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# Business Concentration around the World: 1900-2020

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## ABSTRACT

We collect new data to document the long-run evolution of the firm size distribution in ten market-based economies in Asia, Europe, North America, and Oceania, where we can obtain comprehensive coverage of the population of firms. Around the world, we observe prevalent increases in the concentration of sales, net income, and equity capital over the past century. These trends hold in the aggregate and at the industry level. Meanwhile, employment concentration has been stable over the long run in most cases. The evidence shows that the rising dominance of large firms is a pervasive phenomenon, not limited to the recent decades or the United States, and that large firms often achieve greater scale without proportionally more workers.

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# I Introduction

The extent to which production can be accomplished through organizations and planning has been one of the most enduring themes in the history of economics. In the *Wealth of Nations*, Adam Smith envisioned a decentralized economy of small producers coordinated by the invisible hand. Over the next two and a half centuries, however, large firms emerged and gained prominence. As Coase (1937) described, "islands of conscious power" form in the "ocean of unconscious co-operation like lumps of butter coagulating in a pail of buttermilk." This development has inspired many observers to discuss and debate the span of control of the visible hand and the "centralization of capitals" (Marx, 1867; Marshall, 1890; Hayek, 1945; Galbraith, 1967; Arrow, 1974; Chandler, 1977; Lucas, 1978). But how far has the balance shifted toward large firms and how pervasive is it?

In this paper, we document two sets of facts about the evolution of the organization of production over the past century. These facts hold broadly, across a variety of market-based economies where we can find comprehensive long-run data on the firm size distribution. First, sales, net income, and equity capital have become increasingly concentrated in the largest firms. In many countries, the largest 1% firms by sales now account for around 80% of economy-wide sales, up from around 50% in the early 20th century. The long-run increases of concentration also hold at the industry level. Second, employment concentration has been relatively stable. The largest 1% firms by employees account for roughly 50% of economy-wide employment throughout the 20th century. One exception is retail/wholesale trade, where employment concentration has risen almost as much as sales concentration. These pervasive patterns defy the null that the firm size distribution would remain stable as economies evolve. They show that the rising dominance of large firms is a widespread phenomenon, not limited to the recent decades or the United States. Moreover, large firms scale not so much with labor, and possibly more with capital (except in industries like retail where expanding automation has been more challenging thus far).

We search through market-based advanced economies for long-run data on the firm size distribution. We focus on such economies to uncover the "organic" evolution of the organization of production (in environments that approximate "Smithian" capitalism), which is not heavily influenced by government interventions; they are also the primary countries where we can find high quality long-run data. Our search looks for comprehensive coverage of the business population from official sources (e.g., tax statistics or census), like the firm size distribution data for the U.S. from the Internal Revenue Service *Statistics of Income* in Kwon, Ma, and Zimmermann (2024). The raw data are predominantly tabulations of firms by size bins published by national statistics offices, and we check that the totals in these datasets match well with totals in national accounts. To estimate the share of top firms from these tabulations, we use the

generalized Pareto interpolation (Blanchet, Fournier, and Piketty, 2022), which fits a Pareto coefficient to each size bin and interpolates the Pareto coefficients.[1] In Kwon, Ma, and Zimmermann (2024), we checked that the top share estimates are over 0.99 correlated if we instead fit and interpolate lognormal distributions, or directly add up the top bins to a given number of businesses.

Our first set of results covers firm size by sales, net income, and equity capital, which we later contrast with firm size by employment. Along these dimensions, our data (outside the U.S.) come from European countries (Germany, Austria, France, Switzerland, Denmark, and the U.K.), Canada, Australia, Singapore, and South Korea. Each country may provide tabulations by one or multiple size metrics. All of these countries have data available since before the mid-1970s to present long-run evidence (so the trends are not just shaped by current events that have been scrutinized in recent work), and the earliest data start in 1901. We describe the data in detail in Section II.

In the aggregate economy, we observe a pervasive and persistent rise of large firms by sales, net income, and equity capital. We start with the top 1% share, which is the benchmark for evaluating the disparity of firm size in a number of models (Aghion et al., 2023; Hsieh and Rossi-Hansberg, 2023) and portable across countries that differ in size. For top shares by sales, we have data for Germany, Austria, France, Switzerland, and Denmark, along with the U.S. from Kwon, Ma, and Zimmermann (2024). The top 1% sales share was typically around 50% in the 1950s, and increased to around 80% by the 2010s. Indeed, the patterns are similar between the U.S. and the other countries. For top shares by net income, we have data for Australia, Canada, Singapore, along with the U.S. from Kwon, Ma, and Zimmermann (2024). In Australia and Canada, the top 1% net income share started from around 50% in the 1940s, increased to around 60% by the 1980s, and around 80% by 2000. In Singapore, we observe similar trends, just a few decades later. For top shares by equity capital, we have data for Germany, Denmark, and Switzerland. The top 1% equity capital share started at around 40% in the early 1900s, increased to around 60% by the 1980s, and over 70% later on. We check that the long-run trends are similar within the right tail (robust to small firms coming in and out of the left tail), such as the top 1% as a share of the top 10%.

We then present the economy-wide top 500 share as an illustration of top $N$ shares with a fixed $N$. In this case, the level would be generally higher for smaller countries.[2] For the time trends, we continue to

[1] For instance, if the tabulations are by size of sales, then we estimate the share of the largest firms by sales in overall sales. For tabulations by size of net income, we need to restrict to firms with positive income.

[2] In addition, the top $N$ share is trickier in settings where the size tabulations focus on corporations (but do not cover noncorporations like partnerships and proprietorships). Specifically, in the U.S. data (Kwon, Ma, and Zimmermann, 2024), we observe that the top $N$ share among all businesses, the top $x$% share among all businesses, and the top $x$% share among corporations have similar behavior, but the top $N$ share among corporations can behave differently in settings that experience changes in the prevalence of corporations. The reason is that when corporations become more common, for example, the total volume of corporations expands. As a result, the top $N$ share among corporations can change artificially due to the expanded denominator (whereas the top $x$% share among corporations is not sensitive to the issue because the numerator adapts too). To

observe pervasive and persistent increases in top shares by sales, net income, and equity capital around the world. To adjust for country size, we provide further results of top $N$ shares where $N$ in a given country and year is selected as 100 per one million population. In this case, the level in small countries such as Switzerland and Singapore aligns better with that in larger countries. We again observe upward trends over time.

We also collect industry-level data wherever possible, which mainly cover firms by size of sales. We have the most comprehensive tabulations from Germany, and present the top 1% and top 500 shares over time. In manufacturing, similar to what we observe in the U.S. (Kwon, Ma, and Zimmermann, 2024), the rise of large firms was stronger in the early 20th century, and top shares increased less since the 1980s. In services and retail/wholesale trade, top shares increased more in recent decades. For the U.K., where we have estimates of the share of the 100 largest manufacturing enterprises by net output from 1909 to 1992 (using Prais (1976) data for the early years and Census of Production data for the later years), we observe a substantial rise of the top share until the 1980s. The top 1% share (which can be constructed for size by net output from 1958 to 1992 and by sales since 1985) shows a similar pattern. Like the U.S. and Germany, the rise of large manufacturers in the U.K. was more substantial before recent decades. Meanwhile, for South Korea, where the development of manufacturing is more recent, the top 100 (500) share in manufacturing rose considerably in the last several decades, from around 20% (30%) in the early 1970s to around 45% (55%) by the early 2010s, as shown by data kindly shared by Choi et al. (2025).

Finally, for even more detailed industries, we are able to obtain official reports of concentration ratios that are reasonably consistent over the years in a few cases. In Germany, we are able to find CR10 for two-digit manufacturing industries since 1954 and for four-digit manufacturing industries since 1968, from various government reports. In Australia, we are able to find CR20 for two-digit manufacturing industries from 1968 to 1991, from various manufacturing census reports. These CRx values have increased in both cases.

Our second set of results turns to employment concentration, using tabulations of firm size by employment in the aggregate as well as at the industry level covering manufacturing and retail/wholesale trade when sectoral breakdown is possible (other industries such as services are not consistently defined over time). In this domain, we have the most comprehensive data from Germany and Switzerland since the 1920s in the aggregate and at the industry-level, along with aggregate data from France, and manufacturing data from U.K., Australia, and Korea. We also recently uncovered U.S. data on firm size by employment from census Enterprise Statistics publications, which have consistent coverage for manufacturing and

minimize the impact of the changing prevalence of corporations versus noncorporations, we estimate the size of all businesses for the denominator (using proxies of the corporate share), and we have to assume that the largest firms are all corporations (which may underestimate the top shares).

retail/wholesale trade since 1958. We use these series for the U.S. to complement the other long-run datasets (along with employment size distributions from the standard census Business Dynamic Statistics starting in 1978).

In the aggregate and in manufacturing, we observe that employment concentration has been relatively stable, measured using either top 1% or top 500 shares. In some cases, employment concentration appears to have declined slightly since the 1980s, such as France and U.K. manufacturing. The exception is retail/wholesale trade, where employment concentration has increased over the long run in countries with available data, with magnitudes similar to the increase in sales concentration.

The collection of these facts poses interesting puzzles. The pervasive increases in concentration by sales, net income, and equity capital are already striking, and the combination with largely stable concentration by employment is even more intriguing. In standard production functions where capital and labor are complements, concentration by sales, capital, and employment should move in the same direction: when firms expand, they would increase the use of all inputs. One possibility for the divergence of employment concentration is that large firms expand using capital through automation, rather than using labor. For example, the decline in the relative price of capital over time (correspondingly rising capital productivity) can stimulate more automation, especially among large firms as they are more inclined to pay the automation cost (Hubmer and Restrepo, 2025). If this force is sufficiently strong—which could be the case in manufacturing—then large firms expand more with capital rather than labor. If the scope for additional automation is limited—which could be the case in retail/wholesale trade so far—then standard complementarity between capital and labor implies that sales and employment concentration both increase (e.g., high productivity firms benefit more from the decline in capital price, and complementarity between capital and labor means that they become larger in sales, capital, and labor). We illustrate these forces in a simple model, and provide corroborating evidence (from U.S. Bureau of Economic Analysis data since the 1940s) that the capital to labor ratio has increased much more in manufacturing than in trade, which aligns with the predictions of the model mechanisms.[3]

Another hypothesis is that the divergence between sales and employment concentration might come from rising markups. One set of mechanisms highlights the reallocation of production towards large high markup firms (Autor et al., 2020). Another set of mechanisms emphasizes changes in regulations that can raise firms' markups (Gutiérrez, Jones, and Philippon, 2021). In both cases, it is not easy to explain substantial increases in concentration by capital inputs—with magnitudes similar to increases in the concentration by sales—while concentration by employment remains stable. In addition, most studies

[3]The automation mechanism we analyze relates to the decline of the labor share (Karabarbounis and Neiman, 2014; Hubmer and Restrepo, 2025), but the long-run trends of the labor share can be affected by additional forces as Hubmer (2023) points out, such as higher income leading to consumption of higher labor share goods and services (e.g., luxury products).

find that markups have increased primarily after the 1980s (De Loecker, Eeckhout, and Unger, 2020; De Loecker and Eeckhout, 2021), whereas our results hold since the early 1900s. It is also not obvious why employment concentration has nonetheless increased in retail/wholesale trade.

Lastly, a common hypothesis is that greater outsourcing by large firms can raise their sales without raising employment. In principle, outsourcing should increase sales (gross output) relative to value added (GDP): if firms outsource employment internationally, value added in a country should decrease for a given amount of sales; if firms outsource to others domestically, then for a given amount of value added, sales should increase from more intermediate steps. In national accounts, we observe stable ratios of gross output to GDP, for all of our sample countries with available data. If large firms systematically outsource more over time, such shifts should leave a noticeable mark in the national accounts data.

A natural question is how to think about country-level firm size distributions in the era of globalization. First, Melitz (2003) provides a classic framework for understanding the firm size distribution in a country in the presence of international trade. He suggests that trade could increase the size disparity of firms relative to autarky, as large and productive firms engage in exporting. In the data, we observe strong rising concentration before the age of globalization, and this phenomenon is not specific to a particular trade regime. Second, some might be interested in the global firm size distribution. This endeavor is challenging as we cannot easily aggregate across countries given their different size metrics and reporting conventions. In addition, some of the largest firms globally are influenced by political forces (e.g., Sinopec and Saudi Aramco are among the top ten firms by revenue globally). Firms in each country share more similar economic environments and are more easily comparable.

Our focus is the evolution of the firm size distribution in the economy, which is important for several reasons. First, trends in top firms' shares by sales, capital, and employment—simple statistics that can be estimated reliably over the long run—shed light on changes in the production function. Second, as the firm size distribution becomes more skewed, large firms play a greater role in shaping aggregate outcomes: shocks and frictions that affect them have stronger macroeconomic effects (Gabaix, 2011; Di Giovanni, Levchenko, and Mejean, 2014; Carvalho and Grassi, 2019; Crouzet and Mehrotra, 2020). Third, their increasing economic influence also makes the governance of these large enterprises more consequential (Berle and Means, 1932). Meanwhile, our focus is not competition or market power.[4] It is well recognized that concentration is not a barometer for market power (Demsetz, 1973; Syverson, 2019), and other studies perform extensive analyses of markups and market power (De Loecker, Eeckhout, and Unger, 2020;

[4]In addition, although economy-wide production concentration has been increasing, concentration in the market for a particular product or location may behave differently (Rossi-Hansberg, Sarte, and Trachter, 2021; Hsieh and Rossi-Hansberg, 2023; Benkard, Yurukoglu, and Zhang, 2023; Hoberg and Phillips, 2025), for example if large firms expand into more markets. It may also respond more to regulations at the product market level (Affeldt et al., 2021).

De Loecker and Eeckhout, 2021; De Ridder, 2024). We document that the organization of production has evolved substantially over the long run, but we do not aim to adjudicate whether the rise of large firms is good or bad. Interestingly, across the countries and time periods in our sample, higher concentration of production is not necessarily accompanied by higher inequality among households (Atkinson and Piketty, 2007; Alvaredo et al., 2024), which suggests that their determinants can be different.

**Literature review** Our paper provides new facts about the long-run evolution of economic activities. Changes in production concentration have drawn much attention in recent research. Several influential papers highlight rising industry concentration in the U.S. since the 1980s (Autor et al., 2020; Covarrubias, Gutiérrez, and Philippon, 2020). Recent work using European data has focused on the post-2000 period (Bell and Tomlinson, 2018; Bighelli et al., 2023; Bajgar et al., 2023; Gutierrez and Philippon, 2023; Kalemli-Özcan et al., 2024). Early studies provide some snapshots of production concentration in certain years for the initial decades of the 20th century (Means et al., 1939; Blair, Houghton, and Rose, 1946; Adelman, 1951; Kaplan, 1954; Collins and Preston, 1961; Federal Trade Commission, 1969; Prais, 1976; Khemani, 1980), but systematic long-run evidence is sparse.

The main precedent (to our knowledge) of comprehensive long-run data on the firm size distribution is our previous work (Kwon, Ma, and Zimmermann, 2024), which covers the U.S. from 1918 to 2018. A natural question is whether the long-run increase in production concentration is unique to the U.S. This question also relates to the growing body of studies that investigate the mechanisms behind rising concentration, including technology, globalization, regulation, and demographics (Sutton, 1991, 1998; Brynjolfsson et al., 2008; Bessen, 2020; Ganapati, 2021; Hopenhayn, Neira, and Singhania, 2022; Aghion et al., 2023; Hsieh and Rossi-Hansberg, 2023; Akcigit and Ates, 2023; Lashkari, Bauer, and Boussard, 2024; Peters and Walsh, 2024; Hubmer and Restrepo, 2025; Choi et al., 2025; Firooz, Liu, and Wang, 2025; Crouzet et al., 2025; Kroen et al., 2025). Is the increasing prominence of large firms due to the policies or demographics of the U.S., or economic forces that apply more generally? The pervasive long-run trends we document suggest that broad-based economic forces are important to consider. Moreover, the divergence of concentration by sales, net income, and equity capital compared to concentration by employment is not easy to explain by standard production functions with complementarity between capital and labor, and presents an interesting puzzle that can guide future analyses about the evolution of production technologies. At the same time, each country and each decade can be influenced by additional factors, and our findings about the general trends complement studies that analyze specific settings.

The rest of the paper is organized as follows. Section II describes the data sources. Section III presents the main results. Section IV concludes.

# II Data

This section explains data sources and variable construction. Section II.A describes our data coverage, measurement objectives, and each of the main datasets we use. Sections II.B and II.C describe how we build the top share measures.

## II.A Sources and Coverage

Our large-scale data collection starts with countries that approximate market-based economies: we search through official sources in OECD countries and look for tabulations of firm size that have comprehensive and consistent coverage over the long run. We focus on such economies to uncover the "organic" evolution of the organization of production, which is not heavily influenced by government interventions such as through state-owned enterprises like in China (Liu and Chen, 2025). These are also the primary countries where we can find high quality long-run data.

We have been able to obtain high quality long-run data for the list of countries summarized in Table 1. The column "Size Bin Type" shows the size measure available in the tabulations. The column "Firm Type" shows the types of firms covered, such as corporations or all types of firms (including corporations and noncorporations). The column "Year" shows the time span. All the sample countries have data available since before the mid-1970s to provide long-run evidence (so the results are not just shaped by current events that have been scrutinized in recent work).[5] The frequency is mostly annual, except for occasional gaps (especially in early years). The column "Source" references further elaborations of the underlying data sources. In Appendix IA2, we provide detailed information about the sources, scope, as well as the definition of firms and size metrics in each country's data. Our focus is the firm size distribution—by "business concentration," we mean the extent to which a small set of top businesses account for a large share of production output, capital, or employment. Our focus is not concentration in specific product markets, which are more difficult to define,[6] and it is well recognized that concentration is not a metric for market power (Demsetz, 1973; Syverson, 2019).

Some recent research has been interested in the concentration of control through common ownership, given the rise of large asset managers (e.g., Vanguard, BlackRock) that own a significant fraction of shares across multiple firms (see Schmalz (2018) and Backus, Conlon, and Sinkinson (2019) for reviews of the

[5] Although we are interested in data before 1900, so far we have not been able to find good sources at the firm level; some census data exist at the establishment level (Hornbeck et al., 2025).

[6] Correspondingly, our data on firm size distribution focus on firms based in a given country, and we do not calculate "market shares" which would include imports in addition to domestic production.

Table 1 – Data Coverage

| Country | Size Bin Type | Firm Type | Year | Source |
|---|---|---|---|---|
| Australia | By net income<br>By employment | Corporations<br>All (manufacturing) | 1940–2020<br>1968–2005 | See Table IA1 |
| Austria | By sales | All | 1954–2020 | See Table IA2 |
| Canada | By net income | Corporations | 1944–1987 | See Table IA3 |
| Denmark | By capital<br>By sales | Corporations & LLCs<br>All | 1902–2018<br>1970–2020 | See Table IA4 |
| France | By sales<br>By employment | All (industrial & commercial)<br>All | 1949–1998<br>1966–1998 | See Table IA5 |
| Germany | By capital<br>By sales<br>By employment | Corporations & LLCs<br>All<br>All | 1904–1992<br>1926–2019<br>1925–2018 | See Table IA6 |
| Korea | By sales<br>By employment | Corporations (manufacturing)<br>Corporations (manufacturing) | 1972–2011<br>1972–2011 | Choi et al. (2025) |
| Singapore | By net income | Corporations | 1972–2022 | See Table IA7 |
| Switzerland | By capital<br>By sales<br>By employment | Corporations & LLCs<br>All<br>All | 1901–1985<br>1965–2021<br>1929–2022 | See Table IA8 |
| U.K. | By net output<br>By sales<br>By employment | All (manufacturing)<br>All (manufacturing)<br>All (manufacturing) | 1909–1992<br>1985–2022<br>1958–2022 | See Table IA9 |

*Notes:* This table summarizes the coverage of firm size distribution data for each country.

common ownership literature). Such common ownership driven by large asset managers is unlikely to affect most of our sample period (before index funds became prominent) and sample firms (the vast majority are not publicly listed).[7]

### II.A.1 Size by Sales, Net Income, and Equity Capital

We start with data on firm size by financial variables, including sales, net income, and equity capital, which we use in Section III.A. Below we explain the data across five groups of countries based on the similarity of data sources: 1) Germany, Austria, and France, 2) Denmark and Switzerland, 3) Australia, Canada, and Singapore, 4) United Kingdom, and 5) South Korea. Some of these tabulations have a minimum size threshold, and a possible question is whether such thresholds affect the denominator of top shares (they would not affect the numerator which are the largest firms). For tabulations by sales, they typically

[7] Some countries have holding companies or business groups that control multiple operating companies. Although it is difficult to verify the exact reporting details, the treatment in our data should be consistent over time since total sales relative to GDP and gross output are stable. If individual operating companies are consolidated more or less over time, then it would likely change total reported sales to GDP.

cover all types of firms and the thresholds are associated with the minimum size for filing sales tax or value added tax: we check that our coverage is comprehensive (and small firms below the size threshold have minimal impact on total sales) by comparing totals in our data with totals in national accounts (e.g., total GDP and gross output). For tabulations by net income and capital, they typically cover corporations (and limited liability companies), and we adjust for their share in the total economy to get a more comprehensive denominator as we elaborate in Section II.C.

**Germany** We use two types of tabulations for Germany. First, we have tabulations by size of sales for all types of firms from 1926 to 2019, published by the German statistical office (see Table IA6 for detailed descriptions of the sources). We obtain physical books of the publications before 1935 through the German National Library (Statistisches Reichsamt, 1931, 1932, 1938), and download PDFs afterwards through the digital statistical library of the Statistisches Bundesamt (Statistisches Bundesamt, 1955-1961, 1962-1976, 1978-2011, 2012-2022*a*); we then transcribe the data. The tabulations are based on information from the sales tax and value added tax (VAT), which all firms have to pay if their sales exceed a pre-specified threshold. The threshold was 8,000 Deutsche Mark in 1958, 20,000 Deutsche Mark by 1980, and 17,500 Euros by 2003 (see Appendix IA2.6 for more details).[8] The tabulations sort firms based on total sales (including both taxable and tax-exempt sales) in Germany. Exports are included, but foreign sales (place of supply and place of delivery entirely abroad) are not included in the statistics. Before 1945, the tax statistics cover firms from the entire German Reich. After 1945, the statistics cover West Germany. West Berlin is included from 1957 onward, the Saarland from 1960 onward, and East Germany from 1992 onward. Since sales in East Germany were less than 15% that of West Germany around the time of the reunification (see 1992 issue of Statistisches Bundesamt, 1978-2011), this change does not have a material impact on total sales or top shares. Figure IA15 shows that the ratio of total sales in our data relative to GDP is around two, and relative to gross output is around one in years when gross output data are available (gross output in national accounts—which is the counterpart of sales—is typically twice the level of GDP); this check verifies that the coverage of our data is comprehensive and consistent over time.[9]

Second, we have tabulations by size of equity capital for corporations and limited liability companies (LLCs) from 1936 to 1992, published by the German statistical office (see Table IA6 for detailed descriptions of the sources). We download PDFs from the statistical library of the Statistisches Bundesamt (Statistisches Reichsamt, 1937-1942; Statistisches Bundesamt, 1956-1981, 1957-1960, 1987-1994), and transcribe the

[8]The tabulations in some years before 1958 have a minimum threshold while others do not. For the years when there is no minimum threshold, we set the thresholds to maintain consistency over time. For the years between 1955 and 1958, we set this threshold to 8,000 Deutsche Mark to be consistent with later years. For 1950, we set the threshold to 6,000 Deutsche Mark (since 8,000 is not a size bin threshold in that year). For the years until 1935 that use a different currency, we set this threshold to 5,000 Reichsmark.

[9]Trade margins tend to make the total sales of firms slightly larger than gross output in national accounts.

data. To extend the German data further back in time we incorporate tabulations for Prussia from 1904 to 1920 published by the Prussian statistical office, following the approach of other studies producing long-run data for Germany (e.g., Albers, Bartels, and Schularick, 2025).[10] We obtain physical books of the Prussian statistical yearbook from the ZBW Library in Kiel and download PDFs from HathiTrust (Königliches Statistisches Landesamt, 1905-1923); we then transcribe the data. The information in the tabulations by equity capital comes from the company register for corporations and limited liability companies.[11] To register a corporation, a minimum capital threshold was introduced at 5,000 Mark in 1884. In 1923, the threshold was set at 5,000 Goldmark for existing firms and 50,000 Goldmark for new firms; the minimum capital threshold was raised to 500,000 Reichsmark in 1937, and reset to 100,000 Deutsche Mark after 1965. For LLCs, the minimum was 20,000 Mark (since this legal form was introduced in 1892), and was raised to 50,000 Deutsche Mark in 1980. After the Prussia years, the data for 1936 to 1941 cover the entire German Reich. Starting in 1955, the statistics cover West Germany. The Saarland is included since 1962, West Berlin since 1964, and East Germany since 1992.

**Austria** The Austrian sources offer tabulations by size of sales for all types of firms starting in 1954, published by the Austrian statistical office (see Table IA2 for detailed descriptions of the sources). We obtain physical books from the German National Library before 2012 (Österreichischen Statistischen Zentralamt, 1958; Österreichisches Statistisches Zentralamt, 1960-1980; Österreichischen Statistischen Zentralamt, 1977-1999; Statistik Österreich, 2000; Statistik Austria, 2001-2014), and download PDFs from the website of the Austrian statistical office afterwards (Statistik Austria, 2015-2023*a*); we then transcribe the data. The information in the size tabulations comes from the sales tax and the VAT, which all firms have to pay if their sales exceed a pre-specified threshold. The threshold was 1,500 Schillings in 1954, 40,000 Schillings in 1973, 30,000 Euros in 2018, and 35,000 Euros in 2020. The tabulations sort firms based on total sales (including both taxable and tax-exempt sales) in Austria. This includes exports, but excludes foreign sales. Figure IA10 shows that the ratio of total sales in our data relative to GDP is around two, and relative to gross output is around one in years when gross output data are available; this check verifies that the coverage of our data is comprehensive and consistent over time.

**France** For France, we have tabulations by size of sales for industrial and commercial (Bénéfices Industriels et Commerciaux, or BIC) firms from 1949 to 1998, published by the French statistical office (Insee) (see Table IA5 for detailed descriptions of the sources). The data exclude noncommercial (Bénéfices Non Commerciaux, or BNC) firms (e.g., self-employed professionals like doctors and lawyers) and agriculture

[10] An additional tabulation for the number of firms by size of capital for the whole of Germany was published for 1909 (Statistisches Reichsamt, 1910). The resulting top 1% share by capital is very similar to those based on the Prussian data.

[11] The German and Prussian tabulations are based on nominal equity capital, which is the total amount of shares multiplied by their par value.

(Bénéfices Agricoles, or BA) firms.[12] We stop in 1998 because size tabulations up to this point include finance, but tabulations afterwards exclude finance. We obtain physical books from the University of Chicago Library (Institut National de la Statistique et des Études Économiques, 1954-1984) and download PDFs from Gallica (Institut National de la Statistique et des Études Économiques, 1953, 1954-2000), which is the digital library of the French national library; we then transcribe the data. The tabulations are based on information from the corporate tax and the personal income tax on industrial and commercial profits. Sales capture the total revenue generated by a firm in French territories, including exports. Figure IA14 shows that the ratio of total sales in our data relative to GDP is around two, and relative to gross output is around one in years when gross output data are available.

**Denmark** We use two types of tabulations for Denmark. First, we have tabulations by size of equity capital for corporations since 1902, as well as LLCs after they were introduced in 1974, from Statistics Denmark (see Table IA4 for detailed descriptions of the sources). We download PDFs of these publications from Statistics Denmark (Danmarks Statistik, 1903-1975, 1928-1932, 1984-1987), and transcribe the data. The tabulations are based on information from corporate register data. In addition, for 1989 to 2018, we directly obtain customized estimates of top 1% and top 500 shares by book equity from Statistics Denmark (Danmarks Statistik, 2025*b*). These series are compiled using accounting data in annual reports, which all corporations and LLCs are required to file at the Danish Ministry of Economic and Business Affairs (Bennedsen et al., 2007).[13] In 1977, a minimum capital size requirement of 100,000 Kronor for corporations and 30,000 Kronor for limited liability companies was introduced. The thresholds were raised to 300,000 Kronor for corporations and 80,000 Kronor for LLCs in 1983, and 500,000 Kronor for corporations and 200,000 Kronor for LLCs in 1991. The thresholds were then reduced to 125,000 Kronor for LLCs in 1996, 80,000 Kronor in 2010, and 50,000 Kronor in 2014.

Second, we have tabulations by size of sales for all types of firms (not just corporations and LLCs) since 1970, from Statistics Denmark (see Table IA4 for detailed descriptions of the sources). Between 1970 and 1999, we use publications on VAT from Statistics Denmark; these tabulations were discontinued in 2000. We download PDFs from Statistics Denmark (Danmarks Statistik, 1973-1981, 1983-2001*b*), and

[12] After 1981, the tabulations by size only included firms that belong to the Bénéfices Réels Normal (BRN) tax regime, but not smaller firms that belong to the Régime Social des Indépendants (RSI) tax regime; before then both types were combined in the Bénéfices Réels (BR) tax regime and included in the tabulations by size. The tabulations by size of sales do not cover firms that belong to the Forfait (FORF) tax regime, which are small in size. To maintain consistency, in years when RSI firms are not included in the size tabulations, we assign all of them to the size bin that corresponds to their average size; we also assign all FORF firms to the size bin that corresponds to their average size. This assumption should not affect top share estimates because RSI and FORF firms by definition have low sales, so they matter little for the numerator of top shares.

[13] The tabulations use the value of paid-in capital until 1964, and subscribed capital since 1965. Subscribed capital is the total amount of shares that investors have agreed to purchase times their par value; paid-in capital is the portion of that amount that has actually been paid to the firm. Both concepts are comparable in magnitude. From 1989 onward, the data are based on firms' reported book equity.

transcribe the data. The tabulations are based on information from the VAT (introduced in Denmark in 1967). Between 2000 and 2020, we obtain customized tabulations by sales directly from Statistics Denmark. These tabulations are compiled based on the Danish business register. They are restricted to active businesses, with the definition of active businesses (industry specific sales cutoffs) changing over time (Danmarks Statistik, 2020). We set a 100,000 Kronor threshold for the years prior to 2000 and drop all returns with zero or negative sales to generate consistent coverage for the entire sample period. The Danish tabulations by sales capture total domestic sales and exports, but exclude other foreign activities. Figure IA12 shows that the ratio of total sales in our data relative to GDP is around two, and relative to gross output is around one; this check verifies that the coverage of our data is comprehensive and consistent over time.

**Switzerland** We also use two types of tabulations for Switzerland. First, we have tabulations by size of equity capital for corporations since 1901, as well as LLCs after they were introduced in 1937 until they end in 1985, published by the Swiss statistical office (see Table IA8 for detailed descriptions of the sources). We download PDFs of the Statistical Yearbook and special issues on joint stock corporations from the Swiss statistical office (Eidgenössisches Statistisches Amt, 1934, 1922-1986); we then transcribe the data. The tabulations are based on analyses of corporations and LLCs recorded in the Business and Enterprise Register.[14] In 1937 a minimum capital requirement of 50,000 Francs was introduced for newly formed corporations and 20,000 Francs for LLCs (corporations with less capital continued to operate, but gradually disappeared in the 1940s, and disappeared entirely by 1952).

Second, we have tabulations by size of sales for all types of firms since 1995, published by the Federal Tax Administration in an annual volume on VAT statistics (see Table IA8 for detailed descriptions of the sources). We download PDFs from the Swiss statistical office (Eidgenössische Steuerverwaltung, 1997-2023), and transcribe the data. The tabulations are based on information from the VAT (introduced in Switzerland in 1995). These Swiss tabulations by sales use total sales of Swiss firms, including their foreign sales. This is different from the tabulations by sales in Austria, Germany, and Denmark, which do not include foreign sales. In addition, the Swiss statistical office published a tabulation of firms by sales size, based on the Establishment Census in 1965 (Eidgenössisches Statistisches Amt, 1967). Sales in this year do not include foreign sales. Figure IA18 shows the coverage of the sales tabulations for Switzerland. This ratio of sales in our data relative to gross output has increased from around 1.2 in 1995 to around 2.6 in 2020, which is higher than other countries in our data. This is likely due to the rise of foreign sales (which are not part of GDP or gross output), which are present in the data for Switzerland but not much in other

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[14] The Swiss tabulations by capital are based on nominal equity capital, which is the total amount of shares multiplied by their par value.

by sales tabulations.

**Australia** For Australia, we have tabulations by size of taxable income for corporations since 1940 from *Taxation Statistics* published by the Australian Taxation Office (see Table IA1 for detailed descriptions of the sources). We download PDFs from the National Library of Australia until income year 1993-1994 (Australian Taxation Office, 1944-1961, 1962-1995) and transcribe the data; we download data in Excel spreadsheets from `data.gov.au` afterwards (Australian Taxation Office, 2016-2023*a*). The tabulations are based on information from the corporate income tax. The data cover corporations with positive taxable income. Nonresident corporations are also included in the tabulations.

**Canada** For Canada, we have tabulations by size of taxable income for corporations between 1944 and 1964 from *Taxation Statistics* published by the Department of National Revenue, and between 1969 and 1987 from *Corporation Taxation Statistics* published by Statistics Canada (see Table IA3 for detailed descriptions of the sources). We obtain physical books from the University of Chicago Library (Department of National Revenue, 1944-1964; Statistics Canada, 1969-1987), and transcribe the data. The tabulations are based on information from the corporate income tax, and cover corporations that file a T2 corporation income tax return. Banks and insurance companies are excluded between 1944 and 1964; correspondingly, we use tabulations for total nonfinancial industries for 1969 to 1987 to maintain consistency. Before 1964, corporations with gross revenue less than $2,000 were generally excluded from the tabulations; from 1985 to 1987, corporations with assets less than $50,000 and sales less than $10,000 were excluded from the tabulations (see Appendix IA2.3 for more details). The data include both resident and nonresident corporations.

**Singapore** For Singapore, we have tabulations by size of taxable income for corporations since 1972, published by the Department of Statistics using data from the Inland Revenue Department and the Inland Revenue Authority (see Table IA7 for detailed descriptions of the sources). We download PDFs from the Singapore National Library before 2005 (Singapore Department of Statistics, 1972-2004) and transcribe the data; we download data in Excel spreadsheets from the website of the Inland Revenue Authority of Singapore (IRAS) since 2005 (Inland Revenue Authority of Singapore, 2005-2007, 2008-2022). The tabulations are based on information from the corporate income tax. The data include both resident and nonresident corporations.

**U.K. (manufacturing)** Our analysis for the U.K. focuses on manufacturing due to data availability. We use two types of tabulations (see Table IA9 for detailed descriptions of the sources). First, we have tabulations by size of net output (value added) for private sector enterprises employing 100 or more persons, from the Census of Production between 1958 and 1992. For the numerator, it is reasonable to assume that

the largest manufacturers have more than 100 employees. For the denominator, we then collect information about the total number of enterprises and total net output in manufacturing from separate summary tables. We download PDFs from the LSE digital library (Board of Trade, 1960-1973; Department of Industry Business Statistics Office, 1973-1992), and transcribe the data. Prais (1976) provides additional estimates of the share of the 100 largest enterprises in manufacturing by net output for selected years since 1909. The solid line with circles in Figure IA20 shows that net output in our data relative to U.K. manufacturing GDP is stable at one.

Second, we have tabulations of the number of businesses by size of turnover (sales), from the *Size Analyses of United Kingdom Businesses* published by the Great Britain Business Statistics Office since 1985. We obtain physical books from Harvard University Library and Stanford University Library before 1998 (Department of Trade and Industry, Business Statistics Office, 1985-1997), and transcribe the data; we download data in Excel spreadsheets from the Office for National Statistics afterwards (Office for National Statistics, 1998-2003, 2004-2013, 2015-2022*a*). These data are based on VAT returns submitted to HM Customs and Excise. They cover VAT-registered enterprises, and the registration has a time-varying minimum turnover threshold (enterprises below the threshold are excluded before 1992 and are included afterwards if they have chosen to register voluntarily or not to de-register). The data represent total U.K. turnover, "including exempt and zero-rated supplies" (Office for National Statistics, 1998-2003), which suggests that exports are included and foreign sales are excluded. The dashed line with diamonds in Figure IA20 shows that turnover in our data relative to U.K. manufacturing gross output is stable at around one; this check verifies that the coverage of our data is comprehensive and consistent over time.

**South Korea (manufacturing)** Choi et al. (2025) collect data on the largest manufacturers in Korea. They kindly shared estimates of the largest 100 and 500 manufacturers by sales in total manufacturing gross output. Their data start in the 1970s and end in 2011. For 1972 to 1982, they digitize the historical Annual Reports of Korean Companies published by the Korea Productivity Center. For 1982 to 2011, they obtain data from KIS-VALUE, which covers firms with assets above three billion Korean Won, for which reporting balance sheet data is mandatory.

**CRx in detailed industries** We are able to find CRx data for detailed manufacturing industries reported reasonably consistently over time in a few instances. First, for Germany, we have CR10 for two-digit manufacturing industries since 1954, and for four-digit manufacturing industries since 1968. The data come from reports by the Federal Cartel Office and the Monopolies Commission for 1954 to 1982 (Statistisches Bundesamt, 1985), and the German statistical office's Fachserie 4.2.3 publications for 1983 to 2016 (Statistisches Bundesamt, 1986-2018); we download PDFs from the statistical library of the Statistisches Bundesamt, and transcribe the data. The publication of the Fachserie was discontinued in

2016, and we obtain updated files for 2017 to 2021 directly from the German statistical office (Statistisches Bundesamt, 2017-2021). The two-digit manufacturing industries became less granular in the 1990s due to changes in industry classifications, resulting in an evident discontinuity in the level of CR10.[15] Second, for Australia, we are able to find consistent tabulations of CR20 for two-digit manufacturing industries from 1968 to 1991. The data come from concentration statistics publications based on manufacturing censuses. We obtain physical books from the ZBW Library in Kiel (Australian Bureau of Statistics, 1990) and download PDFs from the Australian Bureau of Statistics (Australian Bureau of Statistics, 1994); we then transcribe the data.[16]

### II.A.2 Size by Employment

In addition, we search for data on firm size by employment to estimate employment concentration. We collect data for the aggregate economy, and at the industry level when possible. We limit the industry-level breakdown to manufacturing and retail/wholesale trade, as these industries are consistently defined over time (unlike for example services). We are able to obtain long-run data for Germany (aggregate and industry level), France (aggregate only), Switzerland (aggregate and industry level), U.K. (manufacturing only), Australia (manufacturing only), and Korea (manufacturing only). We also compare with U.S. data as described in Section III.B. Most of the data come from censuses or firm registers, and hence provide the most representative coverage of the economy.

**Germany** We use two sets of tabulations by size of employment for all types of firms in Germany (see Table IA6 for detailed descriptions of the sources). First, we have tabulations from the Census of Establishments between 1925 and 1986, which was conducted at irregular intervals during this time period. We obtain physical books before 1961 from the German National Library (Statistisches Bundesamt, 1930), and download PDFs for 1961, 1970, and 1987 censuses through the statistical library of the Statistisches Bundesamt (Statistisches Bundesamt, 1965, 1990).[17] The Census of Establishments covers all non-agricultural enterprises and their employees. Before 1945, the statistics include firms from the entire German Reich. After 1945, the statistics cover West Germany (including West Berlin). Second, we obtain tabulations directly from the German statistical office for 2003 to 2018 (Statistisches Bundesamt, 2003-2022*b*). The data come from the company register managed by the German statistical office, based on information from tax authorities, the federal employment agency, surveys, and commercial data providers. The data

[15] At the start, in 1954, the statistics cover West Germany and West Berlin. The Saarland is included from 1955 onward, and East Germany from 1991 onward.

[16] Data from census publications also exist for 1992 and 1993, but they are not consistent due to the change of industry classification from ASIC to ANZSIC.

[17] No firm-level employment size tabulations are available for the 1933, 1939, and 1950 censuses.

cover non-agricultural firms.[18]

**France** We have tabulations by size of employment for industrial and commercial (Bénéfices Industriels et Commerciaux, or BIC) firms for 1966 to 1998, from various publications of the French statistical office (see Table IA5 for detailed descriptions of the sources). Data for 1966 come from an early version of the French business registry. We download PDFs from Gallica (Institut National de la Statistique et des Études Économiques, 1954-2000), and then transcribe the data. Data for 1973 and 1975 come from businesses' fiscal declarations. We download PDFs from Persée (Brocard and Gandois, 1978; Brocard, 1979), a digital open access library by the French Ministry of Education, and transcribe the data. Data for 1981 to 1998 come from sources that we also use for the tabulations by sales (Institut National de la Statistique et des Études Économiques, 1954-2000). The data cover industrial and commercial (Bénéfices Industriels et Commerciaux, or BIC) firms; noncommercial (Bénéfices Non Commerciaux, or BNC) firms (e.g., self-employed professionals like doctors and lawyers) and agriculture (Bénéfices Agricoles, or BA) firms are excluded.[19]

**Switzerland** We use two sets of tabulations by size of employment for all types of firms in Switzerland (see Table IA8 for detailed descriptions of the sources). First, we have tabulations from the Establishment Census between 1929 and 2008. We download PDFs from the Swiss statistical office (Eidgenössisches Statistisches Amt, 1933, 1946, 1965, 1967, 1977; Bundesamt für Statistik, 1994, 1998, 2000, 2002, 2007), and then transcribe the data. The Establishment Census is a nationwide survey of all establishments and firms in Switzerland, excluding agriculture. The final edition of the Establishment Census was conducted in 2008, after which it was replaced by the business register Structural Business Statistics (STATENT). Second, we obtain tabulations for 2011 to 2022 directly from the Swiss statistical office, which uses information in STATENT (Bundesamt für Statistik, 2011-2022). The data cover all sectors of the economy, and we exclude agriculture to ensure consistency with census data. A firm that pays social security contributions on income above 2,300 Swiss Francs per year is recorded in STATENT (Bundesamt für Statistik, 2025).

**Australia (manufacturing)** The Australian data on firm size by employment come from two sources (see Table IA1 for detailed descriptions of the sources). We are restricted to manufacturing because of the scope of the earlier census data. The first source is *Enterprise Statistics* by the Australian Bureau of Statistics (ABS) (Australian Bureau of Statistics, 1968-1982, 1983-1987), which was first published for the 1968–1969 integrated economic census. It is published continuously every year from 1977–1978 to

[18] In this data, self-employed and working owners are excluded unless registered as employees subject to social security contributions. The narrower definition of employees between 2003 and 2018 tends to raise top employment shares slightly.

[19] We have to drop the data for 1977 to 1980 because these years provide tabulations combining BIC, BNC, and BA firms, which we cannot separate, whereas all other years tabulate BIC firms only.

1986–1987, and discontinued after that. Single establishment enterprises with fewer than four persons employed are excluded. This exclusion should not affect top firms in the numerator. For the denominator, we fill in the total number and employment of single establishment enterprises with fewer than four persons employed from additional publications (Commonwealth Bureau of Census and Statistics, 1973; Australian Bureau of Statistics, 1980, 1981, 1985, 1986). The second source is *Australian Industry* by the ABS (Australian Bureau of Statistics, 2007), which covers the economy as a whole and main sectors for 2004 and 2005.

**U.K. (manufacturing)** The U.K. data on the employment size distribution come from the same sources as above: the Census of Production between 1958 and 1993 (Board of Trade, 1960-1973; Department of Industry Business Statistics Office, 1973-1992), and the *Size Analyses of United Kingdom Businesses* after 1985 (Department of Trade and Industry, Business Statistics Office, 1985-1997; Office for National Statistics, 1998-2003, 2004-2013, 2015-2022*a*). We use the Census of Production data until 1993 and the *Size Analyses of United Kingdom Businesses* afterwards because the data from the Census of Production are more granular.

**Korea (manufacturing)** The Korean data on corporations by size of employment also come from Choi et al. (2025). They kindly also shared estimates of the largest 100 and 500 manufacturers by employment in total manufacturing employment.

## II.B Estimating Top Shares

We estimate the share of top firms from size bins in the tabulations. Our baseline method uses the generalized Pareto interpolation (Blanchet, Fournier, and Piketty, 2022), which is also the baseline in Kwon, Ma, and Zimmermann (2024). This method is the standard approach developed to estimate household top shares from income bins with a similar format (Blanchet, Fournier, and Piketty, 2022; Piketty and Saez, 2003). The generalized Pareto interpolation starts by calculating the inverted Pareto coefficient $b(p_i)$ for each bin threshold $y_i$, where $p_i$ is the fraction of firms with size above $y_i$, and $b(p_i)$ is the ratio between the average size above $y_i$ and the threshold $y_i$. It then fits a continuous curve of inverted Pareto coefficients. In Kwon, Ma, and Zimmermann (2024), we verified that the generalized Pareto interpolation gives almost identical results to interpolating lognormal curves, or directly adding up the top bins such that the number of businesses in these bins approximates a certain amount (e.g., top 1%).[20]

[20] Most tabulations provide both the number of firms and the total size for each bin. For U.K. data by size of sales, the tabulations only show the number of firms in each bin, but not their total size. In this case, we can still use the generalized Pareto interpolation, but estimates can be less precise. We use the average firm size (for all firms) to provide additional disciplining information for the interpolation, which tends to improve the fit.

## II.C Top Percent Shares and Top $N$ Shares

We provide results using both top percent shares (e.g., top 1%) and top $N$ shares. The Herfindahl-Hirschman Index (HHI) is another measure of concentration, but it requires data on the size of every single firm and therefore it is not possible to calculate reliably from our raw data that tabulate firm size bins.

**Top percent shares** We start with the top 1% and the top 0.1% shares. The benchmark for evaluating the disparity of business size is the top percent share in a number of models (Aghion et al., 2023; Hsieh and Rossi-Hansberg, 2023). Analyzing the top percent share is also the standard approach in research on household income and wealth inequality.

Moreover, the top percent share has several practical advantages. First, it is portable across different countries that differ a lot in size, and across different levels of aggregation (e.g., the overall economy versus a particular industry). In comparison, picking the right $N$ across these different settings is challenging. Second, for tabulations that focus on corporations, the total size of corporations in the denominator can change as the prevalence of corporations changes over time. For the top percent share, the numerator is allowed to expand (shrink) when corporations become more (less) common, so it is not sensitive to shifts in the prevalence of corporations. For the top $N$ share, the numerator does not adjust, and the top $N$ share among corporations can move around due to the changing prevalence of corporations. In Kwon, Ma, and Zimmermann (2024), we show that in the U.S., the top $N$ share among all businesses, the top $x$% share among all businesses (with a corresponding percentile), and the top $x$% share among corporations have very similar behavior, whereas the top $N$ share among corporations can behave differently in settings that experience changes in the prevalence of corporations.

One common concern about the top percent share is that it might be affected by small and extraneous firms coming in or out of the sample (therefore changing the total number of firms). Specifically, if small and extraneous firms come in (out) of the data, the total number of firms in the top 1% will increase (decrease). Thus the top 1% share can increase (decrease), as the small firms have little impact on the total value of the denominator while the numerator will include more (fewer) firms. To make sure that our results are not affected by this issue, we also calculate the top $x$% as a fraction of the top $y$% (e.g., the top 1% as a share of the top 10%), and present the results in Appendix IA1. One can show that for Pareto distributions, this relative share only depends on $x/y$ and the tail coefficient $k$. In other words, top 1%/top 10% $=$ top $0.01N$/top $0.1N$ is invariant to the total number of firms $N$.

**Top $N$ shares** We present top $N$ shares as well, using the top 500 share as the focal example. Fixing the same $N$ across different settings can make the levels harder to compare or interpret across countries, so

we also present additional checks where we pick the economy-wide $N$ as 100 per one million population.

The top $N$ share is relatively straightforward to implement when we have tabulations for all types of firms. It is trickier when tabulations focus on corporations, as mentioned above. In this case, to minimize the impact of the changing prevalence of corporations on the denominator, we use the estimated size of all businesses for the denominator of the top $N$ share. Specifically, we start with the total size of corporations, and estimate the share of corporations in total businesses. We explain this procedure in detail when we present the top $N$ shares in the next section.

# III Main Facts

We present the main results for top business shares in this section. We analyze firm size by sales, net income, and equity capital in Section III.A, and by employment in Section III.B. We discuss the possible economic mechanisms behind our findings in Section III.C.

## III.A Concentration by Sales, Net Income, and Equity Capital

In Section III.A.1, we present long-run concentration trends in the aggregate. In Section III.A.2, we present results in broad sectors and in detailed industries when such data are available.

### III.A.1 Economy-Wide Results

We start with top 1% shares, and then proceed to top 500 shares as an example for top $N$ shares.

**Top percent shares** Figure 1 shows the sales share of the top 1% firms by sales (left panel), the net income share of the top 1% firms by net income (middle panel), and the equity capital share of the top 1% firms by equity capital (right panel). We observe steady increases of the top shares throughout the 20th century, in all countries with available data and with all three size measures. These trends around the world also date back much further than the recent decades.

For top shares by sales, we have data for Germany, Austria, France, Switzerland, and Denmark, along with the U.S. since 1959 from Kwon, Ma, and Zimmermann (2024). The share of the large 1% firms by sales was typically around 50% to 60% in the 1950s and 1960s, and around 70% to 80% by the 2010s. Indeed, the patterns are fairly similar between the U.S. and the other sample countries in Europe. For top shares by net income, we have data for Australia, Canada, Singapore, along with the U.S. between 1918 and 1974 from Kwon, Ma, and Zimmermann (2024). In Australia and Canada, the top 1% net income share

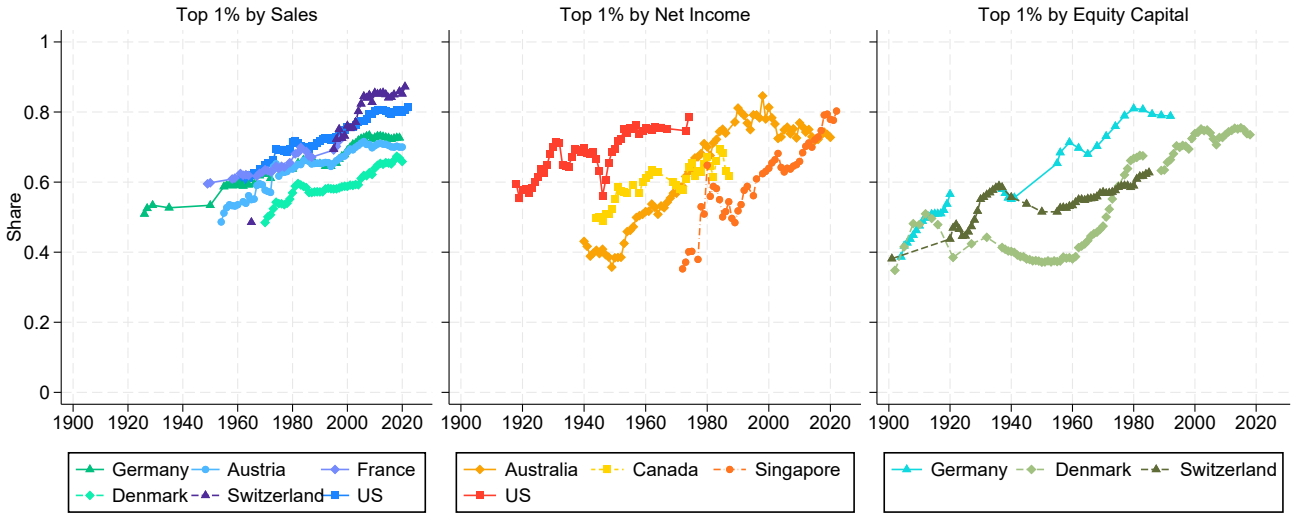



Figure 1. Top 1% Share by Sales, Net Income, and Equity Capital

*Notes:* This figure shows the sales share of the top 1% firms by sales (left panel), the net income share of the top 1% firms by net income (middle panel), and the equity capital share of the top 1% firms by equity capital (right panel).

among corporations started from around 40% to 50% in the 1940s, increased to around 60% by the 1970s and 1980s, and around 80% by 2000 (after which the Australian top shares have been relatively flat and Canadian data currently end in 1987). In Singapore, the data started later in the early 1970s, and the top shares show similar trends as Australia and Canada, just a few decades later. The U.S. top shares by net income are slightly higher in level, but display similar time trends. For top shares by equity capital, we have data for Germany, Denmark, and Switzerland. The top 1% share started at around 40% in the early 1900s and increased to 60% or more by the 1980s when the German and Swiss series ended. For Denmark, it continued to increase to more than 70% today. Figure IA1 shows similar time trends for the top 0.1% share.

As mentioned in Section II.C, it is useful to analyze relative top shares (e.g., top 1% among top 10%) in the right tail, and check that our results are not driven by small and extraneous firms coming in or out of the sample. Figure IA2 shows the share of the top 1% among the top 10% for the same series in Figure 1. In this case, we also observe similar trends of widespread increases in top shares over the long run.

**Top $N$ shares** The top $N$ shares are relatively straightforward to implement in settings where we have data from all types of firms. It is trickier to implement in settings where we only have comprehensive data on corporations: Australia, Canada, and Singapore by net income, as well as Denmark, Germany, and Switzerland by equity capital. Two issues arise in these settings.

First, for the denominator, the total size of corporations is affected by the changing prevalence of corporations (which tends to increase over time in most countries). For example, as corporations become more common, the denominator (the total size of corporations) expands. For the top percent share, the

numerator is allowed to expand (shrink) when corporations become more (less) common, so it is not sensitive to shifts in the prevalence of corporations. For the top $N$ share, the numerator does not adjust, and it can move around due to the changing prevalence of corporations. In the U.S. data (Kwon, Ma, and Zimmermann, 2024), we observe that the top $N$ share among all businesses, the top $x\%$ share among all businesses (with a corresponding percentile), and the top $x\%$ share among corporations have very similar behavior, whereas the top $N$ share among corporations can behave differently in settings that experience changes in the prevalence of corporations.

To minimize the impact of the changing prevalence of corporations on the denominator, we use the estimated size of all businesses for the denominator of the top $N$ share. Specifically, we start with the total size of corporations, and estimate the share of corporations in total businesses. This denominator adjustment proceeds as follows:

- All countries with by net income tabulations (Australia, Canada, and Singapore): We estimate the corporate share using corporate value added to private business value added. We discuss the procedures in detail in Appendix IA2.1, IA2.3, and IA2.7. Figures IA9, IA11, and IA17 show the estimates for Australia, Canada, and Singapore, respectively.

- Germany by capital tabulations: We use the sales share of corporations and LLCs (which have data by capital) in total sales from sales tax statistics (based on the sources described in Appendix IA2.6.1). Figure IA16 shows the estimated corporate share. We do not compute the top $N$ share when we only have data from Prussia between 1904 and 1920, since we do not have corporate share estimates for Prussia and the top $N$ share in Prussia may not be comparable with the top $N$ share in Germany for the same $N$ (whereas the top 1% share is more portable across domains).

- Denmark by capital tabulations: For 1948 to 2018, we use the share of corporate sales in total business sales using data from Statistics Denmark and census publications (Danmarks Statistik, 1973-1981, 1983-2001*b*, 1925-1958, 2025*a*). We include LLCs in corporate sales from 1974 onward, aligning with the coverage of our tabulations. Before 1948, we are able to obtain estimates of the share of corporate employment in total business employment among industrials from the manufacturing census (Danmarks Statistik, 1908-1914, 1925-1958). Figure IA13 shows these two series. They are both available in 1948, in which case they align closely.

- Switzerland by capital tabulations: We can find the share of corporate employment in total business employment for benchmark years dating back to 1929 (Eidgenössischen Statistischen Amt, 1933-1998); we include LLCs after they were introduced in 1937. We linearly interpolate the missing years. Before 1929, we extend the series further back in time using a linear extrapolation based

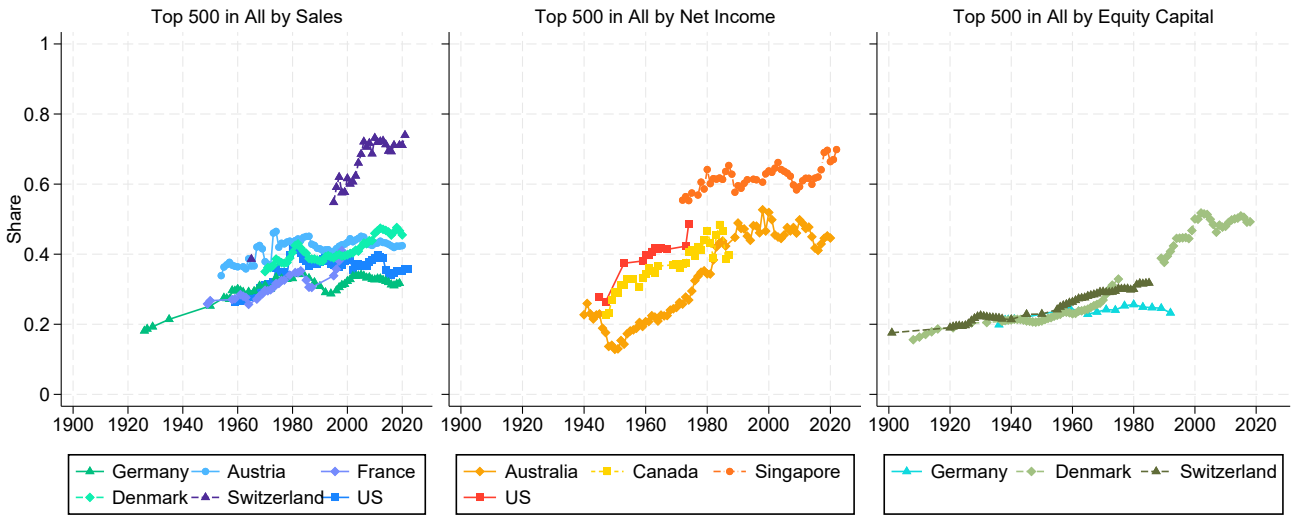



Figure 2. Top 500 Share by Sales, Net Income, and Equity Capital

*Notes:* This figure shows the sales share of the top 500 firms by sales (left panel), the net income share of the top 500 firms by net income (middle panel), and the equity capital share of the top 500 firms by equity capital (right panel).

on the proportion of corporations among all registered businesses from the Historical Statistics of Switzerland (Eidgenössisches Statistisches Amt, 1934). Figure IA19 shows the resulting series.

Second, for the numerator, we can only use the top $N$ *corporations* in these settings. Accordingly, we may underestimate the top $N$ share if some of the largest businesses are noncorporations.

Figure 2 shows the estimated top 500 share. We plot the sales share of the top 500 by sales (left panel), the net income share of the top 500 by net income (middle panel), and the equity capital share of the top 500 by equity capital (right panel).[21] The level of the top 500 share can be less directly comparable across countries of different size, and it is generally higher in smaller countries such as Switzerland and Singapore. The upward trends are evident in this case as well.[22]

In Figure IA3, we provide further results adjusting for country size using top $N$ shares where $N$ in a given country and year is selected as 100 per one million population (or one per ten thousand people). In this case, the level in small countries such as Switzerland and Singapore aligns better with that in larger countries. We continue to observe upward trends over time.

[21]The U.S. data by size of sales and net income from Kwon, Ma, and Zimmermann (2024) also cover corporations, so for the denominator of the top 500 share, we start with the total size of corporations and estimate the size for total businesses by adjusting for the ratio of corporate sales in corporate plus noncorporate sales (available since 1945).

[22]In the following cases, the top bin in the tabulations became much coarser than 500, which makes it more challenging to estimate the top 500 share precisely, and changes in the granularity of the top bin could affect the estimates: U.S. by sales after the 1980s, Australia by net income after the mid-1990s, and Singapore after the 2010s.

### III.A.2 Industry-Level Results

At the industry-level, we can find tabulations by size of sales in several countries, and present the results below.

**Broad sectors** Among our sample countries, Germany provides the most extensive industry-level tabulations, in a largely consistent way over time (see Appendix IA2.6.1 for details about industry harmonization). Figure 3 shows the top 1% sales share for three main sectors: manufacturing, services, and retail/wholesale trade. In each sector, we estimate the share of the largest firms by sales in total sales. The industry-level series have a few discontinuities due to changes in industry definitions. We observe rising top shares over the long run at the industry level as well.

Figure 4 turns to the U.K., where we are only able to construct long-run series of top shares consistently for manufacturing. The left panel shows the top 1% share. The dashed line with diamonds uses tabulations of firm size by net output from the Census of Production. The solid line with circles uses tabulations of size by sales from the Great Britain Business Statistics Office. We observe that the top 1% net output share increased from around 60% in the late 1950s to around 70% in the 1980s, and the top 1% sales share increased mildly between the 1980s and the 2010s. The right panel shows the top 100 net output share estimated among U.K. manufacturers, using Prais (1976) data from 1909 to 1970 and Census of Production data afterwards till 1992 (the tabulations for recent decades are not granular enough to estimate the top 100 share reliably). The estimated top 100 share increased from 16% to 40% between 1909 and 1970, and stayed around the same level afterwards. Similar to other countries with earlier industrialization including U.S. (Kwon, Ma, and Zimmermann, 2024) and Germany (above), rising top shares in U.K. manufacturing appear stronger before the 1980s.

Finally, Figure 5 shows the share of the largest 100 and 500 manufacturers by sales in total manufacturing gross output in Korea, estimated by Choi et al. (2025) for the early 1970s to the early 2010s. During this period of rapid economic development and industrialization, top shares in Korean manufacturing increased substantially. The top 100 (500) sales share in manufacturing increased from around 20% (30%) in the early 1970s to around 45% (55%) by the early 2010s. Interestingly, in South Korea where industrialization was more recent, concentration in manufacturing rose considerably in the last several decades, unlike the early industrialization countries such as U.S., U.K., and Germany.

**CRx in detailed industries** We also search for official reports of concentration ratios in detailed industries that are reasonably consistent over time. In Germany, we are able to find CR10 for two-digit manufacturing industries since 1954, and for four-digit manufacturing industries since 1968, shown in Panel A of Figure 6. The data come from reports by the Federal Cartel Office, the Monopolies Commission,


Figure 3. Germany: Industry-Level Top Shares

*Notes:* This figure shows the sales share of the top 1% firms in Panel A and the top 500 firms in Panel B, for manufacturing (left panel), services (middle panel), and retail/wholesale trade (right panel) in Germany. The series for services stops in 2009 to be able to consistently exclude telecommunications from services.

and the German statistical office (Statistisches Bundesamt, 1985, 1986-2018). The two-digit manufacturing industries became less granular in the 1990s due to changes in industry classifications, so the CRx became lower after the change and not directly comparable with the series before. In Australia, we are able to find consistent tabulations of CR20 for two-digit manufacturing industries from 1968 to 1991, shown in Panel B of Figure 6. Data come from various manufacturing census reports (Australian Bureau of Statistics, 1990, 1994). The solid line with circles presents the equal weighted average CRx among detailed industries. The

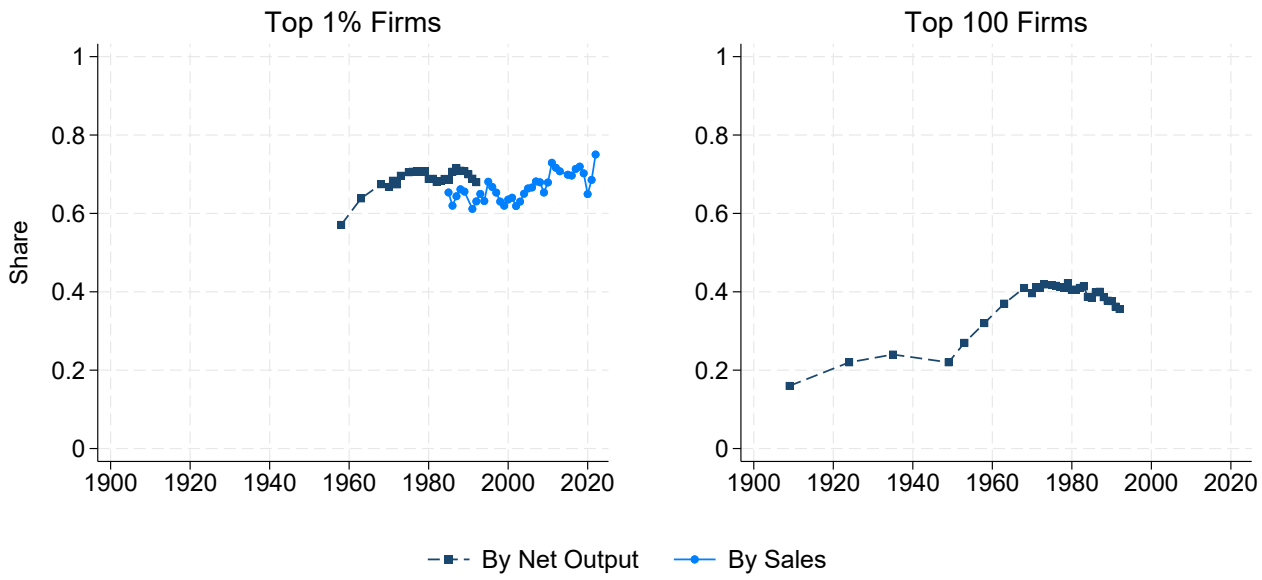



Figure 4. Top Shares in U.K. Manufacturing

*Notes:* The dashed line with squares shows the net output share of the top 1% U.K. manufacturers by net output (left panel), and the net output share of the top 100 U.K. manufacturers by net output (right panel). The solid line with circles shows the sales share of the top 1% U.K. manufacturers by sales (left panel).

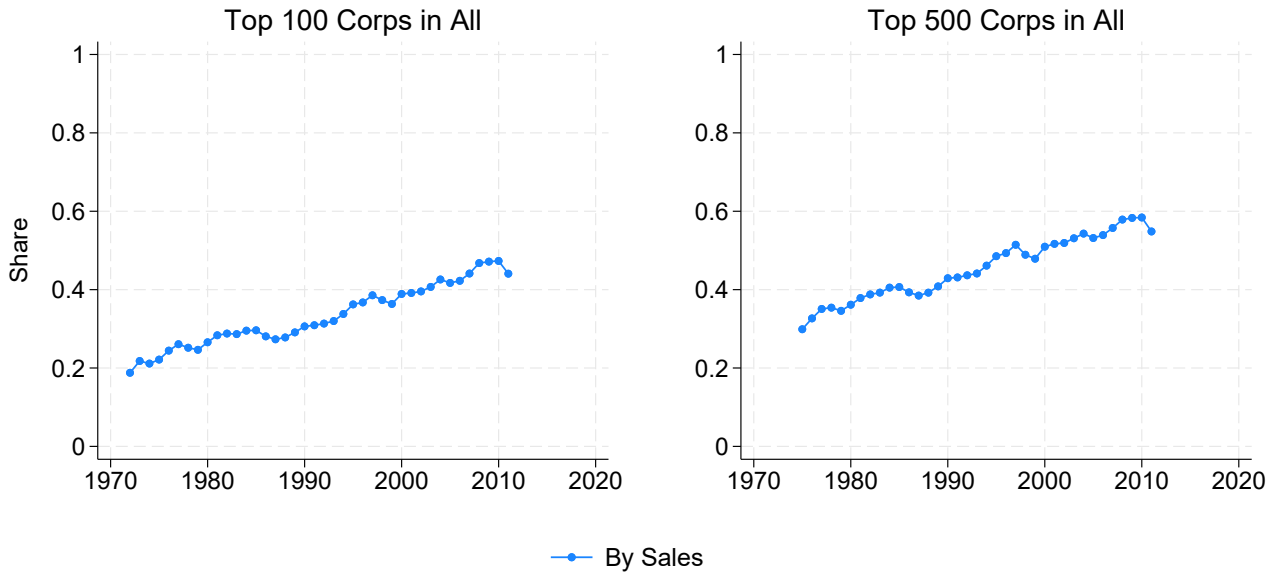



Figure 5. Top Shares in Korean Manufacturing

*Notes:* This figure shows the sales share of the largest 100 and 500 manufacturers by sales in total manufacturing gross output in Korea.

dashed line with diamonds presents the sales weighted average. Overall, we observe increases of the CRx in granular industries as well.

Panel A. Average CR10 in German Manufacturing


Panel B. Average CR20 in Australian Manufacturing

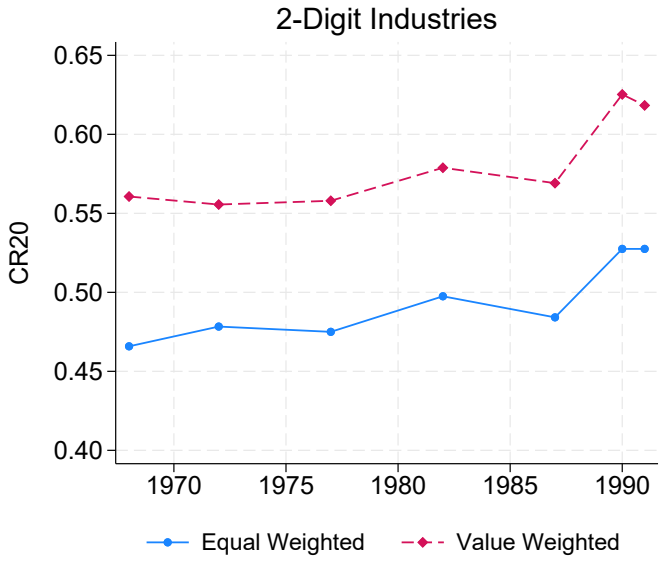



Figure 6. CRx Data from Government Publications

*Notes:* Panel A shows CR10 for Germany from reports by the Federal Cartel Office, the Monopolies Commission, and the German statistical office. Industry classifications were revised between 1994 and 1995, and between 2008 and 2009. Comparisons across these periods should be made with caution. These discontinuities are reflected by the absence of connecting lines between these years. Panel B shows CR20 for Australia from manufacturing census. The solid line with circles shows the equal weighted average. The dashed line with diamonds shows the sales weighted average.

## III.B Concentration by Employment

In this section, we turn to concentration by employment, for which we can obtain long-run data for several countries described in Section II.A.2. We supplement them with U.S. data from two sources. First, we use aggregate firm size by employment from the standard census Business Dynamic Statistics (BDS) dataset, available since 1978 (U.S. Census Bureau, 2022). Industry-level employment concentration is difficult to estimate using public BDS data because the size bins are based on the total employment of the firm, whereas the reported employment is restricted to the specific industry.[23] As a result, the average employment in a size bin often falls below the bin thresholds. Second, we are able to find consistent tabulations of firm size by employment for manufacturing and retail/wholesale trade since 1958 from census Enterprise Statistics (ES) publications (U.S. Department of Commerce, 1963, 1972*a*,*b*, 1981, 1986-2012). Firms in other industries such as services are not consistently covered, so we cannot use data from these industries or construct economy-wide estimates.

### III.B.1 Economy-Wide Results

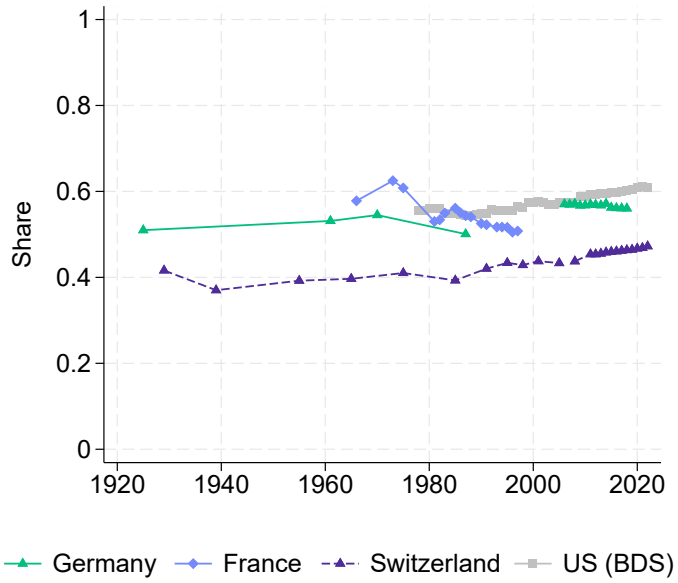
Figure 7 shows the top 1% share by employment in Panel A, and the top 500 share by employment in Panel B. We observe that employment concentration is largely stable in the aggregate. It increased slightly in Germany in the early decades and in the U.S. in recent decades, and decreased slightly in France between the 1970s and 1990s. Figure IA4, Figure IA5, and Figure IA6 show that the patterns are similar for the top 0.1% share, the share of the top 1% in the top 10%, as well as the top $N$ share where $N$ is selected as 100 per one million population. By and large, employment concentration does not show substantial time trends. These patterns are different from top shares by sales, net income, and equity capital shown in Section III.A.1. Several studies have noted that concentration by employment is more stable than concentration by sales in recent U.S. and U.K. data (Luttmer, 2010; Bell and Tomlinson, 2018; Autor et al., 2020). Relatedly, Barkai and Panageas (2025) find that young firms in the U.S. have declining contribution to employment but not to sales, and attribute this phenomenon to the rise of "low marginal and high average" revenue-product-of-labor firms.

### III.B.2 Industry-Level Results

At the industry level, Figure 8 shows the top 1% share by employment in Panel A, and the top 500 share by employment in Panel B. As mentioned earlier, we are able to find consistent industry-level data on firm

[23] See https://www.census.gov/library/working-papers/2021/adrm/CES-WP-21-08.html.

Panel A. Top 1% Share




Panel B. Top 500 Share

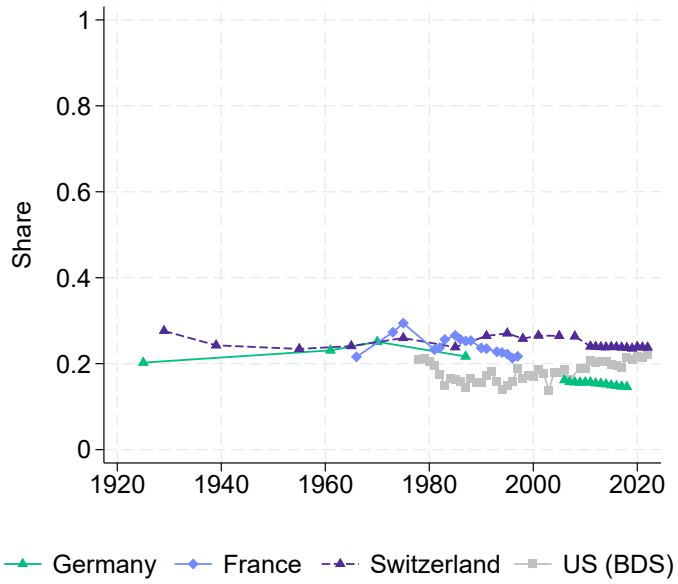
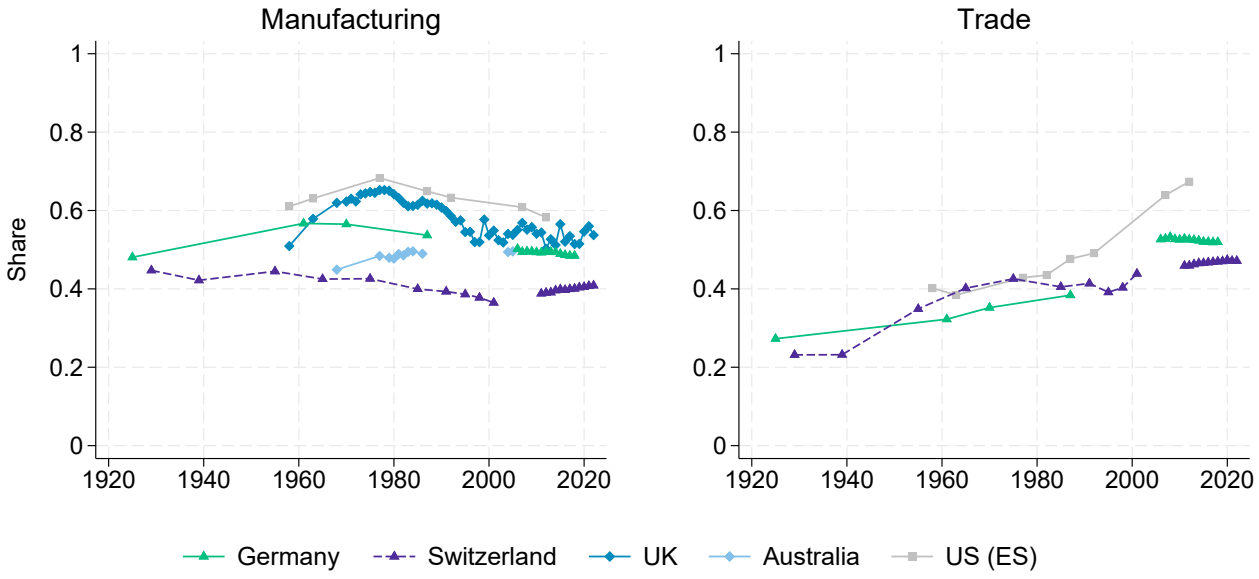



Figure 7. Top Share by Employment

*Notes:* This figure shows the employment share of the top 1% firms by employment in the aggregate in Panel A, and the employment share of the top 500 firms by employment in the aggregate in Panel B.

size distribution by employment mainly for manufacturing and retail/wholesale trade. In manufacturing, employment concentration is largely stable over the long run. It increased somewhat in Germany, U.K., U.S., and Australia in the earlier decades, which reverted in recent decades. In Switzerland and Korea, employment concentration appears almost entirely flat over time. In retail/wholesale trade, interestingly,

Panel A. Top 1% Share




Panel B. Top 500 Share

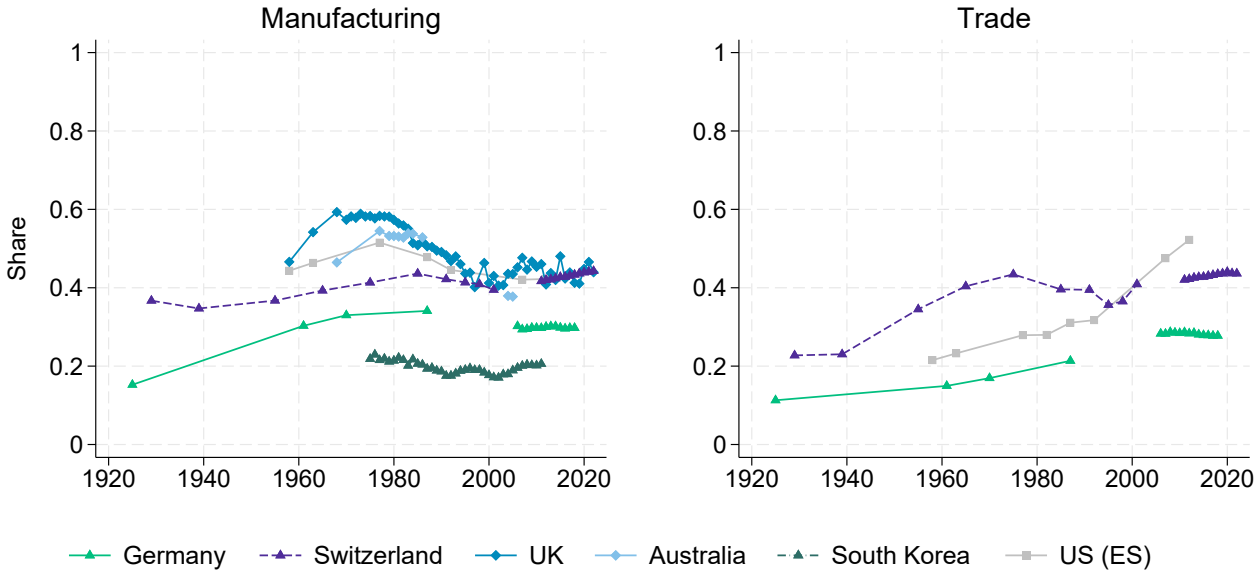



Figure 8. Top Share by Employment

*Notes:* This figure shows the employment share of the top 1% firms by employment in manufacturing (left panel) and retail/wholesale trade (right panel) in Panel A, and the employment share of the top 500 firms by employment in manufacturing (left panel) and retail/wholesale trade (right panel) in Panel B.

employment concentration has risen noticeably in all three countries where we have data. In both Germany and the U.S., the rise of the top 1% share by employment, from around 40% in the 1960s to over 60% in recent years, is comparable to the rise of the top 1% share by sales in retail/wholesale trade over this period.

A common question is whether payroll might have increased more than employment among top firms, for example if they focus on employing high skilled workers rather than employing more people in general. Appendix Figure IA7 and Figure IA8 show that top firms' shares in employment and in payroll have similar trends in two settings where we can find data for both. First, in U.S. census Enterprise Statistics (ES) publications used in the gray lines in Figure 8, we have information on the employment and payroll by size bins of employment (there are no separate tabulations by size bins of payroll). In Figure IA7, we estimate the share of the top 1% and top 500 firms in total employment (solid line with circles) and their share in total payroll (dashed line with diamonds), for manufacturing and retail/wholesale trade.[24] Top firms' employment and payroll shares are both stable over time in manufacturing, and rising in retail/wholesale trade. Second, in Australian CR20 data used in Panel B of Figure 6, we have information on the employment and payroll by size bins of sales in two-digit manufacturing industries. In Figure IA8, we show the share of the top 20 firms in employment (solid line with circles for the equal weighted average and solid line with diamonds for the value weighted average) and their share in payroll (dashed line with circles for the equal weighted average and dashed line with diamonds for the value weighted average). Here the trends in top firms' employment and payroll shares are again similar.

## III.C Discussion

Why does sales concentration increase substantially while employment concentration is relatively stable? With standard production functions where capital and labor are complements, concentration of sales, capital, and employment should move in the same direction. When firms expand in output, they would increase the use of all inputs. One possibility for the divergence of employment concentration is that large firms scale using capital (physical or intangible) rather than labor. For example, declining capital price over time—correspondingly rising capital productivity—can stimulate more automation, especially among large firms as they are more inclined to pay the automation cost (Hubmer and Restrepo, 2025). It can also reallocate towards capital intensive firms (Desazars, 2025).

Appendix IA3 provides a simple model for illustration. Following Hubmer and Restrepo (2025), firms have a continuum of tasks, which they can complete using capital (i.e., automation) or labor. They choose the fraction of tasks done by capital versus labor, and more automation incurs greater costs. High productivity

[24] We estimate these top shares by adding up the top bins—instead of using the generalized Pareto interpolation—because here the bins are based on employment size but we are also interested in top firms' shares in payroll (not just by employment). Specifically, if the total number of firms is $N$ and the number of firms in the top $k$ bins adds up to less than $0.01N$ or 500 (whereas the top $k+1$ bins add up to more than $0.01N$ or 500), then we take all the businesses in the top $k$ bins and add $(0.01N - \sum_{i=1}^{k} n_i)/n_{k+1}$ fraction from the $k+1$th bin (where $n_i$ denotes the number of businesses in the $i$th bin). In other words, we take all businesses in the top $k$ bins and fill in the residual from the $k+1$th bin.

firms will choose to automate a higher fraction of tasks (given the cost of automation). When the price of capital decreases (or equivalently the productivity of capital increases), high productivity firms using more automation will expand in sales and capital. If additional increases in automation is difficult—which could be the case for retail/wholesale trade so far (e.g., the scope for mechanization is more limited because of extensive human interactions with customers etc.)—then employment concentration would rise along with sales and capital concentration, due to the complementarity between capital and labor (so that top firms expand with both capital and labor). If additional increases in automation is not very costly, then it is possible that employment concentration does not rise, or it even declines as top firms automate more production.[25] Figure IA21 verifies that the relative price of capital has declined over time, in the economy overall, in manufacturing, and in retail/wholesale trade, using U.S. Bureau of Economic Analysis (BEA) data (U.S. Bureau of Economic Analysis, 2025*b*,*c*,*e*,*f*). Interestingly, Figure IA22 shows that capital to employment ratio using U.S. BEA data (U.S. Bureau of Economic Analysis, 2025*a*,*d*) and Bureau of Labor Statistics (BLS) data (U.S. Bureau of Labor Statistics, 2025) has increased substantially in manufacturing, and much less in retail/wholesale trade, which is in line with the possibility that additional increases in automation is easier in manufacturing and more challenging in retail/wholesale trade (and consistent with the predictions of our model).

Another hypothesis is that the divergence between sales and employment concentration might come from rising markups. One set of mechanisms highlights the reallocation of production towards large high markup firms (Autor et al., 2020). Another set of mechanisms emphasizes changes in regulations that can raise firms' markups (Gutiérrez, Jones, and Philippon, 2021).[26] In both cases, it is not easy to explain substantial increases in concentration by capital inputs—with magnitudes similar to increases in the concentration by sales—while concentration by labor remains stable. In addition, most studies find that markups have increased primarily after the 1980s (De Loecker, Eeckhout, and Unger, 2020; De Loecker and Eeckhout, 2021), whereas our results hold since the early 1900s. It is also not obvious why employment concentration has nonetheless increased in retail/wholesale trade. Other mechanisms such as changes in trade costs (Melitz, 2003) also generally predict increases in both sales and employment concentration.[27]

[25] Furthermore, once capital is sufficiently cheap and the level of automation is already high for high productivity firms, then additional declines in the price of capital may not raise employment concentration (see Appendix IA3 Corollary IA3 for details). This can be consistent with the flatter trends of concentration in manufacturing among the early industrialization countries.

[26] If firms have variable markups where markups increase with size as larger firms face more inelastic demand, a higher superelasticity (i.e., large firms face less elastic demand) raises large firms' markups but makes them smaller in typical calibrations (Edmond, Midrigan, and Xu, 2023). Therefore, this driver of higher markups cannot match rising sales concentration.

[27] Can changes in financial frictions explain our facts? We explore this issue using the model of Gopinath et al. (2017) with size-dependent borrowing constraint $k \leq \lambda_0 a + \lambda_1 \Phi(k)$, where $a$ is internal funds and $k$ is capital. Larger firms have higher debt capacity per unit of internal funds that scales with $\lambda_1$. In this model, sales concentration and employment concentration are the same. Moreover, higher concentration requires higher $\lambda_1$, i.e., large firms having greater borrowing advantage relative to small firms. To the extent that large firms have always had reasonable access to financing, and financial development over time expands access to small firms, it is unclear that $\lambda_1$ would have increased substantially over the past century.

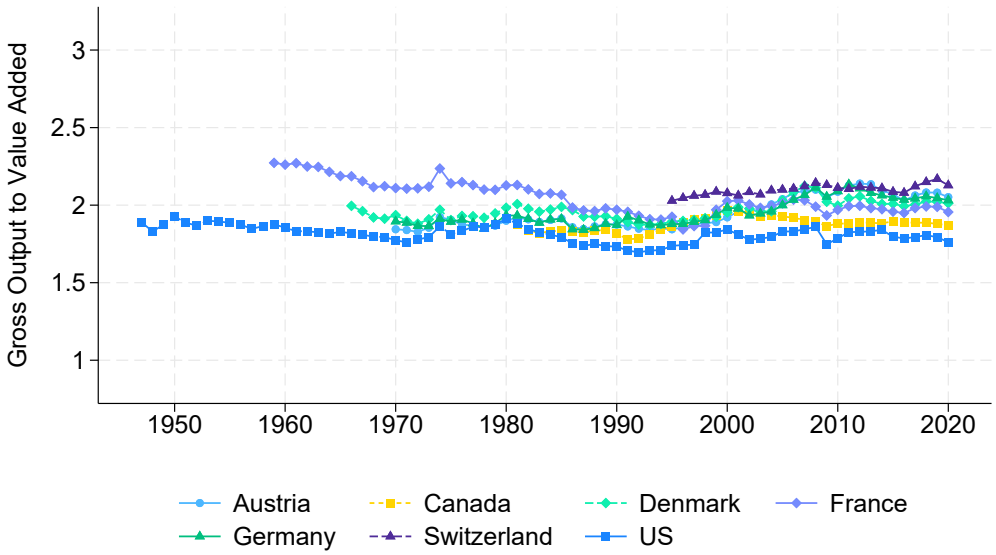



Figure 9. Gross Output to GDP

*Notes:* This figure shows the ratio of gross output to GDP. Gross output and GDP data come from National Accounts Statistics from United Nations (United Nations, 2022*a*,*b*). Additional U.S. data on gross output and GDP come from Bureau of Economic Analysis (BEA) (Bureau of Economic Analysis, 2021, 2025).

Finally, a common hypothesis is that the divergence between sales concentration and employment concentration trends could result from large firms outsourcing their production to other firms or overseas. In this case, we would expect the ratio of sales (gross output) to value added (GDP) should increase. Specifically, if firms outsource employment internationally, then value added in the country should decrease for the same amount of sales. If firms outsource to others domestically, then for a given amount of value added in the country, sales should increase from more intermediate steps. Figure 9 shows that we observe stable ratios of gross output to GDP among countries and time periods in our sample with available data. Since the largest firms are sizable in value terms, if they systematically increase the amount of outsourcing, these shifts should be reflected in the aggregate. Accordingly, it seems unlikely that our findings are driven by systematic increases in outsourcing.

# IV Conclusion

We collect long-run data on the firm size distribution in a variety of countries with available information. We find that the rise of big businesses is a pervasive phenomenon around the world over the past century. Moreover, their size has grown by sales and capital much more than by employment.

The pervasiveness of this phenomenon suggests that a full account about the underlying mechanisms

needs to apply broadly (not just to the U.S. in the recent decades), and it needs to explain the divergence between concentration by sales and concentration by employment. Over the past two centuries, some authors have hypothesized that technological change may lead to the inevitable "centralization of capitals" or the expansion of the span of control (Marx, 1867; Marshall, 1890; Lenin, 1916; Lucas, 1978). The long-run evidence from around the world makes it even more intriguing to contemplate their conjectures.

A common question is whether the largest firms have stayed the same. The firm size tabulations that cover the entire economy do not disclose information about individual firms. Ma et al. (2025) hand collect data about the identity of the largest firms in the U.S., Germany, and the U.K. They find that the individual firms at the top have changed substantially over time. In other words, the largest firms in the economy have become more prominent, but they are not the same firms.

The rise of large firms has a wide range of implications. Several studies point out that the firm size distribution affects the determinants of macroeconomic outcomes. In general, higher production concentration increases the aggregate impact of large firms' shocks (Gabaix, 2011), innovation (Braguinsky et al., 2025), operations and management (Berle and Means, 1932), and financing conditions (Crouzet and Mehrotra, 2020). The divergence between sales concentration and employment concentration also implies that large firms have more influence on aggregate output and investment, whereas small firms have more influence on aggregate employment. Moreover, this divergence provides substantial information and restrictions regarding the long-run evolution of the production function. Future research can further investigate the connections between these facts and theories of economic growth.

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# Internet Appendix

## IA1 Additional Results

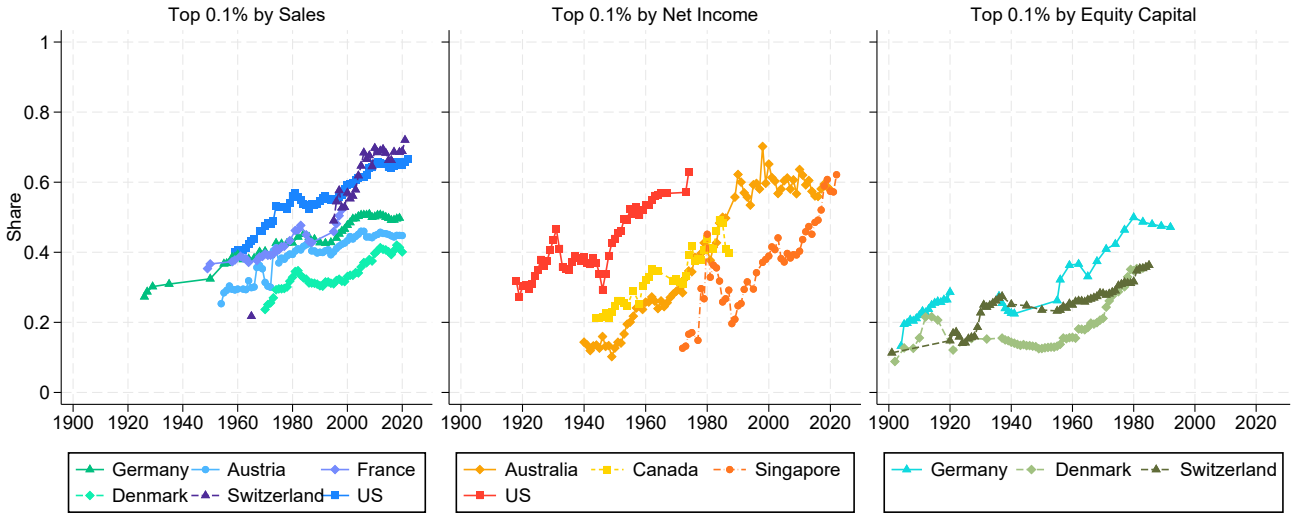



Figure IA1. Top 0.1% Share by Sales, Net Income, and Equity Capital

*Notes:* This figure shows the sales share of the top 0.1% firms by sales (left panel), the net income share of the top 0.1% firms by net income (middle panel), and the equity capital share of the top 0.1% firms by equity capital (right panel).

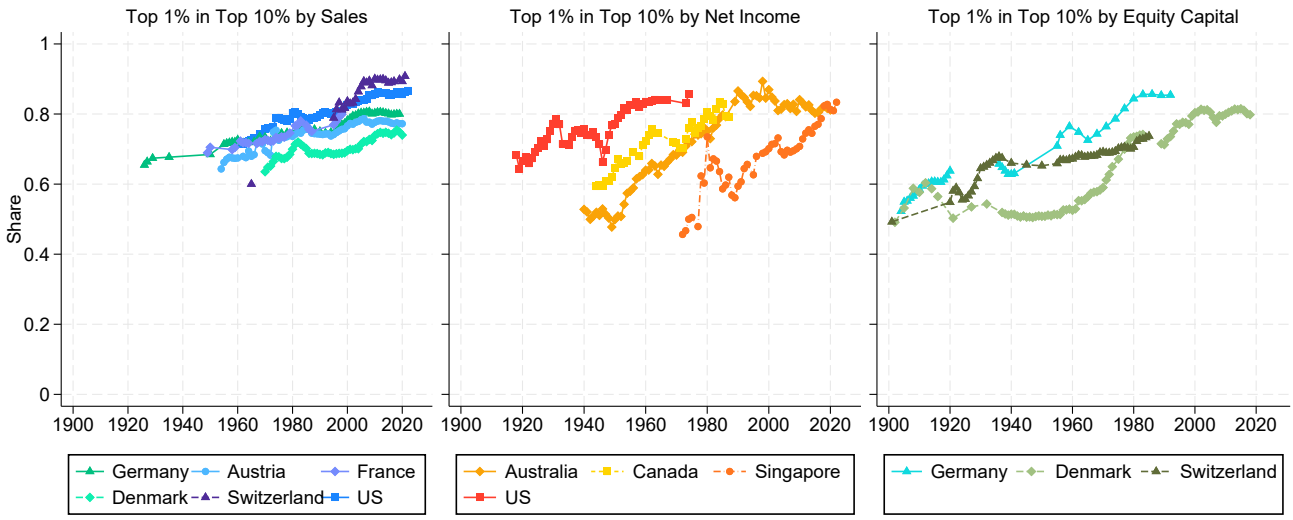



Figure IA2. Relative Top Share by Sales, Net Income, and Equity Capital

*Notes:* This figure shows the sales share of the top 1% firms in top 10% firms by sales (left panel), the net income share of the top 1% firms in top 10% firms by net income (middle panel), and the equity capital share of the top 1% firms in top 10% firms by equity capital (right panel).

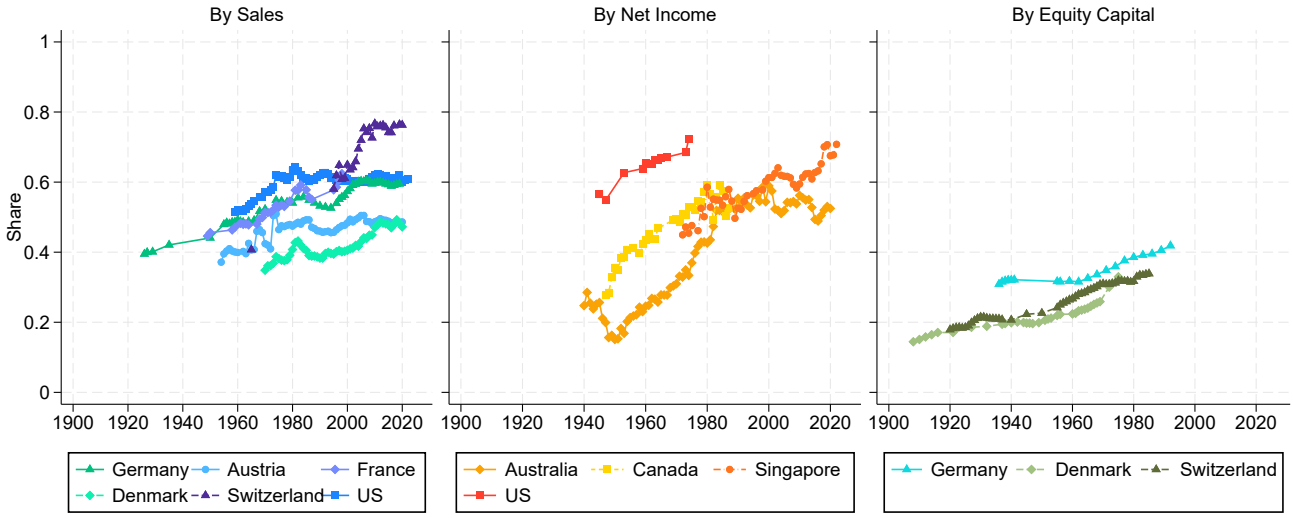



Figure IA3. Top $N$ Share by Sales, Net Income, and Equity Capital with Population Adjustment

*Notes:* This figure shows the sales share of the top $N$ firms by sales (left panel), the net income share of the top $N$ firms by net income (middle panel), and the equity capital share of the top $N$ firms by equity capital (right panel). The number $N$ in a country and a given year is selected as 100 per one million population (or one per ten thousand people). Population data come from Jordà, Schularick, and Taylor (2017) and Bolt and van Zanden (2024).

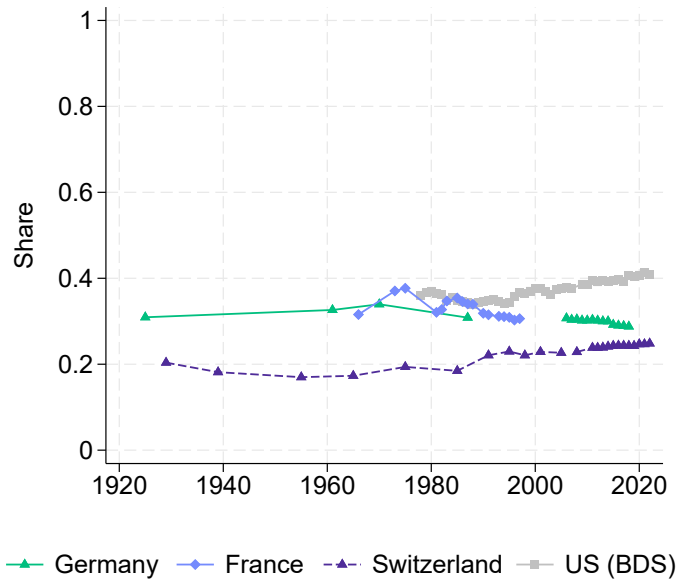



Figure IA4. Top 0.1% Share by Employment

*Notes:* This figure shows the employment share of the top 0.1% firms by employment in the aggregate.

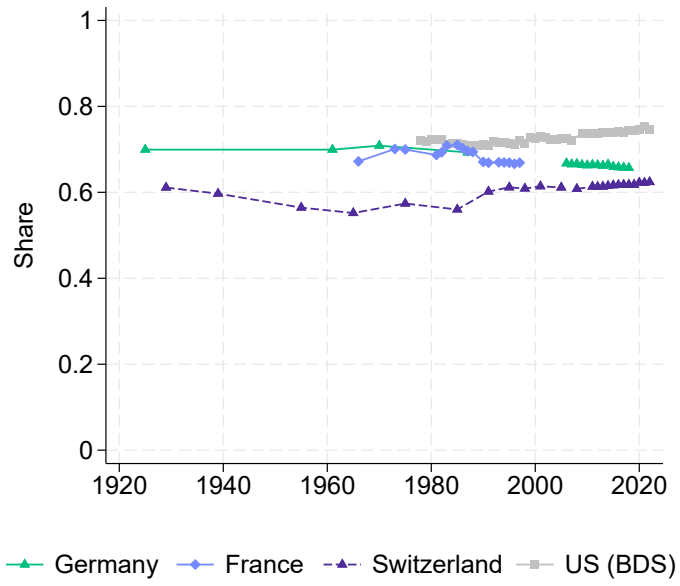



Figure IA5. Relative Top Share by Employment

*Notes:* This figure shows the employment share of the top 1% firms in the top 10% firms by employment in the aggregate.

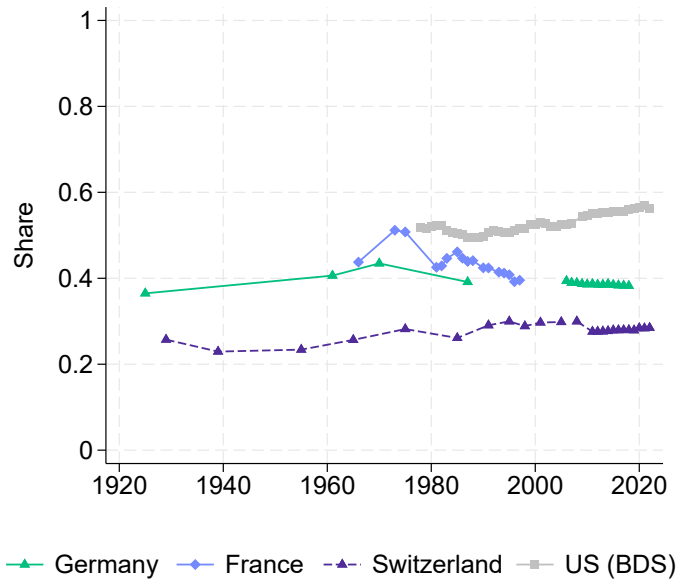
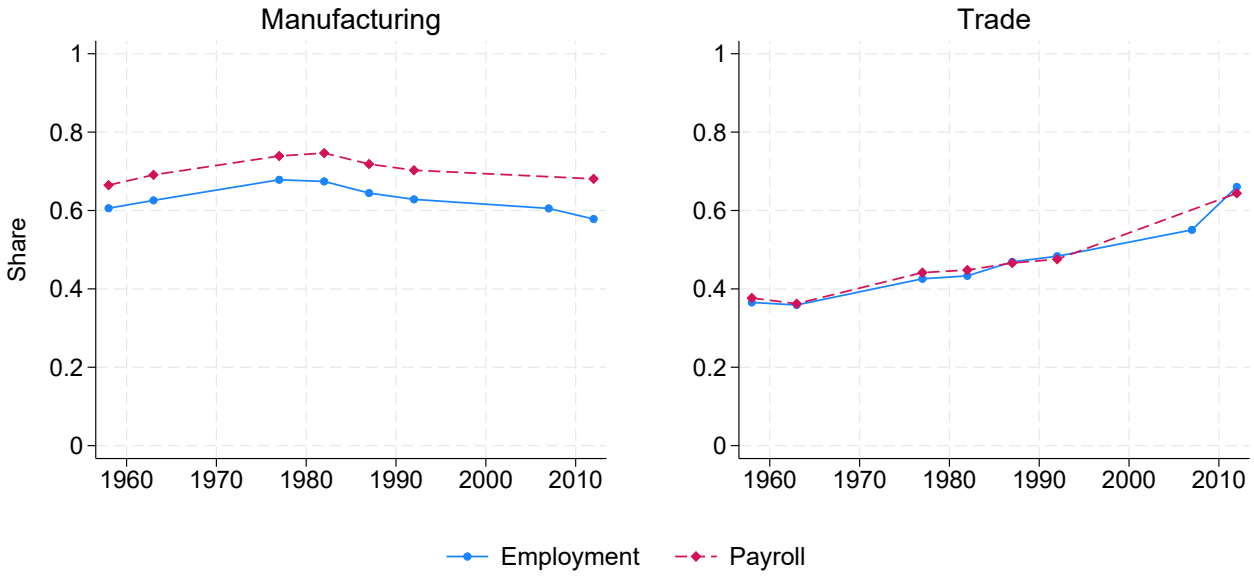



Figure IA6. Top $N$ Share by Employment with Population Adjustment

*Notes:* This figure shows the employment share of the top $N$ firms by employment in the aggregate where $N$ is selected as 100 per one million population. Population data come from Jordà, Schularick, and Taylor (2017) and Bolt and van Zanden (2024).

Panel A. Top 1%




Panel B. Top 500

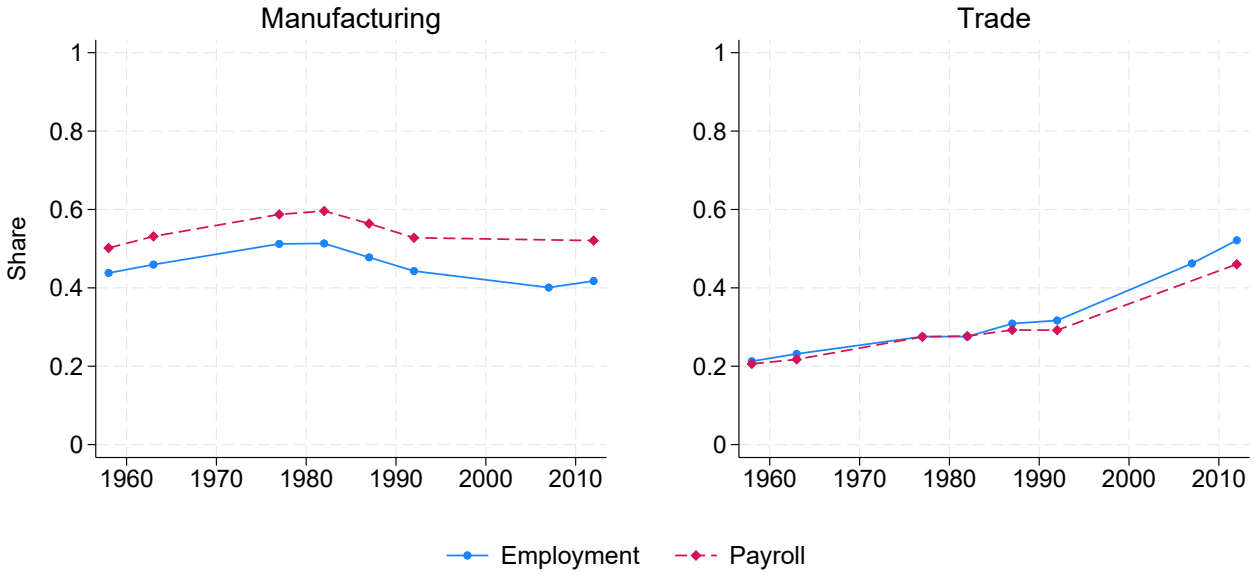



Figure IA7. Top 1% and 500 Shares by Employment and Payroll in U.S. Enterprise Statistics Data

*Notes:* Panel A shows the share of the top 1% firms by employment in total employment (solid line with circles) and in total payroll (dashed line with diamonds). Panel B shows the share of the top 500 firms by employment in total employment (solid line with circles) and in total payroll (dashed line with diamonds). The data come from U.S. Enterprise Statistics (used in the gray lines in Figure 8). Payroll is defined as annual payroll, including all forms of compensation (salaries, wages, commissions, dismissal pay, bonuses, vacation and sick leave pay, and payments in kind) paid during the year to all employees and prior to payroll deductions (such as employees' Social Security contributions, withholding taxes, group insurance, union dues, etc.).

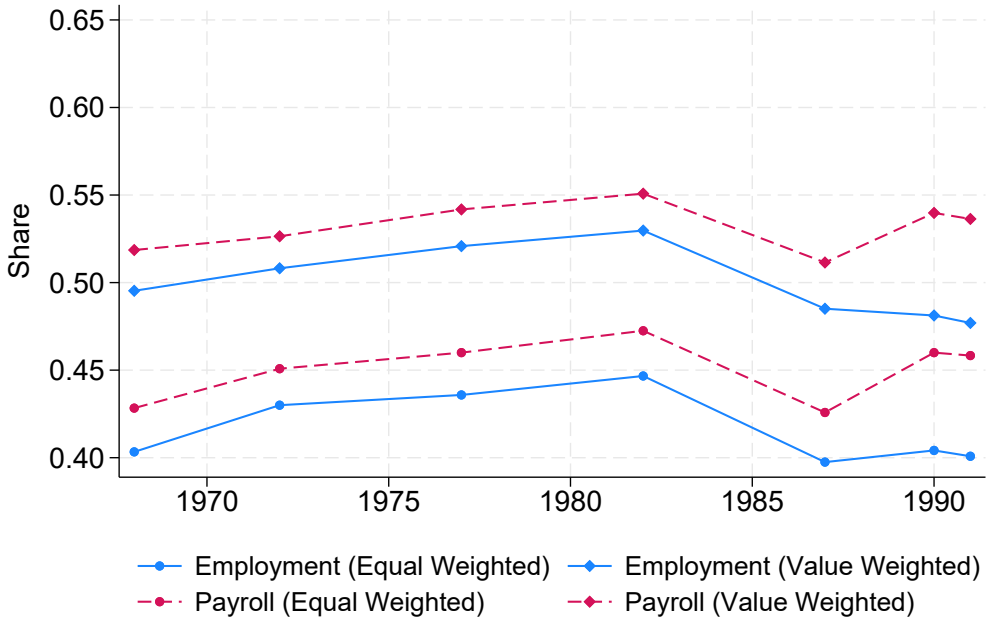



Figure IA8. Top 20 Share by Employment and Payroll in Australian Manufacturing

*Notes:* This figure shows the employment share of the top 20 firms by sales in total employment, in equal weighted average (solid line with circles) and sales weighted average (solid line with diamonds) among two-digit manufacturing industries. It also shows the payroll share of the top 20 firms by sales in total payroll, in equal weighted average (dashed line with circles) and sales weighted average (dashed line with diamonds) among two-digit manufacturing industries; The data come from Australian CR20 statistics (used in Panel B of Figure 6). Payroll is defined as total wages and salaries of all employees on the payroll.

# IA2 Data Description by Country

## IA2.1 Australia

Table IA1 lists the sources that we use for Australia.

Table IA1 – Australia: Data Sources

| Type | Period | Source |
|---|---|---|
| Tabulations by net income | 1940–1957 | Australian Taxation Office (various years) *Report of the Commissioner of Taxation*. |
| | 1958–2020 | Australian Taxation Office (various years) *Taxation Statistics*. Digital files from 1994 onwards. |
| CR20 by sales (manufacturing) | 1968–1987 | Australian Bureau of Statistics (1987) *Manufacturing Industry Concentration Statistics*. |
| | 1990–1991 | Australian Bureau of Statistics (1994) *Manufacturing Industry*. |
| Tabulations by employment (manufacturing) | 1968–1986 | Australian Bureau of Statistics (various years) *Enterprise Statistics*. |
| | 2004–2005 | Australian Bureau of Statistics (various years) *Australian Industry*. |

*Notes:* This table lists the sources of the Australian data.

### IA2.1.1 By Net Income

**Sources** We are able to find tabulations by size of taxable income for corporations starting in 1940 from *Taxation Statistics* published by the Australian Taxation Office. We download PDFs from the National Library of Australia until income year 1993-1994 (Australian Taxation Office, 1944-1961, 1962-1995) and transcribe the data; we download data in Excel spreadsheets from `data.gov.au` afterwards (Australian Taxation Office, 2016-2023*a*). The tabulations are based on information from the corporate income tax.

**Scope** The data have corporations with positive taxable income; partnerships and proprietorships are not included. Each unit is a company defined under the Assessment Act. Up to 1949, we use taxable companies with positive taxable income because the data only have taxable companies. After 1950, we have both taxable and non-taxable companies with positive taxable income, but the number of non-taxable companies with positive taxable income is negligible, and we check that the results are similar if we restrict to taxable companies. The tabulations by size include both resident and nonresident companies before 1999, and only resident companies after 2000. In years when there are breakdowns of resident and nonresident

companies, we check that the results are similar if we restrict to resident companies only.

**Variable definition** Taxable income is defined as the amount remaining after deducting from assessable income all deductions allowed. Such deductions include all normal business expenses, certain special deductions for expenditure of a capital nature and certain non-business deductions (Australian Taxation Office, 1962-1995). For resident companies, income includes all sources (domestic and foreign); for nonresident companies, only income derived from Australia is included.

**Corporate share** Since the size tabulations for Australia are restricted to corporations, we need to estimate the share of corporations relative to all businesses, which is especially relevant for the top $N$ shares in Section III.A. We use the estimated corporate share in gross value added of private businesses.

Specifically, we have data on gross operating surplus of corporations and gross mixed income of noncorporations since 1960 from the Australian Bureau of Statistics (Australian Bureau of Statistics, 2023) and before then from (Butlin, 1985). To estimate gross value added of corporations and noncorporations, we also need information about the compensation of employees of corporations and noncorporations. The Australian national accounts provide total compensation of employees (including wages and employers' social contributions) for the public and private sector since 1983. The national accounts do not have a breakdown for compensation of employees by corporations versus noncorporations. For most years since 1981, we can obtain salaries and wage expenses by corporations and noncorporations from *Taxation Statistics* (Australian Taxation Office, 1992, 2023*b*).

To cover the sample period of our Australian firm size distribution data since 1940, we estimate the corporate share over this period by assuming that the ratio of compensation of employees to value added among corporations is the same as that in the overall private businesses. In this case, the corporate value added share would be the same as gross operating surplus of corporations relative to gross operating surplus of corporations plus gross mixed income of noncorporations. This estimate is shown by the solid line with diamonds in Figure IA9. For 1983 onward, we can directly compute corporations' share in value added: we take compensation of employees among the private sector from the national accounts, and allocate to corporations and noncorporations using their shares in salary and wage expenses according to Taxation Statistics data; then we obtain the corporation value added share as corporate compensation of employees plus corporate gross operating surplus, divided by private business compensation of employees plus corporate gross operating surplus plus noncorporate mixed income. This series is shown by the dashed line with triangles in Figure IA9. This cross check suggests that our baseline estimate is sensible.

**Data construction**

- Top $x$% net income share = Net income of top $x$% corporations by net income in a given year/Net income of corporations in a given year. Restricted to those with positive net income.
- Top $x$% net income share among top $y$% = Net income of top $x$% corporations by net income in a given year/Net income of top $y$% corporations in a given year. Restricted to those with positive net

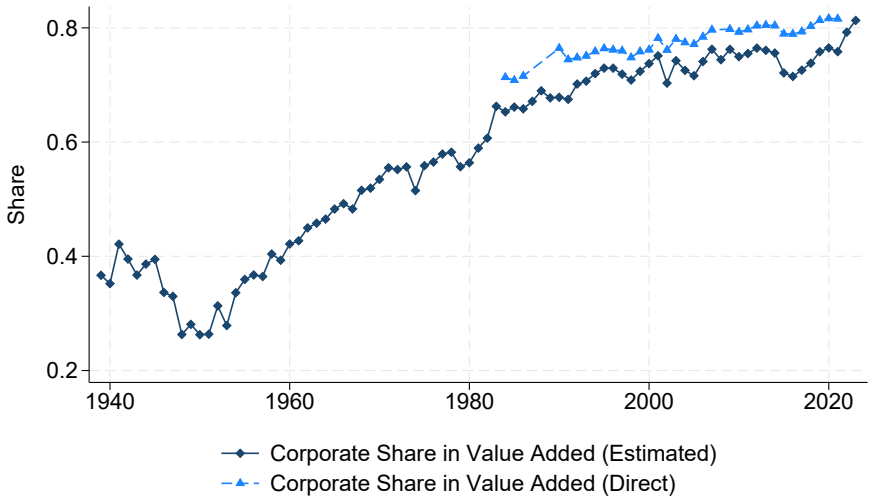



Figure IA9. Australia: Corporate Share Estimates

*Notes:* The figure shows the estimated corporate share in private business value added for Australia. The solid line uses the ratio of corporate gross operating surplus to corporate gross operating surplus plus noncorporate mixed income. The data come from the Australian Bureau of Statistics Australian Bureau of Statistics (2023) after 1960 and Butlin (1985) before then. This estimate assumes that the ratio of compensation of employees to value added among corporations is the same as that among private businesses overall. The dashed line uses the ratio of corporate gross operating surplus plus corporate compensation of employees to corporate gross operating surplus plus noncorporate mixed income plus private business compensation of employees. Corporate compensation of employees is obtained by multiplying private business compensation of employees with the ratio of corporate to corporate and noncorporate salary and wage expenses in Taxation Statistics.

income.

- Top $N$ net income share = Net income of top $N$ corporations by net income in a given year/Estimated net income of corporations and noncorporations in a given year (starting with net income of corporations and divide by estimated corporate share as discussed above). Restricted to those with positive net income.

### IA2.1.2 CR20 by Sales

**Sources** We are able to find CR20 for two-digit manufacturing industries reported consistently from 1968 to 1991, from publications by the Australian Bureau of Statistics (ABS) based on manufacturing censuses. We obtain physical books from Kiel University Library for data up to 1987 (Australian Bureau of Statistics, 1990), and download PDFs from the ABS website for 1990 to 1991 (Australian Bureau of Statistics, 1994); we then transcribe the data.

**Scope** The data cover manufacturing enterprise groups in Australia. Single establishment enterprises with fewer than four persons employed are excluded. The unit of observation is an enterprise group, which include all operations in Australia of a group of legal entities (enterprises) under common ownership or control following the Companies Acts. Enterprise groups in the concentration statistics are formed by

combining establishments within the enterprise group with the same industry classification. The data cover all legal forms, including corporations, partnerships, and sole proprietorships.

**Variable definition** Sales are defined as sales of goods.

#### IA2.1.3 By Employment

**Sources** We are able to find Australian data on firm size by employment in manufacturing from 1968 to 2005. First, we have tabulations for 1968 to 1986 from *Enterprise Statistics* by the Australian Bureau of Statistics (ABS), which was first published for the 1968–1969 integrated economic census, then continuously every year from 1977–1978 to 1986–1987, and apparently discontinued after that. We obtain physical books from Cornell University Library (1980, 1981, 1983, 1984), Stanford University Library (1974), University of Chicago Library (1977 and 1978), and University of London Library (1968, 1979, 1982, 1985, and 1986) (Australian Bureau of Statistics, 1968-1982, 1983-1987); we then transcribe the data. Second, we are able to find tabulations for 2004–2005 and 2005–2006 from *Australian Industry* published by the ABS. We download data in Excel spreadsheets from `abs.gov.au` (Australian Bureau of Statistics, 2007). These tabulations are coarser, and report the number and employment of small (zero to 19 employees), medium (20 to 199 employees), and large (over 200 employees) businesses. Since the large business bin contains about 630 manufacturing firms, we can estimate the share of the top 500 firms fairly accurately, so the top shares are not too sensitive to interpolation methods when the bins are coarse in the 2000s.

**Scope** For the first source, the data come from integrated economic censuses. Single establishment enterprises with fewer than four persons employed are excluded. This exclusion should not affect top firms in the numerator. For the denominator, we fill in the total number and employment of single establishment enterprises with fewer than four persons employed from additional publications (Commonwealth Bureau of Census and Statistics, 1973; Australian Bureau of Statistics, 1980, 1981, 1985, 1986). The unit of observation is an enterprise, which covers all the operations in Australia of a single operating legal entity.

For the second source, the estimates presented are derived using a combination of directly collected data from the annual Economic Activity Survey (EAS) conducted by the Australian Bureau of Statistics (ABS), and business income tax (BIT) data provided by businesses to the Australian Taxation Office (ATO). It covers the population of private sector businesses. We use manufacturing businesses to be consistent with earlier census data. The unit of observation is a business in the ABS Business Register. The data cover all legal forms, including corporations, partnerships, sole proprietorships, etc.

**Variable definition** Employment includes employees and working proprietors on payroll, including part-time employees.

**Data construction**

- Top $x$% employment share = Employment of top $x$% enterprises in a given year/Total employment

Table IA2 – Austria: Data Sources

| Type | Period | Source |
|---|---|---|
| Tabulations by sales | 1954–1957 | Österreichisches Statistisches Zentralamt (various years) *Steuerstatistiken*. |
| | 1960–1980 | Österreichisches Statistisches Zentralamt (various years) *Statistisches Handbuch für die Republik Österreich*. Used to fill in gaps. |
| | 1973–2020 | Österreichisches Statistisches Zentralamt (various years) *Umsatzsteuerstatistik*. Renamed to Statistik Österreich (various years) *Statistik der Umsatzsteuer* in 1998. |

*Notes:* This table lists the sources of the Austrian data.

of enterprises in a given year.

- Top $N$ employment share = Employment of top $N$ enterprises in a given year/Total employment of enterprises in a given year.

## IA2.2 Austria

Table IA2 lists the sources that we use for Austria.

**Sources** We are able to find tabulations by size of sales for all types of firms since 1954, in tax-related statistical publications by the Austrian statistical office. We obtain physical books from the German National Library before 2012 (Österreichischen Statistischen Zentralamt, 1958; Österreichisches Statistisches Zentralamt, 1960-1980; Österreichischen Statistischen Zentralamt, 1977-1999; Statistik Österreich, 2000; Statistik Austria, 2001-2014), and download PDFs from the website of the Austrian statistical office afterwards (Statistik Austria, 2015-2023*a*); we then transcribe the data. The tabulations are based on information from the sales tax (first introduced in 1923) and value added tax (VAT) after the conversion to VAT in 1972. The Austrian statistical office published tabulations by total sales for the first time in 1954.[28]

**Scope** The tabulations by sales cover all types of firms with sales above a minimum threshold. The unit of observation in the tabulations is a VAT-taxpayer. If an individual operates multiple businesses, the total revenue from all businesses is combined (and the threshold applies to this combined amount). The minimum sales threshold was 1,500 Schillings in 1954 (Österreichischen Statistischen Zentralamt, 1958), 40,000 Schillings in 1973 (Österreichischen Statistischen Zentralamt, 1977), 30,000 Euros in 2018 (Statistik Austria, 2021), and 35,000 Euros in 2020 (Statistik Austria, 2023*b*). Firms that want to claim a VAT refund on their inputs also file tax returns and are included in the tabulations even if they are below these size thresholds. We impose a minimum size threshold of 40,000 Schillings (until 1998) and 3,000

[28]The statistical office also publishes tabulations by size from the business tax and corporate tax. We focus on the sales tax system because it includes all types of firms, while the other taxes exclude sole proprietorships.

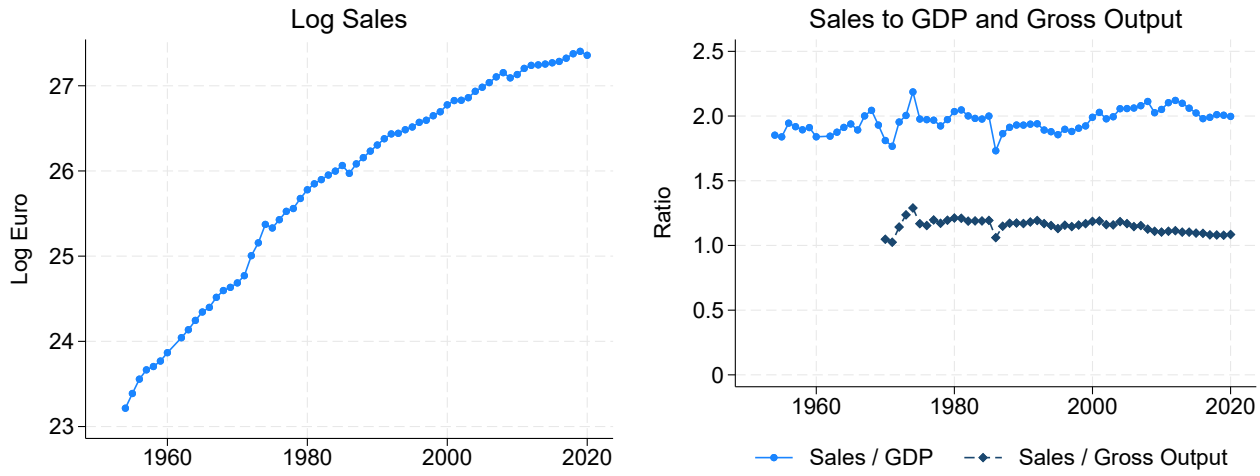



Figure IA10. Austria: Coverage of Sales in Tax Statistics

*Notes:* The left panel shows the log of all tabulated sales in our data. The right panel shows the ratio of tabulated sales to GDP (solid line with circles), the ratio of tabulated sales to gross output (dashed line with diamonds). GDP data come from Statistisches Bundesamt (1960-1972) and OECD (2014). Gross output data come from National Accounts Statistics from United Nations (United Nations, 2022*a*,*b*). Before 1999, we convert the Austrian Schilling to Euro with rate of 1 Euro = 13.7603 Schillings.

Euros (from 1999) for all tabulations. This excludes returns with zero or very small sales, and ensures that firm counts do not have major discontinuities due to changes in filing thresholds. The data cover all legal forms, including corporations, limited liability companies, partnerships, and sole proprietorships.

**Variable definition** The statistics tabulate firms based on total sales from the provision of all goods and services that a business carries out in Austria (including exports). Certain types of economic activities are exempt from VAT (most of banking and insurance services, healthcare, private education, cultural services, and the long-term leasing of real estate). Sales in these sectors are only captured by the tax statistics if firms are required to submit a return (for example, due to additional taxable activities) or if they voluntarily file a tax return.

Figure IA10 shows the coverage of the dataset. The left panel shows log total sales from the tabulations. The right panel shows the ratio of tabulated sales relative to GDP (solid line with circles) is around two, and relative to gross output (dashed line with diamonds) is around one in years when we can find gross output data. These comparisons show that our data have comprehensive and consistent coverage (gross output in national accounts—which is the counterpart of sales—is typically twice the level of GDP).

**Data construction**

- Top $x$% sales share = Sales of top $x$% firms by sales in a given year/All sales in a given year.
- Top $x$% sales share among top $y$% = Sales of top $x$% firms by sales in a given year/Sales of top $y$% firms by sales in a given year.

Table IA3 – Canada: Data Sources

| Type | Period | Source |
|---|---|---|
| Tabulations by net income | 1944–1964 | Revenue Canada (various years) *Taxation Statistics*. |
| | 1969–1987 | Statistics Canada (various years) *Corporation Taxation Statistics*. |

*Notes:* This table lists the sources of the Canadian data.

- Top $N$ sales share = Sales of top $N$ firms by sales in a given year/All sales in a given year.

## IA2.3 Canada

Table IA3 lists the sources that we use for Canada.

**Sources** We have tabulations by size of taxable income for corporations between 1944 (published in 1946) and 1964 (published in 1966) from *Taxation Statistics* published by the Department of National Revenue, and between 1969 and 1987 from *Corporation Taxation Statistics* published by Statistics Canada. We obtain physical books from the University of Chicago Library (Department of National Revenue, 1944-1964; Statistics Canada, 1969-1987), and transcribe the data. These tabulations are based on corporate income tax returns.

**Scope** The data cover corporations that file a T2 corporation income tax return, and we use corporations with positive income. During the *Taxation Statistics* years, the tabulations include all fully tabulated corporations, which exclude banks and insurance companies, co-operatives, personal corporations, and companies with incomplete returns. During the *Corporation Taxation Statistics* years, the tabulations exclude credit unions, insurance carriers, nonprofit organizations, trusteed pension funds, and municipally owned corporations. For these years, we use the tabulations for total nonfinancial industries given the exclusion of banks in the earlier years. A nonresident corporation has to file a return if, at any time in the year, one of the following situations applies:[29] 1) it carried on business in Canada; 2) it had a taxable capital gain; 3) it disposed of taxable Canadian property, unless the disposition meets all the exemption criteria.

In some years, corporations below a certain threshold are excluded.

- From 1944 to 1947, corporations with gross revenue less than $1,000 were considered inactive companies and excluded (with the exception of mining or oil development companies that spend over $1,000 on their property, and investment trusts with a balance sheet that shows cash or marketable securities having a value in excess of $25,000).

[29] See more information here: https://www.canada.ca/en/revenue-agency/services/forms-publications/publications/t4012/t2-corporation-income-tax-guide-before-you-start.html.

- From 1948 to 1964, corporations with gross revenue less than $2,000 were excluded (with the exception of mining or oil development companies that spend over $2,000 on their property, and investment trusts with a balance sheet that shows cash or marketable securities having a value in excess of $25,000).
- From 1969 to 1980, the publications did not explicitly mention size exclusion.
- From 1981 to 1984, corporations for which assets, equity, sales, profits before taxes, and taxable income less than $25,000 were not sampled, but estimates for them were included in the tabulations.
- From 1985 to 1987, corporations with assets less than $50,000 and sales less than $10,000 were considered inactive and excluded from both sampling and estimation.

**Variable definition** The tabulations use taxable income. For resident companies, income includes all sources (domestic and foreign); for nonresident companies, only income derived from Canada is included.

**Corporate share** Since the size tabulations for Canada are restricted to corporations, we need to estimate the share of corporations relative to all businesses (especially relevant for the top $N$ shares in Section III.A). We use the estimated corporate share in net value added of private businesses.

Specifically, we have data on corporate profits and net income of unincorporated businesses (farm and non-farm), for the entire sample period from Statistics Canada (Statistics Canada, 1960-2011*a*) and Historical Statistics of Canada (Historical Statistics of Canada, 1926-1976). The Canadian national accounts data on the net income of unincorporated businesses includes imputed rent from owner-occupied housing, which we remove using additional data.[30] Like in the case of Australia, we do not have direct information about the compensation of employees by corporations versus noncorporations, except for wages, salaries, and employee benefits for the corporate sector since 1999 reported in the *Financial and Taxation Statistics for Enterprises* (Statistics Canada, 2002, 2006, 2011*b*, 2016). This dataset covers all incorporated enterprises within the domestic economy of Canada, but exclude enterprises classified to Management of Companies and Enterprises (NAICS 55); Religious Organizations (NAICS 8131); Political Organizations (NAICS 81394); Public Administration (NAICS 91); as well as Funds and other Financial Vehicles (NAICS 526).[31]

To cover the sample period of our Canadian firm size distribution data, we estimate the corporate share over this period by assuming that the ratio of compensation of employees to value added among corporations is the same as that in the overall private businesses (similar to the Australian case). In this

[30]We use data on the net value added of owner-occupied housing from Piketty and Zucman (2014) available since 1960, and estimate it in earlier years using a closely related item "gross imputed rent" available from the Canadian national accounts since 1960 (Statistics Canada, 1976). Net value added of owner-occupied housing from Piketty and Zucman (2014) has a stable relationship with gross imputed rent for years with overlap, so we project the former onto the latter and then predict the former between 1947 and 1960.

[31]The Canadian national accounts have breakdown of "Wages, salaries and supplementary labour income" into from business, from persons, and from government. The business sector includes corporations as well as unincorporated business enterprises (the persons sector includes individuals as well as universities and other non-profit organizations) (Statistics Canada, 1975). Therefore, we cannot use this breakdown to directly obtain wages of the corporate sector.

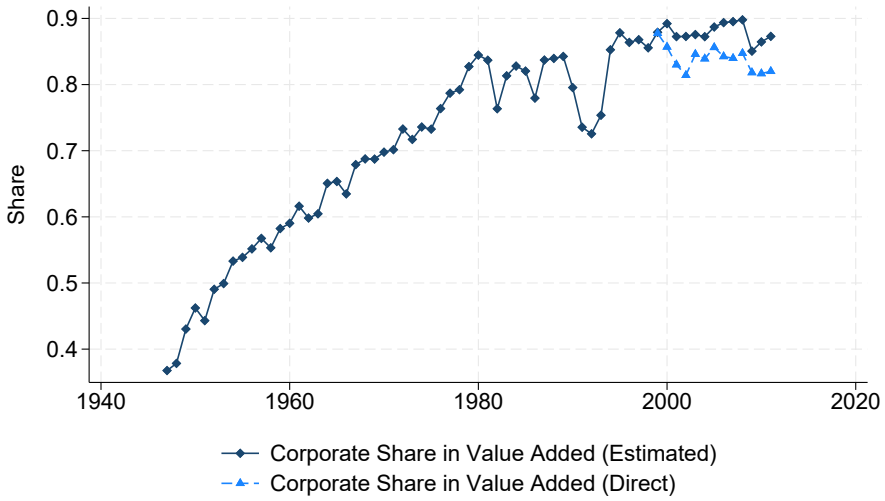



Figure IA11. Canada: Corporate Share Estimates

*Notes:* The figure shows the estimated corporate share in private business value added for Canada. The solid line uses the ratio of corporate profits to corporate profits plus net income of unincorporated businesses (excluding imputed rents from owner-occupied housing). This estimate assumes that the ratio of compensation of employees to value added among corporations is the same as that among private businesses overall. The dashed line uses the ratio of corporate wages, salaries and employee benefits plus corporate profits, divided by wages, salaries and supplementary labor income from businesses and persons (from national accounts) plus corporate profits plus net income of unincorporated businesses (excluding imputed rents from owner-occupied housing).

case, the corporate value added share would be the same as the ratio of corporate profits to corporate profits plus net income of unincorporated businesses (excluding imputed rents from owner-occupied housing). This estimate is shown by the solid line with diamonds in Figure IA11. For 1999 onward, we can directly compute corporations' share in value added as corporate wages, salaries and employee benefits (from *Financial and Taxation Statistics for Enterprises*) plus corporate profits, divided by wages, salaries and supplementary labor income from businesses and persons (from national accounts) plus corporate profits plus net income of unincorporated businesses (excluding imputed rents from owner-occupied housing). This series is shown by the dashed line with triangles in Figure IA11. The two lines are similar; the exclusion of NAICS 55 in corporate wages, salaries and employee benefits data could lead to slight underestimate in the dashed line. Overall, this cross check suggests that our baseline estimate is sensible.

**Data construction**

- Top $x$% net income share = Net income of top $x$% corporations by net income in a given year/Net income of corporations in a given year. Restricted to those with positive net income.
- Top $x$% net income share among top $y$% = Net income of top $x$% corporations by net income in a given year/Net income of top $y$% corporations by net income in a given year. Restricted to those with positive net income.

Table IA4 – Denmark: Data Sources

| Type | Period | Source |
|---|---|---|
| Tabulations by sales | 1970–1999 | Danmarks Statistik (various years) *Statistiske Efterretninger - Momsregistrerede Virksomheder*. |
| | 2000–2020 | Danmarks Statistik; directly obtained from the Business Statistics group at Danmarks Statistik. |
| Tabulations by equity capital | 1902–1974 | Danmarks Statistik (various years) *Statistisk Aarbog*. |
| | 1920–1931 | Danmarks Statistik (various years) *Statistiske Meddelelser - Aktieselskaber*. |
| | 1977–1983 | Danmarks Statistik (various years) *Statistiske Efterretninger - Bestanden af Aktie og Anpartsselskaber*. |
| | 1989–2018 | Danmarks Statistik; directly obtained from the Business Statistics group at Danmarks Statistik. |

*Notes:* This table lists the sources of the Danish data.

- Top $N$ net income share = Net income of top $N$ corporations by net income in a given year/Estimated net income of corporations and noncorporations in a given year (starting with net income of corporations and divide by estimated corporate share as discussed above). Restricted to those with positive net income.

## IA2.4 Denmark

Table IA4 lists the sources that we use for Denmark.

### IA2.4.1 By Sales

**Sources** We have tabulations by size of sales for all types of firms since 1970, published by Statistics Denmark. First, between 1970 and 1999, we use publications on value added tax (VAT) from Statistics Denmark. These tabulations were discontinued in 2000. We download PDFs from Statistics Denmark (Danmarks Statistik, 1973-1981, 1983-2001*b*), and transcribe the data. These tabulations are based on the business registry and VAT returns (the VAT was introduced in Denmark in 1967). Second, between 2000 and 2020, we directly obtain customized tabulations by sales from Statistics Denmark. These tabulations are compiled based on the Danish business register, and Danmarks Statistik (2020) explains the sample.

**Scope** The tabulations by sales cover all types of firms with sales above a minimum threshold. The unit of observation is the enterprise, defined as the smallest combination of legal units forming an organizational and financially autonomous entity. The minimum sales threshold was 5,000 Kronor in 1970 (Danmarks

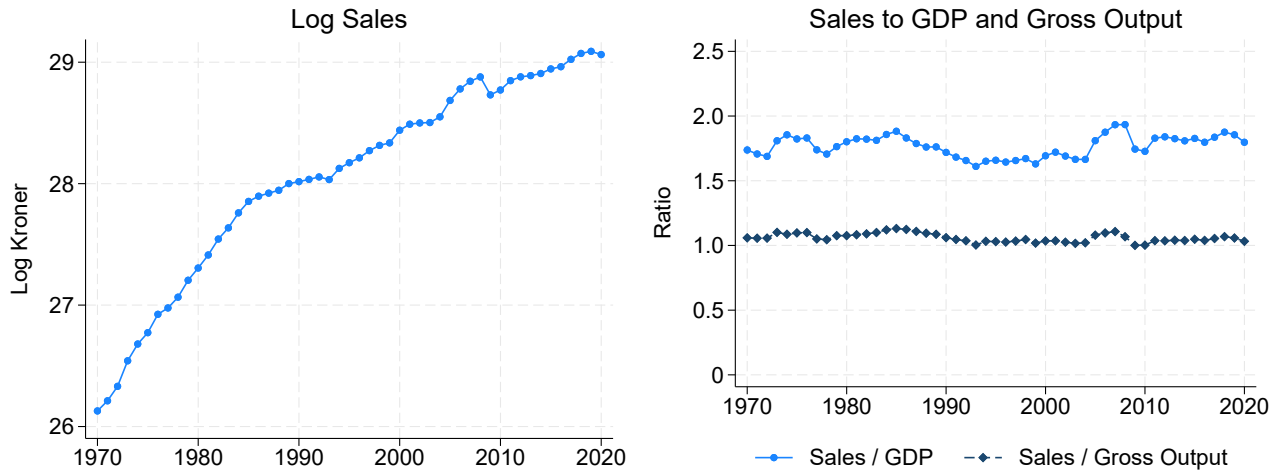



Figure IA12. Denmark: Coverage of Sales in Tax Statistics

*Notes:* The left panel shows the log of all tabulated sales in our data. The right panel shows the ratio of tabulated sales to GDP (solid line with circles), the ratio of tabulated sales to gross output (dashed line with diamonds). GDP data come from Jordà, Schularick, and Taylor (2017). Gross output data come from National Accounts Statistics from United Nations (United Nations, 2022*a*,*b*).

Statistik, 1973) and 20,000 Kronor in 1999 (Danmarks Statistik, 2001*c*). The tabulations by sales are restricted to active non-agriculture businesses after 2000, with the definition of active businesses (industry-specific sales cutoffs) changing over time. This creates a large decline in the number of firms in 2000 and then again a large increase in 2019. We set a 100,000 Kronor threshold for the years up to 2000 and remove returns with zero or negative turnover for the years afterwards to generate a consistent firm count for the entire sample period. The data cover all legal forms, including corporations, limited liability companies, partnerships, and sole proprietorships.

**Variable definition** The Danish tabulations by sales capture total domestic sales and exports, but exclude other foreign activities of Danish firms (Danmarks Statistik, 2001*a*). Certain types of economic activities are exempt from VAT (most of banking and insurance services, healthcare, private education, cultural services, and the long-term leasing of real estate). Sales in these sectors are only captured by the tax statistics if firms are required to submit a return (for example, due to additional taxable activities) or if they voluntarily file a tax return.

Figure IA12 shows the coverage of the sales tabulations. The left panel shows log total sales from the tabulations. The right panel shows the ratio of tabulated sales relative to GDP (solid line with circles) is around two, and relative to gross output (dashed line with diamonds) is around one. These comparisons show that our data have comprehensive and consistent coverage (gross output in national accounts—which is the counterpart of sales—is typically twice the level of GDP).

**Data construction**

- Top $x$% sales share = Sales of top $x$% firms by sales in a given year/All sales in a given year.
- Top $x$% sales share among top $y$% = Sales of top $x$% firms by sales in a given year/Sales of top $y$% firms by sales in a given year.
- Top $N$ sales share = Sales of top $N$ firms by sales in a given year/All sales in a given year.

#### IA2.4.2 By Equity Capital

**Sources** We have tabulations by size of equity capital for corporations since 1902 and limited liability companies (LLCs) after they were introduced in 1974, published by Statistics Denmark. First, between 1902 and 1983, these tabulations are regularly published in the *Statistisk Årbog* and in accompanying publications (with additional information) by Statistics Denmark. We download PDFs from the website of Statistics Denmark (Danmarks Statistik, 1903-1975, 1928-1932, 1984-1987), and transcribe the data. The tabulations are based on information from corporate register data. Second, between 1989 and 2018, we directly obtain customized estimates of top 1% and top 500 shares from Statistics Denmark (Danmarks Statistik, 2025*b*). These series are compiled on the basis of accounting data that Statistics Denmark recently acquired from the data provider KOB/Experian. The accounting data come from annual reports that all corporations and LLCs are required to file at the Danish Ministry of Economic and Business Affairs (Bennedsen et al., 2007).

**Scope** The tabulations by capital are restricted to corporations and LLCs. The unit of observation is the company as recorded in the Company Register. The register records each legal entity separately. In 1977, a minimum capital size requirement of 100,000 Kronor for corporations and 30,000 Kronor for limited liability companies was introduced (Danmarks Statistik, 1984-1987). The thresholds were raised to 300,000 Kronor for corporations and 80,000 Kronor for LLCs in 1983, and 500,000 Kronor for corporations and 200,000 Kronor for LLCs in 1991. The thresholds were then reduced to 125,000 Kronor for LLCs in 1996, 80,000 Kronor in 2010, and 50,000 Kronor in 2014.

**Variable definition** The Danish tabulations by capital use the value of paid-in capital until 1964, and subscribed capital since 1965 (Danmarks Statistik, 1965). Subscribed capital is the total amount of shares that investors have agreed to purchase times their par value. Paid-in capital is the portion of that amount that has actually been paid to the firm. Both concepts are comparable in magnitude (paid-in capital in 1964 was 7,972 million Kronor, and subscribed capital in 1965 was 8,622 million Kronor). From 1989 onward, the data are based on firms' reported book equity.

**Corporate share** Since the tabulations by capital are restricted to corporations and LLCs, we need to estimate of the share of corporations and LLCs relative to all businesses (especially relevant for the top $N$ shares in Section III.A). For 1948 to 2018, we estimate the corporate share using the sales share of corporations (all years) and LLCs (starting in 1974) in total sales, available from Statistics Denmark and

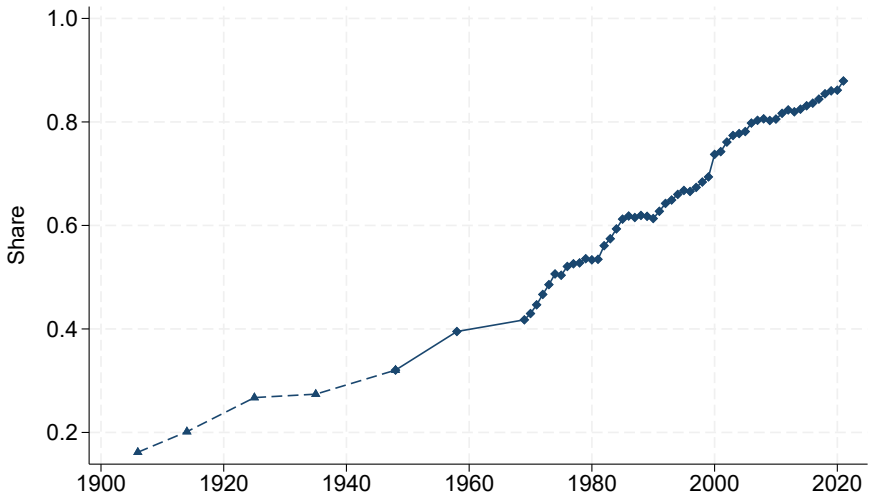



Figure IA13. Denmark: Corporate Share Estimates

*Notes:* The figure shows the estimated corporate share for Denmark. We use the sales share of corporations and LLCs (after their introduction in 1974) in total sales after 1948 (solid line with diamonds), and the employment share of industrial corporations among all industrial businesses before then (dashed line with triangles).

census publications (Danmarks Statistik, 1973-1981, 1983-2001*b*, 1925-1958, 2025*a*). Before 1948, we can obtain estimates of the corporate employment share for industrials (Danmarks Statistik, 1908-1914, 1925-1958).[32] The two estimates are both available in 1948, and align closely. We therefore use the employment share series to extend our corporate share series further back in time.

**Data construction**

- Top $x$% capital share = Capital of top $x$% corporations (and LLCs) by capital in a given year/Capital of corporations (and LLCs) in a given year.
- Top $x$% capital share among top $y$% = Capital of top $x$% corporations (and LLCs) by capital in a given year/Capital of top $y$% corporations (and LLCs) by capital in a given year.
- Top $N$ capital share = Capital of top $N$ corporations (and LLCs) by capital in a given year/Estimated total capital in a given year (starting with capital of corporations and LLCs and divide by their estimated share as discussed above).

## IA2.5 France

Table IA5 lists the sources that we use for France.

[32]The industrials sector includes construction, manufacturing, utilities, and mining.

Table IA5 – France: Data Sources

| Type | Period | Source |
|---|---|---|
| Tabulations by sales | 1949–1950 | Institut National de la Statistique et des Études Économiques (1949, 1950) *Bulletin Mensuel de Statistique*. |
| | 1952–1979 | Institut National de la Statistique et des Études Économiques (various years) *Statistiques & Études Financières*. |
| | 1980–1998 | Institut National de la Statistique et des Études Économiques (various years) *Annuaire Statistique de la France*. |
| Tabulations by employment | 1966, 1981–1998 | Institut National de la Statistique et des Études Économiques (various years) *Annuaire Statistique de la France*. |
| | 1973 | Brocard and Gandois (1978) *Grandes Entreprises et PME*. Economie et Statistique 96.1, 25-41. |
| | 1975 | Brocard (1979) *Les Entreprises Françaises. Concentration et Grandes Entreprises des Secteurs et des Branches*. Collections de l'INSEE. Série E. Entreprises 64. |

*Notes:* This table lists the sources of the France data.

### IA2.5.1 By Sales

**Sources** We have tabulations by size of sales for industrial and commercial (Bénéfices Industriels et Commerciaux, or BIC) firms from 1949 to 1998, using data from the French statistical office (Insee). Since 1952, our main source is the "Statistiques & Études Financières." For 1949 and 1950, we are able to find additional data from Bulletin "Mensuel de Statistique." We obtain physical books of "Statistiques & Études Financières" from the University of Chicago Library (Institut National de la Statistique et des Études Économiques, 1954-1984), and download PDFs of "Annuaire Statistique de la France" and "Bulletin Mensuel de Statistique" from Gallica (Institut National de la Statistique et des Études Économiques, 1953, 1954-2000), which is the digital library of the French national library. We then transcribe the data. The tabulations are based on information from the corporate tax and the personal income tax on industrial and commercial profits.

**Scope** The data cover industrial and commercial (Bénéfices Industriels et Commerciaux, or BIC) firms. Noncommercial (Bénéfices Non Commerciaux, or BNC) firms (e.g., self-employed professionals like doctors and lawyers) and agriculture (Bénéfices Agricoles, or BA) firms are excluded. Each unit is a siren (Système d'Identification du Répertoire des Entreprises). After 1981, the tabulations by size only included large firms that belong to the Bénéfices Réels Normal (BRN) tax regime, but not smaller firms that belong to the Régime Social des Indépendants (RSI) tax regime; before then both types were combined in the Bénéfices Réels (BR) tax regime and included in the tabulations by size. The tabulations by size of sales do not cover firms that belong to the Forfait (FORF) tax regime, which are small in size. To maintain

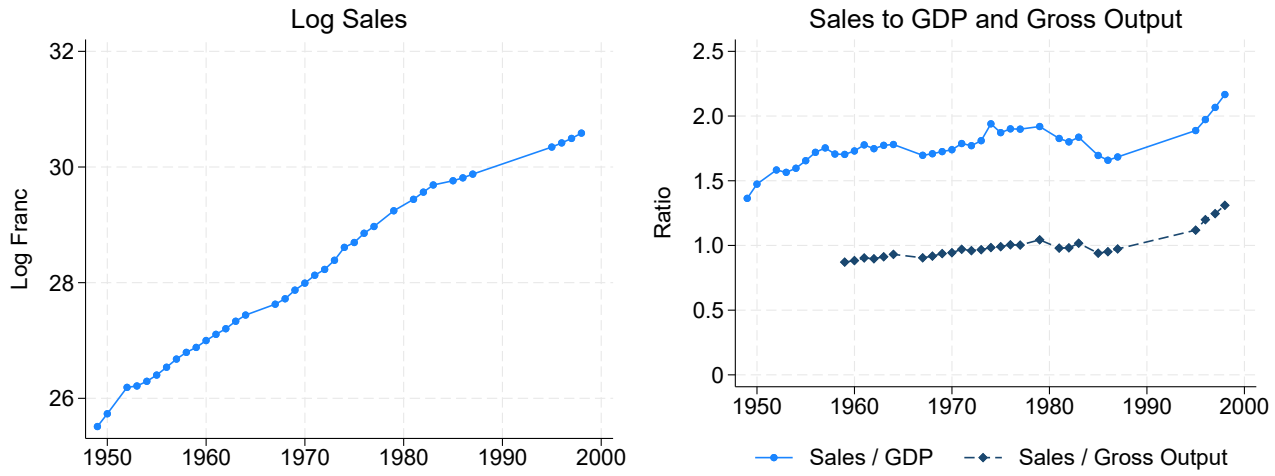



Figure IA14. France: Coverage of Sales in Tax Statistics

*Notes:* The left panel shows the log of all tabulated sales in our data. The data is expressed in USD equivalents to allow for a comparability between Old Franc, New Franc and Euro values. The right panel shows the ratio of tabulated sales to GDP (solid line with circles), the ratio of tabulated sales to gross output (dashed line with diamonds). GDP data come from Jordà, Schularick, and Taylor (2017). Gross output data come from National Accounts Statistics from United Nations (United Nations, 2022*a*,*b*).

consistency, in years when RSI firms are not included in the size tabulations, we assign all of them to the size bin that corresponds to their average size; we also assign all FORF firms to the size bin that corresponds to their average size.[33] This assumption should not affect top share estimates because RSI and FORF firms by definition have low sales, so they matter little for the numerator of top shares.

**Variable definition** Sales are defined as the total revenue generated by a firm in French territories, including exports.

Figure IA14 shows the coverage of the dataset. The left panel shows log total sales from the tabulations. The right panel shows the ratio of tabulated sales relative to GDP (solid line with circles) is around two, and relative to gross output (dashed line with diamonds) is around one in years when we can find gross output data. These comparisons show that our data have comprehensive coverage (gross output in national accounts—which is the counterpart of sales—is typically twice the level of GDP).

**Data construction**

- Top $x$% sales share = Sales of top $x$% firms by sales in a given year/All sales in a given year.
- Top $x$% sales share among top $y$% = Sales of top $x$% firms by sales in a given year/Sales of top $y$% firms by sales in a given year.
- Top $N$ sales share = Sales of top $N$ firms by sales in a given year/All sales in a given year.

[33] We obtain the total number and sales of RSI and FORF firms from tables on the totals by tax regime in the same publications.

### IA2.5.2 By Employment

**Sources** We have tabulations by size of employment for industrial and commercial (Bénéfices Industriels et Commerciaux, or BIC) firms from 1966 to 1998, using data from the French statistical office (Insee). Data for 1966 come from an early version of the French business registry (Fichier des Entreprises et des Établissements). We download PDFs from Gallica (Institut National de la Statistique et des Études Économiques, 1954-2000), and then transcribe the data. Data for 1973 and 1975 come from businesses' fiscal declarations. We download PDFs from Persée (Brocard and Gandois, 1978; Brocard, 1979), which is a digital open access library by the French Ministry of Education, and then transcribe the data. Data for 1981 to 1998 come from the "Annuaire Statistique de la France" publication, which we also use for the tabulations by sales and is based on the SUSE database ("Système Unifié de Statistique d'Entreprise"). We download PDFs from Gallica (Institut National de la Statistique et des Études Économiques, 1954-2000), and then transcribe the data.

**Scope** The data cover industrial and commercial (Bénéfices Industriels et Commerciaux, or BIC) firms. Noncommercial (Bénéfices Non Commerciaux, or BNC) firms (e.g., self-employed professionals) and agriculture (Bénéfices Agricoles, or BA) firms are excluded.[34] Each unit is a siren (Système d'Identification du Répertoire des Entreprises). After 1981, the tabulations by size only included large firms that belong to the Bénéfices Réels Normal (BRN) tax regime, but not smaller firms that belong to the Régime Social des Indépendants (RSI) tax regime; before then both types were combined in the Bénéfices Réels (BR) tax regime and included in the tabulations by size. The tabulations by size of employment included firms that belong to the Forfait (FORF) tax regime until 1980, but not afterwards. To maintain consistency, in years when RSI firms are not included in the size tabulations, we assign all of them to the size bin that corresponds to their average size; we also assign all FORF firms to the size bin that corresponds to their average size.[35] This assumption should not affect top share estimates because RSI and FORF firms by definition are small, so they matter little for the numerator of top shares.

**Variable definition** Employment includes all individuals who reported being salaried workers and who are not classified as self-employed or employers. The classification is based solely on the legal status of having a paid employment relationship with an employer, rather than on working hours or contract duration. This definition covers all wage-earning workers regardless of whether they are full-time or part-time, permanent or temporary.

**Data construction**

- Top $x$% employment share = Employment of top $x$% firms by employment in a given year/Total employment in a given year.

[34] We have to drop the data for 1977 to 1980 because these years provide tabulations combining BIC, BNC, and BA firms, which we cannot separate, whereas all other years tabulate BIC firms only.

[35] We obtain the total number and employment of RSI and FORF firms from tables on the totals by tax regime in the same publications.

- Top $x$% employment share among top $y$% = Employment of top $x$% firms by employment in a given year/Employment of top $y$% firms by employment in a given year.
- Top $N$ employment share = Employment of top $N$ firms by employment in a given year/Total employment in a given year.

## IA2.6 Germany

Table IA6 lists the sources that we use for Germany.

Table IA6 – Germany: Data Sources

| Type | Period | Source |
|---|---|---|
| Tabulations by sales | 1926–1929 | Statistisches Reichsamt (various years) *Statistik des Deutschen Reichs Band 361 and 399 - Umsatz und Umsatzsteuer in Deutschland*. |
| | 1935 | Statistisches Reichsamt (1938) *Statistik des Deutschen Reichs Band 511 - Umsatzsteuerstatistik 1935*. |
| | 1950–1959 | Statistisches Bundesamt (various years) *Die Umsätze der Umsatzsteuerpflichtigen und deren Besteuerung*. |
| | 1960–1974 | Statistisches Bundesamt (various years) *Finanzen und Steuern Fachserie L Reihe 7 - Umsatzsteuer*. |
| | 1976–2009 | Statistisches Bundesamt (various years) *Finanzen und Steuern Fachserie 14 Reihe 8 - Umsatzsteuer*. |
| | 2010–2019 | Statistisches Bundesamt (various years) *Finanzen und Steuern Fachserie 14 Reihe 8.1 - Umsatzsteuerstatistik (Voranmeldungen)*. |
| CR10 by sales (manufacturing) | 1954–1982 | Statistisches Bundesamt (1985) *Konzentrationsstatistische Daten für den Bergbau und das Verarbeitende Gewerbe, Fachserie 4 Reihe S.9*. |
| | 1983–2016 | Statistisches Bundesamt (various years) *Konzentrationsstatistische Daten für den Bergbau und das Verarbeitende Gewerbe sowie das Baugewerbe, Fachserie 4 Reihe 4.2.3*. |
| | 2017–2021 | Statistisches Bundesamt (2025) *Konzentration der Unternehmen nach Wirtschaftszweigen*. Provided by the German statistical office. |
| Tabulations by equity capital | 1904–1920 | Königlich Statistisches Bureau (various years) *Statistisches Jahrbuch für den Preussischen Staat*. |
| | 1936–1941 | Statistisches Reichsamt (various years) *Wirtschaft und Statistik*. |
| | 1955–1980 | Statistisches Bundesamt (various years) *Wirtschaft und Statistik*. |

| | | |
|---|---|---|
| | 1956, 1959 | Statistisches Bundesamt (various years) *Statistisches Jahrbuch der Bundesrepublik Deutschland*. |
| | 1983–1992 | Statistisches Bundesamt (various years) *Unternehmen und Arbeitstätten Fachserie 2 Reihe 2.2 - Zahl und Nominalkapital der Kapitalgesellschaften*. |
| Tabulations by employment | 1925 | Statistisches Reichsamt (1930) *Statistik des Deutschen Reichs Band 413, IV - Gewerbliche Betriebszählung - Die gewerblichen Betriebe und Unternehmungen im Deutschen Reich, Teil IV.* |
| | 1961 | Statistisches Bundesamt (1965) *Unternehmen und Arbeitsstätten Fachserie C - Arbeitsstättenzählung von 6. Juni 1961, Heft 4 Nichtlandwirtschaftliche Unternehmen (Wirtschaftseinheiten) und Beschäftigte.* |
| | 1970, 1987 | Statistisches Bundesamt (1990) *Unternehmen und Arbeitsstätten Fachserie 2 - Arbeitsstättenzählung vom 25. Mai 1987, Heft 11 Arbeitsstätten, Unternehmen und Beschäftigte 1987, 1970, 1961, 1950.* |
| | 2003–2018 | Statistisches Bundesamt (2025) *Statistisches Unternehmensregister, Rechtliche Einheiten nach Sondergrößenklassen der Beschäftigten*. Provided by the German statistical office. |

*Notes:* This table lists the sources of the German data.

### IA2.6.1 By Sales

**Sources** We use tabulations by size of sales for all types of firms from 1926 to 2019, published by the German statistical office. We obtain physical books of the publications before 1935 through the German National Library (Statistisches Reichsamt, 1931, 1932, 1938), and download PDFs through the statistical library of the Statistisches Bundesamt afterwards (Statistisches Bundesamt, 1955-1961, 1962-1976, 1978-2011, 2012-2022*a*). We then transcribe the data. The tabulations are based on information from the sales tax (first introduced in 1916 on the delivery of all goods, and expanded to cover all goods and services in 1918) and the value added tax (VAT) (following additional reforms that led to the transition in 1967). The German statistical office published regular reports based on submitted tax records including tabulations of businesses by size of sales since 1924. We restrict our analysis to data from 1926 onward because tabulations for 1924 and 1925 exclude tax-exempt sales (e.g., exports).

**Scope** The tabulations by sales cover all types of firms with sales above a minimum threshold. The unit of observation consists of a legal entity required to pay VAT and submit a VAT pre-declaration. If multiple businesses are financially, economically, and organizationally integrated, they typically file a joint VAT return. Firms have to pay VAT (sales tax before 1968) if their sales exceed a pre-specified threshold. The threshold was 8,000 Deutsche Mark in 1958 (Statistisches Bundesamt, 1955-1961), 20,000 Deutsche Mark in 1980, and 17,500 Euros by 2003 (Statistisches Bundesamt, 1978-2011). The tabulations in some years before 1958 have a minimum threshold while others do not. For the years when there is no minimum

threshold, we impose one ourselves to maximize consistency over time. For the years between 1955 and 1958, we set this threshold to 8,000 Deutsche Mark to be consistent with later years. For 1950, we set the threshold to 6,000 Deutsche Mark (since 8,000 is not a size bin threshold in that year). For the years until 1935 that use a different currency, we set this threshold to 5,000 Reichsmark. Before 1945, the tax statistics include firms from the entire German Reich. After 1945, the statistics cover West Germany. West Berlin is included from 1957 onward, the Saarland from 1960 onward, and East Germany from 1992 onward. The data cover all legal forms, including corporations, limited liability companies, partnerships, and sole proprietorships.

**Variable definition** The tax statistics tabulate firms based on total sales in Germany.[36] This includes taxable sales and tax-exempt sales, such as exports. Sales conducted outside of Germany or without payment for goods or services are not accounted for in the statistics. In addition, internal transactions within a tax group are non-taxable and not included.[37] Certain types of economic activities are exempt from VAT (most of banking and insurance services, healthcare, private education, cultural services, and the long-term leasing of real estate). Sales in these sectors are only captured by the tax statistics if firms are required to submit a return (for example, due to additional taxable activities or imports from another EU country) or if they voluntarily file a tax return. In addition, tax-exempt banking and insurance sales are generally eliminated from the published statistical results (even if firms report them in tax returns and tax-exempt sales are otherwise included in the by sales tabulations).

Figure IA15 shows the coverage of tabulated sales in our data. The left panel shows log total sales from the tabulations. The integration of East Germany did not create a sizable discontinuity, as the East German economy was small relative to the West German economy. The right panel shows the ratio of tabulated sales relative to GDP (solid line with circles) is around two, and relative to gross output (dashed line with diamonds) is around one in years when we can find gross output data. These comparisons show that our data have comprehensive and consistent coverage (gross output in national accounts—which is the counterpart of sales—is typically twice the level of GDP).

**Sector harmonization** The German tax statistics include tabulations by sector. We use these sectoral tabulations to estimate top shares in manufacturing, retail/wholesale trade, and services, which are roughly comparable with SIC codes 20-39 (manufacturing), 50-59 (retail/wholesale trade), and 70-89 (services). The statistical office periodically updated its sector classifications, requiring some adjustment to create sectors that are as consistent as possible over the long run. For manufacturing, we exclude "Mining," "Metal extraction," and "Stone, ceramics, glass extraction and processing" (which were sometimes mixed with

[36] Sales tax statistics in Germany have two different underlying sources. One is "voranmeldungen," which is pre-registration that firms have to file at regular intervals during the year. The other is "veranlagungen," which is final tax assessment from firms' tax returns submitted at the end of the fiscal year. The advantage of pre-registration statistics is that they can usually be published much faster. The main difference is that pre-registrations are only filed by firms that exceeded the tax threshold in the previous year, and thus exclude entrants and firms with sales below the exemption threshold in the previous year. Assessment statistics are available from 2006 onward and prior to 1950. We use assessment statistics before 1950 and, for consistency and to avoid changing sources, pre-registration statistics after 1950.

[37] Imports are subject to sales tax (Einfuhrumsatzsteuer), but not covered by the statistics.

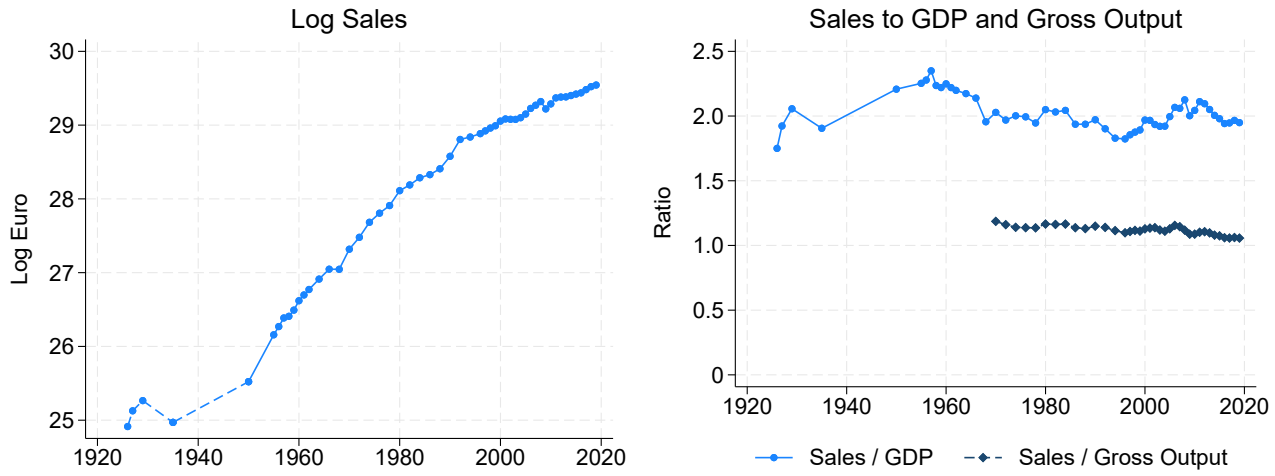



Figure IA15. Germany: Coverage of Sales in Tax Statistics

*Notes:* The left panel shows the log of all tabulated sales in our data. The data is expressed in Euro equivalents. The right panel shows the ratio of tabulated sales to GDP (solid line with circles), the ratio of tabulated sales to gross output (dashed line with diamonds). Data for East Germany are included from 1992 onward. GDP data come from Jordà, Schularick, and Taylor (2017) for 1950 onwards (in Deutsche Mark) and Ritschl and Spoerer (1997) for the earlier years (in Reichsmark). Gross output data come from National Accounts Statistics from United Nations (United Nations, 2022*a*,*b*). Before 2000, we convert the Deutsche Mark to Euro with rate of 1 Euro = 1.95583 Mark. To plot log sales before and after World War II in a single figure, we assume a one-to-one exchange rate between the Reichsmark and the Deutsche Mark, consistent with the one-to-one conversion rate of wages during the 1948 currency reform.

mining) to obtain a consistent series. For services, the definitions of the services subsectors (which we combine to obtain one series for services as a whole) changed over time, with particularly significant adjustments in 1968 and 2009. We stop in 2009 to be able to exclude telecommunications consistently from services. We exclude healthcare prior to 1968 due to inconsistent coverage following the adoption of the VAT. Before 1968, healthcare included both institutional providers and independent practitioners. After 1968, only institutional providers remained. Therefore, the number of firms in the healthcare sector is not comparable before and after the change. We exclude "Asset Management Firms" from 1962 to 1998 to match with the coverage of the services sector before 1961; due to limited data granularity, "Asset Management Firms" cannot be excluded for the period of 1999 to 2008. We also exclude “Political and Economic Organizations,” “Religious Organizations,” and “Sovereign and Chamber Administrations” from the entire series. Due to limited data granularity, "Religious Organizations" cannot be excluded from 1999 to 2008, but it only represents only a small share of the services sector and doesn’t affect the overall concentration trends.

**Data construction**

- Top $x$% sales share = Sales of top $x$% firms by sales in a given year/All sales in a given year.
- Top $x$% sales share among top $y$% = Sales of top $x$% firms by sales in a given year/Sales of top $y$% firms by sales in a given year.

- Top $N$ sales share = Sales of top $N$ firms by sales in a given year/All sales in a given year.

### IA2.6.2 CR10 by Sales

**Sources** We have data on CR10 reported for two-digit manufacturing industries since 1954, and for four-digit manufacturing industries since 1968. The data come from reports by the Federal Cartel Office and the Monopolies Commission for 1954 to 1982 (Statistisches Bundesamt, 1985), and the German statistical office's Fachserie 4.2.3 publications for 1983 to 2016 (Statistisches Bundesamt, 1986-2018); we download PDFs from the statistical library of the Statistisches Bundesamt, and transcribe the data. The publication of the Fachserie was discontinued in 2016, and we obtain updated files for 2017 to 2021 directly from the German statistical office (Statistisches Bundesamt, 2017-2021).[38]

**Scope** The data for 1954 to 1975 are restricted to firms with 10 or more employees. The data for 1976 to today are restricted to firms with 20 or more employees. A comparison between the levels before and after should therefore be made with caution. Census data on firm size by employment (see Appendix IA2.6.4) show that the share of employment in firms with fewer than 20 employees has declined over time. As a result, concentration statistics restricted to firms with at least 20 employees likely cover a larger share of activity now than in the past, which may understate the increase in CR10. The unit of observation is a firm, defined as the smallest legal entity required to maintain accounting records and prepare financial statements for commercial and/or tax purposes. This definition includes all administrative operations, as well as non-manufacturing divisions (e.g., trading departments). However, it excludes foreign branches and legally independent subsidiaries. Firms are classified entirely to the economic sector in which they are primarily active. At the start, in 1954, the statistics cover West Germany and West Berlin. The Saarland is included from 1955 onward, and East Germany from 1991 onward. The data cover all legal forms, including corporations, limited liability companies, partnerships, and sole proprietorships.

**Variable definition** Sales are defined as the value of invoiced deliveries and services to third parties, excluding VAT. It includes revenue from own products and services but excludes non-operating income like asset sales, interest income, and dividends.

### IA2.6.3 By Equity Capital

**Sources** We have tabulations by size of equity capital for corporations and limited liability companies (LLCs) from 1936 to 1992, published by the German statistical office based on public filings with the commercial register. Corporations and LLCs are tabulated separately. Tabulations for corporations are published more regularly than the corresponding tabulations for LLCs. We restrict our analysis to years

[38] In addition, the German statistical office provided us with an internal version of the Fachserie 4.2.3 (which includes the concentration statistics) for 2007 and 2008, which was based on the industry classification WZ2003. The published version available online uses the WZ2008 classification but does not include data for 2007.

when tabulations for both groups are available. We download PDFs through the statistical library of the Statistisches Bundesamt (Statistisches Reichsamt, 1937-1942; Statistisches Bundesamt, 1956-1981, 1957-1960, 1987-1994), and transcribe the data.

To extend the German data further back in time, we add tabulations for both corporations and LLCs for Prussian firms from 1904 to 1920 published by the Prussian statistical office. Prussia accounted for about 60% of the German population at that time and Prussian data is often used to extend series for Germany further back in time (see Albers, Bartels, and Schularick, 2025). We download PDFs from HathiTrust (Königliches Statistisches Landesamt, 1905-1923) and then transcribe the data.

**Scope** The tabulations by capital are restricted to corporations and LLCs. The unit of observation is a firm registered as either a corporation or a LLC in the commercial register. The law stipulates a minimum amount of nominal capital for both legal forms. For corporations, a minimum nominal capital threshold was imposed implicitly at 5,000 Mark in 1884. In 1923, a legal minimum nominal capital threshold of 5,000 Goldmark for existing firms and 50,000 Goldmark for new firms was introduced. In 1937, the national socialist government increased the minimum nominal capital threshold to 500,000 Reichsmark in an effort to force conversions to other legal forms. After the war, the minimum amount of capital for corporations was set at 100,000 Deutsche Mark. For LLCs, the minimum capital was originally set at 20,000 Deutsche Mark when the legal form was introduced in 1892. This amount remained unchanged across the various currency regimes until 1980, when it was raised to 50,000 Deutsche Mark. Firms were granted a grace period to raise their nominal capital or to convert to another legal form whenever the statutory minimum was increased. Data between 1904 and 1920 are restricted to Prussia. Data for 1936 to 1941 cover the entire German Reich. Starting in 1955, the statistics cover West Germany. The Saarland is included since 1962, West Berlin since 1964, and East Germany since 1992.

**Variable definition** The German tabulations by capital use the value of nominal capital. Nominal capital is defined as the total amount of shares multiplied by their par value.

**Corporate share** Since the tabulations by capital are restricted to corporations and LLCs, we need an estimate of their share relative to all businesses (especially relevant for the top $N$ shares in Section III.A). We estimate the corporate share using the sales share of corporations and LLCs in total sales from sales tax statistics. The resulting corporate share series is shown in Figure IA16.

**Data construction**

- Top $x$% capital share = Capital of top $x$% corporations (and LLCs) by capital in a given year/Capital of corporations (and LLCs) in a given year.
- Top $N$ capital share = Capital of top $N$ corporations (and LLCs) by capital in a given year/Estimated total capital in a given year (starting with capital of corporations and LLCs and divide by their estimated share as discussed above).

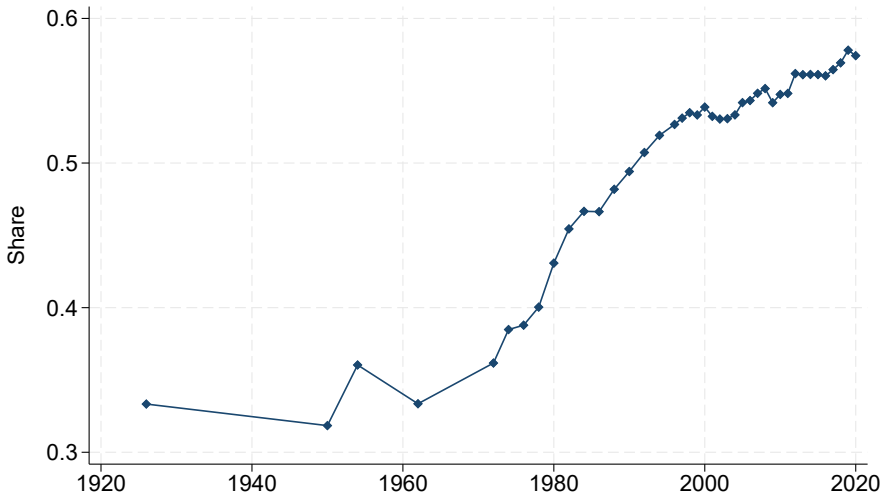



Figure IA16. Germany: Corporate Share Estimates

*Notes:* The figure shows the estimated corporate share for Germany. We use the sales share of corporations and LLCs in total sales.

### IA2.6.4 By Employment

**Sources** We use two types of tabulations by size of employment for Germany. First, between 1925 and 1987, we have tabulations from the Census of Establishments, which was conducted at irregular intervals approximately every ten to 15 years during this time period. We obtain physical books of pre-1961 Census of Establishment publications from the German National Library (Statistisches Bundesamt, 1930), and download PDF files for the 1961, 1970, and 1987 censuses from the statistical library of the Statistisches Bundesamt (Statistisches Bundesamt, 1965, 1990). No firm-level employment size tabulations are available for the 1933, 1939, and 1950 censuses.[39] Second, for 2003 to 2018, the data come from the company register managed by the German statistical office (Statistisches Bundesamt, 2025). The statistical office maintains and updates the register using information from tax authorities, the federal employment agency, surveys, and commercial data providers. The statistical office kindly provided us with detailed tabulations for all years.

**Scope** The Census of Establishments covers all non-agricultural firms and their employees. The unit of observation is a company, defined as the smallest legal unit that maintains financial records for business or tax purposes. Companies (or "economic units" as they are called in early issues of the census) can either be single establishment firms or the aggregation of several establishments that belong to the same legally independent enterprise. The tabulations include data from all domestic establishments (even if the establishments engage in agricultural activities). Before 1945, the statistics include firms from the entire German Reich. After 1945, the statistics cover West Germany (including West Berlin). The data cover all

[39]The 1933 census publications omitted firm size tabulations. A planned 1939 census volume on firm-level statistics was never published. The 1950 census publications only tabulated firm size based on sales rather than employment.

legal forms, including corporations, limited liability companies, partnerships, and sole proprietorships.

The company register includes businesses from all sectors, except agriculture, public administration, and extraterritorial entities. The unit of observation is a legal unit. A legal entity is included in the register if its annual revenue exceeds a sales threshold (which is equal to the corresponding sales threshold in the VAT tabulations) or if it has at least one employee subject to social security contributions. The data from 2003 to 2005 are based on the industry classification WZ 2003. Later years are classified based on WZ 2008, which may have resulted in small changes in the population of firms, even at the aggregate level according to the statistical office. The data cover all legal forms, including corporations, limited liability companies, partnerships and sole proprietorships.

**Variable definition** In the Census of Establishments, employees include all full-time and part-time workers who are in an employment relationship on the reference date and are listed on the payroll. This also includes active owners and unpaid assisting family members, regardless of the number of hours they work at the workplace. In the company register, employees include all workers subject to social security contributions (i.e., those earning above a minimum threshold). Self-employed and working owners are excluded unless registered as employees subject to social security contributions (e.g., a LLC managing director with a salary). This narrower definition of employees tends to raise top employment shares by a small amount between 2003 and 2018[40].

**Sector harmonization** The Census of Establishments and the company register include tabulations of firms by sector and employment size. We use these sectoral tabulations to estimate top shares in manufacturing and retail/wholesale trade, which are roughly comparable with SIC codes 20-39 (manufacturing) and 50-59 (retail/wholesale trade). Sectoral classifications were updated over our sample period requiring some adjustment to create sectors that are as consistent as possible over the long run. We make sure that manufacturing always excludes construction, mining, and utilities. Trade typically includes retail, wholesale, and trade brokerage. The company register also groups firms classified as automobile repair shops under trade, a category that falls under manufacturing in the census and cannot be isolated in either source due to insufficient sectoral detail.

**Data construction**

- Top $x\%$ employment share = Employment of top $x\%$ firms by employment in a given year/Total employment in a given year.
- Top $x\%$ employment share among top $y\%$ = Employment of top $x\%$ firms by employment in a given year/Employment of top $y\%$ firms by employment in a given year.
- Top $N$ employment share = Employment of top $N$ firms by employment in a given year/Total employment in a given year.

[40]The 2019 data show that employees not subject to social security contributions account for a larger share of employment in small firms compared to large firms.

Table IA7 – Singapore: Data Sources

| Type | Period | Source |
|---|---|---|
| Tabulations by net income | 1972–2004 | Inland Revenue Department (various years) *Yearbook of Statistics, Singapore*. |
| | 2005–2022 | Inland Revenue Authority of Singapore (various years) *Taxable Companies by Assessed Income Group*. |

*Notes:* This table lists the sources of the Singaporean data.

## IA2.7 Singapore

Table IA7 lists the sources that we use for Singapore.

**Sources** We have tabulations by size of taxable income for corporations since 1972, published by the Department of Statistics using data from the Inland Revenue Department before 1992 and the Inland Revenue Authority afterwards. We obtain tabulations from PDFs of the Yearbook of Statistics on the website of the Singapore national library before 2005 (Singapore Department of Statistics, 1972-2004), and transcribe the data; we download data in Excel spreadsheets from the website of the Inland Revenue Authority of Singapore (IRAS) since 2005 (Inland Revenue Authority of Singapore, 2005-2007, 2008-2022). These tabulations are based on corporate income tax returns.

**Scope** The tabulations include resident and nonresident corporations with positive income. They do not include partnerships, sole proprietorships, trusts, and associations (including cooperatives).

**Variable definition** Before 2005, the data are tabulated by assessed income. From 2005 onward, tabulations are by chargeable income (taxable income). There is no major discontinuity in the totals when the variable definition changes from assessed to chargeable income between 2004 and 2005. Foreign-sourced income is only taxable and included in the data if it is received in Singapore or brought back to Singapore.

**Corporate share** Firm size tabulations for Singapore are restricted to firms subject to the corporate tax. Therefore, we need to obtain an estimate of the share of corporations relative to all businesses (especially relevant for the top $N$ shares in Section III.A). We can use data from national accounts from the Singapore Department of Statistics (Singapore Department of Statistics, 1985-2022) from 1985 onward, by taking the ratio of corporate sector GDP to corporate plus noncorporate GDP. We use data on assessed income by legal form from the Yearbook of Statistics between 1972 and 1985, by taking the ratio of corporate assessed income to corporate plus noncorporate (partnership and sole proprietorship) assessed income (Singapore Department of Statistics, 1972-2004); we take five-year moving average of this series to make it more stable. The resulting corporate share series is shown in Figure IA17.

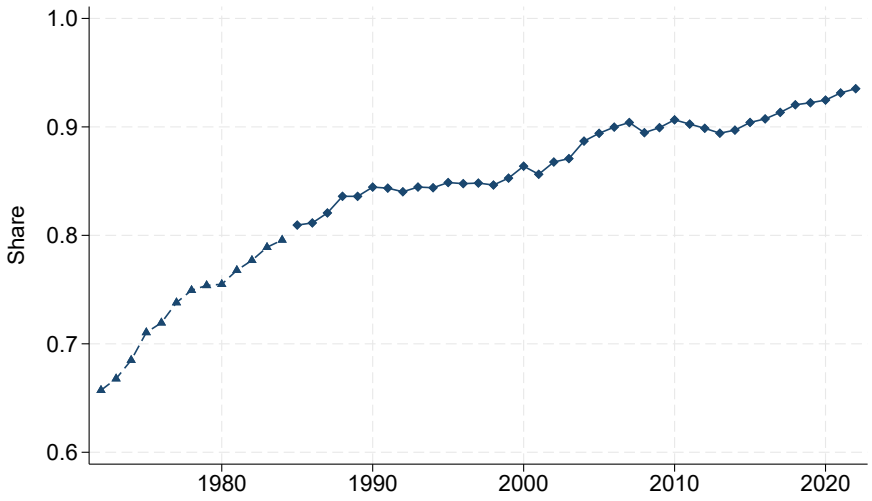



Figure IA17. Singapore: Corporate Share Estimates

*Notes:* The figure shows the estimated corporate share for Singapore. We use the ratio of corporate GDP to corporate GDP to corporate and noncorporate GDP since 1985 (solid line with diamonds), and the five-year moving average of corporate assessed income to corporate plus noncorporate (partnership and sole proprietorship) assessed income (dashed line with triangles) between 1972 and 1985.

**Data construction**

- Top $x$% net income share = Net income of top $x$% corporations by net income in a given year/Net income of corporations in a given year. Restricted to those with positive net income.
- Top $x$% net income share among top $y$% = Net income of top $x$% corporations by net income in a given year/Net income of top $y$% corporations by net income in a given year. Restricted to those with positive net income.
- Top $N$ net income share = Net income of top $N$ corporations by net income in a given year/Estimated net income of corporations and noncorporations in a given year (starting with net income of corporations and divide by estimated corporate share as discussed above). Restricted to those with positive net income.

## IA2.8 Switzerland

Table IA8 lists the sources that we use for Switzerland.

### IA2.8.1 By Sales

**Sources** We have tabulations by size of sales for all types of firms since 1995, published by the Federal Tax Administration in an annual publication of value added tax (VAT) statistics. We download PDFs from

Table IA8 – Switzerland: Data Sources

| Type | Period | Source |
|---|---|---|
| Tabulations by sales | 1965 | Eidgenössisches Statistisches Amt (1967) *Statistische Quellenwerke der Schweiz Heft 409, Reihe Df 1, Unternehmungen Hauptergebnisse für die Schweiz*. |
| | 1995–2021 | Eidgenössische Steuerverwaltung (various years) *Die Mehrwertsteuer in der Schweiz.* |
| Tabulations by equity capital | 1901–1930 | Eidgenössisches Statistisches Amt (1934) *Statistische Quellenwerke der Schweiz / Heft 56 - Schweizerische Aktiengesellschaften 1921 bis 1933.* |
| | 1921–1985 | Eidgenössisches Statistisches Amt (various years) *Statistisches Jahrbuch der Schweiz.* |
| Tabulations by employment | 1929 | Eidgenössisches Statistisches Amt (1933) *Statistische Quellenwerke der Schweiz Heft 29, Die Unternehmungen in der Schweiz, Band 5 der Eidgenössischen Betriebszählung 1929.* |
| | 1939 | Eidgenössisches Statistisches Amt (1946) *Statistische Quellenwerke der Schweiz Heft 171, Die Unternehmungen in der Schweiz*. |
| | 1955 | Eidgenössisches Statistisches Amt (1965) *Statistisches Jahrbuch der Schweiz 1965.* |
| | 1965 | Eidgenössisches Statistisches Amt (1967) *Statistische Quellenwerke der Schweiz Heft 409, Reihe Df 1, Unternehmungen Hauptergebnisse für die Schweiz*. |
| | 1975 | Eidgenössisches Statistisches Amt (1977) *Statistische Quellenwerke der Schweiz Heft 606, Eidgenössische Betriebszählung 1975 Unternehmungen, Hauptergebnisse für die Schweiz*. |
| | 1985 | Bundesamt für Statistik (1994) *Die Wirtschaftliche Entwicklung im Spiegel der Betriebszählung 1985 and 1991.* |
| | 1991-2008 | Bundesamt für Statistik (2025) *Betriebszählung, 1991 bis 2008.* Provided by the STATENT Team at the Swiss statistical office. |
| | 2011-2022 | Bundesamt für Statistik (2025) *Institutionelle Einheiten (Unternehmen) Marktwirtschaftlich nach Grössenklasse und Wirtschaftssektor*. Provided by the STATENT Team at the Swiss Federal Statistical Office. |

*Notes:* This table lists the sources of the Swiss data.

the Swiss statistical office (Eidgenössische Steuerverwaltung, 1997-2023), and transcribe the data. The tabulations are based on information from the VAT (introduced in Switzerland in 1995). In addition, the Swiss statistical office published a tabulation of firms by sales size as part of the 1965 Establishment

Census. We download PDFs from the Swiss Statistical Office (Eidgenössische Steuerverwaltung, 1997-2023; Eidgenössisches Statistisches Amt, 1967), and transcribe the data (Appendix IA2.8.3 also uses this source).

**Scope** The tabulations by sales from the VAT statistics cover all types of firms with sales above a minimum threshold. Businesses with an annual turnover above the threshold must register in the VAT register and submit periodic declarations to the Federal Tax Administration. The unit of observation consists of a legal entity or a group of entities registered as a single taxpayer that submits standard monthly, quarterly, or semi-annual tax returns. If multiple entities are under unified management, they can file a joint VAT return (management is considered unified when control is exercised through a majority of votes or other means). The minimum sales threshold is 75,000 Swiss Francs in 1995 (Eidgenössische Steuerverwaltung, 1997), and 100,000 Swiss Francs in 2010 (Eidgenössische Steuerverwaltung, 2013). However, there are many firms below the threshold still filing a VAT return (e.g., 17.8% of returns in 2015). The data cover all legal forms, including corporations, limited liability companies, partnerships, and sole proprietorships.

The tabulation by sales from the 1965 Establishment Census includes all businesses in Switzerland, excluding agriculture, banking and insurance. Each unit of observation is a firm, defined as the smallest legally independent economic unit. The data cover all legal forms, including corporations, limited liability companies, partnerships, and sole proprietorships.

**Variable definition** The tabulations by sales from the VAT statistics use total sales of Swiss firms, including their foreign sales. This is different from the tabulations by sales in Austria, Germany, and Denmark, which do not include foreign sales. Certain types of economic activities are exempt from VAT (most of banking and insurance services, healthcare, private education, cultural services, and the long-term leasing of real estate). Sales in these sectors are only captured by the tax statistics if firms are required to submit a return (for example, due to additional taxable activities) or if they voluntarily file a tax return. However, the statistical office acknowledges in its documentation of the tax statistics that firms may not always report tax-exempt sales accurately on their tax returns. For the 1965 Establishment Census, sales are reported for the year 1964 or the most recently completed fiscal year before the census period. Sales include all income from business activities, excluding taxes, subsidies, asset sales, and cost deductions. Firms with foreign branches report only revenue from Swiss operations. During the processing, the statistical office had to exclude a substantial share of firms because, due to misunderstanding in the form, many firms reported net profits instead of sales (Eidgenössisches Statistisches Amt, 1967).

Figure IA18 shows the coverage of the sales tabulations. The left panel shows log total sales from the tabulations. The right panel shows the ratio of tabulated sales relative to GDP (solid line with circles), and relative to gross output (dashed line with diamonds). These ratios are higher than other countries in our data, especially in recent years. This is likely due to the rise of foreign sales (which are not part of GDP or gross output), which are present in Swiss data but not in other by sales tabulations.

**Data construction**

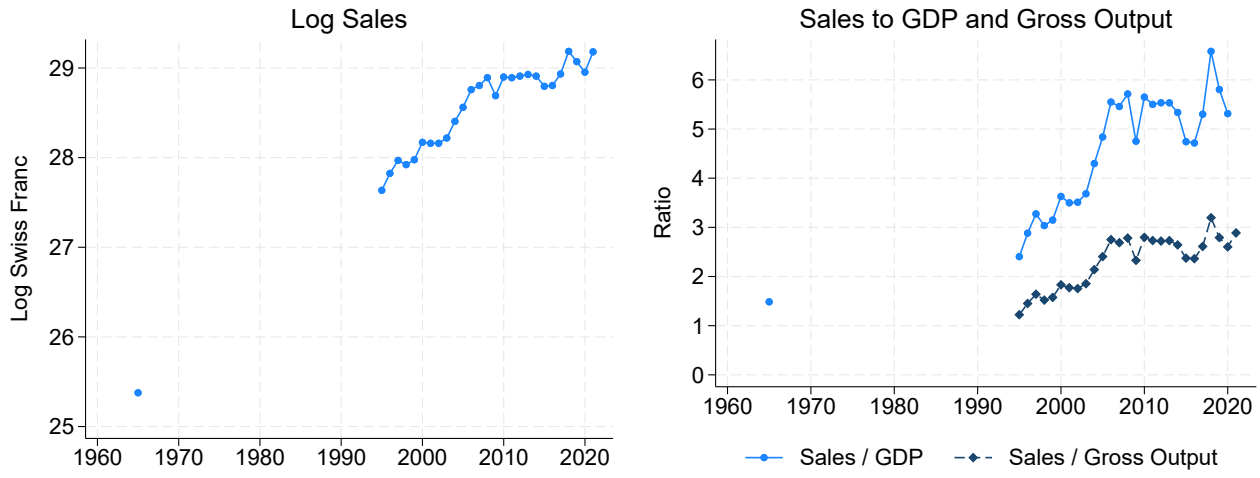



Figure IA18. Switzerland: Coverage of Sales in Tax Statistics

*Notes:* The left panel shows the log of all tabulated sales in our data. The right panel shows the ratio of tabulated sales to GDP (solid line with circles), the ratio of tabulated sales to gross output (dashed line with diamonds). GDP data come from Jordà, Schularick, and Taylor (2017). Gross output data come from National Accounts Statistics from United Nations (United Nations, 2022*a*,*b*).

- Top $x$% sales share = Sales of top $x$% firms by sales in a given year/All sales in a given year.
- Top $x$% sales share among top $y$% = Sales of top $x$% firms by sales in a given year/Sales of top $y$% firms by sales in a given year.
- Top $N$ sales share = Sales of top $N$ firms by sales in a given year/All sales in a given year.

### IA2.8.2 By Equity Capital

**Sources** We have tabulations by size of equity capital for corporations from 1901 and limited liability companies (LLCs) after they were introduced in 1937, until they end in 1985, published by the Swiss statistical office. The publications based on analyses of corporations and LLCs recorded in the Business and Enterprise Register.[41] Corporations and LLCs are tabulated separately. Tabulations for corporations are published more regularly than the corresponding tabulations for LLCs. We restrict our analysis to years when tabulations for both groups are available. We download PDFs from the Statistical Yearbook and special issues on joint stock corporations published by the Federal Statistical Office (Eidgenössisches Statistisches Amt, 1934, 1922-1986); we then transcribe the data.

**Scope** The tabulations by capital are restricted to corporations and LLCs. The unit of observation is a legal entity registered as a corporation or a LLC in the Business and Enterprise Register. Thus, the data is generally recorded on an unconsolidated basis, with each legal entity considered separately. In

[41]The entries in the register are based on information published in the Swiss Commercial Gazette.

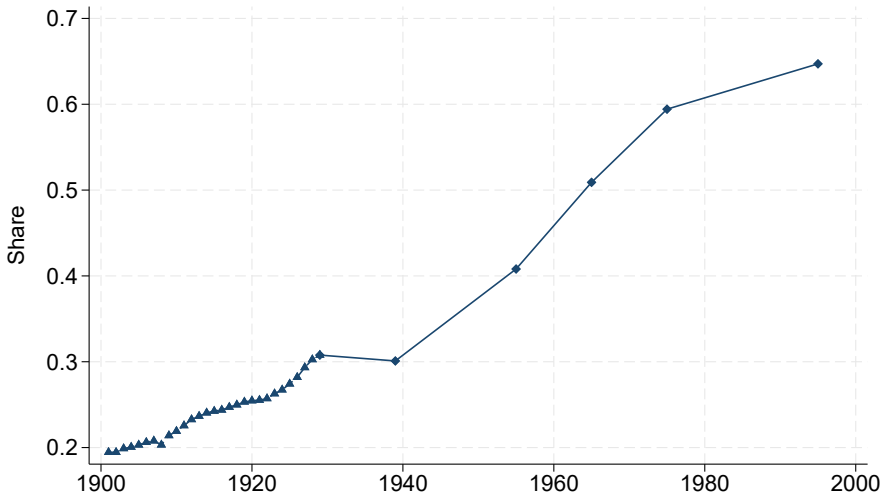



Figure IA19. Switzerland: Corporate Share Estimates

*Notes:* The figure shows the estimated corporate share for Switzerland. We use the employment share of corporations and LLCs (after their introduction in 1937) after 1929 (solid line with diamonds), and a linear extrapolation based on the proportion of corporations among all registered businesses before then (dashed line with triangles).

1937 a 50,000 Swiss Francs minimum capital requirement was introduced for newly formed corporations and 20,000 Francs for LLCs (Federal Government of Switzerland, 1936). Corporations with less capital continued to operate, but gradually disappeared in the 1940s (Eidgenössisches Statistisches Amt, 1947), and disappeared entirely by 1952 (Eidgenössisches Statistisches Amt, 1953).

**Variable definition** The Swiss tabulations by capital use the value of nominal capital. Nominal capital is defined as the total amount of shares multiplied by their par value.

**Corporate share** Since the tabulations by capital are restricted to corporations and LLCs, we need to estimate of the share of corporations and LLCs relative to all businesses (especially relevant for the top $N$ shares in Section III.A). After 1929, we can obtain data on the employment share of corporations and LLCs (after they were introduced in 1937) from the Federal Business Census for benchmark years (Eidgenössischen Statistischen Amt, 1933-1998); we linearly interpolate the employment share for years in between. Before 1929, we extend the series further back in time using a linear extrapolation based on the proportion of corporations among all registered businesses from the Historical Statistics of Switzerland (Eidgenössisches Statistisches Amt, 1934). The resulting series is shown in Figure IA19.

**Data construction**

- Top $x$% capital share = Capital of top $x$% corporations (and LLCs) by capital in a given year/Capital of corporations (and LLCs) in a given year.
- Top $x$% capital share among top $y$% = Capital of top $x$% corporations (and LLCs) by capital in a

given year/Capital of top $y$% corporations (and LLCs) by capital in a given year.

- Top $N$ capital share = Capital of top $N$ corporations (and LLCs) by capital in a given year/Estimated total capital in a given year (starting with capital of corporations and LLCs and divide by their estimated share as discussed above).

#### IA2.8.3 By Employment

**Sources** We use two sets of tabulations by size of employment for Switzerland. First, we have tabulations between 1929 and 2008 from the Establishment Census ("Eidgenössische Betriebszählung"). We download PDFs from the Swiss statistical office (Eidgenössisches Statistisches Amt, 1933, 1946, 1965, 1967, 1977; Bundesamt für Statistik, 1994, 1998, 2000, 2002, 2007), and then transcribe the data. The Establishment Census is a nationwide survey of all establishments and firms in Switzerland, excluding agriculture. The final edition of the Establishment Census was conducted in 2008, after which it was replaced by the business register Structural Business Statistics (STATENT). Second, we obtain tabulations for 2011 to 2022 directly from the Swiss statistical office, which uses information in STATENT (Bundesamt für Statistik, 2011-2022). The data cover all sectors of the economy, and we exclude agriculture to ensure consistency with census data.

**Scope** The Establishment Census is a nationwide survey of all establishments and firms in Switzerland, excluding agriculture. The census covers all establishments where one or more individuals are engaged in full-time or part-time work for at least 20 hours per week. Each unit of observation in our tabulations is a firm, defined as the smallest legally independent economic unit. Firms can consist of multiple establishments. The data cover all legal forms, including corporations, limited liability companies, partnerships and sole proprietorships.

STATENT provides nationwide data on all enterprises in Switzerland, and are based on administrative data from the Swiss social security register and the Swiss business register. In STATENT, the unit of observation is a legally independent entity with decision-making autonomy, such as making strategic choices and paying employees. An economic entity (individual or legal) that pays social security contributions on income above 2,300 Swiss Francs per year is recorded as a productive unit ("company") in STATENT (Bundesamt für Statistik, 2025). The data cover all sectors of the economy and we exclude agriculture to ensure consistency with census data. The data cover all legal forms, including corporations, limited liability companies, partnerships and sole proprietorships.

**Variable definition** In the Establishment Census data, employment includes all individuals who work at least six hours per week, regardless of pay, including business owners, unpaid family members, and temporary workers (except employment in 1985 is restricted to employees working more than 30 hours per week). In STATENT, employment includes all individuals (both employed and self-employed) earning more than the social security threshold of 2,300 Swiss Franc. This threshold did not change over our

sample period.

**Sector harmonization** The Establishment Census and STATENT include tabulations of firms by sector and employment size. We use these sectoral tabulations to estimate top shares in manufacturing and retail/wholesale trade, which are roughly comparable with SIC codes 20-39 (manufacturing) and 50-59 (retail/wholesale trade). Sectoral classifications were updated over our sample period requiring some adjustment to create sectors that are as consistent as possible over the long run. We make sure that manufacturing always excludes construction, mining, and utilities. Trade typically includes retail, wholesale, and trade brokerage. Automobile repair shops have been classified as part of the trade sector since 1994, whereas before they were considered part of manufacturing. However, they cannot be easily or consistently assigned to either sector.

**Data construction**

- Top $x\%$ employment share = Employment of top $x\%$ firms by size of employment in a given year/All employment in a given year.
- Top $x\%$ employment share among top $y\%$ = Employment of top $x\%$ firms by employment in a given year/Employment of top $y\%$ firms by employment in a given year.
- Top $N$ employment share = Employment of top $N$ firms by size of employment in a given year/All employment in a given year.

## IA2.9 United Kingdom

Table IA9 lists the sources that we use for the United Kingdom.

### IA2.9.1 By Net Output and Turnover

**Sources** Our analysis for the U.K. focuses on manufacturing due to data availability in the early years. First, we have tabulations by size of net output from the Census of Production between 1958 and 1992. We download PDFs from the LSE digital library (Board of Trade, 1960-1973; Department of Industry Business Statistics Office, 1973-1992), and transcribe the data. Prais (1976) provides additional estimates of the share of the 100 largest enterprises in manufacturing by net output for selected years since 1909 (see Appendix A of Prais (1976) for details). Second, we can find tabulations of the number of businesses by size of turnover (sales) since 1985. Between 1985 and 1997, we obtain physical books from Harvard University Library and Stanford University Library, and transcribe the data (Department of Trade and Industry, Business Statistics Office, 1985-1997); after 1998, we download data in Excel spreadsheets from the Office for National Statistics afterwards (Office for National Statistics, 1998-2003, 2004-2013, 2015-2022*a*).

Table IA9 – U.K.: Data Sources

| Type | Period | Source |
|---|---|---|
| Tabulations by net output | 1909–1968 | Prais (1976). |
| | 1958–1992 | Office for National Statistics (various years) *Census of Production*. |
| Tabulations by sales | 1985–2022 | Office for National Statistics (various years) *Size Analysis of United Kingdom Businesses*; from 2004 onwards titled *UK Businesses: Activity, Size and Location.* |
| Tabulations by employment | 1958–1993 | Office for National Statistics (various years) *Census of Production* |
| | 1985–2022 | Office for National Statistics (various years) *Size Analysis of United Kingdom Businesses*; from 2004 onwards titled *UK Businesses: Activity, Size and Location.* |

*Notes:* This table lists the sources of the U.K. data.

These data are based on value added tax (VAT) returns submitted to HM Customs and Excise (processed by the Central Statistical Office until 1995, and the Office for National Statistics thereafter).

**Scope** The census tabulations by net output include private enterprises employing 100 or more persons. Each unit of observation is an enterprise, defined as establishments under common ownership or control. It is reasonable to assume that the largest manufacturers in the numerator have more than 100 employees. We supplement these tabulations with information about the total number of enterprises and total net output in manufacturing from separate summary tables to get the proper denominator. The census data do not include foreign establishments or non-industrial establishments of manufacturing firms.[42] The data cover all legal forms, including corporations, partnerships, and sole proprietorships.

The tabulations by turnover are based on VAT-registered enterprises. Each unit of observation is a legal unit before 1995 and an enterprise afterwards. The enterprise is generally the same as the legal unit but in some cases enterprises are formed from several legal units with close financial links. The VAT registration has a time-varying minimum turnover threshold, from £18,000 in 1985 to £85,000 in 2022 (Department of Trade and Industry, Business Statistics Office, 1985-1997; Office for National Statistics, 1998-2003, 2004-2013, 2015-2022*a*). Enterprises below the VAT registration threshold are excluded before 1992, and are included afterwards if they have chosen to register voluntarily or not to de-register (zero turnover firms are excluded before 2003 and included afterwards if their employment is non-zero). The data cover all legal forms, including corporations, partnerships, and sole proprietorships.

[42] For the years 1958, 1963 and 1968, the census does not include enterprise counts for firms with less than 25 employees. We extrapolate the total number of enterprises using the total number of establishments in these years (establishment counts are relatively stable between 1958 and 1970).

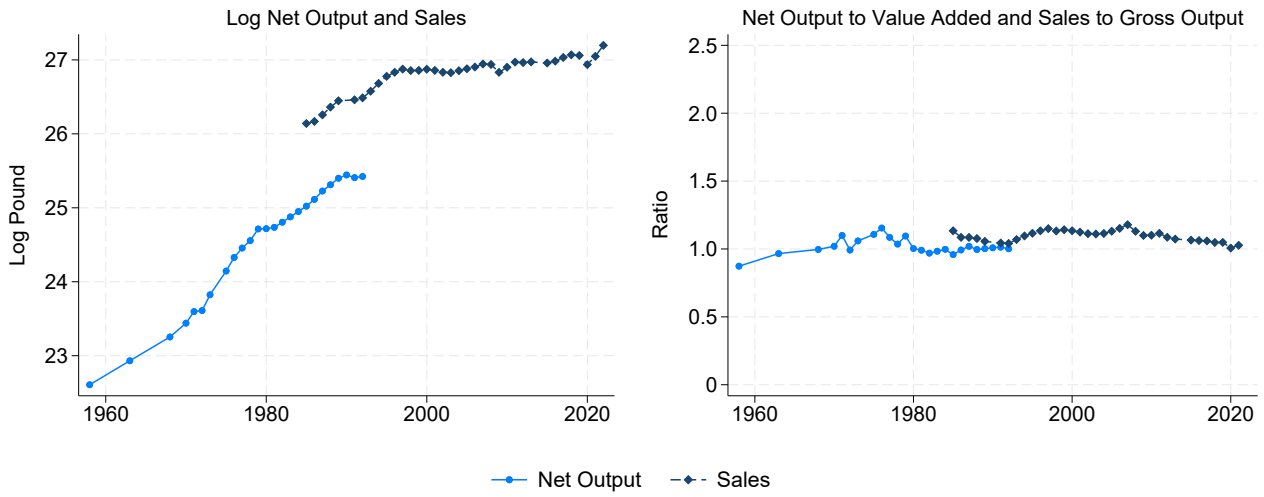



Figure IA20. UK: Coverage of Net Output and Turnover Tabulations

*Notes:* The left panel shows the log of all tabulated net output and turnover in our data. The right panel shows the of tabulated net output relative to manufacturing value added (solid line with circles), and the ratio of tabulated sales relative to manufacturing gross output (dashed line with diamonds). Manufacturing value added data come from Chadha et al. (2018) and United Nations (2023*a*,*b*). Manufacturing gross output data come from National Accounts Statistics from United Nations (United Nations, 2022*a*,*b*).

**Variable definition** For the census data (Board of Trade, 1960-1973; Department of Industry Business Statistics Office, 1973-1992), net output is defined as "the value added to materials by the process of production (including the margin on selling any merchanted or factored goods)." It is calculated as gross output − purchases adjusted for change in value of stocks of fuel and raw materials − payments for work given to other establishments − payments for transport − net amount of any duties, subsidies, allowances and levies payable.

For the turnover data (Department of Trade and Industry, Business Statistics Office, 1985-1997; Office for National Statistics, 1998-2003, 2004-2013, 2015-2022*a*), they generally exclude VAT but include other taxes, such as the revenue duties on alcoholic drinks and tobacco. The data represent total U.K. turnover, "including exempt and zero-rated supplies" (Office for National Statistics, 1998-2003), which suggests that exports are included and foreign sales are excluded.

Figure IA20 shows the coverage of the net output and turnover tabulations. The left panel shows log total net output and total turnover from the tabulations. The right panel shows the ratio of tabulated net output relative to manufacturing value added (solid line with circles), and the ratio of tabulated sales relative to manufacturing gross output (dashed line with diamonds). Both ratios are stable around one, which indicates that the coverage of our data is comprehensive and consistent.

**Data construction**

- Top $x$% net output share = Net output of top $x$% manufacturers by net output in a given year/All manufacturing net output in a given year.

- Top $N$ net output share = Net output of top $N$ manufacturers by net output in a given year/All manufacturing net output in a given year.
- Top $x$% sales share = Sales of top $x$% manufacturers by sales in a given year/All manufacturing sales in a given year.

For U.K. data by size of sales, the tabulations only show the number of firms in each bin, but not their total sales. In this case, we can still use the generalized Pareto interpolation, but estimates can be less precise. We use the average firm size (for all firms) to provide additional disciplining information for the interpolation, which tends to improve the fit. To calculate the average firm size, we obtain total manufacturing sales from the Census of Production for 1985 to 1993 (Department of Industry Business Statistics Office, 1985-1993), the Annual Business Inquiry for 1995 to 2007, and the Annual Business Inquiry (successor of the Annual Business Inquiry) from 2008 to 2022 (Office for National Statistics, 2010); we linearly interpolate manufacturing sales in 1994.

#### IA2.9.2 By Employment

**Sources** Tabulations for manufacturing firms by size of employment come from two sources like the above. The first source is the Census of Production, from 1958 to 1993 (Board of Trade, 1960-1973; Department of Industry Business Statistics Office, 1973-1992). The second source is the *Size Analyses of United Kingdom Businesses*, from 1985 to 2022 (Department of Trade and Industry, Business Statistics Office, 1985-1997; Office for National Statistics, 1998-2003, 2004-2013, 2014-2022*b*). We use the Census of Production data until 1993 and the *Size Analyses of United Kingdom Businesses* afterwards because the data from the Census of Production are more granular.

**Scope** The tabulations by employment in the Census of Production include private sector enterprises employing one or more persons. The tabulations by employment in the *Size Analysis of United Kingdom Businesses* cover VAT-registered enterprises, which are described above in Appendix IA2.9.1.

**Variable definition** Employees in the Census of Production data include full and part-time employees and working proprietors. Employees in the Size Analyses data include all workers paid directly from the business's payrolls, and excludes voluntary workers or agency workers paid directly from the agency payroll.

**Data construction**

- Top $x$% employment share = Employment of top $x$% firms by size of employment in a given year/All employment in a given year.
- Top $N$ employment share = Employment of top $N$ firms by size of employment in a given year/All employment in a given year.

# IA3 Simple Model

In this section, we lay out a simple model to illustrate the economic forces that can influence concentration in sales, capital, and employment. In particular, the data show that sales concentration has increased over time, yet employment concentration remains relatively stable, except for in retail/wholesale trade where it rises along with sales concentration. In production functions where capital and labor are complements, the concentration of sales, capital, and employment should have similar trends: when top firms get larger, their output and all inputs should increase. To generate the divergence between sales and employment concentration, a natural approach is to counteract the standard complementarity by introducing the possibility of automation. We study the impact of declines in the relative price of capital (Karabarbounis and Neiman, 2014; Hubmer and Restrepo, 2025; Desazars, 2025). If large firms automate more than small firms (e.g., due to costs associated with automation), then declines in capital price would make large firms expand more than small firms, raising sales concentration. The complementarity between capital and labor will make them expand in both capital and employment, but if additional automation is appealing in light of lower capital price, then large firms may increase automation so that they expand with capital but not with employment.

Below we show that when the automation adjustment cost is low, we can obtain higher sales and capital concentration, but not necessarily higher employment concentration as capital price declines. Meanwhile, if the automation adjustment cost is high, then concentration by sales, capital, and employment can all increase as capital price declines. To the extent that additional automation is more difficult in retail/wholesale trade thus far, this case can map into the evidence of rising sales and employment concentration in retail.

## IA3.1 Setup

**Overview and timing** The economy features a unit mass of monopolistically competitive firms, each producing a differentiated variety that is aggregated by a constant elasticity of substitution (CES) final good technology. Time is discrete with two periods $t \in \{0, 1\}$. Each firm has a continuum of complementary tasks, and can choose to produce a fraction of the tasks with capital (the rest with labor). In each period $t$, firm $f$ chooses its price $p_{f,t}$, output $y_{f,t}$, a task cutoff $\alpha_{f,t} \in [0, 1]$ that assigns tasks to capital ($x \leq \alpha_{f,t}$) or labor ($x > \alpha_{f,t}$), and task-level factor inputs $\{k_{f,t}(x),\ \ell_{f,t}(x)\}_{x\in[0,1]}$, taking the aggregate price index and demand, $(P_t, Y_t)$, wage and capital price, $(w, q_t)$ as given. At $t = 0$, the firm pays a one-time installation cost for the initial level of automation:

$$\mathcal{C}_{\text{fix}}(\alpha_{f,0}) = \frac{1}{2}\alpha_{f,0}^2. \tag{IA1}$$

At $t = 1$, it treats $\alpha_0$ as predetermined, and incurs an adjustment cost to change the automation level:

$$\mathcal{C}_{\text{adj}}(\alpha_{f,1}; \alpha_{f,0}) = \max\left(\frac{\kappa}{2}\alpha_{f,1}^2 - \frac{\kappa}{2}\alpha_{f,0}^2, 0\right) \tag{IA2}$$

if $\alpha_{f,1} \neq \alpha_{f,0}$. Capital price $q_t$ decreases in period 1, $q_1 < q_0$, which firms anticipate at $t = 0$. When $\kappa$ is higher, achieving a higher level of automation is more costly when the price of capital falls. Accordingly, low $\kappa$ may capture manufacturing, where mechanization has become highly developed and relatively easy to enhance; high $\kappa$ may capture retail, where the scope for mechanization is so far more limited because of extensive human interactions with customers etc.

**Final good aggregator and demand** At date $t \in \{0, 1\}$, the final good is a CES aggregator of firm-level varieties with elasticity $\sigma > 1$:

$$Y_t = \left(\int_f y_{f,t}^{\frac{\sigma-1}{\sigma}} \, df\right)^{\frac{\sigma}{\sigma-1}}. \tag{IA3}$$

This implies the induced demand for variety $f$ at price $p_{f,t}$:

$$y_{f,t} = \left(\frac{p_{f,t}}{P_t}\right)^{-\sigma} Y_t. \tag{IA4}$$

**Task technology and factor usage** We suppress the firm index $f$ for simplicity. Production within period $t$ uses a continuum of tasks $x \in [0, 1]$ with across-task elasticity $\eta \in (0, 1)$:

$$y_t = z\left(\int_0^1 y_t(x)^{\frac{\eta-1}{\eta}} \, dx\right)^{\frac{\eta}{\eta-1}}, \tag{IA5}$$

where $z > 0$ is a firm-level productivity shifter that scales the efficiency of the CES task aggregator.

Tasks with $x \leq \alpha_t$ are performed by capital and tasks with $x > \alpha_t$ by labor:

$$y_t(x) = \begin{cases} \psi_k(x)\, k_t(x) & \text{if } x \leq \alpha_t, \\ \psi_\ell(x)\, \ell_t(x) & \text{if } x > \alpha_t, \end{cases} \tag{IA6}$$

where $\psi_k(x) > 0$ and $\psi_\ell(x) > 0$ are task efficiency functions.

Total factor usage and sales (revenue) for a firm in period $t$ are

$$k_t = \int_0^{\alpha_t} k_t(x)\, dx, \qquad \ell_t = \int_{\alpha_t}^1 \ell_t(x)\, dx, \qquad R_t \equiv p_t\, y_t. \tag{IA7}$$

**Firm's problem** The firm chooses $\{\alpha_t, p_t, y_t\}_{t=0}^{1}$ and task-level inputs $\{k_t(x), \ell_t(x)\}_{x\in[0,1]}$ to solve

$$\max_{\substack{\{\alpha_t,p_t,y_t\}_{t=0}^{1},\\ \{k_t(\cdot),\ell_t(\cdot)\}_{t=0}^{1}}} \quad \Pi_0(k_0,\ell_0,\alpha_0,y_0,p_0) \;-\; \mathcal{C}_{\text{fix}}(\alpha_0) \;+\; \beta E_0[\Pi_1(k_1,\ell_1,\alpha_1,y_1,p_1) \;-\; \mathcal{C}_{\text{adj}}(\alpha_1;\alpha_0)] \tag{IA8}$$

$$\text{s.t.} \qquad y_t = z\left(\int_0^{\alpha_t}\Big[\psi_k(x)\,k_t(x)\Big]^{\frac{\eta-1}{\eta}}\,dx + \int_{\alpha_t}^{1}\Big[\psi_\ell(x)\,\ell_t(x)\Big]^{\frac{\eta-1}{\eta}}\,dx\right)^{\frac{\eta}{\eta-1}}, \tag{IA9}$$

$$y_t = \left(\frac{p_t}{P_t}\right)^{-\sigma} Y_t, \tag{IA10}$$

$$\Pi_t(k_t,\ell_t,\alpha_t,y_t,p_t) = p_t\,y_t \;-\; \int_0^{\alpha_t} q_t\,k_t(x)\,dx \;-\; \int_{\alpha_t}^{1} w\,\ell_t(x)\,dx, \tag{IA11}$$

$$0\le\alpha_t\le 1, \quad k_t(x)\ge 0, \quad \ell_t(x)\ge 0, \qquad \forall x\in[0,1],\ t=0,1. \tag{IA12}$$

Expectations $E_0[\cdot]$ are conditional on period-0 information; since the environment is deterministic, $E_0[X]=X$, and we set $\beta=1$.

**Firm heterogeneity and concentration** There are two types of firms, which have high and low productivity, indexed by $i\in\{h,l\}$, with $z^h>z^l$. Types are fixed over time. The high productivity firms will be larger, and will represent top firms. The low productivity firms represent other firms. We use two types for parsimony. The mechanisms are similar for a continuum of firm types.

At each date $t$, we check that the size ordering holds in sales, capital, and labor: a high productivity firm has at least as much capital and labor, produces at least as much output, and achieves at least as much sales as a low productivity firm. In other words, for $X\in\{\ell,k,y,R\}$, $X_t^h\ge X_t^l$. Sufficient parameter restrictions ensuring this ordering are stated in the propositions.

Accordingly, concentration at date $t$ is $X_t^h/X_t^l$. Concentration increases from $t=0$ to $t=1$ iff

$$\frac{X_1^h}{X_1^l} > \frac{X_0^h}{X_0^l} \quad\Longleftrightarrow\quad \frac{X_1^h/X_0^h}{X_1^l/X_0^l} > 1. \tag{IA13}$$

## IA3.2 Optimization

To facilitate closed-form expressions, we set $P_t\equiv 1$, $Y_t\equiv 1$, and we assume constant task efficiencies, $\psi_k=1$ and $\psi_\ell=\psi$. We define the price–efficiency ratio, $\rho_t\equiv \frac{q_t^{1-\eta}}{w^{1-\eta}\,\psi^{\eta-1}}$, which is the key variable for subsequent comparative statics. A lower capital price means a lower $q_t$, so it implies a lower $\rho_t$ given $\eta<1$. We focus on the case $\rho_0<1$, in which case the firm is willing to pay the installation cost of capital in period 0 because (efficiency-adjusted) capital is cheap. We first solve the within-period problem given the automation level; then choose the automation level at periods 0 and 1 by trading off the marginal gains from automation against the marginal installation and adjustment costs.

**Optimal factor allocation** For each $t \in \{0,1\}$ and firm $i$, the optimal within-period allocations satisfy

$$\ell_t^{*i} = (1-\alpha_t^i)\,\psi^{\eta-1}\,C_t^i, \qquad k_t^{*i} = w^{\eta} q_t^{-\eta}\,\alpha_t^i\,C_t^i, \tag{IA14}$$

where

$$C_t^i = z^{i\sigma-1}\left(\frac{\sigma-1}{\sigma}\right)^{\sigma} w^{-\sigma}\,\psi^{\sigma-\eta}\left[1-\alpha_t^i+\rho_t\,\alpha_t^i\right]^{-\frac{\sigma-\eta}{1-\eta}}. \tag{IA15}$$

Prices are set at a constant markup, and output and sales are

$$y_t^{*i} = z^{i\sigma}\left(\frac{\sigma-1}{\sigma}\right)^{\sigma} w^{-\sigma}\,\psi^{\sigma}\left[1-\alpha_t^i+\rho_t\,\alpha_t^i\right]^{-\frac{\sigma}{1-\eta}}, \qquad R_t^{*i} = \left(y_t^{*i}\right)^{1-\frac{1}{\sigma}}. \tag{IA16}$$

**Marginal benefits and costs of adjusting automation** For firm type $i \in \{h,l\}$, define the marginal gain from raising automation at level $\alpha$ in period $t$:

$$\mathrm{MG}_t^i \equiv \frac{w\,\psi^{\eta-1}}{1-\eta}\,(1-\rho_t)\,C_t^i. \tag{IA17}$$

With the automation adjustment cost specified in (IA2), the marginal adjustment cost for increasing automation is $\mathrm{MC}_1^i = \partial \mathcal{C}_{\text{adj}}/\partial \alpha_1^i = \kappa\,\alpha_1^i$. This specification creates an inaction threshold: at the kink $\alpha_1^i = \alpha_0^i$, the marginal cost equals $\kappa\alpha_0^i$, so if $\mathrm{MG}_1^i \le \kappa\,\alpha_0^i$, the solution is no adjustment. If $\mathrm{MG}_1^i > \kappa\,\alpha_0^i$, the interior optimum (when it exists) satisfies

$$\kappa\,\alpha_1^i \;=\; \mathrm{MG}_1^i. \tag{IA18}$$

and has $\alpha_1^i > \alpha_0^i$. Lemma 1 provides a sufficient condition ensuring this inequality holds under a decline in $\rho$, so Equation (IA18) has a unique interior solution.

**Lemma 1.** *A sufficient condition for a decline in the capital price ($\rho_1 < \rho_0$) to raise the marginal gain from automation, making the firm more willing to automate, is $\rho_0 \in \left(\frac{\sigma-\eta}{\sigma+1-2\eta},\,1\right)$.*

*Proof.* For convenience, we log-linearize Equation (IA18) around the baseline $(\rho_0, \alpha_0)$ and get

$$\alpha_1 - \alpha_0 \approx -\frac{\frac{\sigma-\eta}{1-\eta}\cdot\frac{\alpha_0}{1-\alpha_0+\rho_0\alpha_0}+\frac{1}{1-\rho_0}}{\frac{1}{\alpha_0}-\frac{\sigma-\eta}{1-\eta}\cdot\frac{1-\rho_0}{1-\alpha_0+\rho_0\alpha_0}}\,(\rho_1-\rho_0) \tag{IA19}$$

If $\rho_0 \in \left(\frac{\sigma-\eta}{\sigma+1-2\eta},\,1\right)$, then

$$\frac{\partial \mathrm{MC}_0^i}{\partial \alpha_0^i} - \frac{\partial \mathrm{MG}_0^i}{\partial \alpha_0^i} \propto \frac{1}{\alpha_0} - \frac{\sigma-\eta}{1-\eta}\cdot\frac{1-\rho_0}{1-\alpha_0+\rho_0\alpha_0} > 0. \tag{IA20}$$

As a result, when $\rho_1 < \rho_0$, we have

$$\frac{d\mathrm{MG}_0^i}{d\rho_0} = \underbrace{\frac{\partial \mathrm{MG}_0^i}{\partial \rho_0}}_{<0} + \underbrace{\frac{\partial \mathrm{MG}_0^i}{\partial \alpha_0^i}}_{>0} \cdot \underbrace{\frac{d\alpha_0^i}{d\rho_0}}_{<0} < 0.^{43} \tag{IA22}$$

□

We have the condition $\rho_0 \in \left(\frac{\sigma-\eta}{\sigma+1-2\eta},\ 1\right)$ here and in the following because if capital is already very cheap, firms will find it more attractive to expand by increasing capital on existing automated tasks, compared to broadening automation on more tasks which incurs additional costs. In other words, the "intensive margin" of increasing capital use (on already automated tasks) becomes more attractive than the "extensive margin" through greater automation.

Combining period-0 optimal condition for $\alpha_0^i$, the firm-specific adjustment threshold in period 1 is:

$$\bar{\kappa}^i = \left[1 + \frac{1-\rho_0}{1-\rho_1}\left(\frac{1-\alpha_0^i+\rho_1\alpha_0^i}{1-\alpha_0^i+\rho_0\alpha_0^i}\right)^{\frac{\sigma-\eta}{1-\eta}}\right]^{-1}. \tag{IA23}$$

**Two regimes for automation adjustment** As long as $\alpha_0^h > \alpha_0^l$, we have $\bar{\kappa}^h > \bar{\kappa}^l$, then we consider two regimes in period 1:

*Regime I (high adjustment cost):* if $\kappa \geq \bar{\kappa}^h$, then

$$\alpha_1^h = \alpha_0^h, \qquad \alpha_1^l = \alpha_0^l. \tag{IA24}$$

*Regime II (low adjustment cost):* if $\kappa < \bar{\kappa}^l$, then

$$\alpha_1^h > \alpha_0^h, \qquad \alpha_1^l > \alpha_0^l.^{44} \tag{IA25}$$

## IA3.3 High Automation Adjustment Cost

**Proposition IA1.** *In the high automation adjustment cost regime, given $\alpha_0^h > \alpha_0^l$, $\ell_0^{*h} > \ell_0^{*l}$, and $k_0^{*h} > k_0^{*l}$, when the capital price decreases in period 1, sales, capital, and employment concentration increase.*

*Proof.* In the high automation adjustment cost regime, firms choose not to adjust their automation level

[43] $$\frac{\partial \mathrm{MG}_0^i}{\partial \rho_0} = \frac{w\psi^{\eta-1}}{1-\eta} C_0^i \left[-1 - \frac{\sigma-\eta}{1-\eta}\cdot\frac{(1-\rho_0)\,\alpha_0^i}{1-\alpha_0^i+\rho_0\alpha_0^i}\right], \quad \frac{\partial \mathrm{MG}_0^i}{\partial \alpha_0^i} = \frac{w\psi^{\eta-1}}{1-\eta} C_0^i \frac{\sigma-\eta}{1-\eta}\cdot\frac{(1-\rho_0)^2}{1-\alpha_0^i+\rho_0\alpha_0^i}. \tag{IA22}$$

[44] If $\bar{\kappa}^l < \kappa < \bar{\kappa}^h$, then it is a special case of Regime II, where $\alpha_1^h > \alpha_0^h,\ \alpha_1^l = \alpha_0^l$.

in period 1, so the level of automation stays the same as period 0 for all firms. With $\alpha_1 = \alpha_0$ in period 1, when the price of capital decreases, labor demand increases due to the complementarity between labor and capital:

$$\frac{\partial \ln \ell_1^{*i}}{\partial \rho_1} = -\frac{\sigma - \eta}{1 - \eta} \cdot \frac{\alpha_0^i}{1 - \alpha_0^i + \rho_1 \alpha_0^i} < 0. \tag{IA26}$$

This effect is stronger if the firm has a higher automation level in period 0 and uses more capital. Given $\alpha_0^h > \alpha_0^l$, we have

$$\frac{\partial \ln \ell_1^{*h}}{\partial \rho_1} < \frac{\partial \ln \ell_1^{*l}}{\partial \rho_1} < 0. \tag{IA27}$$

Similarly,

$$\frac{\partial \ln k_1^{*i}}{\partial \rho_1} = -\frac{\sigma - \eta}{1 - \eta} \cdot \frac{\alpha_0^i}{1 - \alpha_0^i + \rho_1 \alpha_0^i} - \frac{\eta}{(1-\eta)\rho_1} < 0, \tag{IA28}$$

$$\frac{\partial \ln y_1^{*i}}{\partial \rho_1} = -\frac{\sigma}{1 - \eta} \cdot \frac{\alpha_0^i}{1 - \alpha_0^i + \rho_1 \alpha_0^i} < 0, \tag{IA29}$$

$$\frac{\partial \ln R_1^{*i}}{\partial \rho_1} = \frac{\sigma - 1}{\sigma} \cdot \frac{\partial \ln y_1^{*i}}{\partial \rho_1} = -\frac{\sigma - 1}{1 - \eta} \cdot \frac{\alpha_0^i}{1 - \alpha_0^i + \rho_1 \alpha_0^i} < 0, \tag{IA30}$$

and

$$\frac{\partial \ln k_1^{*h}}{\partial \rho_1} < \frac{\partial \ln k_1^{*l}}{\partial \rho_1} < 0, \qquad \frac{\partial \ln y_1^{*h}}{\partial \rho_1} < \frac{\partial \ln y_1^{*l}}{\partial \rho_1} < 0, \qquad \frac{\partial \ln R_1^{*h}}{\partial \rho_1} < \frac{\partial \ln R_1^{*l}}{\partial \rho_1} < 0. \tag{IA31}$$

As a result, $h$ firms' sales, capital, and employment all increase more than $l$ firms as capital price declines, so concentration by sales, capital, and employment will all increase. □

We now specify the sufficient condition for $h$ firms to have a higher level of automation than $l$ firms in period 0, as well as the regularity condition such that they are larger than $l$ firms in employment as well.

**Proposition IA2.** *In the high automation adjustment cost regime, a sufficient condition for $\alpha_0^h > \alpha_0^l$ and $k_0^{*h} > k_0^{*l}$ is $\rho_0, \rho_1 \in \left(\frac{\sigma-\eta}{\sigma+1-2\eta}, 1\right)$. Moreover, if in addition $\bar{\alpha}_0 > \alpha_0^h > \alpha_0^l$, then $\ell_0^{*h} > \ell_0^{*l}$.*

*Proof.* In the high automation adjustment cost regime, both types of firms anticipate they will not adjust their automation level in period 1. The period-0 FOC implies

$$\alpha_0^i = \mathrm{MG}_0^i + \mathrm{MG}_1^i = \frac{w\psi^{\eta-1}}{1-\eta}\Big[(1-\rho_0)C_0^i + (1-\rho_1)C_1^i\Big], \quad \frac{C_1^i}{C_0^i} = \left(\frac{1-\alpha_0^i+\rho_1\alpha_0^i}{1-\alpha_0^i+\rho_0\alpha_0^i}\right)^{-\frac{\sigma-\eta}{1-\eta}}. \tag{IA32}$$

Differentiating with respect to $z^i$ gives

$$\frac{d\alpha_0^i}{dz^i} = \frac{\frac{\sigma-1}{z^i}\alpha_0^i}{1 - \frac{\sigma-\eta}{1-\eta}\sum_{t=0}^{1}\omega_t^i \frac{(1-\rho_t)\alpha_0^i}{1-\alpha_0^i+\rho_t\alpha_0^i}}, \quad \omega_t^i \equiv \frac{(1-\rho_t)C_t^i}{(1-\rho_0)C_0^i + (1-\rho_1)C_1^i}. \tag{IA33}$$

By the same reasoning as in Equation (IA20), if $\rho_0, \rho_1 \in \left(\frac{\sigma-\eta}{\sigma+1-2\eta}, 1\right)$, then for each $t$,

$$1 - \frac{\sigma-\eta}{1-\eta} \cdot \frac{(1-\rho_t)\alpha_0^i}{1-\alpha_0^i+\rho_t\alpha_0^i} > 0, \tag{IA34}$$

hence the denominator in Equation (IA33) is positive and $d\alpha_0^i/dz^i > 0$. Since $z^h > z^l$, we get $\alpha_0^h > \alpha_0^l$.

Since $k_0^{*i} = w^\eta q_0^{-\eta}\alpha_0^i C_0^i$,

$$\frac{d}{d\alpha}\ln k_0^* \geq \frac{2}{\alpha} - \frac{\sigma-\eta}{1-\eta}\cdot\frac{\rho_0-\rho_1}{\rho_0\rho_1} > \frac{2}{\alpha} - \frac{\sigma-\eta}{1-\eta}\left(\frac{1}{\rho_1}-1\right) > \frac{2}{\alpha} - \frac{\sigma-\eta}{1-\eta}\left(\frac{1}{\frac{\sigma-\eta}{\sigma+1-2\eta}}-1\right) \geq \frac{2}{\alpha} - 1 \geq 1, \tag{IA35}$$

so $k_0^*(\alpha)$ is strictly increasing on $(0,1]$. With $\alpha_0^h > \alpha_0^l$ we obtain $k_0^{*h} > k_0^{*l}$.

Since $\ell_0^{*i} = (1-\alpha_0^i)\psi^{\eta-1}C_0^i$,

$$\frac{d}{d\alpha}\ln \ell_0^{*i} = \frac{1-2\alpha}{\alpha(1-\alpha)} - (\text{positive term}), \qquad \lim_{\alpha\downarrow 0}\frac{d}{d\alpha}\ln\ell_0^{*i} = +\infty. \tag{IA36}$$

By continuity there exists a $\bar{\alpha}_0 \in (0, 1/2)$ such that $\frac{d}{d\alpha}\ln\ell_0^{*i} > 0$ for all $\alpha \in (0, \bar{\alpha}_0]$. If $\bar{\alpha}_0 > \alpha_0^h > \alpha_0^l$, monotonicity yields $\ell_0^{*h} > \ell_0^{*l}$. □

### IA3.4 Low Automation Adjustment Cost

**Proposition IA3.** *In the low automation adjustment cost regime, given $\alpha_0^h > \alpha_0^l$, $\ell_0^{*h} > \ell_0^{*l}$, and $k_0^{*h} > k_0^{*l}$, when the capital price decreases in period 1 such that each firm raises automation level: $\alpha_1^i > \alpha_0^i$ for $i \in \{h, l\}$, then sales and capital concentration increase. Moreover, if in addition $\frac{1-\eta}{(\sigma+1-2\eta)(1-\rho_0)} > \alpha_0^h > \frac{1}{2} > \alpha_0^l$, $\alpha_1^h + \alpha_1^l < 1$, and $\alpha_1^h > \alpha_1^l$, then employment concentration decreases.*

*Proof.* In the low automation adjustment cost regime, firms choose to adjust their automation level in period 1. Using Equation (IA23), the change ratio between period 0 and 1 for firm $i$ can be written as

$$\frac{\ell_1^{*i}}{\ell_0^{*i}} = \frac{\alpha_1^i(1-\alpha_1^i)}{\alpha_0^i(1-\alpha_0^i)}\cdot\frac{1-\rho_0}{1-\rho_1}, \quad \frac{k_1^{*i}}{k_0^{*i}} = \left(\frac{\alpha_1^i}{\alpha_0^i}\right)^2\cdot\frac{1-\rho_0}{1-\rho_1}\cdot\left(\frac{\rho_1}{\rho_0}\right)^{\frac{\eta}{\eta-1}}, \quad \frac{y_1^{*i}}{y_0^{*i}} = \left(\frac{1-\alpha_1^i+\rho_1\alpha_1^i}{1-\alpha_0^i+\rho_0\alpha_0^i}\right)^{-\frac{\sigma}{1-\eta}}. \tag{IA37}$$

Using the log-linearization result, we have[45]

$$\ln \frac{\ell_1^{*i}}{\ell_0^{*i}} \approx \left[ -\frac{1-2\alpha_0^i}{\alpha_0^i\left(1-\alpha_0^i\right)} \frac{\frac{\sigma-\eta}{1-\eta}\cdot\frac{\alpha_0^i}{1-\alpha_0^i+\rho_0\alpha_0^i}+\frac{1}{1-\rho_0}}{\frac{1}{\alpha_0^i}-\frac{\sigma-\eta}{1-\eta}\cdot\frac{1-\rho_0}{1-\alpha_0^i+\rho_0\alpha_0^i}} + \frac{1}{1-\rho_0} \right] (\rho_1-\rho_0). \tag{IA40}$$

If $\frac{1-\eta}{(\sigma+1-2\eta)(1-\rho_0)} > \alpha_0^h > \frac{1}{2} > \alpha_0^l$, we have

$$\frac{\ell_1^{*h}}{\ell_0^{*h}} < \frac{\ell_1^{*l}}{\ell_0^{*l}}.^{46} \tag{IA41}$$

To guarantee that high productivity firms still use more labor than low productivity firm (so that changes in employment concentration are in the same direction as changes in $\ell_1^{*h}/\ell_0^{*h}$ relative to $\ell_1^{*l}/\ell_0^{*l}$), we need to have

$$\ell_1^{*h} > \ell_1^{*l} \Longleftrightarrow \alpha_1^h\left(1-\alpha_1^h\right) > \alpha_1^l\left(1-\alpha_1^l\right) \Longleftrightarrow \alpha_1^h+\alpha_1^l < 1 \text{ and } \alpha_1^h > \alpha_1^l. \tag{IA42}$$

For sales and capital, as long as $\alpha_0^h > \alpha_0^l$, we have

$$\frac{k_1^{*h}}{k_0^{*h}} > \frac{k_1^{*l}}{k_0^{*l}}, \qquad \frac{y_1^{*h}}{y_0^{*h}} > \frac{y_1^{*l}}{y_0^{*l}}, \qquad \frac{R_1^{*h}}{R_0^{*h}} > \frac{R_1^{*l}}{R_0^{*l}}, \tag{IA43}$$

and

$$k_1^{*h} > k_1^{*l}, \qquad y_1^{*h} > y_1^{*l}, \qquad R_1^{*h} > R_1^{*l}. \tag{IA44}$$

□

We now specify the sufficient condition for $h$ firms to have a higher level of automation than $l$ firms in period 0, as well as the regularity condition such that they are larger than $l$ firms in employment as well.

**Proposition IA4.** *In the low automation adjustment cost regime, a sufficient condition for* $\frac{1-\eta}{(\sigma+1-2\eta)(1-\rho_0)} > \alpha_0^h > \alpha_0^l$ *and* $k_0^{*h} > k_0^{*l}$, *is* $\rho_0 \in \left(\frac{\sigma-\eta}{\sigma+1-2\eta}, 1\right)$. *Moreover, if in addition* $\alpha_0^h+\alpha_0^l < 1$, *then it follows that* $\ell_0^{*h} > \ell_0^{*l}$.

[45] Similarly,

$$\ln \frac{k_1^{*i}}{k_0^{*i}} \approx \left[ -\frac{2}{\alpha_0^i} \frac{\frac{\sigma-\eta}{1-\eta}\cdot\frac{\alpha_0^i}{1-\alpha_0^i+\rho_0\alpha_0^i}+\frac{1}{1-\rho_0}}{\frac{1}{\alpha_0^i}-\frac{\sigma-\eta}{1-\eta}\cdot\frac{1-\rho_0}{1-\alpha_0^i+\rho_0\alpha_0^i}} + \frac{\eta}{(\eta-1)\rho_0} + \frac{1}{1-\rho_0} \right] (\rho_1-\rho_0) > 0, \tag{IA38}$$

$$\ln \frac{y_1^{*i}}{y_0^{*i}} \approx \left[ -\frac{\sigma}{1-\eta}\cdot\frac{\alpha_0^i}{1-\alpha_0^i+\rho_0\alpha_0^i} \left( \frac{1-\rho_0}{\rho_0}\cdot\frac{\frac{\sigma-\eta}{1-\eta}\cdot\frac{\alpha_0^i\rho_0}{1-\alpha_0^i+\rho_0\alpha_0^i}+\frac{\rho_0}{1-\rho_0}}{\frac{1}{\alpha_0^i}-\frac{\sigma-\eta}{1-\eta}\cdot\frac{1-\rho_0}{1-\alpha_0^i+\rho_0\alpha_0^i}} + 1 \right) \right] (\rho_1-\rho_0) > 0. \tag{IA39}$$

[46] When $\bar{\kappa}_l \le \kappa < \bar{\kappa}_h$, only high productivity firms adjust their automation level, $\alpha_1^h > \alpha_0^h$, $\alpha_1^l = \alpha_0^l$, if $\alpha_0^h > \frac{1}{2}$, then when the capital price falls, we have $\frac{\ell_1^{*h}}{\ell_0^{*h}} < 1 < \frac{\ell_1^{*l}}{\ell_0^{*l}}$, so employment concentration decreases as well.

*Proof.* Under low adjustment cost regime, both types of firms anticipate they will adjust their automation level in period 1. By the same reasoning in Equation (IA20), if $\rho_0 \in \left(\frac{\sigma-\eta}{\sigma+1-2\eta}, 1\right)$, then

$$\frac{d\alpha_0^i}{dz^i} = \frac{\frac{\sigma-1}{z^i}\alpha_0^i}{1 - \frac{\sigma-\eta}{1-\eta}\cdot\frac{(1-\rho_0)\alpha_0^i}{1-\alpha_0^i+\rho_0\alpha_0^i}} > 0, \qquad \alpha_0^h < \frac{1-\eta}{(\sigma+1-2\eta)(1-\rho_0)}. \tag{IA45}$$

For capital, we have

$$k_0^{*h} > k_0^{*l} \iff \left(\frac{\alpha_0^h}{\alpha_0^l}\right)^2 > 1 \iff \alpha_0^h > \alpha_0^l. \tag{IA46}$$

For labor we have

$$\ell_0^{*h} > \ell_0^{*l} \iff \left(\frac{z^h}{z^l}\right)^{\sigma-1} > \frac{1-\alpha_0^l}{1-\alpha_0^h}\left(\frac{1-\alpha_0^h+\rho_0\alpha_0^h}{1-\alpha_0^l+\rho_0\alpha_0^l}\right)^{\frac{\sigma-\eta}{1-\eta}} \iff \alpha_0^h+\alpha_0^l < 1 \text{ and } \alpha_0^h > \alpha_0^l. \tag{IA47}$$

□

In the data, we observe that employment concentration has been relatively stable over time, while sales concentration increases substantially. Corollary IA1 spells out the conditions that facilitate these patterns.

**Corollary IA1** (Moderate changes in employment concentration vs. large changes in sales concentration)**.** *Note that Equation* (IA40) *and Equation* (IA39) *imply*

$$\ln\frac{\ell_1^{*i}}{\ell_0^{*i}} \approx \Lambda_i\,(\rho_1-\rho_0), \qquad \ln\frac{y_1^{*i}}{y_0^{*i}} \approx \Upsilon_i\,(\rho_1-\rho_0).$$

*where*

$$\frac{|\Upsilon_i|}{|\Lambda_i|} \gtrsim \frac{\frac{\sigma}{1-\eta}\cdot\frac{\alpha_0^i}{1-\alpha_0^i+\rho_0\alpha_0^i}}{\frac{1}{1-\rho_0} + \frac{|1-2\alpha_0^i|}{\alpha_0^i(1-\alpha_0^i)}\cdot\frac{\frac{\sigma-\eta}{1-\eta}\cdot\frac{\alpha_0^i}{1-\alpha_0^i+\rho_0\alpha_0^i}+\frac{1}{1-\rho_0}}{\frac{1}{\alpha_0^i}-\frac{\sigma-\eta}{1-\eta}\cdot\frac{1-\rho_0}{1-\alpha_0^i+\rho_0\alpha_0^i}}}, \tag{IA48}$$

*then the following are sufficient to ensure a* comparatively large *output response and a* moderate *employment response (i.e.,* $|\Upsilon_i| > |\Lambda_i|$*):*

*(i)* $\rho_0$ *lies well inside* $\left(\frac{\sigma-\eta}{\sigma+1-2\eta}, 1\right)$ *so that* $\frac{1}{1-\rho_0}$ *is moderate and* $\frac{1}{\alpha_0^i} - \frac{\sigma-\eta}{1-\eta}\cdot\frac{1-\rho_0}{1-\alpha_0^i+\rho_0\alpha_0^i}$ *is positive and bounded away from zero.*[47]

*(ii)* $\alpha_0^i$ *is close to* $\frac{1}{2}$ *so that* $|1-2\alpha_0^i|$ *is small and* $\frac{\sigma}{1-\eta}\cdot\frac{\alpha_0^i}{1-\alpha_0^i+\rho_0\alpha_0^i}$ *is sizable.*[48]

[47] Near the lower bound $\frac{\sigma-\eta}{\sigma+1-2\eta}$, the denominator in Equation (IA19), $\frac{1}{\alpha_0^i} - \frac{\sigma-\eta}{1-\eta}\cdot\frac{1-\rho_0}{1-\alpha_0^i+\rho_0\alpha_0^i}$, becomes small for a large $\alpha_0^i$. In that case, a modest decline in capital price can generate a large increase in automation and induce a strong extensive margin shift of tasks from labor to capital. Near the upper bound 1, the proportional response $\ln\frac{\ell_1^i}{\ell_0^i}$ is ill-conditioned because Equation (IA37) shows it contains $\ln\frac{(1-\rho_0)}{(1-\rho_1)}$, which becomes highly sensitive when $1-\rho_0$ is close to zero.

[48] Under CES demand, $\frac{\partial \ln y}{\partial \ln mc} = -\sigma$, where constant markup pricing implies $mc \propto y^{-1/\sigma}$, so $\sigma$ measures the elasticity of

For employment concentration, a lower capital price has two effects: 1) increasing labor demand due to the complementarity between capital and labor, and 2) potentially decreasing labor demand due to more automation. These two forces balance out when $\alpha_0^i$ is close to $\frac{1}{2}$, under the automation adjustment cost function in (IA2). For sales concentration, higher elasticity of substitution for products $\sigma$ makes firms gain more sales by reducing cost with additional automation, and higher cross-task elasticity $\eta$ makes automation stronger in response to capital price declines. The regularity condition $\rho_0$ inside $\left(\frac{\sigma-\eta}{\sigma+1-2\eta},\ 1\right)$ so that $\frac{1}{1-\rho_0}$ avoids the extreme of all firms automating very little or all firms automating a lot (in either extreme the benefit that $h$ firms have relative to $l$ firms from lower capital price would be less differentiated).

This model also has implications for the capital to labor ratio:

**Corollary IA2** (Capital/labor ratio rises more under low automation adjustment cost)**.** *For any firm $i$, capital relative to labor is*

$$\frac{k_t^i}{\ell_t^i} = \psi\, \rho_t^{\frac{\eta}{\eta-1}} \frac{\alpha_t^i}{1-\alpha_t^i}. \tag{IA49}$$

*In the high adjustment cost regime,*

$$\frac{(k_1^i/\ell_1^i)}{(k_0^i/\ell_0^i)} = \left(\frac{\rho_1}{\rho_0}\right)^{\frac{\eta}{\eta-1}} > 1. \tag{IA50}$$

*In the low adjustment cost regime,*

$$\frac{(k_1^i/\ell_1^i)}{(k_0^i/\ell_0^i)} = \left(\frac{\rho_1}{\rho_0}\right)^{\frac{\eta}{\eta-1}} \cdot \frac{\alpha_1^i/(1-\alpha_1^i)}{\alpha_0^i/(1-\alpha_0^i)} > \left(\frac{\rho_1}{\rho_0}\right)^{\frac{\eta}{\eta-1}} > 1 \tag{IA51}$$

*because $\alpha_1^i > \alpha_0^i$ implies $\frac{\alpha_1^i/(1-\alpha_1^i)}{\alpha_0^i/(1-\alpha_0^i)} > 1$.*

*Hence, $k^i/\ell^i$ increases in both regimes when capital price falls, and the increase is* larger *in low adjustment cost regime.*

In Figure IA21, we verify that the relative price of capital has declined overall, as well as in both manufacturing and retail/wholesale trade. We use BEA data on nominal nonresidential fixed asset investment relative to the corresponding chain-type quantity index (available at the industry level since 1947) to construct a capital price index, and divide it by CPI. In Figure IA22, we provide auxiliary evidence that the capital to labor ratio has increased over time, and the increase is stronger in manufacturing, which is consistent with Corollary IA2. We construct the capital to labor index using BEA data on the chain-type quantity index for the stock of nonresidential fixed assets, and divide by BLS employees on nonfarm payroll. We start with the level of capital stock to employment in 1947 and let it grow based on the growth rate of capital quantity relative to employment.

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output with respect to the marginal cost of output. Moreover, $\frac{\partial \ln mc}{\partial \rho} = \frac{1}{1-\eta} \cdot \frac{\alpha_0^i}{1-\alpha_0^i+\rho_0\alpha_0^i}$ and the factor $\frac{1}{1-\eta}$ captures task complementarity, so that a decline in the capital price has a larger effect on marginal cost when tasks are more complementary. The term $\frac{\alpha_0^i}{1-\alpha_0^i+\rho_0\alpha_0^i}$ gives the share of the marginal cost response attributable to capital-intensive tasks, since $1-\alpha_0^i+\rho_0\alpha_0^i$ is a weighted average of labor-task cost and capital-task cost, equal to 1 when $\alpha_0^i = 0$ and to $\rho_0$ when $\alpha_0^i = 1$.

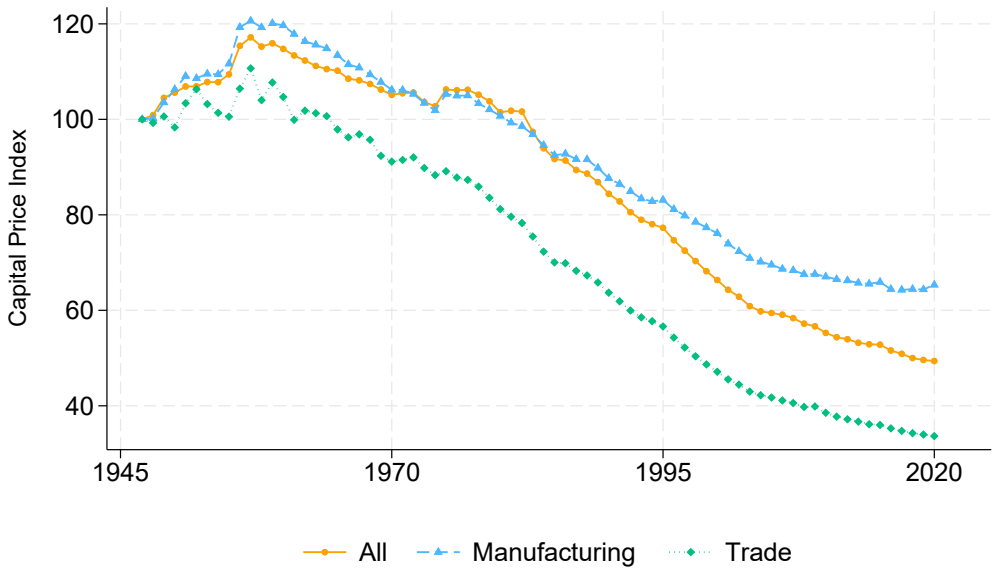


Figure IA21. Relative Price of Capital

*Notes:* This figure shows capital price relative to 1947 for private nonresidential fixed assets in all sectors, manufacturing, and retail/wholesale trade, using data from the BEA. We calculate the relative price of capital using nominal investment (U.S. Bureau of Economic Analysis, 2025*b*,*e*) divided by chain-type quantity index (U.S. Bureau of Economic Analysis, 2025*c*,*f*), then normalized by the CPI (Jordà, Schularick, and Taylor, 2017). We then benchmark the value to one in 1947.

Finally, if capital price is already low and high productivity firms are almost saturated with automation, it is even possible that sales concentration no longer increases as capital price falls further. This mechanism could apply to manufacturing in recent decades among the early industrialization countries (e.g., U.S., Germany, U.K.), where concentration does not rise much. We state these conditions below.

**Corollary IA3** (Conditions for decreasing sales concentration)**.** *If we have*

$$1-\frac{1-\eta}{\alpha_0^l(\sigma+1-2\eta)}<\rho_0<1-\frac{1-\eta}{\alpha_0^h(\sigma+1-2\eta)}<\frac{\sigma-\eta}{\sigma+1-2\eta},$$

*then*

$$\frac{1}{\alpha_0^l}-\frac{\sigma-\eta}{1-\eta}\cdot\frac{1-\rho_0}{1-\alpha_0^l+\rho_0\alpha_0^l}>0>\frac{1}{\alpha_0^h}-\frac{\sigma-\eta}{1-\eta}\cdot\frac{1-\rho_0}{1-\alpha_0^h+\rho_0\alpha_0^h}.$$

*As a result,*

$$\frac{y_1^{*h}}{y_0^{*h}}<\frac{y_1^{*l}}{y_0^{*l}},\qquad \frac{R_1^{*h}}{R_0^{*h}}<\frac{R_1^{*l}}{R_0^{*l}}.$$

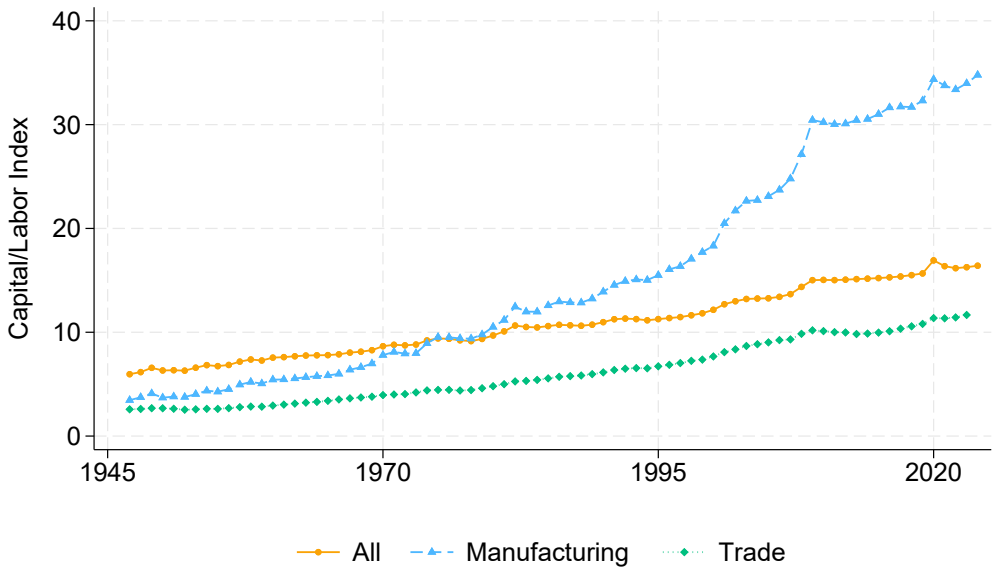


Figure IA22. Capital/Labor Ratio Index

*Notes:* This figure shows capital to labor ratio for private nonresidential fixed assets in all sectors, manufacturing, and retail/wholesale trade, using data from the BEA (U.S. Bureau of Economic Analysis, 2025*a*,*d*). We calculate real capital growth using the chain type quantity indices, and employment growth using Bureau of Labor Statistics (BLS) data on employees on nonfarm payrolls (U.S. Bureau of Labor Statistics, 2025). Our index starts with the ratio of capital stock to employment (in millions) in 1947, and grows each year by the growth rate of real capital stock to employment.