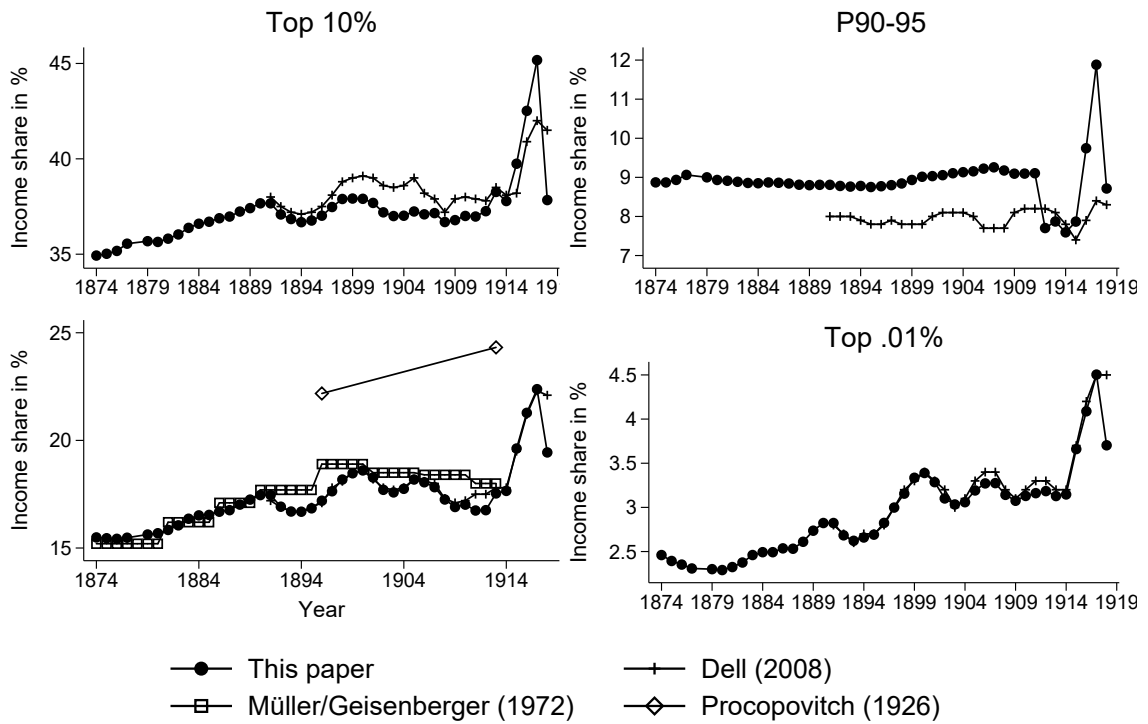

Figure F.4: Top income shares in Prussia, 1874-1918

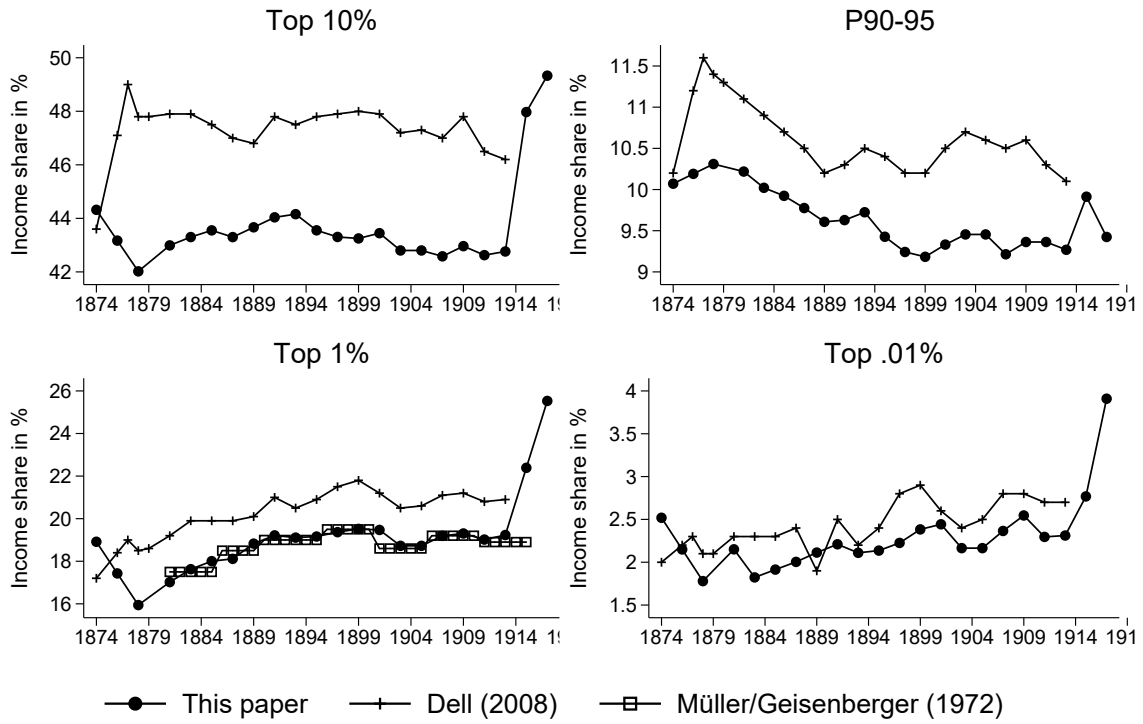Figure F.5: Top income shares in Saxony, 1874-1917

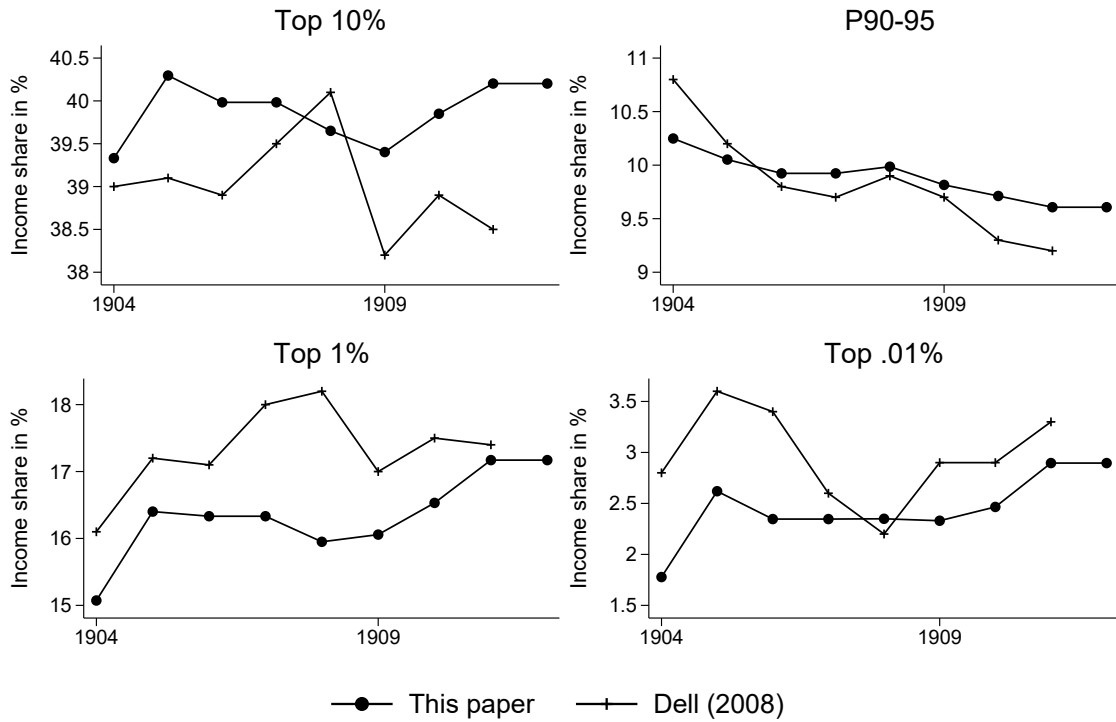Figure F.6: Top income shares in Wurttemberg, 1904-1912

Figure F.7: Top income shares in Germany: This paper vs. Dell (2007)