Testing Marx. Capital Accumulation, Income Inequality, and Socialism in Late Nineteenth-Century Germany*

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Abstract

We study the dynamics of capital accumulation, income inequality, capital concentration, and voting up to 1914. Based on new panel data for Prussian regions, we re-evaluate the famous Revisionism Debate between orthodox Marxists and their critics. We show that changes in capital accumulation led to a rise in the capital share and income inequality, as predicted by orthodox Marxists. But against their predictions, this did neither lead to further capital concentration nor to more votes for the socialists. Instead, trade unions and strike activity limited income inequality and fostered political support for socialism, as argued by the Revisionists.

JEL Classification: D31, D63, J31, N30

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1 Introduction

What can we learn from Marx and his followers about inequality? The current debate about inequality is frequently referring to ideas about capitalist dynamics that were first formulated by Karl Marx and orthodox Marxists. These ideas were especially influential in Germany before 1914. There, leaders of the labor movement based their analyses and actions on the writings of Marx, and the main labor party (SPD) was among the largest and arguably the most influential Marxist parties in the world. In this paper we ask – with the benefit of hindsight – which predictions of orthodox Marxism were borne out in the data of nineteenth century Germany. We do so by drawing on a wealth of historical statistics and modern econometrics.

Our focus is on the effects of a continued accumulation of industrial capital, considered by Karl Marx and orthodox Marxists such as Karl Kautsky to be the defining feature of capitalism. We look at the decades between the foundation of the German Empire and the First World War, arguably the heyday of German industrial capitalism and orthodox Marxism alike. To test for causal effects of capital accumulation, we exploit the spatial diffusion of industrialization over time across Prussia. This allows us to test key predictions of orthodox Marxism on the effects of capital accumulation, namely on income inequality, capital concentration, and political support for socialism. However, these effects were disputed at the time even within the socialist movement. The so-called Revisionists heavily attacked the orthodox Marxists arguing that, with the help of trade unions, capitalism could be changed for the benefit of workers. We test their competing predictions and investigate how trade unions and labor conflict turned out to be related to income inequality and political support for socialism.

In accordance with orthodox Marxists, we find that capital accumulation increased income inequality and the capital share. However, we cannot confirm a positive effect either on capital concentration or on votes for the socialists. Instead, we find support for claims made by the Revisionists on the key role of trade unions. Our evidence suggests that the activity of trade unions was positively related to political support for socialism. Finally, we show that successful strikes were associated with a reduction in the capital share, in top income shares, and even in absolute top incomes.

For our analysis, we compile new panel data on capital accumulation, income inequality, capital share, capital concentration, and socialism across 28 districts and 544 counties within Prussia between 1874 and 1913. We use regional wealth and income tax statistics to estimate capital accumulation and top income shares, respectively. We compute regional capital shares by combining tax statistics with additional data sources on retained earnings and self-employment. Based on the firm census, we calculate average firm size to measure capital concentration. We use vote shares in general elections, strike activity, and membership in trade unions to capture regional support for socialism.

To causally identify the effect of capital accumulation on income inequality, capital share, capital concentration and socialism, we exploit the convergence process with higher growth rates in regions that were initially less industrialized. We follow Fernihough and O'Rourke (2021) and use the distance of a county's centroid to carboniferous strata, that is, strata in which coal can be found,

to instrument growth in industrial capital accumulation. To rule out concerns about a potentially weak-instrument, we demonstrate our instruments' validity by implementing two recommendations by Andrews et al. (2019): First, we implement the weak-instrument confidence intervals. Second, we report the F-statistics for the case of clustered standard errors by Olea and Pflueger (2013). Both corroborate the strength of our instrument. For potential violations of the exclusion restriction, we use the method by Conley et al. (2012) which allows for direct effects of the instrument on the dependent variable. These results lend credence to our empirical strategy.

Our analysis can be read as a contribution to the history of economic thought that uses econometric methods to test claims made by economists of the past. In particular, we investigate the famous Revisionism Debate between orthodox Marxists and their critics during the decades preceding the First World War. Arguably, the debate on the observed increase in inequality during Germany's industrialization and their political repercussions shaped all later discussions about income inequality in capitalist economies. This influence extended to the work of Kuznets (1955), who predicted – in response to orthodox Marxism – that inequality would first rise with economic development and then fall. At the center of the Revisionism Debate was the orthodox Marxist prediction that capitalist development would necessarily lead to more inequality, growing economic concentration, social and political conflict, and ultimately to socialism.

Based on the writings of Karl Kautsky – the leading theoretical Marxist of the Second International (Gronow, 2016) –, we formulate three hypotheses that formed the core of this debate: First, capital accumulation leads to a rising share of capital in total income and growing income inequality. Second, capital accumulation implies a growing concentration of capital in a few hands. Third, rising inequality strengthens political support for the radical left due to a growing mass of impoverished workers. The Revisionists around Eduard Bernstein questioned these claims. One of their major arguments revolved around the role of trade unions, which Bernstein regarded as a key institution to improve the position of the working class (Bernstein, 1899). Hence, we also test their counter-hypothesis: that strikes can reduce inequality and that trade union activity fostered the political success of the SPD. Both sides of the debate grounded their arguments in statistical evidence from the German statistical office and other contemporary official statistics. Using the same sources but relying on modern statistical techniques, we reevaluate this debate. It may be argued that by using this approach, we ignore several aspects of Marx's writings deemed crucial by the Marxist literature, such as the labor theory of value. More generally, we are treating Marxist ideas as generally falsifiable hypotheses (in the spirit of Popper 2011, ch. 20), which can be questioned. But our aim is to test the contemporary interpretation of Marx by orthodox Marxists such as Karl Kautsky, who indeed considered Marx's work as a body of empirically testable theories (Kautsky, 1899a and Kautsky 1901), and to test the counter-arguments of the Revisionists. As the debaters did, we focus on the evidence for Germany before 1914.

Our findings add to the literature on the determinants of changes in inequality, which is still in disagreement over the relative importance of market forces versus institutions. We show that capital accumulation per se had a causal effect on inequality. Next, by documenting the negative associa-

tion between successful strikes and inequality, we connect to two recent studies demonstrating the inequality-moderating role of unions (Farber et al., 2021) and worker power (Stansbury and Summers, 2020) as well as to the emerging historical inequality literature that argues for an inequality-increasing effect of regressive fiscal institutions between ca. 1300 and 1850 (Alfani, 2021).[1]

Our new *regional* inequality panel further expands the international data landscape to analyze inequality using regional or cross-country panels. Our inequality series is most closely related to the body of research following Piketty (2003) using income tax statistics to measure the concentration of income within the topmost part of the distribution for one country.[2] Prior to our study, long-run regional inequality series existed only for US states covering the period from 1917 to the present (Frank et al., 2015). Germany has income tax statistics going back to the nineteenth century – in contrast to most other countries, which introduced modern income tax systems at the beginning of the twentieth century (e.g., the United States in 1913) – offering the unique possibility of producing series covering the era of industrialization. Our series from 1874 to 1913 connects to the growing number of historical inequality studies investigating the development of inequality in pre-modern times. Several historical inequality studies for Europe and the United States have shown that inequality had been rising *before* industrialization.[3] In line with the regional wealth inequality estimates by Alfani et al. (2022), we document higher inequality in urban than in rural regions in the nineteenth century.[4]

Research has long been interested in changes that took place during industrialization and their impact on income inequality – from increasing inequality in the first phase of the classic Lewis model, during "Engels' pause" or along the Kuznets curve to constant or declining inequality in later phases of development (Lewis, 1954; Allen, 2009; Kuznets, 1955). Galor and Moav (2004) suggest a theory of long-run development, in which the transition from physical to human capital accumulation changes the relation between economic growth and inequality.[5] We add to this literature the causal effect of capital accumulation on different inequality measures and the inequality-moderating role of strikes. Our results lead us to rethink the notion of an "ownership society" (Piketty, 2020, p.194) as a dominant feature of the period before the First World War. Instead, our evidence underscores the increasing role of workers' bargaining power, which was institutionalized through unions, in raising wages and counteracting inequality.

Our paper is organized as follows. Section 2 introduces the main variables of our regional panel

[1] Another strand of literature emphasizes the role of technological change in pushing up inequality by creating an increased demand for skilled workers (Acemoglu and Autor, 2011; Goldin and Katz, 2008; Goldin et al., 2020). Rising capital shares and evidence of rising income inequality also inspired a number of books critically assessing the future of capitalism, for example, Corneo (2018) and Milanovic (2019).

[2] These long-run country series are available from the World Inequality Database (wid.world).

[3] For example, Lindert and Williamson (2016) document increasing income inequality in American colonies between 1774 and 1860. Alfani (2021, p.3) provides a comprehensive overview of this development and concludes that "in the period ca. 1300-1800, inequality of both income and wealth grew monotonically almost everywhere in Europe, with the exception of the century-long phase of inequality decline triggered by the Black Death of 1347-52."

[4] For estimates of regional land inequality in Germany in the nineteenth century see Wegge (2021) and Cinnirella and Hornung (2016).

[5] Empirical investigations of whether industrialization was skill-enhancing are a related line of research; see, for instance, recent contributions by Lafortune et al. (2019) and De Pleijt et al. (2020).

for the period 1874-1913. In Section 3, we sketch the Revisionism Debate between orthodox Marxists and Revisionists that forms the historical context of our data and analysis. Based on this we formulate several testable hypotheses. In Section 4, we present our main results on the causal effect of capital accumulation on income inequality, concentration and socialism, and the role of trade unions. We conclude in Section 5 with a reevaluation of the Revisionism Debate and place our findings in a broader context.

2 Income Inequality, Concentration, and Socialism in Nineteenth Century Germany

The German Empire was characterized by a dynamically growing economy and increasing social and political tensions. Between 1850 and 1910, Germany went from a backward economy to Europe's industrial powerhouse. Real GDP per capita roughly doubled between 1871 and 1913 (Pfister, 2020). This rapid industrialization was accompanied by increasing income inequality (Bartels, 2019). With industrialization, the political landscape in Germany changed fundamentally. Socialism became a rising force in Germany as in other parts of Europe in the second half of the nineteenth century. Despite attempts to repress the socialist movement with anti-socialist laws (*Sozialistengesetze*) (1878-1890), the socialists became the strongest party in Germany in the first decade of the twentieth century. While these aggregate developments are well documented in economic history, we highlight the remarkable variation across Prussian regions, particularly between rural and industrialized districts and counties. Our main concepts, measures, time periods and regional coverage are summarized in Appendix Table A.1. In the following, we describe our data sources, the construction of our main measures and present the trends in capital accumulation, income inequality, capital share, capital concentration, and socialism. We analyze the period after the foundation of the German Empire in 1871. Our panel begins in 1874 because income taxation was extended to all parts of Prussia including larger cities in 1874 (see Appendix Section C.1 for more details). Appendix Table D.1 presents summary statistics for our main variables.

Capital accumulation According to Kautsky, the main driver of capitalist development is industrial capital accumulation (Kautsky, 1892, p.65f). We measure capital accumulation using business assets (non-corporate firms) recorded in wealth tax data for the period 1895-1911. Unfortunately, wealth tax data do not allow us to further break down financial assets, which include, on the one hand, shares in corporations, and, on the other hand, cash, all forms of interest and non-interest bearing financial assets, the net present value of annuities, appanage, and retirement contracts. By restricting our capital accumulation measure to non-corporate business assets, we might underestimate capital accumulation, particularly in the heavy industries with a significant degree of incorporation (Feldenkirchen, 1979). Yet, contrasting the change in business assets with the change in capital invested in limited liability corporations (*GmbHs*) reveals a positive correlation (see Appendix Figure D.1). That is, districts with high corporate capital growth also experienced high non-corporate capital

growth. This holds independently of their degree of industrialization.

Figure 1a displays capital accumulation between 1895 and 1911. Capital accumulation in rural and mixed districts started at rather low levels of about 500 RM per capita, on average, in 1895, but then rose quickly. In contrast, in industrial districts, capital started at high levels of about 1,100 RM, on average, but increased only moderately.

Income inequality We measure income inequality by the share of total income accruing to a particular fraction of the population such as the top 5%, the top 1% or the bottom 95%. The choice of top income shares as our inequality measure is pre-determined by the high quality of income tax data in Prussia providing detailed information on the income distribution of taxpayers (in contrast to the poor quality or lack of annual wage and poverty statistics at the time). The Prussian statistical office annually published tabulations of the number of taxpayers per income bracket, often listing more than 100 income brackets and also differentiating between rural (*Land*) and urban (*Städte*) municipalities within each district.[6] We digitized these fine-grained statistics on the district-level and constructed 28 harmoniously defined administrative districts in Prussia between 1874 and 1913.[7] By combining the income distribution in rural and urban municipalities in each district, which has been recorded since 1891, with census data on the rural/urban population within each county, we can estimate inequality measures for 544 counties in Prussia between 1891 and 1913. The share of the population included in income tax statistics varies both across districts and over time (see Appendix Figure C.2).[8] The richer the district, the higher the share of taxpayers. For example, the share of taxpayers increased from 12% in 1891 to 27% in the rural district of Königsberg/Gumbinnen and from 33% in 1891 to 60% in 1913 in industrial Brandenburg (incl. Berlin). Given that the top 5% of the income distribution is consistently captured over time and across districts/counties, we can compute the income share of the top 5% and of smaller groups at the top. Estimation procedures for top income shares on the district-, constituency and county-level are described in the Appendix, Section C.2.

Between 1874 and 1913, income inequality increased in both rural and industrial districts. Figure 1b displays the evolution of the top 1% income share in rural, mixed, and industrial districts.[9] We categorize districts according to their share of agricultural employment in 1882. Rural districts were mostly located in the East of Prussia (today's Poland and Russia), while industrial districts were mostly located in the center and West of Prussia including the districts of Düsseldorf, the Ruhr area, Cologne, Aachen and Wiesbaden in the West, but also Berlin and Brandenburg in the center. Two differences between rural and industrial districts should be noted. First, income inequality in industrial districts was substantially higher than in rural districts. Second, the timing of the inequality increase diverges. In industrial districts, the top 1% income share increased from about

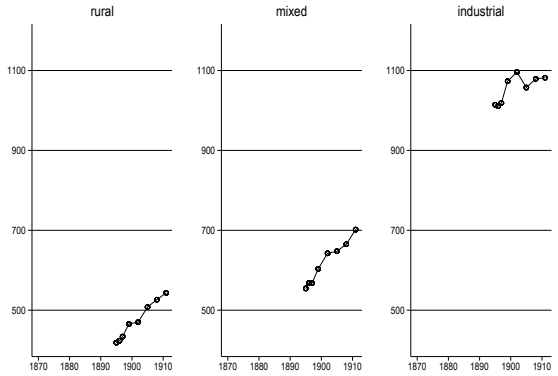
[6] See Appendix Figure A.1 for an example of the historical income tax statistics for tax years 1900 and 1901.

[7] See Appendix B for more details on the geographical units.

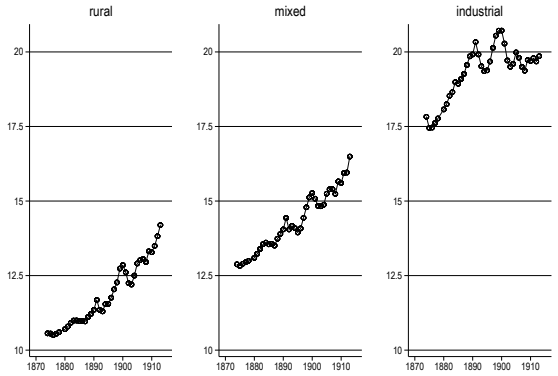
[8] In Prussia, income taxation for top income earners was introduced in 1851 and extended to the entire population in 1874. See Appendix C.1 and Spoerer (2004, Chapter 2.2) for details on Prussian income tax regimes in the nineteenth century.

[9] Appendix Figure D.2 displays the development of the top 1% income share separately for each district.

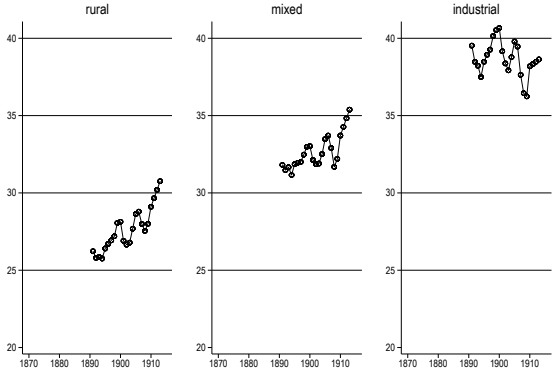
Figure 1: Main Variables by District Type, 1874-1913



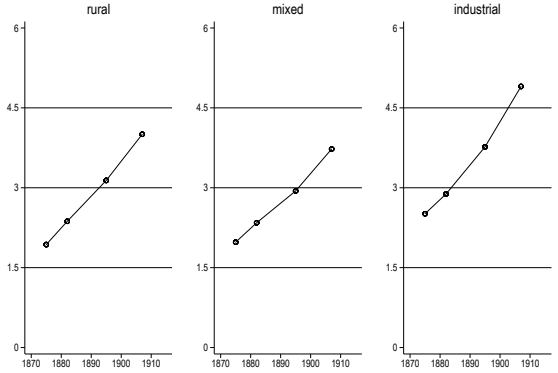
(a) Capital accumulation



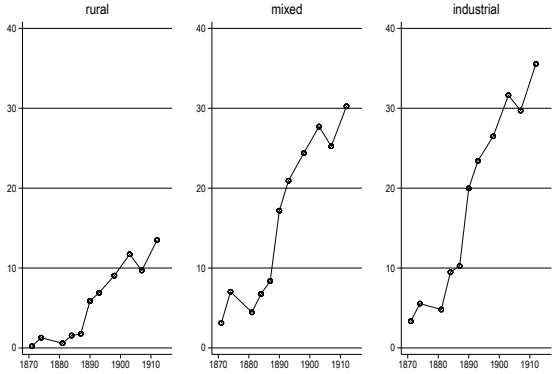
(b) Top 1% income share



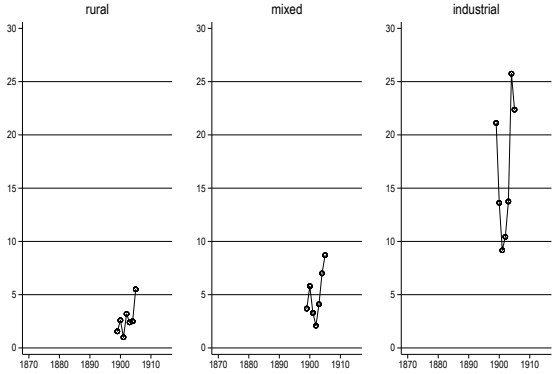
(c) Capital share



(d) Capital concentration



(e) Votes for the SPD



(f) Successful strikes

Notes: The graphs shows capital accumulation (a), top 1% income share (b), capital share (c), capital concentration (d), votes for the SPD (e) by district type and number of successful strikes (f). Capital accumulation is in RM per capita; top 1% income share, capital share, and union membership is in %. Capital concentration is average workers per firm. Successful strikes is annual aggregate. Districts with more than 50% employment in agriculture in 1882 are classified as rural (left panel), districts with between 40% and 50% as mixed (middle panel), and districts with less than 40% as industrial (right panel). The categorization of each district is listed in Appendix B. Main variables by county and constituency type are displayed in Appendix Figures D.7 and D.8, respectively.
Sources: See Appendix A.

17% in the 1870s to more than 20% in 1900, and then fluctuated around this elevated level up to 1913. In contrast, rural and mixed districts saw a relatively steady increase up to 1913.

Income inequality in Prussia's industrial districts was comparable to that in other countries like France, the United Kingdom and Sweden, where the top 1% held around 20% of total income on the eve of First World War and the United States with a top 1% share of about 18% of total income (see https://wid.world/). However, income inequality in Prussia as a whole was low in international comparison because of the more equal income distribution in rural districts. This finding corroborates Alfani et al. (2022) and Wegge (2021), who find that wealth inequality in Germany was comparably low by the mid-nineteenth century.

Many of the previous studies analyzing inequality for the nineteenth century such as Cinnirella and Hornung (2016) and Ziblatt (2008) focus on land inequality.[10] However, our results presented in Appendix Figure D.3 show that land inequality is not a reliable proxy for income inequality during this period: Our top 1% income share negatively correlates with land inequality computed by Cinnirella and Hornung (2016) in 1882 and also with the land share of large landholdings. While land was extremely concentrated in East Prussia, top incomes of East Prussia's landowning elite (the supposedly wealthy Prussian *Junkers*) were comparably low, both in comparison to lower incomes in East Prussia and in comparison to top incomes of the industrial elite in the West of Prussia. At the same time, land was less concentrated in the West of Prussia and, hence, the measure of landholdings inequality was low. Similarly, Becker and Hornung (2020) find that inequality measured with the voting weights in the Prussian three-class franchise and land inequality were negatively correlated. Our results provide a new and different perspective on inequality during the period of industrialization highlighting the more important role of industrial incomes of the entrepreneurial elite from increasingly large firms in the West and center relative to agricultural incomes of the aristocratic, landowning elite in the East.

Capital share We calculate the capital share from the income-side. Capital income is the sum of interest, distributed profits (=dividends), undistributed profits (=retained earnings), and capital gains. Our main data source is income tax statistics on capital income from interest and distributed profits, which we supplement with undistributed profits, self-employment capital income and government's capital income from additional data sources. Income tax statistics represent the most accurate data source for aggregate income during the German Empire, which is also underscored by the fact that other pre-1913 German national income series are based on the same income tax data, for example, Hoffmann and Müller (1959).[11] We describe the construction of our capital share measure in Appendix C.5.

Between 1891 and 1913, the capital share increased in rural and mixed districts and fluctuated

[10] Cinnirella and Hornung (2016) measure concentration of landownership as the ratio of landholdings larger than 300 PM (circa 75 hectares) over the total number of landholdings per county. Ziblatt (2008) calculates a Gini coefficient to describe the distribution of land ownership across different bins.

[11] Pfister (2020) is a recent contribution estimating a national income series, 1851-1913, from the income-side based on factor incomes. He focuses on improving the estimate of agricultural incomes in national income and also draws on Prussian tax data.

at an elevated level in industrial districts, as shown in Figure 1(c). As noted for income inequality, capital share levels are substantially higher in industrial districts than in rural districts. We also see that the capital share increased in the more rural districts up to 1913 but stagnated after 1900 in the more advanced districts, closely resembling our findings for the share of top incomes. Appendix Figure D.4 compares our capital share for Prussia as a whole to the capital share for the entire German Empire as estimated by Bengtsson and Waldenström (2018) and Pfister (2020) and shows that our estimate documents the same trend over time, but on a slightly lower level.

Capital concentration Our measure of capital concentration is constructed using several firm censuses. These data are available for 1875, 1882, 1895, and 1907. We divide the number of employees by the number of firms in each district and county. Between 1875 and 1907, capital concentration increased sharply in both rural and industrial districts, as displayed in Figure 1(d). This universal trend is in contrast to the diverse trends documented for income inequality and capital shares across district types. [12] The level of capital concentration was higher in industrial districts. Note that these statistics were blamed for painting a nostalgic picture of the German economy based on small workshops, where each small workshop was counted separately even within one firm, understating increasing capital concentration among big businesses in Germany (Tooze, 2007).[13] Hence, our measure of capital concentration must be conceived as a lower bound.

Socialism To capture regional support for socialism, we use vote shares for the socialist party, membership in unions, and strike activity. We use general elections for the national parliament (*Reichstag*) as the electoral laws of states, such as the three-class franchise in Prussia, were often much less democratic.[14] The *Reichstag* elections were held directly in single-member constituencies with representatives elected by a majority, following the principle of "one man, one vote". Suffrage covered basically all men above the age of 25 excluding those under tutelage, in bankruptcy, or on welfare. While the German Empire was a monarchy, elections were much more than just tests of opinion: The *Reichstag* could propose laws or refuse to agree to laws proposed by the executive, and most importantly, the executive required parliamentary support, for example, to pass trade policy and the budget (but not for military spending).[15] *Reichstag* elections were held in 229 Prussian constituencies in 1871, 1874, 1877, 1878, 1881, 1884, 1887, 1890, 1893, 1898, 1903, 1907, and 1912, all of which we include depending on the availability of our other variables. The *Sozialdemokratische*

[12] We also construct a measure of profit concentration using corporate tax statistics available since 1891. We do not make further use of this measure because only a negligible share of firms was incorporated so several districts have less than ten corporations in total and the introduction of limited liability companies (*GmbHs*) in 1906 causes a serious break in the series (see Appendix Section C.6).

[13] Tooze (2007, p.59) concludes: "The entire repertoire of Imperial statistics was thus moulded around the interests of German business. Inquiries to which business objected were boycotted." This changed only with the outbreak of the First World War.

[14] Becker and Hornung (2020) analyze the political economy of Prussia's three-class franchise.

[15] However, the *Reichstag* did not have the power to elect the chancellor nor his fellow ministers, who were chosen directly by the emperor. The emperor also had the right to dissolve the parliament and was able to call for new elections at any time.

Partei Deutschlands (SPD) (and its predecessors) was the only political representative of socialism in Germany.[16]

Between 1871 and 1912, political support for the socialists exploded, as can be seen from Figure 1(e). Their vote share started to increase in the 1880s, in spite of the anti-socialist law.[17] After the abolition of this law in 1890 and the publication of the *Erfurter Programm* in 1891, the vote share increased rapidly, particularly in industrial districts. Their rise was only interrupted by the election of 1907, when nationalist agitation in the context of Germany's colonial policy created a temporary backlash against the socialists. In rural districts, the average SPD vote share increased from near zero to almost 15% in 1912. In industrial districts, the average SPD vote share increased from below 10% to above 30%. The SPD became the strongest party in the Reichstag in terms of vote share in 1890, i.e., even before the end of the anti-socialist law, and the strongest party in terms of MPs in 1912.

We also analyze union membership and strikes to directly capture socialist activity. In the wake of new trade laws of 1869, a growing number of trade unions had been formed in Germany. They quickly improved their organization and managed to mobilize an increasing part of the industrial workforce. After the end of the anti-socialist laws in 1890, unions were allowed to resume their activities. We digitized union membership data on a county level from 1896 to 1906, as well as a previously unused source that lists every single strike by sector and location for every year between 1899 and 1905.[18] We georeferenced these entries to construct a county×industry dataset, covering 21 sectors and 544 counties (hence over 10,000 observations). Appendix Figure D.5 shows the average number of strikes per 100 workers across counties by sector. Most sectors saw, on average, 2 to 6 strikes per 100 workers per year. Between 1896 and 1906, union membership steadily and sharply increased, while (successful) strikes show a volatile but overall rising trend between 1899 and 1905 (Figure 1(f) and Appendix Figure D.6).

3 Orthodox Marxism and the Revisionism Debate

The relationships between capital accumulation, capital share, concentration, income inequality, and socialism were hotly debated at the time. While the socialists gained dramatically in the polls, internal struggles emerged within the socialist movement between the orthodox Marxists on one side and the more pragmatic, reform-oriented activists on the other. The former had their stronghold within the main party organization, whereas the latter dominated the trade unions. The *Erfurter*

[16] In 1863, Ferdinand Lassalle founded the first socialist mass party in Germany, the *Allgemeine Deutsche Arbeiterverein* (ADAV). In 1869, the *Sozialdemokratische Arbeiterpartei* (SDAP) led by August Bebel and Wilhelm Liebknecht emerged, with a more radical orientation that was strongly influenced by Marx and Engels. In 1875, both parties merged and formed the *Sozialistische Arbeiterpartei Deutschland* (SAP). In 1890, the party was renamed the *Sozialdemokratische Partei Deutschlands* (SPD).

[17] The rising success of socialist parties and trade unions led to increased suppression in the form of Bismarck's anti-socialist law (*Sozialistengesetze*) (1878-1890), which banned the socialist party and trade unions. However, individual supporters could still run for parliament and be elected to office. On the political economy of the anti-socialist law see Kersting (2022).

[18] The statistical office only collected data on this disaggregated level for these years.

Programm from 1891[19] was an effort to guide the party after the abolition of the anti-socialist laws. The program was largely based on earlier drafts written by Karl Kautsky and Eduard Bernstein, with the former contributing the theoretical foundations and long-run strategy, and the latter contributing the short-term tactical objectives. The theoretical part was influenced by the writings of Karl Marx and Friedrich Engels and took its starting point in a sharp critique of rising inequality and capital concentration.

The *Erfurter Programm* and Kautsky's interpretation of Marx in *Karl Marx' oekonomische Lehren* (Kautsky, 1886) are significant as they represent more broadly what would later be called "orthodox Marxism" and would characterize the Second International (1889-1916). In particular, Kautsky's commentary on the *Erfurter Programm*, published in 1892 (Kautsky, 1892), was widely circulated and read well beyond Germany. We cannot even scratch the surface of Marx's writings and the exegesis of his works by Marxists and non-Marxists. Therefore, we focus on key aspects of orthodox Marxism as formulated by Kautsky (1886, 1892) and on the critique thereof formulated by the Revisionists around Bernstein (1899). At the center of orthodox Marxism lies a notion of historical materialism, in which economic conditions determine the cultural and political structure of society in a way that can be empirically tested ("scientific Marxism"). The main predictions of Kautsky's historical materialism are that capitalist development will inevitably lead to growing economic, social and political conflict and ultimately to socialism. Let us formulate three predictions from orthodox Marxism and a counter-position from the Revisionists that can be confronted with empirical evidence:

1) Capital accumulation increases the capital share and income inequality.
In his commentary on the *Erfurter Programm*, Kautsky (1892, pp.65ff) argues that the main force of capitalist development is the accumulation of industrial capital. Further, he argues that with capital accumulation, the rate of profit will tend to decline, but the volume of capital will increase faster (Kautsky, 1892, p.76). Hence, with capital accumulation, the share of capital in income will increase, while income from labour will tend to decline, leading to growing inequality (Kautsky, 1892, p.57). This is derived from his (simplified) reading of Marx's writing on capital accumulation. Consider Marx's famous "general law of capitalist accumulation": "It follows therefore that in proportion as capital accumulates, the situation of the worker [...] must grow worse. [...] The [general law] necessitates an accumulation of misery equivalent to the accumulation of capital." (Marx, 1867, Ch.23, p.675). On the next pages Marx (1867, Ch.23), refers to the English income tax statistics for the years 1853-1864 to illustrate this.[20] He shows that incomes from taxable profits have increased much more than total taxable incomes, suggesting a rising capital share and growing income inequality. Summarizing Kautsky's orthodox reading, we can distinguish two parts of a prediction, namely (1.a) that capital accumulation leads to a rising share of capital in total income and (1.b) that capital accumulation leads to an increase in income inequality.

2) Capital accumulation leads to more capital concentration.

[19]For an English translation, see SPD (1984).
[20]Note that we always refer to the German edition of Marx in Marx-Engels-Werke (MEW). In accepted English translations, chapter 23 of the German text corresponds to chapter 25.

Kautsky (1892, pp.77ff) argues that capitalist production has the tendency to concentrate all capital into fewer and fewer hands, and ultimately to become the private property of a single person or corporation. This process of capital concentration is sometimes called "centralization". Kautsky derived this from his reading of Marx (1867, Ch.23), who again used the English income tax statistics to show that for the years 1864 and 1865, taxable incomes from profits were highly concentrated and increasingly so. Marx stated that "[...] with the development of the capitalist mode of production, there is an increase in the minimum amount of individual capital necessary to carry on a business under its normal conditions.[...] Centralization would reach its extreme limit if all the individual capitals [...] were fused into a single capital." (Marx, 1867, p.656). On closer inspection, we can split this prediction into two parts, namely (2.a) the prediction of increasing capital concentration, and (2.b) the prediction that capital accumulation will cause more capital concentration.

3) Capital accumulation fosters political support for socialism.
Kautsky (1892, pp.108ff) and again Kautsky (1899a, p.1) argues that capital accumulation must lead to growing misery of the working class, that is, an increase in absolute poverty, alongside the concentration of capital, which will inevitably result in a political regime change towards socialism. He argues repeatedly that capitalism cannot be reformed but must be abolished in a socialist revolution. "The less bearable the existing mode of production becomes (...) the more numerous will the members of non-proletarian classes flock to the social democrats and follow hand in hand with the irresistibly advancing proletariat his lead to victory and triumph." (Kautsky, 1892, p.262). Clearly, this leaves little room for the organization of the workers, for example, in trade unions, in order to improve their economic status. Kautsky's hypothesis was rooted in his reading of Marx: "Along with the constantly diminishing number of the magnates of capital [...] grows the mass of misery [...]; but with this too grows the revolt of the working class [...]." (Marx, 1867, Ch.23). This leads to the prediction that capital accumulation leads to growing political support for socialism.

In the years following the *Erfurter Programm*, several members of the SPD started to question whether Marxism could provide viable guidance for the party. The most vocal proponent of this critique was Eduard Bernstein. The dispute was mainly about the "empirical validity of the economic laws of capitalist development and the Marxist prognosis about the increasing centralisation of capital and the growing proletarianisation of (...) the population (...)" (Gronow, 2016, p.36).

Bernstein challenged all major predictions of orthodox Marxism and did so on the basis of recent statistical evidence. The debate started in 1896 with an exchange between Ernest Belfort Bax and Eduard Bernstein in the weekly *Die Neue Zeit*, the leading journal of theoretical Marxism at the time, founded and edited by Kautsky (Tudor and Tudor, 1988, p.11). In 1898, Bernstein formulated a summary of his positions, which culminated in his statement "I frankly admit that I have extraordinarily little feeling for, or interest in, what is usually termed 'the final goal of socialism.' This goal, whatever it may be, is nothing to me; but the movement is everything." (cited after Tudor and Tudor 1988, p.19). This sparked a heated debate involving Bax, Alexander Parvus, Rosa Luxemburg, and Georgi Plekhanov arguing against Bernstein, but also Konrad Schmidt in his support (Tudor and Tudor, 1988, pp.19ff). It was only at the party conference in Stuttgart in 1898 that Kautsky joined the

debate with a sharp rebuttal of Bernstein, which was widely accepted as the official position of the SPD. In the following years, Bernstein and Kautsky clarified their positions in two books (Bernstein 1899, Kautsky 1899a), which will be our focus. So, what exactly was Bernstein's Revisionism, and how did Kautsky respond?

On the most general level, Bernstein questioned the Marxist prediction that capitalism would necessarily lead to ever-increasing inequality, capital concentration ("centralization") and political revolution. To start with the first prediction, Bernstein (1899, pp.49f) provided evidence from English, French, Prussian, and Saxon income statistics for various years in an attempt to show that the number of middle to high-income taxpayers had increased, and more generally that capital accumulation was not necessarily associated with any dramatic increase in income inequality or polarization into a few rich and many poor. Instead, he argued that there was evidence of a growing middle class and an increasingly differentiated society (Bernstein, 1899, p.51). Moreover, Bernstein doubted that there was evidence of a rising capital share, but could not show this. In his reply, Kautsky (1899a, p.91) showed that Bernstein had used the data selectively, and provided a comparison for the years 1876 and 1890 as an example demonstrating that income inequality had indeed increased.

Next, Bernstein (1899, p.58) challenged the prediction of an ever-increasing concentration of capital, using statistical evidence from the occupation and firm census of 1882 and 1895. He showed that the large majority of employees were still working in small and medium-sized enterprises. While Bernstein conceded that factories tended to be increasing in size, he argued that this was sector-specific and countered with the spread of capital ownership in joint stock companies. In his reply, Kautsky clarified that the question of capital concentration was crucial for his concept of orthodox Marxism: "The concentration of capital sets the historical task: the introduction of a socialist social order. It produces the forces to accomplish this task, the proletarians, and it creates the means of doing so: social production."(Kautsky 1899a, p.54, translation from Gronow 2016). In his reply to Bernstein, Kautsky revised the statistical evidence and highlighted that employment in small enterprises actually decreased in relative terms. Kautsky also discussed the evidence from income tax statistics to argue that incomes in the highest tax brackets had increased most strongly between 1876 and 1890. Overall, he concluded: "If ever a theory was splendidly confirmed, it was the theory by Marx in the data from the German occupation and industry census." (Kautsky 1899a, p.68, own translation).

Finally, Bernstein questioned the prediction that capitalist development would lead to the immiseration of the working class and foster ever-growing political support for socialism among workers. Given the (in his view) weak evidence for other Marxist predictions, and instead evidence for a broadening middle class, the SPD should not rely on any imminent collapse of capitalism, but rather on the role of trade unions, cooperatives and pragmatic work in parliament to improve the political and economic conditions for the working classes (Bernstein, 1899, pp.168ff). In fact, he argued the SPD could only succeed in the polls if it changed into a democratic party working for social reforms (Gronow, 2016, p.51). The trade unions take center stage in this, as the "democratic element in industry" (Bernstein, 1899, p.121). In contrast to Kautsky (1892, p.108), who claimed that neither strikes

nor any other organized activity of workers could ever change the course of capitalist development, Bernstein argued that trade unions could effectively reallocate profits to wages and hence improve the conditions of workers (Bernstein, 1899, pp.118ff.). In particular, Bernstein considered strikes to be an effective weapon for workers to improve their position (see especially Bernstein 1906).

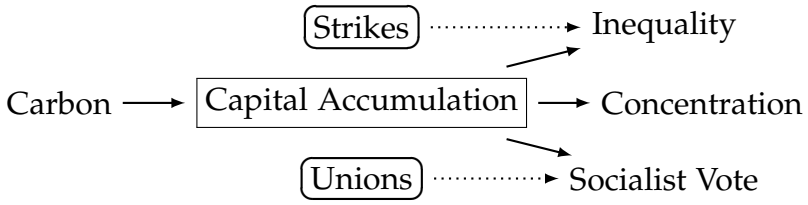
In his response, Kautsky had to modify his earlier statements about a deterministic path towards socialism, see, for example, Kautsky (1892, p.110). He stressed that it would be impossible to "statistically calculate when society has become ripe for socialist production. This production will not merely be a product of economic development, but also of the class struggles arising from this development" (Kautsky, 1899b, translation from Gronow, 2016, p.51). With reference to earlier arguments by Rosa Luxemburg, Kautsky restated the Marxist concept of immiseration to mean not physical but social misery, that is "the discrepancy between cultural needs and the means of a wage worker to satisfy them."(Kautsky 1899a, p.128, own translation). And while socialism would not be an automatic outcome of economic development, he pointed to the very remarkable political success of socialism over the last few decades, particularly of the SPD in recent years (Kautsky, 1899a, pp.190f.). Regarding the role of trade unions, Kautsky argued that they derived their influence not from their organization but only from the underlying economic process [of capital accumulation] (Kautsky, 1899a, p.168). He reformulated this in Kautsky (1909), stressing again the primacy of the party over trade union activities.

This was in stark contrast to the position of Bernstein (1899, 1906) and trade union leaders such as Carl Legien who considered the trade unions as the key agent of social progress and political success (e.g., Legien 1910). To summarize, while Kautsky (and the SPD establishment) interpreted any electoral success as a sign of growing inequality and class struggle, Bernstein argued that the party could only win votes through pragmatic work for better living conditions. We can thus formulate a fourth hypothesis to capture the essence of Bernstein's Revisionism:

4) Trade unions can change capitalism to benefit workers. Their activity can limit inequality and foster political support for the SPD.
Bernstein argued that activities of trade unions (such as strikes) can effectively improve the position of workers and limit income inequality (4.a). He and his followers maintained that (4.b) the struggle of trade unions for better working conditions rather than growing "misery" would foster political support for the SPD.

To summarize, while orthodox Marxists argued for the existence of general laws of capitalist development, the Revisionist contested this and argued for the agency of workers via trade unions and institutional change. We illustrate their hypotheses in Figure 2. We first show the orthodox Marxist prediction that capital accumulation will increase inequality, concentration and ultimately support for socialism. We will test for a causal effect of capital accumulation using an IV strategy based on carboniferous strata. Next, we show the Revisionist position: institutions such as trade unions can modify the effects of capital accumulation and foster support for socialism in their own right. We cannot test for this causally, but will provide supportive evidence.

Figure 2: Illustration of Hypothesis 1-4



Notes: The figure illustrates the four hypotheses in the paper and their relationship. Solid arrows indicate hypothesized causal effects, dotted arrows indicate hypothesized relations without claiming causality. The orthodox Marxist hypotheses 1-3 are shown in the three solid arrows from capital accumulation to various outcomes. We also show how we use carboniferous strata ("carbon") to instrument for capital accumulation. Hypotheses 4.a and 4.b as stated by the Revisionists are shown in the two dotted arrows, originating from strikes and unions respectively.

In the next section, we present our empirical strategy and findings to shed light on this debate. We are of course aware that these data do not cover all aspects of the debate, nor do they allow us to test "Marxism" in general. But our analysis provides new evidence on core arguments of orthodox Marxism that were discussed in the period before 1914 and are still influential today.

4 Testing Marx

Our aim in this section is to provide systematic evidence in favor of or against orthodox Marxist predictions and Bernstein's Revisionism, in the context of nineteenth-century Germany. To this end, we interpret the predictions as empirically testable (and of course refutable) hypotheses. We first focus on the effects of capital accumulation on the share of capital, income inequality, capital concentration, and votes for the SPD, thus testing the Marxist predictions illustrated in Figure 2 by solid arrows. Second, we investigate whether trade unions and strike activity mitigated inequality and increased support for socialism, depicted in Figure 2 by dotted arrows.

4.1 Testing Orthodox Marxist Predictions (H1-3)

To provide causal evidence on the Marxist Hypotheses 1-3, we exploit the spatial diffusion of industrialization. Industrialization first took off in European cities that were close to carboniferous strata (Fernihough and O'Rourke, 2021). During the first phase of the industrialization, proximity to coal deposits was crucial for running steam engines. Technology diffusion in general as well as increasing electrification and falling transport costs in particular contributed to the spread of industrialization across regions and initiated a process of industrial capital convergence.[21] Data for capital accumulation exist since 1895, which we can use to show that initially more rural regions saw higher rates of capital accumulation between 1895 and 1910. In contrast, capital accumulation slowed down in

[21] On the role of different power sources in the spatial distribution of economic activity across Germany, see Gutberlet (2014).

regions with a higher level of industrial capital after 1895. Figure 4(a) illustrates the strong negative relationship between the initial level of industrial capital in 1895 and capital accumulation between 1895 and 1910 with a large and highly significant OLS coefficient of -1.78 (se: 0.08) (without further controls).

To establish causality in this convergence process, we use an instrumental variable approach. We follow Fernihough and O'Rourke (2021) and use distance from a county's centroid to carboniferous strata, that is, strata, in which coal can be found, to instrument growth in industrial capital accumulation. To test the strength of our instrument, we plot the distance to carboniferous strata against capital accumulation between 1895 and 1910. Figure 4(b) shows a clear positive correlation: The larger the distance to carboniferous strata, the higher the capital accumulation between 1895 and 1910.

The necessary exclusion restriction for this instrument is that distance to carboniferous strata affects the growth in our dependent variables only through growth in capital accumulation. Given that carboniferous strata are of little use except to the coal industry and, thus, to industrialization as shown for European regions in Fernihough and O'Rourke (2021), this assumption seems plausible. We will test for this assumption further below.

We estimate the following equation by 2SLS:

$$1^{st} \text{ stage} : \Delta CA_c = \beta \cdot DistanceCarbon_c + X_c' \cdot \gamma + u_c \tag{1}$$

$$2^{nd} \text{ stage} : \Delta y_c = \beta \cdot \Delta \widehat{CA}_c + X_c' \cdot \gamma + \varepsilon_c \tag{2}$$

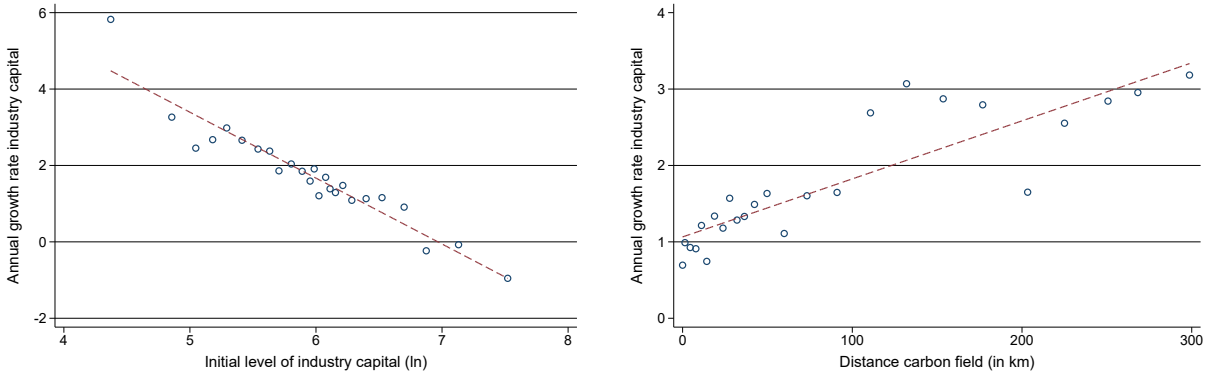
In the first stage, we regress capital accumulation between 1895 and 1910, ΔCA in county c, on the distance to carboniferous strata, $DistanceCarbon$ (in km) for county c. X_c' denotes a vector of control variables including initial population, the share of urban population in 1895 and population growth from 1895 to 1910. For the second stage, we use the predicted capital accumulation as explanatory variable for the change in our outcome variables, top 1% share, capital share, firm size, and support for socialism.

A potential concern for our estimation is the weak instruments problem. A weak first stage could lead to unreliable IV estimates. To address this, we follow recent recommendations by Andrews et al. (2019) and the implementation in Enikolopov et al. (2020). As suggested there, we use a test for weak instruments for the case of clustered standard errors by Olea and Pflueger (2013). The resulting effective F-Statistic in Table 1 is around 11. This is below the threshold of 15 in Olea and Pflueger (2013) for the case of 20% potential bias and a 5% significance. However, it is still above 10, which is the relevant rule-of-thumb threshold for the case of clustered standard errors according to Andrews et al. (2019). Following Andrews et al. (2019) and Enikolopov et al. (2020), we report the weak-instrument robust confidence intervals for our main coefficient. The intervals exclude zero in all cases.

Another important concern lies in violations of the exclusion restriction. Here, we use the methodology pioneered by Conley et al. (2012) which explicitly tests the violation of the exclusion

restriction by allowing for direct effects of the instrument on the dependent variable. Appendix Figure D.9 shows that our results are robust to this test, especially for the effect of capital accumulation on the capital share.

Figure 3: Capital Accumulation Convergence, 1895-1910



(a) Capital Accumulation Convergence

(b) First Stage: Carboniferous Strata and Growth in Capital Accumulation

Notes: Figure 4(a) plots the relationship between initial level of industrial capital accumulation as of 1895 (in logs) and the annual growth rate for the same variable between 1895 and 1910. Each bin represents on average 22 counties. The coefficient for the initial level of industrial capital accumulation in an OLS-regression (without further controls) is -1.78 (se: 0.08). Figure 4(b) plots the relationship between distance to carboniferous strata (in km) and the annual growth rate in industrial capital accumulation between 1895 and 1910. Each bin represents on average 22 counties. The coefficient for the initial level of industrial capital accumulation in an OLS-regression (without further controls) is 0.0076 (se: 0.0008).
Sources: See Appendix A.

Testing Hypothesis 1: Capital Accumulation Increases Capital Share and Inequality

We first consider the orthodox Marxist hypothesis that rising capital accumulation will positively affect the capital share and the top 1% income share (our income inequality measure). Results from the 2SLS estimation using the IV of Equation 2 are found in Table 1 columns (1) and (2). Those from the OLS estimation are shown in columns (3) and (4).[22] Results for the capital share (Hypothesis 1a) are reported in Panel 1 and results for the top 1% share in Panel 2 (Hypothesis 1b). Both provide clear support for the hypothesis. The coefficients from the IV estimation indicate that a 1 percentage point increase in the annual capital accumulation share increases the capital share by 0.9 pp and the top 1% share by 0.7 pp. Expressed differently, a 1 standard deviation increase in capital accumulation can explain roughly 70% of a standard deviation increase of the change in the top 1% income share and

[22]We present the reduced-form effects and the first stage in Appendix Table D.2. Moreover, Appendix Figure D.10 provides binscatters for H1-3 that show the relation between capital accumulation and various dependent variables after controlling for residuals form the first stage of our IV approach, following Cattaneo et al. (2022).

more than 75% of a standard deviation increase of the change in the capital share.[23] Note that the coefficients remain of similar size once we control for population growth in column (2), a potentially important confounder. The results presented provide evidence that capital accumulation increased the capital share and income inequality. This is clearly in line with the reasoning of orthodox Marxism and against the claims made by Revisionists.

Table 1: Regression Results for OLS and IV, Hypothesis 1 and 2

	IV		OLS	
	(1)	(2)	(3)	(4)
Panel 1: Δ **Capital Share, 1895-1907** (in pp)				
Δ CA	0.909**	0.847**	0.752***	0.746***
	(0.397)	(0.384)	(0.173)	(0.189)
Weak IV 95% CI	0.684; 1.186	0.607; 1.117		
Mean dep. var.	0.39	0.39	0.39	0.39
Controls		✓		✓
F-stat	10.810	12.259		
Observations	544	544	544	544
Panel 2: Δ **Top 1% Income Share, 1895-1910** (in pp)				
Δ CA	0.697**	0.781**	0.348**	0.326**
	(0.339)	(0.363)	(0.142)	(0.143)
Weak IV 95% CI	0.508; 0.956	0.415; 0.835		
Mean dep. var.	0.93	0.93	0.93	0.93
Panel 3: Δ **Firm Size, 1895-1907** (in logs)				
Δ CA	-0.022	-0.015	-0.004	-0.000
	(0.014)	(0.013)	(0.006)	(0.006)
Weak IV 95% CI	-0.040; -0.006	-.033; 0.001		
Mean dep. var.	0.19	0.19	0.19	0.19

Notes: Unit of analysis: county (Panel 1-3). Standard errors clustered on the district level reported in parentheses. * p<0.1, ** p<0.05, *** p<0.01. For convenience, we report the effective F-statistics and number of observations only in Panel 1. In all specifications, we control for population (in logs) as of 1895. In columns (2) and (4), we additionally control for population growth (1895-1910) and the share of urban population in 1895. Appendix Figure D.10 shows binscatters for H1-3.
Sources: See Appendix A.

Testing Hypothesis 2: Capital Accumulation Leads to More Capital Concentration

We now turn to the Marxist prediction that rising capital accumulation will lead to increasing capital concentration. We measure capital concentration by the number of employees per firm (= firm size). We already showed evidence that capital concentration measured by firm size sharply increased in rural, mixed and industrial districts alike between 1875 and 1907. We also noted that this measure is

[23]For this, we multiply the effect from column 1 with the standard deviation (1.82) and divide this by the variation in the change in the capital share (2.42) and the top 1% income share (1.67), respectively: $(0.91 \times 1.82)/2.42 = 0.68$ and $(0.70 \times 1.82)/1.67 = 0.76$.

likely to represent a lower bound. Overall, these trends lend credence to the orthodox prediction of increasing capital concentration (Hypothesis 2a).

Results for Hypothesis 2b, that capital accumulation increases capital concentration are displayed in Panel 3 of Table 1. Trends presented in Figure 1 suggest that accumulation became decoupled from concentration since the late 1890s, particularly in industrial districts: While capital concentration continued to increase, capital accumulation hovered at an elevated level in mixed and industrial districts. All estimators show a negative coefficient. The insignificant negative sign speaks against the orthodox prediction of a strong positive effect of accumulation on concentration.

Testing Hypothesis 3: Capital Accumulation Fosters Political Support for Socialism

Next, we examine the economic drivers of support for socialism. Orthodox Marxists predicted that rising accumulation and also the immiseration of workers, would strengthen political support for socialism. Is there evidence for a growing immiseration of workers in late nineteenth-century Germany? Wage data show the opposite (and we are not the first to point this out, see for example Allen (2009) on the United Kingdom). Detailed wage data on day laborers from Becker et al. (2014) show that wages increased even for these precariously employed workers. On average, between 1892 and 1901, wages increased by 22% for rural day laborers, and by 16% for urban day laborers. Different estimations of real wages in Germany over this period point in the same direction (Ritter and Tenfelde, 1992, p.491-496). Our average income measure based on income tax statistics also documents an upward trend (see Appendix Figure C.3). Given the increase in wages (across regions) and the simultaneous surge in votes for the SPD (see Figure 1(e)), we have to reject the first part of the political hypothesis put forward by the orthodox Marxists: There is no evidence for a growing immiseration of workers and, hence, nothing to suggest a deterministic path towards socialism.

Still, the rise of the socialist party might be related to increasing capital accumulation, provided that the increase in wages was smaller than for capital accumulation and provided that voters responded to this with more support for the SPD. The SPD vote share increased from less than 10% in the 1870s to more than 30% in mixed and industrial districts in 1912 (see Figure 1(e)). As described in Section 3, the SPD considered the increasing capital accumulation to be a major economic problem. Therefore, in their famous revolutionary *Erfurter Program* from 1891, they called for, among other things, the abolition of private property, better protection for workers, and a more progressive tax system. Does our IV strategy provide evidence that voters reacted to increases in capital accumulation by voting more for the socialist party? The results in columns (1) and (2) of Table 2 for our IV estimation suggest that this was not the case. The coefficient in columns (1) and (2) is *negative* and statistically significant. Thus, we have to reject the orthodox hypothesis according to which growing capital accumulation leads to rising support for socialism.[24] But why did the SPD gain so strongly?

[24]Exploiting the end of the anti-socialist-law in Germany in 1890 is another approach to investigate this hypothesis. If the Orthodox were right, the end of the anti-socialist law should have had no differential effect on votes for the socialist party. Because capital accumulation is only observed since 1895 and county data is available starting in 1891, we use the district as unit of analysis and rely on inequality as independent variable here. Our variable of interest is the interaction between the top 1% share and a dummy variable for the end

Table 2: Regression Results for OLS and IV, Hypothesis 3 and 4b

	IV			OLS		
	(1)	(2)	(3)	(4)	(5)	(6)
Δ **Vote Share SPD, 1893-1912** (in pp)						
Δ CA	-8.662***	-8.305***	-7.430**	-1.653	-1.543	-1.173
	(3.038)	(3.019)	(2.912)	(1.232)	(1.396)	(1.300)
Δ % Union, 1896-1906			1.723***			2.332***
(in pp)			(0.636)			(0.644)
Mean dep. var.	8.04	8.04	8.04	8.04	8.04	8.04
F-stat	10.92	12.44	11.46			
Further controls		✓	✓		✓	✓
Observations	229	229	229	229	229	229
R-squared				0.04	0.07	0.13

Notes: Unit of analysis: constituency. Dep. var.: Change vote share SPD (in pp). Standard errors clustered on the district level reported in parentheses. * p<0.1, ** p<0.05, *** p<0.01. In all specifications, we control for population (in logs) as of 1895. In columns (2) and (4), we control in addition for population growth and the share of urban population.
Sources: See Appendix A.

4.2 Testing the Revisionists' Counter-arguments (H4)

Bernstein emphasized the importance of trade unions and their activities in improving political and economic conditions for the working classes (Bernstein, 1899, p.168ff). Historians of the German Empire highlight the increasing role of trade unions and their strike activity for wage growth and reduced income inequality during this period (Kaelble and Volkmann, 1986). As illustrated in Figure 2, we distinguish two aspects here. First, we ask whether there is evidence that strikes improved the position of workers and thus reduced income inequality (or redistributed income between rich and poor, respectively capital and labor), in support of hypothesis H4a? And second, do we see a positive correlation between union activity and votes for the SPD, supporting hypothesis H4b? We treat these ideas as counter-arguments to the Marxist hypotheses, and therefore test them together with their Marxist counterparts. However, we cannot provide causal evidence in these cases, therefore our results need to be interpreted with caution.

Testing H4a: Strikes and Inequality To what extent did strikes contribute to a redistribution of income from the top (capitalists) to the bottom (workers) of the income distribution and, thereby, moderate income inequality (H4a)? To investigate this empirically, we use our county panel for the period 1899-1905, for which we have yearly strike data. We estimate a two-way fixed effects model

$$y_{dt} = \beta \cdot strikes_{dt} + Z'_{dt}\gamma + \alpha_d + \tau_t + \epsilon_{dt}, \tag{3}$$

of the anti-socialist law. Evidence in favor of the orthodox camp would be an insignificant interaction. The results in Table D.3 speak strongly against the Orthodox claim, as the interaction term is highly significant.

where y_{dt} denotes the outcome variables that are various indicators for the distribution of income in year t and county d. The variable $strikes_{dt}$ denotes strikes as the main explanatory variable from a Revisionist perspective. In all cases, α_d captures county fixed effects, τ_t captures time fixed effects.[25] Z_{dt} is a vector of control variables including firm size, agricultural employment, urban population, income per capita, union members and turnout. We cluster standard errors at the next level of aggregation, that is, at the district-level. Obviously, not all strikes should have mattered equally, only those that succeeded. Strikes were categorized as successful if employers met the strikers' demands, and higher wages represented the most common demand.[26] While strikes are hardly exogenous, we can more plausibly assume this for factors leading to the success of a strike, controlling for the total number of strikes in a year and county as well as county and year effects. Note that we do not instrument capital accumulation in this setting, because our coal IV is suited for long-run changes and has limited explanatory power for annual variations.

Table 3 shows results for Equation 3 with four different income inequality measures as outcome variable. We always consider the association with successful strikes conditional on total strikes, and next check whether this is robust to the inclusion of capital accumulation. According to column (1), a 10% increase in the number of successful strikes is associated with a reduction of the top 1% income share by ca. 1.4 pp (column 1) and a rise of the bottom 95% income share by ca. 2 pp (column 3). These are sizable magnitudes given that, on average, the top percentile received 12% of total income and the bottom 95% received 76%. Apparently, the greater the number of successful strikes, the more income was redistributed from top-income earners to the middle and bottom of the distribution. What is more, the top 1% even seem to have lost in absolute terms (column 5). In contrast to the relevance of successful strikes, the occurrence of a strike *per se* (successful or not) shows no significant association with income inequality.[27]

[25] The inclusion of time effects will for example take the business cycle into account, which is particularly important when investigating strikes, because unions increasingly organized strikes during periods of economic upswing, when their chances of success were higher (Kaelble and Volkmann, 1986, p.170).

[26] For example, in 1899, 40% of the strikes were for higher wages, and 13% for lower working hours (Kaiserliches Statistisches Amt, 1900, p.XV).

[27] As a robustness check, we exclude Berlin from the regression analysis. Every fourth strike and almost one-third of all successful strikes between 1899 and 1905 occurred in the city of Berlin. Hence, we might be concerned that the extensive strike activity in Berlin drives our results. Our results remain qualitatively and quantitatively unchanged when excluding Berlin (see Appendix Table D.4).

Table 3: County-Year Income Inequality and Strikes, 1899-1905, Hypothesis 4a

	Top 1% Share		Bott. 95% Share		Top 1% Mean Income		Capital Share	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Successful Strikes	-0.144***	-0.091**	0.190***	0.116***	-0.013***	-0.007**	-0.199**	-0.088
	(0.043)	(0.033)	(0.056)	(0.041)	(0.004)	(0.003)	(0.090)	(0.064)
Strikes	-0.000	0.016	-0.005	-0.027	0.000	0.002	-0.049	-0.016
	(0.036)	(0.030)	(0.041)	(0.035)	(0.004)	(0.003)	(0.059)	(0.043)
Capital Accumulation		3.158***		-4.446***		0.362***		6.629***
		(0.608)		(0.810)		(0.060)		(1.255)
Year FE & County FE & Further Controls	✓	✓	✓	✓	✓	✓	✓	✓
R-squared Within	0.40	0.53	0.36	0.53	0.43	0.57	0.39	0.55
R-squared Overall	0.36	0.60	0.48	0.71	0.47	0.75	0.19	0.41
Observations	3808	3808	3808	3808	3808	3808	3808	3808
Mean Outcome	12.41	12.41	75.86	75.86	9.41	9.41	28.93	28.93
SD Outcome	3.67	3.67	5.08	5.08	.41	.41	6.54	6.54

Notes: The unit of observation is the county. Number of successful strikes, top 1% mean income and capital accumulation are in logs. Further controls include urban population share, capital concentration, agricultural employment share. Standard errors clustered on the district-level displayed in parentheses. * p<0.1, ** p<0.05, *** p<0.01.
Sources: See Appendix A.

Once we control for capital accumulation (columns 2, 4, 6 and 8) we still find a strong negative association between successful strikes and inequality and a strong positive association between capital accumulation and inequality (as shown earlier in Table 1, panel 1 and 2). The coefficient on successful strikes is slightly reduced when also controlling for capital accumulation, but remains statistically significant for our inequality outcomes – top 1% income share, bottom 95% income share and mean income of the top 1%. A one percent increase in capital accumulation from one year to the next is associated with a 3 percentage point increase in the top 1% share (column 2) and a 4 percentage point reduction of the bottom 95% share (column 4). Comparing the magnitude of the coefficients of successful strikes and capital accumulation – in the spirit of a horse race between the orthodox Marxists and the Revisionists – suggests that numerous successful strikes were needed to offset the inequality increasing effect of capital accumulation.[28] While the evidence for strikes is not causal, it lends strong support to the Revisionist perspective that strikes can be an effective antidote against rising inequality.

We also explore heterogeneous effects across industries and find that the top income reduction associated with successful strikes was particularly pronounced in construction and mining (see Appendix Tables D.5-D.6). These findings are in line with historical reports on union activity in these sectors (Schneider, 1989).[29]

However, any such redistributive effect might have been temporary. Once we include time-lags we find that the relation with strikes was present for one more year, but faded thereafter (see Appendix Table D.7). This suggests that in the absence of institutionalized wage setting between employers and employees – general wage negotiations were to come with the Stinnes-Legien Agreement in November 1918 – new strikes were needed to reduce top incomes and increase the relative income of the workers.

We need to be careful with the interpretation of these results for various reasons. A recent literature in econometrics has raised concerns about two-way fixed effect (TWFE) specifications. For example, de Chaisemartin and D'Haultfœuille (2020), Callaway and Sant'Anna (2021) and Goodman-Bacon (2021) have shown that the underlying estimator is a weighted average of all possible two-group/two-period difference-in-difference (DD) estimators. If average treatment effects vary over time or across regions, already-treated units act as controls and changes in their outcomes are subtracted, which may result in a negative estimate even if all average treatment effects are positive. The literature to date has focused mainly on providing alternative estimators for binary treatment and staggered adoption, leaving the development of heterogeneity-robust estimators for more complicated designs for future research (de Chaisemartin and D'Haultfœuille, 2022, p.23). For example,

[28] Dividing the capital accumulation coefficient by the successful strike coefficient (3.158/0.091=34.7) suggests that it would need 35% more successful strikes to compensate for a one percent increase in capital accumulation. Capital accumulation indeed increased quite continuously by about one percent annually, on average across counties. Yet, the number of strikes was very volatile. Strikes strongly increased in 1902, 1903, and 1904 (indeed in the magnitude of 30 to 70%, on average), but declined in 1900, 1901 and 1905.

[29] Another potential concern is that higher productivity in larger firms could be the underlying driver of more strike activity. However, historical evidence suggests that workers in the largest firms in Germany were less organized (Schneider, 1989). This is also in line with evidence from the United States for the same period, according to which there is a hump-shaped relationship between firm size and labor conflict (Schmick, 2018).

de Chaisemartin and D'Haultfœuille (2020) propose a DD estimator comparing the outcome evolution among the switchers, the groups whose treatment changes between $t-1$ and t, to the evolution among control groups whose treatment remains constant. In our setting, treatment is non-binary and counties almost never experience the same number of successful strikes in two consecutive years.[30] To address concerns about the potential bias of TWFE estimators, we provide additional evidence in Appendix Tables D.8 and D.9, where we split our sample into two-period samples 1899-1900, 1900-1901 et cetera and restrict observations to counties that experienced no strikes in the first year and focus on the key sectors construction and mining. Some counties experience a strike in the second year (moving into treatment), while most of the counties experience no strikes in the second year and remain in the control group. Overall, this exercise reveals coefficients of the same sign and of similar magnitude for all three outcomes as in our baseline estimation in Table 3, but less precisely estimated, likely due to the smaller number of observations.

Testing H4b: Trade Unions and SPD Votes Political support for the socialist party grew at a fast pace starting in the mid-1880s in all regions, while capital accumulation stayed at an elevated level in industrial regions, where support for the socialist party was particularly pronounced (see Figure 1). Accordingly, we did not find support for the Marxist hypothesis (H3), which predicted that economic factors would determine political outcomes. Yet, the share of trade union members in the population increased rapidly from ca. 0.2-0.3% in the 1890s to more than 1% in 1907, even reaching 6-10% in industrial centers (see Appendix Figure D.6). With this increased share of union membership, the influence of trade unions within the socialist movement grew.[31] Although the orthodox Marxists still had their stronghold within the party, a more pragmatic, reform-oriented strategy slowly started to become the dominant position within the SPD. Did the reformist strategy of strengthening the position of workers through strikes and unionization mobilize workers to vote for the socialists?

We add the change in union membership to our regression in Table 2, columns 3 and 6, using our data on votes and union membership at the constituency-level. This reveals a highly significant and positive coefficient. A 1 pp increase in union members is associated with a 1.7 pp increase in SPD votes (column 3). Clearly, we cannot interpret this as a causal effect, but the association lends support to the hypothesis that pragmatic policies and active voter mobilization through the unions may have attracted more votes than capital accumulation *per se*.

Overall, we find quite strong support for the Revisionist hypotheses. Strikes seem to have been an effective tool to redistribute income to the workers. The agency of trade unions mattered for the success of the SPD rather than the law-like effects of capital accumulation.

[30] Note also that our setting is neither a staggered adoption design, where groups can switch in but not out of treatment, nor can we estimate group-time average treatment effects in an event-study design with leads and lags (Callaway and Sant'Anna, 2021) given that strikes happen in all years of our 7-year period including the very first year.

[31] This is epitomized by the Mannheim agreement of 1906 between the SPD and trade unions that established their strategic role for the years to come (Nipperdey, 2013, pp.568ff).

5 Conclusion

The German Empire in the late nineteenth century provides us with a case study on the dynamics of capital accumulation, income inequality, concentration, and socialism. We compiled new panel data for Prussian districts, constituencies and counties to shed new light on the forces that drive distributive dynamics and political consequences. Our results clearly indicate that both economic forces and institutions shaped the distribution of income in the decades before the First World War. Specifically, we document a causal effect of capital accumulation on the capital share and top 1% income share. Moreover, we find suggestive evidence that labor conflict limited the increase in income inequality. Apparently, the "Belle Epoque" was not solely an "ownership society" as described by Piketty (2020). While, without any doubt, income inequality reached its peak during this era, the opposition from the left became stronger and its influence visible and effective.

We placed the focus of our analysis on the Revisionism Debate between orthodox Marxists and their critics in the German Empire before 1914. Let us summarize our main results with an overall assessment of this debate.

With regard to the first hypothesis on the effect of capital accumulation on the capital share and income inequality, the orthodox Marxists around Kautsky were correct. For Imperial Germany before 1914, we have strong evidence that capital accumulation causally led to a growing share of capital in income and contributed to income inequality, as first predicted by Karl Marx and believed by his followers, but contested by their critics. Next, the evidence is mixed about the role of concentration within the process of capital accumulation. The orthodox Marxists were right in their prediction that capital concentration was rising steeply. However, they were mistaken in their conviction that this "centralization" of capital was causally driven by capital accumulation. Given the weight that Kautsky (1899a) placed on this question , this finding is significant. Let us turn to the third orthodox Marxist hypothesis regarding the relationship between capital accumulation and support for socialism. This was always related to the claim that capital accumulation would lead to an immiseration of the working class, which would fuel the political struggle. Our findings speak against this. Real wages started to increase, significantly in the 1890s. We also do not find evidence that capital accumulation strengthened political support for socialism through any other channel.

This leads us to the Revisionist counter-hypothesis. The Revisionists rightfully stressed the role of labor conflict in limiting income inequality. We found support for the claim that successful strikes helped to redistribute income, albeit only temporarily. What is more, the Revisionist strategy of strengthening the trade unions seems to have been a building block for the political success of the SPD.

Crucially, the possibility of institutional change that could limit inequality and let workers benefit from industrial growth was not part of the Marxist predictions. This speaks to the bemoaned dilemma of social democratic socialism: "Socialism cannot be achieved without participation in democratic institutions, but participation erodes the will for socialism" (Przeworski and Sprague, 1986, p.2). Our paper also illustrates why theories seeking "general laws of capitalism" are bound

to fail, unless they place historical factors such as institutional and technological change center stage (Acemoglu and Robinson, 2015). From yet another angle, one can interpret our study as a case of how economic theory itself—in the form of Marxist thinking—can lead to policy responses that make a given economic model no longer a good fit to the data.[32]

Finally, let us return to the present debate. Simultaneous increases of capital accumulation, income inequality, capital share, and capital concentration are observed today, just as they were back then. This might be surprising given the fundamental changes in technology and society over the last 150 years. Yet, our results also point to the importance of institutions such as trade unions and strikes, which acted as factors offsetting the increase in inequality. However, our evidence is from nineteenth-century Germany, a setting where these institutions were successful within a national framework, with growing political participation. Clearly, it has become more difficult to counter capital accumulation and maintain the bargaining power of workers today as shown, for example, by Stansbury and Summers (2020). This might be related to the global mobility of multinational firms and capital markets compared to the still very limited mobility of people. Interestingly, we did not find a relation between capital accumulation (nor income inequality) and votes for the socialists before 1914. This is not only at odds with Marxist predictions, but also against any simple neoclassical intuition, and frankly our own priors. However, it is informative with respect to recent evidence, showing that there is little direct relation between income inequality and votes for the left (Gethin et al., 2022), while trade unions seem to matter for both the reduction of income dispersion (Farber et al., 2021), and the mobilization of votes for the left (Rennwald and Pontusson, 2021).

To conclude, our evidence on Germany before 1914 showed again that any quest for general laws of capitalist development must be elusive. We found that Marx and his orthodox followers were (partly) correct in their diagnosis on the wide-ranging effects of capital accumulation. However, they underestimated the scope for institutional adjustment within a capitalist society. Nevertheless, while Marx is long dead, his question about the long-run dynamics of capitalism will continue to haunt us.

[32]We are grateful to an anonymous referee for highlighting this "postmodern" aspect of our analysis.

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Online Appendix

A Data Sources

Income tax statistics represent the main data source for capital accumulation, top 1% income share, and capital share. The Prussian statistical office regularly published tabulations with the number of taxpayers per income bracket and the aggregated tax or aggregated taxable income per income bracket. These tables are the source of information for the distribution of top incomes. Since the 1890s, these publications also included information on income composition and capital (wealth tax was first collected in 1895). Sources for income and wealth tax statistics by district are given in Table A.2. Income is generated in the year preceding the tax year, e.g., incomes taxed in 1914 are generated in 1913. For the tax years 1874 to 1891, tabulations by district are published in volumes of *Anlagen zu den Stenographischen Berichten über die Verhandlungen des Hauses der Abgeordneten*; for the tax years 1892 to 1914, tabulations by district are published in in volumes of *Mitteilungen aus der Verwaltung der direkten Steuern im preußischen Staate*.

Capital accumulation. We measure capital accumulation using business assets (non-corporate firms) (*Vermögen aus Handel, Gewerbe und Bergbau*) recorded in wealth tax data 1895-1911. Sources for wealth tax statistics (*Ergänzungsteuer*) are listed in Table A.2.

Income inequality. We measure income inequality by the share of total income accruing to a partic-ular fraction of the population such as the top 5%, the top 1% or the bottom 95%. The method is described in Section C.2. Income tax statistics are the main data source which are available from 1874 to 1913. Sources for income tax statistics (*Einkommensteuer*) are listed in Table A.2.

Capital share. Our main data source are income tax statistics recording capital income from interest and distributed profits, which we supplement with undistributed profits, self-employment capital income and government's capital income from additional data sources. Section C.5 provides details on our method to compute the capital share. The composition of income is included in income tax statistics from 1893-1913. Sources for income tax statistics (*Einkommensteuer*) are listed in Table A.2.

Income per capita. District-level income per capita is the total reference income (see Section C.4) divided by total reference population (see Section C.3). County-level income per capita is a population-weighted average between urban and rural counties in the district.

Capital concentration. Our measure of capital concentration is constructed using data on employment and the number of firms based on several firm censuses. We divide the number of employees by the number of firms in each district and county. We use district-level data reported by the Prussian statistical office for 1875 and 1882 and county-level data reported by the German statistical office for 1895 and 1907. The data allow also to calculate firm size by sector. We use volumes 40 and 83 of the *Preussische Statistik, Amtliches Quellenwerk* and volumes 116 and 218 of the *Statistik des Deutschen Reichs, Neue Folge*.

Votes for the SPD (share). We use election results provided by Caramani (2004). These data include the number of people allowed to vote, turnout and votes for all parties over multiple ballots for *Reichstag* elections. Available for elections in 1871, 1874, 1877, 1878, 1881, 1884, 1887, 1890, 1893, 1898, 1903, 1907, 1912.

Trade union membership (share). We digitize county-level data on membership in the free trade unions reported in Hirschfeld (1908). This source includes number of members in trade unions by sector from 1896 to 1906.

Strikes The *Statistik des Deutschen Reichs, Neue Folge* lists all strikes for the years between 1899 and 1905 by sector and place. We aggregate these data to the county-level. We use the following volumes of the *Statistik des Deutschen Reichs, Neue Folge*: 134, 141, 148, 157, 164, 171, and 178.

Sectoral employment. Occupation by sector on a county-level is reported in a census conducted by the German national statistics. We divide employment in industry or agriculture by total employment. This share is available for 1882, 1895, and 1907. We use volumes 2, 109, and 209 of the *Statistik des Deutschen Reichs, Neue Folge*.

Urban population. We measure the share of urban population in a county or district using the data provided by Galloway (2007), available for 1871, 1875, 1880, 1885, 1890, 1895, 1905, and 1910.

Population density. Based on data provided by Galloway (2007), available for 1871, 1875, 1880, 1885, 1890, 1895, 1905, and 1910.

Carboniferous strata. Based on the geological map provided by Asch (2005).

Table A.1: Prussian Inequality Panel, 1874-1913

Concept	Measure	Time Period	Region
Capital Accumulation	Business Assets	1895-1897,1899, 1902,1905,1908, 1911	28 Districts, 544 Counties
Income Inequality	Top Income Shares	1874-1913	28 Districts
	Top Income Shares	1891-1910	544 Counties
Capital Share	Capital Share	1891-1913	28 Districts
Capital Concentration	Mean Firm Size	1875,1882, 1895,1907	544 Counties
Socialism	SPD Votes	1874-1912	229 Constituencies
	Union Membership	1896-1906	544 Counties
	(Successful) Strikes	1899-1905	17 Sectors $\times$ 544 Counties

Notes: Summary statistics are given in Appendix Table D.1.
Sources: See Appendix A.

Table A.2: Sources of Income and Wealth Tax Statistics for Prussia

Income tax year	Source
1874	Stenogr. Berichte über die Verhandlungen des Hauses der Abgeordneten, 1875
1875	Stenogr. Berichte über die Verhandlungen des Hauses der Abgeordneten, 1876
1876	Stenogr. Berichte über die Verhandlungen des Hauses der Abgeordneten, 1877
1877	Stenogr. Berichte über die Verhandlungen des Hauses der Abgeordneten, 1877/78
1881	Stenogr. Berichte über die Verhandlungen des Hauses der Abgeordneten, 1882
1882	Stenogr. Berichte über die Verhandlungen des Hauses der Abgeordneten, 1882/83
1883	Stenogr. Berichte über die Verhandlungen des Hauses der Abgeordneten, 1883/84
1884	Stenogr. Berichte über die Verhandlungen des Hauses der Abgeordneten, 1885
1885	Stenogr. Berichte über die Verhandlungen des Hauses der Abgeordneten, 1886
1886	Stenogr. Berichte über die Verhandlungen des Hauses der Abgeordneten, 1887
1887	Stenogr. Berichte über die Verhandlungen des Hauses der Abgeordneten, 1888
1888	Stenogr. Berichte über die Verhandlungen des Hauses der Abgeordneten, 1889
1889	Stenogr. Berichte über die Verhandlungen des Hauses der Abgeordneten, 1890
1890	Stenogr. Berichte über die Verhandlungen des Hauses der Abgeordneten, 1890/91
1891	Stenogr. Berichte über die Verhandlungen des Hauses der Abgeordneten, 1892
1892/93	Statistik der preußischen Einkommensteuer-Veranlagung, 1892/93
1894/95	Statistik der preußischen Einkommen- und Ergänzungsteuer-Veranlagung, 1895/96
1896	Statistik der preußischen Einkommen- und Ergänzungsteuer-Veranlagung, 1896/97
1897/98	Statistik der preußischen Einkommen- und Ergänzungsteuer-Veranlagung, 1898
1899	Statistik der preußischen Einkommen- und Ergänzungsteuer-Veranlagung, 1899/1901
1900/01	Statistik der preußischen Einkommensteuer-Veranlagung, 1901
1902	Statistik der preußischen Einkommen- und Ergänzungsteuer-Veranlagung, 1902/04
1903/04	Statistik der preußischen Einkommensteuer-Veranlagung, 1904
1905	Statistik der preußischen Einkommen- und Ergänzungsteuer-Veranlagung, 1905/07
1906	Statistik der preußischen Einkommensteuer-Veranlagung, 1907
1907/08	Statistik der preußischen Einkommen- und Ergänzungsteuer-Veranlagung, 1908/10
1910	Statistik der preußischen Einkommensteuer-Veranlagung, 1910
1911	Statistik der preußischen Einkommen- und Ergänzungsteuer-Veranlagung, 1911/13
1911/12	Statistik der preußischen Einkommensteuer-Veranlagung, 1912
1913/14	Statistik der preußischen Einkommensteuer-Veranlagung, 1914

Note: Income is generated in the year preceding the tax year. For example, incomes taxed in 1914 are generated in 1913.

Figure A.1: Prussian Income Tax Statistics

Staat. — Regierungsbezirke.		Veranlagung zum Einkommen von mehr als 3 000 ℳ,								
		über 6 500 bis 7 000 ℳ			über 7 000 bis 7 500 ℳ			über 7 500 bis 8 000 ℳ		
		zu dem jährlichen Steuersatze von:								
		176 ℳ			192 ℳ			212 ℳ		
		Zahl der Censiten		Steuerbetrag *)	Zahl der Censiten		Steuerbetrag *)	Zahl der Censiten		Steuerbetrag *)
		physische Personen	nicht physische Personen*)	ℳ	physische Personen	nicht physische Personen*)	ℳ	physische Personen	nicht physische Personen*)	ℳ
1		79	80	81	82	83	84	85	86	87
Staat	A. Städte 1901	11 583	.	2 038 608	9 674	.	1 857 408	8 321	.	1 764 052
	1900	*10 937*	.	*1 924 912*	*9 327*	.	*1 790 784*	*7 857*	.	*1 665 684*
	B. Land 1901	2 753	.	484 528	2 264	.	434 688	1 893	.	401 316
	1900	*2 581*	.	*454 256*	*2 128*	.	*408 576*	*1 738*	.	*368 456*
	C. Ueberhaupt 1901	14 336	31	2 528 592	11 938	21	2 296 128	10 214	27	2 171 092
	1900	*13 518*	*22*	*2 383 040*	*11 455*	*20*	*2 203 200*	*9 595*	*22*	*2 038 804*
1. Königsberg	A. Städte 1901	264	.	46 464	215	—	41 280	160	—	33 920
	1900	*277*	—	*48 752*	*201*	—	*38 592*	*177*	.	*37 524*
	B. Land 1901	48	.	8 448	45	—	8 640	36	—	7 632
	1900	*40*	—	*7 040*	*35*	—	*6 720*	*32*	.	*6 784*
	C. Ueberhaupt 1901	312	1	55 088	260	—	49 920	196	—	41 552
	1900	*317*	—	*55 792*	*236*	—	*45 312*	*209*	*1*	*44 520*
2. Gumbinnen	A. Städte 1901	124	—	21 824	77	—	14 784	57	—	12 084
	1900	*119*	—	*20 944*	*87*	—	*16 704*	*65*	—	*13 780*
	B. Land 1901	42	—	7 392	34	—	6 528	26	—	5 512
	1900	*35*	—	*6 160*	*32*	—	*6 144*	*22*	—	*4 664*
	C. Ueberhaupt 1901	166	—	29 216	111	—	21 312	83	—	17 596
	1900	*154*	—	*27 104*	*119*	—	*22 848*	*87*	—	*18 444*

Source: Statistik der preußischen Einkommensteuer-Veranlagung 1902.

B Definitions of Geographical Units: Counties, Constituencies and Districts

Counties. We rely on the county boundaries as of 1895.

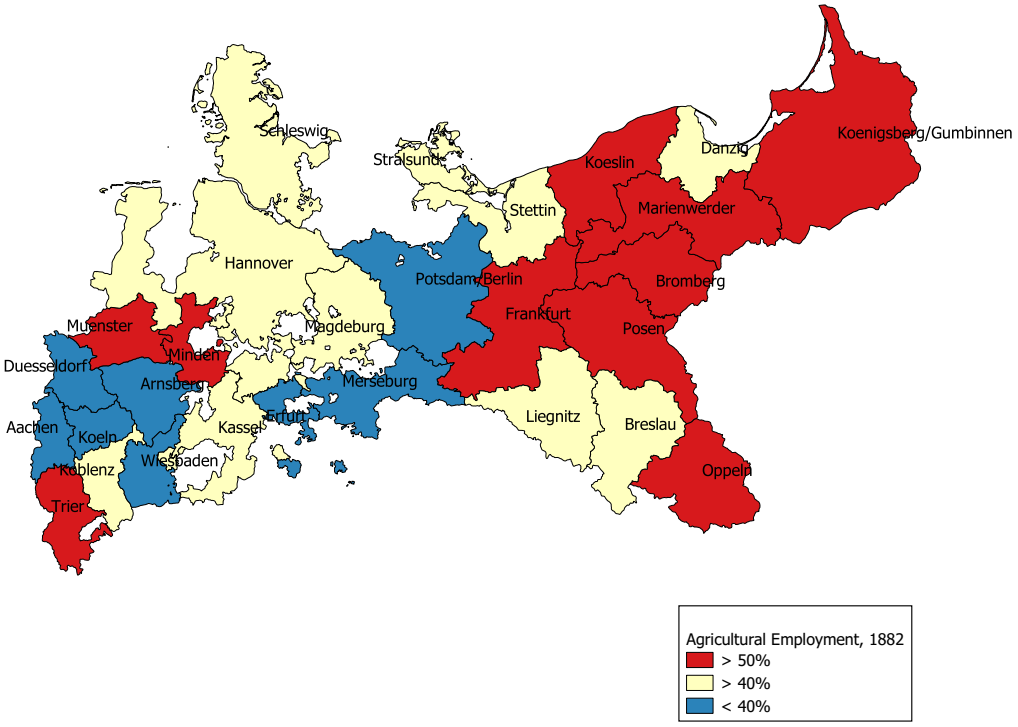
Constituencies. We rely on the boundaries for the nation-wide elections.

Districts. Several reforms changed the borders of Prussian districts. We harmonize the districts over time which leaves us with 28 harmonized districts for our analysis. We make the following four adjustments:

1. We combine Aurich, Hildesheim, Stade, Lüneburg, Osnabrück to Hannover.
2. We combine Gumbinnen, Königsberg, and Allenstein to Königsberg/Gumbinnen.
3. We combine Berlin and Potsdam to Brandenburg.
4. We drop Sigmaringen.

Figure B.1 illustrates the regional variation of industrialization across Prussian districts in 1882. Districts with more than 50% employment in agriculture in 1882 are classified as rural (red), districts with between 40% and 50% employment in agriculture in 1882 are classified as mixed (yellow), and districts with less than 40% employment in agriculture in 1882 are classified as industrial (blue).

Figure B.1: Districts by Agricultural Employment



Notes: Districts classified by agricultural employment.
Source: See Appendix A.

C Measuring Income Inequality and Capital Share

C.1 Income Tax Regimes

As income inequality and capital share measures are mostly based on income tax statistics, we start this section with a brief description of income tax regimes in Prussia. The Prussian income tax legislation can be divided 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.[1] 12 subclasses were distinguished to which authorities of the municipality assigned all households[2] 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 Schlachtsteuer*) on flour and meat consumption.[3] 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 grind and butcher tax in order to evade the class tax.

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 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.[4] Since 1851, the class tax 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 tax year 1874, the grind and butcher tax was abolished and income taxation (classified and class tax) equally applied to cities and rural areas. Taxable income was defined as income from capital, renting and leasing, business, trade, and employment.

In 1891, a far-reaching income tax reform finally abolished the class tax. The definition of taxable income remained unchanged (§7 EStG). 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

[1] 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 laborer. 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).

[2] 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).

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

[4] 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).

in Prussia. The share of the taxed population steadily increased and reached 50% 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 (§24 EStG).

The obligation for top income earners to file a tax return induces an upward shift of top incomes in many districts, particularly in rich districts like Wiesbaden and Köln. This provides further evidence that the tax authorities underestimated top incomes before 1891. Therefore, we adjust our top income share series 1874-1890 upwards, proportionately to the shift we observe between 1890 and 1891.

The Prussian wealth tax (*Ergänzungsteuer*) was introduced in 1893 and wealth was assessed in 1895, 1896, 1897, 1899 and then every three years. The wealth tax distinguished between business assets, financial assets and real estate. Business assets included all assets and rights of non-corporate firms operating in Prussia. Financial assets included, on the one hand, shares in corporations, but also cash, the net present value of annuities, appanage, and retirement contracts.

C.2 Pareto Interpolation

Top income shares – our measure for income inequality – are obtained by applying the Pareto interpolation method commonly used in the top income share literature since the contributions of Piketty (2001, 2003). Note that both the shape and the scale parameters are estimated for each income bracket separately allowing the parameters to vary across the distribution. This procedure is similar to the most recent methodological innovation of Generalized Pareto interpolation by Blanchet et al. (2022). Our estimation procedure involves several steps:

The first step is to construct measures of total potential taxpayers, N_{dt}, and total income $\sum_{i=1}^{N_{dt}} y_{idt}$ in district d and year t. Total income is the sum of taxed and tax-exempt income. We estimate tax-exempt income following Hoffmann and Müller (1959), who produced historical national accounts for Germany 1851-1957. Appendix Figure C.3 displays the evolution of total reference income per capita in Prussian administrative districts. The total reference population is the sum of tax units and tax-exempt; both are given in the Prussian income tax statistics. We provide further details on reference total income in Appendix C.4 and total population in Appendix C.3.

The second step is to estimate the average income of the top x%, $\bar{y}_{dt,topx}$, using the Pareto interpolation method. The shape parameter $b = a/(a-1)$ is computed using the lower bound of the income bracket $y_{low,topx}$, where the percentile cut-off of the top x% is located, and from the average income above this lower bound, $\bar{y}_{low,topx}$:

$$b_{topx} = \bar{y}_{low,topx} / y_{low,topx} \tag{C.1}$$

The scale parameter k is computed as

$$k_{topx} = y_{low,topx} \cdot {p_{low,topx}}^{1/a_{topx}}, \tag{C.2}$$

where $p_{low,topx}$ is the population share at the lower threshold of the top x%'s income bracket. Third, the top x% income threshold is computed as

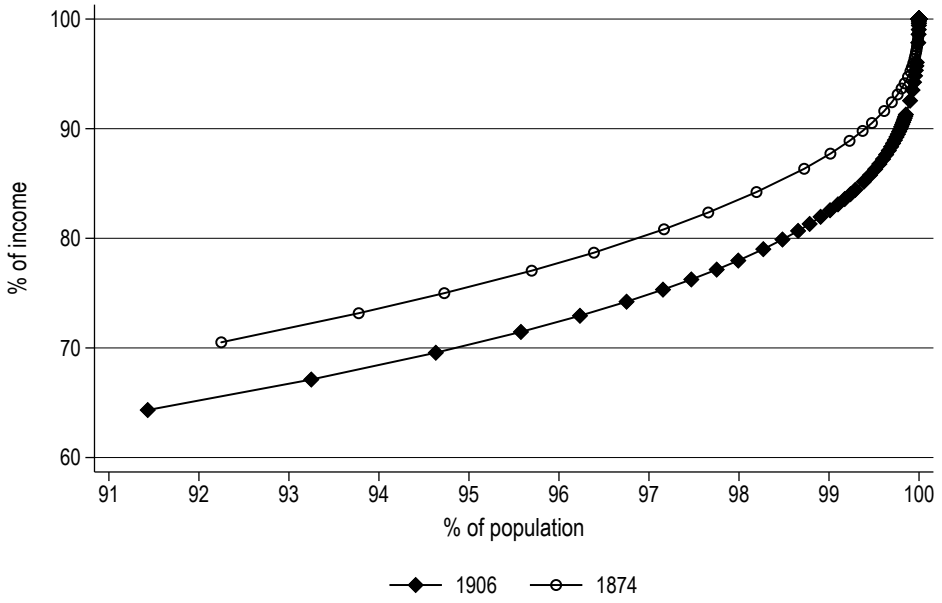
$$thr_{topx} = k_{topx} / (p^{1/a_{topx}}) \tag{C.3}$$

where p is equal to 0.01 for the top 1%, for example. Fourth, average income of the top x%, $\bar{y}_{topx}$, is then estimated from

$$\bar{y}_{topx} = b_{topx} \cdot thr_{topx} \tag{C.4}$$

Appendix Figure C.1 illustrates the extremely fine-grained nature of Prussian income tax data, particularly at the top of the income distribution: One income bracket often includes less than 0.1% of total potential taxpayers so that we can estimate top thresholds like the top 1%-threshold very precisely.

Figure C.1: Top Tail of the Lorenz Curve Based on Prussian Income Tax data, 1874 and 1906



Notes: Each marker represents the cumulative population share and cumulative income share of an income tax bracket and above as recorded in official income tax statistics for Prussia as a whole in 1874 and 1906.
Source: Stenogr. Berichte über die Verhandlungen des Hauses der Abgeordneten, 1875; Statistik der preußischen Einkommensteuer-Veranlagung 1907.

The top x% income share in district d in year t results from dividing the total income of the top x% by total income of the population:

$$\text{Top x\% Share}_{dt} == \frac{\bar{y}_{dt,topx} \cdot N_{dt} \cdot x\%}{\bar{y}_{dt} \cdot N_{dt}} \tag{C.5}$$

We estimate the top x% income share in a Prussian county or constituency c using the urban and rural income distribution of the county's or constituency's district d, which is recorded in Prussian income tax data, and the county's urbanization rate, u_{ct}. Our approach is related to the measure of international weighted inequality from Milanovic (2005) reconstructing subgroup distributions from the overall distribution. We first compute the average income in the district's rural areas and urban areas – $\bar{y}_{dt,rural}$ and $\bar{y}_{dt,urban}$ – as well as the top x% average income in rural and urban areas $\bar{y}_{dt,rural,topx}$ and $\bar{y}_{dt,urban,topx}$. Urban top income shares systematically exceed rural top income shares, because urban incomes are higher than rural incomes and the urban-rural income gap is even larger for top incomes than for average incomes.

$$\text{Top x\% Share}_{ct} = \frac{((u_{ct} \cdot \bar{y}_{dt,urban,topx}) + ((1-u_{ct}) \cdot \bar{y}_{dt,rural,topx})) \cdot N_{ct} \cdot x\%}{((u_{ct} \cdot \bar{y}_{dt,urban}) + ((1-u_{ct}) \cdot \bar{y}_{dt,rural})) \cdot N_{ct}} \tag{C.6}$$

C.3 Reference Total Population

The reference total population is needed to compute the number of tax units that represent a particular fractile of the population, such as the top percentile or the top decile. In general, 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. For the period 1874-1913, the number of tax exempt is documented in income tax statistics in Prussia. Hence, we can apply the bottom-up approach and obtain our reference total population as

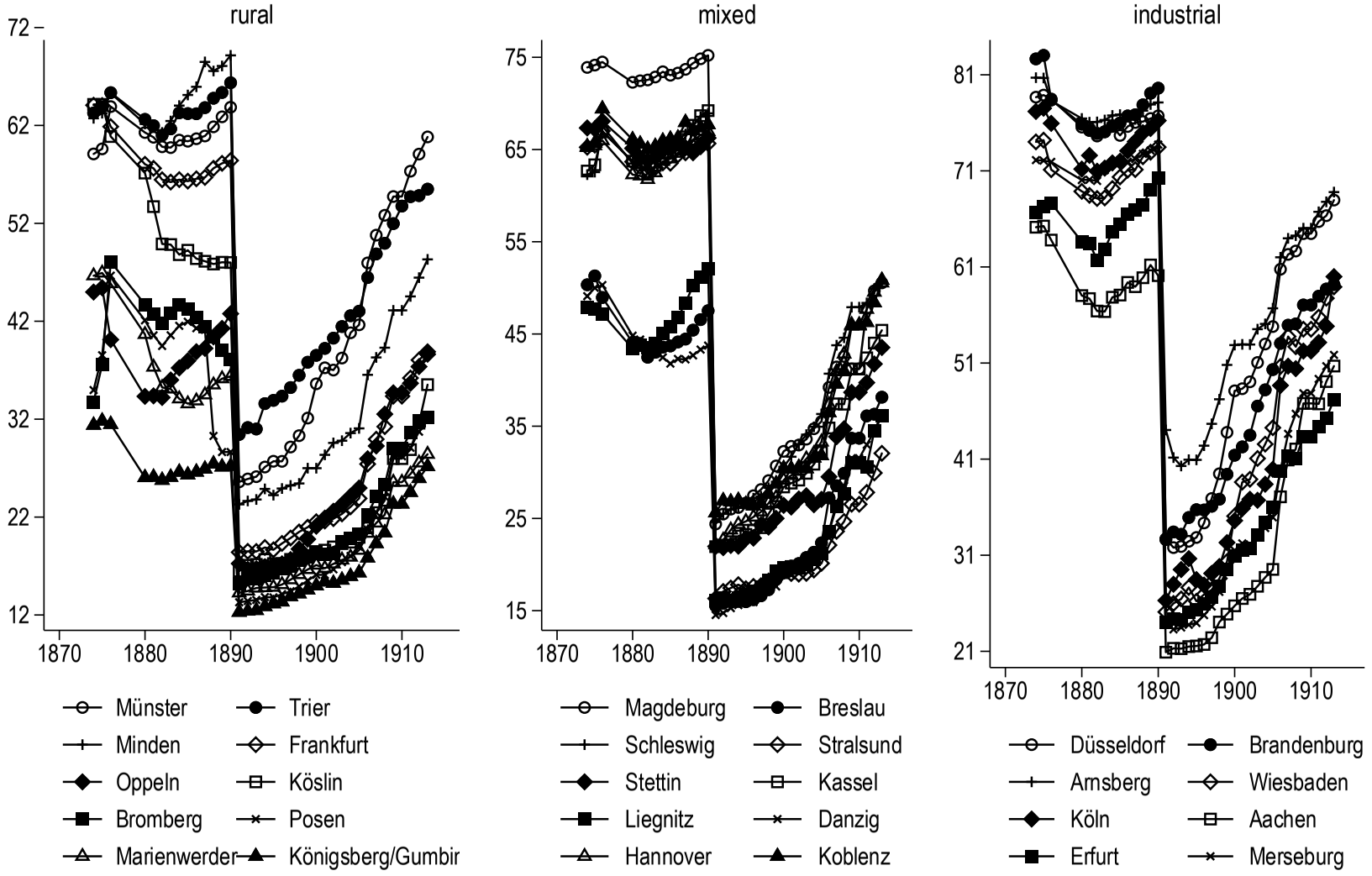
number of tax units recorded in tax statistics

\+ tax exempt

= reference total population

Figure C.2 shows that more than half of the population were taxpayers across Prussian districts from 1874 to 1890. This share was reduced by the introduction of a tax allowance in 1891 and then steadily increased.

Figure C.2: Share of Taxpayers in Total Population in Prussian Districts, 1874-1913



Notes: Share of Taxpayers in % of total population. The introduction of a tax threshold of 900RM with the tax reform of 1891 drastically reduced the share of taxpayers.
Sources: See Appendix A.

C.4 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. We apply the bottom-up approach as national accounts were first produced in Germany in the interwar period.

During our period of observation, 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. Despite recurring criticism of this series, no attempt of replacing it has been undertaken.[5] 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 1874-1913 is obtained as

Tax income recorded in tax statistics (1)

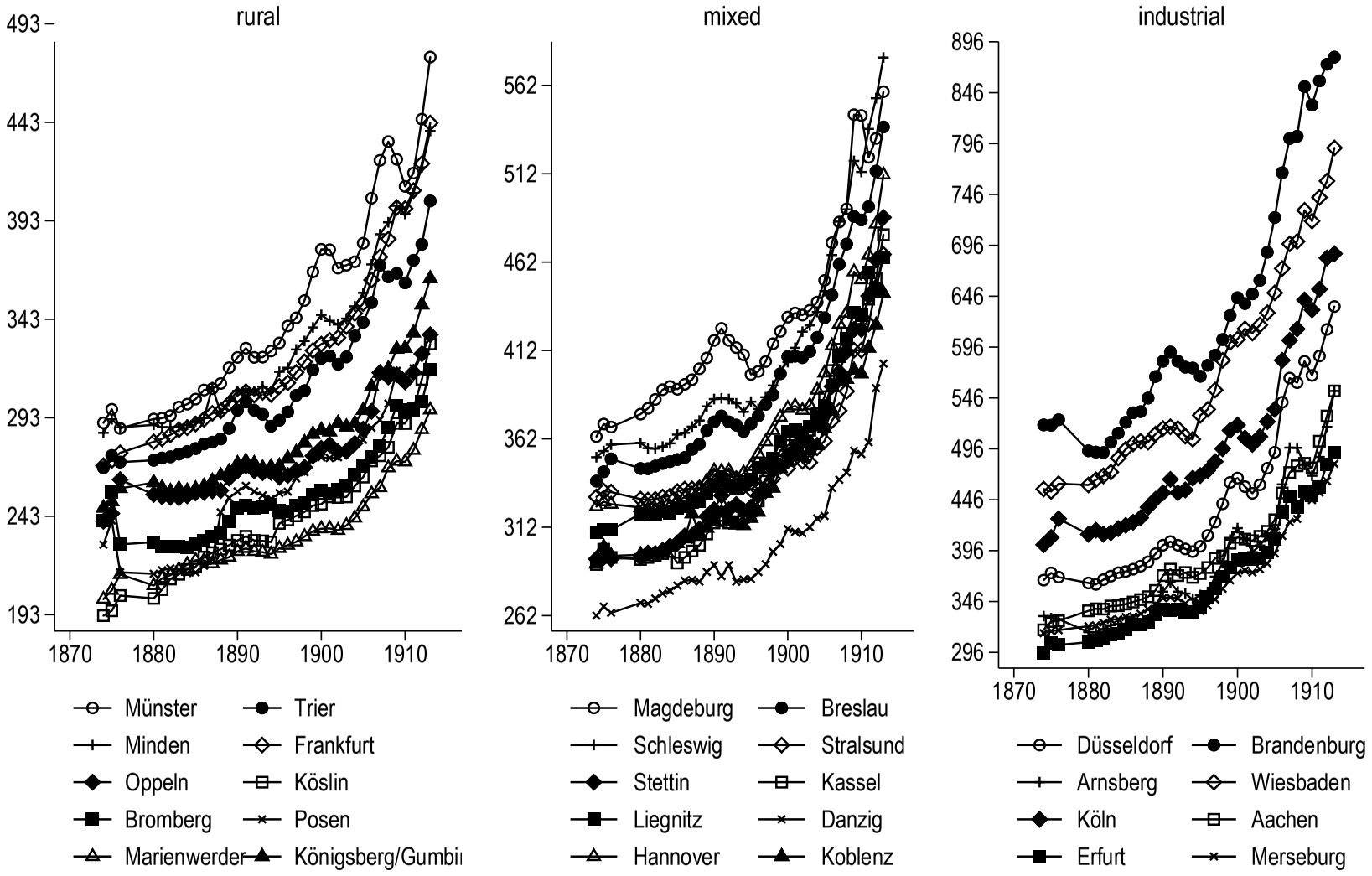
\+ Income of non-filers with income beneath the tax allowance (from Hoffmann and Müller 1959) (2)

= Reference total income

Tax income (1) per income bracket is imputed under the assumption that incomes are Pareto distributed following Piketty and Saez (2003). The group of non-filers (2) consists of two subgroups. The first group is exempted because their income is below the exemption limit of the income tax. The Statistical Office (Statistisches Reichsamt, 1932) published an estimate of the average income of tax-exempted non-filers for the year 1913. We follow Hoffmann and Müller (1959) and 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). The second group is exonerated from tax statistics because of personal circumstance that reduce the capability to generate income such as the number of children, sickness, and indebtedness (§18 and §19 Prussian EStG 1891). This group exists since the tax reform in 1891. Average income of exonerated tax units in Prussia from 1891 to 1913 and in each province in 1907 is provided by the Statistical Office (Statistisches Reichsamt, 1932). As we do not have further information, we assume that average income of this group is equal across districts within a province. We deflate 1907 province average incomes using an index for Prussia 1891-1913. Figure C.3 displays the evolution of total reference income per capita in Prussian administrative districts.

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

Figure C.3: Reference Total Income per Capita in Prussian Districts, 1874-1913



Notes: Per capita income in current RM.
Sources: See Appendix A.

C.5 Capital Share

We calculate the capital share from the income-side. Capital income is the sum of interest, distributed profits (=dividends), undistributed profits (=retained earnings) and capital gains. Our main data source are income tax statistics recording capital income from interest and distributed profits, which we supplement with undistributed profits, self-employment capital income and government's capital income from additional data sources. Since 1891, Prussian income tax statistics documented the income composition of top income earners (roughly the top 1%) on the district level.

More precisely, tax statistics record the income composition of income earners with incomes exceeding 3,000 RM distinguishing between four income categories: capital income, income from renting and leasing, income from trade, business and mining, and, finally, employment income. Keeping in mind that these incomes accrue to roughly the top 1% of income earners, we count all income types as capital income (and not as labor income) except employment income. We might overestimate capital income in richer districts compared to poorer districts, because more taxpayers cross the 3,000 RM income threshold in richer districts so that more capital income is recorded in the income composition statistics.

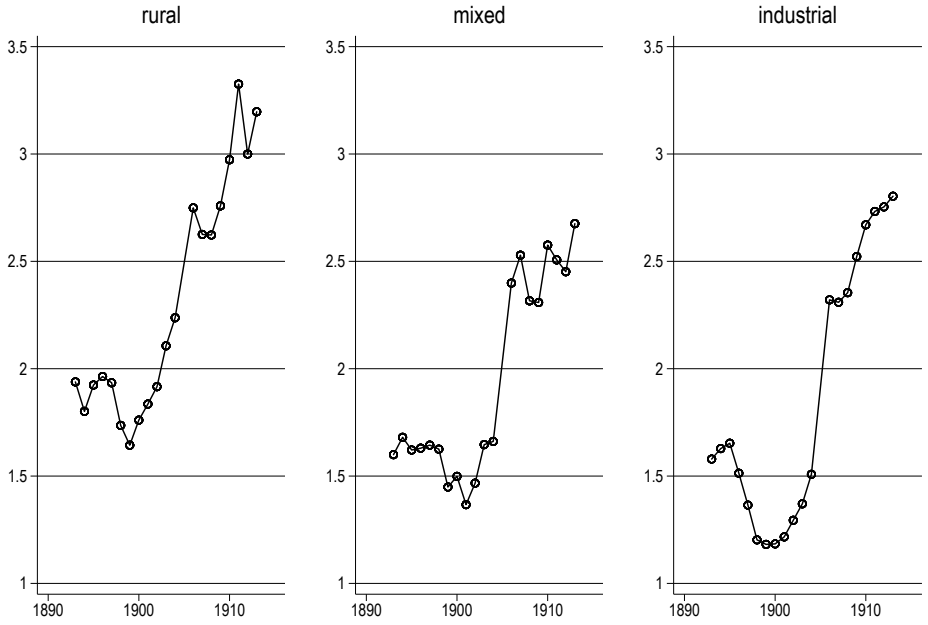
We use the capital income recorded in income tax statistics as an estimate for capital income from interest and distributed profits. We argue that capital income almost exclusively accrued to this top group so that the income composition data miss a negligible share of capital income. We add undistributed profits using the share of undistributed profits in total profits as estimated for Prussian corporations by Hoffmann and Müller (1959, p.28). According to their estimates, this share reached about 35% in 1891 and 1913, but varied. We add the capital share of self-employment income following Bengtsson and Waldenström (2018).[6] Finally, we add government's capital income. In order to compute district government capital income, we compute the share of Prussian government capital income in national income as documented by Hoffmann and Müller (1959) and apply this share to district income. National income is the sum of total private income (see Appendix Section C.4), government's capital income and undistributed profits.

[6] Bengtsson and Waldenström (2018) compute the capital share of self-employment income as $0.33 \times$ share of self-employed $\times$ total labor income using national self-employment shares from Hoffmann (1965). We use Hoffmann (1965) national self-employment data by sector and compute district self-employment shares by weighting national sector self-employment shares with the district sector employment shares.

C.6 Capital Concentration Using Tax Data

We also construct a measure of profit concentration among highly profitable firms using corporate tax statistics, which are available since the introduction of corporate taxation in 1891. One should note that corporate taxation since 1891 disproportionately increased the tax burden on the new industrial elite with respect to the old landed elite because firm owners were taxed twice on the corporate and on the personal level (Mares and Queralt, 2020). The Half-Squared Coefficient of Variation (HSCV) is declining until 1900 and then sharply increases (see Appendix Figure C.4). We do not make further use of this measure for three reasons. First, only a negligible share of firms were incorporated, meaning that the concentration of corporate profits is not representative for capital concentration in Prussia. Second, several districts have less than ten corporations in total. Third, the tax reform of 1906, which introduced limited liability companies (*GmbHs*) causing the number of corporations to increase two- to three-fold in all parts of Prussia, creates a serious break in the series.

Figure C.4: Firm Profit Concentration, 1893-1913



Notes: Half-squared coefficient of variation using grouped income taxes of corporations (*nicht-physische Personen*). Limited liability corporations (*GmbHs*) included since 1906.
Sources: See Appendix A.

D Additional Tables and Figures

Table D.1: Summary Statistics

	mean	sd	p50	p25	p75
County					
Δ capitalshare (in pp), 1895-1907	0.39	2.42	0.38	-1.13	1.73
Δ top 1% (in pp), 1895-1910	0.93	1.67	0.71	-0.13	1.81
Δ rate firmsize (log), 1895-1907	0.19	0.14	0.18	0.11	0.27
Annual growth rate industry capital (in %), 1895-1910	1.77	1.82	1.99	0.65	2.66
Observations	544				
Constituency					
Growth Votes SPD (in pp), 1893-1912	8.04	7.41	6.92	2.53	12.81
Annual growth rate industry capital, 1895-1910	1.60	1.68	1.87	0.58	2.53
Observations	229				

Sources: See Appendix A.

Table D.2: Reduced Form and First Stage, Hypothesis 1-3

	(1)	(2)
Δ Capital Share, 1895-1907 (in pp)		
Least Distance to Carbon Field in km for county c	0.007**	0.006**
	(0.003)	(0.003)
Mean dependent variable	0.39	0.39
SD dependent variable	2.42	2.42
R-squared	0.06	0.09
Δ Top % Income Share, 1895-1910 (in pp)		
Least Distance to Carbon Field in km for county c	0.005**	0.004**
	(0.002)	(0.002)
Mean dependent variable	0.93	0.93
SD dependent variable	1.67	1.67
R-squared	0.08	0.12
Δ Firm Size, 1895-1907 (logs)		
Least Distance to Carbon Field in km for county c	-0.000*	-0.000
	(0.000)	(0.000)
Mean dependent variable	0.19	0.19
SD dependent variable	0.14	0.14
R-squared	0.05	0.08
Δ Vote Share SPD (in pp)		
Least Distance to Carbon Field in km for county c	-0.026***	-0.025***
	(0.007)	(0.008)
Mean dependent variable	8.04	8.04
SD dependent variable	7.41	7.41
Observations	229	229
R-squared	0.13	0.13
First Stage: Annual growth rate industry capital. 1895-1910		
Least Distance to Carbon Field in km for county i	0.007***	0.007***
	(0.002)	(0.002)
Mean dependent variable	1.77	1.77
SD dependent variable	1.82	1.82
Observations	544	544
R-squared	0.19	0.26

Notes: Unit of analysis: county (Panel 1-3; 5) and constituency (Panel 4). Standard errors clustered on the district level reported in parentheses. * p<0.1, ** p<0.05, *** p<0.01. For convenience, we report the number of observations only in Panel 5 (and not in Panel 1, 2 and 3 because the first stage is identical). Further control: population (in logs) as of 1895. In column (2), we control in addition for population growth and share of urban population. Panels 1-4 report the reduced form effect. Panel 5 reports the first stage.
Sources: See Appendix A.

Table D.3: Inequality, the end of the anti-socialist law and votes for the SPD, 1874–1912

	(1)	(2)
Top 1% share	-0.749	0.868
	(0.629)	(0.588)
Post1890 × Top 1% share		-1.380***
		(0.456)
Year FE	✓	✓
District FE	✓	✓
Further Controls	✓	✓
R-squared within	0.80	0.89
R-squared overall	0.72	0.65
Observations	336	336
Districts	28	28
Elections	12	12
Mean Outcome	11.71	11.71
SD Outcome	12.76	12.76

Notes: The unit of observation is the district. * p<0.1, ** p<0.05, *** p<0.01. Controls: Urban population (in %), income per capita, and turnout. We include all elections between 1874 and 1912 (elections were held in 1874, 1878, 1878, 1881, 1884, 1887, 1890, 1893, 1898, 1903, 1907, and 1912).
Sources: See Appendix A.

Table D.4: County-Year Income Inequality and Successful Strikes excl. Berlin, 1899-1905

	Top 1% Share		Bottom 95% Share		Top 1% Mean Income	
	(1)	(2)	(3)	(4)	(5)	(6)
Successful strikes	-0.126**	-0.144***	0.163**	0.189***	-0.010**	-0.013***
	(0.048)	(0.044)	(0.060)	(0.056)	(0.004)	(0.004)
Strikes	-0.003	-0.000	-0.004	-0.005	0.001	0.000
	(0.046)	(0.036)	(0.056)	(0.041)	(0.005)	(0.004)
Year FE	✓	✓	✓	✓	✓	✓
County FE	✓	✓	✓	✓	✓	✓
Further Controls		✓		✓		✓
R-squared within	0.20	0.40	0.12	0.36	0.22	0.43
R-squared overall	0.00	0.35	0.00	0.48	0.00	0.47
Observations	3801	3801	3801	3801	3801	3801
Counties	543	543	543	543	543	543
Years	7	7	7	7	7	7
Mean Outcome	12.41	12.41	75.86	75.86	9.41	9.41
SD Outcome	3.67	3.67	5.08	5.08	.41	.41

Notes: The unit of observation is the county. Number of successful strikes and top 1% mean income are in logs. Further controls include urban population share, firm size, agricultural employment share. Standard errors clustered on the district level displayed in parentheses. * p<0.1, ** p<0.05, *** p<0.01.
Sources: See Appendix A.

Table D.5: County-Year Income Inequality and Successful Strikes in Construction, 1899-1905

	Top 1% Share		Bottom 95% Share		Top 1% Mean Income	
	(1)	(2)	(3)	(4)	(5)	(6)
Successful strikes	-0.164***	-0.147**	0.249***	0.233***	-0.015**	-0.014**
	(0.058)	(0.055)	(0.075)	(0.077)	(0.006)	(0.006)
Strikes	-0.091	-0.126*	0.099	0.132	-0.008	-0.012
	(0.060)	(0.069)	(0.074)	(0.078)	(0.006)	(0.008)
Year FE	✓	✓	✓	✓	✓	✓
County FE	✓	✓	✓	✓	✓	✓
Further Controls		✓		✓		✓
R-squared within	0.21	0.41	0.13	0.37	0.22	0.43
R-squared overall	0.00	0.34	0.02	0.46	0.00	0.47
Observations	3808	3808	3808	3808	3808	3808
Counties	544	544	544	544	544	544
Years	7	7	7	7	7	7
Mean Outcome	12.41	12.41	75.86	75.86	9.41	9.41
SD Outcome	3.67	3.67	5.08	5.08	.41	.41

Notes: The unit of observation is the county. Number of successful strikes and top 1% mean income are in logs. Industry-specific controls include Number of strike days per year. Number of firms of respective industry per county. Industry share is share of county's employees in respective industry. Share of strikes among industry's employees. Further controls include urban population share, firm size, agricultural employment share in the county. Standard errors clustered on the district level displayed in parentheses. * p<0.1, ** p<0.05, *** p<0.01.
Sources: See Appendix A.

Table D.6: County-Year Income Inequality and Successful Strikes in Mining, 1899-1905

	Top 1% Share		Bottom 95% Share		Top 1% Mean Income	
	(1)	(2)	(3)	(4)	(5)	(6)
Successful strikes	-0.284***	-0.314***	0.356***	0.396***	-0.025***	-0.028***
	(0.092)	(0.102)	(0.109)	(0.123)	(0.008)	(0.010)
Strikes	0.006	-0.009	0.006	0.032	0.002	0.000
	(0.092)	(0.112)	(0.121)	(0.133)	(0.009)	(0.009)
Year FE	✓	✓	✓	✓	✓	✓
County FE	✓	✓	✓	✓	✓	✓
Further Controls		✓		✓		✓
R-squared within	0.20	0.39	0.11	0.35	0.22	0.43
R-squared overall	0.00	0.36	0.00	0.47	0.00	0.47
Observations	3808	3808	3808	3808	3808	3808
Counties	544	544	544	544	544	544
Years	7	7	7	7	7	7
Mean Outcome	12.41	12.41	75.86	75.86	9.41	9.41
SD Outcome	3.67	3.67	5.08	5.08	.41	.41

Notes: The unit of observation is the county. Number of successful strikes and top 1% mean income are in logs. Industry-specific controls include number of strike days per year, number of firms, industry's employment share in the country, share of strikers among industry's employees. Further controls include urban population share, firm size, and agricultural employment share. Standard errors clustered on the district level displayed in parentheses. * p<0.1, ** p<0.05, *** p<0.01.
Sources: See Appendix A.

Table D.7: County-Year Income Inequality and Successful Strikes including Lags, 1900-1905

	Top 1% Share		Bott. 95% Share		Top 1% Mean Income	
	(1)	(2)	(3)	(4)	(5)	(6)
Successful	-0.098	-0.114**	0.133	0.151***	-0.006	-0.009**
	(0.066)	(0.044)	(0.081)	(0.049)	(0.007)	(0.004)
L.Successful	-0.077	-0.098	0.100	0.125*	-0.007	-0.010*
	(0.094)	(0.061)	(0.110)	(0.067)	(0.010)	(0.006)
L2.Successful	0.005	-0.031	-0.018	0.030	0.001	-0.003
	(0.079)	(0.048)	(0.096)	(0.060)	(0.009)	(0.005)
Year FE	✓	✓	✓	✓	✓	✓
County FE	✓	✓	✓	✓	✓	✓
Further Controls		✓		✓		✓
R-squared within	0.22	0.47	0.11	0.44	0.32	0.60
R-squared overall	0.00	0.02	0.02	0.02	0.00	0.01
Observations	2720	2704	2720	2704	2720	2704
Counties	544	544	544	544	544	544
Years	5	5	5	5	5	5
Mean Outcome	12.31	12.35	75.96	75.91	9.41	9.41
SD Outcome	3.62	3.60	5.04	5.02	0.41	0.40

Notes: The unit of observation is the county. Number of successful strikes and top 1% mean income are in logs. Further controls include urban population share, firm size, and agricultural employment share. Standard errors clustered on the district level displayed in parentheses. * p<0.1, ** p<0.05, *** p<0.01.
Sources: See Appendix A.

Table D.8: County-Year Income Inequality and Strikes in Construction, 2-Year-Periods

	Top 1% Share		Bottom 95% Share		Top 1% Mean Income	
	(1)	(2)	(3)	(4)	(5)	(6)
1899-1900						
Successful strikes	0.193	0.195	-0.177	-0.167	0.019	0.018
	(0.153)	(0.185)	(0.135)	(0.166)	(0.015)	(0.019)
Further Controls		✓		✓		✓
Observations	950	950	950	950	950	950
1900-1901						
Successful strikes	-0.128	-0.021	0.139	0.017	-0.010	0.000
	(0.095)	(0.096)	(0.114)	(0.106)	(0.009)	(0.011)
Further Controls		✓		✓		✓
Observations	930	930	930	930	930	930
1901-1902						
Successful strikes	0.070	0.084	-0.081	-0.112	0.011	0.007
	(0.116)	(0.137)	(0.163)	(0.172)	(0.013)	(0.013)
Further Controls		✓		✓		✓
Observations	986	986	986	986	986	986
1902-1903						
Successful strikes	-0.262**	-0.153*	0.318**	0.139	-0.019*	-0.008
	(0.111)	(0.084)	(0.137)	(0.098)	(0.010)	(0.008)
Further Controls		✓		✓		✓
Observations	988	988	988	988	988	988
1903-1904						
Successful strikes	-0.043	-0.042	0.091	0.075	-0.006	-0.005
	(0.086)	(0.062)	(0.086)	(0.071)	(0.010)	(0.007)
Further Controls		✓		✓		✓
Observations	948	948	948	948	948	948
1904-1905						
Successful strikes	0.033	0.082	-0.025	-0.069	-0.002	0.003
	(0.059)	(0.074)	(0.062)	(0.074)	(0.007)	(0.007)
Further Controls		✓		✓		✓
Observations	906	906	906	906	906	906

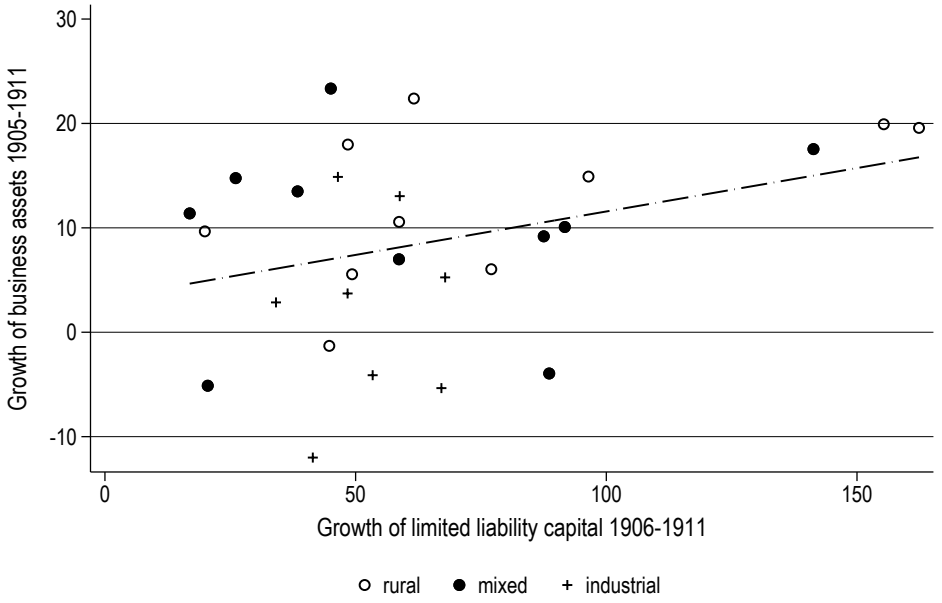
Notes: The unit of observation is the county. Standard errors clustered on the district level reported in parentheses. Sample into two-period samples 1899-1900, 1900-1901 etc. and restricted observations to counties that experienced no strikes in the first year. For some pairs of years, restricting observations to untreated counties in the first year leaves no observed strikes in the second year so that the coefficient is estimated as zero. Further controls: S total number of strikes, industry's employment share, agricultural employment share, share of urban population, and firm size. * p<0.1, ** p<0.05, *** p<0.01.
Sources: See Appendix A.

Table D.9: County-Year Income Inequality and Strikes in Mining, 2-Year-Periods

	Top 1% Share		Bottom 95% Share		Top 1% Mean Income	
	(1)	(2)	(3)	(4)	(5)	(6)
1899-1900						
Successful strikes	-0.171	-0.267	0.225***	0.277	-0.026**	-0.028
	(0.151)	(0.279)	(0.075)	(0.229)	(0.011)	(0.025)
Further Controls		✓		✓		✓
Observations	950	950	950	950	950	950
1900-1901						
Successful strikes	-0.254*	-0.314***	0.161	0.195*	-0.021	-0.027**
	(0.138)	(0.110)	(0.131)	(0.113)	(0.013)	(0.013)
Further Controls		✓		✓		✓
Observations	930	930	930	930	930	930
1901-1902						
Successful strikes	-0.169	0.357	0.240**	-0.371	-0.020*	0.039
	(0.105)	(0.476)	(0.110)	(0.544)	(0.011)	(0.059)
Further Controls		✓		✓		✓
Observations	986	986	986	986	986	986
1902-1903						
Successful strikes	-0.182***	-0.052	0.212***	0.075	-0.025***	-0.016
	(0.055)	(0.137)	(0.072)	(0.171)	(0.006)	(0.013)
Further Controls		✓		✓		✓
Observations	988	988	988	988	988	988
1903-1904						
Successful strikes	0.000	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)	(.)
Further Controls		✓		✓		✓
Observations	948	948	948	948	948	948
1904-1905						
Successful strikes	0.204	0.360	-0.151	-0.341	0.007	0.018
	(0.344)	(0.332)	(0.321)	(0.312)	(0.027)	(0.025)
Further Controls		✓		✓		✓
Observations	906	906	906	906	906	906

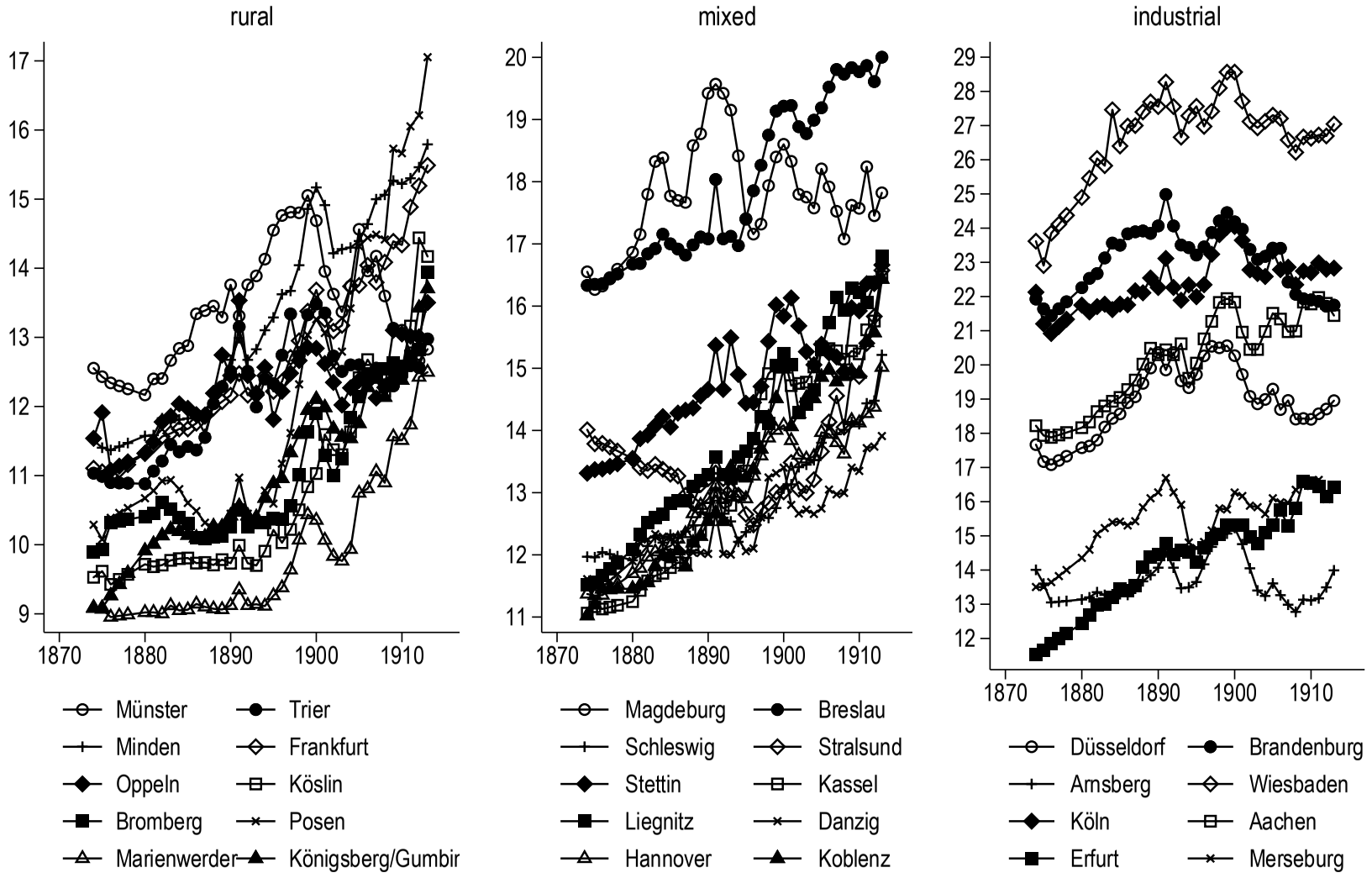
Notes: The unit of observation is the county. Standard errors clustered on the district level reported in parentheses. Sample into two-period samples 1899-1900, 1900-1901 etc. and restricted observations to counties that experienced no strikes in the first year. For some pairs of years, restricting observations to untreated counties in the first year leaves no observed strikes in the second year so that the coefficient is estimated as zero. Further controls: total number of strikes, industry's employment share, agricultural employment share, share of urban population, and firm size. * p<0.1, ** p<0.05, *** p<0.01.
Sources: See Appendix A.

Figure D.1: Corporate vs. Non-corporate Capital Accumulation, 1905/06.1911



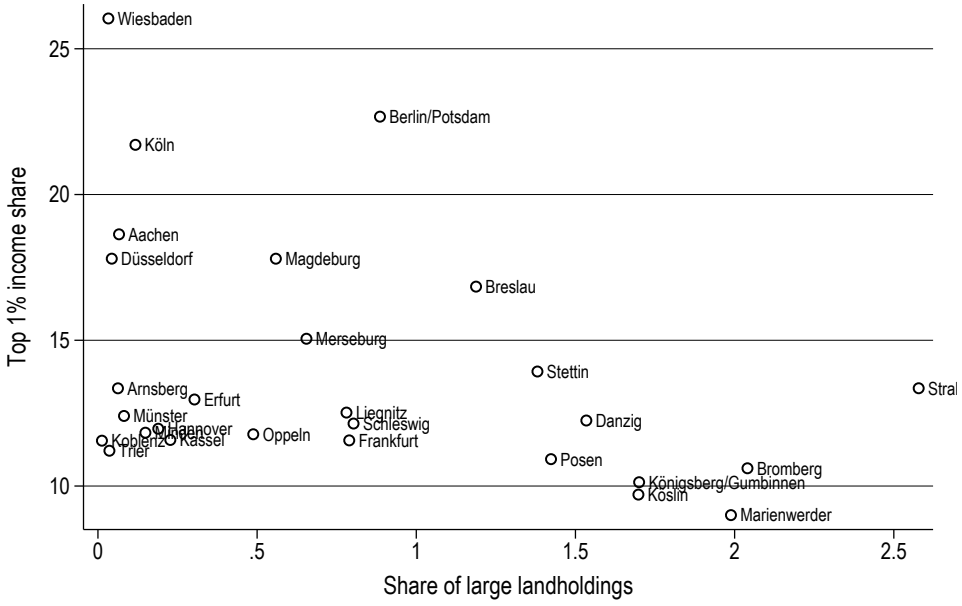
Notes: Aggregate capital growth in % compared to base year (1905 or 1906).
Sources: Limited liability capital (*Stammkapital GmbHs*) is from the *Statistisches Jahrbuch für den Preussischen Staat* 1907 (p.121) and 1912 (p.249). Business assets including all assets and rights of non-corporate firms operating in Prussia is from income tax records listed in Appendix A.26.

Figure D.2: Top 1% Income Share in Prussian Districts, 1874-1913

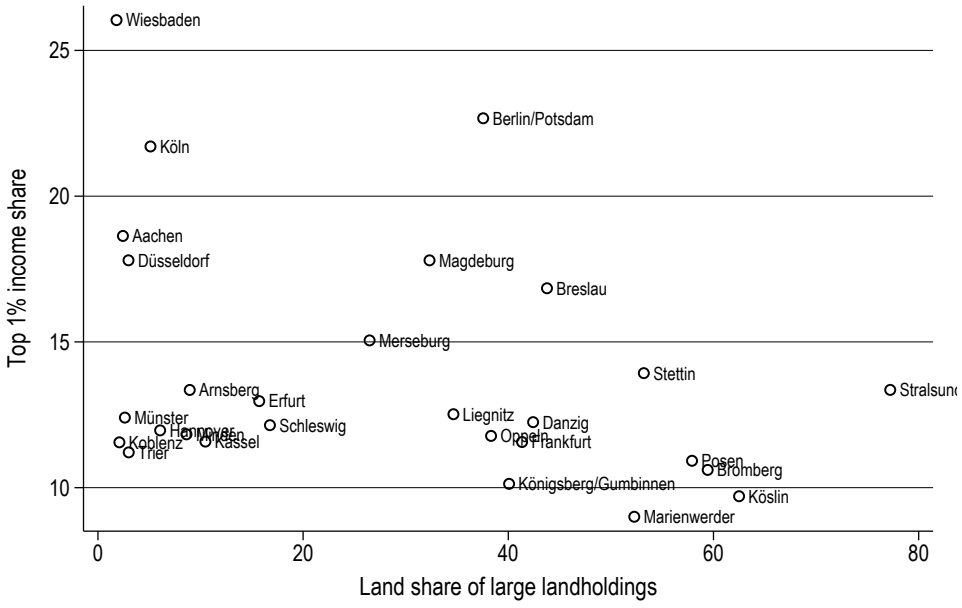


Notes: Top income share in %.
Sources: See Appendix A.

Figure D.3: Land Inequality vs. Income Inequality, 1882



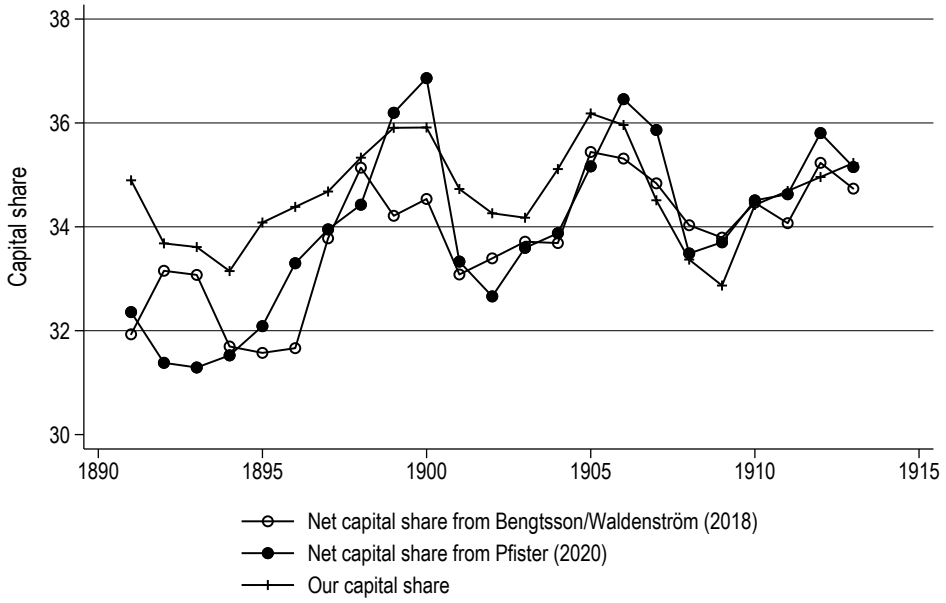
(a) Large landholdings and top 1%



(b) Land owned by large landholdings and top 1%

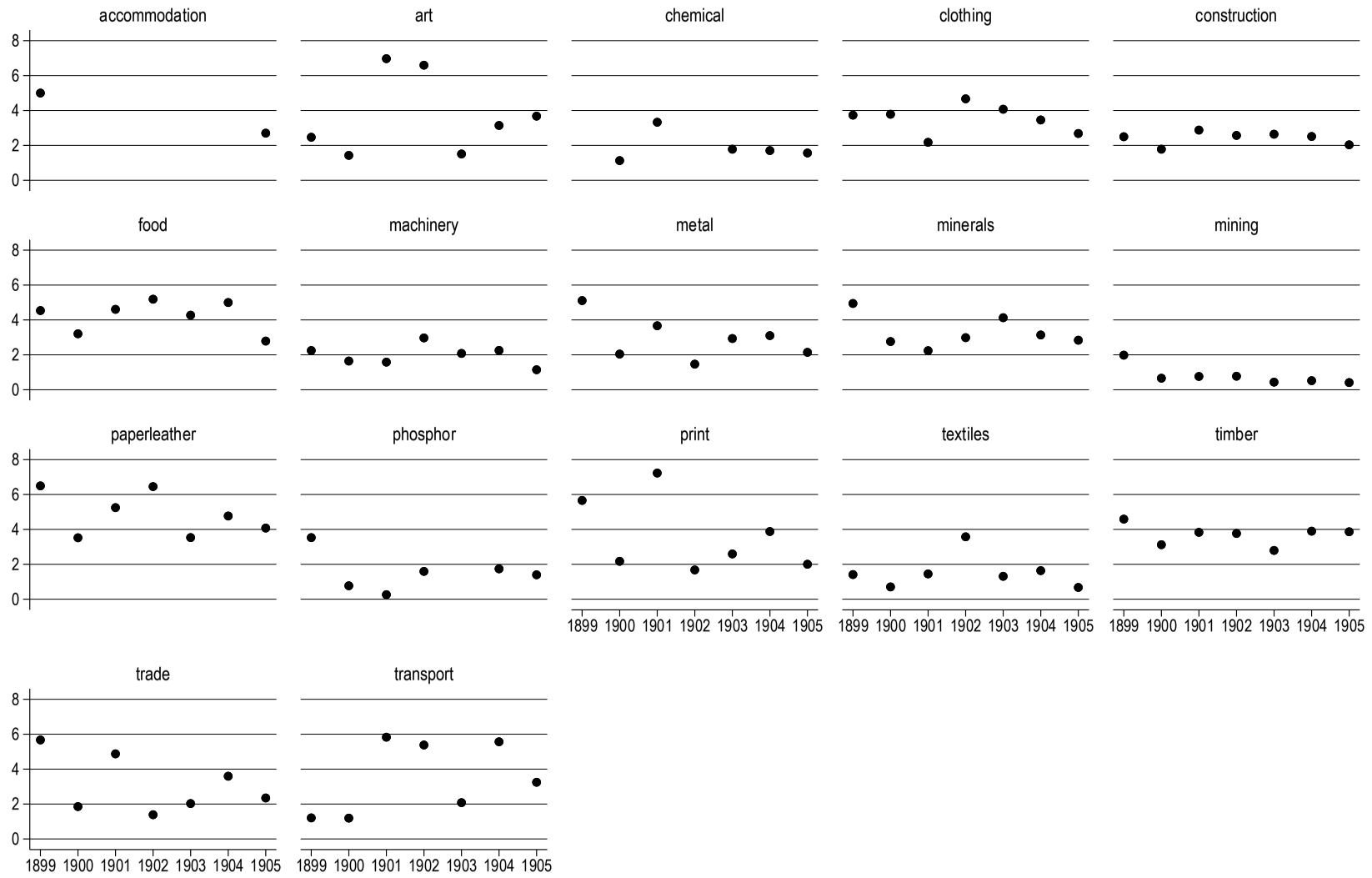
Notes: Top income share in %. Share of large landholdings in % as of 1882 is computed following Cinnirella and Hornung (2016) by dividing the number of landholdings with more than 75ha by the number of landholdings. Share of land owned by large landholdings is calculated by dividing the land owned by large landholdings by the agricultural area in one district.
Sources: See Appendix A and Cinnirella and Hornung (2016).

Figure D.4: Contrasting Different Capital Share Estimates, 1891-1913



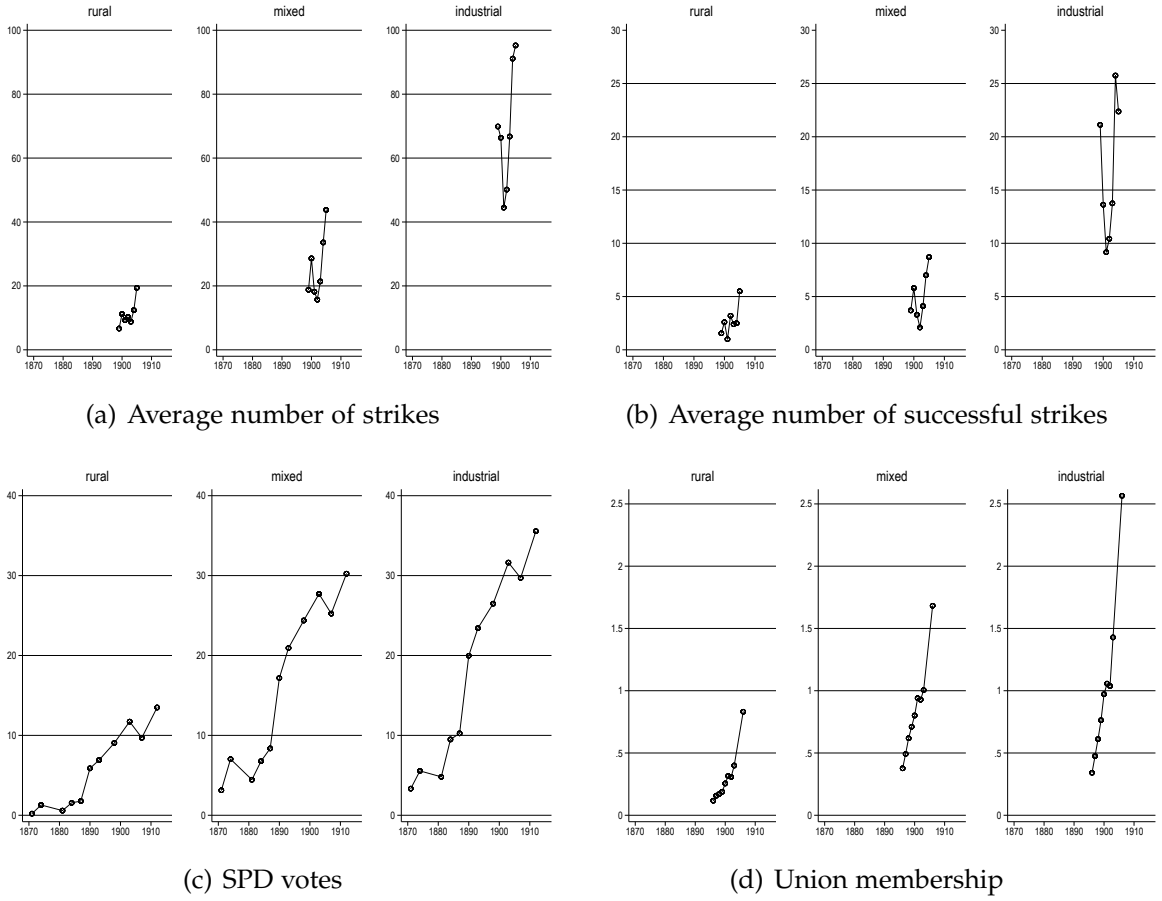
Notes: Capital share in %. Our estimate for Prussia. Capital shares from Bengtsson and Waldenström (2018) and Pfister (2020) are computed for the German Empire.
Sources: See Appendix C.5, Bengtsson and Waldenström (2018) and Pfister (2020).

Figure D.5: Cross-county Average of Strikes per 100 Workers, 1899-1905



Notes: Strikes per 100 workers in each sector. Annual average across counties.
Sources: See Appendix A.

Figure D.6: Socialist Activity by District Type, 1874-1913



(a) Average number of strikes

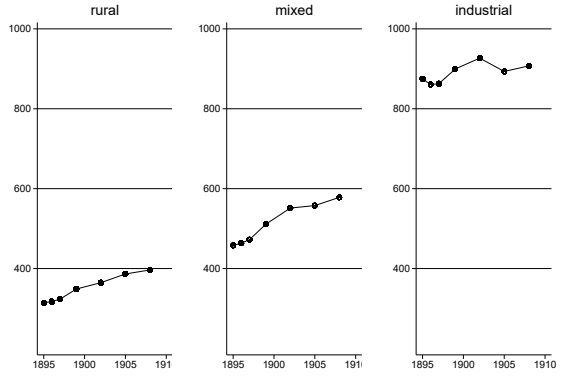
(b) Average number of successful strikes

(c) SPD votes

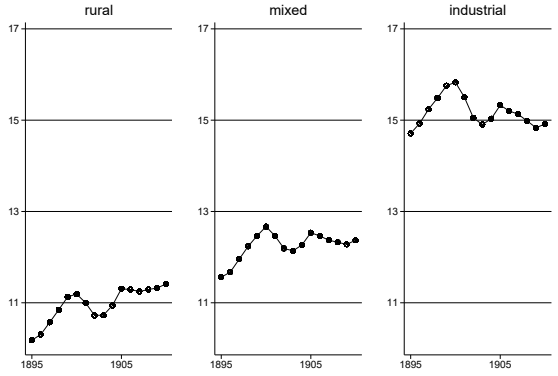
(d) Union membership

Notes: The graphs shows the average number of strikes (a), successful strikes (b), union membership among employees (c) by district type. Districts with more than 50% employment in agriculture in 1882 are classified as rural (left panel), districts with between 40% and 50% employment in agriculture in 1882 are classified as mixed (middle panel), and districts with less than 40% employment in agriculture in 1882 are classified as industrial (right panel).
Sources: See Appendix A.

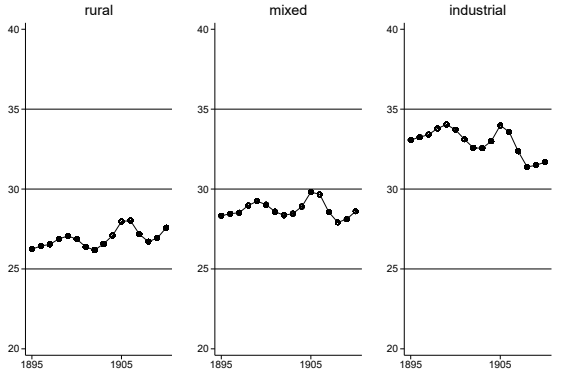
Figure D.7: Main Variables by County Type, 1895-1911



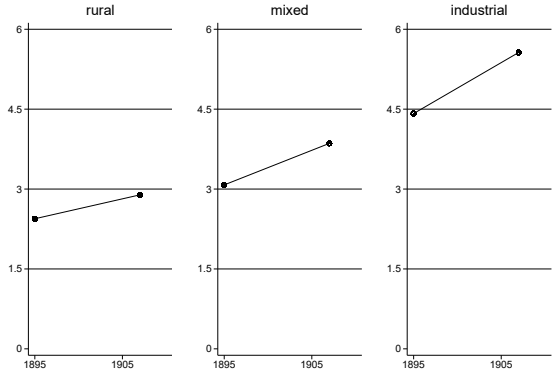
(a) Capital accumulation



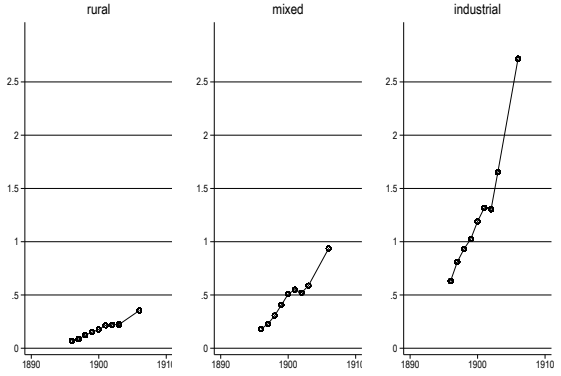
(b) Top 1% income share



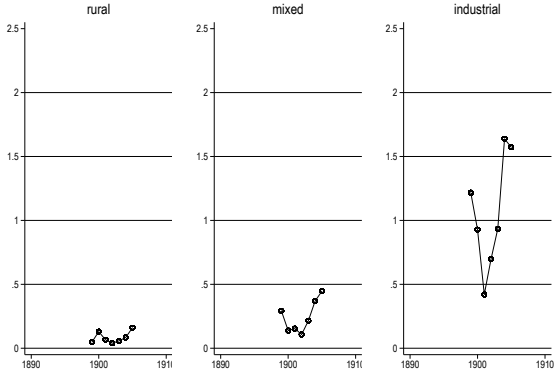
(c) Capital share



(d) Capital concentration



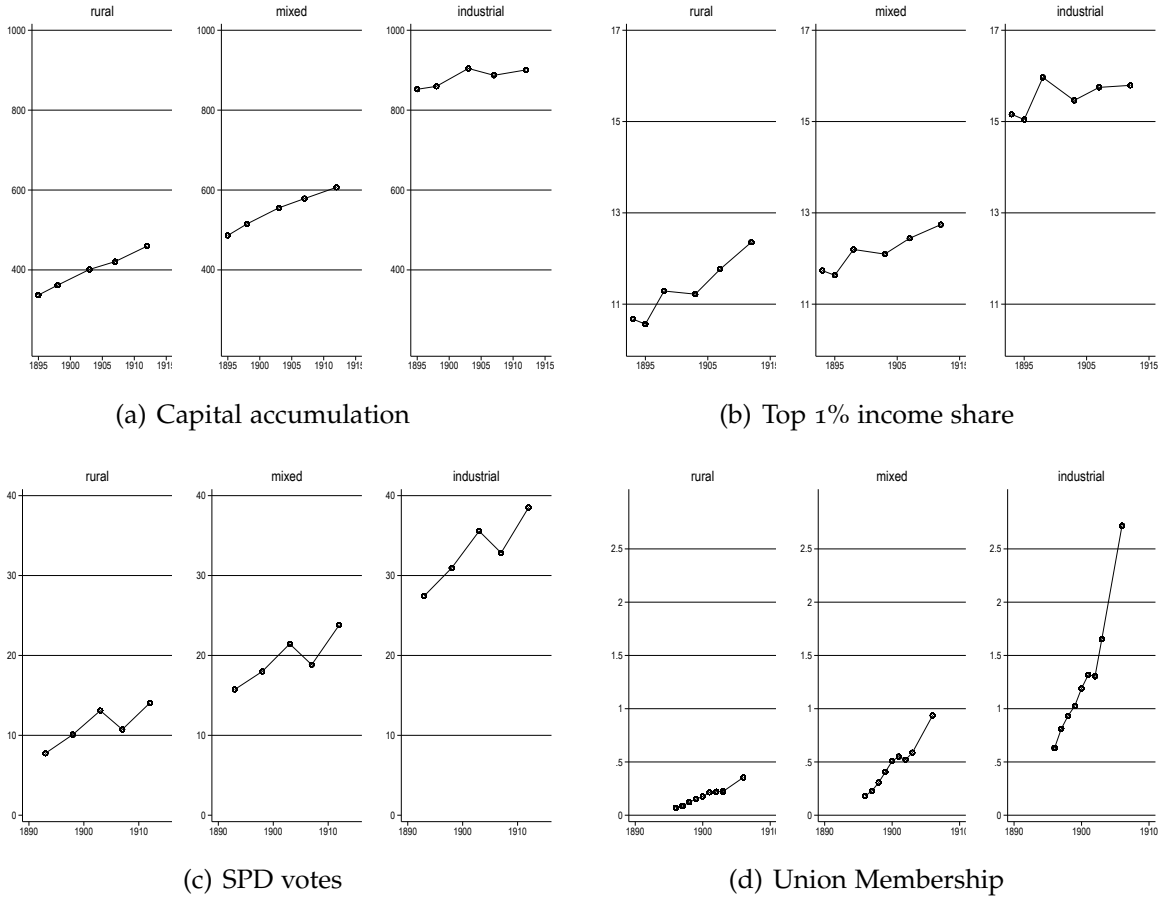
(e) Union membership



(f) Successful strikes

Notes: The graphs shows the top 1% income share (a), capital share (b), capital concentration (c), and votes for the SPD (d) by county type. Counties with more than 50% employment in agriculture in 1882 are classified as rural (left panel), counties with between 40% and 50% employment in agriculture in 1882 are classified as mixed (middle panel), and counties with less than 40% employment in agriculture in 1882 are classified as industrial (right panel).
Sources: See Appendix A.

Figure D.8: Main Variables by Constituency Type, 1895-1912



(a) Capital accumulation

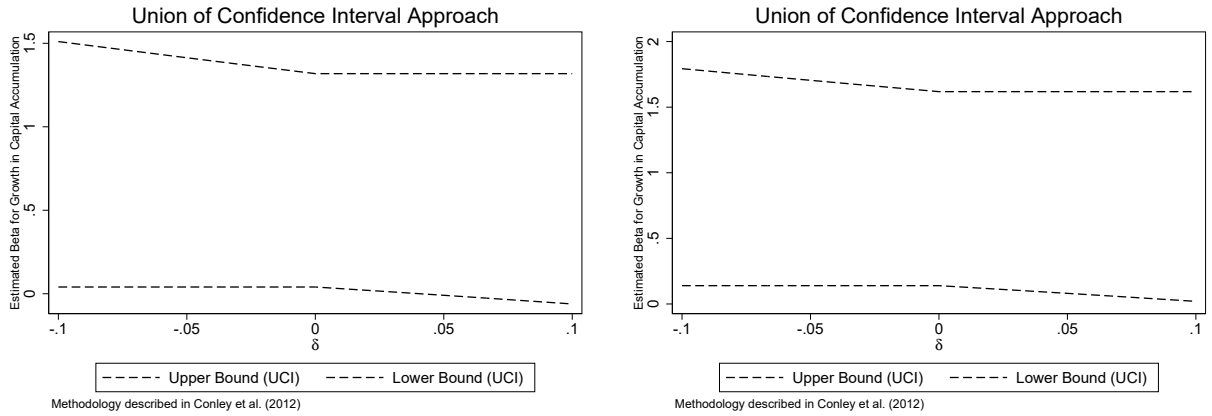
(b) Top 1% income share

(c) SPD votes

(d) Union Membership

Notes: The graphs shows the top 1% income share (a), capital share (b), capital concentration (c), and votes for the SPD (d) by constituency type. Constituencies with more than 50% employment in agriculture in 1882 are classified as rural (left panel), constituencies with between 40% and 50% employment in agriculture in 1882 are classified as mixed (middle panel), and constituencies with less than 40% employment in agriculture in 1882 are classified as industrial (right panel).
Sources: See Appendix A.

Figure D.9: Boundaries on IV Estimates under Plausible Exogeneity



(a) Results for Top 1% Income Share

(b) Results for Capital Share

Notes: This graph shows Conley et al. (2012) union of confidence interval boundaries for IV estimates of the impact of growth in capital accumulation on the top 1% income share (Panel a) and the capital share (Panel b). The specification corresponds to Table 2, panel 1, column 1 and Table 2, panel 2, column 1. We plot the estimated 95 percent confidence interval bounds for δ (-0.1, 0.1). To allow for better comparison, we standardize our instrument.
Sources: See Appendix A.

Figure D.10: Binscatters for Hypotheses 1-3

(a) Capital Share

(b) Top 1% Income Share

(c) Firm Size

(d) SPD votes

Notes: The graphs show binscatters for Hypotheses 1-3 using the stata command *binsreg* (Cattaneo et al., 2022) with quantile-spaced binning and controlling for residuals from the first-stage regression of capital accumulation on distance to coal (equivalent to a control function approach as described in Wooldridge (2015)). *Sources*: See Appendix A.

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