

Top Incomes in Germany over the Twentieth Century: 1891–1995

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Abstract:

This paper presents new homogeneous series on top income shares in Germany from 1891 to 1995 using tax returns data. The general pattern is consistent with recent results for France, *i.e.* the secular decline in income inequality is for the most part a capital income phenomenon. Very top incomes were badly hurt by the major shocks of the 1914-1945 period and never recovered afterwards possibly because of the rise in progressive taxation. Since 1945, top income shares have been relatively stable, with no rise during the recent years (unlike in the U.S.). The striking episode before WWII is how Nazi power brought top income shares to almost double within five years. The striking result after WWII is that German top incomes are more concentrated within the top decile than in other industrialized countries. Thus the German super rich were richer than their American counterparts until the late 1980's.

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<i>CONTENTS</i>	1
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Contents

1 Introduction	2
2 Data and Methodology used	4
3 Top Incomes in Germany	6
3.1 Trends in Top Income Shares	6
3.1.1 General Pattern	6
3.1.2 Pre-WWI Years and World War One	9
3.1.3 Interwar Period	9
3.1.4 Federal Republic's Years	14
3.2 Evolution of Top Incomes Composition	17
4 Germany compared to other industrialized countries	21
4.1 Shares evolution	21
4.2 Basic Facts concerning the real levels	31
5 Conclusion	35

APPENDIXES 36

A Former Estimates of Income Inequalities in Germany over the long run	36
B Sources of Tabulated Income Tax Data for Germany over the Twentieth Century	36
C Total Tax Units and Total Income Data for Germany over the Twentieth Century	41
D Estimation technique using Pareto's Law	49

1 Introduction

In this paper, we estimate, to the best of our knowledge for the first time, top income shares for Germany over the Twentieth Century. Using income tax data, we are able to trace top income shares back into the past as far-off as 1891, when the first modern income tax was put into effect in Prussia. We can thus study top income shares series for a period longer than a century, beginning at a time when Germany was still in a phase of late industrialization.¹ Following seminal works by Kuznets ([24]) and more recently by Piketty ([34] and [35]), the use of income tax data to estimate top income distribution has become widespread, since such data are most of the time the only available data for remote periods. Focusing on top market incomes over long periods of time gives one the opportunity to identify factors which may govern the changes in income distribution. North-America is now well surveyed ([37] for the United States and [42] for Canada) and top incomes from the southern hemisphere are better known thanks to [3]. As far as Europe is concerned, the United Kingdom and the Netherlands have now been studied (see [4]). as well as Scandinavian countries.

Moreover, comparisons between industrialized countries help to understand which variations in top incomes are purely short-run, tax-law driven phenomena, and which others may be part of an overall trend in the evolution of inequalities, driven by fundamental economic transformations. Crucial factors which might affect income distribution over the long run are technological change and macro-economic business cycles but also government intervention through tax policy.

The Germany case provides us with new evidence on what in Kuznet's hypothesis is still of interest, and what should now be considered as disqualified by empirical results.²

Moreover, being very similar to France, Germany constitutes an appropriate comparison point to deepen our understanding of how top incomes distribution changes. Like France, Germany was deeply shaken by two World Wars. Like France, Germany built a comprehensive Welfare State after WWII. Like France, Germany did not experience sharp tax cuts in the 1980's.

Indeed, one (still tentative) explanatory factor of top income share's evolution is the (progressive) income tax system. As [37] put it, 'top capital incomes

¹The First Industrial Revolution came relatively late in Germany (later than in France, and obviously later than in the United-Kingdom).

²According to Kuznets' very influential theory, inequality follows an inverse-U shape along the development process. Inequality should rise and then decline as the share of the population working in the higher-paying industrial sector grows and finally becomes a majority.

were never able to recover from these [World Wars and Great Depression] shocks probably because of the dynamic effects of progressive taxation on capital accumulation and wealth inequality'. The German experience could enlighten us on this issue because of the proximity and similarity between German and French economies, associated with different tax systems.³

Nevertheless, Germany is also a country which path through the Twentieth Century was strewn with more exogenous shocks than any other industrialized country. Two periods deserve special attention: first, the Third Reich, when nazi power drastically changed the share of top incomes in the context of an ever less market driven economy and second, the years since the Reunification, when two radically different income distributions were merged and a fifth of the new Germany entered an accelerated transition process.

Lastly our series, beginning very early⁴, enables us to study the 1891-1913 period, usually too remote to be documented, and nevertheless very interesting since it gives insight in how income inequalities might have looked like during the end of the industrialization process.

Among former attempts to estimate income shares (or simply assess income distribution) in Germany), one should cite [29], [27] and [32] as well as [12] and [53]. These attempts are not as comprehensive as the present work in the percentiles they estimate and in the periods they study. Moreover, the methodology used is often very elusively described, thus preventing us to assess the reasons of some discrepancies with our results.⁵

Other references on income distribution in Germany include [10], [23] and [26], but do not give new estimates and only recycle estimates made before the 1970's.

Our main results are the following: top income share fell in Germany over the twentieth century following the very chaotic period of 1914-1945. Although nazi power had a very positive impact on top income shares, pre-WWI levels were never recovered. After WWII, top income shares were relatively stable until

³Most importantly, German tax law relies on a 'bachelor-penalty' system (*Splittingstabelle vs. Grundtabelle*) whereas the French system relies on a 'children-bonus' system (with the so-called *Quotient Familial*).

⁴Equivalent data are only available after 1915 for France, after 1914 for the Netherlands, after 1913 for the U.S. and after 1908 for the U.K.

⁵Most notably, [32] argues that top incomes grew dramatically during WWI (*i.e.* between 1913 and 1919, his only two point estimates). [27] and [53] are the most complete studies (unfortunately concerning only respectively the Pre-WWI Years and Interwar Period). Cited in [23], their results are perfectly in line with ours. See appendix A for a detailed summary pre-existing literature.

nowadays (only the top 0,01% exhibits a high volatility). This stability goes along with an original physiognomy within the top decile: the gap between the top one percent and the following nine percentiles is much wider than in any other developed country.

The present paper is organized as follows: section 2 presents our data sources and explains our estimation methods. Section 3 constitutes the core of the paper and presents top income shares series over the century. Section 4 offers a systematic comparison of the German trends with comparable series for France and the U.S. as well as concluding comments and further research perspectives.

2 Data and Methodology used

This section briefly presents the different data we exploit in this paper and the methodology used to estimate top income shares. More details on this topic can be found in appendices B to D.

Our data rely on tax returns statistics compiled by the successive German fiscal administrations over the twentieth century. The raw data we use consists of tables containing, for a large number of income brackets, the number of taxpayers and the amounts declared. Other such tabulations are available (unfortunately only after 1926) to assess composition by income sources.

Unlike other developed countries, the German state did encounter numerous breaks over the twentieth century. So did the data we use. Three major periods can thus be highlighted: before 1920, the Interwar Years, and the Federal Republic period.

Before 1920, there was no central fiscal administration: in the *Wilhelmine Empire*, direct tax collection was conducted at the level of the member states of the federation. Direct income taxes did not exist everywhere in the *Reich* at the end of the nineteenth century. Nevertheless around 1900 all major states (Saxony, Bavaria, Hessen and most notably Prussia) had brought modern income taxes into operation. The present version of this paper only uses Prussian data to document the pre-1920 period⁶. Income tax was introduced in Prussia in 1891 and the first

⁶It is important to bear in mind that before World War I, Prussia was accounting for two thirds of the total German population. Moreover, Prussian territory encompassed low-density rural areas (*e.g. Ostpreußen*) as well as high density industrial regions (*e.g. Ruhrgebiet*) with numerous cities. The capital of the empire, Berlin, was also part of it. Prussian high incomes are therefore probably a good proxy of German high incomes for the pre-1920 period. Nevertheless, data from other member states such as Saxony and Bavaria are available and are currently exploited in order

data we use relate to the tax year 1891. Until 1918, tabulated income tax data were published unevenly (see appendix B) but often enough to enable us assessing the pre-war levels and evolution of high incomes.

After World War One and the German Revolution, the Weimar Republic saw the institution of a federal income tax with a relatively broad base (X% of all tax units). Together with the development of a modern and centralized Statistical Office⁷, this new tax system led to the first all-german income tax statistics. However, the coexistence of an *ex-post* declaration-based income tax (*Einkommensteuer*, henceforward ES) with a *ex-ante* pay-as-you-earn tax system on wages and salaries (*Steuerabzug vom Arbeitslohn* or *Lohnsteuer*, henceforward LS) led to two series of statistical publications (see appendix B) which must be dealt with with caution. Moreover, data for the Hyperinflation Years (1920-1924), World War Two (1939-1945) and the Allied Occupation Years (1945-1949) are unfortunately lost or were never gathered. Nevertheless, available data give us the opportunity to relate the puzzling evolution of high incomes in the Interwar Period, as well as their composition.

After World War Two, income tax in the Federal Republic of Germany kept being organized along the same lines as before the war. Tabulations were published regularly at 3 years intervals. Although the double taxation system of the Interwar Years continued to apply (it still exists), statistics were unified. The two last tabulations available (1992 and 1995) also account for the ex-Democratic Republic of Germany, known as the *neue Bundesländer*⁸. To summarize, we have data for 1891-1918 (on a yearly basis), 1925-1938 (on a yearly basis or every two years) and 1950-1995 (every three years).

Incomes considered in the various publications used for this paper are total 'net incomes (*i.e.* minus expenses necessarily incurred in obtaining these incomes, the so-called *Werbungskosten*), before social transfers and taxes, but after employers' payroll taxes and corporate income tax. However, over the whole century, some changes in fiscal legislation occurred that modified what taxable income meant. Fortunately these changes do not damage the continuity of our series for high incomes. For a detailed account of these changes and their consequences, see appendix B.

Because our data rely on tax return, they only provide information about incomes at the tax unit level. We cannot assess intra-tax unit income distribution

to complete the Prussian data. Data for the 1873-1891 years are also available.

⁷The *Statistisches Reichsamt*, see [54] on the issue.

⁸For more on the issue of Reunification after 1990, see appendices B and C

with our data. The fractiles we estimate are defined relative to the total number of potential tax units derived from population and family census statistics (see appendix C for more details). Following [35], we focus on the top decile and on smaller fractiles within it that are of crucial interest to understand with finesse the evolution of top incomes. We thus built series for the top decile (denoted by P90-100), the top 5 percent (P95-100), the top one percent (P99-100), the top 0,5 percent (P99,5-100), the top 0,1 percent (P99,9-100) and the top 0,01 percent (P99,99-100). As the top tail of income distributions is generally well approximated by Pareto distribution, we use simple parametric methods to estimate thresholds and average income for all of our fractiles (for more details on the method see appendix D. In order to control, within the top decile, for the (heavy) effect of the top fractiles, we systematically analyse intermediate fractiles P90-95, P95-99, P99-99,5, P99,5-99,9 and P99,9-99,99.

We then estimate the shares of each fractile in the overall personal income by dividing the amounts accruing to each fractile by homogeneous total personal income derived from national accounts (after 1920) and from reliable series built by [14] for the Pre-WWI years (see appendix C).

3 Top Incomes in Germany

3.1 Trends in Top Income Shares

3.1.1 General Pattern

Series of top incomes shares are presented in Table ???. One immediately notice the two basic facts that characterize top income evolution in Germany: a long-run decrease combined with short-term jerky variations.

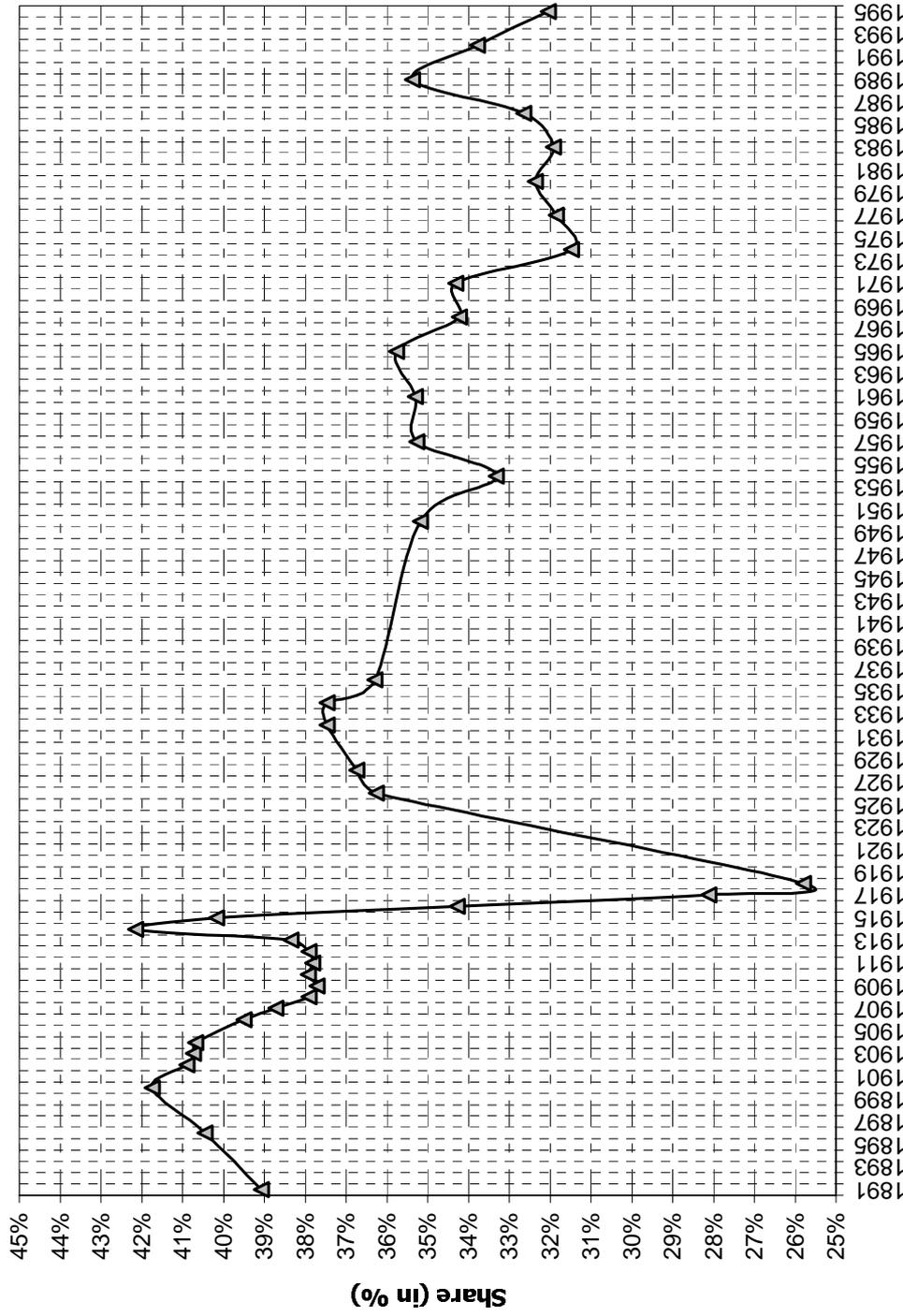
Figure 1 shows the evolution of the income share of the top decile over the century. Before WWI, the top decile share varied between 38% and 42% of total income. After WWII, it has been oscillating between 32% and 36%. The decline thus took place between 1914 and 1945. The Top Percentile (see Figure ??) experienced the same evolution. Before WWI, its share was about 18 to 20% of total income. The two World Wars brought this share down under 15%. Since the 1970's the share even remained under 11%.⁹ In other word, since 1891, the share of the top percentile was divided by two in Germany. If we look at the upper

⁹The outlier for 1989 is still to be understood more precisely although careful checking did not identify any artefactual result there.

percentile of this top percentile (see Figure 5), we see that (once again taking no notice of the 1989 point) its share was ranging between 3 and 4% at the beginning of the century and now remains inferior to 2%.

We can thus say that in the course of the twentieth century, the share of top incomes in Germany was dramatically reduced, and all the more that one looks farther in the right tail of the distribution.

Looking at intermediate fractiles enable us to have a more subtle view of this process. Looking at the lower part of the top decile (see Figure 2) we see that the picture is practically the opposite: the first half of the top decile (P90-95) saw its share of total income growing over the century. From about 8% at the end of the Nineteenth Century, it has remained since the late 1970's above 10%. As far as the P95-99 is concerned, one can see that its share actually remained quasi-unchanged in the course of the century. From 13% in 1891, it now weighs a bit more than 12%.



Sources: author's computations on German income tax data

Figure 1: Share of the Top Decile

3.1.2 Pre-WWI Years and World War One

Once these basic facts set, one can look more precisely at short-term variations. They are of great magnitude, reflecting the chaotic history of Germany over the century. The Pre-WWI years can be divided into two periods. First, from 1891 to 1901, top incomes grew to reach their secular maximum. Then, in a symmetrical movement, top income shares fell down in the first years of the Twentieth Century. The years immediately preceding WWI saw a revival of the top incomes but the War itself constituted a brutal shock from which top incomes never recovered.

The growth of top incomes at the beginning of the studied period is easily understandable since it correspond to the final phase of heavy and concentrated industrialization of the German economy immediately following the depression of the years 1873-1890. On the contrary, the fall at the beginning of the twentieth century cannot be accounted for easily. A (still to be done) more in-depth study of the evolution of industrial capitalism in Germany before WWI could probably cast light on this issue.

The pattern observed during WWI is much more easily understandable. Two series of factors can account for the evolution of top income during the war. First, financing the war led the Kaiser to resort to huge loans, the interests of which were paid thanks to new taxes on capital. Second, the war caused huge disruptions in the productive sector. The Sea Blockade imposed on Germany by the Allies (and the subsequent need to reorganize the economy in order to produce *ersatz*), and the concessions made to the Unions to guaranty a United Front in German society are two example of such non-economic factors that did hurt top incomes a lot¹⁰.

Once the war was over, the monetary instability it had launched plunged the German economy into chaos until 1924-1925.

3.1.3 Interwar Period

The global impact of Hyperinflation Years (1920-1924) on top incomes (and on income distribution in general) is a highly disputed issue of German economic history. However, comparing the end of the War (1918) with the first year of economic stability (1925) enables us to draw conclusions on this topic. Once again, dividing the top decile into smaller fractiles proves to be absolutely necessary in

¹⁰The sudden rise of top incomes just before the war (*i.e.* in 1914) still needs to be accounted precisely for. One could nonetheless argue that the production-fostering effects of war (especially in heavy industry sectors) were at the time already in action whereas the destructive consequences were still to come.

order to have a precise picture of what happened. The top percentile's share remained approximately unchanged during these years (at about 13%) and the share of the top 0,01% was significantly negatively affected (falling from more than 2% to less than 1,5%). On the other hand, lower fractiles within the top decile (P90-95 and P95-99) experienced a much more enviable fate. These results are perfectly in-line with the diagnostic of [16].¹¹ On the other hand, [33] argues in favor of a global stability of top incomes over the hyperinflation years, combined with a complete modification of the structure of the top decile.¹²

One can anyway assert that as the Weimar Republic finally enjoyed a stable economy (and as we at last enjoy tax data), top income shares above the top percentile were substantially under their pre-war levels. As far as the (lower) rest of the top decile is concerned, the pre-war shares had been regained (even slightly improved for P90-95).

The second half of the 1920's and the 1930's were the theater of the most dramatic variation of top income shares in the Twentieth Century. The late Years of the Weimar Republic let top income shares remain at the levels WWI and the subsequent inflation episode had brought them to¹³. The Great Depression had a very different effect within the top decile. Between 1927 and 1933, the top percentile's share decreased brutally from 13% to 10% of total income (its global minimum over the century). Within the top percentile, the top 0,01% lost about 30% of its share between 1929 and 1933. At the same time however, P90-95 and P95-99 experienced a sharp rise: P90-95 reached its all-century maximum at about 12% in 1932 and 1934. This contrasting situation can be understood as follows: on the one hand, the higher part of the top decile did suffer of the Depression and of the deflationary measures imposed by the Brüning government at the time (one striking example: the government decided (by decree) to lower coal prices by 7% in 1931). On the other hand, the lower part of the top decile,

¹¹these results are based on the same raw-data as those used in the present paper (p.271sq.) Note however that Holtfrerich draws conclusions on the whole 1913-1928 period, without trying to disentangle the effect of the War and that of Hyperinflation, his assumption being that Germany actually experienced one single large inflation period from 1914 to 1924. This perspective is not necessarily accurate to study income distribution.

¹²Persons of private means were badly hurt whereas businessmen keen on bold investments were largely rewarded. This is not necessarily contradictory with our results: it depends a lot on the limits of the period studied. The fact that data concerning income composition is not available for this period is sorely lacking.

¹³The late Weimar Republic is actually subject to very controversial debate (among others about the question of overvalues wages). See [6], and [38] for a recent econometric testing attempt of this assumption.

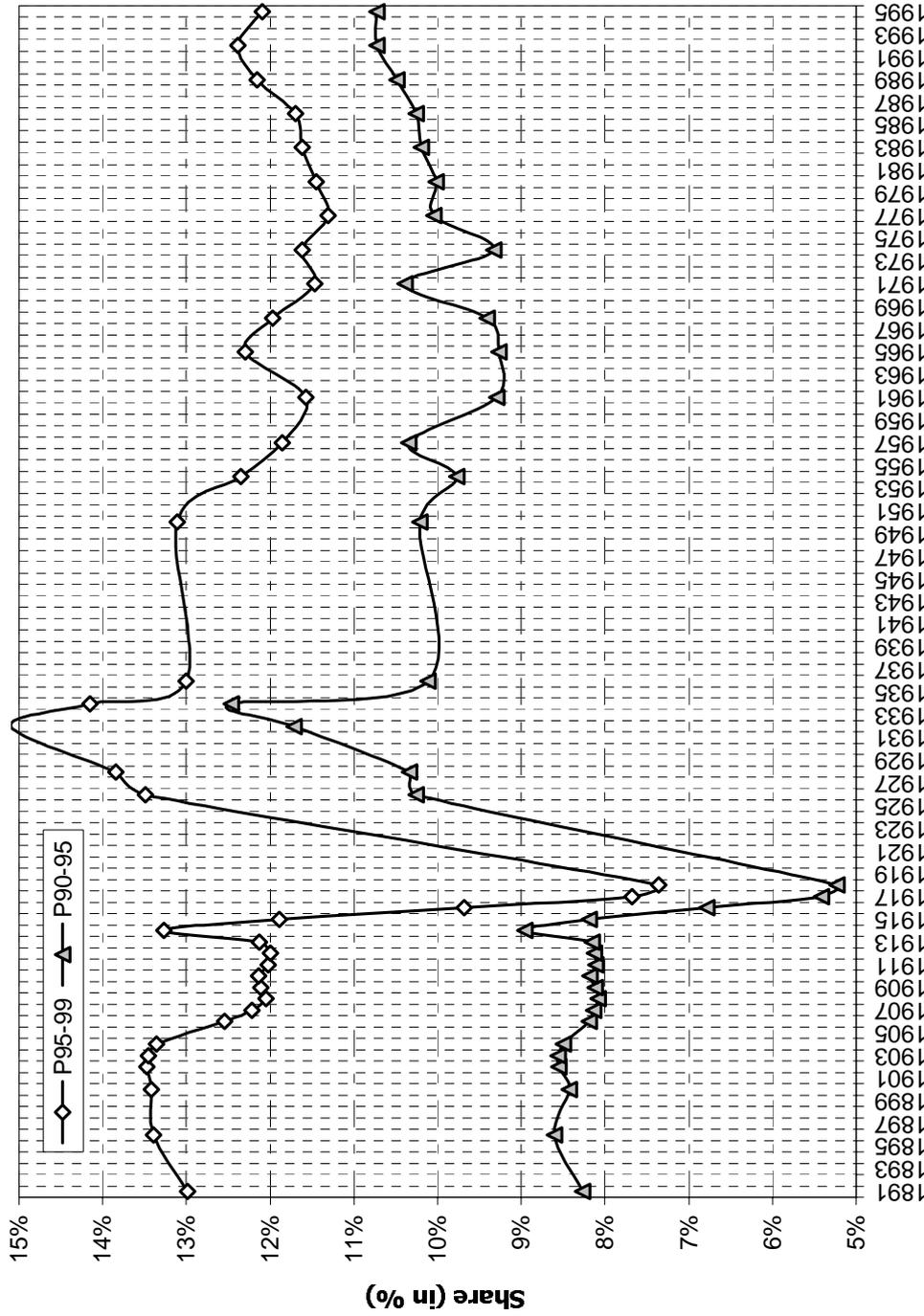
being mainly composed of (short-term downward rigid) wages (see section 3.2), deflation did not hit them and even made their weight grow. When nazis came to power in 1933, the top decile had been thoroughly equalized: (P99-100; P95-99; P90-95) had moved from a (20%,13%,9%) pattern in 1913 to a (10%,15%,12%) pattern in 1913. Note however that top fractiles real mean incomes were hardly hit by the Depression. The mean income of the whole top decile was about 60,000 Marks (1995 Deutsche Marks) in 1929 and was reduced by 30% in 1933 to a mere 40,000 Marks a year.

The effect of nazi economic administration changed radically this outcome of 30 years of inequality evolution. In a period of time of only five years, the pre-WWI shares were nearly recovered and levels were noticeably improved. From 1933 to 1938, the share of the top percentile grew from 10% to 16%; the share of the top 0,01 Percent grew by more than 100% from less than 1,25% to more than 2,5% thus almost recovering its 1891 level (although not its 1901 or 1914 shares). P90-95 and P95-99 were brought back to their pre-Depression levels of respectively 10% and 13%. This evolution can be easily accounted for by the consequences of the nazis coming to power. Two distinct periods can be highlighted. The first phase (1933-1934) consisting in strengthening their grasp on power (among others by bringing back full-employment thanks to civil building works) trickled down on the whole economy. Once the country was brought into line (*Gleichschaltung*), the second phase began after 1934, aiming to prepare the economy to war (*Wehrhaftmachung*). Interior consumption was curbed, wages growth was instantly stopped (so-called *Lohnstop*). The whole expansionist fiscal policy was directed to the very concentrated heavy industry sector thus letting top business incomes grow quickly.

To what precise extent the nazi regime helped a new category of ‘nazi entrepreneurs’ to thrive is nevertheless hard to assess precisely given the incomplete income composition information at our disposal.¹⁴

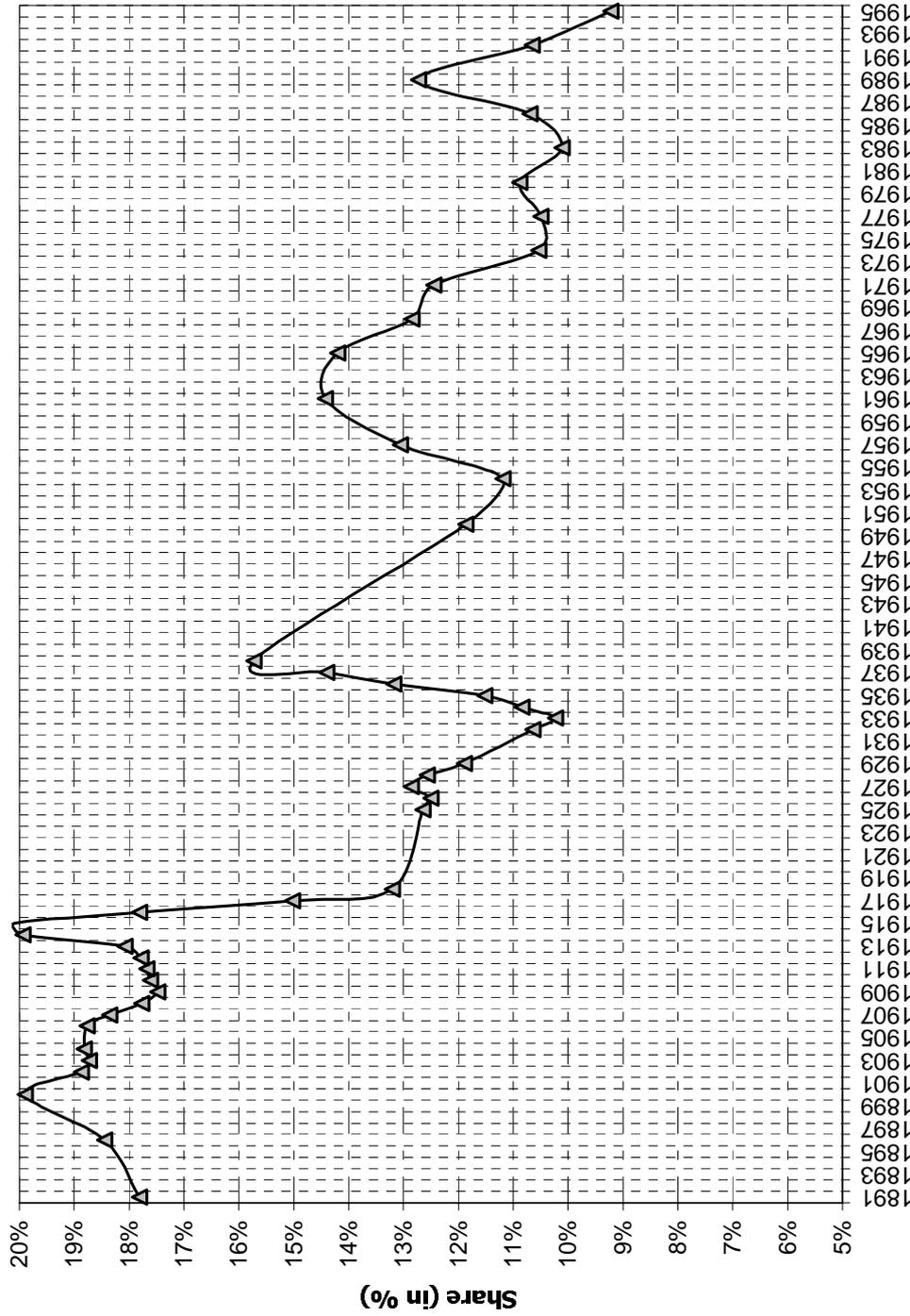
Unfortunately, we do not have data on WWII and its aftermath. As for the Hyperinflation years, we can only compare the situation before (1938) with the outcome in 1950.

¹⁴Work by [43], based on precise exploitation of German firms account, confirms the fact that the post-1935 years were characterized by huge real profits in the German industry. Spoerer demonstrates that these profits were independent of firm size but only to be found in rearmament linked sectors. He argues that these profits were used by the Nazi Regime to seduce and incite firms to accept a transition to a highly risky war oriented economy. Were these ‘entrepreneurs’ junior partners of the nazis or only opportunists and profiteers, the question remains open.



Sources: author's computations on German income tax data

Figure 2: Share of P90-95 and P95-99



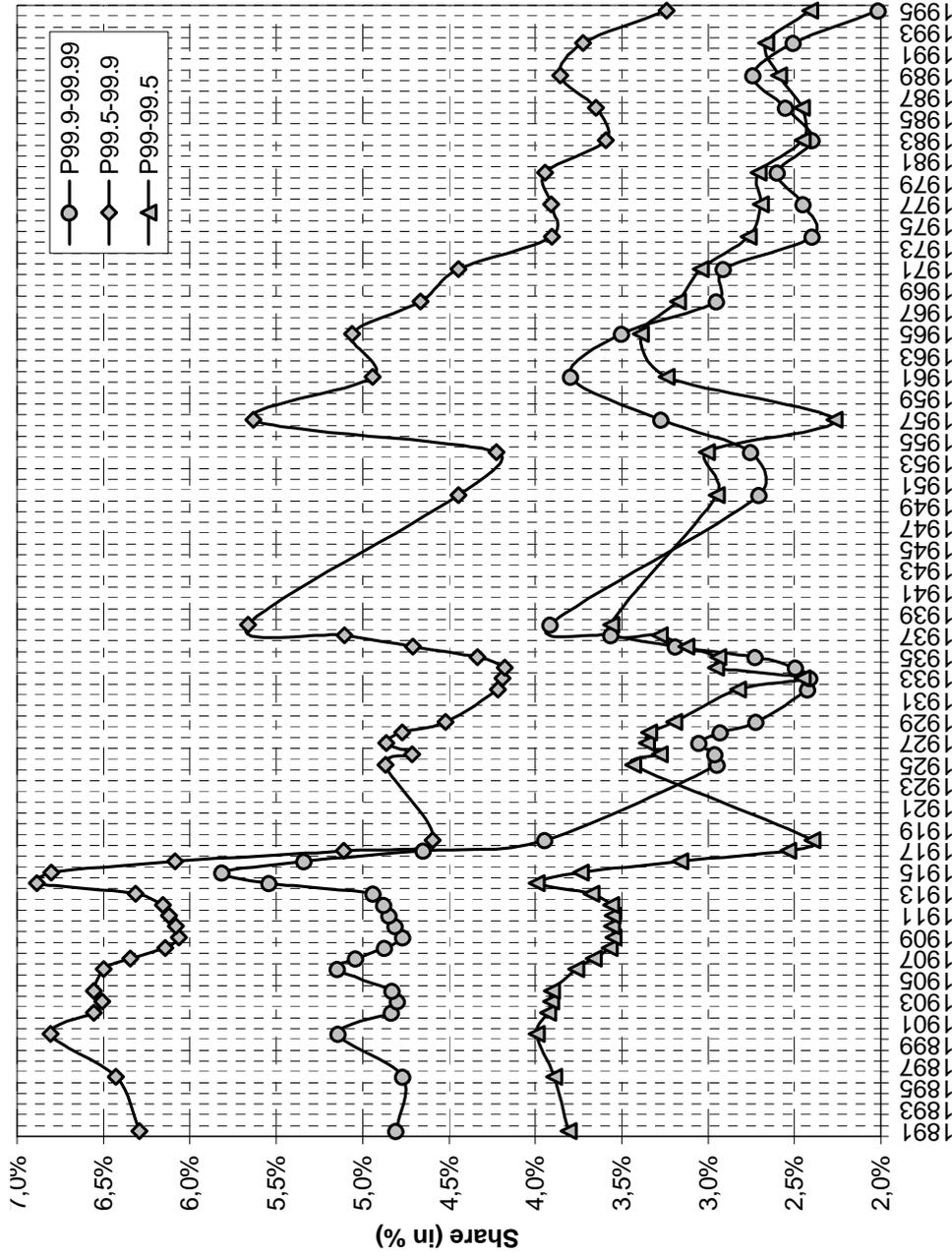
Sources: author's computations on German income tax data

Figure 3: Share of the Top Centile

3.1.4 Federal Republic's Years

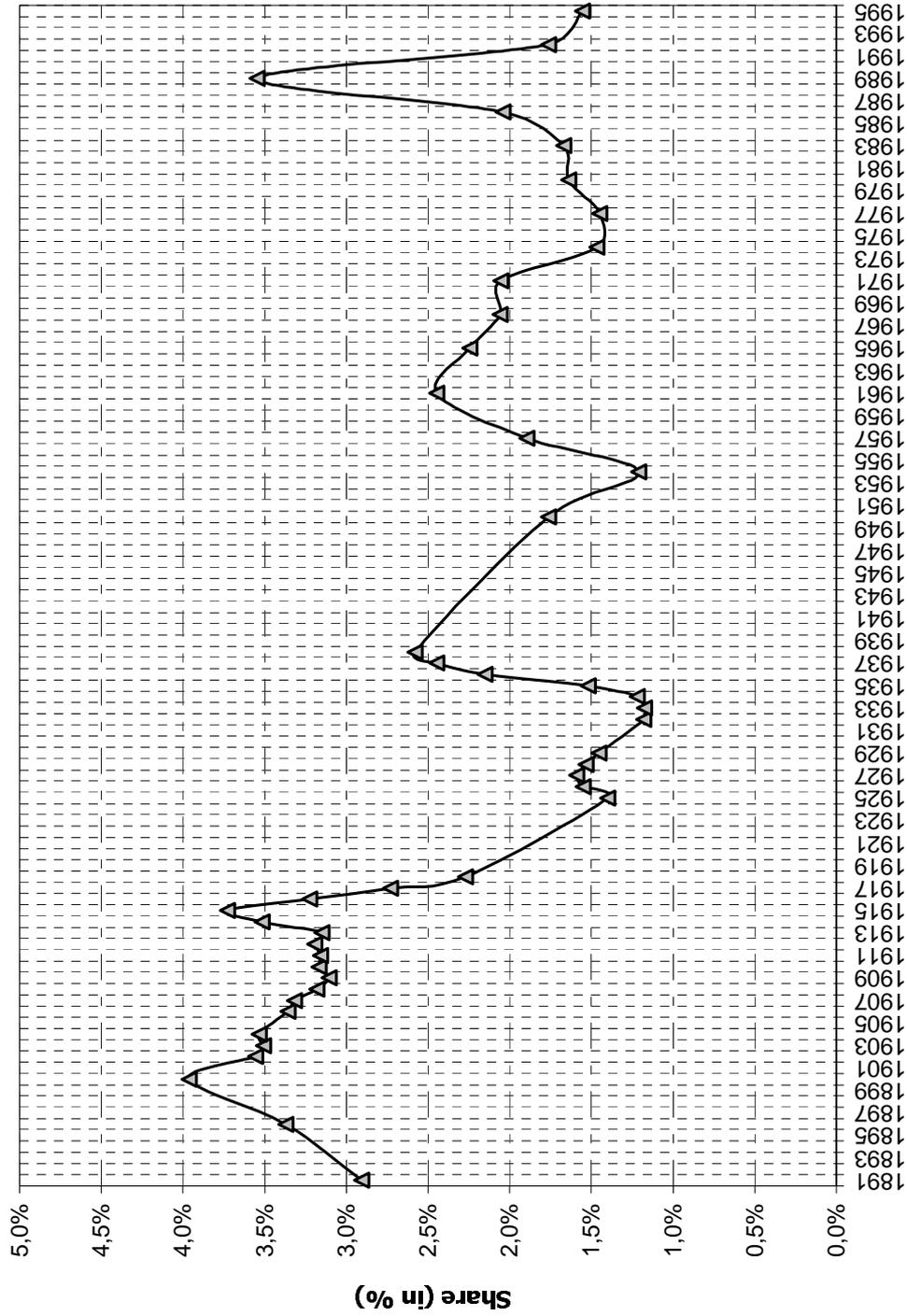
The Federal Republic's Years from 1950 to 1995 can be characterized as a period of global stability of top incomes. The top decile's share oscillated between 32% and 36% over the whole period. Most of this variability is caused by the top percentile. Indeed, P90-95 and P95-99 exhibit amazing stability from 1950 to 1995 (respectively around 10% and 12% of total income). The top percentile's evolution is more complex. Within it, fractiles P99-99.5, P99.5-99.9 and P99.9-99.99 experienced a continuous decline since the late 1950's whereas the Top 0.01 Percentile saw its share follow a non monotonous course. Representing in 1954 only a bit more than 1% of total income (with 1932/33 its minimum over the century), these top incomes grew in the late 1950's and stabilized (although with a downward trend) in the 1960's between 2 and 2.5% of total income. In the 1970's, the depression brought them down to about 1,5%. Un upward trend is to be identified in the 1980's, culminating in 1989 at an amazing 3,5%. At last, Reunification, by mechanically diluting income distribution diminished the weight of the top percentile as a whole.¹⁵

¹⁵Precise inter-*Länder* analysis of top incomes for the 1986-1995 period is still to be realized to assess more precisely the effect of Reunification. Two effects should be identified: first, a mechanical effect: the population grew, the 'eastern' income distribution contained no 'high' incomes, so the top income shares dropped. How far down the distribution (top percentile, top decile, top 20% ?) this effect can be observed remains to be checked. Second a more fundamental economical effect linked with the peculiar transition of ex-GDR should be assessed: the opportunity for West-German businesses to capture short term rents in the East could have balanced the first effect.



Sources: author's computations on German income tax data

Figure 4: Share of P99.9-99.99, P99.5-99.9 and P99.99.99



Sources: author's computations on German income tax data

Figure 5: Share of the Top 0,01 Percent

3.2 Evolution of Top Incomes Composition

Information on sources of income enable us to estimate the share of various income sources at different levels of the income distribution, using simple linear interpolation methods. Unfortunately, such information is not available before 1926. The data for the post-1950 period are currently being exploited. We thus simply present here estimates concerning the Interwar period (see figures 6 to 8).

The basic fact about the composition of top incomes is, as in France or the U.S., the growing share of capital incomes at the top of the distribution. In 1928 as in 1936, 70% to 80% of the P90-95 percentile is made of wages. The rest being capital and business income, and self-employment income. The top 0,1%¹⁶ is on the contrary basically made of capital income and wages only represent a mere 10 to 20% of this fractile. It should be noted here that German tax law registers as ‘business income’ incomes that would, for example in France, be recorded as capital income. This phenomenon still exists today and the precise mechanisms that enables one to declare dividends as ‘business income’ are still under investigation. Suffice to say that the economically significant gap is that between wages on the one hand and business and capital income on the other. The structure of top incomes (at least during the Interwar Period) thus appears to be very similar to that of other countries: even the local maximum of self-employment incomes about the P99 threshold is there. Thus if the secular decline in top income shares is to be understood, capital income should under close investigation.

¹⁶We do not give estimates for the top 0,01% because it would most of the time entail linear extrapolations, which are obviously not robust.

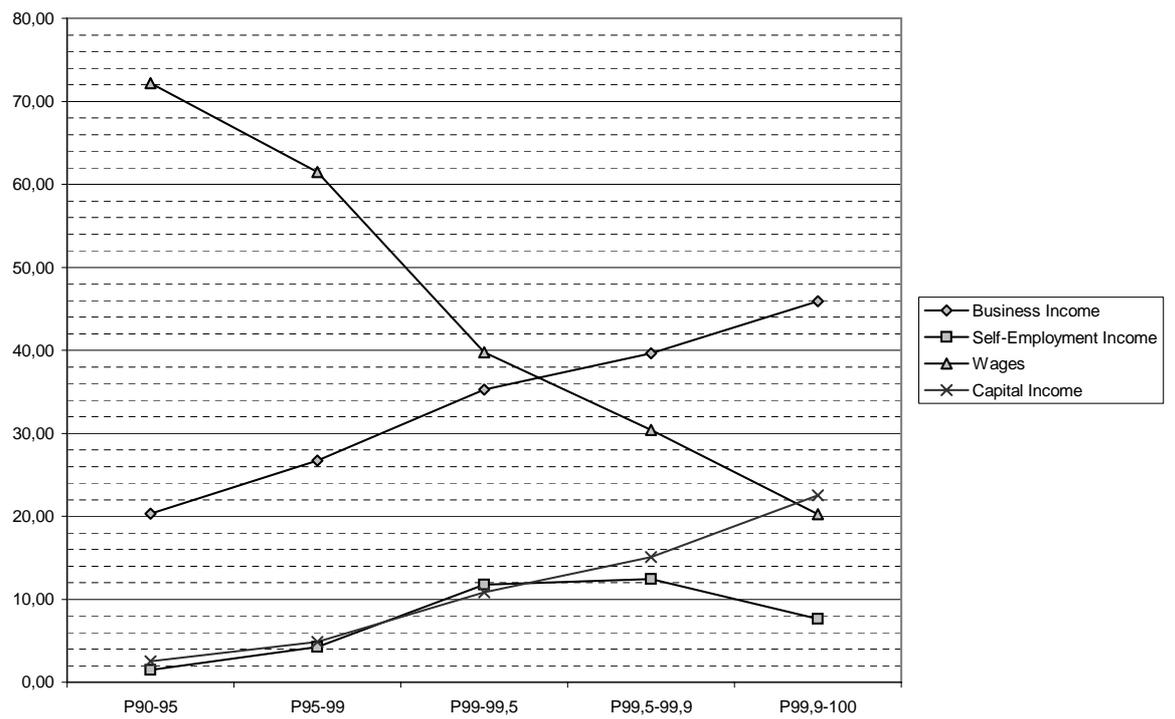


Figure 6: Sources of Income in Top Percentiles in 1928

These income composition estimates also cast an interesting light on economic shocks such as the Great Depression. Not only did the Great Depression lower all top incomes: as already said, the top decile was fundamentally transformed during the Depression with lower centiles weighting more whereas the share of the top centile was substantially negatively affected. 1932 composition estimates confirm very clearly our former assumption that this phenomenon was the result of real wages having become relatively more important within the top decile thanks to deflation. In 1932 indeed, wages are more present higher in the distribution: they still represent about 35% of incomes in the top 0,1 percentile whereas four years before, as four years later, they represent a maximum of 20%.

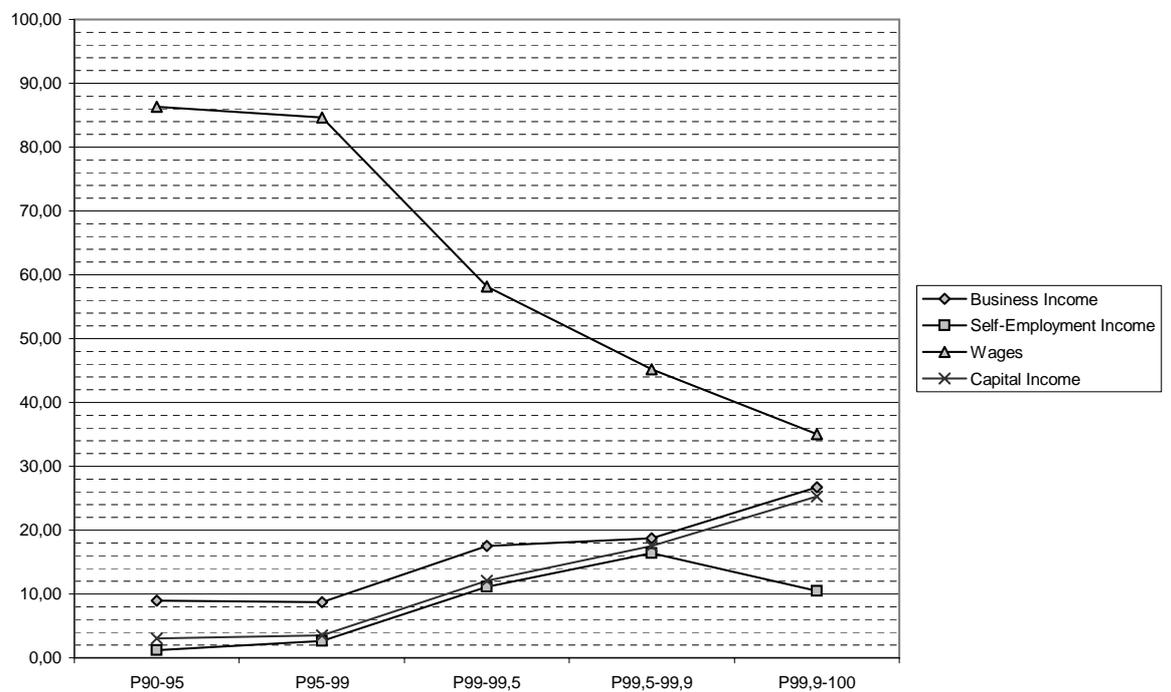


Figure 7: Sources of Income in Top Percentiles in 1932

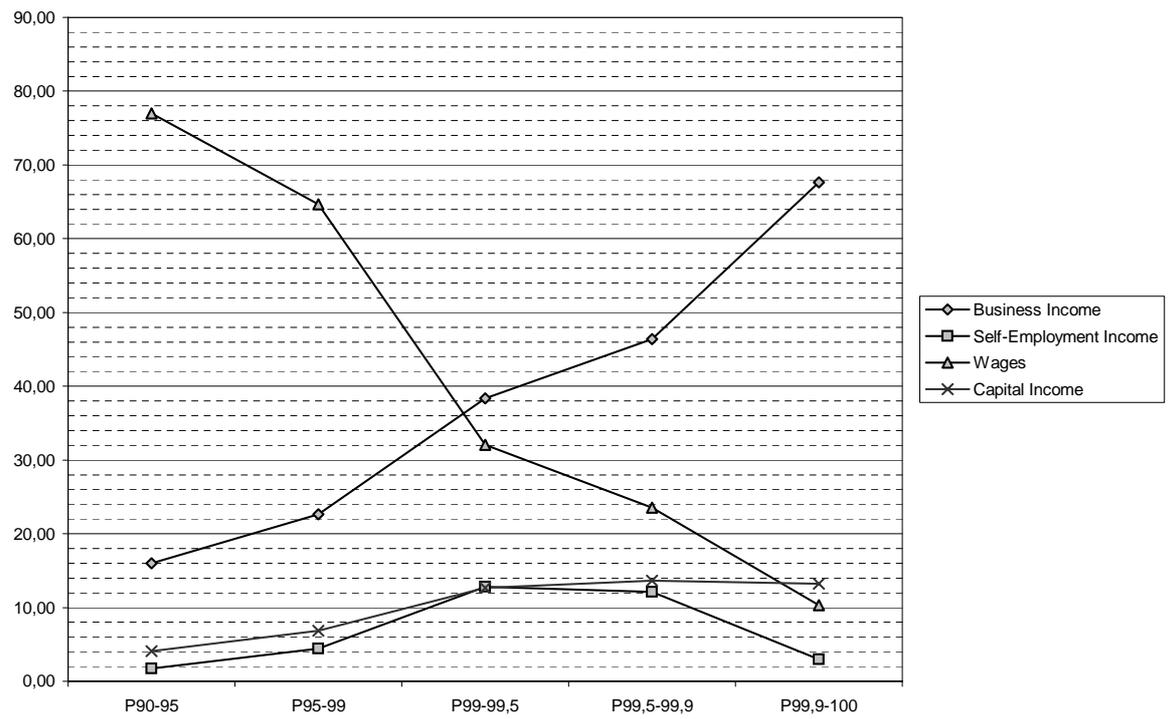


Figure 8: Sources of Income in Top Percentiles in 1936

4 Germany compared to other industrialized countries

4.1 Shares evolution

Before WWII, the overall evolution of German top income shares was marked by the initial WWI shock. The shares of higher fractiles within the top decile seemed to follow an opposite path in comparison to US and French top fractiles.

The evolution within the top centile was very different: as already noticed, German top incomes did not experience a boom in the late 1920's. On the other hand the impact of the Great Depression was less brutal, and the 'nazi recovery' was so quick that by the late 1930's German shares were for the first time since 1913 at the level of their French and US counterparts. If French and US top centiles followed inverse U-shaped patterns in the Interwar Years, German ones had a U-shaped profile. With the lower part of the top decile following patterns equivalent to the French and US ones, the top decile was on the whole less concentrated than in other countries: the share of P90-95 was over those of France and the U.S. whereas the opposite was true for P95-100 (see Figures 9, 10 and 14).

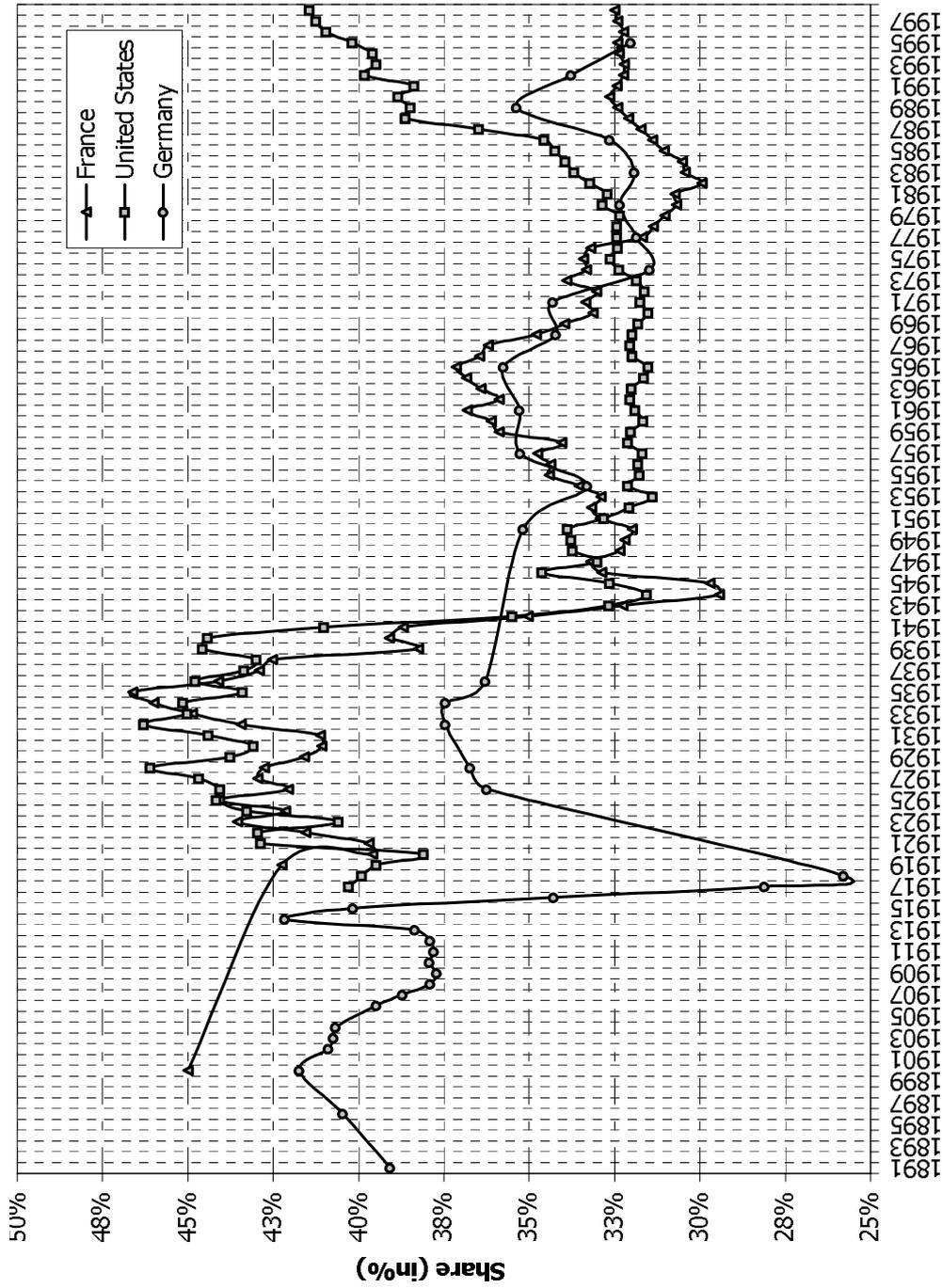
The evolution of top income shares in Germany after WWII on the contrary led to a more concentrated top decile. Unfortunately, we cannot assess the evolution of top incomes during WWII. We therefore cannot know what was the lower point (probably 1945) in top income shares in Germany. Indeed, our first point after the war (1950) corresponds to a moment when the German economy had already at least partially recovered from the 1945 Capitulation. Although our series give this impression, we cannot say that WWII had a smaller impact on German top incomes than WWI. There are good reasons to believe (see [43]) that the observed trend for the years 1933-1938 did continue for a while (until 1941 probably). On the other hand, it is probable (although not certain given the downward 1950-1954 evolution of shares within the top centile) that the lower point at the end of the war was substantially lower than the 1950 point (as it was the case in France). Therefore the impact of WWII is minimized by our incomplete series both because the entry point is too low and because the exit point is already too high.

In the 1950 however, very stable characteristics of top income shares emerged that did last until nowadays. P90-95 and P95-99 exhibit a very stable share of total income, the share of P95-99 being substantially lower than that of the French and US equivalent fractiles. The top centile, on the contrary, has a share 20 to 50% higher over the whole 1950-1995 period. Not only did the German super rich earn

4 *GERMANY COMPARED TO OTHER INDUSTRIALIZED COUNTRIES*²²

more since WWII than their French and American counterparts in absolute terms, but they also did better relative to the mean (or total) income. This result however only holds for the upper half of the top centile.

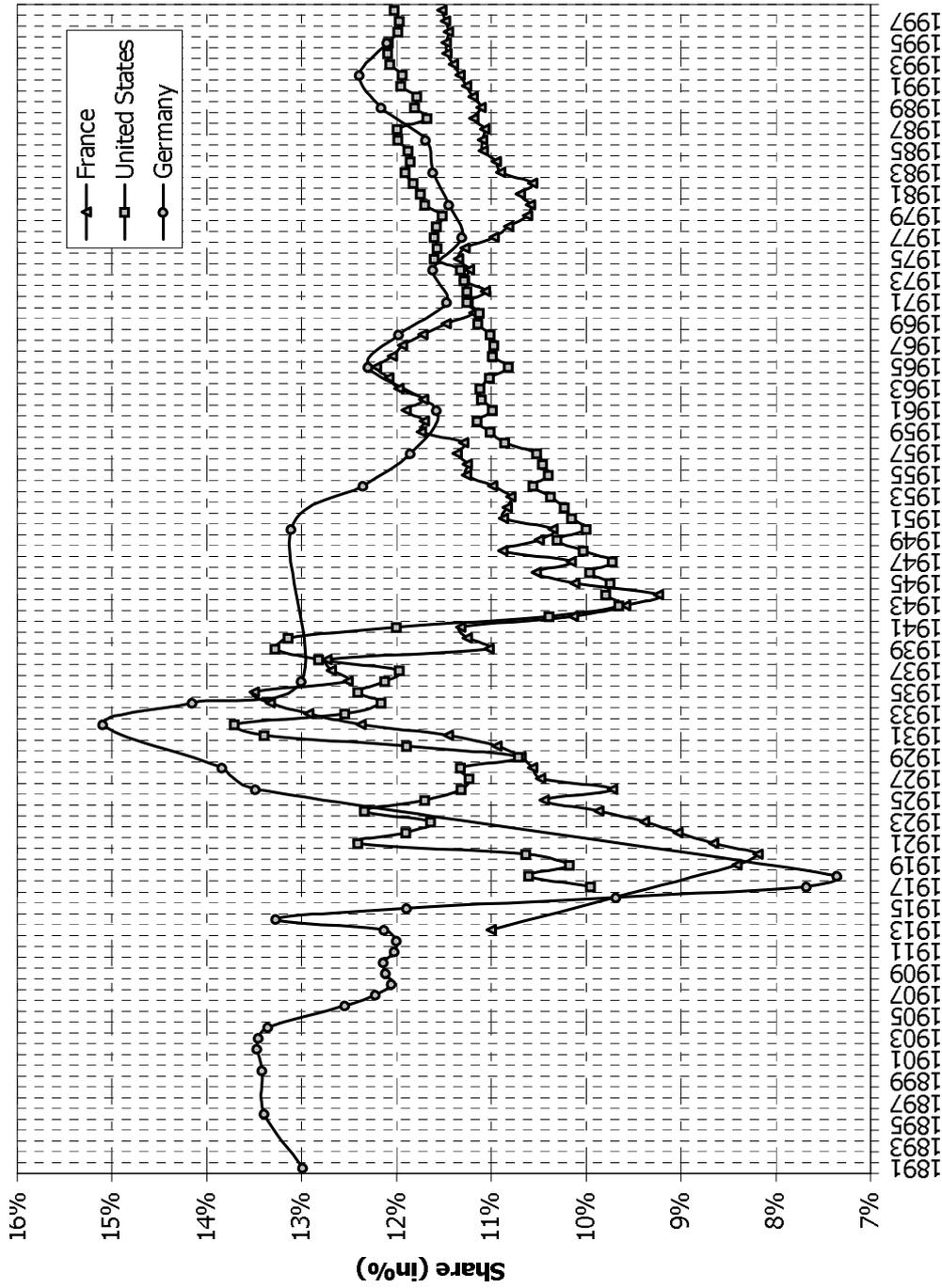
4 GERMANY COMPARED TO OTHER INDUSTRIALIZED COUNTRIES23



Sources: France: Piketty(2001); U.S.: Piketty&Saez(2001);
Germany: author's computations

Figure 9: Share of the Top Decile

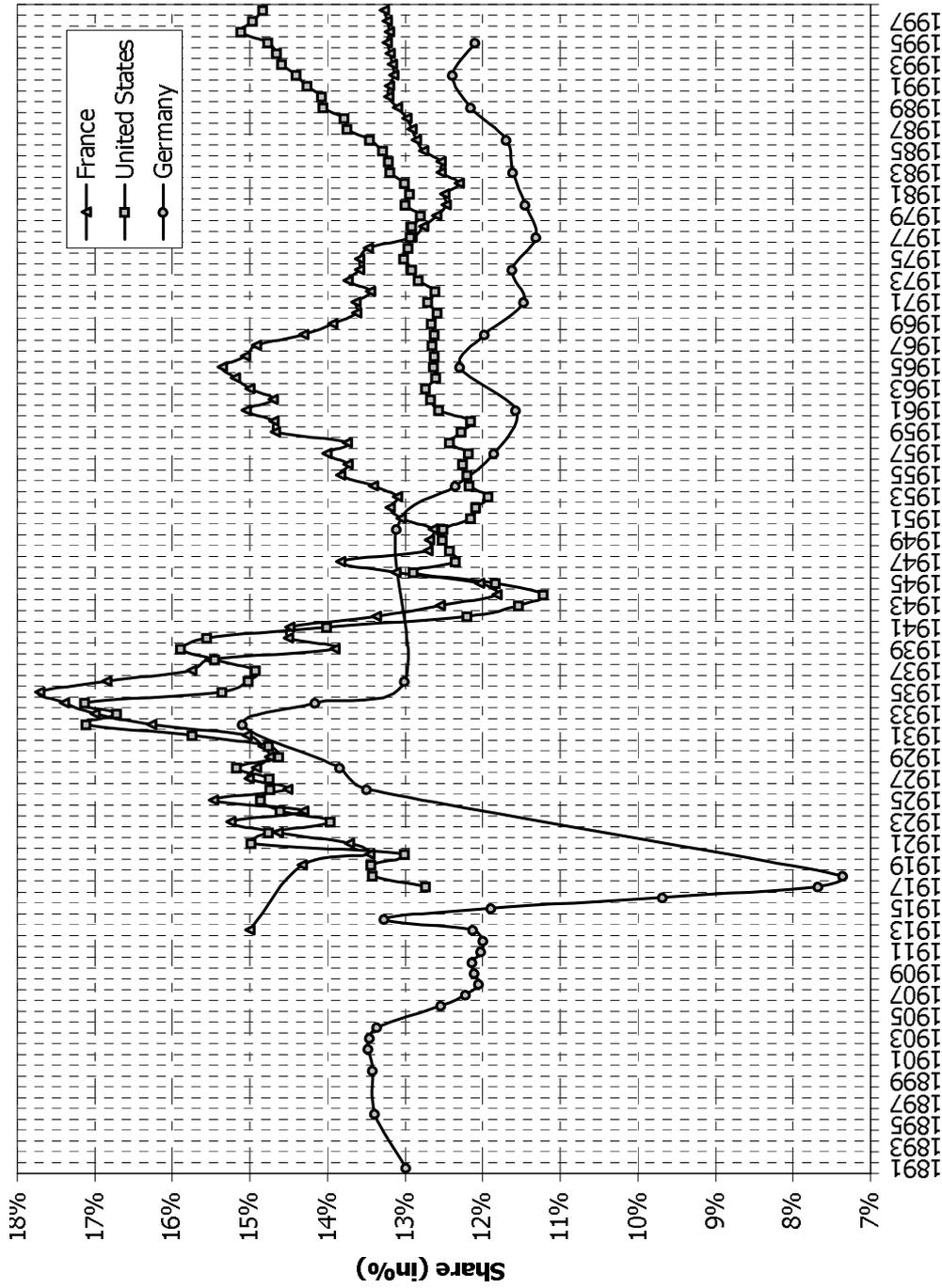
4 GERMANY COMPARED TO OTHER INDUSTRIALIZED COUNTRIES²⁴



Sources: France: Piketty(2001); U.S.: Piketty&Saez(2001);
Germany: author's computations

Figure 10: P90-95

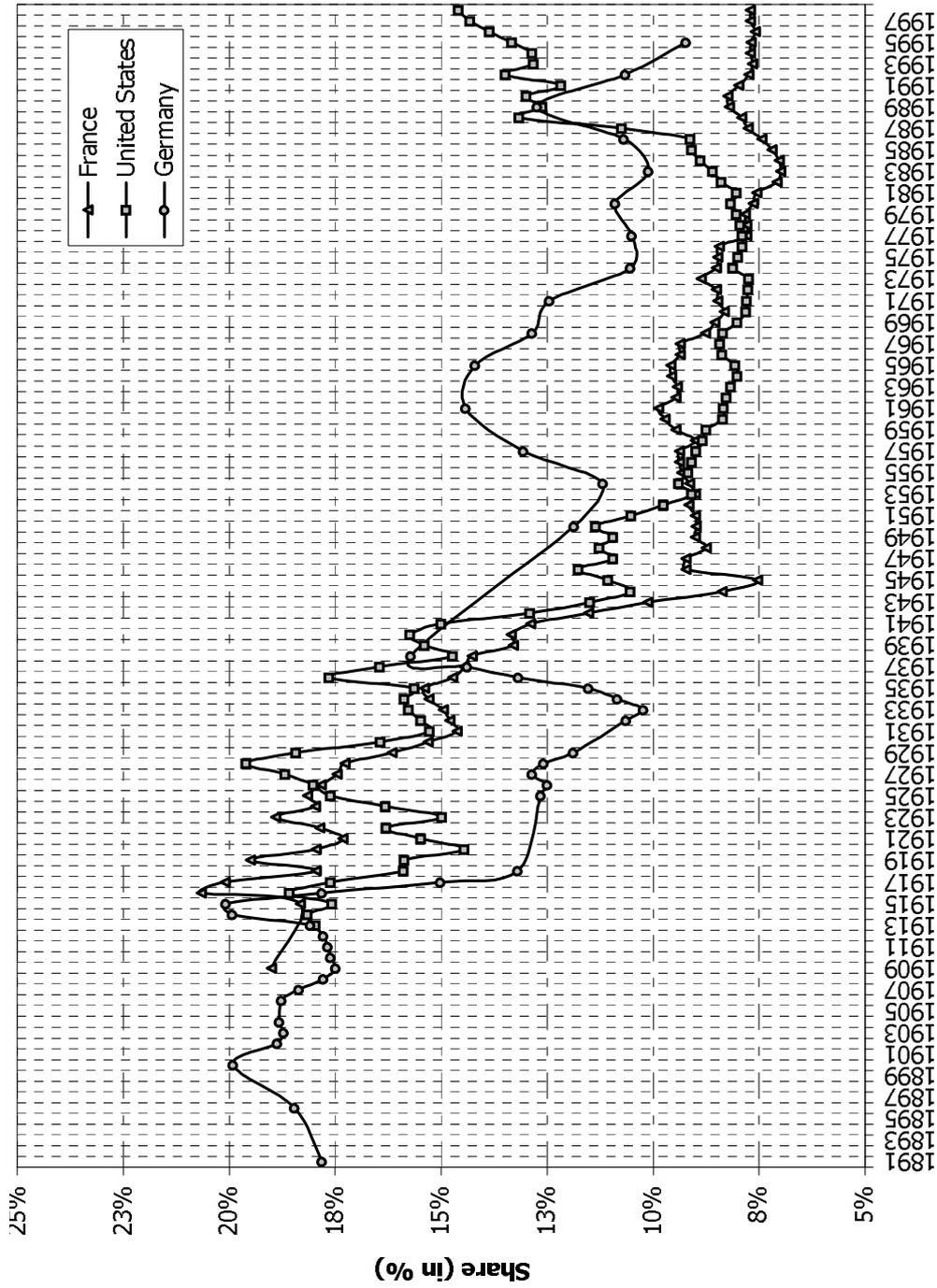
4 GERMANY COMPARED TO OTHER INDUSTRIALIZED COUNTRIES²⁵



Sources: France: Piketty(2001); U.S.: Piketty&Saez(2001);
Germany: author's computations

Figure 11: P95-99

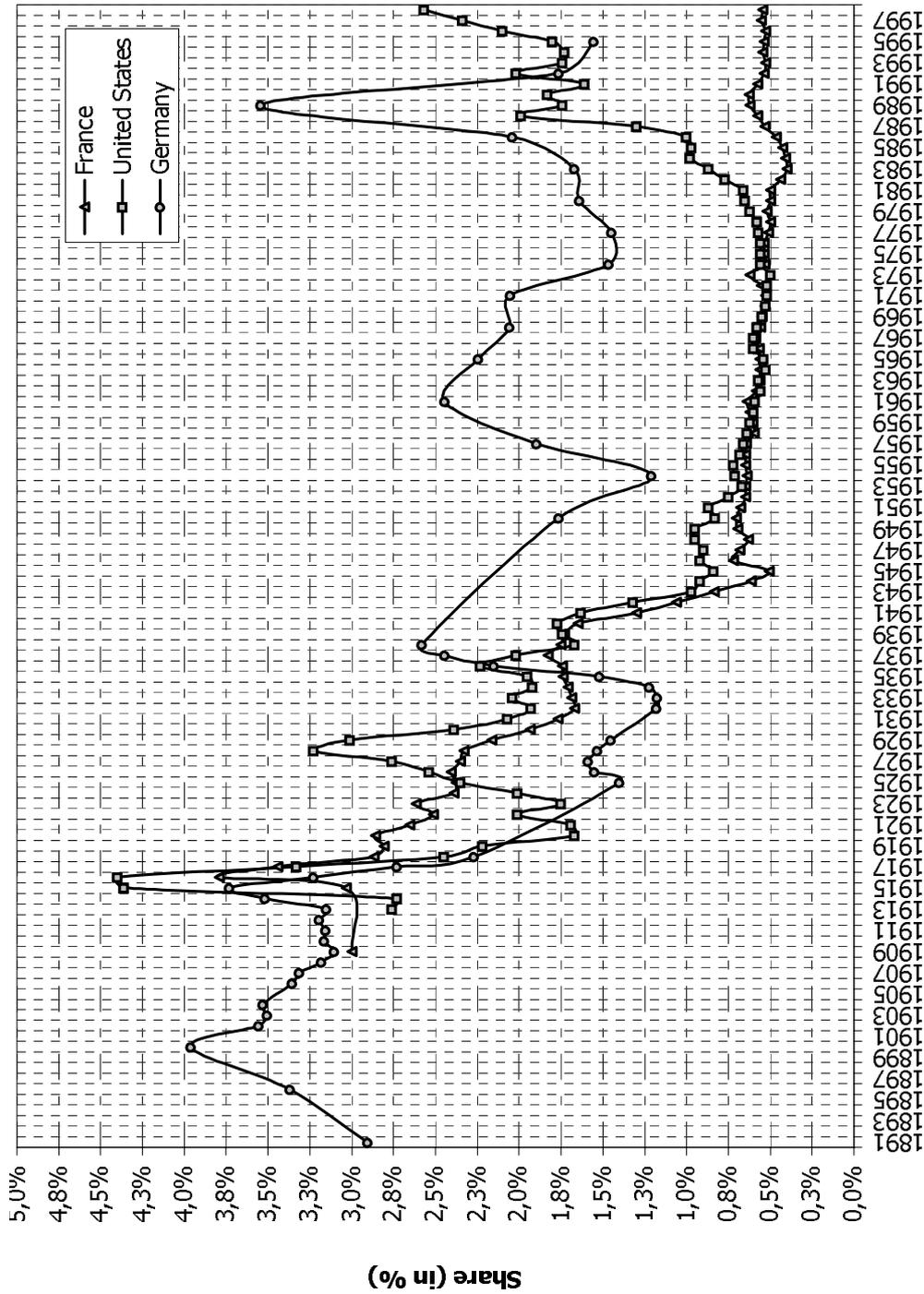
4 GERMANY COMPARED TO OTHER INDUSTRIALIZED COUNTRIES 26



Sources: France: Piketty(2001); U.S.: Piketty&Saez(2001);
Germany: author's computations

Figure 12: Share of the Top Centile

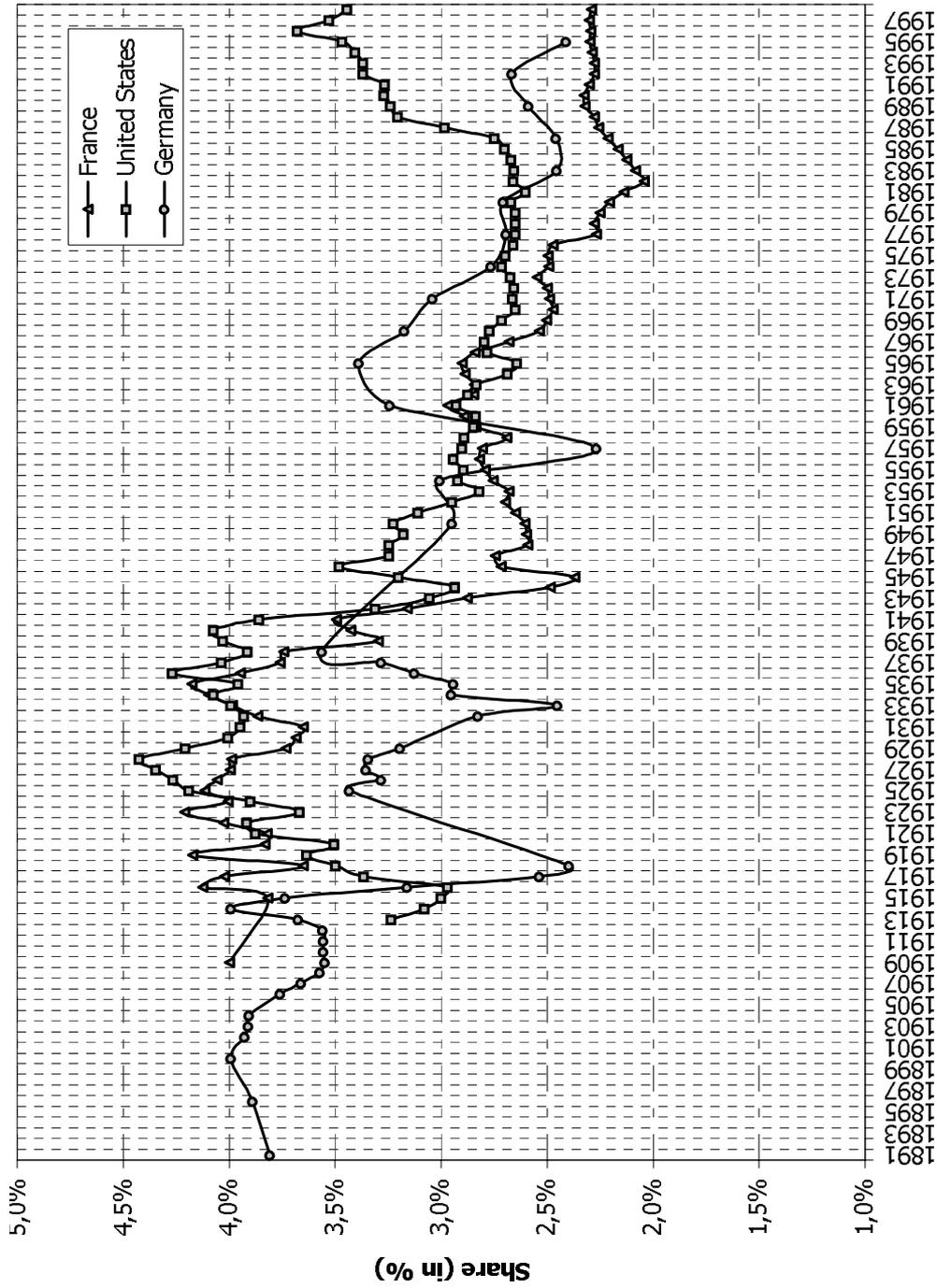
4 GERMANY COMPARED TO OTHER INDUSTRIALIZED COUNTRIES27



Sources: France: Piketty(2001); U.S.: Piketty&Saez(2001);
Germany: author's computations

Figure 13: Share of the Top 0.01 Percentile

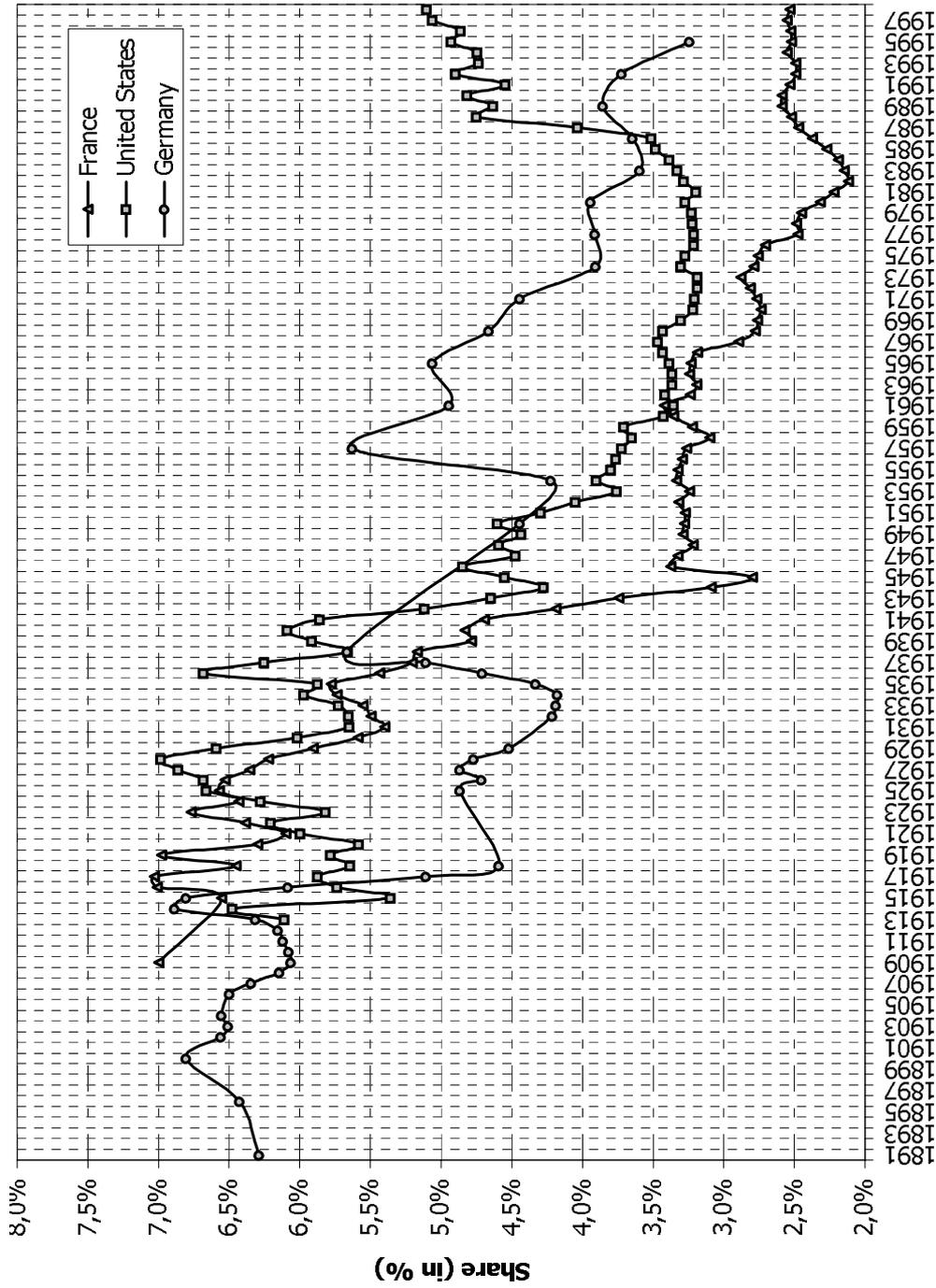
4 GERMANY COMPARED TO OTHER INDUSTRIALIZED COUNTRIES 28



Sources: France: Piketty(2001); U.S.: Piketty&Saez(2001);
Germany: author's computations

Figure 14: P99-99.5

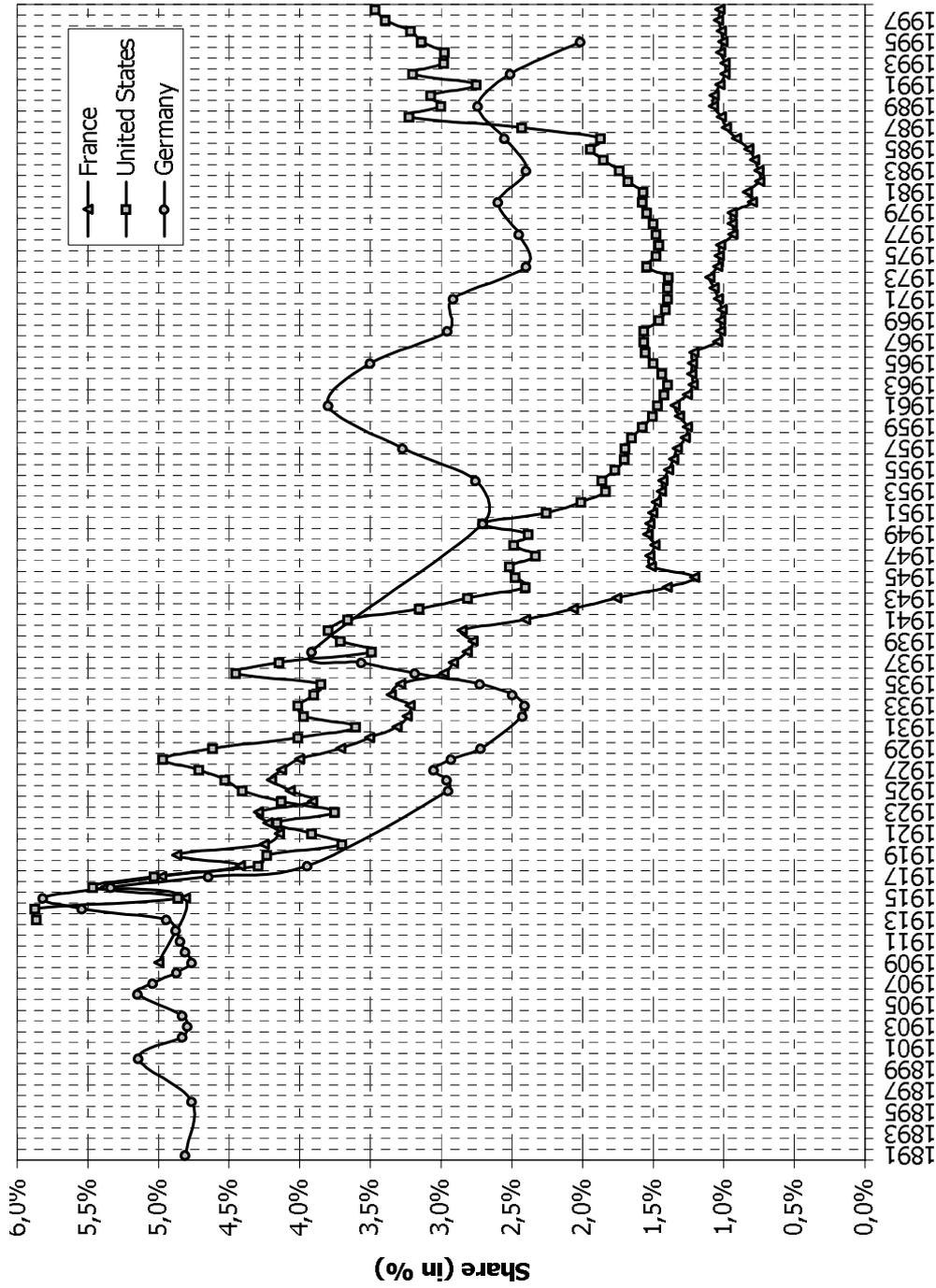
4 GERMANY COMPARED TO OTHER INDUSTRIALIZED COUNTRIES29



Sources: France: Piketty(2001); U.S.: Piketty&Saez(2001);
Germany: author's computations

Figure 15: P99.5-99.9

4 GERMANY COMPARED TO OTHER INDUSTRIALIZED COUNTRIES³⁰



Sources: France: Piketty(2001); U.S.: Piketty&Saez(2001);
Germany: author's computations

Figure 16: P99.9-99.99

4.2 Basic Facts concerning the real levels

Comparing real levels of top incomes between industrialized countries should be done with caution. Indeed, the purchasing power parity is not easy to estimate over long periods of time. We nevertheless present a rapid comparison of our German series with equivalent data for France (see [35]) and the United States (see [37]). Comparing real levels enables one to observe high incomes independently of any total income series (which might entail small shares biases (in levels) when one compares two countries with different national account systems.

In order to compare the real level series, and given the fact that we do not have any long-term PPP at our disposal, we simply used 1998 exchange rates to convert all series in 1998 US dollars.

The most striking fact is that German very high incomes were higher than any others after WWII, and were just recently caught up by US ones. Looking at the Top 0,01 Percent real incomes (see Figure 19, one sees that German higher incomes were first in an intermediate position between France and the U.S. before WWI. After the war the levels were significantly under the French ones. The nazis helped incomes of the Top 0,01 Percentile to rise and reach U.S. levels (for the first time since 1891). After the WWII shock, German P99.99-100 caught rapidly recovered their 1938 levels and from 1957 onward remained at levels 2 to 3 times higher than the US ones. Only in the late 1980's and after the Reunification did U.S. top incomes (which grew dramatically at the time, see [37]) overrun the German ones.

At the same time, mean incomes from the top decile did not reach such levels (see Figure 17). The real mean income of the German top decile remained at the level of the French one until the late 1960's when it began to grow slightly faster. The evolution of the top percentile shows very distinctly how the French growth path was abandoned in the late 1950's and the American one was joined up in the 1960's after a decade of accelerated growth (see Figure 18).

This higher concentration of German top incomes can be equally seen if one compares German top income shares with their French and American counterparts. For more simplicity, we compare within two separate periods: before World War II and after it.

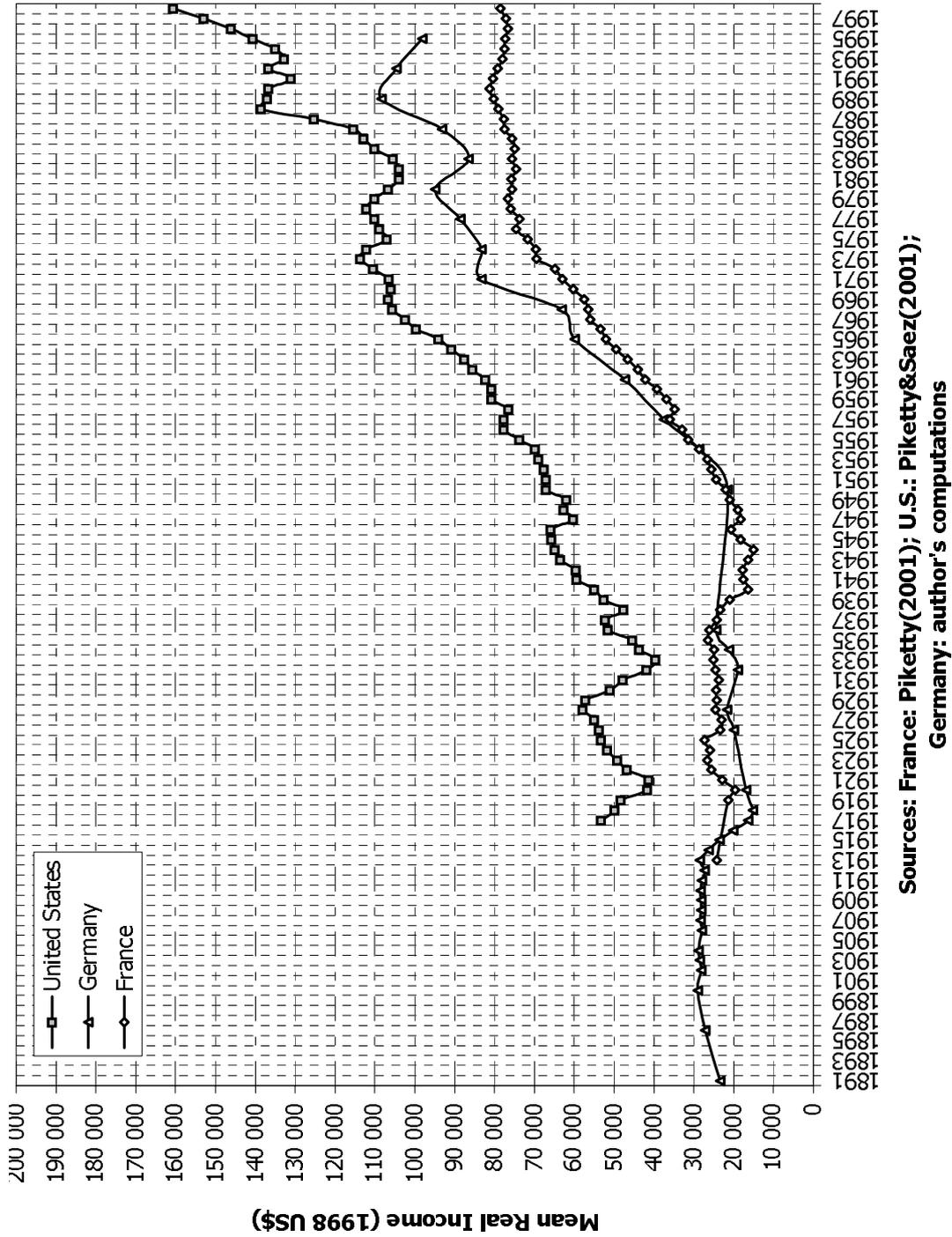


Figure 17: Mean Income of the Top Decile

4 GERMANY COMPARED TO OTHER INDUSTRIALIZED COUNTRIES33

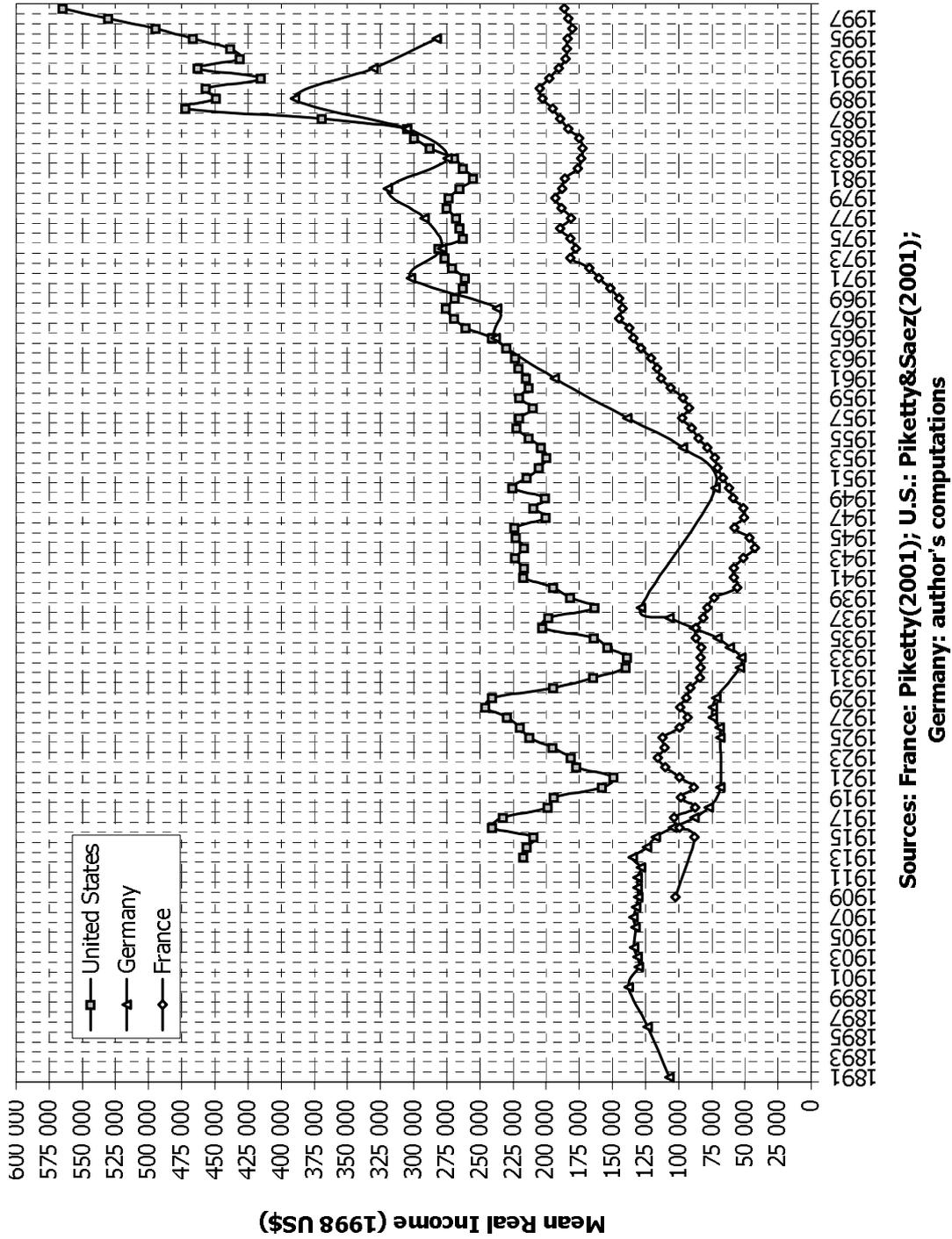


Figure 18: Share of the Top Centile

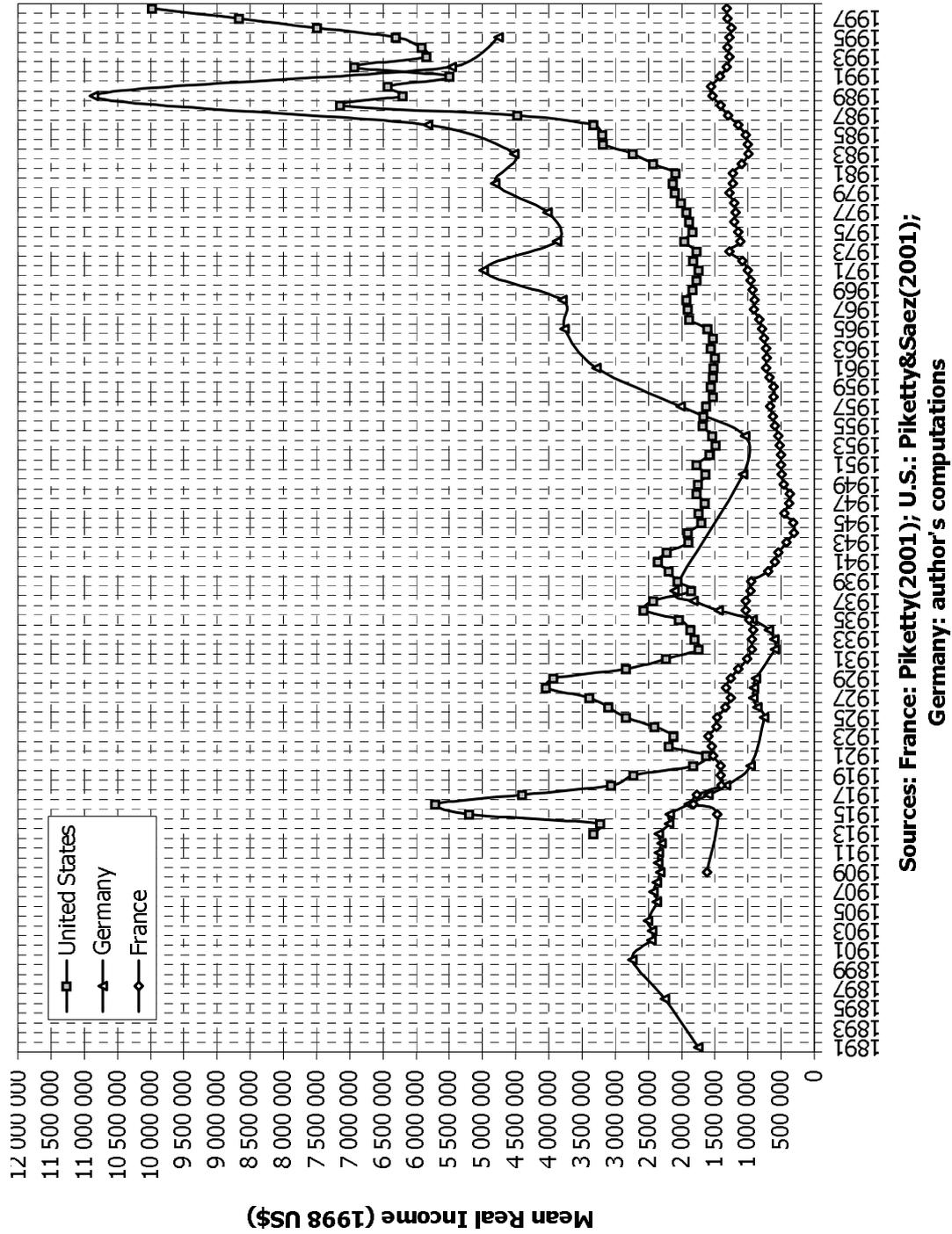


Figure 19: Mean Income of the Top 0.01 Percentile

5 Conclusion

In this paper we display for the first time the complete pattern of evolution of top incomes in Germany over the twentieth century. We show that top incomes decreased over the century, largely because of the shocks of the 1914-1945 period. We also highlight an original evolution during the Interwar Years: nazi power helped top incomes to recover part of their pre-1913 shares. We pinpoint a specific structure of the top decile of the German income distribution after WWII, characterized by high stability and high concentration: super rich Germans are richer than super rich American until the 1980's.

Using (partial) estimates of income sources we show that these top incomes which were hit hard in the course of the century were basically capital incomes. Thus understanding the pattern observed should incite us to look more precisely at wealth distribution and the effect of progressive income tax on wealth accumulation dynamics over the century.

Appendix A

Former Estimates of Income Inequalities in Germany over the long run

For the 1913-1950 period see [9].

The survey for other periods is currently being written.

Appendix B

Sources of Tabulated Income Tax Data for Germany over the Twentieth Century

List of sources (todo)

1920 and 1949 were not used because the robustness was not assured

Chronology of German Tax Laws

References to the various laws are given through the different versions of the german 'Journal Officiel'

- **until 1919:** fiscal laws we are concerned with were actually prussian laws: gathered in the *preussische Gesetzsammlung* (thereafter *p.Gs.*).
- **between 1920 and 1945:** after the fiscal centralization process, law of the Reich, which were gathered in the *Reichsgesetzblatt* (thereafter *R.G.Bl.*) or sometimes (for more technical and time-dependant aspects like the various *Steuertabelle* in the late thirties) in the specifically tax oriented *Reichssteuerblatt* (thereafter *R.St.Bl.*).
- **between 1945 and 1949:** several fiscal decrees were promulgated by occupying forces. This period exhibits a very complex chronology (with huge variations from zone to zone). Since there no available data for these years, a precise presentation of the fiscal legislation for this period is beyond the scope of this paper¹⁷.

¹⁷Nevertheless, for a very stimulating account of the differents processes which led, in the western zones, to the rebuilding of a full operating tax system, see [8]

- **from 1949 onward:** laws of the Federal Republic of Germany were published in the *Bundesgesetzblatt* (thereafter *B.G.Bl.*). Like before, practical considerations were published separately in a specific publication: the *Bundessteuerblatt*, thereafter *B.St.Bl.*. Formally, tax laws exist for almost every year since 1949, since a new version of income tax law is published every year (*Bekanntmachung der Neufassung des Einkommensteuergesetzes*). The chronology (table 1) therefore only contains laws which introduced notable change in fiscal law.

Table 1: Main income tax laws in Germany over the Twentieth Century

Wilhelmine Empire: Prussia	
1891: 24.06.1891	<i>Preussisches Einkommensteuergesetz</i> – first ‘modern’ income tax in Germany
1914-1918: World War One – German Revolution	
Weimar Republic	
1920: 29-31.03.1920	<i>Erzberger’sches Einkommensteuergesetz</i> – first all-German income tax
1920-1924: German Hyperinflation	
1925: 10.08.1925	EStG 1925 – new income tax after monetary stabilization
1929-1932: Great Crisis	
Third Reich	
1934: 14.10.1934	EStG 1934 – new income tax after Nazis seized power
1939-1945: World War Two	
1945-1949: Allied Occupation of Germany	
Federal Republic of Germany	
1949: 10.08.1949	EStG 1949
1974: 05.08.1974	EStReformG 1974: 1975 Tax Reform
1989/1990: Fall of the Berlin Wall and Reunification	

Technical details

The tax legislation affects the comparability of the fractiles and shares both internally across time, and at a given date, with other countries. We therefore first present the variations of the tax-law framework that occurred over the twentieth century and their consequences. We then give hints of the differences between the notions of income used in this paper and those used to build equivalent high in-

come series for other countries such as US, UK, France, Netherlands and Canada.

Continuity of tax unit definition

As shown in table 1, the first German income tax was introduced in Prussia in 1891. Tax units were couple-based (*Haushaltbesteuerungsprinzip*). In comparison with other European countries like France or the United Kingdom, who introduced income taxes only during or after World War One, Prussia was quite ahead of its time. The broad basis of Prussia's income tax was a mark of modernity: whereas France's first income tax applied to less than 5% of the entire French population, Prussia's income tax basis represented about 50% of its Population in 1891.¹⁸

After 1920, tax units remained couple-based but the introduction of a pay-as-you-earn tax on wages, built on individual-based tax units, made things more complex. The vast majority of tax payers only paid this so-called *Lohnsteuer* and were therefore recorded in specific statistics. Above a given income threshold, one had to file a tax return and thus entered the 'classical' income tax (*Einkommensteuer*) statistics. This fiscal dichotomy still exists today. It entails that one has to agglomerate income tax data coming from two different kinds of tabulations in order to estimate fractiles under the top 1% of the income distribution.¹⁹

This problem is particularly significant for the Interwar period and just after World War Two. After 1961, the German Statistical Office published income tabulations which already contained agglomerate data and could therefore be used without further treatment. Before 1961, one has to agglomerate the various tabulations on its own. The presence of cases when tax-payers are counted twice (once in each tabulation) makes this merging process difficult. A precise description of the methods and assumptions used by the author to tackle this problem is to be found in later versions of the present paper. Note that for 1954, we had to use p-a-y-e data from 1955 (the only ones published). For the years 1925, 1927, 1929, 1933, 1935 and 1937-38, the lack of p-a-y-e statistics made it impossible for us to estimate fractiles P90 and P95.

Another problem linked to this dichotomy is the heterogeneity of tax units (individual-based at the bottom, couple-based at the top) since p-a-y-e tax was

¹⁸For a precise account of the genesis of Prussia's fiscal modernity at the turn of the century, see [22].

¹⁹The threshold indeed guarantees that higher fractiles (top 1% and higher) are only constituted of *ex-post* income tax payers.

collected on an individual basis.²⁰

Variations in taxable income definition / income concept used in fiscal statistics

The Prussian income tax was a ‘modern’ income tax because of its very broad definition of taxable income: wages, capital income, self-employment incomes were part of the taxable basis. Apart from an exemption threshold (*Existenzminimum*), every income was to be taxed. Dependent children were taken into account by ‘moving’ tax-payers one, two or three brackets down the tax-schedule. The published statistics however most of the time record incomes before application of this system.²¹ Prussian income tax statistics are therefore used without any specific treatment in this paper.

After World War One however, the simplicity of the Prussian system was lost. Interwar German tax laws were extremely variable in the way they took dependent children into account. Moreover, tax return statistics made these changes even more harmful by changing the definition of income tabulations were based on very often.²² Two main problems should be mentioned here: first, the income concept used was slightly more restrictive and law-dependant than the one we used before 1920 and after 1950: some exonerated incomes were not recorded (the so-called *Sonderausgaben*). Suffice to say that exonerated amounts were bounded and trifling when compared to top incomes. Nevertheless one should bear in mind that the fractiles for the Interwar period (especially the P90 and P95 fractiles) might be slightly underestimated.²³

Post-1949 German tax law is based on a decreasing series of income concepts. Each concept is based on the previous one, new deductions being subtracted. Estimates of top incomes shares in this paper are based on the «overall amount of incomes» concept of the German fiscal legislation.

This is the more upstream concept available *i.e.* the one from which fewer law dependant-deductions were taken away. What it measures is thus relatively close to an economically relevant concept of income.

²⁰See appendix C for more on the impact of that problem.

²¹The knowledge of the tax schedule and the fact that effectively paid taxes are most of the time also reported in tax return statistics enables us to verify that tax-payers reported in a given bracket effectively had the income which did correspond to it.

²²For a detailed presentation of the bushy legislation of the time, see [9].

²³A systematic assessment of this bias is currently under way. See [9], for a first assessment (not accurate for lower brackets though).

Appendix C

Total Tax Units and Total Income Data for Germany over the Twentieth Century

Total Tax Unit Series (Control Totals for Population)

In order to calculate top income shares, we need to know the total number of tax units in the population. This total number is most of the time considerably higher than the number of actual taxpayers and should not be confused with the total number of households.

In order to build such control totals for the population, we use the simple formula:

$$\text{Tax Units} = \frac{\text{Married couples}}{2} + \text{Bachelors} - \text{Children}$$

The accuracy of this total depends on two questions. First, the definition of children should be chosen in a such way that all children are dependant and all adults are either separate tax units or part of a couple (population cut-off problem). Second the formula relies on the assumption that all married couple are treated as single tax units by tax law and fiscal statistics.

The first problem is difficult to tackle without very precise information about occupational status in different age groups, and its evolution over the century. Such information being not at our disposal, we decided to define children as individuals aged 20 or less²⁴.

The second question is more complex. Once again, one has to come back to the dichotomy of the German fiscal system to find a solution. As far as the ES is concerned, couples are most of the time treated as a single tax unit²⁵. Conversely,

²⁴Two remarks should be added here. First, under the assumption that the upper tail of the distribution is Pareto, one can estimate the difference in terms of top income shares entailed by the choice of a cut-off at 15 rather than 20. As shown in [1], this difference is ‘rather modest’. Second, the problem of cut-off population is, at least in the German case, linked to the law-dependant tax unit definition problem. Individuals under the cut-off age and nonetheless economically independent can be expected to be most of the time wage-earners. They therefore enter ‘tax return’ statistics as p-a-y-e contributors, who are anyway treated as individual tax units (see *infra*).

²⁵Tax payers can choose between common declaration (*Zusammenveranlagung*) and separate declaration (*getrennte Veranlagung*). Common declaration was the default option from 1949 to 1954 included. >From 1957 onward, separate declaration became the standard. The number of separate declarations is not known. Nonetheless, common taxation most of the time leads to less

the LS p-a-y-e system is based on individual tax units. Thus the use of control totals for population relying on couples being counted only once could bias our top income fractiles upward (since the tax unit total is underestimated one has to go further up to locate the top fractiles).

As noted in [1], ‘the impact of moving from couple-based to individual-based tax units depends on the joint distribution of income’. Conversely, given the fact that we use a couple-based tax unit total, the accuracy of our estimates crucially depends on how many couples choose separate taxation. If no couple make such a decision, then our population total control is perfectly adequate. If all couples are actually taxed separately, then we underestimate the total by a $1/(1+m)$ factor, where $m \in (0, 1)$ is the share of married couples in the original couple-based tax unit total²⁶. Following [1], the error we then make is equal to the variation that would have been entailed by moving from individual-based to couple-based tax unit totals, if couples contain only one income earner and the upper tail of the income distribution is Pareto. If married couples represent 40% of all tax units and the Pareto coefficient $a = 2$, then we underestimate the share by a factor $(1+m)^{1/a-1} = 0,85$. If the estimated share of top 10% is 25% with couple-based tax unit, then in the worst possible case (all couples actually separately taxed) the real share could be only $25\% \times 85\% = 21,25\%$.

Bearing this potential underestimation in mind, we calculated couple-base total tax units controls with a cut-off age of 20 for the whole century.

taxes (specially for high incomes) thanks to the *Splittingstabelle* system, which corresponds to a french-like ‘Quotient Familial’. Note that the system does not take children into account and thus looks more like a bachelor-tax than the natality fostering mecanism it aims to be in France.

²⁶Note that if all couples are taxed separately, the estimated distribution of individual incomes differs from that of incomes of the couple-based tax units. Apart from the fact that this distribution has no real economical meaning (since it is based on a legal ‘marriage criterion’ more than on a well-being related ‘household criterion’), estimate it robustly is beyond the scope of this study and would necessitate precise information on intra-couple income distribution.

Total Household Income Series (Control Totals for Total Income)

To estimate income distributions, we use an income concept originating from tax system and fiscal law. Top income shares should therefore be calculated with the total income which would have been reported on tax return statistics, ‘had every single tax unit been required to declare its income’ as [42] put it. As argued in [1], national accounts provide a good starting point to calculate such a total income denominator: it guaranties historical continuity as well as a link between countries²⁷. Nevertheless, some adjustments need be done in order to stick as much as possible to fiscal income characteristics. Various strategies have been adopted by authors who dealt with long period top income share series (see [1] for an synthetic review of those strategies). Most of the time, however, authors use at least one reference point to calibrate a ‘(*total fiscal income*) on (*chosen national account total income agregate*)ratio.’ Unfortunately, we do not have (yet ?) a clear benchmark for Germany.

Federal Republic Years

Even in recent years, the total number of declaration filled is much lower than the theoretical tax unit total (see previous section). Table 2 shows the post-1945 evolution of the total number of filers.²⁸

The starting point for 1950 is part of an attempt of the *Statistisches Bundesamt* to estimate the whole income distribution ([45] and [46]). The middle and the top of the distribution are estimated thanks to income tax data for 1950, and the bottom is unfortunately estimated with unspecified methodology.

During the following years (excepted 1965²⁹ and 1977 where income were

²⁷The SNA (United Nations System of National Accounts) provides a common framework which makes comparisons easier. Most importantly the ESA95 (European System of Accounts, base-year 1995), which should be used everywhere in the European Union since 1999 imposes a normalized use of fully equivalent aggregates. Thanks to retropolation works led by the national institutes, we can thus have fully comparable income aggregates inside the Union, from about 1980 onward.

²⁸Note that the expression ‘filers’ does not precisely fit the German reality (nor the British one) since only a fraction (about 3 million in 1950, about 15 million in the 1990’s) of all tax-payers do effectively file an income tax return every year. The remaining part of German tax-payers never file tax return: they pay the pay-as-you-earn tax.

²⁹Note that the 1965 figure for Tax Return Total is abnormally high, due to methodological variations in the pay-as-you-earn tax for 1968 (used for backward retropolation to get the 1965 figures). Fortunately, this only affects the bottom of the distribution. Nevertheless, the bias is still to be assessed.

	Tax Units Total Children < 20 y.o.	Share of Total	Tax Returns Total
1950	22 121 538	91%	20 123 649
1954	22 894 678	69%	15 879 476
1957	23 385 500	65%	15 163 814
West-Berlin and Saarland enter the Official Statistics			
1961	26 867 500	67%	18 031 980
1965	27 438 000	81%	22 153 337
1968	27 467 500	70%	19 317 036
1971	27 796 000	76%	21 077 300
1974	28 717 300	76%	21 690 900
1977	29 080 800	71%	20 615 700
1980	30 322 250	71%	21 458 076
1983	31 512 050	69%	21 815 590
1986	32 923 250	70%	22 895 631
1989	33 546 725	69%	23 120 511
Reunification - five new <i>Länder</i> and East-Berlin enter the Federal Republic			
1992	43 934 400	63%	27 556 294
1995	44 618 900	62%	27 683 079

Table 2: Theoretical tax unit total and actual tax returns

dramatically affected by the 1973/74 crisis) the share of tax filers among total tax units has been steadily growing to reach a mere 80% in 1989. Reunification significantly lowered these figures since inhabitants from the new *Länder* had much lower incomes (and thus more often stood outside the scope of income tax statistics).

Thus, we do not have a precise estimation of the structural gap between national accounts aggregates of personal income and the total fiscal income (as for example in France, see [34]).

The total income series computed for 1950-1995 is based on the ESA95 concept of Net Primary Income of Private Households.³⁰ This aggregate is available back to 1980 thanks to retropolations operated on a ESA95 basis by the *Statistisches Bundesamt* ([52]). This NPIPH aggregate is the sum of:

- gross wages and salaries paid to the households by the firms (including payroll taxes)³¹
- pre-tax net wealth income³²
- pre-tax net profits³³
- pre-tax net self-employment income³⁴

This aggregate thus only contains factor incomes and is calculated before taxes and social transfers. Following [37] and [42], we decided to take as control total for income 80% of NPIPH in 1950. Taking this share of personal income seems adequate for at least two reasons: first, table 3 shows that the total amount of fiscal income recorded in tax returns in Germany in 1950 amounts to more than 75% of NPIPH. Given the fact that this recorded total fiscal income corresponds to the top 90% tax units, choosing 80% of NPIPH as income denominator amounts to

³⁰Thereafter NPIPH, in German *Nettonationaleinkommen der privaten Haushalte*. Earlier *Primäreinkommen*. Unfortunately, this aggregate is most of the time published for two ‘Institutional Sectors’ together: Households (*private Haushalte*) (S.14) and ‘non-profit oriented private Organizations’ *private Organisationen ohne Erwerbszweck* (S.15; thereafter *p.O.o.E.*. Note that *net* means that factor income take capital depreciation into account. NPIPH is a pre-tax, pre-transfers income.). The reader should therefore bear in mind that the control totals for income might be slightly overestimated (and thus the top income shares slightly underestimated). The magnitude of this problem is to be assessed later on.

³¹Code: D1; *Arbeitsnehmerentgelt* in German

³²Code: D4; *Vermögenseinkommen* in German

³³Code: B2n; *Nettobetriebsüberschuss* in German

³⁴Code: B3n; *Selbstständigeneinkommen* in German

assume that the bottom 10% (missing) tax units earn about 5% of total pre-tax pre-transfers income, which seems an acceptable assumption³⁵.

For more recent years, however, the share of tax units recorded is stable at about 70-75% of all tax units, for an income share of all returns of 65 to 70% of NPIPH.³⁶ Keeping a total income denominator of 80% of NPIPH could thus seem questionable (since it would mean that the bottom 25 to 30% of all tax units earn about 10 to 15% of total market income, which might be a little bit too much). For France, where national accounts are also governed by SEC95 (and where the so-called ‘base-80’ national accounts still used in [34] were very close to the SEC95), the income denominator chosen (with benchmark points in the recent years) is about 65 to 70% of ‘Revenu Primaire Brut’ an income concept close to NPIPH but structurally larger (about 3% more), since capital depreciation is not taken into account. Thus, there could be reasons to believe that our personal income denominator for the late 80’s and early 90’s is slightly too high (thus leading us to underestimate top income shares at the end of the century). Nevertheless, since there are (yet ?) no good benchmark aggregates at our disposal to rectify this potential bias, we stick to the simple hypothesis of a ‘*total fiscal income / NPIPH ratio*’ of 80% over the period.

For the pre-1980 years, we built *ad-hoc* homogeneous NPIPH series from 1950 onward using detailed German national accounts series.

Interwar years

The Interwar Years saw the development of ‘modern’ national accounting in Germany (see [54]). In their seminal work, [14] provide us with series of personal income (*Einkommen der privaten Haushalte*). Like for the post-WWII years, there were some attempts of the Statistical Office (at that time, *Statistisches Reichsamt*) to build comprehensive income tabulations, using not only fiscal data but also data from social benefits (see [?]). We thus have reference points of the total fiscal income (for 1913, 1926, 1928, 1932, 1934 and 1936) which, together with personal income series enable us to build a control for income total.³⁷

³⁵See for example Deiniger–Squire ?

³⁶These two figures were substantially lowered by the Reunification. We therefore use 1989 as a reference point, more than 1995.

³⁷Unfortunately, as for 1950, the methodology used to reconstruct the bottom of the distribution is largely unspecified. Thus the fact that between 1928 and 1932 the ‘*total fiscal income / total personal income ratio*’ grows from 80% to 90% thus remains unaccounted for.

	NPIPH	Total Income Declared	Share
1950	67 814 000 000	51 509 579 000	76%
1954	107 464 000 000	82 936 838 068	77%
1957	144 140 000 000	107 005 984 749	74%
West-Berlin and Saarland enter the Official Statistics			
1961	223 446 000 000	161 978 205 000	72%
1965	319 210 000 000	226 409 396 674	71%
1968	376 124 000 000	256 257 328 000	68%
1971	555 210 000 000	402 517 500 000	72%
1974	755 280 000 000	542 559 200 000	72%
1977	920 520 000 000	619 865 300 000	67%
1980	1 141 780 000 000	768 386 022 000	67%
1983	1 267 600 000 000	834 829 772 000	66%
1986	1 456 950 000 000	956 311 967 000	66%
1989	1 662 350 000 000	1 137 513 619 000	68%
Reunification - five new <i>Länder</i> and East-Berlin enter the Federal Republic			
1992	2 415 919 449 200	1 550 236 000 000	64%
1995	2 649 308 643 100	1 650 177 328 000	62%

Table 3: Share of Net Personal Income of private Households in Returns Total

Pre-WWI period

National account in their modern form did not exist at the time of the Wilhemine Empire. Fortunately, [14] did reconstruct series of personal income for the 1891-1913 period. The series are based on fiscal sources with precise estimation of the part of personal income that do not appear in tax return statistics. We thus have at our disposal series which are intrinsically homogeneous with the fiscal incomes we use to estimate the fractiles. Total fiscal income amount to 85 to 90% of total personal income over the period 1891-1913.

For the 1913-1918 years, such series are unfortunately not available. The income denominator we use for the WWI years is thus extrapolated thanks to GDP indices. Note that - especially in war times - personal income is not necessarily expected to change like GDP. Variations of top income shares during the war years should therefore be interpreted with some precautions (although the general movement is clearly robust).³⁸

³⁸Moreover, in 1917-1918, the beginning of a rapid three digit annual inflation could add some noise over the signal.

Appendix D

Estimation technique using Pareto's Law

The useful property of Pareto's Law is the following one: let $\bar{x}[x]$ be the mean income of people earning more than x , then:

$$\bar{x}[x] = \frac{\int_{z>x} z f(z) dz}{\int_{z>x} f(z) dz} = \frac{\int_{z>x} \frac{dz}{z^a}}{\int_{z>x} \frac{dz}{z^{a+1}}} = \frac{ax}{a-1}$$

With:

$$b = \frac{a}{a-1} = \frac{\bar{x}[x]}{x}$$

Suffice to know the couples $(x, \bar{x}[x])$ to be able to estimate b . Then one only has to know $N(x)$, the number of individuals earning more than x in order to estimate k .

With our German data, we have at our disposal tabulations with brackets containing amounts and the number of tax payers. This can be formalized with the following triplets (s_i, y_i, n_i) ,

We then have:

$$b_i = \frac{\bar{x}[s_i]}{s_i} = \frac{\sum_{j \geq i} y_j}{\sum_{j \geq i} n_j}$$

then

$$a_i = \frac{b_i}{b_i - 1}$$

and

$$k_i = s_i p_i^{1/a_i}$$

Indeed:

$$p_i := \frac{\sum_{j \geq i} n_j}{\sum_j n_j} = 1 - F(s_i) = \frac{k_i^{a_i}}{s_i^{a_i}}$$

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