Chapter I

The state and development of business concentration in Germany

Summary

Under § 44(1) first sentence of the Act Against Restraints on Competition, the Monopolies Commission is tasked by law with assessing the state of and development of business concentration in Germany. The Monopolies Commission fulfils this mandate by, firstly, ascertaining the **concentration of companies** in the economy as a whole, that is in **aggregate** terms, and secondly by tracing developments in **industry concentration**. Furthermore, **firm-specific mark-ups**, which may serve as an indicator of market power, are calculated and used to assess how competition is developing within the manufacturing industry, as well as in the services sector.

In order to assess the aggregate business concentration, the Monopolies Commission regularly identifies the one hundred largest companies in Germany and their share of value added in the economy as a whole. **This share fell by roughly five percent** in the reporting period, and was 14 percent in the year under report 2020. This indicates a continuation of the downward trend that has been observed since reporting started. The Monopolies Commission identifies **the personnel cross-links and the cross-shareholdings between the "Top 100"** as another indicator. Nine companies from the group of the "Top 100" hold more than 1-percent shares in 26 companies from this group. The total number of capital cross-holdings in the "Top 100" is 42 in the reporting year. This makes eleven fewer holdings than in the reporting year 2018, but only two fewer holdings than in the year under report 2016. Developments in personnel cross-links are assessed via the cross-links between members of the management, i. e. the number of cases in which members of the management of one company were also part of supervisory bodies of other "Top 100"-firms, as well as cross-links via persons with no management mandate who have mandates in supervisory bodies of several "Top 100"-firms. In the reporting year 2020, both figures were at their lowest level since reporting started. The number of cross-links via members of the management was 32 (reporting year 2018: 42), and that of cross-links via persons with no management mandate was 71 (reporting year 2018: 88).

The economy-wide average of **industry concentration** in Germany **continues flat**, and remains at a **low level**. Average **changes in economic mark-ups are also moderate**, and do not indicate general growth in market power. The average mark-up increased **by 1.8 percent in the manufacturing sector** between 2008 and 2017, and even went down by 6 percent in the services sector. Major differences however exist between individual industries. Counter to the average downward trend in the services sector, the concentration in some already highly concentrated industries within the sector rose by up to 60 percent between 2009 and 2019. These include the regulated industries telecommunications, postal activities and interurban passenger rail transport. **The steepest mark-up increase was observed** in the **manufacture of coke and refined petroleum products** from 2008 to 2017 (21 percent). In the services sector, high mark-ups are generally accompanied by high levels of investment in productivity-boosting digitalisation. The manufacturing industry also shows a positive link between investment in digitalisation and increases in mark-ups, but does not exhibit similar increases in productivity. The **digital transformation** therefore appears to be accompanied by **competition** in the **services sector**, whilst in **manufacturing** it entails an **increase in market power**. Against the background of rising raw materials prices in the wake of the Russian invasion of Ukraine, energy-intensive industries in particular face the risk of this impacting competition.

The **Monopolies Commission concludes** that the current trend of **concentration** in Germany **does not give cause for concern**, and thus that there is no immediate need for action in terms of competition policies. That having been said, there is a need to continue to observe the increasing concentration in highly-concentrated service industries, the growing price mark-ups of large corporations and in concentrated industries, as well as the high degree of common ownership of companies by institutional investors.

1 The status and development of aggregate business concentration in Germany

1.1 Estimating the aggregate business concentration

1.1.1 The social significance of large companies

1. The aggregate business concentration reflects the concentration of companies in the economy as a whole. Unlike estimating the concentration of separate markets, which provides information concerning the intensity of competition in these markets, the concept of the aggregate business concentration aims to facilitate an assessment of the concentration of companies at a macroeconomic level. Therefore, macroeconomic indicators such as employment or value added are used in order to estimate the aggregate concentration.[1] The share of the largest companies in relation to the economy as a whole is estimated based on these indicators, and reflects the level of the aggregate concentration of firms.[2]

2. Studying the aggregate business concentration originated in the 1960s and `70s when an increase in the number of conglomerate mergers was observed in the USA.[3] For a time being US competition authorities had considered to respond by banning mergers, which would increase the aggregate concentration of firms.[4] Later, however, competition economic theories of harm overwhelmingly suggested that the aggregate business concentration initiated by conglomerates poses few risks in terms of competition, given that it does not relate to competition in individual markets. The strong growth of large, diversified digital firms – such as Google, Apple, Meta (formerly Facebook) and Amazon – has however rekindled the debate on competition implications linked with the growing impact of these conglomerates.[5] This is also reflected in recent legal amendments at national and EU level, which aim to make it easier to prosecute anti-competitive conduct of large diversified digital firms.[6] By comparison, a review of the aggregate business concentration aims to assess the influence exerted by large companies on macroeconomic developments in Germany.

3. If the aggregate business concentration is comparatively high, it is less likely that fluctuations of the economic situation of individual companies are balanced out in the economy, so that these large companies may largely influence certain developments in the economy as a whole. Empirical studies also make this connection. One study for instance concluded that the ten largest industrial companies of an industry in Germany have a disproportionately large impact on the industry in question. Even though the share of the ten largest companies was around 20 percent in each case, the empirical model traced between 30 and 50 percent of the fluctuations in turnover in the industries back to fluctuations in turnover in the respectively ten largest industrial companies.[7] This indicates that developments in the economy as a whole may be influenced by the economic development of

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1 White, L.J./Yang, J., What has been happening to Aggregate Concentration in the U.S. Economy in the twenty-first Century?, John Wiley & Sons, Ltd , Contemporary Economic Policy, 38, 2020, pp. 483–495.

2 Clarke, R./Davies, S.W., Aggregate Concentration, Market Concentration and Diversification, The Economic Journal, 93, 1983, pp. 182–192.

3 Bourreau, M./de Streel, A., Digital conglomerates and EU competition policy, https://cerre.eu/news/digital-conglomerates-and-eu-competition-policy/, accessed 19 May 2022.

4 Schefzig, J., Die Beurteilung konglomerater Unternehmenszusammenschlüsse in Europa und den USA, 2013.

5 Bourreau/de Streel, Digital conglomerates and EU competition policy, *supra* note 3.

6 Cf. firstly section 19a of the German Act against Restraints of Competition (Competition Act – GWB), which addresses the abusive conduct of (platform) companies which are of paramount significance for competition across markets, and which was inserted into the Act as part of the 10th amendment of the Competition Act which came into force in January 2021, as well as, secondly, the Proposal of the European Commission for Regulation on contestable and fair markets in the digital sector (Digital Markets Act). The Digital Markets Act has not yet come into force; the Commission, the Council and the Parliament, however, reached a political agreement on the legislative proposal on 24 March 2022 as part of a "trilogue procedure". Cf. also Monopolkommission, 82. Sondergutachten (2021): Empfehlungen für einen effektiven und effizienten Digital Markets Act.

7 Wagner, J., The German manufacturing sector is a granular economy, Applied Economics Letters, 19, 2012, pp. 1663–1665..

individual companies if a comparatively large share of macroeconomic indicators, such as value added, is generated by individual companies.

4. Since the largest companies in an economy may have a particular significance for the economic development of an economy, they also attract particular attention of policy-makers. In May 2021, provisions of security in information technology for critical infrastructures were expanded to include companies of particular public interest. In accordance with section 2 subsection (14), first sentence, No. 2 of the Act on the Federal Office for Information Security (BSIG),[8] these include companies, which are among the largest in Germany in terms of their domestic value added, and therefore are of considerable macroeconomic significance for the Federal Republic of Germany. The reason for expanding the provisions on IT security to include large companies was that for instance cyberattacks or other IT disruptions may prevent a company from carrying out its commercial activities for a prolonged period of time. Failures or disruptions affecting companies, which are among the largest in Germany in terms of their domestic value added, might therefore be of significance to society as a whole.[9] Section 8f BSIG lists the provisions on IT security for companies of public interest. These companies have to register with the Federal Office for Information Security, submit a self-declaration on IT security, and immediately report specific disruptions among other things. This relates, for example, to disruptions which have halted or considerably affected value-adding activities, and to major disruptions which may halt or considerably affect value-adding activities, section 8f subsection (7) Nos. 1 and 2 BSIG.

5. As the introduction of these provisions shows, the economic significance of large companies is often also related to increased political attention. Hence, the empirical literature also considers the size of a company, along with the intensity of competition in and the regulation of a sector, as a decisive factor regarding the intensity of exchange between company representatives and policy-makers.[10] Such an exchange is to be welcomed if it helps to improve policy-makers' understanding of the impact of economic policy measures. However, such an exchange can also lead to extensive welfare losses if it is used to convince them of the company's own, potentially anti-competitive interests.[11] For instance, it was possible to show that the attention of policy-makers had been used in the past by the established companies in a market to make market entries more difficult, or indeed impossible.[12]

6. The legislature was aware of the potential impact of concentrated economic control as part of the second amendment of the Competition Act, which tasked the Monopolies Commission to regularly observe the concentration of firms.[13] While the Act's explanatory notes did not judge the concentration of firms as either positive or negative, it is nonetheless presumed that a restriction of competition by means of concentration jeopardises the functioning of a free, socially satisfactory economic and social system. The legislature therefore saw the exercise of economic control in the hands of a constantly shrinking number of individuals critical.[14] The Monopolies Commission therefore fulfils its mandate by presenting the status and the development of the

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8 Gesetz über das Bundesamt für Sicherheit in der Informationstechnik (BSI-Gesetz) vom 14 August 2009, BGBl. I S. 2821., most recently amended by Article 12 of the Gesetzes zur Regelung des Datenschutzes und des Schutzes der Privatsphäre in der Telekommunikation und bei Telemedien of 23 June 2021, BGBl. I p. 1982.

9 Bundesregierung, Entwurf eines Zweiten Gesetzes zur Erhöhung der Sicherheit informationstechnischer Systeme, BT-Drs. 19/26106 vom 25 January 2021., p. 58.

10 Dellis, K./Sondermann, D., Lobbying in Europe: new firm-level evidence, European Central Bank Working Paper Series, 2017.; de Figueiredo, J.M./Richter, B.K., Advancing the Empirical Research on Lobbying, Annual Review of Political Science, 17, 2014, pp. 163–185.; Borghesi, R./Chang, K., The determinants of effective corporate lobbying, Springer & Academy of Economics and Finance , Journal of Economics and Finance, 39, 2015, pp. 606–624..

11 Magnolfi, L./Roncoroni, C., Political connections and market structure, https://warwick.ac.uk/fac/soc/economics/staff/croncoroni/politicalconnectionsmarketstructure.pdf, accessed 15 March 2022.

12 Matsumura, T./Yamagishi, A., Lobbying for Regulation Reform by Industry Leaders, Journal of Regulatory Economics, 52, 2017, pp. 63–76.

13 Bericht über das Ergebnis einer Untersuchung der Konzentration in der Wirtschaft, BT-Drs. IV/2320 vom 5 June 1964.

14 Fraktionen der SPD, FDP, Entwurf eines Zweiten Gesetzes zur Änderung des Gesetzes gegen Wettbewerbsbeschränkungen, BT-Drs. 7/76 vom 25 January 1973.

aggregate concentration of firms, thus creating transparency regarding the distribution of economic control. This allows potential aberrations to be identified at an early stage.

1.1.2 Identifying the largest companies based on domestic value added

7. Since it started reporting, the Monopolies Commission has determined the aggregate business concentration based on the 100 largest companies in Germany (referred to below as the "Top 100").[15] The term "company" here does not refer to a separate legal entity. The large companies in question are in fact groups of companies. All legally independent companies, which belong to a group of companies, are defined as economic unit. The highest-level company in an economic unit is a "parent company". Parent companies that are headquartered in Germany are obliged in accordance with section 290 of the Commercial Code (HGB) to draw up a consolidated financial statement. This statement has to include all companies on which the parent company can exert a direct or indirect dominant influence.[16] These companies are referred to as subsidiaries. Since this frequently also applies to companies that are headquartered abroad, these subsidiaries are also to be included in the consolidated financial statement. The mandate of the Monopolies Commission is however comprised of an evaluation of the concentration of firms in Germany. Subsidiaries located abroad are therefore not considered in this chapter. Hence, the Monopolies Commission generally includes (parts of) groups of companies, considering only those subsidiaries of a group of companies, which are headquartered in Germany (domestic group).[17]

8. The Monopolies Commission has used companies' value added since its IV Biennial Report in order to define the Top 100 group.[18] Value added is a concept known from national accounts, where it appears in the output, income and expenditures statement. The macroeconomic value added corresponds to the production value of all companies, minus input costs (output method). If, on the other hand, the income of the groups is considered which were involved in this process, the macroeconomic value added corresponds to the total of this income, meaning the total of the earned income, business and investment income, and the taxes on production paid to the State (incomes-received method). As with national accounts, the value added of an individual company can also be looked at from two perspectives. Firstly, the value added of a company corresponds to the value which the company adds to the intermediate products used, and secondly to earned income, profit and interest, as well as taxes generated by the company.[19]

9. Using the value added of companies to ascertain the aggregate business concentration has distinct advantages over alternative indicators. It makes it possible to compare the economic performance of companies from different sectors. Unlike the indicators that are customary in the sector, such as turnover for industrial[20], trade and service companies, balance sheet totals in the case of financial institutes[21], or gross written premiums in the case of insurance companies[22], value added makes it possible to carry out a comparison.[23] Using companies' value

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15 Monopolkommission, I. Hauptgutachten: Mehr Wettbewerb ist möglich, Baden-Baden, 1976, para. 209.

16 § 290 HGB regulates the obligation for stock corporations to draw up a consolidated financial statement. The obligation for partnerships to draw up such a statement is regulated in § 11 PublG.

17 The Monopolies Commission also collects information on subgroups, which do not have a domestic parent company. These are for instance companies with a foreign parent company, such as the Shell-Gruppe Deutschland, or also horizontal groups such as the Debeka-Versicherungsgruppe. The Monopolies Commission also combines companies, which are regarded as a competition unit such as the EDEKA-Gruppe.

18 The first reports separated out the largest companies by turnover (Monopolkommission, IV. Hauptgutachten: Fortschritte bei der Konzentrationserfassung, Baden-Baden, 1982., para. 345).

19 The precise method for calculating value added on the basis of annual accounts data is described in the Annex to the present Report (cf. section 2.1.1).

20 The term "industry" is used in this chapter for manufacturing. In accordance with the sub-division of the Federal Statistical Office (*Klassifikation der Wirtschaftszweige*, 2008 edition), economic sections B (Mining), C (Manufacturing industry), D (Energy supply), E (Water supply, sewerage, waste management) and F (Construction) are attributed to manufacturing.

21 The term "financial institutes" is used in this chapter for the banking industry (WZ 2008: division K 64, groups K 66.1 and K 66.3).

22 The term "insurance companies" is used in this chapter for the insurance sector (WZ 2008: division K 65, group K 66.2).

added also makes sense given the fact that reporting on the aggregate business concentration is intended to provide transparency with regard to the distribution of economic control. Gross domestic product is generally used at macroeconomic level to assess economic performance, and hence is relevant to the success of policy-makers as well.[24] Macroeconomic value added is very similar to gross domestic product, and is therefore suited to be used as a comparative macroeconomic value when assessing the aggregate concentration of companies.

1.1.3 Estimating domestic value added where insufficient data are available

10. In order to identify the Top 100 for the reporting year 2020, companies, which potentially might be candidates, were identified based on enquiries made in the "ORBIS Europe All Companies" database made available by the provider Bureau von Dijk, and of publicly accessible information on the commercial development of individual companies. Since the value added of the domestic part of a group of companies cannot generally be determined based on the published consolidated financial statement, the majority of possible companies were asked to provide financial statement data of the domestic subsidiaries of the group of companies. It is generally necessary to request such data from the companies because the parent companies, as already mentioned, are obliged nationally (section 290 of the Commercial Code) and internationally (IFRS 10) to include and/or consolidate all their subsidiaries in their consolidated financial statement. Parent companies which are headquartered in Germany therefore generally also include subsidiaries based abroad in their consolidated financial statement, so that it is often not possible to determine the value added of those companies of the group that are based in Germany on the basis of these publicly available data.[25]

11. In total, 203 companies were asked to provide information for the reporting year 2020. The Monopolies Commission was provided by 166 (81.8 percent) of these companies with indicators to calculate domestic value added. The data submitted however in many cases did not provide an adequate basis to be able to calculate domestic value added. The domestic value added of these companies, as well as of those companies which failed to provide any data, was estimated where possible. When looking at only those companies, which belonged to the Top 100 in Germany in the reporting year 2020, domestic value added was calculated on the basis of an estimation procedure in 26 cases.

12. Different procedures were used depending on the respective group structure and on the available data material. If for instance a consolidated financial statement was available that included foreign subsidiaries, the domestic value added of a company was frequently calculated from the worldwide value added based on size comparisons. A similar procedure was used with companies in food retailing, given that no consolidated financial statement is available here as a rule that covers the entire group. Comparative sizes of individual retailers and cooperatives were used with these groups in order to calculate the total value added of the group in question, using data from the provider TradeDimensions.

13. Additional procedures were also used in order to estimate domestic value added. Domestic value added was for instance calculated on the basis of the data of the individual financial statement of a single subsidiary headquartered in Germany if it was possible to attribute it to a parent company headquartered abroad, and the value added of this parent company in Germany was largely generated by this subsidiary. If the lion's share of the

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[23] One could also use corporate value in order to facilitate a supra-sectoral comparison. This method would however come up against major methodical problems with non-listed companies.

[24] Brender A. and A. Drazen (2008) studied the connection between economic growth and the probability of re-election in 74 countries for the period from 1960 to 2003, and found a significant connection. That having been said, this is likely to be related to the inclusion of developing countries and young democracies (Brender, A./Drazen, A., How Do Budget Deficits and Economic Growth Affect Reelection Prospects? Evidence from a Large Panel of Countries, The American Economic Review, 98, 2008, pp. 2203–2220).

[25] This is one of the most common reasons for needing to carry out a survey. Further reasons relate to a lack of a disclosure obligation for the profit and loss account with partnerships in accordance with § 9 Abs. 2 PublG, or a release from the obligation to draw up a sub-group financial statement if there are foreign corporate headquarters which draw up a consolidated financial statement (§§ 291 f. HGB).

domestic value added was generated by a limited number of subsidiaries headquartered in Germany, which in turn could be attributed to a foreign parent company, the respective individual financial statements were also evaluated, and the domestic value added was calculated as the sum of the value added of these companies.[26]

14. Identifying the Top 100 based on domestic value added is therefore very much dependent on the cooperation of the companies potentially belonging to this group. Whilst the majority of approached have been willing in the past to provide data to the Monopolies Commission, the data has been inadequate in many instances in order to directly calculate the value added. In these cases the estimation procedures described above are used in order not to exclude those companies from the evaluation, which are highly likely to be among the hundred largest companies in Germany, simply because of a lack of available data.

15. The revised version of the Act to Improve Security in Information Technology of the Federation (*Gesetz zur Stärkung der Sicherheit in der Informationstechnik des Bundes*), which subjects the largest companies identified via the criterion of domestic value added to special provisions concerning IT security, might lend a fresh impetus to the survey of the Monopolies Commission. This should be taken into consideration when drawing up a legal ordinance in accordance with section 10 subsection (5) of the Act on the Federal Office for Information Security. The wording of the Act does not refer to the Top 100 in Germany identified by the Monopolies Commission. However, the explanatory notes state that companies are particularly subject to the provisions contained in section 8f of the Act on the Federal Office for Information Security if they have generated domestic value added according to the most recent Biennial Report of the Monopolies Commission of the Federal Government in the period under review on the basis of which they are considered, in accordance with the legal ordinance under section 10 subsection (5), to constitute companies in the particular public interest.[27]

16. Companies in the particular public interest now need to determine the figures required for the calculation themselves in order to be able to ascertain whether they need to register with the Federal Office for Information Security. This has the advantage that the data in question do not need to be gathered within the company for the Monopolies Commission alone, so that willingness to provide the Monopolies Commission with the appropriate data might increase given that the additional effort is negligible. If companies however presume that they are regarded as companies in the particular public interest if the most recent report of the Monopolies Commission considered them to belong to the Top 100, companies might however conversely be tempted not to seek inclusion in this list. Such incentives might make it much more difficult for the Monopolies Commission to carry out its task of assessing the concentration of firms in Germany, since this might make even less data available. The Monopolies Commission therefore suggests obliging companies which meet the prerequisites contained in the legal ordinance in accordance with section 10 subsection (5) for companies in the particular public interest to provide the Monopolies Commission with the data needed to calculate domestic value added on request.

1.1.4 The structure of reporting on the aggregate business concentration

17. First, the Top 100 are presented in section 1.2, including their value added, their employee headcount, and their business volume (including the sector to which they belong) in Germany. Then the Top 100 are analysed based on these benchmarks. This includes comparisons with macroeconomic comparative figures. Since cross-links between large companies can further enhance their macroeconomic significance, this analysis is added in section 1.3 and 1.4 to include studies of the cross-shareholdings and personnel cross-links between the Top 100. Section 1.5 summarises how many merger projects the Federal Cartel Office registered in the period under report by companies belonging to the Top 100, and how many merger projects the Federal Cartel Office approved. The findings permit to draw conclusions on the external growth of the Top 100. Section 1.6 concludes with a sector-specific review of large companies in which the respective sector-specific volume of business serves as an indicator of size.

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[26] Details are provided in section 2.1.2 of the Annex regarding the estimation procedures and which procedures were used in individual cases.

[27] Bundesregierung, BT-Drs. 19/26106, *supra* note 9., p. 83.

1.2 The Top 100 companies in Germany

1.2.1 The composition of the group of the 100 largest companies

18. Table I.1 shows the Top 100 companies in Germany in the reporting year 2020. Domestic value added was used as an indicator of size. In addition to domestic value added, the table also shows the number of employees and the business volume generated by the German companies within the group. This includes turnover (in the case of industrial, construction, trade and service companies), the balance sheet total (in the case of financial institutes), or gross written premiums (in the case of insurance companies) depending on the sector to which the reported company belongs.

Table I.1: The Top 100 companies in the reporting year 2020 by domestic value added

Ranking	Trend[2]	Company[3]	Value added[4] in m EUR	Change in %	Head-count	Business Volume in m EUR	Sector[5]
1	—	Volkswagen AG	28,697	(- 8.9)	294,510	145,285	i
2	—	Daimler AG	16,584	(- 10.2)	166,599	103,442	i
3	↑	Siemens AG	12,462	(+ 3.4)	87,000	25,886	i
4	↑	Deutsche Telekom AG	10,732	(- 6.2)	89,032	24,730	d
5	—	Robert Bosch GmbH	10,700	(- 14.7)	131,827	46,773	i
6	↓	Deutsche Bahn AG	9,687	(- 27.4)	207,996	21,567	d
7	↓	Bayerische Motoren Werke AG	9,432	(- 33.7)	88,666	75,064	i
8	↑	Deutsche Post AG	8,956	(+ 9.8)	166,143	15,585	d
9	↓	INA-Holding Schaeffler GmbH & Co. KG[E]	7,223	(- 15.1)	58,809	10,198	i
10	↑	REWE-Gruppe	7,117*	(+ 8.7)	193,958	53,414	h
11	↑	Fresenius SE & Co. KGaA	6,682	(+ 27.1)	96,915	11,065	i
12	↑	SAP SE	5,774	(- 5)	22,183	16,233	d
13	↑	E.ON SE	5,576	(+ 44.2)	36,090	34,052	i
14	↑	Vonovia SE	5,484	(+ 19.8)	9,400	3,299	d
15	↓	Bayer AG	5,139	(- 33)	23,398	15,862	i
16	↑	Roche-Gruppe Deutschland	4,884*	(+ 32.1)	14,018	7,809	i
17	↑	EDEKA-Gruppe	4,742*	(+ 29.8)	402,000	61,434*	h
18	↑	Schwarz-Gruppe	4,672*	(+ 3.6)	150,000	41,500*	h
19	↓	Airbus-Gruppe Deutschland	4,198*	(- 23.5)	45,568	15,146,5	i
20	↓	Deutsche Bank AG	4,115	(- 36.5)	37,315	919,944	k
21	↓	ZF Friedrichshafen AG	4,021	(-19.6)	50,786	11,767	i
22	↑	Allianz SE	3,913	(+ 5.9)	39,768	28,940	v
23	↑	Commerzbank AG	3,746	(+ 15.5)	28,397	393,851	k

Ranking	Trend[2]	Company[3]	Value added[4] in m EUR	Change in %	Head-count	Business Volume in m EUR	Sector[5]
24	↑	C. H. Boehringer Sohn AG & Co.	3,674*	(+ 17.2)	15,011	11,825	i
25	↓	BASF SE	3,559	(- 45.1)	53,739	24,733	i
26	↑	Aldi-Gruppe	3,439*	(+ 5.6)	86,360	27,395*	h
27	↑	Bertelsmann SE & Co. KGaA	3,262	(+ 2.1)	33,054	6,468	d
28	↑	Asklepios Kliniken GmbH & Co. KGaA	3,239	(+ 32.1)	50,371	4,343	d
29	↑	RWE AG	3,130	(+ 124.1)	14,701	13,537	i
30	↑	AXA-Gruppe Deutschland	2,722	(+ 94.2)	9,138	11,095	v
31	↑	EnBW Energie Baden-Württemberg AG	2,701	(+ 18.7)	20,740	16,376	i
32	↑	KfW Bankengruppe	2,548	(+ 31.1)	7,382	546,384	k
33	↓	Münchener Rückversicherungs-Gesellschaft AG	2,454	(- 26.3)	18,636	36,601	v
34	↑	Ford-Gruppe Deutschland	2,372	(+ 10.9)	21,860	15,666	i
35	↓	thyssenkrupp AG	2,367	(- 45.7)	55,528	18,070	i
36	↓	Rethmann SE & Co. KG	2,357*	(+ 4.7)	45,278	9,055	d
37	↑	HGV Hamburger Gesellschaft für Vermögens- und Beteiligungs-management mbH	2,186*	(+ 13.7)	21,649	4,569	i
38	↓	Evonik Industries AG	2,161	(- 31.4)	18,931	5,316	i
39	↑	STRABAG-Gruppe Deutschland	2,085*	(+ 9.7)	28,150	7,323	b
40	new	Vodafone-Gruppe Deutschland	2,066		15,798	12,984	d
41	↑	Shell-Gruppe Deutschland	2,051*	(+ 12.7)	3,386	12,048	i
42	↓	Adolf Würth GmbH & Co. KG	2,024	(+ 3.7)	24,514	6,073	h
43	↑	Sana Kliniken AG	1,957	(+ 8.6)	30,574	2,924	d
44	↓	IBM-Gruppe Deutschland	1,944	(- 2.2)	8,728	3,968	i
45	↓	Merck KGaA	1,938	(- 47)	12,829	4,638	i
46	↑	Carl Zeiss AG	1,936*	(+ 70.5)	13,794	4,336	i
47	↑	DZ Bank AG	1,935	(+ 39.2)	29,017	553,946	k
48	↑	UniCredit-Gruppe Deutschland	1,787	(+ 23.9)	11,043	277,503	k
49	↓	Sanofi-Gruppe Deutschland	1,707	(- 16.1)	8,109	4,643	i
50	↓	Otto Group	1,678	(+ 7)	26,822	10,425	h
51	↑	Liebherr-International-Gruppe	1,660*	(+ 34.1)	20,891	6,014	i
52	new	Hapag-Lloyd AG	1,586		3,600	12,589	d

Ranking	Trend[2]	Company[3]	Value added[4] in m EUR	Change in %	Head-count	Business Volume in m EUR	Sector[5]
53	↓	PricewaterhouseCoopers Aktiengesellschaft	1,571	(+ 8.3)	12,108	2,410	d
54	↓	ING-Gruppe Deutschland	1,546*	(- 19.9)	5,059		k
55	↑	DEERE-Gruppe Deutschland	1,447	(+ 60.5)	9,928	6,662	i
56	↓	Henkel AG & Co. KGaA	1,442	(- 7.4)	8,693	3,328	i
57	↑	KPMG AG Wirtschaftsprüfungs-gesellschaft	1,431	(+ 5.2)	12,270	1,810	d
58	↑	Deutsche Börse AG	1,412	(+ 13.2)	2,900	2,385	d
59	new	Amazon-Gruppe Deutschland	1,388*		29,641*	4,768*	h
60	↑	Bayerische Landesbank	1,382	(+ 4.1)	7,694	251,271	k
61	↓	Deloitte GmbH Wirtschafts-prüfungsgesellschaft	1,310	(- 3)	8,813	1,656	d
62	↑	EWE AG	1,304	(+ 23.6)	9,016	5,577	i
63	↑	Ernst & Young GmbH Wirtschafts-prüfungsgesellschaft[6]	1,290	(+ 11.4)	11,300	2,116	d
64	↑	Landesbank Baden-Württemberg	1,283	(+ 25.8)	8,822	261,699	k
65	↑	Philip Morris International-Gruppe Deutschland[E]	1,272	(+ 22.5)	1,487	2,566	i
66	↑	Stadtwerke München GmbH	1,269	(+ 2.7)	10,777	7,483	i
67	new	Generali-Gruppe Deutschland	1,269*		9,486	14,418	v
68	↑	B. Braun SE[7]	1,231	(+ 12.9)	15,866	3,747	i
69	↓	Salzgitter AG	1,218	(- 32.3)	18,109	6,426	i
70	↓	DEKRA SE	1,208*	(- 9.8)	19,919	1,960	d
71	new	HDI Haftpflichtverband der Deutschen Industrie V.a.G.	1,203*		9,670	8,547	v
72	↓	HUK-COBURG	1,200	(+ 3.2)	10,255	8,050	v
73	↑	dm-drogerie markt Verwaltungs-GmbH	1,175	(+ 9.8)	23,620	7,389	h
74	↓	maxingvest AG	1,167*	(- 5.9)	13,834	3,671	i
75	↑	Rolls-Royce-Gruppe Deutschland	1,146*	(+ 3.3)	9,800	935	i
76	new	Dirk Rossmann GmbH	1,126*		22,876	6,706	h
77	↑	HELLA GmbH & Co. KGaA[8]	1,107	(+ 4.4)	8,657	2,588	i
78	new	TenneT TSO GmbH	1,092		2,287	3,903	i
79	↑	MAHLE GmbH	1,076	(+ 0.6)	11,999	2,523	i
80	↑	Stadtwerke Köln GmbH	1,067	(+ 4.8)	13,807	5,378	i

Ranking	Trend[2]	Company[3]	Value added[4] in m EUR	Change in %	Head-count	Business Volume in m EUR	Sector[5]
81	↑	Procter & Gamble-Gruppe Deutschland[S]	1,058	(+ 4.6)	8,630	1,775	i
82	↑	Wacker Chemie AG	1,038	(- 0.7)	10,096	3,588	i
83	↑	Novartis-Gruppe Deutschland	1,017	(+ 3.4)	5,497	4,335	i
84	↓	United Internet AG	1,012*	(- 10)	7,929	4,884	d
85	↑	Linde-Gruppe Deutschland	999	(- 1.7)	6,128	3,522	i
86	new	Infineon Technologies AGE	993		12,201	5,346	i
87	—	Axel Springer SE	992	(- 4.6)	8,067	1792	d
88	↓	Ceconomy AG	990	(- 36.5)	20,188	10,160	h
89	new	Zalando SE	984		13,568	7,977	h
90	↓	LANXESS AG	978	(- 5.7)	7,557	3,863	i
91	↓	Versicherungskammer Bayern VöR	973	(- 6.8)	5,824	9,358	v
92	↓	Adecco-Gruppe Deutschland	958	(- 25.7)	2,263	1,112	d
93	new	Charité Universitätsmedizin Berlin KöR	955		19,400	1,405	d
94	↑	VINCI-Gruppe Deutschland	954*	(- 5.3)	14,382	2,851	b
95	↓	Freudenberg & Co. KG	948	(- 13.9)	12,203	2,669	i
96	↓	Debeka-Gruppe	947	(- 10.8)	16,226	11,448	v
97	new	Rhön-Klinikum AG	930		18,449	1,360	d
98	new	Drägerwerk AG & CO. KGaA	928		7,350	2,392	i
99	new	Telefónica-Gruppe Deutschland	926		8,271	7,532	d
100	↓	Vivantes - Netzwerk für Gesundheit GmbH	919	(- 18.8)	17,876	1,506	d

1 The Data refers to the financial year including 30 June 2020.

2 The trend shows the change in the ranking vis-à-vis the financial year 2018: The ↑ symbol means that the company has a higher ranking in 2020 than in 2018, whereas ↓ indicates a lower ranking. The — symbol indicates that the ranking is unchanged in 2020 compared to 2018. If (new) is shown in the corresponding column, the company was not among the Top 100 in 2018.

3 Entries marked with an [S] refer to the combined financial statements; [E] stands for the individual financial statement.

4 Unless otherwise indicated, value added of the consolidated domestic group company. A figure marked with an * shows the value of a company that had to be estimated in the year in question. The estimation methods used in the individual cases are described in the Appendices to this Report.

5 The companies are attributed to one of the following sectors according to their main area of business: industry (i), construction (b), trade (h), services (including transport) (d), credit (k) or insurance (v). If a company has been attributed to the industry, construction, trade or services sector, the business volume stated indicates the consolidated turnover of the domestic group companies, meaning the consolidated turnover of the domestic group companies including turnover with foreign affiliated companies. The balance sheet total is stated for financial institutes and the gross written premiums for insurance companies. Any figure marked with an * is an estimation.

6 2018: Ernst & Young-Gruppe Deutschland

7 2018: B.Braun Melsungen AG

8 2018: Hella KGaA Hueck & Co.

Source: Own surveys

19. The reporting year 2020 is marked by the economic impact of the COVID-19 pandemic. For example, Lufthansa and Frankfurt Airport are no longer listed in the Top 100. The domestic value added of Fraport AG Frankfurt Airport Services Worldwide fell by almost 69 percent and that of Deutsche Lufthansa AG by as much as 91 percent. Deutsche Lufthansa AG, which was still the eleventh-largest company in Germany in the reporting year 2018, is therefore no longer included in the list of the Top 100 in the reporting year 2020. Fraport AG Frankfurt Airport Services Worldwide, which ranked 50th among the largest companies in Germany in the reporting year 2018, also disappeared from the Top 100 in the reporting year 2020. Besides these two companies, the following companies also left the Top 100 (ranking from 2018 in brackets): Adidas AG (51), Hamburg Commercial Bank AG (54), PSA-Gruppe Deutschland (55), ExxonMobil-Gruppe Deutschland (63), Rheinmetall AG (65), AVECO Holding AG (66), KION GROUP AG (79), ABB-Gruppe Deutschland (93), Saint-Gobain-Gruppe Deutschland (97), Krones AG (98), Vattenfall-Gruppe Deutschland (99).

20. These companies no longer appear in the ranking for different reasons. Hamburg Commercial Bank AG and the PSA-Gruppe, for instance, underwent changes with regard to the companies' owners. Hamburg Commercial Bank AG has now been privatised, and Stellantis N.V. took over the production of the Opel car brand, which generated the value added of the PSA-Gruppe in Germany. By contrast, AVECO Holding AG is likely to have dropped out of the ranking for reasons related to the data collection. Whilst it was still possible to estimate the value added of the domestic group of companies in the reporting year 2018, it was no longer possible to do so for the reporting year 2020, as the necessary data could not be obtained. Conversely, for the ABB-Gruppe Deutschland it was necessary to estimate the domestic value added the reporting year 2018. However, the company provided the necessary data in the reporting year 2020, so that it was not necessary to estimate the value added. It therefore remains unclear as to whether the estimate in the reporting year 2018 was too high, or the value added has actually fallen over time.

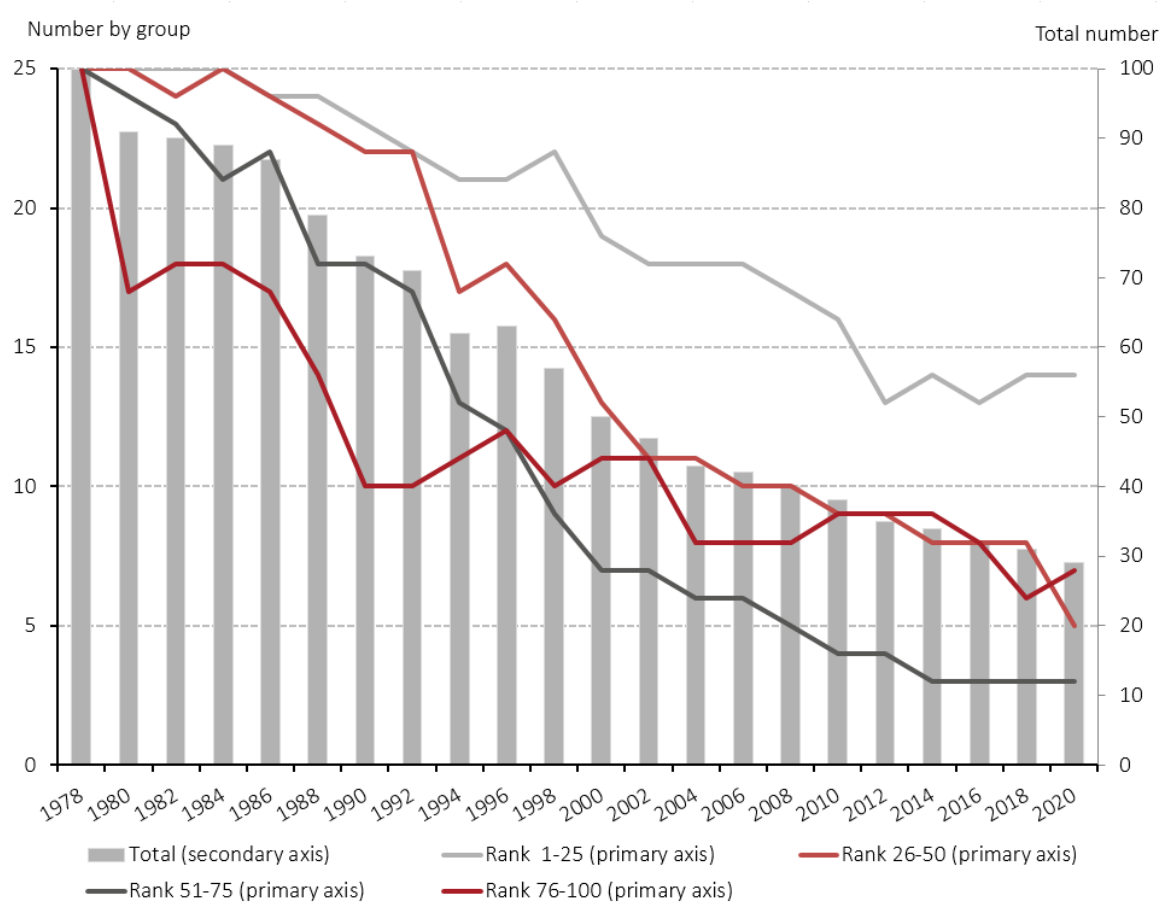
21. The following new companies were admitted to the group of the Top 100 in the reporting year 2020 (ranking in 2020 in parentheses): Vodafone-Gruppe Deutschland (40), Hapag-Lloyd AG (52), Amazon-Gruppe Deutschland (59), Generali-Gruppe Deutschland (67), HDI Haftpflichtverband der Deutschen Industrie V.a.G. (71), Dirk Rossmann GmbH (76), TenneT TSO GmbH (78), Infineon Technologies AG (86), Zalando SE (89), Charité Universitätsmedizin Berlin KöR (93), Rhön-Klinikum AG (97), Drägerwerk AG & CO. KGaA (98) and Telefónica-Gruppe Deutschland (99). The entry of Amazon and Zalando are worth highlighting as companies that are active in online retailing and have therefore experienced positive economic development during the COVID-19 pandemic. However, with regard to the Amazon-Gruppe Deutschland the figures reported for the domestic group of companies in the present Report may be too high, because, as in the previous reporting years, Amazon has once again failed to provide any data on the domestic group of companies to the Monopolies Commission for the reporting year 2020. The largest subsidiaries of Amazon located in Germany were therefore combined, which is a methodology that is regularly applied by the Monopolies Commission.[28] The number of companies combined, at 28, is however comparatively high, so that the risk of duplicate recording, for instance because of sales transactions taking place between individual subsidiaries, increases.

22. The changes in the composition of the group of the Top 100 in the reporting year 2020 have largely taken place in the lower half of the ranking list, i.e. in positions 50 to 100. This corresponds to the observation of previous reporting years in that especially very large companies were able to consolidate their economic positions over time. Figure I.1 illustrates this. The grey bars indicate for the respective reporting year how many of the companies, which were among the Top 100 in the respective reporting year, already belonged to this group when reporting began in 1978. For instance, as many as 29 companies belonged to the Top 100 in 2020, which were already in the Top 100 in 1978. Figure I.1 furthermore also stresses how the companies have developed depending on the ranking group to which they belonged when reporting began. The lines illustrate the number of companies

[28] Cf. section 2.1.2 of the Annex on the methods of estimating domestic added value.

for each ranking group, which remain in the Top 100 in the respective reporting year. A trend can be observed that especially the largest companies have been able to consolidate their economic position over time. Besides, 14 of the largest 25 companies from 1978 are still among the Top 100 in the reporting year 2020. By contrast, an average of only roughly five companies from the other ranking groups from 1978 can still be found among the Top 100 in 2020.

Figure I.1: Number of companies which were among the Top 100 in 1978 and in the respective reporting year



Source: Own surveys

1.2.2 The macroeconomic significance of the Top 100

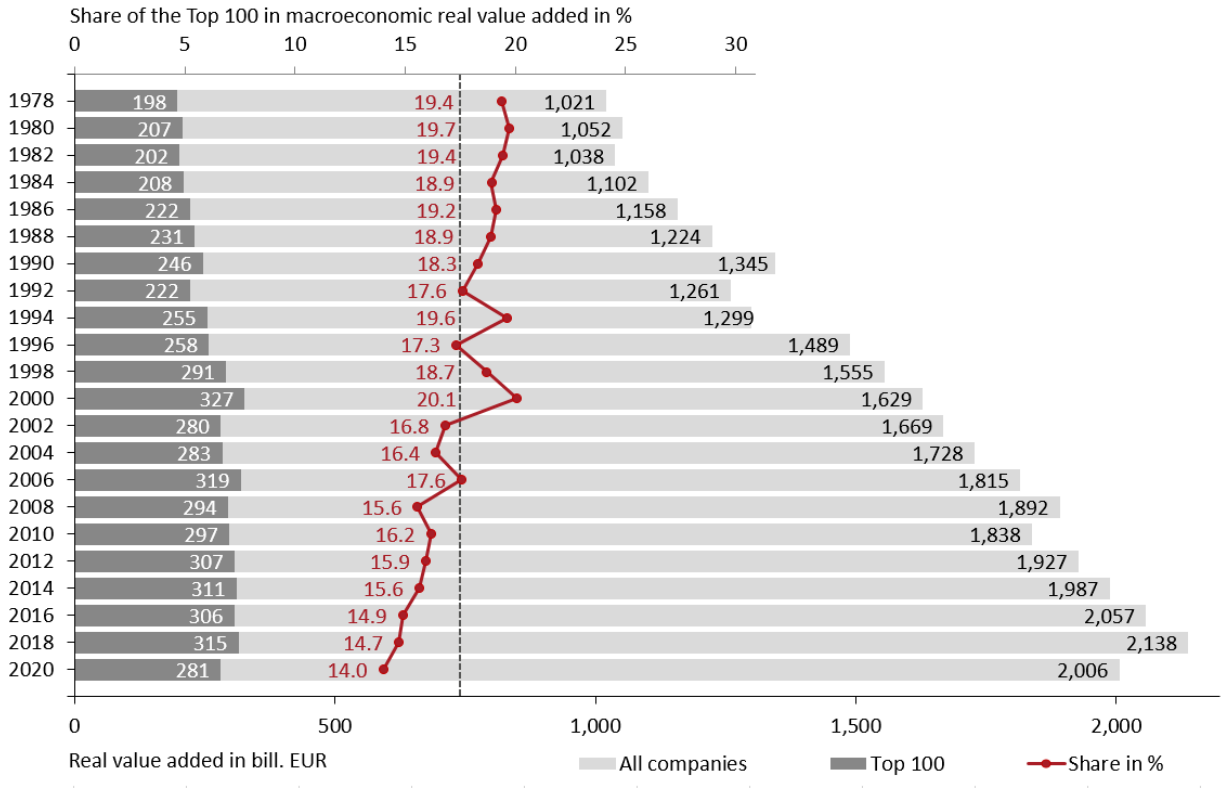
23. The 100 largest companies in Germany identified for the reporting year 2020 are analysed below with regard to their macroeconomic significance. First, the share accounted for by the Top 100 in the macroeconomic value added is calculated. Second, the headcount of the Top 100 is compared to that of all companies in Germany. Finally, an analysis is also carried out of the significance of individual sectors within the Top 100. The outcome of these analyses is however to be interpreted against the background of the global COVID-19 pandemic in 2020. It is thus not possible to impute any long-term developments from the changes observed in comparison to the reporting year 2018.

Share in the value added

24. The share in the macroeconomic value added accounted for by the Top 100 is calculated by aggregating the domestic value added of the Top 100 and comparing it to the macroeconomic value added. The development of the two figures over time since 1978, corrected for price developments, is shown in Figure I.2. The figures for 2020 reflect the economic consequences of the COVID-19 pandemic. The real value added of all companies in Germany fell by 6.2 percent to EUR 2,005.7 billion compared to the reporting year 2018. The value added of the Top 100

dropped by 10.8 percent to EUR 280.8 billion in the same period. The more pronounced drop in the domestic value added of the Top 100, in comparison to the drop of the real value added of all companies, decreased the Top 100's share of the macroeconomic value added. It declined by roughly 0.7 percentage points to 14 percent. Hence, the trend of the previous reporting years continued (cf. red line in Figure I.2). The share of the Top 100 declined by roughly 12 percent in the past ten reporting years, thus averaging roughly 15 percent. It therefore shows a considerable drop in comparison to the first ten reporting years, during which it averaged more than 19 percent.

Figure I.2: Development of value added in the period from 1978 to 2020



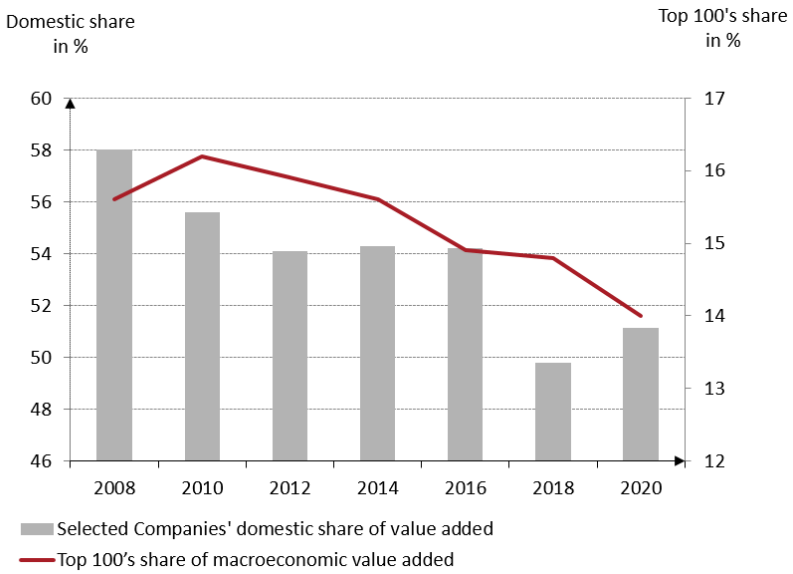
Note: The macroeconomic comparative value up to 2002 is the total net value added adjusted for inflation, and from 2004 onwards the gross value added adjusted for inflation not including the public sector, and not-for-profit private organisations without real estate and housing. The figures were deflated using the implied price index of the macroeconomic value added (at previous year's prices, base year: 2015; Source: Own calculations on the basis of data from the Federal Statistical Office, Fachserie 18 Reihe 1.5, p. 53, calculated in November 2021). The Appendix to the present Report contains detailed information regarding the figures shown.
Source: Own calculations based on companies' submissions as well as data from the Federal Statistical Office

25. The internationalisation of production and procurement processes generally causes a part of the value added of a company to be generated abroad. The domestic value added of the TOP 100 companies therefore frequently only reflects a part of their total value added. The significance of the group companies located in Germany for the Top 100 can be estimated using the share of value added accounted for by the domestic group companies in their overall value added. As in previous reporting years, those companies were selected for this review which are active in the economic fields of industry, trade and service (including transport), and have corporate headquarters in Germany. In order to make the comparison easier, only those companies were selected which were among the Top 100 in the reporting years 2018 and 2020. A total of 53 companies were identified and analysed using these criteria.

26. The domestic share of the 53 companies under review was 51.1 percent in the reporting year 2020, which indicates an increase of about 1.3 percentage points compared to the reporting year 2018. This may perhaps be a consequence of the COVID-19 pandemic, which made it difficult to keep international supply chains running in 2020. The domestic share nonetheless remains below the average of the past reporting years. The mean for the

period since the reporting year 2008 is 53.9 percent.[29] The grey bars in Figure I.3 show that there has been a downward trend in the domestic share since the reporting year 2008. Figure I.3 also shows that the share in value added accounted for by the Top 100 fell in the same period (red line). Whilst the significance of the group companies located in Germany has tended to decrease for the entire group among the Top 100 since the reporting year 2008, so has the significance of these companies for the economy as a whole. The question therefore arises whether the internationalisation of production processes is leading to a decrease in the aggregate concentration of companies in Germany.

Figure I.3: Domestic share and value added share of large companies

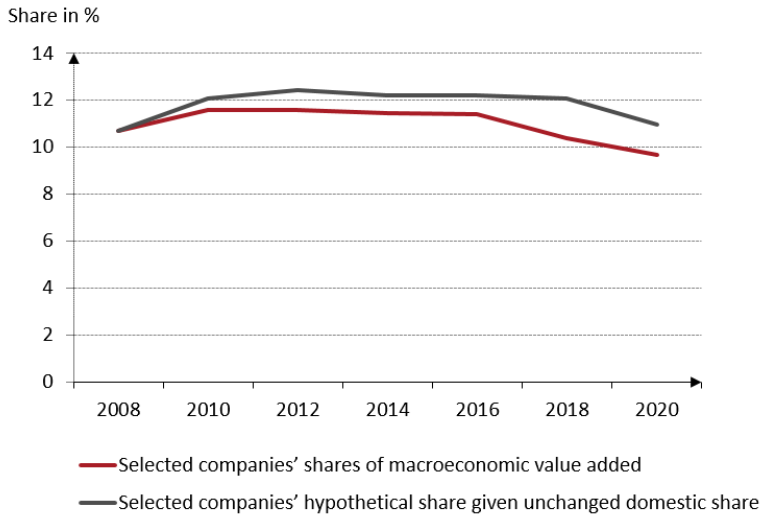


Note: Top 100 Companies were selected, which belonged to the economic sectors of industry, trade and services (including transport), had corporate headquarters in Germany, and belonged to the Top 100 in the respective previous reporting year.
Source: Own calculations

27. In order to examine whether the trends in the aggregate concentration might be related to relocations of large companies' production sites, one may observe how the share of the selected Top 100 companies of domestic value added would have developed had these companies' domestic shares remained unchanged. Figure I.4 indicates that the large companies' value added as a share of the macroeconomic value added in the previous reporting years would have been bigger if the domestic share of these companies had remained unchanged since 2008 (cf. grey line). The actual share in domestic value added, illustrated by the red line, is below the hypothetical value added share in all years under review which the companies would have achieved had the domestic share remained unchanged. Therefore, the drop in aggregate concentration might be linked to the Top 100 relocating production sites. One should however bear in mind that these descriptive observations do not permit to conclude a causal link.

[29] The average domestic share of selected companies from the group of the Top 100 was collected by comparable means for the first time for the reporting year 2008.

Figure I.4: Share of selected companies in domestic value added

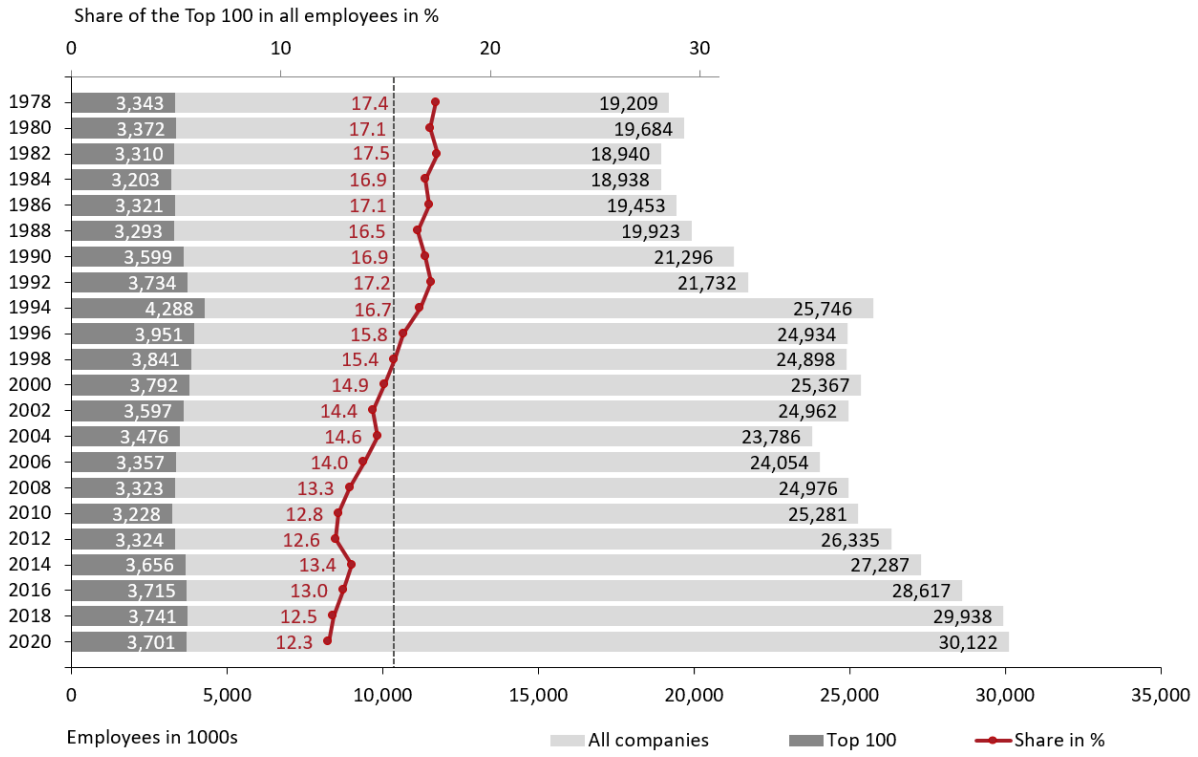


Note: Top 100 Companies were selected, which belonged to the economic sectors of industry, trade and services (including transport), had corporate headquarters in Germany, and belonged to the Top 100 in the respective previous reporting year.
Source: Own calculations

The share of employment

28. In addition to the share of value added, the share of employee headcount in Germany was examined in order to evaluate the aggregate business concentration. Figure I.5 compares the total of all employees of the Top 100 in Germany with the total number of employees subject to obligatory social insurance of all companies in Germany over time (grey bars). The red line furthermore shows the share of employees in Germany of the Top 100 based on the total number of employees of all companies in Germany subject to obligatory social insurance. Since value added is very closely linked with personnel costs, a similar development can be observed here as in Figure I.3, which shows the share of the Top 100 in value added. In each case, a downward trend in the share of the Top 100 is recognisable over time. As in the previous period under report, the total number of all employees subject to obligatory social insurance working in companies in Germany has increased. By contrast, the number of employees of the Top 100 in Germany has decreased for the first time since 2010. The drop in the share of the Top 100 in employee headcount in Germany has thus continued, decreasing by 1.7 percent to 12.3 percent in comparison to the reporting year 2018.

Figure I.5: Development in employment by companies in Germany in the period 1978 to 2020



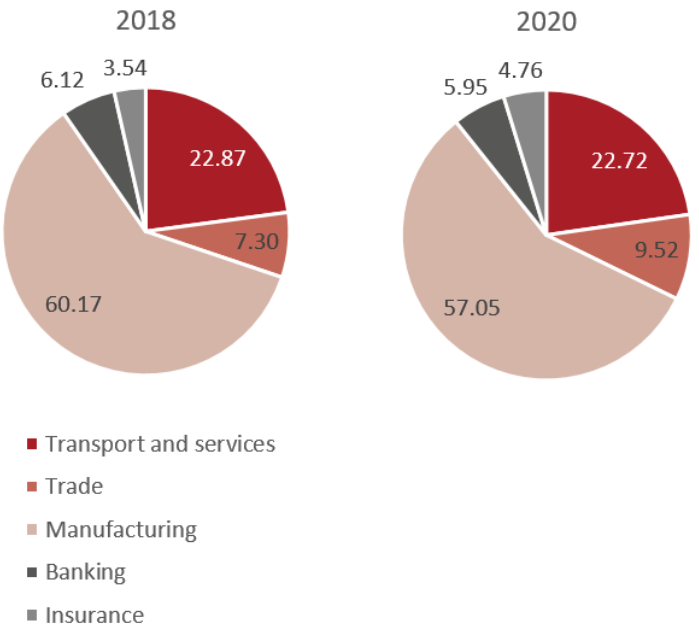
Source: Own calculations based on companies' submissions as well as evaluations of the Federal Statistical Office from the employment statistics of the Federal Employment Agency

Individual sectors' share of value added

29. Industrial companies are highly significant for economic development in Germany, and hence also for policy makers. Figure I.**6** shows the various sectors' value added shares of the Top 100 in 2018 and 2020. Manufacturing generated a major share of the Top 100's value added in both years. Whilst this share decreased by roughly 3 percent compared to the reporting year 2018, it still accounts for a share of more than 50 percent. The Top 100's value added share accounted for by trade increased in the reporting year 2020 and is now 9.5 percent, the highest value since 1978. This, as well as the developments described below, may be at least partly due to the COVID-19 pandemic. One should therefore take into account when interpreting the results that these are not developments that one may expect to be permanent.

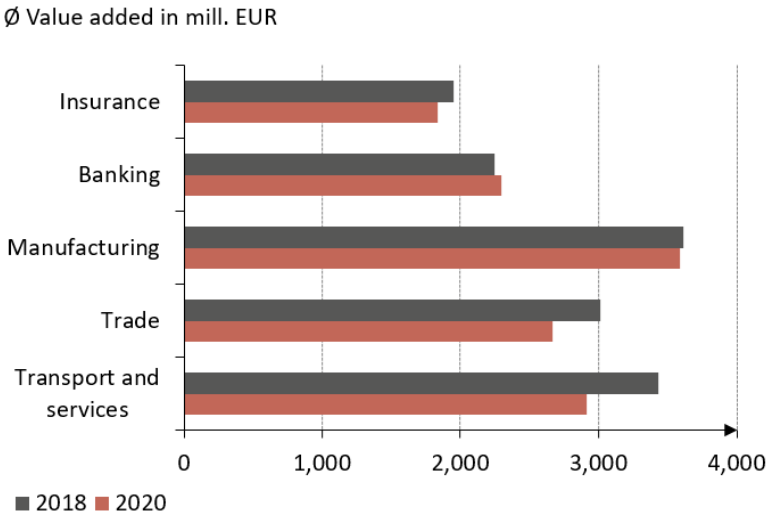
30. When assessing the Top 100 companies' average value added from different sectors, it becomes clear that the decrease in domestic value added does not refer to specific sectors. The banking industry is in fact the only sector where Top 100 companies did not experience a drop in the average value added. The most pronounced drop in average value added in Germany can be observed among companies in the "transport and services" sector. It fell by about 15 percent to EUR 2,917 million in the reporting year 2020 in comparison to the reporting year 2018. The domestic value added of trading companies among the Top 100 dropped about 11.5 percent to EUR 2,667 million. The drop experienced by industrial companies was very moderate by comparison. The average domestic value added of these companies only fell by EUR 25 million, to EUR 3,588 million. Overall, the industry among the large companies in Germany continues to be economically highly significant, hence the development of the large industrial companies is also particularly important for policy makers.

Figure I.6: Sector shares of value added of the Top 100 in 2018 and 2020



Source: Own calculations

Figure I.7: The average value added of the Top 100 in 2018 and 2020 by sectors



Source: Own calculations

1.3 Shareholders and cross-shareholdings of the Top 100

31. The Top 100 are analysed below with regard to their shareholders. Minority holdings held by Top 100 companies in other Top 100 companies are of particular interest, since such cross-links may amplify the potential influence exerted by these companies on macroeconomic developments and political decision-making. This is presumed to be the case because companies with the same shareholders may be incentivised to act less competitively towards one another since the shareholders are likely to be less interested in maximising the profit of each of the companies in which they have a holding, and more interested in maximising the overall profit

obtained from these holdings.[30] While cross-links may also lead to added efficiency resulting from more highly coordinated economic activity, the described potential for aligning interests among the Top 100 needs to be taken into account simultaneously when judging the aggregate concentration.

32. Despite various disclosure obligations with regard to capital holdings in other companies, it is generally not possible to determine the cumulated capital shares of all shareholders.[31] For this reason, the "Orbis" database of the provider Bureau van Dijk has been used since the XX Biennial Report in order to identify the shareholders of the Top 100.[32] Both direct and indirect holdings are considered when identifying shareholders based on this data. Indirect holdings are attributed to the company at the upper end of the chain of holdings if it holds a majority controlling interest in any intermediary holding companies. The reported capital shares furthermore refer to ordinary shares, which carry a voting right.[33] Where necessary, the data is supplemented or corrected to include information from annual accounts.

33. Next, the shareholders with corresponding capital shares are attributed to the categories "Top 100 companies", "identified foreign investors", "public sector", "individuals or families or family foundations", "free float", and "others". Capital shares accounting for less than one percent are attributed to the free float category.[34] Shares in domestic companies which do not belong to the Top 100, as well as capital shares in cooperatives or other identifiable shares which cannot be attributed to the other categories, are attributed to the category "others".

34. A special category exists in the reporting year 2020, which is "majority of shares held by a Top 100 company". Usually, no companies are attributed to this category since this chapter reviews groups of companies. If Company B holds the majority of shares in Company A, it would be attributed to Company B's group of companies within the present reporting.[35] Asklepios Kliniken GmbH & Co. KGaA took over Rhön-Klinikum AG in the middle of the reporting year 2020, hence a Top 100 company held the majority of the shares in Röhn-Klinikum AG as per the end of the reporting year. However, Asklepios Kliniken GmbH & Co. KGaA only included Röhn-Klinikum AG in the consolidated financial statement from mid-2020 onwards.[36] Röhn-Klinikum AG was therefore still part of the Top 100 as a separate entity in the reporting year 2020, and is therefore the only company attributed to the corresponding shareholder category (cf. Figure I.8).

35. Figure I.8 shows that a majority of the shares in more than half of the Top 100 Largest" were held by individuals or families/family foundations (27 companies) or foreign investors (26 companies) in the reporting year 2020. Hence, the number increased by one company in each case compared to the reporting year 2018. Most holdings in both categories are 100 percent holdings. For companies where foreign investors hold the majority of the shares, this means that these are group units in Germany, which can be fully attributed to a foreign parent company. Examples of this include the Vodafone-Gruppe Deutschland or the Shell-Gruppe Deutschland. Where

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30 Reynolds, R.J./Snapp, B.R., The competitive effects of partial equity interests and joint ventures, International Journal of Industrial Organization, 4, 1986, pp. 141–153; Monopolkommission, XXI. Hauptgutachten: Wettbewerb 2016, Baden-Baden, 2016, chap. III.

31 In accordance with § 285 Nr. 11 HGB, stock corporations are obliged to declare in the Notes to the annual accounts if they hold shares of more than 20 percent in other companies. Listed stock corporations are already obliged to do so if they have more than five percent of the voting rights in a large stock corporation (§ 285 Nr. 11b HGB). If a shareholder reaches, or goes above or below, three percent of the voting shares, it must inform the issuer of securities and the Federal Financial Supervisory Authority accordingly, § 33 Abs. 1 WpHG. This report must also be published if the issuer is a company in Germany, § 40 Abs. 1 WpHG.

32 Version: March 2022.

33 It is however not possible to rule out that the reported shares also include shares held for third parties, since the "Orbis" database summarises information from a variety of sources.

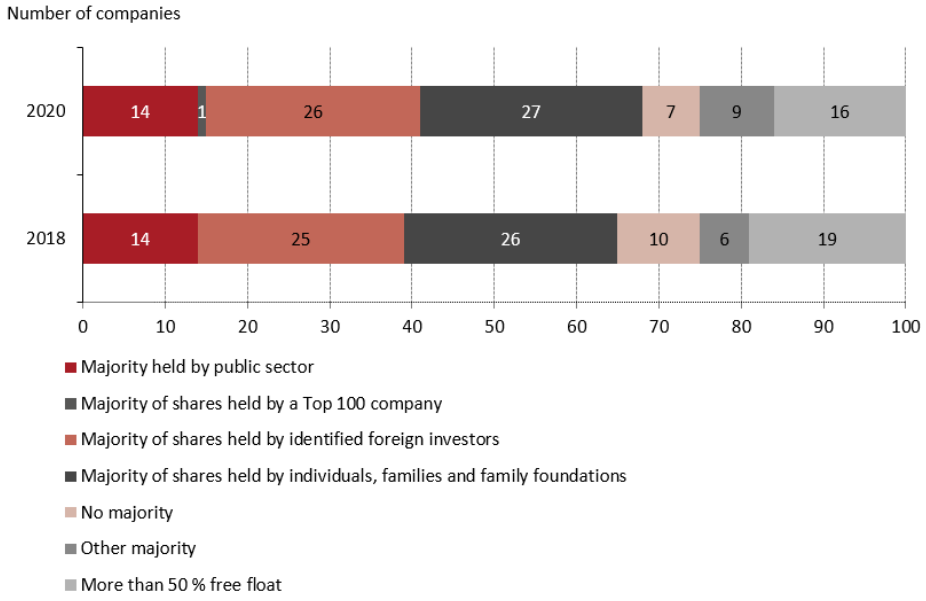
34 In this respect, this analysis deviates from the definition of Deutsche Börse AG, which assigns cumulative capital shares of less than 5 percent to the free float. For details on how investors with minority holdings can exert influence, see Monopolkommission, Wettbewerb 2018: XXII. Hauptgutachten der Monopolkommission, Baden-Baden, 2018, chap. II.4.

35 Cf. para. 7 on the term "company" in the context of the present study.

36 Asklepios, Geschäftsbericht 2020, p. 76.

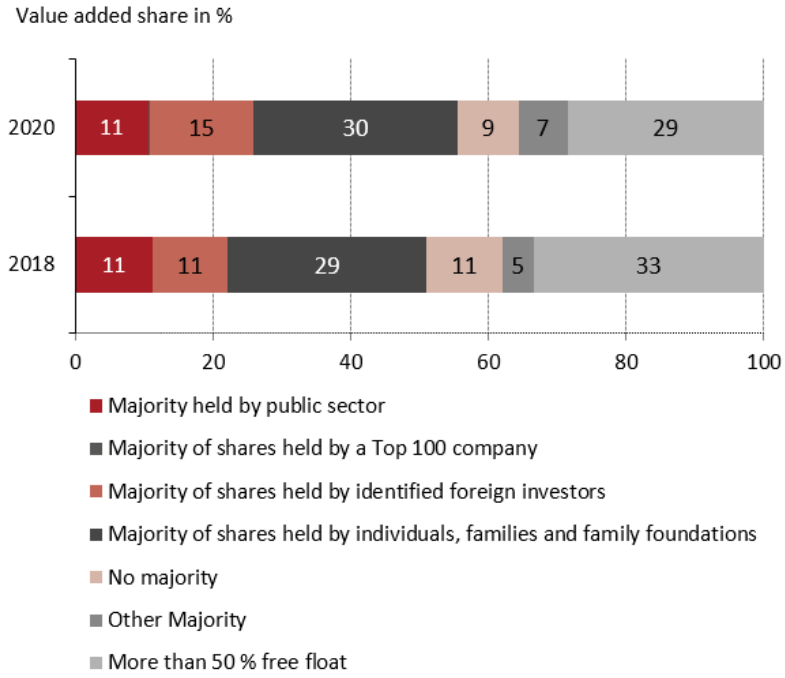
companies are 100 percent owned by individuals or families/family foundations, shares are often distributed among several members of a family. Examples of this are the Rethmann and Würth families. Figure I.9 illustrates the share in the total value added of the Top 100 that was generated by companies from this shareholder category. At roughly 30 percent, companies where individuals or families/family foundations hold a majority of the shares generated the largest share of value added of the Top 100. By contrast, companies where many different investors own a majority of shares (free float) still generated the largest share in the reporting year 2018. Their share however fell from roughly 33 percent to its present level of less than 29 percent.

Figure I.8: The structure of the shareholders of the Top 100 in 2018 and 2020



Source: Own calculations based on the "Orbis" database of the provider Bureau van Dijk (Version: March 2022)

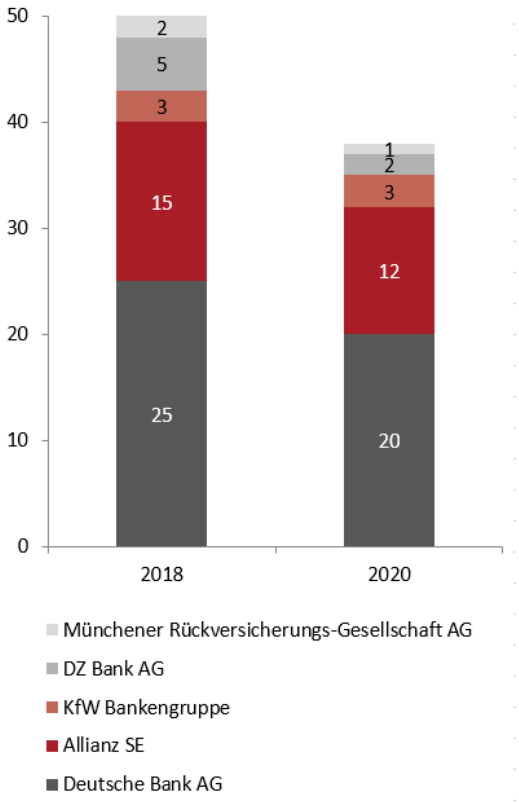
Figure I.9: Share in value added accounted for by the Top 100 by majority holdings in 2018 and 2020



Source: Own calculations based on the "Orbis" database of the provider Bureau van Dijk (Version: March 2022)

36. In addition to the structure of the shareholders of the Top 100, cross-shareholdings between companies from this group are of particular interest in the analysis of aggregate concentration. Figure I.10 shows the development of such cross-links in the reporting period. As in the reporting year 2018, Deutsche Bank AG and Allianz SE also had the largest number of minority holdings in companies from the Top 100 in the reporting year 2020. The network of capital surrounding these two companies has however become smaller in comparison to the reporting year 2018. Deutsche Bank AG's minority holdings decreased since the reporting year 2018 by five to 20 minority holdings in the reporting year 2020. The number of holdings owned by Allianz SE also fell from 15 to twelve in the same period. This means that the number of holdings owned by these two companies has roughly reverted to the levels of the reporting year 2016.

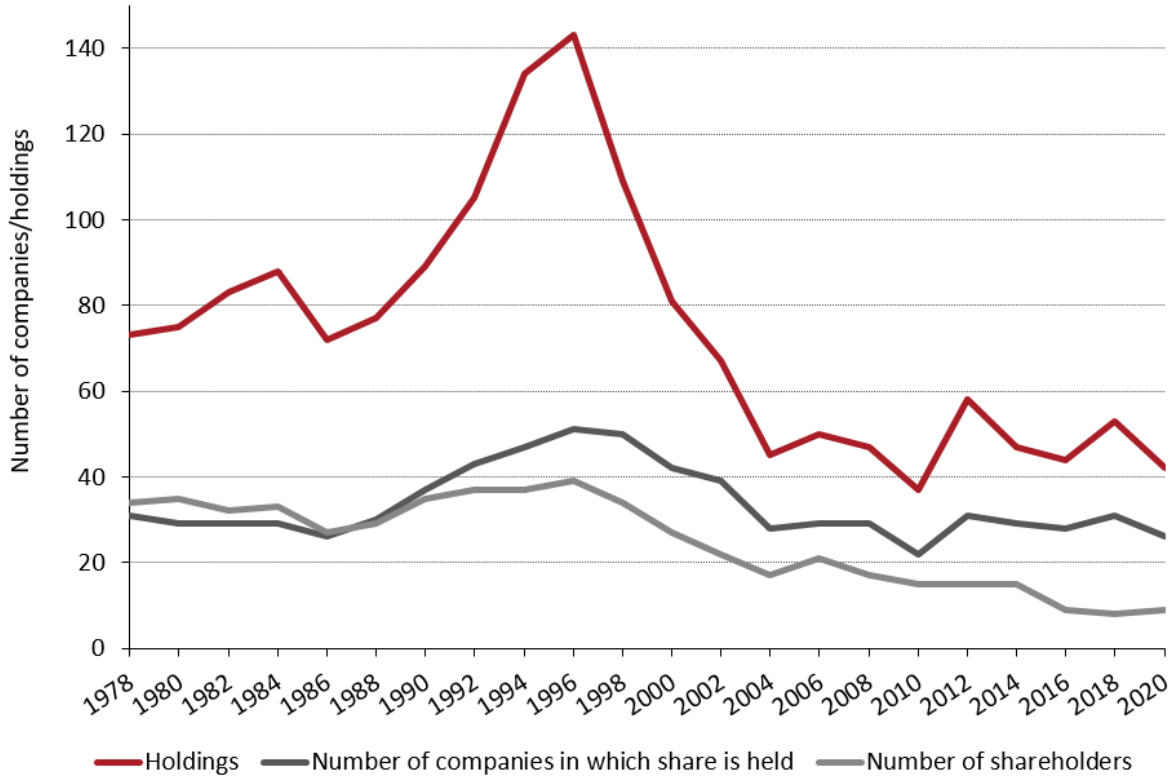
Figure I.10: Number of holdings among the Top 100 in 2018 and 2020



Note: Holdings were counted among the Top 100 companies, which had holdings in more than one company from this group in one of the reporting years.
Source: Own calculations based on the "Orbis" database of the provider Bureau van Dijk (Version: March 2022)

37. Figure I.11 shows the development of cross-shareholdings between the Top 100 since 1978. After a major increase in cross-shareholdings since 1986 onwards, which lasted for about ten years before an equally pronounced decline set in, no comparable developments have been observed since about 2004. The number of holdings in the reporting year 2020 is 42 in comparison to 45 in 2004. Overall, 26 companies owned holdings in the reporting year 2020 compared to 28 companies in 2004. It is however worth noting that there exists a stable downward trend in the number of shareholders among the Top 100 since 1996, when the number of shareholders peaked at 39. There are only nine shareholders of one or more minority holdings in the Top 100 companies in the reporting year 2020, which also belong to this group.

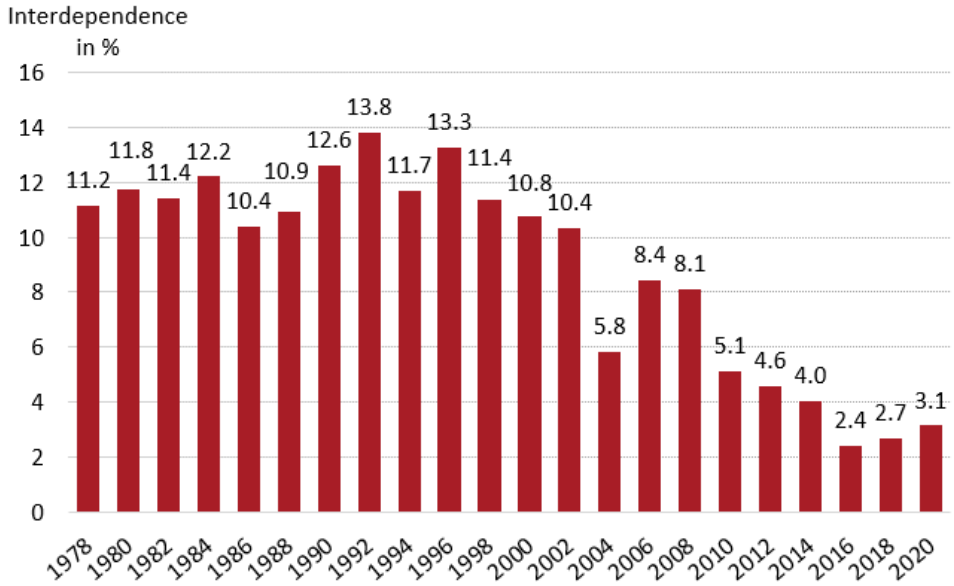
Figure I.11: Developments in cross-shareholdings between the Top 100 (1978–2020)



Note: Since the underlying dataset was changed as per the reporting year 2012, the figures from the reporting year 2012 are not completely comparable with those of the previous years. The number of holdings indicates the number of connections between firms via capital holdings. A Top 100 company is identified as a 'company in which share is held' if another Top 100 company has a more than one percent capital holding in this company. A Top 100 company is recorded as a shareholder if it has a more than one percent capital holding in another Top 100 company.

Source: Own calculations based on published annual reports, and since 2012 of the "Orbis" database of the provider Bureau van Dijk

Figure I.12: Share in value added accounted for by cross-shareholdings between the Top 100



Note: The interdependency indicates what share in the value added of the Top 100 is accounted for by capital holdings of companies which also belong to the Top 100.
Source: Own calculations on the basis of published annual reports, and since 2012 of the "Orbis" database of the provider Bureau van Dijk

38. In addition to the number of shareholders, companies with shareholdings, and actual holdings, Figure I.12 shows the share in the total value added of the Top 100 that is accounted for by capital holdings of companies which also belong to the group of the Top 100 (level of interdependency). The level of interdependency thus includes, firstly, the level of capital holdings between the Top 100 and, secondly, the value added of the companies with shareholdings from the group of the Top 100. For instance, a level of interdependency of 100 percent would emerge if each company from the group of the Top 100 were to belong to one or several companies from this group. After the level of interdependency tended to drop from the mid-1990s onwards, it slightly increased recently, but reached at 3.1 percent a level that continues to be comparatively low in the reporting year 2020.

39. The analyses described relate to direct cross-shareholdings between the Top 100. We did not consider indirect cross-shareholdings between the Top 100, which come about if a company that does not belong to the group of the Top 100 has a holding in more than one company from the group of the Top 100 (common ownership). The Monopolies Commission analysed such cross-shareholdings between the Top 100 for the reporting year 2018. Roughly seven percent of the total capital of the Top 100 were held in 2018 by investors such as BlackRock or Vanguard, which had holdings in more than one company from the group of the Top 100, but without themselves being among the Top 100. The significance of these investors was thus much greater than that of the companies from the group of the Top 100, which had holdings in more than one company from this group. Their share in the total capital of the Top 100 was roughly two percent in the reporting year 2018.[37]

1.4 Personnel cross-links among the Top 100

40. Companies can be cross-linked not only via capital holdings, but also via individuals in their management and supervisory board. If a person with a management or supervisory mandate in a company from the group of the Top 100 has an additional mandate in another company from this group, a cross-link exists between the companies in question via this person. Such cross-links are of interest in order to assess the aggregate concentration of companies, as one may presume that individuals that exercise mandates in several companies

[37] Monopolkommission, XXIII. Hauptgutachten: Wettbewerb 2020, Baden-Baden, 2020, para. 216 et seqq.

are interested in each of these companies being successful. In this regard, personnel cross-links may lead to an alignment of interests, thus amplifying a concentration of economic control in large companies. The Monopolies Commission analyses below in which of the Top 100 companies individuals exercise several mandates in the management and supervisory boards of these companies.

41. Section 285 No. 10 of the Commercial Code obliges stock corporations and certain partnerships to list all members of the management board and of the supervisory board in the Notes to their annual accounts. This means that it is generally possible to identify the members of the management and supervisory boards of the Top 100 based on the published annual reports. Since the analysis of the aggregate business concentration relates to group units in Germany, the boards of the highest-level company in Germany are reported in cases of companies, which have their corporate headquarters abroad in order to identify the management and supervisory mandates. For the reporting year 2020 the necessary data could be collected for 98 companies from the group of the Top 100.[38] A total of 1,923 individuals held positions in the management and supervisory boards of these companies in the reporting year 2020 (2018: 1,990). These individuals held a total of 2,028 mandates (2018: 2,111). Table I.2 illustrates how these mandates are distributed among the management and supervisory boards.

Table I.2: Mandates in the management and supervisory boards of the Top 100

	2018	2020
Management mandates	551	555
of which with a cross-link	37 (6.7 %)	32 (5.8 %)
Mandates in supervisory board	1,560	1,473
of which with a cross-link	184 (11.8 %)	167 (11.3 %)

Source: Own calculations based on published annual reports

42. Table 1.2 shows that individuals that also held a mandate in a supervisory board of at least one other Top 100 company exercised 32 out of the 555 management mandates in the reporting year 2020. This corresponds to a share of 5.8 percent of the management mandates (2018: 6.7 %). Furthermore, individuals, which either exercised another mandate in a supervisory board of at least one other company or also belonged to the management board of another Top 100 company, held 167 of the 1,473 mandates, i.e. 11.3 percent, for the supervisory boards of the Top 100 in the reporting year 2020 (2018: 184 mandates (11.8 percent)). The number of mandates in the management and supervisory boards of the Top 100 with personnel cross-links with at least one more Top 100 company decreased slightly in comparison to the reporting year 2018.

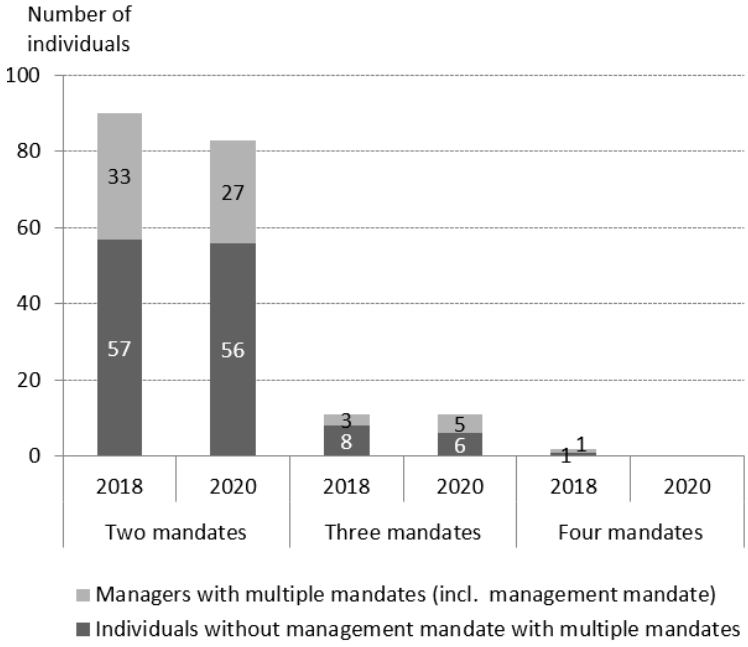
43. The following assesses those mandates, which create cross-links between Top 100 companies in more detail. These mandates are either held by individuals who are a member of the supervisory board of at least two companies from the group of the Top 100, or by individuals who exercise a management mandate in one company, and hold a supervisory mandate in at least one other company from the group. Figure I.13 breaks down these mandate-holders by number of mandates that they hold in the Top 100. In the reporting year 2020, there is no longer a manager, who additionally holds three mandates in supervisory boards of the Top 100 (2018: 1 person).[39] By contrast, the number of managers who additionally hold two mandates in supervisory boards of the Top 100 has risen from three to five. The number of managers who also exercise a supervisory mandate decreased by six to reach 27. This means that the total number of managers who hold at least one mandate in a supervisory

[38] The Aldi-Gruppe and the Schwarz-Gruppe were not included in the analysis of the personnel cross-links because of lack of data.

[39] Three mandates in supervisory boards would also exceed the upper limit of two mandates that the Corporate Governance Code provides for board members of listed companies (Cf. German Corporate Governance Code, 16 December 2019).

body of the Top 100 in addition to the management mandate fell by five to 32. The number of individuals without a management mandate who exercise several mandates in supervisory boards of the Top 100 also fell by four to reach 62. Furthermore, no individual of this group holds four mandates in the reporting year 2020 anymore (2018: 1 person). The number of individuals holding two mandates in supervisory boards has however remained comparatively constant in this group, namely at 56 (2018: 57 persons), and the number of individuals with three mandates in supervisory boards of the Top 100 also only decreased from eight to six.

Figure I.13: Individuals with several mandates in management and supervisory boards in 2018 and 2020



Note: The counts include individuals with mandates in management and supervisory boards of several companies from the Top 100.
Source: Own calculations based on published annual reports

44. Hence, various Top 100 companies are interconnected via their management or supervisory boards. These cross-links are identified by determining for each[40] company from the group of the Top 100:

- In how many other companies do management members of the company under review hold a mandate? (category "Via own management board"),
- In how many other companies are members of the supervisory board of the company under review members of the management board? (category "Via members from own supervisory board with management mandates").
- In how many other companies do individuals of the company's supervisory board exercise a mandate in the supervisory board? (category "Via individuals without a management mandate who are members of own supervisory board").

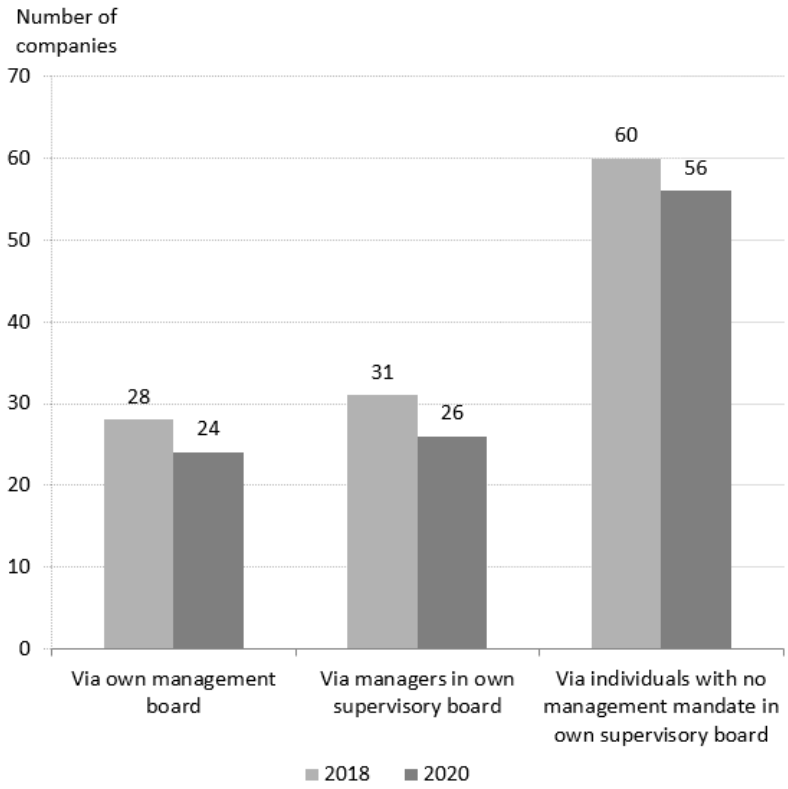
45. Figure I.14 provides an overview of the corresponding cross-links between the Top 100 in 2018 and 2020.[41] The personnel cross-links have declined in number in each of the above categories. Whilst 28 companies were linked with other Top 100 companies in the reporting year 2018 via their own management board, this only applies to 24 companies in the reporting year 2020. Furthermore, 26 companies were linked via managers in their

[40] The Aldi-Gruppe and the Schwarz-Gruppe were not included in the analysis because of a lack of data.

[41] The Annex to the present Report illustrates in table form how the detailed personnel cross-links are spread among the companies from the group of the Top 100.

own supervisory board in the reporting year 2020 with other Top 100 companies. This continued to be the case for 31 companies in the reporting year 2018. As in the reporting year 2018, the majority of the cross-links between the Top 100 arises in the reporting year 2020 as well via individuals without management mandates who hold a mandate in several supervisory boards of these companies. In the reporting year 2020, 56 companies, and therefore four companies less than in the reporting year 2018, were linked in such a way.

Figure I.14: Companies tied via personnel cross-links in 2018 and 2020



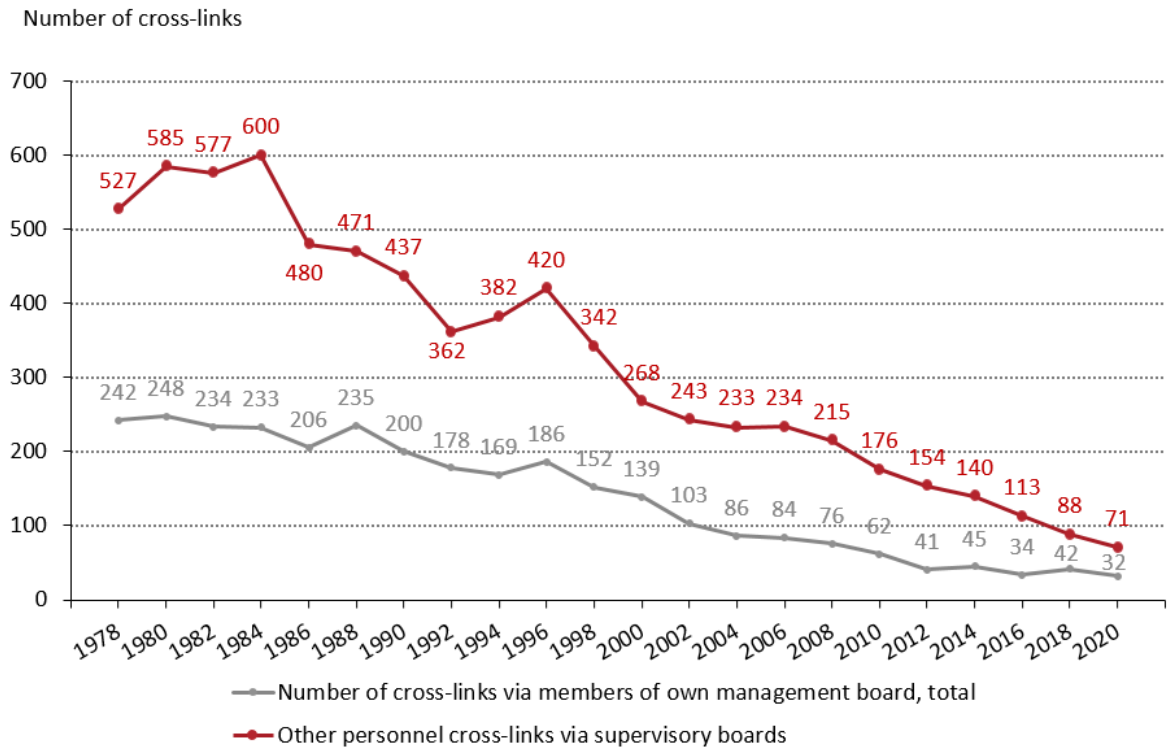
Note: The table states the number of Top 100 companies, which were intertwined with other companies from this group via members of management and supervisory boards.
Source: Own calculations based on published annual reports

46. Figure I.15 shows that the total number of personnel cross-links between the Top 100 has also fallen. The number of personnel cross-links via individuals without a management mandate in one of the companies in question has thus fallen in comparison to the reporting year 2018 by 17 to 71 cross-links in the reporting year 2020 (2018: 88 cross-links). Hence, the trend since 2006 that fewer and fewer cross-links exist via the supervisory boards of the Top 100. At 234, the number of cross-links via the supervisory boards in the reporting year 2006 was three times higher than the figure reported in 2020.[42] The trend is less pronounced when it comes to cross-links via individuals who belong to a management board of a Top 100 company. The number of these personnel cross-

[42] It can be presumed that the drop that is observed in the number of personnel cross-links in the Top 100 is strongly influenced by the Corporate Governance Code. The Code, from 2002, contains principles, recommendations and suggestions for the management board and supervisory board to help ensure that the company is managed in the company's best interests (Deutscher Corporate Governance Codex, 16 December 2019). The Code initially restricted the maximum number of supervisory board mandates in non-group listed companies, which a member of the Board of a listed company can hold to five. The restrictions with regard to the number of mandates were subsequently expanded, in 2009 to three supervisory board mandates in external listed companies, and in 2010 to supervisory board mandates in companies with similar requirements. The current version provides that supervisory board members who do not belong to the management board of any listed company are also not to exercise more than five external supervisory board mandates, and management board members of a listed company no more than two.

links fell significantly by 10 to 32 links in the reporting year 2020 in comparison to 2018. The number of such cross-links however seems to have stabilised since 2012 (cf. Figure I.15).

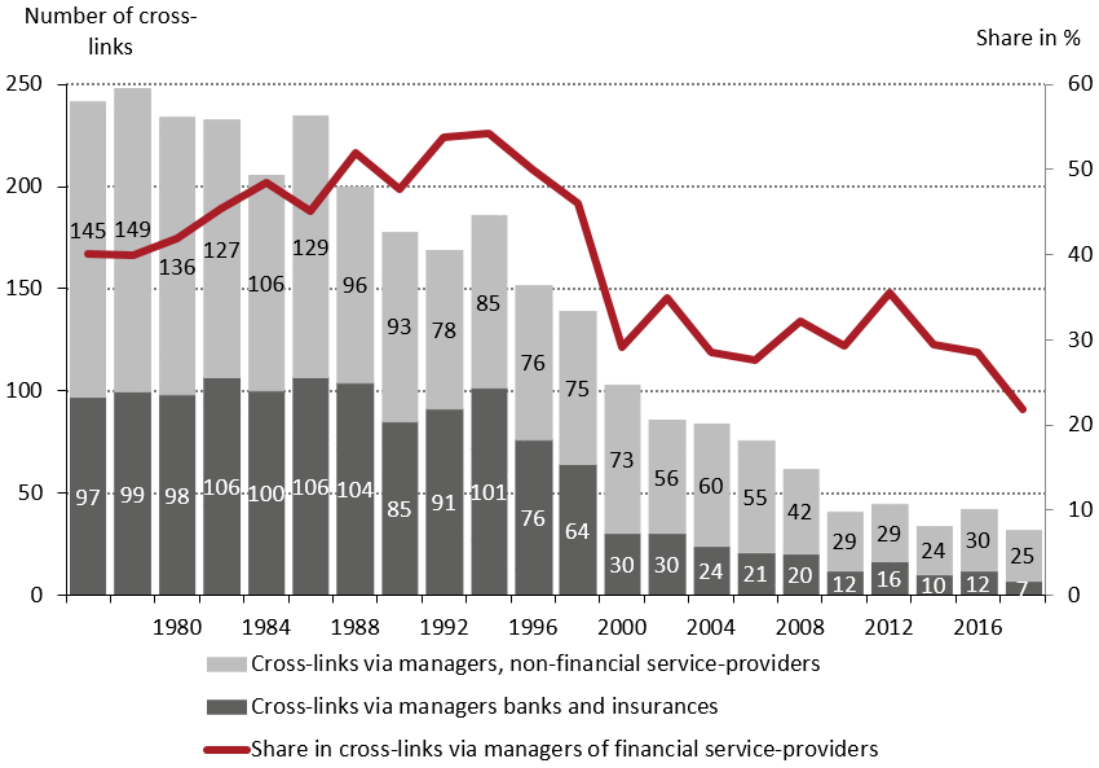
Figure I.15: Developments in personnel cross-links by type of cross-link (1978–2020)



Source: Own calculations on the basis of published annual reports

47. Particular attention is paid to cross-links, which are created by individuals in management boards of financial institutes and insurance companies with mandates in the supervisory boards of the Top 100. These cross-links have been listed separately since 1978 (cf. Figure I.16). The number of such cross-links was constantly high until the mid-1990s, averaging roughly 100. The number of these cross-links fell to seven in the reporting year 2020, this being the lowest value since reporting started. Moreover, the share of members of the management board of financial institutes or insurance companies among all management members with at least one other mandate in supervisory boards of the Top 100 fell over time (cf. Figure I.16). Whilst the share still averaged roughly 46 percent in the years up to 1998, its mean value has been approximately 33 percent since 2000. The significance of such personnel cross-links for the large companies thus appears to be decreasing, as is also the significance of personnel cross-links as a whole. However, this analysis relates to group (sub-)units in Germany. It cannot be ruled out that personnel cross-links are becoming internationalised, similarly to capital cross-links, and are hence not identified in the present Report.

Figure I.16: The number of personnel cross-links via members of the management board (1978-2020)



Source: Own calculations based on published annual reports

1.5 Merger involvement of the Top 100

48. External company growth may contribute to changes in the aggregate business concentration. The analysis of the aggregate concentration of companies therefore closes with a review of merger activities of the Top 100 in the period under report. To this end, it is determined for each Top 100 company in how many cases it was directly or indirectly involved in mergers that were reported to the Federal Cartel Office prior to their implementation. If such a merger is cleared by the Federal Cartel Office, it is assumed that it is also completed by the companies involved. Therefore, the number of clearance decisions with a Top 100 company involved is used in the present analysis to impute the number of mergers in which the companies in question were involved.

49. Three Top 100 companies were involved in at least ten merger projects in the period under report 2020/2021, which the Federal Cartel Office cleared (cf. Table I.3). By comparison, this applied to six companies in the reporting period 2018/2019. The most merger activity in the current period under report was shown by E.ON SE (19 clearances), Rethmann SE & Co. KG (13 clearances), and Allianz SE (10 clearances). These companies had been involved in a similar number of cleared mergers in the previous period under report. It was only in the case of Rethmann SE & Co. KG that the number of involvements in mergers fell from 18 to 13. Such a trend was also observed among the four other companies, which were involved in at least ten cases in the previous reporting period – DZ Bank AG, Volkswagen AG, INA-Holding Schaeffler GmbH & Co. KG and EnBW Energie Baden-Württemberg AG. Particularly DZ Bank AG and INA-Holding Schaeffler GmbH & Co. KG considerably reduced their merger activities compared to 2018/2019 (cf. Table I.3). The number of Top 100 companies, which were involved in mergers cleared by the Federal Cartel Office, also decreased considerably from 71 in the previous reporting period to 46 in 2020/2021.

Table I.3: Companies with at least ten cleared merger proposals in 2020/21 and 2018/19

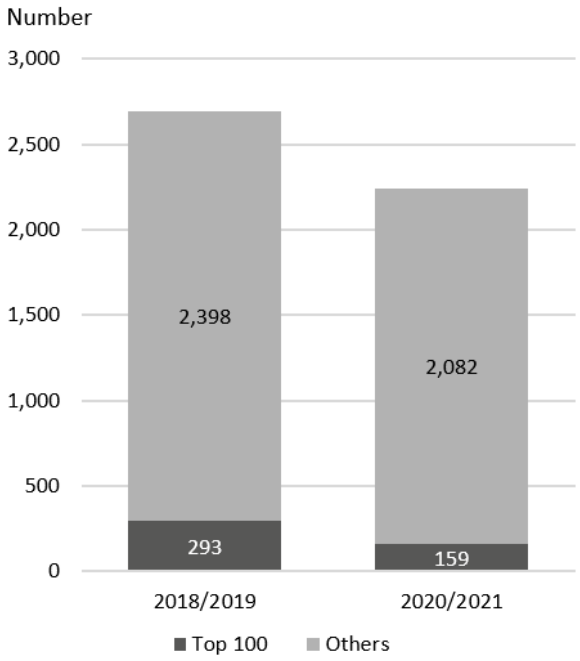
Company	Clearances 2020/2021	Clearances 2018/2019
E.ON SE	19	19
Rethmann SE & Co. KG	13	18
Allianz SE	10	9
DZ Bank AG	0	28
Volkswagen AG	9	15
INA-Holding Schaeffler GmbH & Co. KG	1	13
EnBW Energie Baden-Württemberg AG	9	11

Note: Mergers completed between 1 January and 31 December of the respective years were included when cleared in the preliminary or main investigation procedure with or without remedies. Cases were covered for the respective company if it was either the acquirer or the target, or its parent company was the acquirer or target (cases with no duty to notify are also recorded). The Appendix to the present Report contains an overview of all Top 100 companies involved in cases in the reporting period 2020/2021 that were cleared by the Federal Cartel Office.
Source: Data of the Federal Cartel Office

50. Figure I.17 compares the total number of clearance decisions of the Federal Cartel Office in the reporting years 2020/2021 with that of the previous period 2018/2019. The total number of mergers where Top 100 companies were involved has also fallen significantly compared to the previous period. At 159 cases in the current period, the number of cases fell by more than 45 percent. This development was however not restricted to the Top 100, as the number of merger cases with no involvement of a Top 100 company also fell compared to the previous period (cf. light grey bar “Other” in Figure I.17). However, at about 17 percent, the drop in the number of these cases was much less pronounced. The overall reduction of proposed mergers cleared by the Federal Cartel Office may have been caused, firstly, by the COVID-19 pandemic in 2020, and secondly by the raised notification threshold in the wake of the 10th amendment of the Competition Act as per January 2021.[43]

[43] Cf. para. 170 in this Report.

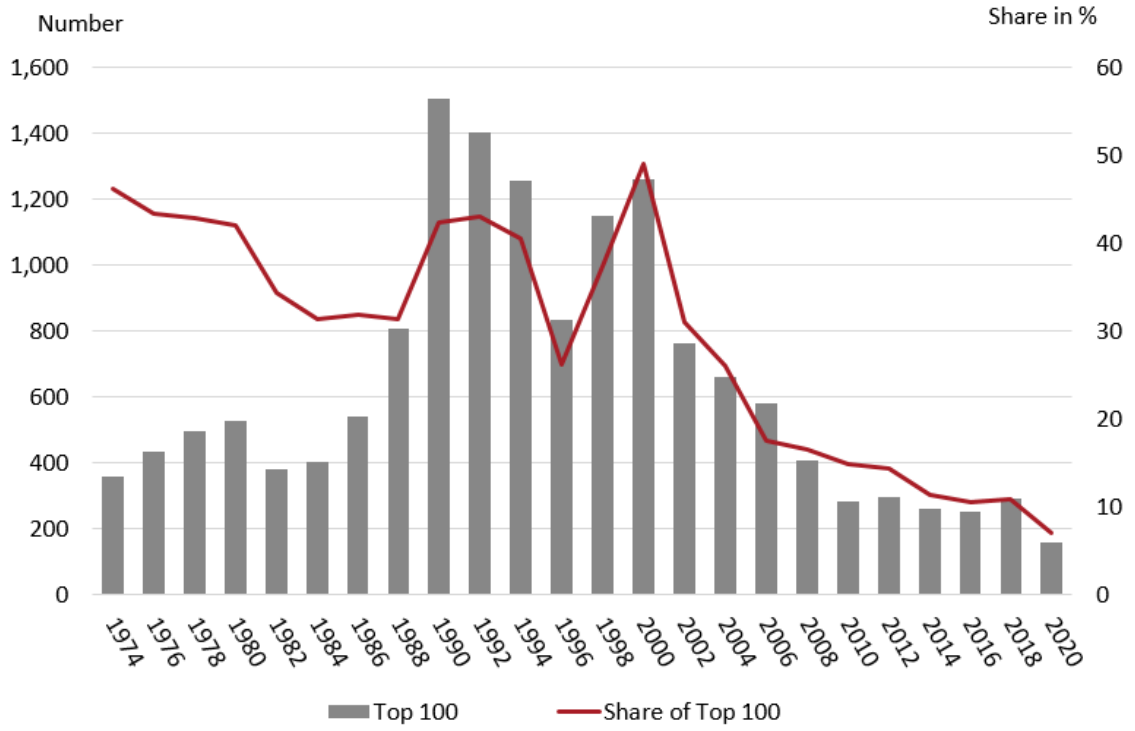
Figure I.17: Clearance decisions of the Federal Cartel Office in the reporting years 2018/2019 and 2020/2021



Note: Mergers completed between 1 January and 31 December of the respective years were included where approval was given in the preliminary or main investigation procedure with or without remedies. The Top 100 category covered clearances in which Top 100 companies were involved if they were either the acquirer or the target, or their parent company was the acquirer or the target (cases with no duty to notify are also recorded). The category "Others" included the other cases cleared by the Cartel Office in which no Top 100 company was involved.
Source: Own calculations based on data from the Federal Cartel Office

51. Since the number of proposed mergers cleared by the Federal Cartel Office fell more sharply among the Top 100 than among other companies in Germany, the Top 100's share of proposed mergers cleared by the Federal Cartel Office decreased to 7.1 percent in the current reporting period (2018/2019: 10.9 percent). As shown by Figure I.18, the trend observable since 2000/2001 continues. Whilst the share of the Top 100 among all mergers notified to the Federal Cartel Office was still almost 50 percent in the reporting period 2000/2001, it has fallen to its lowest level on record in 2020/2021.

Figure I.18: Merger activity of the Top 100 since 1974



Note: Mergers between 1 January of the respective year and 31 December of the following year were included (total period: two years), which were cleared in the preliminary or formal investigation procedure with or without remedies. Clearances in which Top 100 companies were involved were recorded in the category Top 100 if they were either the acquirer or the target, or their parent company was the acquirer or the target (cases with no duty to notify are also recorded). The information up to the period under report 2006/2007 is based on actual mergers that were indicated to the Federal Cartel Office. Given the availability of data, the number of proposed mergers cleared by the Federal Cartel Office was used from the reporting period under report 2008/2009 onwards.
Source: Own calculations based on data from the Federal Cartel Office

1.6 The largest companies of a sector by domestic business

52. The assessment of the Top 100 follows an analysis of the largest companies by sectors. First, the companies are allocated to five sectors – "Industry", "Trade", "Transport and services", "Banking" and "Insurance companies" – based on the focus of their commercial activities, which is in line with the reporting of the Monopolies Commission since the IV Biennial Report.[44] In line with the analysis of the Top 100, this analysis also refers to (parts of) domestic groups. However, unlike the review of the Top 100, the sector-specific business volumes are used below as a basis for classification. The following are identified:

- The 50 largest industrial companies by turnover
- The ten largest trade companies by turnover
- The ten largest transport and service companies by turnover
- The ten largest financial institutes by balance sheet total
- The ten largest insurance companies by gross written premiums

[44] The categorisation by the five sectors mentioned has been used since the IV Biennial Report of the Monopolies Commission, and has been retained since then in order to make sure that the data are comparable over time. Companies are attributed to these sectors using the information in the companies' consolidated financial statements and the information contained in the "Orbis" database of the provider Bureau van Dijk, and this is related to the focus of commercial activities in Germany. This procedure is not followed with DZ Bank, which is recorded as a financial institute via its balance sheet total, and also as an insurance company via gross written premiums of R+V Versicherung.

53. Next, the business volumes of the largest companies of a sector are adjusted for inflation and compared to the corresponding macroeconomic value in order to be able to assess the significance of large companies within a given sector.[45] Yet, when interpreting the results, it should be taken into account that in this analysis no market definition was carried out to formally define relevant competitive markets. It is therefore not possible to draw concrete conclusions from this analysis regarding the market position of individual companies.

The 50 largest industrial companies

Table I.4: The 50 largest industrial companies in 2020 by turnover

Ranking by turnover	Trend	Company	Turnover in m EUR[1]	Total turnover in m EUR	Domestic share in %[2]
1	—	Volkswagen AG	145,285	222,884	65.2
2	—	Daimler AG	103,442	154,309	67.0
3	↑	Bayerische Motoren Werke AG	75,064	98,990	75.8
4	↓	Uniper SE	52,741	50,968	103.5
5	—	Robert Bosch GmbH	46,773	71,494	65.4
6	↑	E.ON SE	34,052	60,944	55.9
7	↓	Siemens AG	25,886	57,139	45.3
8	↑	BASF SE	24,733	59,149	41.8
9	↓	thyssenkrupp AG	18,070	28,899	62.5
10	↓	BP-Gruppe Deutschland	16,763	202,731	8.3
11	↑	EnBW Energie Baden-Württemberg AG	16,376	19,694	83.2
12	↓	Bayer AG	15,862	41,400	38.3
13	↓	Ford-Gruppe Deutschland	15,666	111,315	14.1
14	↑	Airbus-Gruppe Deutschland	15,147	49,912	30.3
15	↓	RWE AG	13,537	13,896	97.4
16	↓	Stellantis-Gruppe Deutschland	13,212	86,676	15.2
17	↑	Heraeus Holding GmbH	12,744	31,532	40.4
18	↓	Shell-Gruppe Deutschland	12,048	158,065	7.6
19	↑	C. H. Boehringer Sohn AG & Co. KG	11,825	19,566	60.4
20	↓	ZF Friedrichshafen AG	11,767	32,611	36.1
21	↑	Umicore-Gruppe Deutschland	11,174	17,485	63.9
22	—	Fresenius SE & Co. KGaA	11,065	36,277	30.5
23	↓	Vattenfall-Gruppe Deutschland	10,947	15,154	72.2

[45] As in section 1.2.2, the implicit price index of the macroeconomic value added is used here in order to deflate the nominal values (cf. for a similar method Lopez-Garcia, P./di Mauro, F., Assessing European Competitiveness: The New CompNet Microbased Database, SSRN Electronic Journal, 2015).

Ranking by turnover	Trend	Company	Turnover in m EUR[1]	Total turnover in m EUR	Domestic share in %[2]
24	↓	INA-Holding Schaeffler GmbH & Co. KG	10,198[E]	51,237	19.9
25	↑	Aurubis AG	9,166	12,429	73.7
26	↓	TOTAL-Gruppe Deutschland	8,935	104,801	8.5
27	↑	Roche-Gruppe Deutschland	7,809	43,427	18.0
28	↓	Stadtwerke München GmbH	7,483	7,483	100.0
29	↓	STRABAG-Gruppe Deutschland	7,323	14,750	49.6
30	↑	DEERE-Gruppe Deutschland	6,662	27,379	24.3
31	↓	Salzgitter AG	6,426	7,091	90.6
32	↓	Liebherr-International-Gruppe Deutschland	6,014	10,341	58.2
33	↑	EWE AG	5,577	6,044	92.3
34	↑	Stadtwerke Köln GmbH	5,378	5,378	100.0
35	new	Infineon Technologies AG	5,346[E]	8,567	62.4
36	new	Evonik Industries AG	5,316	12,199	43.6
37	—	Sanofi-Gruppe Deutschland	4,643	31,554	14.7
38	↑	Merck KGaA	4,638	17,534	26.5
39	↑	HGV Hamburger Gesellschaft für Vermögens- und	4,569[I]	5,058	90.3
40	new	Covestro AG	4,546	10,706	42.5
41	new	Carl Zeiss AG	4,336	6,296	68.9
42	↑	Novartis-Gruppe Deutschland	4,335	42,601	10.2
43	↑	Adidas AG	4,008	19,844	20.2
44	↓	IBM-Gruppe Deutschland	3,968	63,463	6.3
45	↑	Thüga AG	3,930	3,930	100.0
46	new	TenneT TSO GmbH	3,903	5,025	77.7
47	↓	ArcelorMittal-Gruppe Deutschland	3,899[S]	46,638	8.4
48	↓	ExxonMobil-Gruppe Deutschland	3,880	156,342	2.5
49	↓	LANXESS AG	3,863	6,104	63.3
50	new	B. Braun SE	3,747	7,426	50.5

[1] The consolidated turnover of the domestic group companies, including turnover with foreign affiliated companies. Figures marked with an [E] stand for the individual financial statement, [I] for turnover in Germany, and [S] for combined financial statements.
[2] If domestic group companies have generated turnover with foreign affiliated companies, which were consolidated in the consolidated financial statement, the domestic share may be in excess of 100 percent.
Source: Own research and published annual reports

54. Table I.4 illustrates the 50 largest industrial companies in Germany in the reporting year 2020. The group of the 50 largest industrial companies has changed by six companies compared to the reporting year 2018. The

following companies are new to the reported group (2020 ranking in brackets): Infineon Technologies AG (35), Evonik Industries AG (36), Covestro AG (40), Carl Zeiss AG (41), TenneT TSO GmbH (46), and B. Braun SE (50). The following companies have in turn dropped out (ranking by 2018 turnover in brackets): Johnson Controls-Gruppe Deutschland (38), Dr. August Oetker KG (40), Saint-Gobain-Gruppe Deutschland (44), DowDuPont-Gruppe Deutschland (45), LyondellBasell-Gruppe Deutschland (47), and Wacker Chemie AG (50).

55. In addition to the turnover of the domestic group companies, Table I.4 shows the respective turnover of the entire group of companies, and the corresponding domestic share for the 50 largest industrial companies. The average domestic share has increased compared to the reporting year 2018 from 31.9 percent to 36.4 percent. The COVID-19 pandemic may have sparked this development, which made it difficult to maintain international supply chains in 2020. If only those 44 companies are considered that belonged to the 50 largest industrial companies in the two years under report, it becomes evident that the majority of the companies have reduced their domestic share. For 15 of these 25 companies, the fall in domestic share results from a drop both in turnover of the domestic companies and in turnover of the overall group of companies. Since the drop in the turnover of the domestic companies was more pronounced, the domestic share of these companies decreased. In contrast, only eight companies were able to increase turnover of both the domestic companies and of the whole group of companies. For five of these companies, this also involved an increase in the domestic share of their turnover.

56. In the following, the total turnover of the domestic companies among the 50 largest industrial companies is compared to the turnover of all industrial companies in Germany in order to evaluate the significance of these large companies for the German industry. The turnover tax statistics of the Federal Statistical Office are used in order to calculate the turnover of all industrial companies in Germany. The turnover of the following economic sectors is summarised: Mining (B), Manufacturing industry (C), Energy supply (D), Water supply, sewerage, waste management (E) and Construction (F).[46] Turnover is adjusted for inflation in order to facilitate an observation over time.[47]

57. Figure I.19 shows the development of aggregate turnover of the 50 largest industrial companies adjusted for inflation, as well as the turnover of all industrial companies in Germany adjusted for inflation since 1978. Both figures show a pronounced drop in the reporting year 2020 in comparison to 2018. The turnover of all industrial companies adjusted for inflation fell by 9.9 percent to reach EUR 2,568 billion, and the turnover of the 50 largest industrial companies adjusted for inflation fell by as much as 13.9 percent to EUR 787 billion. The COVID-19 pandemic may have caused these massive drops in turnover. However, since the turnover of the 50 largest industrial companies fell more steeply than that of all industrial companies, the share of the large companies in overall industrial turnover fell to 30.7 percent. Hence, this share has fallen for the third time in a row, and is now below the average share of 31.8 percent.

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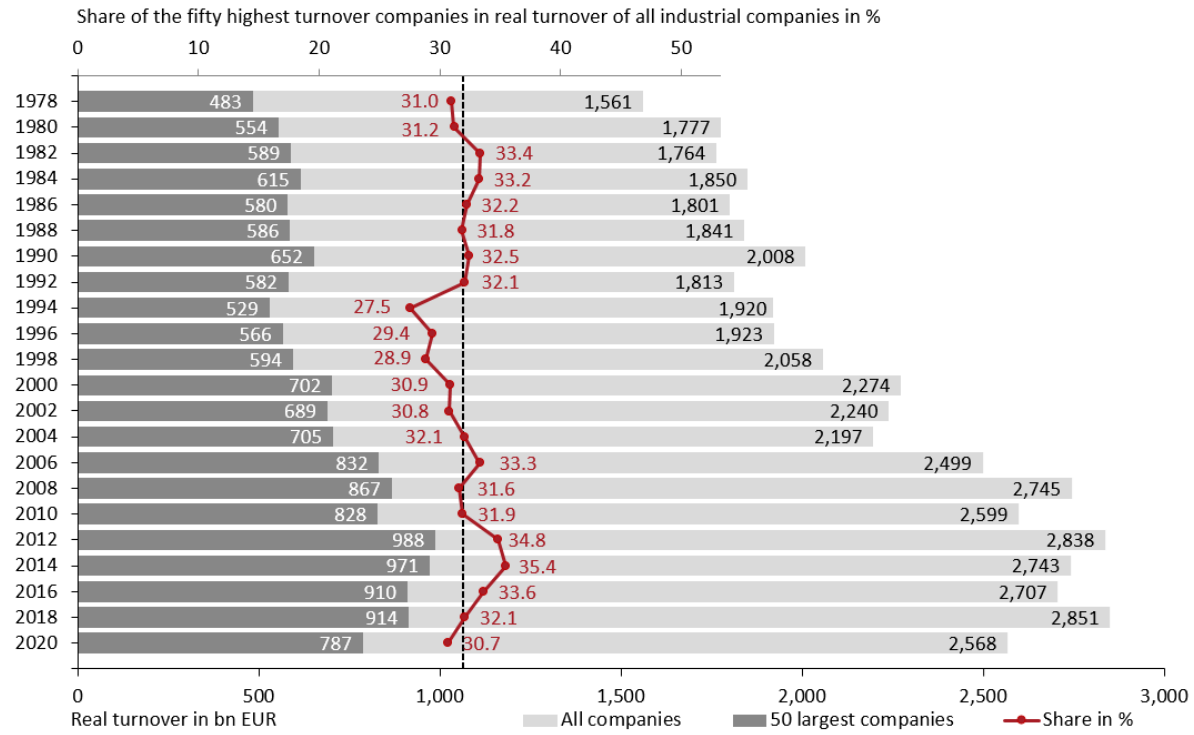
46 Federal Statistical Office, *Finanzen und Steuern – Umsatzsteuerstatistik (Voranmeldungen)*, Fachserie 14 Reihe 8.1, the calculation is from March 2022.

47 The implicit price index of macroeconomic value added was used for this (at the previous year's prices, base year: 2015; Source: Own calculations based on data from the Federal Statistical Office, Fachserie 18 Reihe 1.5, p. 53, the calculation is from November 2021).

Figure I.19: Development of domestic turnover in industry (1978–2020)



Note: The turnover of the 50 largest industrial companies is the turnover of the domestic corporate divisions adjusted for inflation. The turnover of all manufacturing companies adjusted for inflation in accordance with the turnover tax statistics of the Federal Statistical Office is used as a comparative value. The underlying nominal values correspond to the aggregate turnover of the economic sectors B (Mining), C (Manufacturing industry), D (Energy supply), E (Water supply, sewerage, waste management), and F (Construction). All figures were deflated with the aid of the implicit price index of the macroeconomic value added (at the previous year's prices, base year: 2015; Source: Own calculations based on data from the Federal Statistical Office, Fachserie 18 Reihe 1.5, p. 53, the calculation is from November 2021). Details are provided in the Appendices to the present Report regarding the turnover, the rates of change, and the shares illustrated in the chart.
Source: Own calculations based on companies' submissions as well as on turnover tax statistics of the Federal Statistical Office, Fachserie 14 Reihe 8.1

The ten largest trade companies

58. Two companies changed in the group of the ten largest trade companies in the reporting year 2020 compared to 2018. Zalando and the NOWEDA Apothekergenossenschaft are new members of the group, which are ranking eighth and ninth respectively. BayWa AG, which still ranked eighth in the reporting year 2018, and Lekkerland, are no longer among the ten largest trade companies in the reporting year 2020. Lekkerland ranked tenth in the reporting year 2018, but has been taken over by REWE in the meantime. The Federal Cartel Office cleared the merger during the first phase of the investigation into the proposed merger in October 2019.[48] However, this did not lead to a change in REWE-Gruppe's ranking of the reporting year 2020. As was already the case in the reporting year 2018, it ranks second, after the EDEKA-Gruppe and ahead of the Schwarz-Gruppe and the Aldi-Gruppe. All groups mentioned reached the same ranking in the reporting year 2020 as they did in 2018.

Table I.5: The ten largest trade companies by turnover in 2020

Ranking by turnover	Trend	Company	Turnover in m EUR[1]	Total turnover in m EUR	Domestic share in %

[48] BKartA, B2-40-19, 9 October 2019.

Ranking by turnover	Trend	Company	Turnover in m EUR[1]	Total turnover in m EUR	Domestic share in %
1	—	EDEKA-Gruppe	61,434*	61,434	100.0
2	—	REWE-Gruppe	53,414	68,229	78.3
3	—	Schwarz-Gruppe	41,500*	125,300	33.1
4	—	Aldi-Gruppe	27,395*	102,475	26.7
5	↑	Otto Group	10,425	15,460	67.4
6	↓	Ceconomy AG	10,160	21,455	47.4
7	—	PHOENIX Pharmatrade GmbH & Co. KG	9,722	28,209	34.5
8	new	Zalando SE	7,977	7,982	99.9
9	new	NOWEDA Apothekergenossenschaft eG	7,393	7,847	94.2
10	↓	dm-drogerie markt Verwaltungs-GmbH	7,389	11,592	63.7

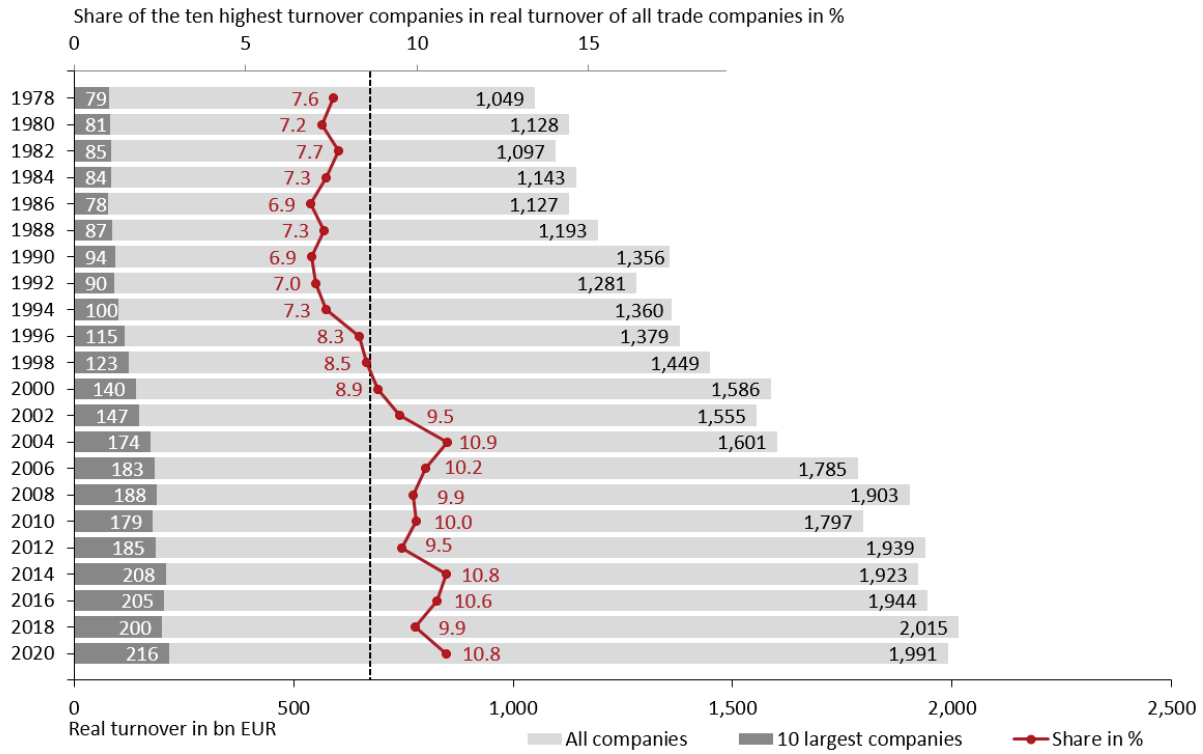
[1] Consolidated turnover of the domestic group companies, including turnover with foreign affiliated companies. Figures marked with an * are estimates.
Source: Companies' submissions and published annual reports. The domestic turnover of the Aldi-Gruppe, the EDEKA-Gruppe and the Schwarz-Gruppe were provided by the TradeDimensions data provider

59. The Amazon-Gruppe Deutschland is not among the ten largest trade companies by domestic turnover. According to estimates of the Monopolies Commission, its turnover was about EUR 4.8 billion. (cf. Table I.1), hence is below the domestic turnover of dm-drogerie markt Verwaltungs-GmbH, which ranks tenth among the largest trade companies in Germany. This estimate is well below the USD 30 billion, which the company states in its Annual Report for the German market.[49] The estimates of the Monopolies Commission however do not relate to the German market, but to the turnover generated by Amazon's subsidiaries located in Germany. The difference between these figures may at least partly result from product sales by Amazon's subsidiaries located abroad to customers residing in Germany. Furthermore, Amazon does not only act as a trader, but also as an intermediary between sellers and buyers of products. Amazon may perhaps attribute its turnover generated by these commercial activities to the German market in its Annual Report. If this "platform business" is however attributed to companies outside of Germany, the corresponding turnover is not included in the Monopolies Commission's estimates.

60. The ten largest trade companies' share in the turnover of all trade companies in Germany is now 10.8 percent, hence increased significantly in the reporting year 2020 compared to 2018. This figure is slightly higher than the mean of the past ten years, at 10.2 percent, and significantly higher than the mean of 8.8 percent recorded since 1978 (cf. dashed vertical line in Figure I.20). The increase was caused above all by a 7.8 percent increase in the aggregate turnover of the ten largest trade companies adjusted for inflation, which reached EUR 216 billion. At the same time, the turnover of all trade companies adjusted for inflation fell by 1.2 percent to EUR 1,991 billion. It remains to be seen whether this development will continue, as it is also likely to be attributable to the COVID-19 pandemic, which entailed a favourable business environment for online retailers, such as Zalando, whilst stationary retailers had to close in Germany for certain periods of time during the pandemic.

[49] Amazon.com - 2021 Form 10-K, page 66.

Figure I.20: Development of domestic turnover in trade (1978-2020)



Note: The turnover of the ten largest trade companies is the turnover of the domestic corporate divisions adjusted for inflation. The turnover of all trade companies adjusted for inflation in accordance with the turnover tax statistics of the Federal Statistical Office is used as a comparative value. The underlying nominal values correspond to the aggregate turnover of economic sectors G (Trade; Repair and maintenance of other transport equipment). All figures were deflated using the implicit price index of the macroeconomic value added (at previous year's prices, base year: 2015; Source: Own calculations based on data from the Federal Statistical Office, Fachserie 18 Reihe 1.5, p. 53, the calculation is from November 2021). Details are provided in the Appendices to the present Report regarding the turnover, the rates of change, and the shares illustrated in the chart.

Source: Own calculations on the basis of own estimates as well as on turnover tax statistics of the Federal Statistical Office, Fachserie 14 Reihe 8.1

The ten largest transport and service companies

Table I.6: The ten largest transport and service companies in 2020 by turnover

Ranking by turnover	Trend	Company	Turnover in m EUR[1]	Total turnover in m EUR	Domestic share in %
1	↑	Deutsche Telekom AG	24,730	100,999	24.5
2	—	Deutsche Bahn AG	21,567	39,901	54.1
3	↑	SAP SE	16,233	27,338	59.4
4	↑	Deutsche Post AG	15,585	66,806	23.3
5	↑	Vodafone-Gruppe Deutschland	12,984	44,974	28.9
6	↑	Hapag-Lloyd AG	12,589	12,772	98.6
7	↓	Deutsche Lufthansa AG	9,653	13,589	71.0
8	—	Rethmann SE & Co. KG	9,055	16,110	56.2
9	—	Telefónica-Gruppe Deutschland	7,532	7,532	100.0
10	—	Bertelsmann SE & Co. KGaA	6,468	17,289	37.4

[1] Consolidated turnover of domestic group companies, including turnover with foreign affiliated companies
Source: Companies' submissions and published annual reports

61. The group of the ten largest transport and service companies has not changed in the reporting year 2020 compared to 2018. There were only a few changes in the company ranking. Deutsche Lufthansa AG, which still ranked first in the reporting year 2018, dropped to seventh position in 2020 after the turnover of the domestic companies more than halved compared 2018 due to the COVID-19 pandemic. Whilst the turnover of its domestic companies was EUR 25.2 billion in the reporting year 2018, they only generated turnover of EUR 9.6 billion in the reporting year 2020. The other changes in ranking within the group of the ten largest transport and service companies were less remarkable. Deutsche Telekom AG now ranks first, up from third position in the reporting year 2018, although the turnover of the domestic companies fell by roughly EUR 500 million. Hence, Deutsche Telekom AG ranks ahead of Deutsche Bahn AG in the reporting year 2020, which because of the pandemic suffered a EUR 3.4 billion loss in the domestic companies' turnover compared to 2018.

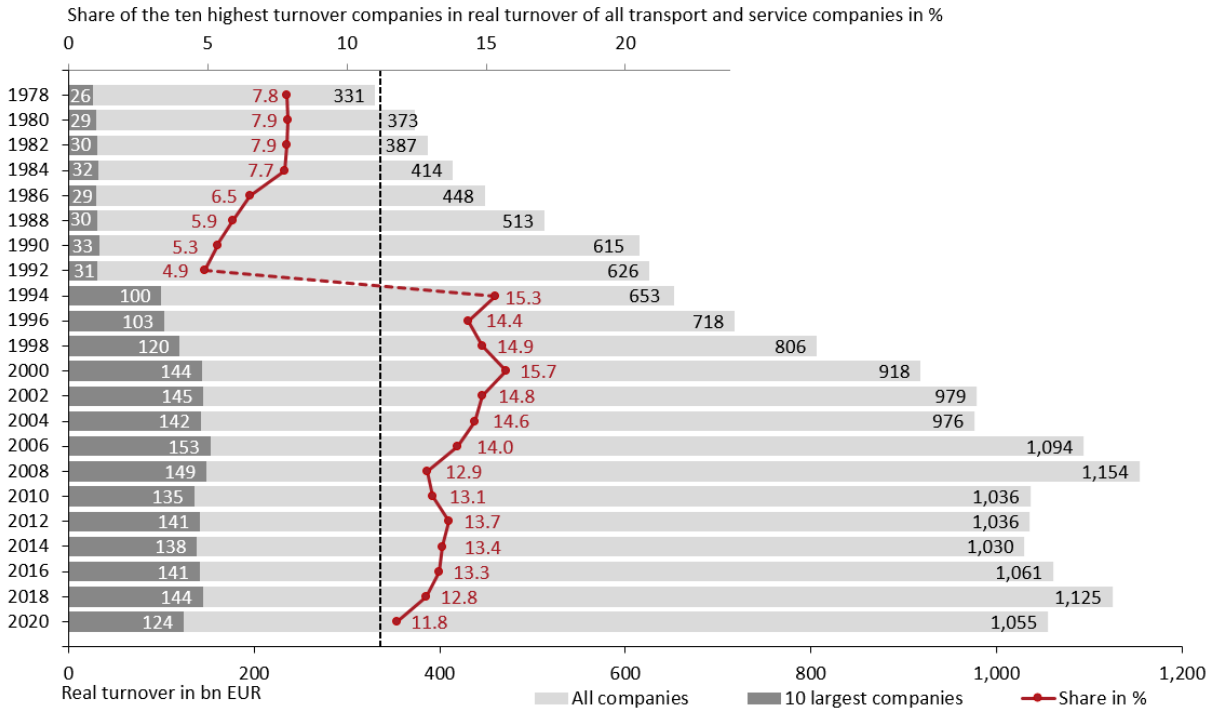
62. The COVID-19 pandemic hit the transport and service companies in Germany[50] particularly hard. The turnover of these companies in Germany decreased in comparison to 2018 by 6.2 percent in real terms[51] to EUR 1,055 billion in the reporting year 2020. However, the ten largest transport and service companies were hit even harder suffering a 14 percent drop in real turnover. They generated turnover of EUR 124 billion in the reporting year 2020 (cf. Figure I.21). This is the most significant decrease in the aggregate domestic turnover of the ten largest transport and service companies since reporting started in 1978. Subsequently, the share of the ten largest transport and service companies in the turnover of all transport and service companies in Germany also decreased

[50] This combined all companies of economic sections H (Transport and storage), J (Information and communication), L (Real estate activities), M (Professional, scientific and technical activities), N (Administrative and support service activities), R (Arts, entertainment and recreation) and S (Other service activities) in accordance with the turnover tax statistics of the Federal Statistical Office.

[51] The implicit price index of the macroeconomic value added was used for deflating (at the previous year's prices, base year: 2015; Source: Own calculations on the basis of data from the Federal Statistical Office, Fachserie 18 Reihe 1.5, p. 53, the calculation is from November 2021).

relatively significantly from 12.8 percent to 11.8 percent. This is the lowest value since the (legal) privatisation of the large formerly state-owned transport and service companies, Deutsche Bahn AG and the former Deutsche Bundespost, in the mid-90s.

Figure I.21: Development of domestic turnover in the transport and service sector (1978–2020)



Note: The turnover of the ten largest transport and service companies is the turnover of the domestic corporate divisions adjusted for inflation. The turnover of all transport and service companies adjusted for inflation in accordance with the turnover tax statistics of the Federal Statistical Office is used as a comparative value. The underlying nominal values correspond to the aggregate turnover of economic sectors H (Transport and storage), J (Information and communication), L (Real estate activities), M (Professional, scientific and technical activities), N (Administrative and support service activities), R (Arts, entertainment and recreation) and S (Other service activities). All figures were deflated using the implicit price index of the macroeconomic value added (at the previous year's prices, base year: 2015; Source: Own calculations on the basis of data from the Federal Statistical Office, Fachserie 18 Reihe 1.5, p. 53, the calculation is from November 2021). Details are provided in the Appendices to the present Report regarding the turnover, the rates of change, and the shares illustrated in the chart. The extraordinary increase in the turnover of the ten largest transport and service companies between 1992 and 1994 is due to the companies of the former Deutsche Bundespost and Deutsche Bahn AG being included in the survey for the first time.
Source: Own calculations based on companies' submissions as well as on the turnover tax statistics of the Federal Statistical Office, Fachserie 14 Reihe 8.1

The ten largest financial institutes

63. The group of the ten largest financial institutes has changed by one company in comparison to the reporting year 2018. The JPMorgan Chase & Co.-Gruppe Deutschland entered the group in the reporting year 2020. Because of the United Kingdom leaving the European Union, JPMorgan relocated major parts of its European business to Frankfurt, and is now one of the largest financial institutes in Germany. Norddeutsche Landesbank Girozentrale, which ranked tenth in the reporting year 2018, by contrast dropped out of the group of the ten largest financial institutes in Germany. It is worth noting that there were no changes in the upper half of the ranking list in comparison to the reporting year 2018. Although all financial institutes increased their balance sheet total in Germany, this did not lead to changes in ranking of the first five positions. The aggregate balance sheet total of the domestic companies of the largest ten financial institutes is about EUR 3.8 billion in the reporting year 2020. This corresponds to an increase of about 16 percent compared to 2018.

Table I.7: The ten largest financial institutes in 2020 by balance sheet total

Ranking by balance sheet total	Trend	Company	Balance sheet total in mill. EUR	Total balance sheet total in mill. EUR	Domestic share in %
1	—	Deutsche Bank AG	919,944	1,325,259	69.4
2	—	DZ Bank AG	553,946	594,573	93.2
3	—	KfW Bankengruppe	546,384	546,384	100.0
4	—	Commerzbank AG	393,851	506,916	77.7
5	—	UniCredit-Gruppe Deutschland	277,503	931,456	29.8
6	↑	Landesbank Baden-Württemberg	261,699	276,449	94.7
7	↓	Bayerische Landesbank	251,271	256,271	98.0
8	new	JPMorgan Chase & Co.-Gruppe Deutschland	244,618	2,964,505	8.3
9	↓	Landesbank Hessen-Thüringen Girozentrale	210,863	219,324	96.1
10	↓	NRW.BANK	155,787	155,787	100.0

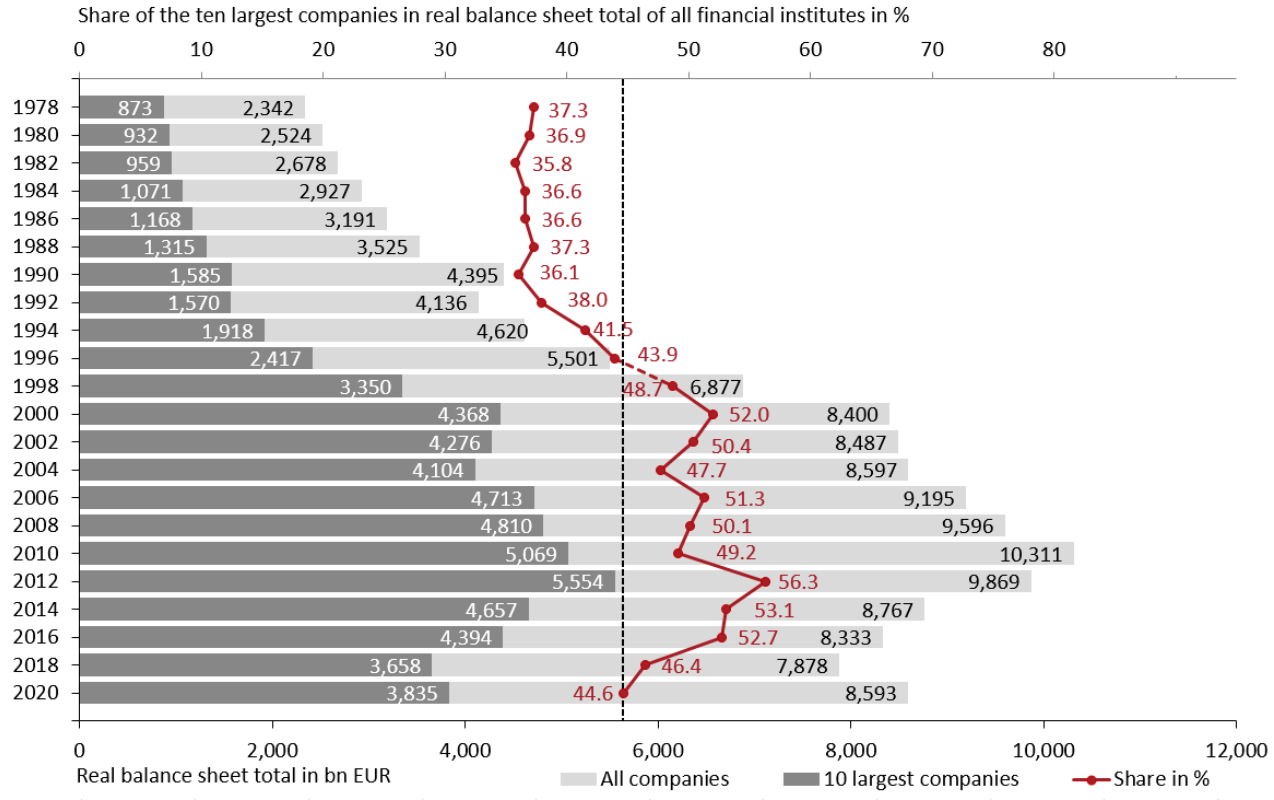
Source: Companies' submissions and published annual reports

64. In order to be able to compare the development of the aggregate balance sheet total of the ten largest financial institutes with that of all financial institutes in Germany, unlike as shown in the consolidated balance sheet total of the financial institutes in Table I.**7**, the unconsolidated balance sheet total was used, given that the comparative figure for all financial institutes in Germany made available by the Bundesbank also relates to individual financial statements.[52] Moreover, the corresponding figures have been adjusted for price developments.[53] As is shown in Figure I.22, the unconsolidated balance sheet total of the ten largest financial institutes in Germany, adjusted for inflation, also increased compared to the reporting year 2018. It was EUR 3,658 billion in the reporting year 2018, and rose by 4.8 percent to EUR 3,835 billion in 2020. The balance sheet total of all financial institutes in Germany rose by 9.1 percent in the same period to EUR 8,593 billion. The share of the ten largest financial institutes in the balance sheet total of all financial institutes therefore dropped in the period under report, and was 44.6 percent in 2020. This roughly corresponds to the average value since the start of reporting (cf. dashed vertical line in Figure I.22). Hence, the share's downward trend since 2012 continues in the current period under report. A lower share of the ten largest financial institutes in the balance sheet total of all financial institutes in Germany was last observed in 1996.

[52] The comparative value for the year 2020 can be found in Deutsche Bundesbank, Statistische Fachreihe, 2022, p. 106.

[53] The implicit price index of the macroeconomic value added was used for deflating (at the previous year's prices, base year: 2015; Source: Own calculations on the basis of data from the Federal Statistical Office, Fachserie 18 Reihe 1.5, p. 53, the calculation is from November 2021).

Figure I.22: Development of balance sheet totals in the banking industry (1978–2020)



Note: The figures shown were adjusted for inflation by the nominal values being deflated using the implied price index of the macroeconomic value added (at previous year's prices, base year: 2015; Source: Own calculations based on data from the Federal Statistical Office, Fachserie 18 Reihe 1.5, p. 53, the calculation is from November 2021). The figure shows the consolidated balance sheet total, adjusted for inflation, up to and including 1996, and from 1998 onwards the unconsolidated balance sheet total adjusted for inflation, of the ten largest financial institutes. A detailed overview of the individual information on the balance sheet total, the respective shares, as well as the rates of change, is published in the Appendices to the present Report.

Source: Own calculations based on companies' submissions as well as on the banking statistics of the Deutsche Bundesbank (Statistische Fachreihe, January 2022, p. 106)

The ten largest insurance companies

Table I.8: The ten largest insurance companies in 2020 by gross written premiums

Ranking by gross written premiums	Trend	Company	Gross written premiums in m EUR	Total gross written premiums in m EUR	Domestic share in %
1	—	Münchener Rückversicherungs-Gesellschaft AG	36,601	54,890	66.7
2	—	Allianz SE	28,940	82,986	34.9
3	—	R+V Versicherung AG	17,151	18,952	90.5
4	—	Generali-Gruppe Deutschland	14,418	70,704	20.4
5	↑	Debeka-Gruppe	11,448	11,448	100.0
6	↓	AXA-Gruppe Deutschland	11,095	32,440	34.2
7	↑	Versicherungskammer Bayern VöR	9,358	9,358	100.0
8	↓	HDI Haftpflichtverband der Deutschen Industrie V.a.G.	8,547	41,106	20.8
9	—	HUK-COBURG	8,050	8,050	100.0
10	—	Zurich Insurance-Gruppe Deutschland	5,782	47,503	12.2

Source: Companies' submissions and published annual reports

65. The group of the ten largest insurance companies did not change in the reporting year 2020 compared to 2018. The same four companies took the first four positions in the period under report. Münchener Rückversicherungs-Gesellschaft AG, whose domestic companies generated gross written premiums of EUR 36.6 billion, remained in the top position in the reporting year 2020. Gross written premiums thus increased by roughly 17 percent compared to 2018. With the exception of the HDI Haftpflichtverband, the other insurance companies were also able to increase gross written premiums of their companies in Germany. The gross written premiums of the HDI Haftpflichtverband, by contrast, remained virtually constant, so that HDI fell back from seventh position in the reporting year 2018 to eighth in 2020. The aggregate gross written premiums of the ten largest insurance companies in Germany was about EUR 151 billion in the reporting year 2020, hence increased by 9.5 percent compared to 2018.

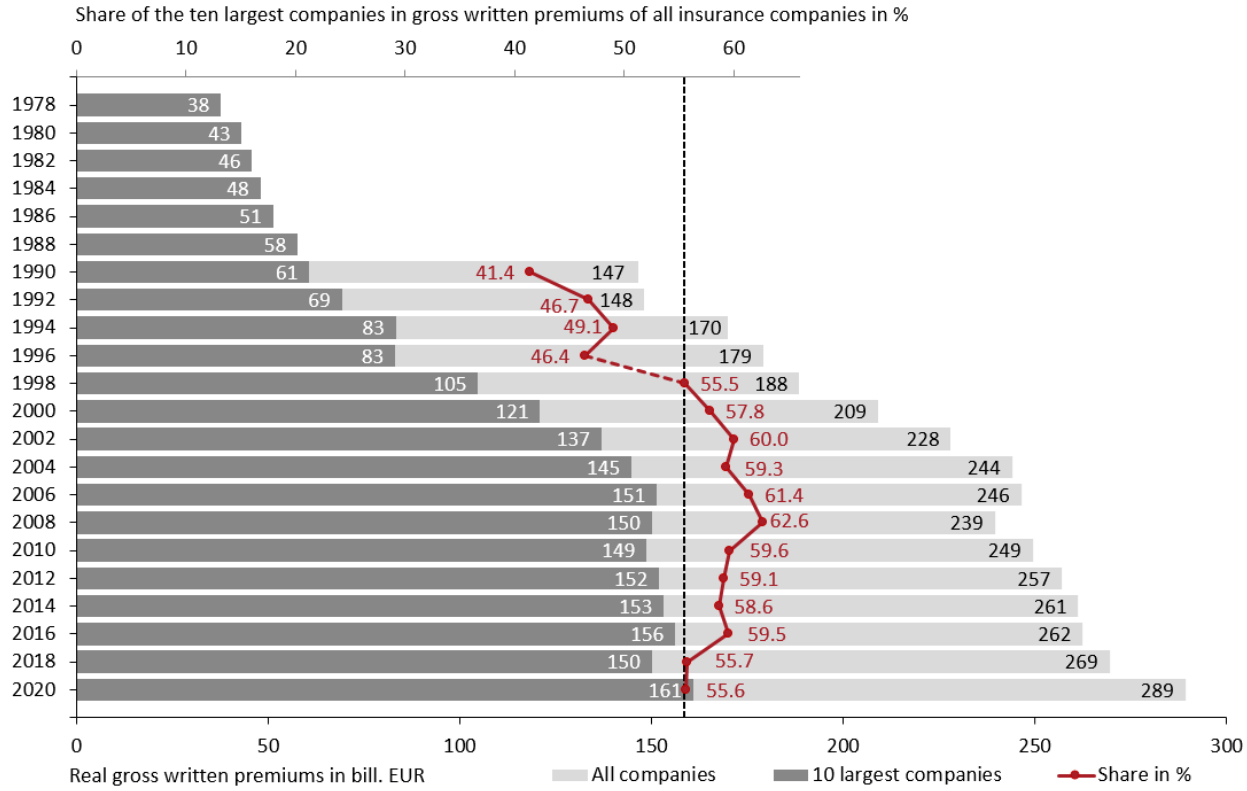
66. The significance of the ten largest insurance companies for the insurance sector in Germany can be estimated based on the share of these companies in the gross written premiums of all insurance companies in Germany. The primary insurance statistics (*Erstversicherungsstatistik*) of the Federal Financial Supervisory Authority, which were published exclusively in table form for the first time for the year 2020, are used for this purpose as macroeconomic comparative figure.[54] Since these statistics are based on individual financial statements, unconsolidated gross written premiums are also used for comparison with the ten largest insurance companies. The figures are also adjusted for inflation to make them easily comparable over time.[55] As Figure I.23 reveals, the aggregate real gross written premiums of the ten largest insurance companies increased significantly by 7.2 percent in the reporting year 2020 to about EUR 161 billion. The comparative figure increased similarly by

[54] Statistics from the BaFin – *Erstversicherungsunternehmen – Ergänzende statistische Daten* – Annex 1 https://www.bafin.de/DE/PublikationenDaten/Statistiken/Erstversicherung/erstversicherung_node.html;jsessionid=53DA0A79B303908AF398C16A8B831351.2_cid503, retrieved on 21 April 2022.

[55] The implicit price index of the macroeconomic value added was used for deflating (at the previous year's prices, base year: 2015; Source: Own calculations on the basis of data from the Federal Statistical Office, Fachserie 18 Reihe 1.5, p. 53, the calculation is from November 2021).

7.3 percent, in the same period to EUR 289 billion in the reporting year 2020. The virtually identical growth in both figures also caused the share of the ten largest insurance companies in the macroeconomic comparative figure to remain almost constant. It was 55.6 percent in the reporting year 2020, hence only fell by 0.1 percentage points compared to 2018. This figure is also close to the mean of 55.5 percent estimated since 1990 (cf. dashed vertical line in Figure I.23).

Figure I.23: Development of gross written premiums of the insurance sector (1978–2020)



Note: The figures shown were adjusted for inflation by the nominal values being deflated with the aid of the implied price index of the macroeconomic value added (at the previous year's prices, base year: 2015; Source: Own calculations on the basis of data from the Federal Statistical Office, Fachserie 18 Reihe 1.5, p. 53, the calculation is from November 2021). The shares shown in the figure up to and including 1996 were calculated using the consolidated gross written premiums of the ten largest insurance groups. The unconsolidated gross written premiums of the ten largest insurance groups were used from 1998 onwards. The unconsolidated total of all gross written premiums as shown in the individual financial statements of all insurance companies were already used to calculate the gross written premiums of all insurance companies in Germany prior to 1998. A detailed overview of the individual figures relating to gross written premiums, the respective shares, as well as the rates of change, is published in the Appendices to the present Report.

Source: Own calculations on the basis of companies' submissions, as well as the primary insurance statistics of the Federal Financial Supervisory Authority

2 Cross-sector market power trends

67. This section analyses the state and trajectory of industry concentration across sectors as well as the development of firm-specific price mark-ups in Germany. The Monopolies Commission regularly carries out studies on the horizontal concentration of companies and on price mark-ups as part of its statutory mandate under § 44(1) first sentence of the German Act against Restraints of Competition (Competition Act – GWB).

68. The interest of economic researchers and policy-makers in empirical studies on industry concentration and on price mark-ups has increased worldwide in recent years. This was triggered by studies for the USA, which showed a marked increase in the average concentration of suppliers and economic mark-ups, i. e. the difference between the price of a product and its marginal costs, over the past few decades. Concentration has risen in the USA in the past two decades in 75 percent of industries, and the mark-ups of US firms have increased by an average of 40 percentage points since 1980.[56] These trends give cause for concern for the USA from a perspective of economic policy, and particularly competition policy, because they may indicate that competition is diminishing.

69. The European Commission for instance however also considers there to be a problem in terms of competition for European economies and markets as a whole arising from increasing concentration and rising price mark-ups in many industries. It states that this could lead to the economic potential of the common European internal market on both the consumer and producer sides not being put to optimum use.[57] After conducting a comprehensive study, the United Kingdom's competition supervision authority also finds indications that competition between suppliers in the United Kingdom may have declined on average in the last two decades.[58]

70. It was recently shown for Germany and other European economies that overall trends are however much less dramatic than in the USA.[59] The Monopolies Commission has repeatedly not found any increase in the cross-sector concentration of firms for Germany in its most recent Biennial Reports that would be comparable in terms of its extent with that seen in the USA.[60] Other studies on the development of concentration in Germany confirm this conclusion, albeit there are differences between individual industries.[61] The studies carried out to date on the

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56 Cf. Grullon, G./Larkin, Y./Michaely, R., Are US Industries Becoming More Concentrated?, Review of Finance, 23, 2019, pp. 697–743; De Loecker, J./Eeckhout, J./Unger, G., The Rise of Market Power and the Macroeconomic Implications, The Quarterly Journal of Economics, 135, 2020, pp. 561–644.

57 European Commission, Single Market Performance Report, COMMISSION STAFF WORKING DOCUMENT Single Market Performance Report 2019, Brussels, 17 December 2019, SWD(2019) 444 final, Accompanying the document Communication from the Commission to the European Parliament, the Council, the European Central Bank, the European Economic and Social Committee, the Committee of the Regions and the European Investment Bank Annual Sustainable Growth Strategy 2020

58 Competition and Markets Authority, The state of UK competition, 2020.

59 For empirical analyses of price markups and concentration measures across sectors in European economies, see e. g. Bajgar, M. et al., Industry Concentration in Europe and North America, 2019–18, 2019; Competition and Markets Authority, The state of UK competition, *supra* note 57; Cavalleri, M.C. et al., Concentration, market power and dynamism in the euro area, 2253, 2019; De Loecker, J./Eeckhout, J., Global Market Power, NBER Working Paper w24768, Cambridge, MA, 2018; Deutsche Bundesbank, Mark-ups of firms in selected European countries, Frankfurt am Main, 2017; Díez, F.J./Leigh, D./Tambunlertchai, S., Global Market Power and Its Macroeconomic Implications, Washington, D.C., 2018; Eide, L.S./Erraia, J./Grimsby, G., Industry Concentration and Profitability in Europe: The Case of Norway, Jahrbücher für Nationalökonomie und Statistik, 241, 2021, pp. 577–622; Gradzewicz, M./Mućk, J., Globalization and the fall of markups, 304, 2019; van Heuvelen, G.H./Bettendorf, L./Meijerink, G., Estimating Markups in the Netherlands, 2019; Weche, J.P./Wambach, A., The Fall and Rise of Market Power in Europe, Jahrbücher für Nationalökonomie und Statistik, 241, 2021, pp. 555–575.

60 Monopolkommission, Wettbewerb 2018, *supra* note 34, chap. 2.3; Monopolkommission, Wettbewerb 2020: XXIII. Hauptgutachten der Monopolkommission, Baden-Baden, 2020, chap. 2.1.

61 Cf. Affeldt, P. et al., Marktkonzentrationstrend steigt in Dienstleistungsmärkten deutlich, DIW Wochenbericht 20/2021, 2021; Deutsche Bundesbank, Mark-ups of firms in selected European countries, Monatsbericht Dezember 2017, Frankfurt am Main, 2017; Ponattu, D. et al., Unternehmenskonzentration und Lohnquote in Deutschland: Eine Analyse auf Branchenebene zwischen 2008 und 2016, Gütersloh, 2018; Weche, J.P./Wagner, J., Markups and Concentration in the Context of Digitization: Evidence from German Manufacturing Industries, Jahrbücher für Nationalökonomie und Statistik, 241, 2021, pp. 667–699; Cavalleri u. a. beobachten in den von ihnen genutzten Daten sogar einen durchschnittlichen Rückgang der Unternehmenskonzentration in Deutschland (Cavalleri, M.C. et al., Concentration, market power and dynamism in the euro area, ECB Working Paper 2253, 2019).

development of price mark-ups in Germany also indicate a relatively moderate development. Many industries in Germany nonetheless also exhibit increasing average mark-ups.[62]

71. A continuous monitoring of company concentration and indicators of market power at aggregate levels is fundamentally significant for economic policy, as this permits one to draw conclusions as to the functionality of the economic system in terms of competition, and hence as to the general allocation of resources. The state and development of the intensity of competition across sectors is currently of particular interest against the background of the digital transformation and concomitant tendencies towards monopolisation on some markets, as well as of potential changes in market structure resulting from the COVID-19 pandemic-[63] Russia's attack on Ukraine on 24 February 2022 has also raised the question as to potential industry-wide effects on market structures and the competitive environment from a competition-policy point of view (cf. section 2.5). This might cause suppliers to drop out of markets because of supply chain disruptions and rising energy prices, thus causing an increase in concentration on these very markets. An increase in the industry concentration was for instance already observed in the vast majority of industries in the context of the second oil price crisis that occurred at the end of the 1970s and the phase of weak economic development to which this led from 1979 to 1981.[64]

72. Statistical indicators of concentration indicators and indicators of market power require careful interpretation. The reason for this is that the available indicators are by no means unambiguous in the sense that there is usually a need for contextual information in order to assess market power and competition intensity conclusively. In particular, there is so far no standardised method for to estimating price mark-ups, so that the results may differ widely, depending on the respective methods used as well as on the underlying database. The section below hence also focusses on the robustness of empirical results on price mark-ups vis-à-vis changes in the econometric methodology and data used, as well as on the conclusiveness of empirically-calculated price mark-ups in terms of market power and competition intensity. To this end, the Monopolies Commission uses representative firm-level microdata from official statistics in order to estimate mark-ups.

73. The next section will start by presenting the indicators used to measure concentration, and discuss their informative value for assessing firms' behavioural constraints in markets. Statistical concentration indicators will then be analysed over time. Because they tend to be more informative regarding the actual competitive pressure, mark-ups are then analysed on the basis of representative microdata from the official statistics for German manufacturing businesses and for the service sector. This also involves studying the degree to which results depend on the methods and data used, with the aim in mind of making an authoritative statement regarding the trajectory of mark-ups in Germany, as well as identifying sectoral differences. The results however neither permit concrete conclusions to be drawn as to competition intensity on sectorally- and geographically-relevant markets, nor can competition-policy recommendations be derived for individual markets. The cross-sector perspective of the analyses below hence complements market-specific analyses. The section then goes on to study potential causes of rising mark-ups. Particular attention is placed here on the role played by intangible assets, digital transformation, as well as common ownership via institutional investors. Finally, this section also discusses the potential macroeconomic consequences of a change in average competition intensity and analyses the correlation between mark-ups and productivity growth.

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62 Monopolkommission, Wettbewerb 2018, *supra* note 34; Monopolkommission, Wettbewerb 2020, *supra* note 59.

63 Cf. on the link between market power and digitalisation chapter V in this report, as well as section 2.3.1 in this chapter. On changes in the market structure resulting from the COVID-19 pandemic cf. Monopolkommission, Wettbewerb 2020, *supra* note 59, para. paras. 270 et seqq.

64 Cf. Monopolkommission, V. Hauptgutachten: Ökonomische Kriterien für die Rechtsanwendung, Baden-Baden, 1984, para. par. 274.

2.1 Industry concentration

2.1.1 Methodology

74. Empirical research on competition as well as competition authorities generally use two indicators, in order to assess the concentration of suppliers on markets, namely the Herfindahl-Hirschman Index (HHI), and the concentration ratio.

75. The HHI is a measure of the degree of concentration of a given market, and uses the sales shares (s_i) of all firms (i) active in that market. To this end, the firm-specific sales shares are squared and added up over all N firms of a market:

$$\mathrm{HHI} = \sum_{i=1}^{N} s_i^2 \tag{1}$$

The HHI ranges between 10,000/N and 10,000; the more highly concentrated a market is, the higher the HHI. It is therefore at 10,000 points in the extreme case of a monopoly.

76. Since the HHI takes into account the sales shares of all firms of a market, the index makes it possible to directly assess the entire market structure. In contrast, the concentration ratio (CR_n) focusses on illustrating structural oligopolisation tendencies in the respective market. This involves adding up the market shares of the n largest suppliers. A supply oligopoly involves a small number of firms together holding a very large market share. It should be borne in mind that the concentration ratio only describes the size of the joint market shares of the largest suppliers, and therefore says nothing about their competitive behaviour. Markets where concentration ratios are high however nonetheless need to monitored by the competition authorities, since the risk of collusive behaviour increases with the concentration ratio. It is for instance easier to coordinate or to impose penalties on one another where there is only a small number of competitors. The Monopolies Commission analyses the concentration ratio of the six largest companies:[65]

$$\mathrm{CR}_6 = \sum_{i=1}^{6} s_i \tag{2}$$

The concentration ratio can take on values between 0 and 100 percent. Should there be a large number of competitors with only small market shares, the concentration ratio is close to 0; if, by contrast, the market is only served by six firms, the concentration ratio is 100. If the concentration ratio CR_6 for instance is at 50, the six largest suppliers account for 50 percent of the market turnover.

77. Both concentration indicators, namely the HHI and the concentration ratio, are used by competition authorities the world over in order to assess the level of competition. If a company has a market share of at least 40 percent, market dominance is presumed under German law; the threshold for this presumption is at a market share of at least 50 percent where up to three firms are involved, whereas it increases to two-thirds of the market where up to five firms are involved. The EU's merger control will not identify horizontal competition concerns if the HHI is between 1,000 and 2,000, and increases by fewer than 250 points as a result of the merger. If the HHI is already above 2,000, a merger raises no horizontal concerns if the HHI increases by fewer than 150 points.[66] According to the US Department of Justice, markets in the USA are considered to be moderately concentrated

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[65] The concentration ratio and the Herfindahl-Hirschman Index are positively correlated. They particularly correlate with one another if only a small number of firms are active in a market, and these firms are taken into account in the concentration ratio, or the remaining firms which are not included in the concentration ratio together account for very small market shares. Unlike the HHI, the concentration ratio does not however reflect relative shifts in the sales shares among the largest firms observed over time. This requires a comparison of the development of different concentration ratios, for instance of CR_6 and CR_3.

[66] European Commission, Guidelines on the assessment of horizontal mergers under the Council Regulation on the control of concentrations between firms (2004/C 31/03), 2004.

where HHI values are between 1,500 and 2,500, and are considered as highly concentrated where the index is higher.[67] The anti-trust authorities however only use the above thresholds as general guidelines when evaluating market structures, and they are usually supplemented by case-specific information.

78. As an indicator to describe the market structure, and certainly the prevailing competition situation, sales-based industry concentration raises several problems in terms of both content and methodology. There was widespread agreement among industrial economists until the 1970s that the structure of a market determines the behaviour of the market participants, and hence exerts a direct impact on the market outcome.[68] This "structure-conduct-performance paradigm" is however considered out of date. Instead, the view has become prevalent that market structure and behaviour are neither necessarily correlated, nor may one presume that there is a one-sided causal relationship. It is thus quite possible that the market outcome determines the market structure, and that a high market concentration, for instance caused by economies of scale, may in particular lead to intensive competition between firms.

79. The concentration indicators are calculated on the basis of the *Klassifikation der Wirtschaftszweige* (WZ 2008) classification of industries in the official statistics. They do not therefore illustrate the concentration on relevant product and geographic markets.[69] What is more, the calculation is restricted to Germany, so that the significance of turnover from exports in international trade, as well as in terms of the competition effects caused by imports, is not taken into account.

80. It should furthermore be borne in mind that each firm is attributed to a specific industry based on its respective main activity, which in turn is determined via the shares of the individual activities in the total value added of production.[70] When calculating the turnover concentration at industry level, the total company turnover is attributed to the industry of this main activity, which may distort the indicator, particularly in case of highly diversified multi-product firms.[71]

81. Despite these restrictions, the industry concentration will continue to be used as an indicator of the existence of market power. This is particularly also the case because there are frequently no alternatives for an intersectoral

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67 The US Department of Justice assesses mergers amongst other things using the absolute HHI values and changes in the HHI values. Mergers on markets with an HHI value lower than 1,500 are not considered anti-competitive, and are normally not the subject of further investigation. Mergers on markets with a moderate or high concentration, and where the HHI value increases by more than 100 points, are regarded as possibly anti-competitive, and are frequently investigated. Mergers on markets with a high concentration and where the HHI value increases by more than 200 points are regarded as highly anti-competitive, so that the lack of any negative impact on competition must be proven by the firms in question (cf. DOJ/FTC, Horizontal Merger Guidelines, 19 August 2010, https://www.justice.gov/atr/horizontal-merger-guidelines-08192010, retrieved on 23 March 2022).

68 Mason (1939, 1949) and Bain (1951, 1956) developed the structure–conduct–performance model which typified traditional industrial economics into the 1970s (cf. Mason, E.S., Price and Production Policies of Large-Scale Enterprise, American Economic Association , The American Economic Review, 29, 1939, pp. 61–74; Mason, E.S., The Current Status of the Monopoly Problem in the United States, The Harvard Law Review Association , Harvard Law Review, 62, 1949, pp. 1265–1285; Bain, J.S., Relation of Profit Rate to Industry Concentration: American Manufacturing, 1936–1940, The Quarterly Journal of Economics, 65, 1951, pp. 293–324; Bain, J.S., Barriers to New Competition: Their Character and Consequences in Manufacturing Industries, Cambridge, Mass., 1956).

69 The Federal Statistical Office classifies economic activities according to a predefined pyramid-shaped scheme in accordance with the *Klassifikation der Wirtschaftszweige* 2008 industries classification scheme. Economic activities are first of all attributed to sections at the top of the pyramid, then further sub-divided into divisions, and then broken down once more into groups, classes and subclasses. The data that the Federal Statistical Office uses in this report are at class level, with a total of 615 classes (industries at 4-digit level). Economic activities are combined in a class if they show a similar manufacturing process for goods and services (cf. Statistisches Bundesamt, Klassifikation der Wirtschaftszweige, Wiesbaden, 2008, p. 18 et seq.).

70 If the value added is not known, the firm can be attributed to an industry using alternative criteria such as turnover, gross production or headcount (ibid., p. 23 et seqq.).

71 The main activity of a firm is determined according to the top-down method in complex cases where firms engage in several activities without any one of these being clearly predominant in terms of value added. This ensures that the classification at the lowest level is coherent with all higher levels within the classification scheme. That having been said, this may lead to a case in which a major share of a firm's value added is generated in an industry which does not correspond to the industry classified as the main activity (ibid., p. 23 et seqq.).

perspective. It should however be borne in mind that cross-sector concentration indicators primarily provide indications of the risk potential of an industry in terms of competition, but do not permit definitive conclusions about the level of competition in relevant product and geographic markets.

2.1.2 Industry concentration remains unchanged

82. The Monopolies Commission has at its disposal the concentration ratios and Herfindahl-Hirschman Indices for the period from 2007 up to and including 2019 in two-yearly intervals as a basis for analysing the industry concentration of German companies.[72] These data are provided by the Federal Statistical Office in a special evaluation, and are available in disaggregated form by classes (4-digit industries) of the *Klassifikation der Wirtschaftszweige* WZ 2008.[73]

83. As was already the case in the Monopolies Commission's XXIII Biennial Report, the average industry concentration in the economy as a whole shows a flat trend. After a slight increase between 2009 and 2011, the mean HHI has remained at the same level around 1,000 points (cf. Figure I.24a). The virtually identical development of the arithmetic mean and the sales-weighted mean, on which 4-digit industries with high turnover exert major influence, suggests that no systematic shift of economic activity takes place towards industries with a higher or lower concentration. The concentration at the upper end of the HHI distribution fell slightly in comparison to the previous report year: The 90th and 95th percentiles show a drop by roughly 11 and 5 percent, respectively, from 2017 to 2019.

84. Whilst the HHI quantifies the overall distribution of turnover shares within industries, the average concentration ratio of the six largest firms per 4-digit industry in Figure I.24b can provide additional information as to how the potential for oligopolies has developed since the last year under report. The total average remains stable and the concentration ratio was roughly 45 percent in 2019. The minor difference between the arithmetic and weighted means, as well as the median, shows that the CR_6 distribution does not contain any one-sided extreme values in individual industries; what is more, turnover also does not vary systematically here depending on the respective concentration ratio, so that no indications of oligopoly formation can be found in the aggregate.

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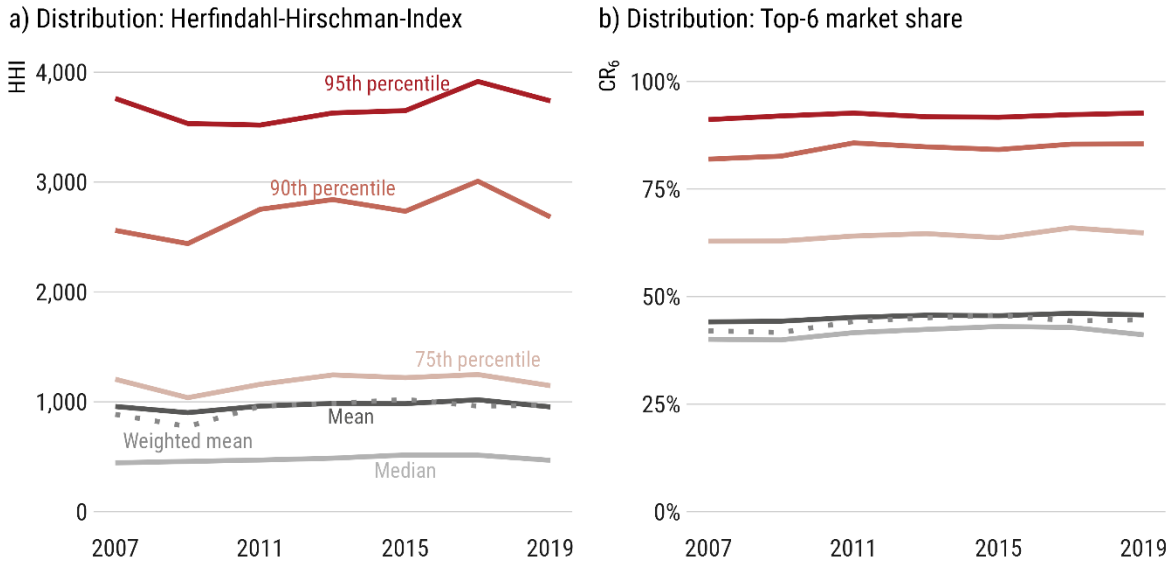
[72] More recent data on industry concentration are not available at the time of writing this Biennial Report.

[73] The complete data are provided at https://monopolkommission.de/en/data. For a more detailed discussion of concentration statistics data for Germany see Heidorn, H./Weche, J.P., Business Concentration Data for Germany, Jahrbücher für Nationalökonomie und Statistik, 241, 2021, pp. 801–811.

Figure I.24: Average industry concentration remains unchanged

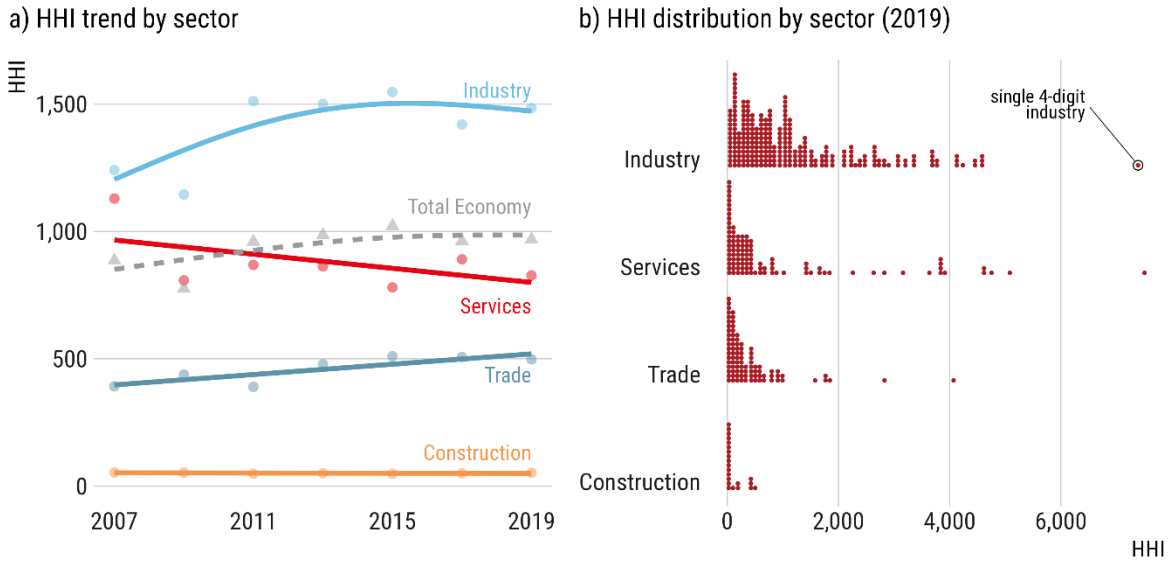


Note: Calculated based on Herfindahl-Hirschman Indices and concentration ratios for 4-digit industries in accordance with WZ 2008, accounting for corporate groups. Weighted means use total turnover per 4-digit industry as weights. Percentiles indicate in how many percent of the 4-digit industries the turnover concentration is below the value shown.
Source: Federal Statistical Office, special statistical preparation of concentration data commissioned by the Monopolies Commission based on the official business register; own calculations

85. The national aggregate of industry concentration hardly suggests any dynamic development, but a differentiated evaluation in Figure I.25a reveals diverging trends between individual sectors of the economy. The service sector shows HHI levels falling on average, the weighted trend there having fallen by about 17 percent since 2007 (roughly -1.6 percent per year). By contrast, concentration in trade rose by roughly 30 percent in the same period (by 2.3 percent per year), albeit starting at a much lower level. Among all sectors analysed, only the concentration of manufacturing, mining and quarrying and other industry (short: "industry") was above the total average. Whereas an increase in concentration was observed in this sector between 2007 and 2013, the trend has since then flattened out, and the HHI of the industrial sector is roughly 1,500 points.[74]

[74] These observations are generally confirmed by results on the basis of markets defined under anti-trust law (Affeldt et al., DIW Berlin, *supra* note 60). An analysis based on the EU's merger database shows that the trend of average market concentration on national product markets remained flat in Germany between 1995 and 2014. Concentration remained static at a high level in the manufacturing sector. A different trend is however observed in the service sector, where the average concentration rose by 41 percent between 1995 and 2014. The national average is also almost three times as high on the basis of the EU's merger database compared to the industry-based results. These differences can be traced back to a more specific definition of relevant markets under anti-trust law. It should however be noted that analyses of the EU's merger database only include markets which have been reviewed by the European Commission in merger control proceedings. This might therefore lead to an overrepresentation of both markets that are problematic in terms of competition, and of international markets. The latter is particularly problematic in the service sector because many markets need regional delimitation here. Additionally, the definition of the services sector as section E–S slightly deviates from the one used in this report (WZ 2008 sections H, J, L, M, N, S95).

Figure I.25: Trends and levels of industry concentration vary between sectors

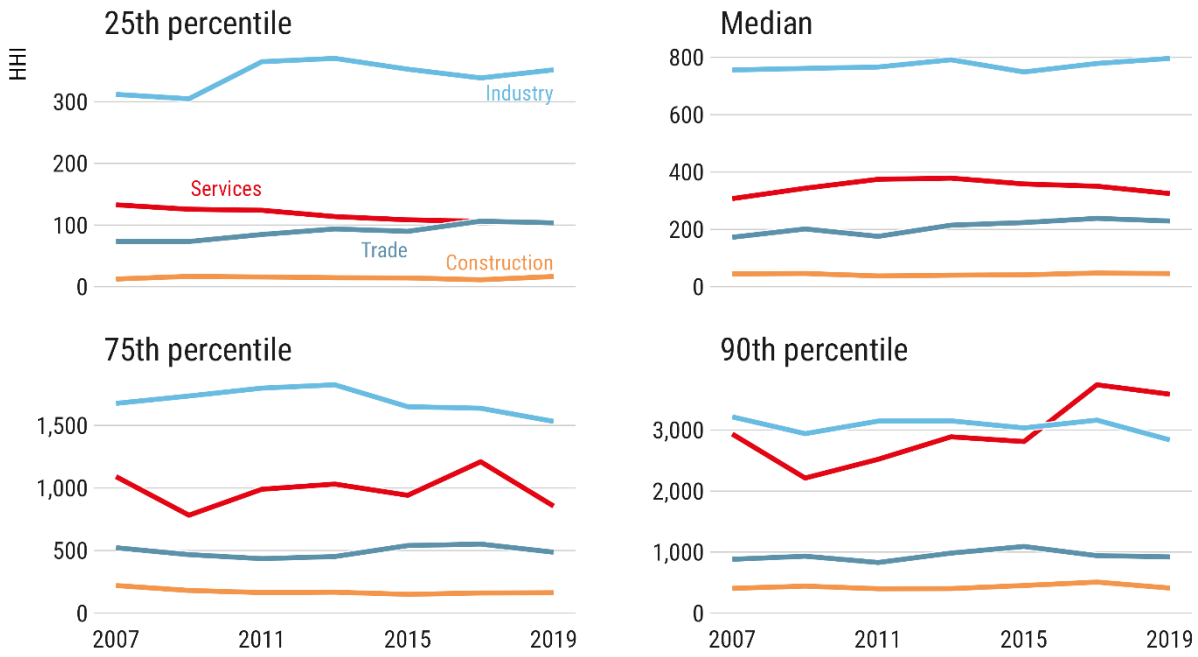


Note: Sectoral trends and annual means in panel a) are based on Herfindahl-Hirschman Indices for 4-digit industries following WZ 2008, and are weighted by turnover. Trends correspond to REML estimates of GAM models with cubic splines. Sector definitions follow the WZ 2008 classification, and combine the industries in sections B, C, D and E as Industry, in sections H, J, L, M, N and division S95 as Services, in section G as Trade, and in section F as Construction.
Source: Federal Statistical Office, special statistical preparation of concentration data commissioned by the Monopolies Commission based on the official business register; own calculations

86. Figure I.25b illustrates the differences in the variance of values between the sectors for 2019. Generally, 4-digit industries in the Industry and Service sectors more frequently exhibit HHI values that are above the economy-wide average of 1,000 points. These sectoral differences are however partly due to the greater variety of economic activities within these two sectors, which is also reflected by the higher number of 4-digit industries. These structural differences in distribution might become problematic from a competition perspective if they became more pronounced over time, as this would favour oligopoly formation in individual industries in both sectors. Against this background, Figure I.26 traces the HHI changes in percentiles of the sectoral distributions between 2007 and 2019. The percentiles shown in Construction, Trade and Industry are relatively stable over time and do not indicate any major shift within these sectors. In the service sector, by contrast, the concentration at the 90th percentile has risen by a good 60 percent since 2008, whilst it has remained virtually unchanged or indeed dropped at the other percentiles. The service sectors which have shown such a high level of concentration include wireless telecommunications, interurban passenger rail transport, as well as postal and courier activities.[75] Overall, these developments indicate that the spread of concentration among industries in the service sector is increasing. Whilst the average trend is negative (cf. Figure I.25a), the HHI shows an upward trend in the industries of the service sector with the highest level of concentration.

[75] Note that HHI-values reflect turnover-based industry concentration and therefore do not measure concentration in relevant product and geographic markets. Furthermore, due to statistical confidentiality data on interurban passenger rail transport are only available up until the year 2017; latest developments such as market entries and exits are not included.

Figure I.26: Increasing industry concentration in highly-concentrated service sectors



Note: Regarding the allocation of individual industries to sectors cf. note to Figure I.25.
Source: Federal Statistical Office, special statistical preparation of concentration data commissioned by the Monopolies Commission based on the official business register; own calculations

Summary: Industry concentration

- The economy-wide average of industry concentration continues to show a flat trend.
- Sectors differ both in terms of the level and the trend of their concentration.
- In contrast to the general trend in the service sector, the concentration in the already highly-concentrated, regulated areas of telecommunications, postal activities and interurban passenger rail transport is rising.

2.2 Mark-ups

87. The cross-market measurement of market power is an active field of research.[76] As part of cross-sector and aggregate analyses, the macro perspective of which hardly permits the definition of relevant product markets, methodical innovations in competition-economic research can therefore be instrumental. Economic price mark-ups are to be preferred for two reasons in conceptual terms over the structural measurement of concentration when identifying restraints on competition due to individual firms' market power. Firstly, mark-ups directly reflect the market behaviour of the individual firms, and are hence independent of any specific market definition. Secondly, mark-ups are calculated directly at the level of firms, so that they make it possible to allow for a much more finely-structured view when judging the competition situation.

88. Since its XXII Biennial Report the Monopolies Commission has therefore been using both the industry concentration as well as mark-ups, the latter being estimated using firm-level data. Using several indicators, each

[76] Cf. for example Autor, D. et al., The Fall of the Labor Share and the Rise of Superstar Firms, The Quarterly Journal of Economics, 135, 2020, pp. 645–709; De Loecker, J./Eeckhout, J./Mongey, S., Quantifying market power, 2020; De Loecker, J./Scott, P.T., Estimating market power Evidence from the US Brewing Industry, Working Paper 22957, 2016; Díez, F.J./Fan, J./Villegas-Sánchez, C., Global Declining Competition, Washington, D.C., 2019; Díez et al., Global Market Power and Its Macroeconomic Implications, *supra* note 58.

of which is able to depict different facets of competition, creates a more comprehensive overall picture of the competition situation, thus facilitating a better assessment of the development.

2.2.1 Methodology

89. Mark-ups are the difference between the market price of a good and its marginal costs, i. e. the costs incurred in the production of the last unit of the good. The fundamental assumption for the interpretation of mark-ups as an indicator of market power is that firms offer their products at marginal-cost prices in the theoretical model of perfect competition. If a firm's prices exceed its marginal costs in the long run, it might have market power. The mark-up μ_{it} of firm i at time t is defined as the ratio of its price p_{it} to its marginal cost λ_{it}. A value higher than 1 is to be interpreted as indicating market power:

$$\mu_{it} = \frac{p_{it}}{\lambda_{it}} \tag{3}$$

90. The (weighted) average mark-up over all relevant firms is used to assess the state of competition within a sector. The higher the average price mark-up is, the lower is the presumed competition intensity.

91. While product prices are generally observable, and could be recorded in databases, it is not possible to directly observe the marginal costs of production. As a remedy, mark-ups can be derived from balance sheet data. The approach by De Loecker and Warzynski has become widely used over the past decade for calculating mark-ups using production and cost data.[77] This approach assumes that firms produce in such a way as to minimise costs. Based on this assumption the firm-specific mark-up corresponds to the ratio of the output elasticity θ^X of a variable production factor X to the share of expenditures on X in total turnover α^X:[78]

$$\mu_{it}^X = \frac{\theta_{it}^X}{\alpha_{it}^X} \tag{4}$$

The output elasticity indicates by what percentage the output quantity changes if the use of the respective production factor is increased by 1 percent. Under perfect competition with a price mark-up of 1, the cost share of a variable input factor in total turnover thus exactly corresponds to its output elasticity. Expanding production with a higher factor input would increase costs to a disproportionate degree relative to turnover at this point.

92. Both the turnover and the respective costs of production factors are available infirm-level databases. Output elasticities, however, can only be determined by estimating production functions. Production functions map all input factors to the output quantity. The exact process is dependent on the productivity of any given firm, reflecting for instance available human resources and quality of management. To a certain extent, this productivity is known within the firm and it is taken into account when planning production. For outside observers this productivity is unknown and thus also not contained in firm-level data. This makes it impossible to distinguish, in a retrospective analysis of the data, between coincidental fluctuations over time and systematic productivity differences between firms. The research literature refers to this challenge as the simultaneity problem; it is the subject of ongoing studies.[79]

93. The two-stage control function approach by Ackerberg, Caves and Frazer (ACF), which is based on earlier studies by Olley and Pakes as well as by Levinsohn and Petrin, has become the established method to account for firm-specific productivity in production function estimations among mark-up studies based on De Loecker and

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77 De Loecker, J./Warzynski, F., Markups and Firm-Level Export Status, American Economic Review, 102, 2012, pp. 2437–2471.

78 For a detailed derivation of equation (4) see Monopolkommission, Wettbewerb 2020, *supra* note 59, chap. 3.1 (appendix A).

79 Cf. for example Gandhi, A./Navarro, S./Rivers, D.A., On the Identification of Gross Output Production Functions, Journal of Political Economy, 128, 2020, pp. 2973–3016; Flynn, Z./Gandhi, A./Traina, J., Measuring Markups with Production Data, SSRN Scholarly Paper ID 3358472, Rochester, NY, 2019.

Warzynski.[80] This involves estimating a "structural value added"(SVA) production function which assumes that the input of raw, auxiliary and operating materials perfectly complements the combination of labour and capital input.[81] This allows the production function to be reduced to two factors, namely labour and capital. The firm's material input is used to resolve the simultaneity problem , and helps estimate firm-specific productivity. All necessary assumptions, as well as the precise econometric specification of the subsequent results, are presented in section 1 of Appendix B.

94. The consequence of an SVA approach is that excluding the material input only leaves labour available as a potentially variable input factor to determine the mark-up according to equation (4). Depending on the sector and labour market regulation, short-term adjustments of the labour input may only be possible to a limited degree, or only by expending additional costs. In this context, van Heuvelen et al. have already analysed the degree to which using a dynamic labour input to estimate mark-ups distorts the results by distinguishing, using suitable data for the Netherlands, between flexible temporary workforce and permanent employees.[82] This revealed that the mark-ups which were estimated by using temporary workforce were smaller than an estimate using permanent employees, in terms of both their amount and their growth over time. In order to examine the extent to which this potential distortion can be transferred to Germany, section 2.2.9 explores the robustness of the main results by presenting and comparing alternative specifications.

2.2.2 Data

95. When estimating mark-ups, the quality and the composition of the underlying company data are crucial to the interpretation and validity of the results. The production approach following De Loecker and Warzynski, which has also been established in the recent research literature, requires detailed data on the production process at the level of firms. For this reason – as has also already been done for parts of the reporting in the XXIII Biennial Report of the Monopolies Commission – firm-level microdata of the official statistics were primarily used. These are the official firm data for Germany (*Amtliche Firmendaten für Deutschland* – AFiD) for the manufacturing and service sectors, which together account for about 53 percent of national gross value added.[83] The AFiD datasets are based on stratified random samples[84] of firms in the respective sectors, thus also conserving the representativeness of the data in different strata and for instance enabling reliable evaluations to be carried out according to the size classes of the firms. The samples are newly drawn on a regular basis via a random process, and encompass an average of up to 45 percent (manufacturing) and 15 percent (service sector) of all firms listed in the official register of companies and attributed to the respective sector.[85] The AFiD data permit general statements to be

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80 Ackerberg, D.A./Caves, K./Frazer, G., Identification Properties of Recent Production Function Estimators, Econometrica, 83, 2015, pp. 2411–2451; Olley, S./Pakes, A., The Dynamics of Productivity in the Telecommunications Equipment Industry, Econometrica, 64, 1996, pp. 1263–1297; Levinsohn, J./Petrin, A., Estimating Production Functions Using Inputs to Control for Unobservables, The Review of Economic Studies, 70, 2003, pp. 317–341.

81 The alternative "gross output" (GO) method is explored in section 2.2.9.

82 van Heuvelen, G.H./Bettendorf, L./Meijerink, G., Markups in a dual labour market: The case of the Netherlands, International Journal of Industrial Organization, 77, 2021, p. 102762.

83 Gross value added of economic sections C, H, J, L, M and N in 2019 (Statistisches Bundesamt, Fachserie 18 Reihe 1.4: Volkswirtschaftliche Gesamtrechnungen Inlandsproduktsberechnung Detaillierte Jahresergebnisse 2020, Wiesbaden, 2021).

84 A stratified random sample consists of a population which is broken down into sub-populations ("strata") (e.g. Federal *Länder*, industries or employee and turnover size classes). The strata are determined in such a way that the elements drawn within a stratum are as homogeneous as possible, and show differences between the sub-populations which are as great as possible. Random samples are then taken within the various strata which are subsequently combined to form a joint random sample. This approach helps prevent the entire random sample having large numbers of elements from one stratum only.

85 Since the structural survey in the service sector relates to a sample of at most 15 percent of firms in specific economic sections, which was moreover drawn again in 2008, 2011, 2014 and 2016, the participation pattern varies in the course of time. The sample taken in 2016 is a special case since the entire method for taking samples changed because of being adjusted in line with EU stipulations. This largely consisted of a new stratification level being added (employees). Since a maximum of 15 percent of the firms are surveyed in total, the case numbers subsequently changed in all stratification categories, and the entire sample

derived regarding sectoral mark-up trends in Germany without needing to restrict the interpretation of the results to for instance publicly-traded firms, as would be necessary in some cases were non-official datasets to be used.

96. The "Orbis Europe" data on firms purchased from the private data provider Bureau van Dijk are additionally used below in order to test the robustness of the results and assess the influence exerted on the estimates by the database. The Orbis database is widely used in competition-economic studies by researchers, as well as by national and supranational organisations. For instance, the Statistics and Data Directorate of the OECD has been using Orbis data since 2009; recent analyses carried out by the European Commission's Directorate-General for Competition, as well as by its Joint Research Centre, by the European Central Bank and by the International Monetary Fund, are also based on the balance sheet data in Orbis.[86] Unlike the data from official statistics, the Orbis data are not a representative sample of all firms, since they only contain publicly-accessible information. This fundamentally poses the risk that individual sub-groups of firms are over- or underrepresented.[87] In order to be able to trace potential differences in the results between the two data sources solely to the database used, identical methods were employed in each case to estimate the mark-ups. The balance sheet data from the Orbis database were appropriately prepared in order to follow the same methodology as with the AFiD data.[88] Comparing the results of the two datasets in section 2.2.9 helps, firstly, to assess the robustness of the identified trends; secondly, it helps to assess whether it is necessary to use official data in order to obtain representative results of aggregate trends in Germany, and to what extent the validity of studies limited to Orbis data – for instance for lack of access to official data or due to a cross-country research design – might be restricted.

97. The AFiD panel data are not only representative, but also offer high data quality in several respects. Unlike in ordinary surveys, given the statutory obligation incumbent on firms to disclose information, the problem of low response rates does not arise.[89] If individual values are nonetheless missing, they are for instance estimated by the Research Data Centre (RDC). This ensures that data are available for the entire representative random sample. Plausibility checks are furthermore carried out in various procedures, allowing individual pieces of information to be corrected by requesting specific information from the firms, for instance in the case of measurement or input errors.

98. The AFiD data analysed here encompass more than 927,000 observations of individual firm years in the period from 2008 to 2017. As shown in Table I.9, more than 80 percent of these come from the service sector. By contrast, the number of observations in the Orbis data is much smaller, at just over 90,000. The service sector in particular is covered to a much lesser degree compared to the official data. This is because smaller firms, which are more likely to be operating in the service sector, are underrepresented in Orbis.

markedly shifted towards larger firms. A substantive interpretation is therefore only possible to a very limited degree given the methodical caesura within the time series.

86 Ribeiro, S.P./Menghinello, S./Backer, K.D., The OECD ORBIS Database: Responding to the Need for Firm-Level Micro-Data in the OECD, OECD Statistics Working Papers, 2010/01, 2010; Koltay, G./Lorincz, S./Valletti, T.M., Concentration and Competition: Evidence from Europe and Implications for Policy, SSRN Electronic Journal, 2021; Rosati, N. et al., Common shareholding in Europe, Luxemburg, 2020; Cavalleri et al., Concentration, market power and dynamism in the euro area, *supra* note 60; Díez et al., Global Declining Competition, *supra* note 74.

87 For a weighing up between official and private data from firms, cf. also Monopolkommission, Wettbewerb 2020, *supra* note 59, chap. 2.2.2.

88 The details of this data processing are described in section 4.2 of Annex B.

89 For instance, the number of non-responses is roughly 2 percent in the cost structure survey carried out in manufacturing.

Table I.9: Number of observed firms in AFiD and Orbis

	AFiD		Orbis	
Year	Manufacturing	Services	Manufacturing	Services
2008	17,113	66,538	5,158	2,414
2009	16,563	69,836	5,364	2,478
2010	16,059	71,671	5,604	2,563
2011	15,603	79,024	5,975	2,735
2012	16,960	80,074	6,249	2,945
2013	16,456	82,143	5,956	2,769
2014	16,011	99,222	4,590	2,102
2015	15,476	99,451	4,257	1,968
2016	16,778	56,406	3,728	1,787
2017	16,242	59,836	3,097	1,444
Total	163,261	764,201	62,697	28,996

Note: Manufacturing includes section C of the *Klassifikation der Wirtschaftszweige* WZ-2008; only division 12 (Manufacture of tobacco products) is excluded because the number of observations is too small. Services include sections H, J, L, M, N, as well as division S95.
Source: AFiD panel on industrial firms 2008–2017 (DOI: 10.21242/42221.2017.00.01.1.1.0); AFiD panel structural survey in the service sector 2008–2017 (DOI: 10.21242/47415.2017.00.01.1.1.0); Orbis Europe; own calculations

99. Because of different collection methods of official and non-official sources, the data preparation followed slightly different steps in order to ultimately calculate comparable variables necessary for the modelling described above. Table I.10provides information on the variables in the raw data used for this purpose. Further details regarding the preparation and cleaning of the AFiD and Orbis data are also described in section 2 of Appendix B.

Table I.10: Operationalising the model variables by dataset

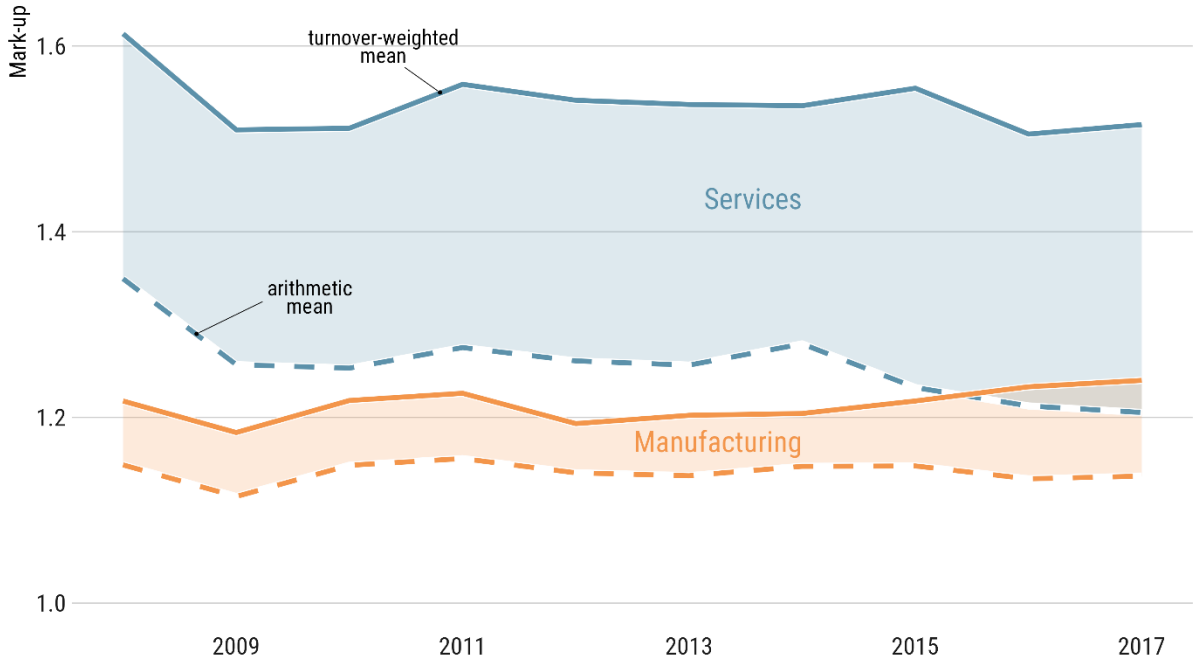
Variable	AFiD	Orbis
Turnover	Gross production value minus turnover with commodities, trading by brokerage and other activities	operating revenue
Labour input	Employees and workers in full-time equivalents	number of employees
Wage/salary costs	Gross payroll incl. employee share, employer share in social costs and other social costs	costs of employees
Material input	Consumption of raw materials and other externally-procured intermediate products, auxiliary and operating materials	material costs
Capital input	Approximation via perpetual inventory method[(a)] from investments and industry-specific rates of depreciation	fixed assets (if not available: tangible fixed assets)

Note: [(a)] Details on the calculation of the capital stock in the official data are in described section 2.1 of Appendix B.

2.2.3 Opposing mark-up trends in the manufacturing and service sectors

100. Figure I.27 provides an overview of the results of the mark-up estimate based on official firm data, and shows developments in mark-ups in the service and the manufacturing sectors between 2008 and 2017. The turnover - weighted mean depicts the sectoral trend; by contrast, the arithmetic mean can be interpreted as the mark-up of a hypothetical average firm. The two sectors show opposing trends in the observation period: The mark-up fell by 6 percent in the service sector, whilst it rose slightly in manufacturing, by 1.8 percent. The turnover-weighted mean is higher than the arithmetic mean in both sectors. This reveals that firms with higher mark-ups generate above-average turnover. The difference between the turnover-weighted mean and the arithmetic mean increased in both sectors from 2014 onwards, which was caused either by a shift in turnover towards firms with high mark-ups, by a rise in mark-ups among high-turnover firms, or by a combination of the two.[90]

Figure I.27: Mark-ups in services and in manufacturing follow opposing trends



Note: The price mark-ups shown are based on an SVA estimate with translog specification and labour as a dynamic factor.
Source: AFiD panel on industrial firms 2008–2017 (DOI: 10.21242/42221.2017.00.01.1.1.0); AFiD panel structural survey in the service sector 2008–2017 (DOI: 10.21242/47415.2017.00.01.1.1.0); own calculations

2.2.4 Within-firm mark-up changes drive sectoral trends

101. The sectoral trends can be decomposed into sub-components in order to determine whether the aggregate results are driven by changes in the firm-specific mark-ups, or rather by shifts in the respective turnover shares.[91] The year-on-year change in the aggregate mark-up ($\Delta\bar{\mu}_t$) is composed of the markup change within firms (Δwithin), a reallocation of economic activity ($\Delta\text{reallocation}$), and the influence exerted by the net market entry of new firms ($\Delta\text{net entries}$).[92] The individual components are calculated as

[90] Results on development of mark-ups at the level of the Federal *Länder* can be found in section 6 of Annex B.

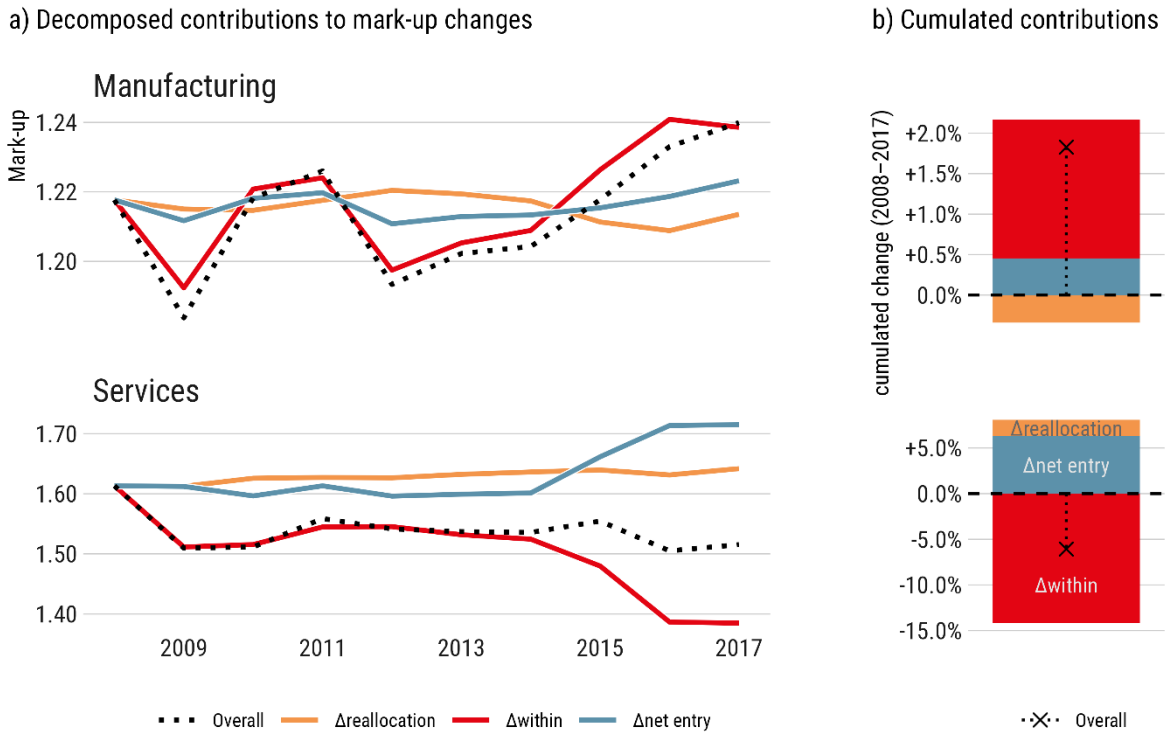
[91] Cf. De Loecker et al., The Rise of Market Power and the Macroeconomic Implications, *supra* note 55.

[92] The reallocation component in turn is a total of the change in the firm's own turnover shares, as well as of a component which reflects the interaction between changed turnover shares and changed price mark-ups. This interaction component is virtually zero in the data portrayed here, so that $\Delta\text{reallocation}$ can be largely interpreted as a shift in the turnover shares.

$$\Delta\bar{\mu}_t = \underbrace{\sum_i m_{it-1}\Delta\mu_{it}}_{\Delta\text{within}} + \underbrace{\sum_i (\mu_{it-1} - \bar{\mu}_{t-1})\Delta m_{it} + \sum_i \Delta\mu_{it}\Delta m_{it}}_{\Delta\text{reallocation}} + \Delta\text{net entries}, \quad (5)$$

where m_{it} is the turnover share of firm i in year t. In the case of a positive $\Delta\text{reallocation}$, the turnover shares of firms with above-average mark-ups would have increased year-on-year. The greater weight of these firms would cause the aggregate mark-up to rise, even though it might have remained unchanged at firm level. The $\Delta\text{net entries}$ component captures the impact of firm entries and exits, e. g. increasing when unproductive firms with low mark-ups discontinue their activities or new firms with high margins become active.[93] Both of these change the overall composition of firms. Since the AFiD panels are designed as repeatedly-drawn samples, $\Delta\text{net entries}$ reflects to a lesser extent firm-demographic entries and exits, and relates to a greater degree to potential changes in the structural composition of the official samples. However, given the representativeness of the AFiD panels, these sample changes nonetheless permit conclusions to be drawn about trends in the entire population of firms in the respective sectors.

Figure I.28: Within-firm mark-up changes drive trends



Note: In order to visualize the relative development of the individual effects over time, the vertical axes of the two sectors use different scaling, and in each case reflect the value ranges of the respective data.
Source: AFiD panel on industrial firms 2008–2017 (DOI: 10.21242/42221.2017.00.01.1.1.0); AFiD panel structural survey in the service sector 2008–2017 (DOI: 10.21242/47415.2017.00.01.1.1.0); own calculations

102. Figure I.28a illustrates the results of this decomposition over time and shows the sectoral trends (black dotted time series) as well as the development of all sub-components since 2008.[94] This makes it clear that the

[93] Formally, this is calculated as $\Delta\text{net entries} = \sum_{i\in\text{entries}} m_{it}(\mu_{it} - \bar{\mu}_{t-1}) - \sum_{i\in\text{exits}} m_{it-1}(\mu_{it-1} - \bar{\mu}_{it-1})$. Following Kouvavas et al., the term was calculated as the difference between the total change ($\Delta\bar{\mu}_t$) and the remaining components ($\Delta\text{within} + \Delta\text{reallocation}$) (Kouvavas, O. et al., Markups and Inflation Cyclicality in the Euro Area, ECB Working Paper 2617, 2021, p. 16).

[94] In order to achieve this, the annual effects of each component were added up over time, so that its impact on the trajectory of the sectoral average can be observed in isolation.

sectoral trends in both the service and manufacturing sectors are mainly driven by mark-up changes within firms. The widening gap between the sectoral average and a hypothetical average firm shown in Figure I.27 can hence be explained by increased mark-ups in firms with high turnover shares (and in the service sector also by a less pronounced fall in high price mark-ups relative to the average mark-up).

103. A reallocation of turnover only took place to a small degree in the two sectors, and had a moderating effect on overall change in both cases, i. e. the aggregate sectoral trends would have been more pronounced without the slight shift in turnover shares between firms. In the manufacturing sector, turnover shares shifted slightly towards firms with below-average mark-ups (cf. Figure I.28b). This effect was offset by the changing structure of the regularly drawn samples: Since firms with below-average mark-ups were replaced by ones with above-average mark-ups, the Δnet entries component exerted a positive effect on the average price mark-up of the manufacturing sector.

104. Turnover shifts also had the least marked effect in the service sector. Unlike manufacturing, firms with above-average mark-ups increased their turnover shares in this sector. More important, however, is the Δnet entries component in the service sector, which led to a six-percent increase in the average mark-up due to a change in the sampling methodology of the AFiD panel from 2016 onwards. The illustration of these contrary effects demonstrates the benefit of this decomposition. Instead of the overall net-effect, it is possible to retrace sub-effects and identify their respective causes. At the firm level, mark-ups in the service sector fell by a good 12 percent. Since the sectoral aggregate better accommodates larger firms from 2016 onwards thanks to changes in the EU stipulations regarding data collection, the sectoral average only fell by 6 percent over the entire period.[95] It will be possible to assess the further markup developments in the service sector as soon as data are available on additional years after the methodological adjustment in sample selection.

2.2.5 No disproportionate increase at the high end of the distribution

105. Whilst the decomposition of components makes it clear that the average mark-up development of both sectors is determined by changes within firms, it remains to be seen whether these are sector-wide trends, or whether structural differences can be observed across the mark-up distribution. For instance, studies on the development of mark-ups in US firms suggest that firms with the highest mark-ups drive their increase.[96] As Figure I.29 shows, Germany does not exhibit such a widening gap between firms with high and low mark-ups, either in the service sector or in manufacturing. This result is corroborated by other studies on Germany.[97] Instead, the mark-up trajectories over time in the upper half of the overall distribution almost move in parallel. The median in the service sector fell more steeply between 2015 and 2016 in comparison to the other statistics. This can however be explained by a change in the sampling method, intended to better accommodate particularly small firms in the data. The spread in manufacturing most recently fell slightly across the upper half of the distribution, since the 90th and 95th percentiles decreased, whilst the median increased slightly over the same period. The trend of the weighted mean is above that of the percentiles in both sectors. This suggests that there is no increase in mark-ups of high-turnover firms at the upper tail of the distribution.

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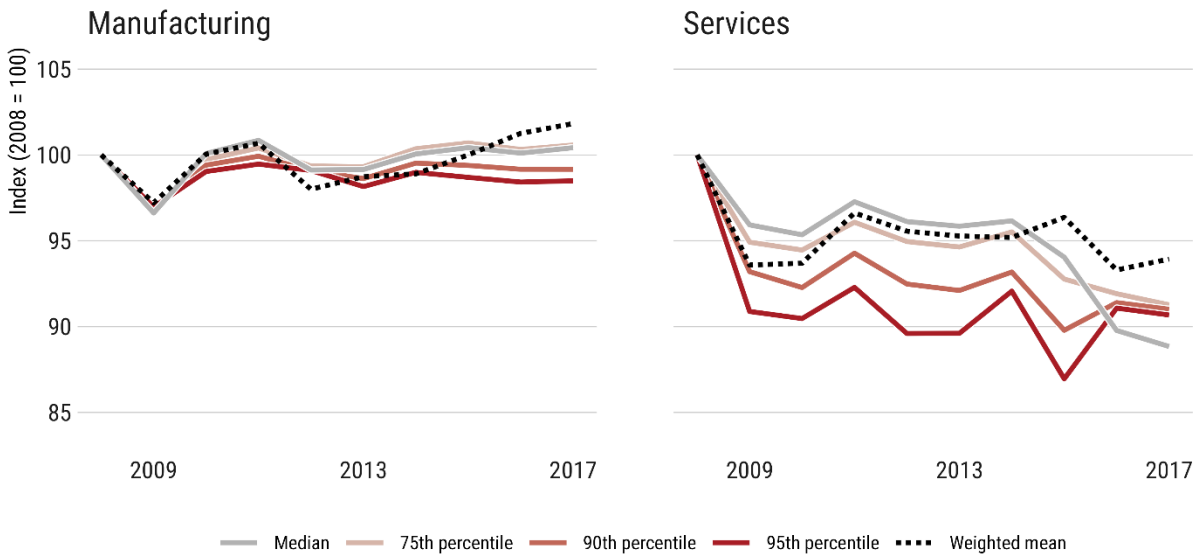
95 Cf. section 2.2.2 for an explanation of methodical changes in the data collection.

96 De Loecker et al., The Rise of Market Power and the Macroeconomic Implications, *supra* note 55.

97 Ganglmair, B. et al., Price Markups, Innovation, and Productivity: Evidence from Germany, Produktivität für Inklusives Wachstum 8, Gütersloh, 2020.

Figure I.29: The spread of mark-ups is stable



Source: AFiD panel on industrial firms 2008–2017 (DOI: 10.21242/42221.2017.00.01.1.1.0); AFiD panel structural survey in the service sector 2008–2017 (DOI: 10.21242/47415.2017.00.01.1.1.0); own calculations

2.2.6 A higher level and a steeper increase in mark-ups among large firms

106. Previous studies on the development of mark-ups in various economies have usually identified differences in levels and trends depending on company size. For instance, Ganglmair et al. find systematically higher mark-ups among small firms in Germany, and point out that there is potentially less competition in niche markets with more specialisation.[98] By contrast, an OECD study drawing on data from 26 countries reaches the conclusion that large firms are more likely to achieve high mark-ups.[99] Both studies use Orbis data to estimate mark-up trends, but the results of the OECD study are based on international cross-sectional analyses, which might fail to consider structural differences between individual economies. However, the OECD study specifies Translog production functions, which allow for a greater degree of flexibility and variance between firms – unlike the Cobb-Douglas form applied in the study by Ganglmair et al.[100] When applying Cobb-Douglas specifications, the same output elasticity is assumed to apply to all firms of a given sector, which may bias the results upwards particularly for small firms. This fact might lead to systematically higher mark-ups among smaller firms in comparison to a Translog-based estimate.

107. Based on Translog production functions, the estimates carried out in the present Report show a positive correlation between the firm size mark-ups. Figure I.30 clearly shows that large firms, i. e. firms with more than 250 employees or an operative annual turnover of more than EUR 50 million, exhibit the highest mark-ups in both the service and manufacturing sectors. The figure also shows that the variance among service-sector firms is much greater than in manufacturing. Finally, the diverging mark-up trends between large firms and all others is striking. Whilst mark-ups in smaller to medium-sized firms move in parallel, large firms have shown a trend of their own since roughly 2012. Contrary to sector-wide average, mark-ups of large service-sector firms are not decreasing; furthermore, the average mark-up increase in the manufacturing sector shown in Figure I.27 is evidently caused solely by mark-up changes in large firms.

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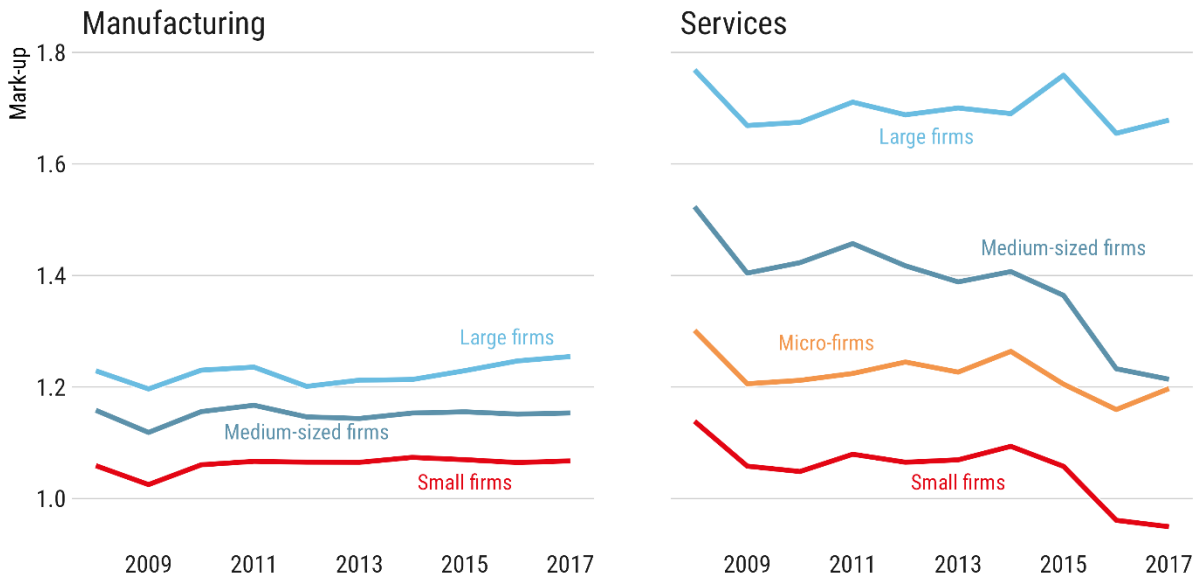
98 Ibid., p. 21.

99 Calligaris, S./Criscuolo, C./Marcolin, L., Mark-ups in the digital era, OECD Science, Technology and Industry Working Papers 2018/10, 2018, n. 4.

100 Cf. section 2.2.9. on the influence exerted by the functional form of production functions.

Figure I.30: Higher mark-ups in large firms



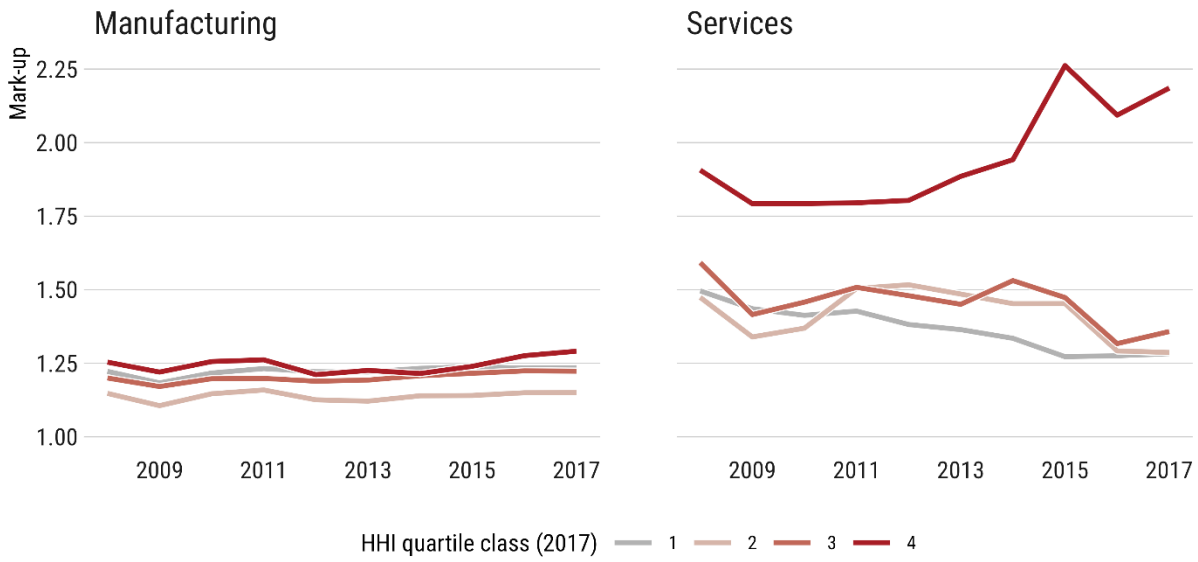
Note: Size classes of firms are based on employee headcount and operative annual turnover. Micro-firms have fewer than ten employees and a turnover of up to 2 million Euro; small firms have fewer than 50 employees and up to 10 million Euro in turnover; medium-sized firms have fewer than 250 employees and up to 50 million Euro turnover; large firms have more than 250 employees or a turnover of more than 50 million Euro. The number of the micro-firms in the AFiD panel on industrial firms is too small for a separate evaluation; they were attributed to the small firms.
Source: AFiD panel on industrial firms 2008–2017 (DOI: 10.21242/42221.2017.00.01.1.1.0); AFiD panel structural survey in the service sector 2008–2017 (DOI: 10.21242/47415.2017.00.01.1.1.0); own calculations

2.2.7 Mark-ups increase in concentrated industries

108. The influence of large – and hence high-turnover – firms can have structural effects on markets in the medium term. If firms with a high turnover achieve above-average mark-ups and they are able to increase these further relative to their competitors, one may presume that they will expand their market shares. The mark-up decomposition in section 2.2.4 has shown that this development can be observed in the service sector in the period under analysis. Such a dynamic ultimately leads to rising concentration. Consequently, there is a fundamental need to analyse whether mark-up trends systematically correlate with the respective industry concentration.

109. Figure I.31 visualises this relationship by showing the turnover-weighted average mark-up conditional on the HHI at 4-digit level in 2017; the industries are broken down into four quartiles for a simplified presentation. Mark-ups in the industries with the highest concentration are on average higher than that of the remaining industries in both sectors. The difference in the service sector is roughly 25 percent at the beginning of the observation period, and rises to almost 70 percent towards the end. The difference in the mark-ups between the HHI-quartiles is less pronounced in the manufacturing sector, which is however caused by the fundamentally lower spread of mark-ups in the sector as a whole. The mark-ups have nonetheless also risen more steeply in concentrated industries since 2014, and in 2017 reached a level that is a good 7 percent higher than the average of the other industries.

Figure I.31: Price mark-ups rose in concentrated economic fields



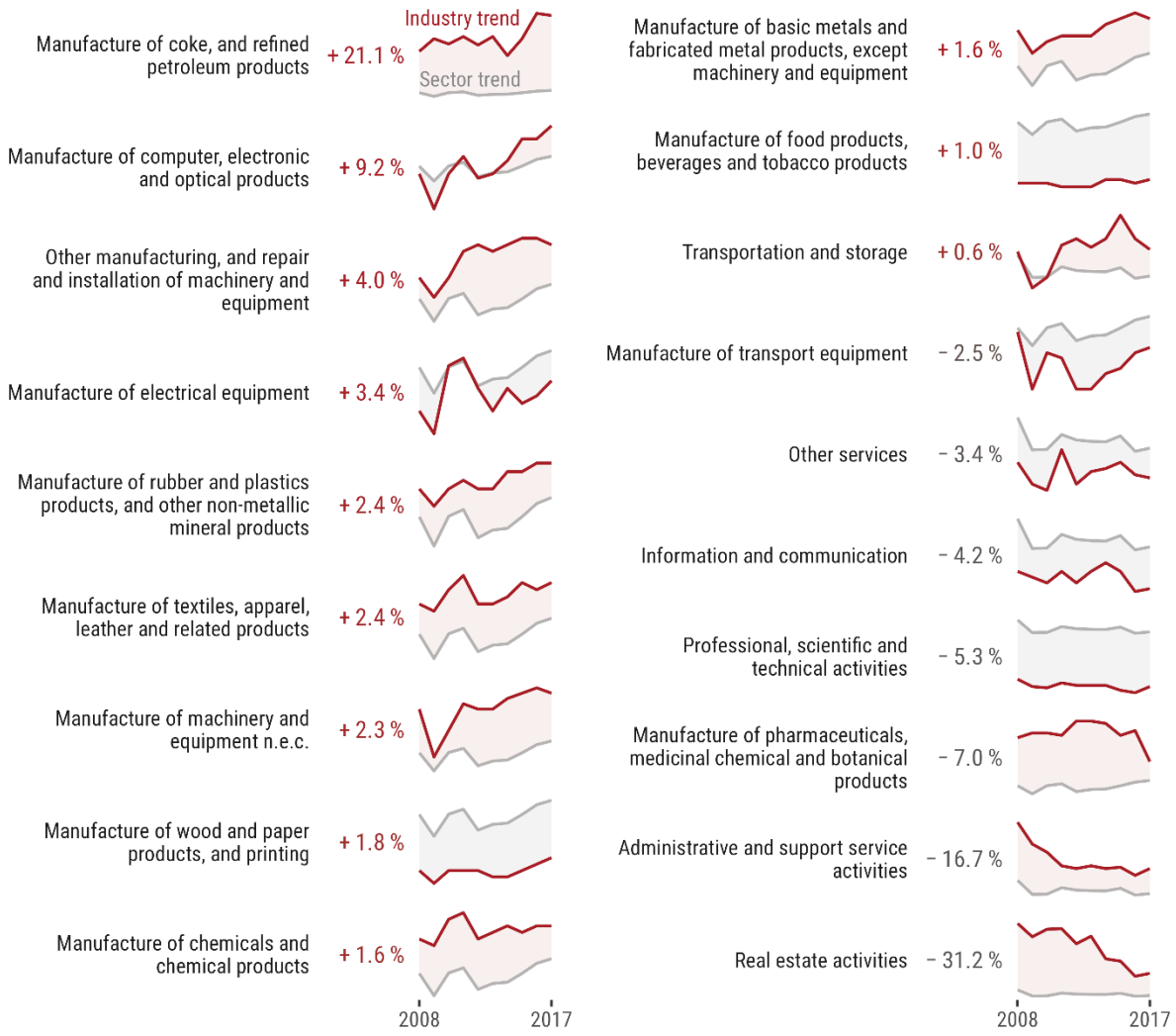
Note: Quartiles are based on the HHI values for 4-digit industries from 2017. Class 1 contains firms from 25 percent of the industries with the lowest HHI values, whilst class 4 correspondingly contains the 25 percent most highly concentrated industries.
Source: AFiD panel on industrial firms 2008–2017 (DOI: 10.21242/42221.2017.00.01.1.1.0); AFiD panel structural survey in the service sector 2008–2017 (DOI: 10.21242/47415.2017.00.01.1.1.0); Federal Statistical Office, special statistical preparation of concentration data commissioned by the Monopolies Commission based on the official business register; own calculations

110. A positive correlation between market concentration and a firm's individual pricing behaviour could indicate in the framework of a structure-conduct-performance paradigm that large market shares cause monopolistic or oligopolistic behaviour, thus leading to mark-ups. At the same time, a positive correlation could also indicate that a concentrated market structure, driven for instance by economies of scale, leads to higher mark-ups due to a greater need for investment (cf. also section 2.3).

2.2.8 Most pronounced mark-up increase in manufacture of coke and refined petroleum products

111. In addition to their high data quality, the stratified and randomly sampled official firm microdata offer the advantage vis-à-vis other data sources of providing representative information on sub-groups of the firms (cf. para. 98). A look at individual industries within the manufacturing or service sectors is thus able to identify potentially different mark-ups trends. To this end, the two sectors were broken down into 19 industries in Figure I.32. This reveals, firstly, which areas achieve mark-ups above or below the respective sectoral average: For instance, manufacture of machinery and equipment is above the average of the manufacturing sector, whilst Professional, scientific and technical activities exhibit below-average mark-ups. Secondly, the figure also shows how the industry-specific mark-ups developed in the period from 2008 to 2017, and how wide the spread is between the industries. The manufacture of coke and refined petroleum products shows by far the highest mark-up increase, even though the mark-up there was already a good 30 percent higher than the average of manufacturing in 2008. The marked increase since 2014 particularly comes to notice. Among all the service industries it is only in the field of transportation and storage that shows an average mark-up increase. The other service industries follow the downward trend of the sectoral average, the fall in real estate activities being the most pronounced.

Figure I.32: Industry-specific mark-up trends vary



Note: The percentage change stated refers to the weighted average of price mark-ups in the respective industry from 2008 to 2017. Manufacturing is broken down by "intermediate aggregates" following national accounts statistics; the service sector is broken down by sections of the industry classification.
Source: AFiD panel on industrial firms 2008–2017 (DOI: 10.21242/42221.2017.00.01.1.1.0); AFiD panel structural survey in the service sector 2008–2017 (DOI: 10.21242/47415.2017.00.01.1.1.0); own calculations

2.2.9 The robustness of the results

112. The mark-ups presented above are based on estimates with various assumptions and modelling decisions, each of which may potentially affect the results of the analysis. In order to examine their robustness, this section first summarises the most important aspects of the model and then compares the results of alternative specifications. In addition this section examines to what degree the sectoral trends shown above depend on the underlying data by comparing the results with analogous estimates using the Orbis database.

2.2.9.1 Variation in the model assumptions

The functional form of the production function

113. First of all, it is crucial when estimating the output elasticities what functional form is used for the production function. The choice is generally between a Cobb-Douglas and a Translog function. The latter was used for all the results presented in section 2.2.3, since it is does not presuppose a log-linear relationship to exist between the

individual production factors and the output quantity, and hence is more flexible. With regard to the estimation of mark-ups, Translog specifications furthermore offer the advantage that they allow for firm-specific output elasticities, since these depend not only on the coefficients of the production function, but also on the input factor levels. Modelling with a Cobb-Douglas function, by contrast, assumes the same output elasticity for all observed firms – regardless of their size.

Flexibility of labour input

114. The two-stage control function approach by ACF for estimating production functions uses a second-stage GMM estimation in order to guarantee that the output elasticities are biased by the correlation between the input factors and company-specific productivity. This involves specifying GMM moments indicating which variables should not be correlated with the random productivity change from one period to the next.[101] The exact specification of these moments depends on the assumptions about the flexibility of the input factors. ACF point out that it might be possible to estimate production functions more precisely under the additional assumption of adjustment costs of labour input.[102] The consequence of this is that the GMM estimation can also use the labour input of the current period in addition to that of the previous period. There may be differences across individual sectors in the extent to which the assumption is justified that firms are unable to deploy their employees flexibly from one year to the next, for instance because of provisions contained in collective agreements or general provisions of labour law. It is difficult to take special features of individual industries into consideration within the cross-sector analysis carried out here.

Selecting the production technology

115. Finally, the modelled production technology may also affect the mark-up estimates. The results presented above are based on structural value added (SVA) estimations.[103] This contrasts with a gross output (GO) method, in which the production function contains in addition to capital and labour the input of materials. The potential advantage of a GO estimate is that it also identifies an output elasticity for the material input, and hence does not have to rely on labour when calculating the mark-ups according to equation (4), which is generally not as flexible as a production factor. The relevant research literature has however yet to reach a consensus as to how GO functions can be identified in order to estimate price mark-ups. The ACF-method is explicitly only suitable to estimate SVA functions, since the modelling assumptions do not provide a sufficient basis to identify a GO function.[104] Both Bond and Söderbom, as well as Gandhi, Navarro and Rivers, formally show why the ACF-method is inadequate for estimating gross output functions.[105] De Loecker and Scott propose an adjustment of the ACF-method for the estimation of GO functions by including firm-specific factor prices.[106] Following this approach, average wages derived from payroll and employee headcount at firm level were used for the present report, and then GO production functions were estimated for a comparison and in order to verify the robustness of the SVA results.[107]

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[101] Cf. section 3 in Annex B for a more detailed description of the method.

[102] Ackerberg et al., Identification Properties of Recent Production Function Estimators, *supra* note 78, p. 2430.

[103] Cf. section 2.2.1 and section 3 of Annex B.

[104] Ackerberg et al., Identification Properties of Recent Production Function Estimators, *supra* note 78.

[105] Bond, S./Söderbom, M., Adjustment costs and the identification of Cobb Douglas production functions, Working Paper 05/04, 2005; Gandhi et al., On the Identification of Gross Output Production Functions, *supra* note 77.

[106] De Loecker/Scott, Estimating market power Evidence from the US Brewing Industry, *supra* note 74.

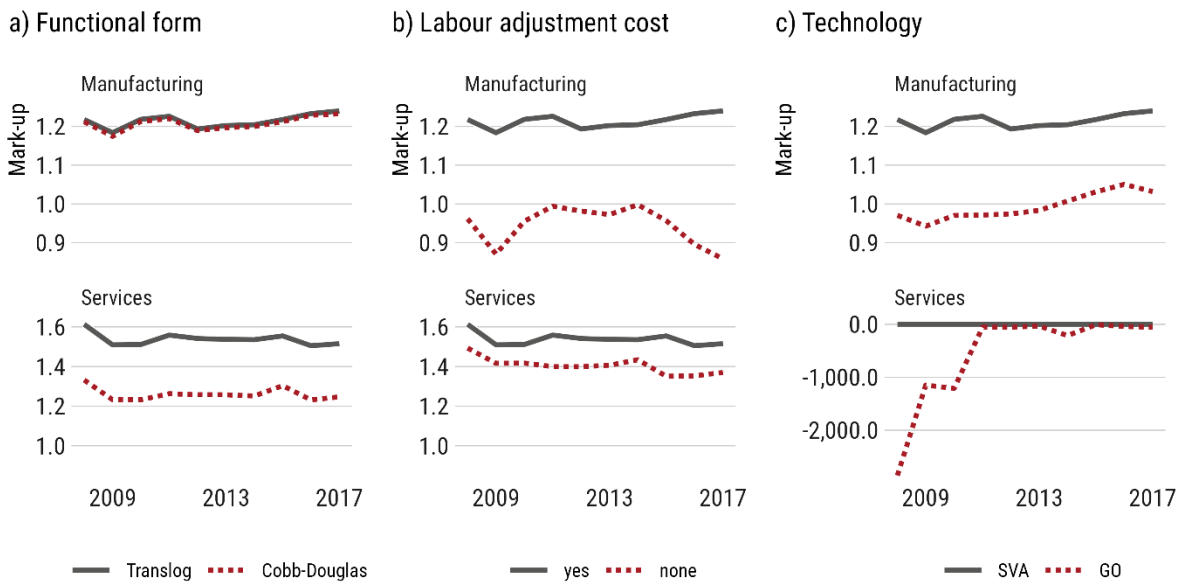
[107] Cf. section 3.2 in Annex B for details on the model specification.

Result: robust trends

116. In order to take account of the above aspects in the modelling, a total of six different variants were for the mark-up estimations in this Report. SVA and GO functions were specified in each case as Cobb-Douglas and Translog functions. Furthermore, two GMM instrumentations were reviewed for the two SVA models with and without adjustment costs of labour input.[108] Figure I.33 provides an overview of the results of this comparison between variants. Figure I.33a makes clear that the assumption regarding the functional form of the production functions has virtually no effect on the estimated trend of the mark-ups in either sector. In the manufacturing sector, the more flexible Translog form also leads to the same mark-up levels as the Cobb-Douglas specification. In the service sector, by contrast, the sectoral average is roughly 20 percent lower when using a Cobb-Douglas function. Since the spread of price mark-ups among service firms is heavily influenced by firm sizes, this difference can be traced back to the uniform output elasticity under a Cobb-Douglas function.

117. As Figure I.33b illustrates, the assumption regarding the adjustment costs of labour and the associated instruments of the GMM stage may significantly affect the sectoral averages. The results in manufacturing change such that instead of a slight increase, the average mark-up drops by roughly 10 percent under flexible labour. Since the average mark-up however remains in the implausible area below 1 in the entire period, the reliability of the results of this model variant need to be called into question. Furthermore, section 3 of Appendix B explains that the quality of the estimates is low in this case, and the assumption of high adjustment costs in manufacturing would seem to be justified. In the service sector, by contrast, whilst one can make out slight differences between the two specifications, the assumption of flexible labour does not lead to qualitative changes in the results. It is possible that lower adjustment costs of the labour input are more realistic in service industries, and price mark-ups, which are roughly 9 percent lower on average, accordingly reflect the less distorted output elasticity.

Figure I.33: Model specification affects results



Note: The grey line shows in each case the preferred specification from section 2.2.3.
Source: AFiD panel on industrial firms 2008–2017 (DOI: 10.21242/42221.2017.00.01.1.1.0); AFiD panel structural survey in the service sector 2008–2017 (DOI: 10.21242/47415.2017.00.01.1.1.0); own calculations

118. Finally, Figure I.33c shows the differences between SVA and GO estimates. The mark-ups of the GO variant are based on the output elasticity of material input. The GO estimation did not identify robust elasticities in the

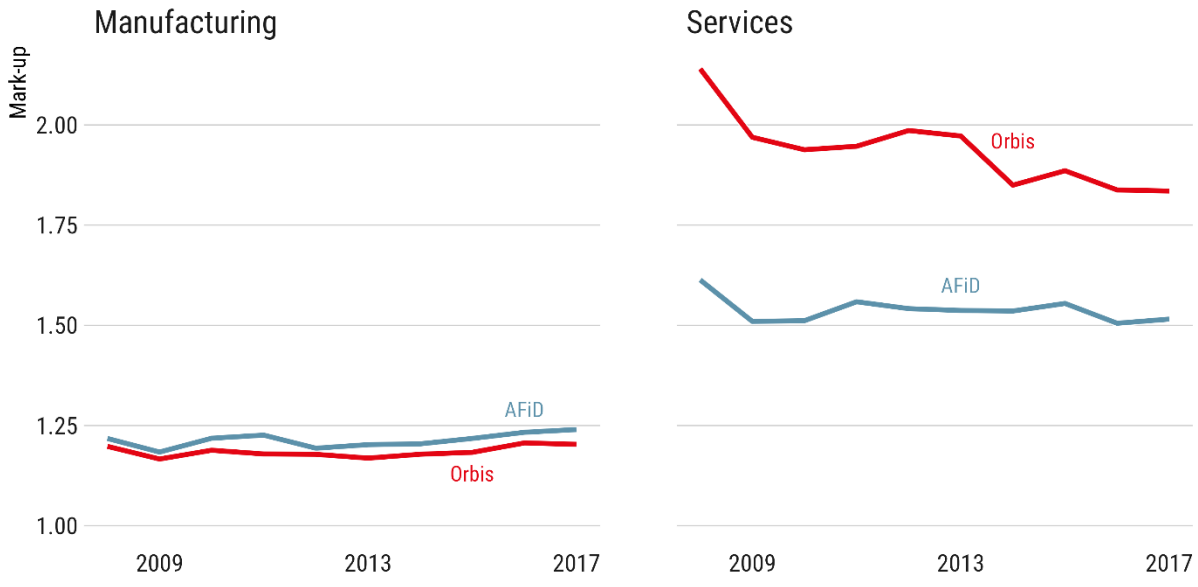
[108] Due to the generally better identification achieved when assuming adjustment costs of labour and availability of flexible material input, no variant assuming flexible labour was included in GO specifications.

service sector. The corresponding negative mark-ups are hence not reliable. In manufacturing, by contrast, the two variants provide similar trends. The constant increase in the mark-ups since 2013 is somewhat higher in the GO estimate, so that the overall result is an increase by roughly 6 percent (instead of 2 percent). However, here too the mark-ups are initially in the implausible area below 1, so that at least their level does not appear to be reliable. This may be due to a downward bias of the estimated output elasticity of material.

2.2.9.2 The relevance of the database

119. Besides the robustness of the results to methodological changes, the extent to which the mark-up trends are robust as to the underlying database needs to be examined. A comparison between mark-up estimates from official data and the results from private databases may shed light on the validity and representativeness of these datasets, which are used widely in the relevant research literature. Since Orbis data are used most frequently at least in studies on Germany and Europe, they constitute the relevant data source for this comparison. Larger firms are overrepresented in Orbis and in private databases in general, so that the data portray a large share of the national and in some cases also sectoral turnover.[109] This initially suggests that the data accurately reflect general trends. That, conversely, small firms are partly underrepresented may however affect the level of sector-specific mark-up estimates if, as shown above, firm-specific mark-ups correlate with the size of an firm (cf. section 2.2.6). It is however currently not clear whether and to what degree the mark-ups estimated from private company data are distorted as a result of this. This means that the results of the present Report may be used as a benchmark. If private and official data provide concurring mark-ups, the lack of statistical representativeness of private databases is negligible for these estimates. If the results differ widely from one another, follow-up analyses may provide indications of the extent to which the interpretation of mark-up estimates on the basis of balance sheet data is subject to restrictions.

Figure I.34: Official and non-official data indicate similar mark-up trends at sectoral level



Note: Mark-ups from SVA estimates of a Translog production function with adjustment costs for labour are shown for both data sources.

Source: AFiD panel on industrial firms 2008–2017 (DOI: 10.21242/42221.2017.00.01.1.1.0); AFiD panel structural survey in the service sector 2008–2017 (DOI: 10.21242/47415.2017.00.01.1.1.0); Orbis Europe; own calculations

[109] Cf. on this a corresponding study on representativeness carried out by the Monopolies Commission, in Monopolkommission, V. Hauptgutachten, *supra* note 63, para. appendix A.

120. A comparison of aggregate mark-ups of the AFiD panel with analogue estimates on the basis of the Orbis data in Figure I.34 suggests that in general similar trends emerge from both data sources. In the manufacturing sector, the difference between the estimated mark-ups is small. It is only in 2017 that the mark-up estimated with Orbis markedly departs from the positive trend. This is presumably an effect of the reduced number of observations at the end of the observation period, and can be taken into account as a matter of principle via corresponding restrictions in the number of observed years. By contrast, the Orbis data indicate much higher mark-ups in the service sector, as well as a more pronounced decline in the trend. Given the lower coverage of service firms as shown in Table I.9, the higher variance of mark-ups within the sector, and particularly the systematic effect of firm sizes, one may presume that the results from Orbis data are subject to a sampling bias. At least in the service sector, estimates could only be interpreted for the sector as a whole to a limited degree.

Summary: Mark-ups

- Mark-ups rose by 1.8 percent in manufacturing between 2008 and 2017, whilst they fell by 6 percent in the service sector in the same period.
- The sectoral trends can be mainly traced to firm-level mark-up changes.
- Regardless of sector, large firms in particular, and firms in highly-concentrated sectors (e.g. in the manufacture of coke and refined petroleum products), show rising mark-ups.

2.3 Determinants of mark-ups

121. A great deal of attention attaches in the relevant research literature and in the economic policy debate to the observation of mark-up trends. Stylised facts have already emerged for economies such as the USA for which relatively large numbers of empirical analyses are available on the topic. The situation is different when it comes to the underlying causes of mark-up developments. This continues to fuel controversial discussions, and the empirical studies are by no means sufficient for a conclusive evaluation. The causes of mark-up developments are however material to their interpretation, and to the economic policy measures that might have to be taken in response. If mark-ups constitute a suitable indicator of competition intensity, the question for instance arises as to which factors are responsible if competition intensity diminishes in the medium to long term. There has been discussion in this context for instance of potential shortcomings in enforcement on the part of the anti-trust authorities, of impediments to the dissemination of innovations and new production technologies, increasing linkages between firms via common ownership by institutional investors, as well as an advancing digital transformation.[110] When examining potential causes, it is highly significant to discuss to what extent mark-ups reflect suppliers' scope in price setting and to what degree mark-ups are necessary to cover fixed costs of production. Since the digital transformation plays a key role in the discussion on both diminishing competition intensity and rising fixed costs, this section will first explore the connection between digitalisation and mark-ups. Afterwards, the role played by indirect horizontal cross-links will be analysed.

2.3.1 Digitalisation and mark-ups

122. The digital transformation has a manifold impact on competition between firms. Particularly the increasing significance of platform markets and network effects, and concomitant monopolisation tendencies, have already led to amendments of anti-trust law at national and European levels.[111] The reason for this is that pronounced network effects pose major barriers for customers when it comes to changing suppliers, so that they find themselves in a lock-in situation. This makes it more difficult to compete for customers, and competition in fact

[110] cf. Monopolkommission, Wettbewerb 2018, *supra* note 34, para. par. 365 et seqq.; OECD, Market Concentration, Issues Paper DAF/COMP/WD(2018)46, 2018; Wambach, A./Weche, J.P., Sektorübergreifende Konzentrations- und Margenzunahme: Bestandsaufnahme, Ursachen und Folgen, Perspektiven der Wirtschaftspolitik, 21, 2020, pp. 120–136.

[111] Cf. chapter V in this report.

takes place for the market itself. A further reason for diminishing competition intensity resulting from digitalisation might be that particularly innovative and productive firms find it increasingly easy to keep up with the rapid pace of innovation and to shore up their innovative lead over competitors.[112]

123. Digitalisation however also has the potential of having a positive impact on competition. The reason for this may be for instance greater market transparency thanks to online comparison platforms, resulting in increased price sensitivity on the demand side. The increased application of digital information and communication technologies (ICT) may also help firms reduce marginal costs and increase productivity, thus providing corresponding latitude, as well as motivations for more intensive price competition. Improvements in productivity via ICT can for instance arise from the possibility to establish larger networks of customers, from gaining better access to regional and product markets, as well as from leveraging economies of scale by investing in intangible assets.

124. Empirical studies on cross-sector correlation between digitalisation and market power have yet to produce any unambiguous results, and give rise to the presumption of a market-specific relationship. Calligaris et al. provide empirical indications of a positive cross-sector link between the intensity of digitalisation and mark-ups: Firstly, their results indicate higher mark-ups in highly-digitalised sectors of OECD countries; secondly, they show that the differences in mark-ups between highly-digitalised and less digitalised sectors increased considerably in the period 2001–2014.[113] Another study furthermore ascertained that larger firms demand higher mark-ups particularly in sectors with a high intensity of digitalisation, and at the same time have a greater leading edge when it comes to productivity. The study attributes these links between company size, productivity and mark-ups to the fact that it is easier to achieve economies of scale in digitalised industries.[114] Other studies for Europe and Germany, by contrast, do not show any increase in the industry concentration among highly-digitalised sectors. In fact, a much less marked increase in the industry concentration has been found for sectors with a high degree of digital intensity in the USA.[115]

125. A somewhat more evident finding is that digital transformation is additionally affecting the level of mark-ups via a quite distinct channel. The constant increase in the significance that firms have attached to intangible assets such as patents, trademarks, licences or firm-specific human capital in recent decades has been identified as a cause for rising mark-ups. A major share of investments in intangible assets is for instance taking place in ICT, as well as in software and related human capital, and is linked directly to the digital transformation. Figure I.35 shows the share of investments in ICT, as well as in software and databases, in total gross fixed capital formation in Germany since 1995. It is however not possible to observe a marked increase in the ICT investment share of German firms until the late 1990s and mid-2000s. Indeed, a marked drop in the share occurred in manufacturing since the turn of the millennium. By contrast, investments in software and databases follow a constant upward trend, which serves as an indicator of increasing digitalisation in German firms. Figure I.36 furthermore shows how the share of IT experts in total employment has increased in the past decade, specifically revealing a much larger share for the service sector. All in all, Germany takes a mid-table position at EU level when it comes to investing in digitalisation (cf. Figure I.37).

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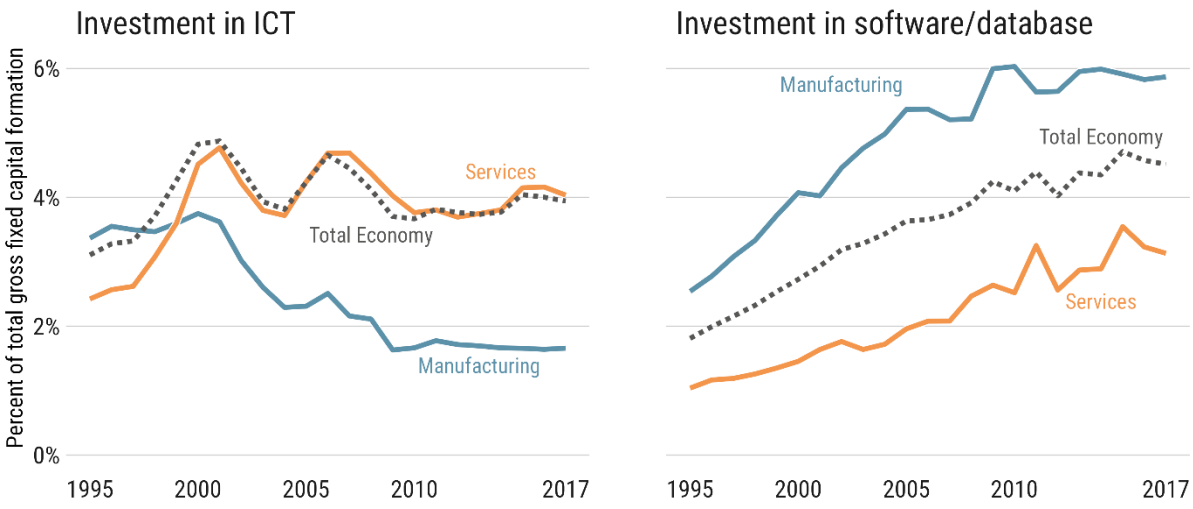
[112] Cf. for example Acemoglu, D./Akcigit, U., Intellectual Property Rights Policy, Competition and Innovation, Journal of the European Economic Association, 10, 2012, pp. 1–42; Andrews, D./Criscuolo, C./Gal, P.N., Frontier Firms, Technology Diffusion and Public Policy: Micro Evidence from OECD Countries, OECD Productivity Working Papers 2015–2, 2015.

[113] Calligaris et al., Mark-ups in the digital era, *supra* note 97.

[114] McMahon, M. et al., Scale, market power and competition in a digital world: Is bigger better?, OECD Science, Technology and Industry Working Papers 2021/01, 2021.

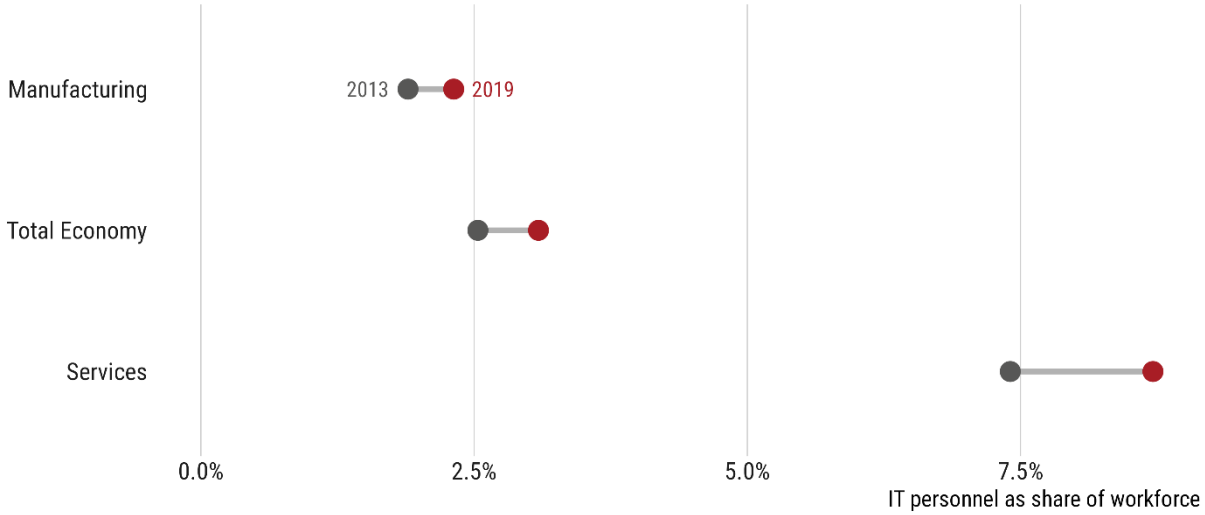
[115] Bajgar, M. et al., Industry Concentration in Europe and North America, OECD Productivity Working Papers 2019–18, 2019; Ferschli, B. et al., Digitalization, Industry Concentration, and Productivity in Germany, Jahrbücher für Nationalökonomie und Statistik, 241, 2021, pp. 623–665.

Figure I.35: Investments in intangible assets predominant in the context of digitalisation



Source: KLEMS; own calculations

Figure I.36: IT personnel in Germany (2013–2019)



Note: Employees subject to obligatory social insurance with the requirement level personnel, specialist and expert (in accordance with the KldB 2010) by industries in WZ 2008. Services include sections H, J, L, M and N; section C represents manufacturing.
Source: Statistics from the Federal Employment Agency; own calculations

126. The rising need for investment in intangible assets might mean that firms rely on increasing the mark-ups in order to be able to cover the higher fixed costs of production and survive in the market.[116] The observation of higher mark-ups in sectors with higher digital intensity would also be consistent in this regard.[117] Nevertheless, rising fixed costs of production would also have to cause average unit costs to increase – holding production

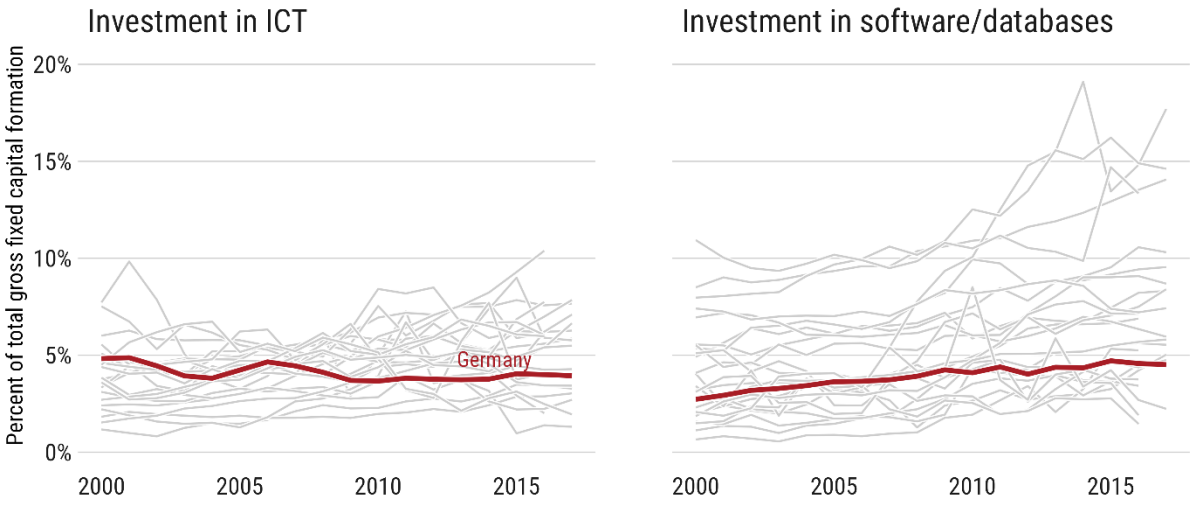
[116] De Loecker, J./Eeckhout, J., Some Thoughts on the Debate about (Aggregate) Markup Measurement, https://www.semanticscholar.org/paper/Some-Thoughts-on-the-Debate-about-(-Aggregate-)-%E2%88%97-Loecker-Leuven/02fb76269190697127d89c93099025635a2f4a8f; van Reenen, J., Increasing Differences Between Firms: Market Power and the Macro-Economy, CEP Discussion Papers 1576, 2018; Ayyagari, M./Demirguc-Kunt, A./Maksimovic, V., The Rise of Star Firms: Intangible Capital and Competition, Policy Research Working Paper 8832, 2019; Berry, S./Gaynor, M./Scott Morton, F., Do Increasing Markups Matter? Lessons from Empirical Industrial Organization, Journal of Economic Perspectives, 33, 2019, pp. 44–68.

[117] Cf. para. 59.

volumes constant –, so that the accounting profit should not increase. Some studies have however observed that the increase in mark-ups has been paralleled by increasing accounting profit margins.[118]

127. If higher mark-ups are at least partly caused by a rising need for investments in the context of digitalisation, their potential as an indicator of market power and competition intensity is exaggerated. This must be considered when interpreting mark-ups, particularly from a competition perspective. Depending on what share of mark-ups can be traced back to rising fixed costs, high mark-ups may rather also be an indicator of improved current or future competitiveness in the sense of a productivity advantage and a technological leading edge. Rising mark-ups would however also not be completely unproblematic in terms of competition where the increase was completely due to fixed costs. This is because rising fixed costs may increase the barriers to market entry, and hence have a negative impact on competition and on the contestability of markets.

Figure I.37: Germany takes a mid-table position EU wide when it comes to investing in digitalisation



Note: Aggregate investments per year and EU Member State. Grey time series depict developments in other EU States. Data on software/database investments are available for 25 countries, and on ICT investments for 23 countries.
Source: KLEMS; own calculations

2.3.1.1 Higher mark-ups in digitalised industries of manufacturing

128. In order to further explore the link between mark-ups, digitalisation and fixed costs, the results of a regression analysis are presented below on the basis of the AFiD panels and of the estimated mark-ups presented above.[119] Various indicators are available for measuring the degree of digitalisation of industries and individual firms. The basic specification of the econometric models is as follows:

$$\ln(\mu_{ijt}) = \alpha_{ij} + \tau_t + \beta d_{ijt} + \gamma X_{ijt} + \varepsilon_{ijt} \quad (6)$$

This involves estimating the influence of a digitalisation variable d_{ijt} on the log mark-up of firm i in industry j at time t. X_{ijt} contains further firm-specific control variables. Given the influence exerted by the firm size, shown in section 2.2.6, this is modelled in each of the estimates below by a second-degree polynomial of the employee

[118] Cf. De Loecker et al., The Rise of Market Power and the Macroeconomic Implications, *supra* note 55; Weche/Wambach, The Fall and Rise of Market Power in Europe, *supra* note 58; Díez et al., Global Market Power and Its Macroeconomic Implications, *supra* note 58.

[119] Regarding intangible assets and fixed costs in production function estimates, see also Acharya, R.C., ICT use and total factor productivity growth: intangible capital or productive externalities?, Oxford Economic Papers, 68, 2016, pp. 16–39; De Ridder, M., Market Power and Innovation in the Intangible Economy, Working Paper, 2019.

headcount. Depending on the specification, furthermore, year and firm or industry fixed effects are taken into account in τ_t and α_{ij}.

Table I.11: OLS estimates: mark-ups depending on digitalisation

	Manufacturing				Services			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ln(employees)	0.192 (0.010)**	0.214 (0.009)***	0.214 (0.009)***	0.424 (0.020)**	-0.118 (0.005)***	-0.101 (0.005)***	-0.101 (0.005)***	0.121 (0.010)***
ln(employees)^2	-0.014 (0.001)**	-0.016 (0.001)***	-0.016 (0.001)***	-0.032 (0.002)**	0.010 (0.001)***	0.012 (0.001)***	0.012 (0.001)***	-0.005 (0.002)***
Digitalised industries (OECD)	0.027 (0.003)**				-0.076 (0.003)***			
ICT share (WZ2)		0.014 (0.005)**				-0.010 (0.001)***		
Software/DB share (WZ2)			-0.005 (0.003)*				0.002 (0.000)***	
Software investment (firms)				-0.003 (0.001)**				-0.001 (0.000)***
FE: Year	✓	✓	✓	✓	✓	✓	✓	✓
FE: 2-digit industry		✓	✓	✓		✓	✓	✓
FE: Firm				✓				✓
N	124,156	124,156	124,156	124,156	731,293	731,293	731,293	730,953
R^2 Adj.	0.060	0.457	0.457	0.924	0.018	0.107	0.107	0.775
R^2 Within	0.059	0.094	0.094	0.083	0.015	0.004	0.004	0.008

Note: * p < 0.05; ** p < 0.01; *** p < 0.001; clustered standard errors at the level of firms in parentheses.
Source: AFiD panel on industrial firms 2008–2017 (DOI: 10.21242/42221.2017.00.01.1.1.0); AFiD panel structural survey in the service sector 2008–2017 (DOI: 10.21242/47415.2017.00.01.1.1.0); KLEMS; own calculations

129. First of all, an OECD classification was used for d_{ijt} which evaluates the degree of digitalisation of 2-digit industries.[120] Industries where the degree of digitalisation is higher than the median are classified as digitalised by the binary indicator variable. The results of the regression in Table I.11 indicate that digitalised industries in manufacturing show an average of roughly 3 percent higher mark-ups.[121] This effect is however negative in the service sector, where the corresponding mark-ups are roughly 7.5 percent lower than the average of non-digitalised industries. This might be caused either by the fact that digitalised industries are less productive than non-digitalised ones, or instead that firms in digitalised industries are highly competitive vis-à-vis one another as a result of increases in productivity. As an additional indicator for digitalisation, annual ICT and software investments at a level of 2-digit industries from the KLEMS database are used.[122] This shows that in manufacturing industries where investments in ICT assets rise by 1 percent, this is accompanied by a roughly 1.4 percent rise in mark-ups; rising intangible software and database investments, by contrast, reduce the mark-up by 0.5 percent. Here too, a contrasting effect can be observed in the service sector: Mark-ups in industries with rising ICT investment fall on average (by 1 percent), whilst rising software investments are linked to moderately-rising price mark-ups. Finally,

[120] Calvino, F. et al., A taxonomy of digital intensive sectors, OECD Science, Technology and Industry Working Papers 2018/14, 2018.

[121] The estimated models furthermore control for the size of a firm via the employee headcount, as well as depending on the specification for invariant effects of calendar years, 2-digit industries and firms.

[122] Stehrer, R. et al., Industry Level Growth and Productivity Data with Special Focus on Intangible Assets: Report on methodologies and data construction for the EU KLEMS Release 2019, Wien, 2019.

the AFiD panels also provide firm-specific information on software investments, and these make it possible to estimate the effect of an increase in the intangible digitalisation assets on the price mark-up of an firm over time. Investments are measured here in relation to operative annual turnover. A 1-percent increase in software investments reduces the price mark-up in both sectors slightly (by 0.3 and 0.1 percent, respectively).

2.3.1.2 High mark-ups cannot be explained by investments and productivity alone

130. Section 2.3.1 outlined both potentially competition-reducing channels of digitalisation as well as competition-boosting effects. Rising productivity of firms, enabling them to develop quality and cost advantages vis-à-vis their competitors via individual aspects of digitalisation, is fundamental to this. Against this background, the regression results in Table I.12 show the degree to which the consideration of firm-specific productivity influences the results available to this point with regard to the difference between digitalised and non-digitalised industries. Total factor productivity (TFP), derived from the estimation of mark-ups, was used to measure productivity.[123] A comparison of the coefficients for digitalised industries, with and without consideration of productivity, shows that the effect in manufacturing remains virtually unchanged: Even when taking into consideration the positive influence of labour productivity, price mark-ups are roughly 3 percent higher there in digitalised industries.[124] By contrast, the difference between digitalised and non-digitalised industries increases in the service sector. Whilst mark-ups were previously shown to be around 7.5 percent lower in digitalised industries, the difference here is almost 19 percent, if one takes productivity into consideration.[125]

Table I.12: The influence exerted by digitalisation conditional on productivity

	Manufacturing	Services
ln(employees)	0.192 (0.010)***	-0.125 (0.005)***
ln(employees)^2	-0.014 (0.001)***	0.012 (0.001)***
Digitalised industry (OECD)	0.030 (0.003)***	-0.206 (0.004)***
Log(TFP)	0.000 (0.000)	-0.010 (0.000)***
FE: Year	✓	✓
N	124,156	731,293
R^2 Adj.	0.060	0.041
R^2 Within	0.059	0.038

Note: * p < 0.05; ** p < 0.01; *** p < 0.001; clustered standard errors at the level of firms in parentheses.
Source: AFiD panel on industrial firms 2008–2017 (DOI: 10.21242/42221.2017.00.01.1.1.0); AFiD panel structural survey in the service sector 2008–2017 (DOI: 10.21242/47415.2017.00.01.1.1.0); KLEMS; own calculations

131. The firm-level results (models (4) and (8) in Table I.11) do not permit the conclusion to be drawn that higher mark-ups are caused by high investments in intangible assets as part of the digitalisation process. The estimates do however indicate that there are structural differences in digitalisation between the sectors observed, and that this leads to corresponding investments in tangible and intangible assets having different effects. Industries with rising investments in intangible assets in the service sector exhibit systematically higher mark-ups. This might

[123] The firm-specific log TFP corresponds to ω_{it} in equation (10) in the Annex.

[124] TFP does not exert any statistically significant influence on mark-ups in manufacturing.

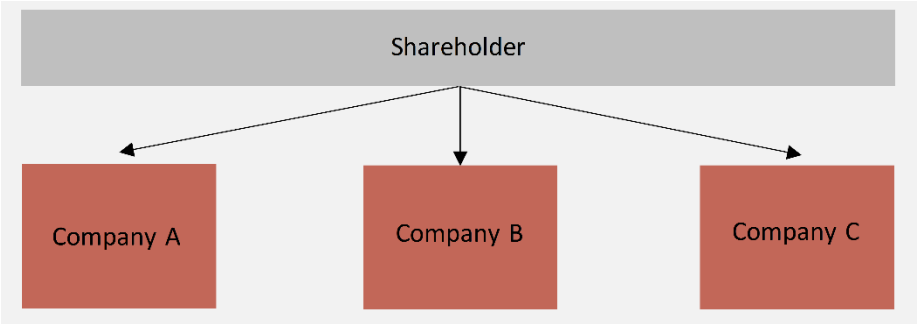
[125] The percentage difference is calculated as $e^{-0,206} - 1$.

reflect the emergence of the barriers to market entry described in para. 130, which have a negative impact on the level of competition in the medium term. At the same time, however, the estimated differences between digitalised and non-digitalised industries, taking firm-specific productivity into consideration, indicate that a considerable degree of digitalisation in the service sector is associated with productivity gains which boost competition between the firms involved, thus leading to lower mark-ups. In manufacturing, by contrast, higher mark-ups tend to correlate with tangible investments. Potential productivity growth to which this may lead does not serve to boost competition, and the possibility arises of high levels of investment in fixed costs becoming barriers to market entry.

2.3.2 Common ownership and mark-ups

132. The rise in common ownership by institutional investors is discussed as a potential cause of falling competition intensity and rising profit margins of firms.[126] Common ownership is regarded as a constellation of owners in which one shareholder holds shares in at least two firms competing with one another in the same market. This means that competing suppliers are indirectly linked via their shareholders (cf. Figure I.38). Such a constellation of owners is also referred to as "horizontal shareholding". The vast majority of such shareholders are institutional investors such as portfolio managers, insurance companies, investment and pension funds, banks, and sovereign wealth funds which bundle and invest the assets of a large number of customers, thus pursuing a diversification strategy in order to minimise investors' risk. The individual capital holdings are comparably small in most cases, and do not generally exceed a level of 10 percent. Mineral oil groups with petrol station networks in Germany, the German auto sector, as well as European telecommunications, chemical and biotechnology companies, for instance demonstrate marked horizontal shareholding.[127]

Figure I.38: Common ownership



Source: Own presentation

133. The Monopolies Commission already addressed the potentially competition-distorting influence exerted by institutional investors in its Biennial Report back in 2016, and most recently identified a major potential for problems in terms of competition once again in its Biennial Report 2018.[128] The discussion of anti-competitive impacts of common ownership, and of suitable regulatory measures, continues to take place at international level, both in academic research and in competition policy. After hearings and studies by the US antitrust authority, the Federal Trade Commission, the OECD and the European Parliament, most recently for instance the Australian

[126] Cf. Monopolkommission, Wettbewerb 2018, *supra* note 34.

[127] Ibid., para. paras. 420 et seq.; Seldeslachts, J./Newham, M./Banal-Estanol, A., Veränderungen bei gemeinsamen Eigentümerstrukturen deutscher Unternehmen, DIW Wochenbericht 30/2017, 2017; Decisions of the European Commission of 27 March 2017, M.7932 – Dow/DuPont and 21 March 2018, M.8084 – Bayer/Monsanto.

[128] Monopolkommission, V. Hauptgutachten, *supra* note 63, para. paras. 667 et seqq.; Monopolkommission, Wettbewerb 2018, *supra* note 34, para. paras. 416 et seqq.

Parliament also carried out a study on the topic.[129] The European Commission however also already takes account of the theories of harm in connection with common ownership in merger control proceedings.[130]

134. A risk in terms of competition emerges in the case of common ownership from different specific theories of harm, which are controversially discussed, in economic research.[131] The problem in terms of competition generally consists of shareholders having holdings in several firms of a market at the same time, and hence the overall market return perhaps being more important to such shareholders than the return of the individual companies in the portfolio. This might weaken the incentives to behave competitively in the market if this is disadvantageous to the overall market return. This applies both to the incentives of the management of the respective companies in the portfolio, and to the incentives for the diversified shareholders to encourage the companies in the portfolio to behave competitively. In addition to foregoing intensive competition in such a one-sided manner, common ownership might make it easier to coordinate market behaviour. A number of studies find empirical indications of anti-competitive effects caused by common ownership in individual markets.[132]

2.3.2.1 Almost 80 percent of industries in Europe affected by common ownership

135. The modified Herfindahl-Hirschman Index (MHHI), developed by Bresnahan and Salop, is largely used in empirical studies of concentration and common ownership of firms.[133] The model-theoretical foundation of the MHHI rests on the assumption that firms maximise not their own profits, but the returns of their shareholders. Horizontally-linked firms then act in a less competitive manner, so that the actual concentration of a market becomes greater than would appear in a calculation based solely on market shares using the HHI.

136. The MHHI for a market of N firms with M shareholders is defined as

$$MHHI = \sum_{j=1}^{N}\sum_{k=1}^{N}\frac{\sum_{i=1}^{M}\gamma_{ij}\beta_{ik}}{\sum_{i=1}^{M}\gamma_{ij}\beta_{ij}}s_j s_k = HHI + \underbrace{\sum_{j=1}^{N}\sum_{\substack{k=1,\\ k\neq j}}^{N}\frac{\sum_{i=1}^{M}\gamma_{ij}\beta_{ik}}{\sum_{i=1}^{M}\gamma_{ij}\beta_{ij}}s_j s_k}_{MHHI\Delta}, \quad (7)$$

where s_j designates the market share of firm j. The financial holding of shareholder i in a firm j is represented by β_{ij}, and additionally multiplied by γ_{ij}, the latter being a measure of the concomitant relative influence on corporate decisions.[134] As equation (7) shows, the MHHI can be broken down into a sum of the traditional HHI and the common ownership component MHHIΔ.[135] $\text{MHHI}\Delta = 0$ applies to a situation without horizontal shareholding, and the concentration of a market is correctly portrayed by the HHI. If, however, diversified shareholders are able to exert an influence, the second summand is positive, and the MHHI is higher than the

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[129] Parliament of the Commonwealth of Australia, Report on the implications of common ownership and capital concentration in Australia, House of Representatives Standing Committee on Economics, March 2021.

[130] Decisions of the European Commission of 27 March 2017, M.7932 – Dow/DuPont and 21 March 2018, M.8084 – Bayer/Monsanto.

[131] For an overview cf. amongst others Monopolkommission, Wettbewerb 2018, *supra* note 34, para. paras. 457 et seqq. or OECD, Common ownership by institutional investors and its impact on competition, Background Note by the Secretariat DAF/COMP(2017)10, 2017.

[132] Azar, J./Raina, S./Schmalz, M., Ultimate ownership and bank competition, Financial Management, 51, 2022, pp. 227–269; Azar, J./Schmalz, M.C./Tecu, I., Anticompetitive Effects of Common Ownership, The Journal of Finance, 73, 2018, pp. 1513–1565.

[133] Bresnahan, T.F./Salop, S.C., Quantifying the competitive effects of production joint ventures, International Journal of Industrial Organization, 4, 1986, pp. 155–175; the MHHI measure was further refined and generalised by O'Brien, D.P./Salop, S.C., Competitive Effects of Partial Ownership: Financial Interest and Corporate Control, Antitrust Law Journal, 67, 2000, p. 559.

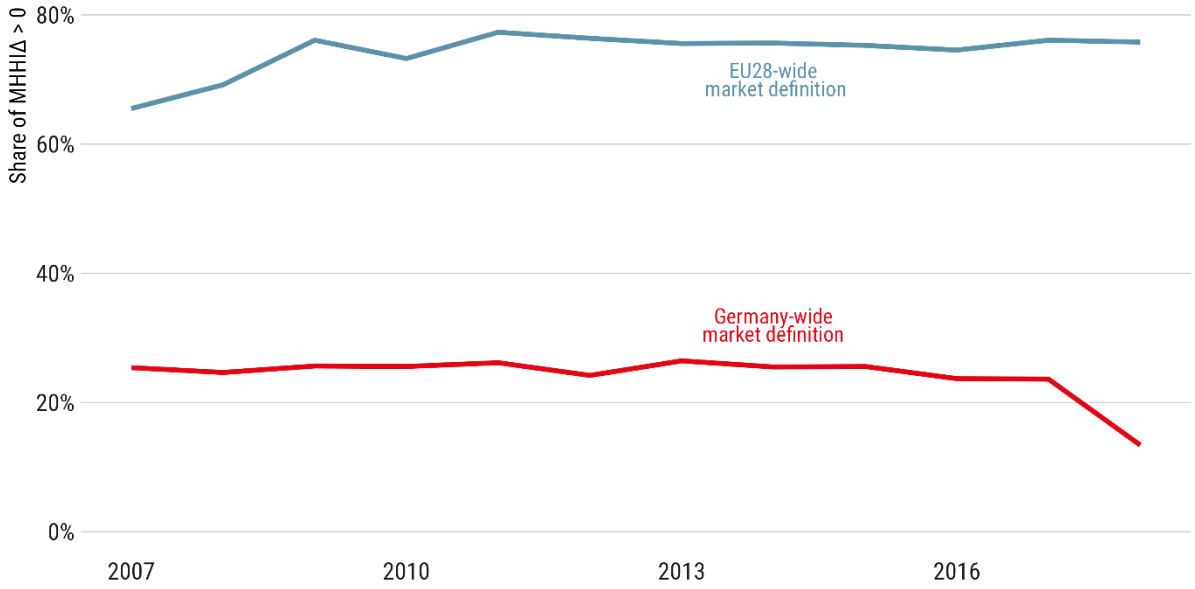
[134] Data on shareholdings from the Orbis database were used in the present Report for the empirical analysis of common ownership. Since these data do not contain any information on voting rights, it was presumed that the relative influence correlates in a linear manner with the shares held, so that $\gamma_{ij} = \beta_{ij}$ applies in each case.

[135] The Δ here stands for difference, and signalises that the component is responsible for the difference between HHI and MHHI.

HHI. The $\mathrm{MHHI}\Delta$ increases with the influence of shareholders or, respectively, their financial investment in several firms within a market.[136]

137. Data on shareholders from the Orbis database were used for the present Report in order to calculate annual $\mathrm{MHHI}\Delta_{st}$ for years t and industries s.[137] The individual industries were delimitated on the basis of groups ("three-digit level") of *Klassifikation der Wirtschaftszweige* WZ-2008. Since, unlike the AFiD data from the official statistics, the Orbis data also contain information on firms in other European countries, two variants of the indicator were also calculated: Only firms located in Germany were considered for $\mathrm{MHHI}\Delta_{st}^{D}$, whilst all firms located in the European Union (EU-28) were included with their respective shareholders for $\mathrm{MHHI}\Delta_{st}^{EU}$. The reason for using both variants is the fact that cross-sector analyses do not permit all particularities of individual markets to be incorporated. Whilst firms in the hospitality industry for instance tend to compete on a limited, regional level, automotive suppliers compete with one another at international level, regardless of where they are located. In order to do justice to this circumstance, both indicator variants constitute helpful scenarios for a narrower and a broader market delimitation. Figure I.39 presents both indicators in one chart. This makes it clear that, with an EU-wide market definition, a much larger number of industries is affected by horizontal shareholding by institutional investors. Almost 80 percent of all 3-digit industries in Europe are affected by common ownership.[138] Irrespective of the regional delimitation, the extent of cross-links was stable between 2007 and 2018.[139]

Figure I.39: Stable share of industries with horizontal shareholdings



Note: Share of all 3-digit industries with positive $\mathrm{MHHI}\Delta$ in the respective year.
Source: Orbis Europe; own calculations

[136] Cf. for a more detailed discussion of the MHHI Monopolkommission, Wettbewerb 2020, *supra* note 59, para. Tz. 487.

[137] Details on the data preparation, particularly on identifying horizontal shareholding within corporate groups, are described in Annex B, section 4.2.2.

[138] The European Commission reaches a similar conclusion in calculations for publicly-traded firms, and finds that "67% of all listed firms active in the EU are cross-held by common shareholders holding at least 5% in each company" (European Commission, JRC Technical Report, Common Shareholding in Europe, 2020, p. 5).

[139] The increase in the number of EU-wide horizontal cross-links between 2007 and 2009 is mainly due to an expansion of the dataset on shareholders contained in the Orbis database. The fall in the number of Germany-wide horizontal shareholdings from 2017 to 2018 is due to delays in reporting and preparing the data (*sample attrition*).

2.3.2.2 Ambiguous correlation between mark-ups and common ownership

138. The relationship between mark-ups and common ownership is analysed below in order to explore the degree to which horizontal shareholdings via diversified institutional investors may be responsible for the intensity of competition between companies in the portfolio. This involves determining the correlation of firms-specific mark-ups with the $\mathrm{MHHI}\Delta$ described above. Table I.13 presents the results of these regression models. Despite the only minor time variance within both indicators, the broad industry coverage in the AFiD panels permits insights on structural differences between more and less intertwined firms. To this end, the basic econometric model presented in equation (6) was adjusted so that the degree of common ownership of a 3-digit industry is also included instead of a digitalisation indicator. Mark-ups rise by roughly 2.4 percent in the manufacturing sector if the domestic horizontal shareholdings increase by one standard deviation (roughly 1.49). This positive correlation between common ownership and mark-ups in the German manufacturing sector is identical to the situation at European level.[140]

Table I.13: OLS results: Relationship between common ownership and mark-ups

	Manufacturing		Services	
	(1)	(2)	(3)	(4)
log(employees)	0.399 (0.022)***	0.403 (0.019)***	0.087 (0.009)***	0.099 (0.009)***
log(employees)^2	-0.031 (0.002)***	-0.030 (0.002)***	-0.003 (0.001)*	-0.005 (0.001)***
log(TFP)	0.101 (0.006)***	0.109 (0.005)***	0.420 (0.003)***	0.413 (0.003)***
High-tech sector	0.730 (9549.323)	0.049 (7298.066)	0.629 (2889.560)	-0.459 (5304.041)
MHHIΔ^{D}	0.016 (0.003)***		0.022 (0.011)	
MHHIΔ^{D} × High-tech sector	0.012 (0.011)		-0.031 (0.015)*	
MHHIΔ^{EU}		-0.018 (0.005)***		-0.012 (0.011)
MHHIΔ^{EU} × High-tech sector		0.008 (0.007)		0.009 (0.013)
FE: Year	✓	✓	✓	✓
FE: Firm	✓	✓	✓	✓
N	92,113	123,277	646,045	730,327
R^2 Adj.	0.928	0.929	0.810	0.808
R^2 Within	0.118	0.138	0.162	0.153

Note: * p < 0.05; ** p < 0.01; *** p < 0.001; clustered standard errors at the level of firm in parentheses. The common ownership indicators were divided by 10,000 in order to guarantee scaling between 0 and 1 in most cases.
Source: AFiD panel on industrial firms 2008–2017 (DOI: 10.21242/42221.2017.00.01.1.1.0); AFiD panel structural survey in the service sector 2008–2017 (DOI: 10.21242/47415.2017.00.01.1.1.0); KLEMS; own calculations

[140] Cf. Gibbon, A.J./Schain, J.P., Rising markups, common ownership, and technological capacities, DICE Discussion Paper 340, 2020.

139. Such a positive correlation however does not necessarily indicate greater market power of firms in industries with a high level of common ownership. Horizontal shareholdings can particularly increase the innovation output of the companies in the portfolio by facilitating or promoting knowledge and innovation spillovers between them.[141] Higher mark-ups for intertwined firms might accordingly indicate above-average innovative activity. Since such effects are likely to be relevant particularly in industries in which knowledge and innovation play a major role, it should be possible to observe a particularly high level of positive correlation in the high-tech sector. The interaction between the $\mathrm{MHHI}\Delta$ and an indicator variable for industries of the high-tech sector in the regression model however does not show a significant link for Germany (cf. Table I.13).[142] The empirical indications hence tend to favour greater average market power of firms in intertwined industries, which cannot be explained by greater innovativeness. It should however be stressed that no causal interpretation can be carried out on the basis of the correlation analysis performed here, as these may particularly be firms with above-average market power in which institutional investors invest. What is more, a quite different picture emerges in the service sector, where the mark-up falls by a good 1.8 percent when there is a corresponding increase in the number of horizontal shareholdings, but only in knowledge-intensive areas. The economic and statistical significance of the connection falls for German firms in both sectors when applying an EU-wide market delimitation (cf. models (2) and (4) in Table I.13). This indicates that the market delimitation proves to be crucial for the results when calculating the $\mathrm{MHHI}\Delta$, something which has received inadequate attention in research so far.

Summary: Determinants of mark-ups

- Firms in digitalised sectors of manufacturing exhibit on average a 3 percent higher mark-ups than do those in non-digitalised sectors. Service sector firms show a reverse relationship (-7.5 percent).
- High mark-ups show only a limited relationship with investments in intangible assets in the context of digitalisation, and hence permit one to conclude the existence of market power.
- Digitalisation leads to different competition effects in the two sectors:
    - Digitalisation enhances productivity among service firms, and boosts competition between them.
    - Investments in digitalisation in the manufacturing sector tend to lead to increasing barriers to market entry.
- Depending on the regional delimitation, 20 to 80 percent of industries are affected by common ownership by institutional investors..
- The competition effects of common ownership are ambiguous:
    - Manufacturing firms in intertwined industries have greater market power on average.
    - Service firms in knowledge-intensive areas, by contrast, have less market power.

2.4 Impact of mark-ups on productivity

140. The change in average mark-ups may have an impact at macroeconomic level. If mark-ups permit conclusions to be drawn as to the existence of pricing latitude, and hence as to market power, mark-up changes would have far-reaching consequences for the allocation of resources within the economy, and on social welfare as a whole. Rising market power hinders the economically-efficient allocation of resources and their utilisation where they might be put to the most productive use. Economic research is still exploring potential relationships between

[141] Cf. on this López, Á.L./Vives, X., Overlapping Ownership, R&D Spillovers, and Antitrust Policy, Journal of Political Economy, 127, 2018, pp. 2394–2437.

[142] The sub-division by technology and knowledge intensity of is based on a Eurostat classification of 2-digit industries (cf. https://ec.europa.eu/eurostat/cache/metadata/Annexes/htec_esms_an3.pdf). Indications of an innovation-boosting role of common ownership can however be found here at European level (cf. Gibbon/Schain, Rising markups, common ownership, and technological capacities, *supra* note 138).

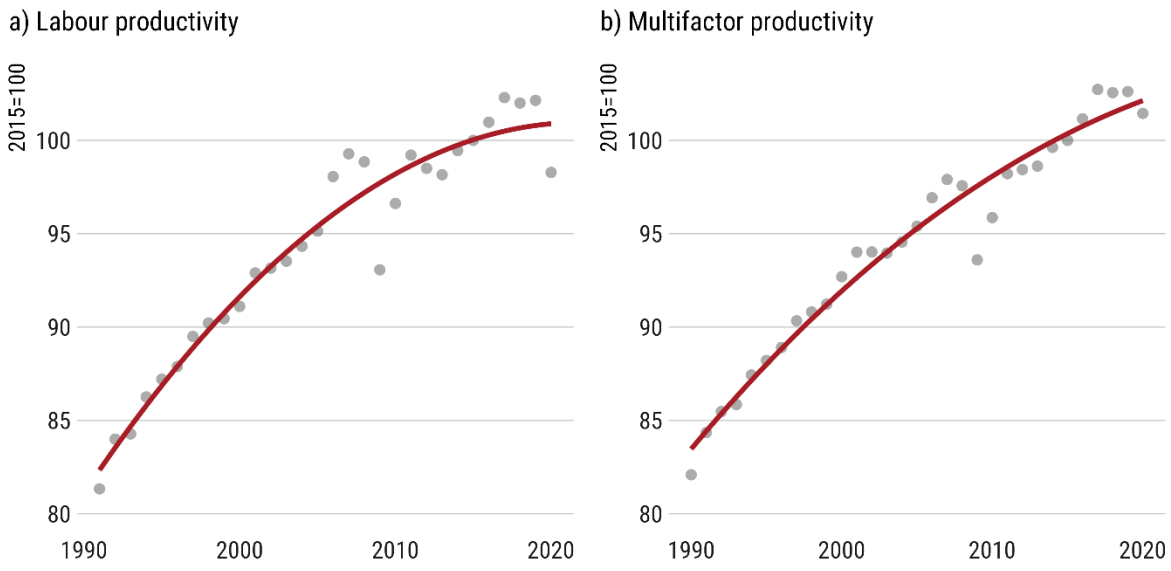
changes in competition intensity and different macroeconomic trends.[143] A drop in competition intensity is for instance being discussed as the cause of declining corporate investment, a falling wage ratio, rising income inequality, and diminishing productivity growth.[144] This section investigates the link between market power and productivity, both at the level of individual firms and at aggregate level, given the keen interest expressed in the economic policy arena.

2.4.1 Productivity trends in Germany

141. Productivity is a key economic variable, and is of particular interest in terms of economic policy. Productivity is generally the measure of the efficiency of the factor input in an economy or in production processes at sector or firm level. It hence reflects for instance both the general resource allocation and technological progress, and is therefore amongst other things a critical benchmark when it comes to tackling structural change caused by the digital transformation and the need for more climate-friendly production.

142. Germany has experienced a constant increase in productivity in recent decades, but this increase has gradually slowed from one year to the next. Figure I.40 illustrates this trend using developments in labour productivity, as well as multifactor productivity in Germany. Labour productivity here reflects macroeconomic production (gross domestic product) per employed person, in contrast to which multi-factor productivity, as a measure of efficiency, takes account of both production factors, namely labour and capital.

Figure I.40: Development in productivity growth in Germany



Note: The figure shows annual productivity values for Germany with 2015 as the baseline year. The red line shows the trend using a LOESS curve. Panel a) shows preliminary values from 2018 onwards.
Source: Federal Statistical Office, *VGR des Bundes – Produktivität, Arbeitnehmerentgelt, Bruttolöhne und -gehälter, Lohnstückkosten: Deutschland, Jahre, Wirtschaftsbereiche (Tabelle 81000-0017)*; OECD, Multifactor productivity (DOI: 10.1787/a40c5025-en); own presentation and calculations

[143] De Loecker et al., The Rise of Market Power and the Macroeconomic Implications, *supra* note 55; Autor, D. et al., Concentrating on the Fall of the Labor Share, American Economic Review, 107, 2017, pp. 180–185; Autor et al., The Fall of the Labor Share and the Rise of Superstar Firms, *supra* note 74; Gutiérrez, G./Philippon, T., Declining Competition and Investment in the U.S., NBER Working Paper 23583, 2017; Gutiérrez, G./Philippon, T., Investment-less Growth: An Empirical Investigation, NBER Working Paper 22897, 2016; Barkai, S., Declining Labor and Capital Shares, The Journal of Finance, 75, 2020, pp. 2421–2463.

[144] Cf. Monopolkommission, Wettbewerb 2018, *supra* note 34, sec. 3.3. Furthermore, price mark-ups are considered to be responsible for the constant inflation development of the past two decades and for the limited effectiveness of monetary policy measures in the Euro Area (cf. Kouvavas et al., Markups and Inflation Cyclicality in the Euro Area, *supra* note 91).

143. Such a slowdown of productivity growth can also be observed in many other economies worldwide which have a relatively high per capita gross domestic product.[145] The decline in aggregate productivity growth is also referred to in the discussion as a productivity paradox, as this reduction is observed in parallel to other developments which at least have the potential to boost productivity growth. First and foremost, this includes advances in technological change with considerable potential for innovation, above all in the shape of digitalisation, as well as increasing employee qualification levels and a rise in the significance of intangible assets.[146] Considerable attention was given to the continuous drop in productivity growth in economic policy circles in Germany and internationally, prior to the outbreak of the COVID-19 pandemic and the economic crisis to which this led.[147] One may anticipate this attention to grow once again if there is a phase of economic recovery from the COVID-19 crisis.[148] This is particularly the case given that productivity growth in Germany is projected to remain low.[149]

144. A wide variety of complementary determinants are discussed as causes of the decline in productivity growth. A slowdown of the internationalisation of economic activity, as reflected for instance in production relocations, as well as the successful integration of less productive workers into the labour market since 2005, might play a role in Germany.[150] A report by the Kiel Institute for the World Economy estimates that the fall in productivity growth in Germany is rather a process of economic adjustment caused amongst other things by a "normalisation process" in the wake of Reunification. Moreover, it considers that investment in information and communication technologies only had minor productivity effects, and that the sectoral shift in economic activity towards services had mainly enhanced the – comparably unproductive – area of business-related services.[151] A link between cross-market changes in competition intensity, and a drop in productivity growth, has only recently been discussed in the investigations of the causes. This link is further explored below by portraying potential channels.

2.4.2 The link between competition and productivity

145. Productivity is a key economic variable which may be considerably influenced by competition. This link is not only fundamentally important to the legitimation of competitive markets, and hence of competition policy, but for instance also to the legitimation of the liberalisation and promotion of international trade. There are a large number of empirical studies which suggest the existence of a positive productivity effect via competition-boosting measures.[152] The specific impact of such channels may be multifarious. One may make a fundamental distinction between effects of competition pressure on the productivity of individual firms and effects on aggregate productivity at market, sector or macroeconomic levels. A further distinction needs to be made between direct

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[145] Cf. amongst others OECD, OECD Compendium of Productivity Indicators, 2021, https://www.oecd-ilibrary.org/content/publication/f25cdb25-en; Gordon, R.J., The rise and fall of American growth: the U.S. standard of living since the Civil War, Princeton, New Jersey, 2017.

[146] See also section 2.3.1.

[147] In Germany, for instance, the Council of Economic Experts was entrusted with the task of establishing a National Productivity Board (NPB) with effect as per 1 August 2019 on the basis of a recommendation issued by the Council of the European Union. The Council of Experts issues an annual national productivity report in fulfilment of this task.

[148] Cf. on this OECD, OECD Compendium of Productivity Indicators, *supra* note 143.

[149] Cf. Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung, Produktivitätswachstum durch Innovation: Digitalisierung vorantreiben, Nationaler Produktivitätsbericht 2020, 2020.

[150] Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung, Jahresgutachten 2015/16: Zukunftsfähigkeit in den Mittelpunkt, Wiesbaden, 2015.

[151] Ademmer, M. et al., Produktivität in Deutschland: Messbarkeit und Entwicklung, Kiel, 2017.

[152] Cf. for example Nicoletti, G./Scarpetta, S., Regulation, productivity and growth: OECD evidence, Economic Policy, 18, 2003, pp. 9–72; Griffith, R./Harrison, R./Simpson, H., Product Market Reform and Innovation in the EU, The Scandinavian Journal of Economics, 112, 2010, pp. 389–415; Aghion, P. et al., Entry and Productivity Growth: Evidence from Microlevel Panel Data, Journal of the European Economic Association, 2, 2004, pp. 265–276.

effects at a given level of technology, and indirect productivity effects brought about by innovation. An overview of the potential channels is provided below.

2.4.2.1 Direct effects at the firm level

146. A competitive market environment may motivate the management of a firm to generate a competitive advantage. Processes may for instance be restructured, or contracts re-negotiated. Moreover, new production technologies and management practices may be adapted which do not strictly count as innovations as they would only be new to the firms adapting them. Management might be more motivated to shoulder such efforts if competition pressure provided the appropriate incentive.[153]

147. The most productive firms are however not necessarily also those which are subject to the greatest competitive pressure. For instance, Autor et al. find indications of increasing importance attaching to large productive firms which at the same time hold considerable market power.[154] De Loecker and Warzynski also find a positive link between firms' mark-ups and their productivity.[155] These observations do not however have to be considered as contradictory, but rather point to the dynamic nature of the links between competitive pressure and productivity development. One could for instance presume that the competitive pressure on today's leading firms was indeed the reason in the past for their being incentivised to gain a competitive advantage through innovation in order to escape competition pressure – at least for a time. The extent to which competitive pressure leads to innovations is explored in more detail in the next section.

2.4.2.2 Indirect innovation effects at the firm level

148. Competition pressure may exert an indirect effect on productivity via the innovation behaviour of firm. Innovations ensure technological progress, and constitute a major driving force for increases in efficiency. This particularly applies to organisational and process innovations, but also to product innovations if these lead to increases in efficiency in downstream production processes. Competition may incentivise firms to obtain a competitive advantage by investing in research and development activities and innovations, and hence higher profit margins. The incentive to innovate would therefore drop as competition pressure fell, and increasing market power or indeed a monopoly position would lead to declining productivity, or at least to the rate of productivity growth flattening out.

149. Competition may however also have a negative impact on innovations. Cost-intensive innovation efforts, for instance in the shape of research and development expenditure, are easier to tackle for firms which have more financial resources. Companies which were better able in the past to achieve a good financial position due to a powerful competitive position and wider profit margins might therefore be better able to fund innovative efforts. Companies which have market power might also be better able to shoulder the risks of research and development projects the success of which is by no means guaranteed.

150. These two contrary effects of competition intensity on the innovativeness and hence the productivity of firms have been taken into account together in the widely-acclaimed empirical study by Aghion et al.[156] The result shows a non-linear link between competition and innovativeness: Competition thus certainly has the potential to have a positive impact on innovation, but only if the competitors are producing at a comparable technological

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[153] This hypothesis is also known as the "quiet life hypothesis", and can be traced back to Hicks, J.R., Annual Survey of Economic Theory: The Theory of Monopoly, Econometrica, 3, 1935, pp. 1–20. Empirical evidence of a positive link between competition and improved management practices is provided amongst others by Bloom, N./Van Reenen, J., Measuring and Explaining Management Practices Across Firms and Countries, The Quarterly Journal of Economics, 122, 2007, pp. 1351–1408.

[154] Autor et al., The Fall of the Labor Share and the Rise of Superstar Firms, *supra* note 74.

[155] De Loecker/Warzynski, Markups and Firm-Level Export Status, *supra* note 75.

[156] Aghion, P. et al., Competition and Innovation: an Inverted-U Relationship, The Quarterly Journal of Economics, 120, 2005, pp. 701–728.

level. In this case, competition provides an incentive to escape competition through innovation, and leads to a greater degree of innovativeness and productivity ("escape competition effect"). This in turn leads to a widening technological gap between technology leaders and laggards. If however the technological gap to the respectively leading firms becomes too wide, competition may indeed have a negative impact on the innovativeness of technological laggards ("Schumpeterian effect").

2.4.2.3 Productivity effects at aggregate level

151. A distinction needs to be made between the effects of competition intensity on productivity at the level of firms, and "reallocation" or "selection" effects at aggregate level. This relates to the reallocation of production factors of relatively unproductive firms towards more productive ones, or from relatively unproductive industries towards more productive ones. Business demographics, i. e. company start-ups and closures, play a decisive role in the reallocation. For instance, if suppliers who have below-average productivity withdraw from the market because of competition pressure in a market or in an economy, this leads to a rise in aggregate productivity. Empirical studies attribute a drop in the business-demographic momentum to reduced productivity growth.[157] Well-functioning competition should particularly ensure such allocative efficiency in the shape of lower barriers to market entry and market exits.

152. Germany experienced a considerable decline in the business dynamics in terms of company start-ups and closures in recent years. A study by Bersch et al. shows that a drop in the momentum is prevalent in this regard in almost all regions and sectors in Germany.[158] The only exception here is the IT sector and the Berlin region. Figure I.41 shows that the rate of entries – as a share of company start-ups relative to all active firms – was still above the dropout rate – as a share of company closures relative to all active firms – in Germany up to 2011, and hence there were more market entries than exits. Such a ratio is beneficial in terms of competition, since the number of competitors increases, and at the same time there is greater potential for new firms to bring innovations into the markets. The ratio of entry and exit rates however reversed in Germany between 2011 and 2015. The entry rate has been above the exit rate again since 2015, but a much more pronounced drop in the number of entries is observed in comparison to exits in total. A contribution to productivity can hence be observed as a result of market entries and exits with regard to aggregate (labour) productivity development in Germany which tends to be small in comparison to the contribution made by improvements in productivity in established firms.[159]

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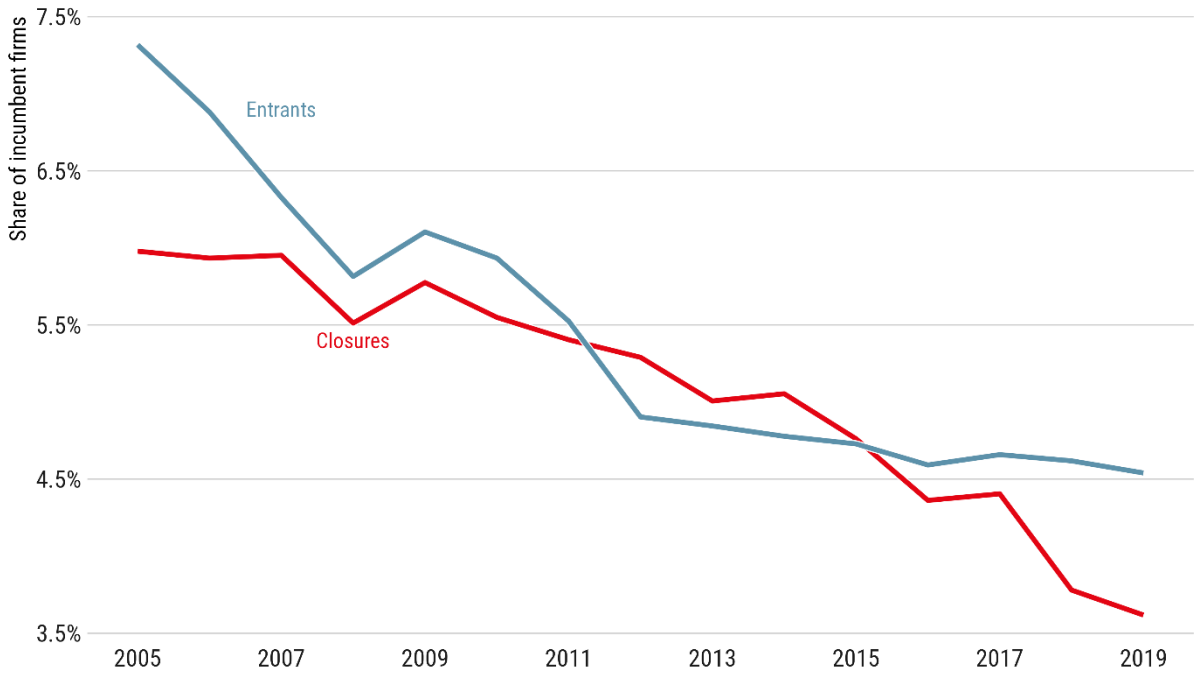
[157] Cf. for example Decker, R.A. et al., Declining Business Dynamism: What We Know and the Way Forward, American Economic Review, 106, 2016, pp. 203–207; Bartelsman, E./Haltiwanger, J./Scarpetta, S., Cross-Country Differences in Productivity: The Role of Allocation and Selection, American Economic Review, 103, 2013, pp. 305–334; Bijnens, G./Konings, J., Declining business dynamism in Belgium, Small Business Economics, 54, 2020, pp. 1201–1239.

[158] Bersch, J. et al., Industry and Productivity Dynamics in Germany, Produktivität für Inklusives Wachstum 12, Gütersloh, 2021.

[159] Ibid.

Figure I.41: Company start-ups and closures in Germany



Source: Bersch, J. et al., Industry and Productivity Dynamics in Germany, productivity for inclusive growth, 12, Gütersloh, 2021; own presentation

2.4.3 Positive effects on productivity in services, but also negative ones in manufacturing

153. As already described in section 2.3.1.1, total factor productivity was calculated on the basis of the official data for the analysis of company productivity in the present Report. Total factor productivity (TFP) reflects the value added of the combination of all production factors. The following regression model is estimated in order to investigate the relationship between firm productivity and mark-ups:

$$\ln(\Omega_{ijt}) = \alpha_{ij} + \tau_t + \beta_1 \ln(\mu_{ijt-1}) + \beta_2 \ln(\mu_{ijt-1})^2 + \varepsilon_{ijt} \quad (8)$$

This involves estimating the influence of the last year's mark-ups μ_{ijt-1} on the log productivity Ω_{ijt} of firm i in industry j at time t. In order to take account of a potentially non-linear relationship, the mark-ups were also included as a second-degree polynomial. Furthermore, year, firmand industry fixed effects are also taken into account in τ_t and α_{ij}, depending on the specification.

154. The direction of the relationship between mark-ups and firm-specific productivity is ambiguous. Firstly, considerable market power and a high mark-up might lead to a drop in productivity because for instance high margins remove the pressure to innovate; secondly, high productivity could lead to high mark-ups because innovative products become a unique selling point. In order to mitigate this simultaneity problem, the panel structure of data can be used to estimate the firm-specific productivity in a given year based on the price mark-ups of the previous year.[160] This lagged structure permits one to rule out the productivity of an firm affecting its mark-up because the latter is from the past.

[160] Ganglmair et al., Price Markups, Innovation, and Productivity: Evidence from Germany, *supra* note 95.

Table I.14: Effect of price mark-ups on company productivity

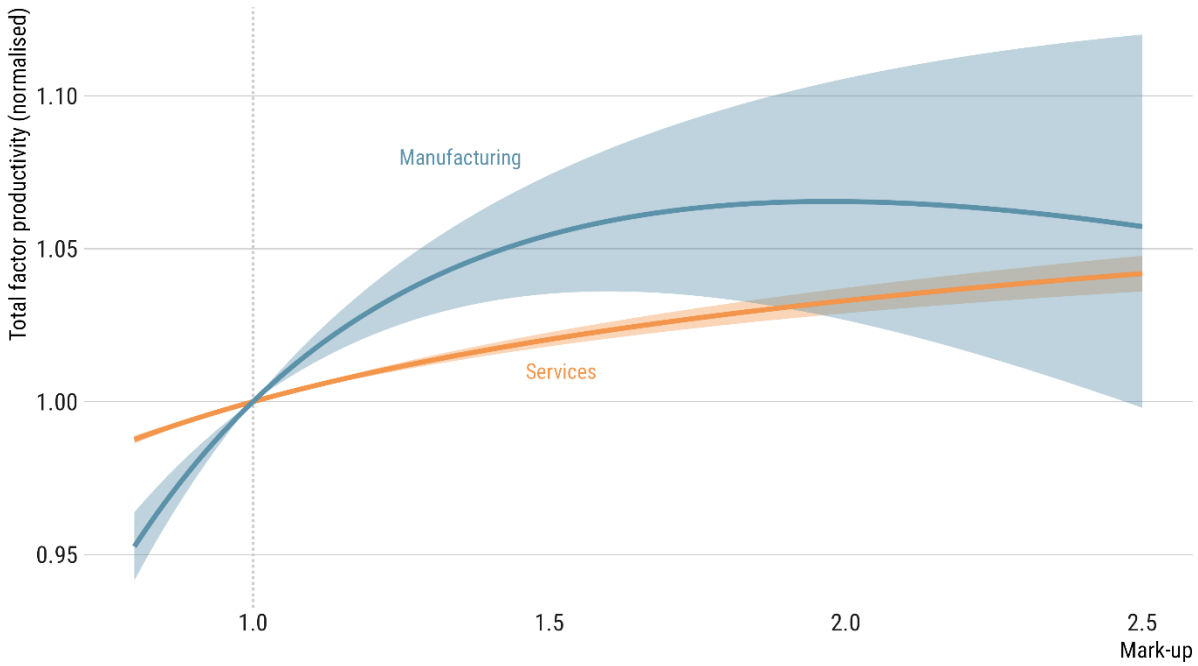
	Manufacturing		Services	
	(1)	(2)	(3)	(4)
$\ln(\text{mark-up}_{t-1})$	0.191 (0.024)***	0.187 (0.024)***	0.051 (0.003)***	0.054 (0.003)***
$\ln(\text{mark-up}_{t-1})^2$		-0.137 (0.033)***		-0.010 (0.002)***
N	98,860	98,860	522,859	522,859
R^2 Adj.	1.000	1.000	0.999	0.999
R^2 Within	0.008	0.009	0.003	0.003
FE: Year	✓	✓	✓	✓
FE: Firm	✓	✓	✓	✓

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; clustered standard errors at the level of firms in parentheses.
Source: AFiD panel on industrial firms 2008–2017 (DOI: 10.21242/42221.2017.00.01.1.1.0); AFiD panel structure survey in the service sector 2008–2017 (DOI: 10.21242/47415.2017.00.01.1.1.0); KLEMS; own calculations

155. The results of this estimation are presented in Table I.14. This table firstly shows an average positive effect of high mark-ups on company productivity in both sectors. The non-linear specifications of models (2) and (4) furthermore permit the effect on productivity to vary within a sector. These specifications suggest that mark-ups have a negative effect on productivity in manufacturing when they exceed a level of about 1.6, whilst in the service sector a consistently positive impact can be seen across the observed range since the productivity-reducing impact does not take effect until a higher mark-up level is reached. The increase in productivity associated with higher mark-ups in manufacturing is a maximum of 6.5 percent in comparison to the TFP level at price mark-ups of 1; productivity in service firms increases by an average of up to 5 percent (cf. Figure I.42).[161]

[161] These effects are much slighter in comparison to a correlation analysis, which disregards causal interaction and does not use the previous year's price mark-ups (cf. section 7 in Annex B).

Figure I.42: Positive mark-ups slightly increase productivity



Note: For comparability between sectors, productivity was normalised at the value with a price mark-up of 1. Values are estimates based on the regression models in Table I.14 with squared price mark-up term (columns (2) and (4)). Transparent surfaces represent confidence intervals at 95 % level.
Source: AFiD panel on industrial firms 2008–2017 (DOI: 10.21242/42221.2017.00.01.1.1.0); AFiD panel structural survey in the service sector 2008–2017 (DOI: 10.21242/47415.2017.00.01.1.1.0); KLEMS; own calculations

Summary: Impact of mark-ups

- High mark-ups and the associated market power of firms can have several contrary effects on aggregate productivity.
- The overall effect is initially positive in companies where market power is low: Productivity increases by up to 6.5 percent in manufacturing, and by up to 5 percent in the service sector.
- High mark-ups of more than 1.6 reduce productivity in manufacturing. The positive effect perseveres in service firms where price mark-ups are high.

2.5 Impact of Russia's war against Ukraine on market structures

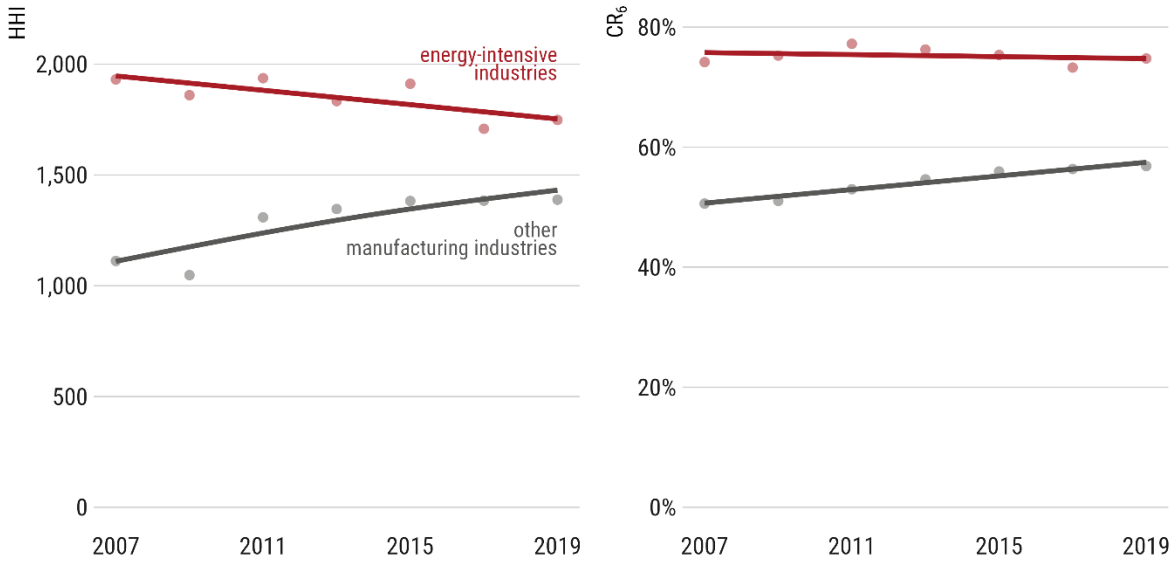
156. Russia's military attack on Ukraine on 24 February 2022 has far-reaching consequences for the German economy. It has caused the prices of raw materials, particularly of fuels, wheat and metals, to rise steeply. The wholesale prices of mineral oil products went up by 63 percent in April 2022 compared to the same month of the previous year.[162] This also poses the question from a competition perspective of the extent to which the conflict has the potential to impact market structures across sectors. The price rises in preliminary and intermediate products, and the disruption of supply chains caused by the economic sanctions that have been imposed on Russia, as well as the harmful effect on economic activity in Ukraine, may not only lead to economic repercussions in the medium term, but also influence competition in individual markets. One might presume that individual firms withdraw from markets because of increased production costs, thus leading to an increase in the industry

[162] Cf. Federal Statistical Office, Press release No. 203 of 1 May 2022, *Großhandelspreise im April 2022: +23,8 % gegenüber April 2021. Stärkster Anstieg der Großhandelspreise seit Beginn der Erhebung im Jahr 1962*, URL: https://www.destatis.de/DE/Presse/Pressemitteilungen/2022/05/PD22_203_61281.html.

concentration. The second oil price crisis at the end of the 1970s, and the associated weak economic development in 1979 to 1981, for instance led to an increase in the concentration in the large majority of industries.[163]

157. Such effects are especially likely in industries characterised by energy-intensive production in the manufacturing sector, which would require special attention by competition policy if they already exhibited a relatively high levels of concentration. Figure I.43 shows the development of concentration in energy-intensive manufacturing industries in Germany.[164] They show a much higher level of industry concentration than other manufacturing industries. Concentration has however tended to decrease over the past years, whilst it has increased in the other areas of manufacturing. The average industry concentration fell by roughly 12 percent in the energy-intensive industries between 2007 and 2019, whilst the HHI increased by a good 25 percent in the other manufacturing industries.

Figure I.43: A drop in the concentration of firms in energy-intensive industries



Note: Trends and annual means are based on Herfindahl-Hirschman Indices and on CR_6 concentration ratios for 4-digit industries in accordance with WZ 2008, and are weighted by turnover. Trends correspond to REML estimates of GAM models with cubic splines.
Source: Federal Statistical Office, special statistical preparation of concentration data commissioned by the Monopolies Commission based on the official business register; own calculations

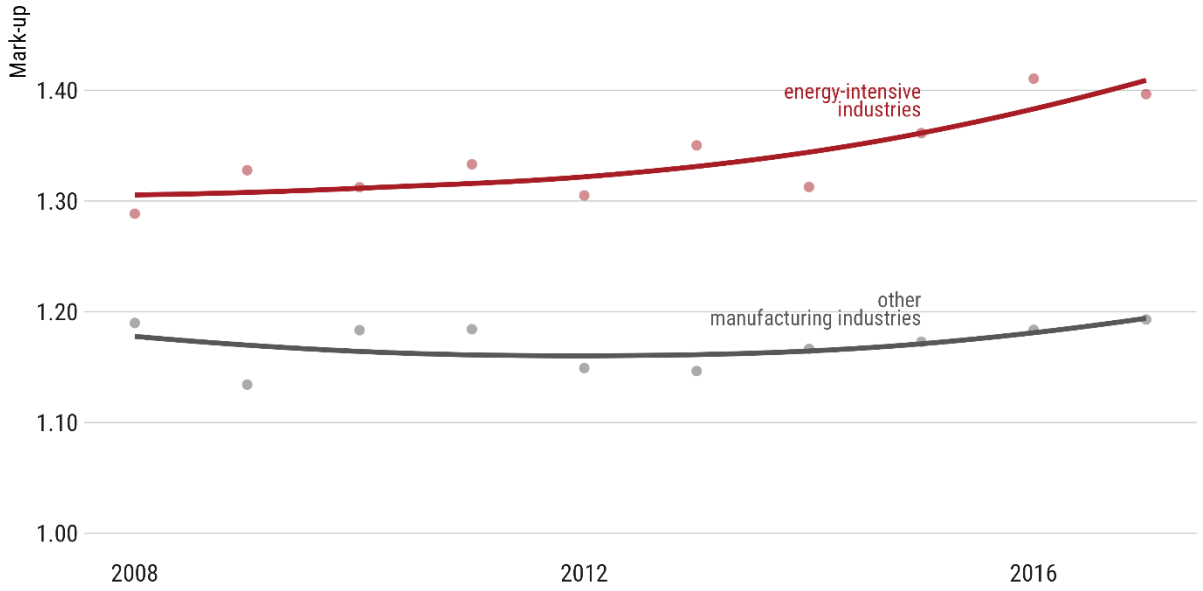
158. A higher concentration signalises a greater risk of competition problems (e.g. due to making coordinated behaviour easier), but does not as a matter of principle indicate a lack of competition. A rising industry concentration may also be an expression of increased efficiency. Firm-level mark-ups may help obtain a better understanding of the competition situation. Sectors with a high level of concentration in which firms also achieve high mark-ups may, firstly, indicate competition problems, but are secondly better equipped to compensate for increased costs – such as those resulting from higher energy prices – without an increase in concentration. One may however rather expect firms to leave the market in sectors with low mark-ups when costs rise, and hence

[163] Cf. Monopolkommission, V. Hauptgutachten, *supra* note 63, para. par. 274.

[164] The concept of "energy-intensive" industries has not been finally and authoritatively defined. This has meant that for the present data analysis a number of industries from manufacturing were attributed to the energy-intensive industries which form part of the European emissions trading system. The following 3-digit industries were classified as energy intensive: Manufacture of pulp, paper and paperboard; Cokery; manufacture of petroleum; Manufacture of basic chemicals, fertilisers and nitrogen compounds, plastics and synthetic rubber in primary forms; Manufacture of basic iron and steel and of ferro-alloys; Manufacture of tubes, pipes, hollow profiles and related fittings, of steel; Other non-ferrous metal production; Casting of metals; Manufacture of glass and glass products; Manufacture of refractory products; Manufacture of clay building materials; Manufacture of cement, lime and plaster.

market structural effects to be triggered by rising production costs.[165] Figure I.44 shows the development in average price mark-ups in energy-intensive industries of the manufacturing sector. Energy-intensive manufacturing industries experience much higher mark-ups in Germany than do other manufacturing industries. Moreover, a much more pronounced increase has been observed since 2014.

Figure I.44: Rising and systematically higher price mark-ups in energy-intensive industries



Source: AFiD panel on industrial firms 2008–2017 (DOI: 10.21242/42221.2017.00.01.1.1.0); own calculations

159. To sum up, Russia's invasion of Ukraine might initially have a particularly strong impact on energy-intensive production in Germany via major rises in energy prices. The energy-intensive industries of the manufacturing sector in Germany are characterised by a relatively high concentration and above-average mark-ups. Whilst the high level of concentration as it stands already gives cause for concern that this might rise even higher as a result of rising energy prices, this concern is lessened by the high mark-ups, which firms might use to absorb the rising production costs. The applicability of this conclusion however vitally rests upon mark-ups in energy-intensive industries not being caused by high fixed production costs.

Summary: Impact of the Russian-Ukrainian war on market structures

- Rising energy and raw materials prices triggered by the Russian invasion of Ukraine may particularly affect competition in energy-intensive sectors.
- Energy-intensive manufacturing industries in Germany are characterised by a high concentration and above-average market power.
- The relatively high mark-ups might generally enable firms to compensate for rising production costs, and hence minimise impacts on the market structure.

[165] The distribution of mark-ups may play an additional role since, if all firms in a market need to take rising energy prices into account in the same way, there will be no unequal treatment in a market if cost and price structures are homogeneous. The more heterogeneous the mark-ups are, the more likely it is that market exits, and hence concentrative developments, will take place. The significance of import competition and the influence of energy price rises might also influence the prices of imports in this context.

2.6 Conclusion

160. The aggregate industry concentration in Germany remained largely constant in the period from 2007 to 2019. There are however marked differences between industries. Industries of the service sector, which are already relatively highly concentrated, for instance show a marked increase in concentration in the observation period. These particularly include the area of wireless telecommunications, postal activities and interurban passenger rail transport.

161. Mark-up trends in Germany continue not to appear quite as worrying in aggregate terms as is the case for instance in the USA. A marked increase can however be observed in individual industries. The highest increase by far is recorded for the manufacture of coke and refined petroleum products, even though the mark-up there was already 30 percent above the average of the manufacturing sector in 2008. The results also show that Germany – also in distinction to other countries – does not display any disproportionately marked increase in mark-ups at the upper tail of the distribution. It is, however, evident that large firms were able to increase their mark-ups in the observation period, and that this actually took place against the sectoral trend in the service sector. Detailed analyses moreover show that it tends to be company-specific changes in mark-ups and gains in the turnover of firms with high price mark-ups that are responsible for sectoral developments, and not the redistribution of market shares between firms.

162. By comparing different methods that are widely used in the literature on the estimation of mark-ups, this report has shown that the specific methodology used may exert a major influence on the results, and hence always needs to be taken into account when interpreting mark-up trends. This discussion also served to corroborate the robustness of the presented trends.

163. It was possible to show with regard to the interpretation of mark-ups as an indicator of market power that high mark-ups are not explained exclusively by investments and associated increases in productivity. However, rising mark-ups are accompanied by increased investment in intangible assets related to digitalisation, and at the same time by higher productivity, particularly in the service sector.[166] In manufacturing too, rising price mark-ups partly reflect high fixed cost investments in digitalisation. High investments in fixed costs and intangible assets may however mean in turn that barriers to market entry become higher, despite an impact that initially leads to increased productivity.

164. Overall, digitalisation processes appear to be a potential cause for rising mark-ups in Germany, particularly in manufacturing. This sector shows a higher average mark-up in highly-digitalised sectors. The results in the service sector suggest a competition-boosting relationship, since mark-ups in highly-digitalised industries are lower here on average than they are in less digitalised industries.

165. The context of common ownership between firms via indirect horizontal holdings was analysed as a further potential cause of rising price mark-ups. The results show that almost 80 percent of industries in Europe are affected by horizontal shareholdings. Furthermore, mark-ups of firms in industries with common ownership in the German manufacturing sector are higher on average, and might hence indicate greater market power. No indications emerge of a facilitation of knowledge and technology externalities by common ownership. A completely different picture emerges for the German service sector, where the mark-up falls when there is a corresponding increase in the number of horizontal shareholdings, but only in knowledge-intensive industries.

166. The impact of rising mark-ups on productivity growth are not linear in nature. In manufacturing in particular, mark-ups initially have a positive impact on firms productivity, but this effect becomes negative beyond a certain mark-up level. In the service sector, by contrast, the effect remains positive up to a much higher mark-up level. The impact of mark-ups on the development of aggregate productivity accordingly appears to be sector specific.

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[166] The UK competition authority, amongst others, and Affeldt et al., reach the conclusion that mark-ups in Europe do not exclusively reflect fixed costs and investments and hence indicate market power (Competition and Markets Authority, The state of UK competition, *supra* note 57; Affeldt et al., DIW Berlin, *supra* note 60).

This is also suggested by the relationship between mark-ups and investment activity, which appears to be much more marked in the service sector in Germany.

A. Appendix to aggregate business concentration in Germany

1 Notes on the methods applied

1.1 The calculation of the companies' domestic value added

Calculation of the value added of industrial, trade and service companies

568. The domestic value added of industrial, trade and service companies is calculated by correcting the earnings before interest and taxes (EBIT) by expenditures that are part of the value added. This includes for instance personnel costs.[1] The result of this calculation is the net value added at factor costs:

Earnings before interest and taxes (EBIT)
+ personnel costs
+ salaries for the members of the supervisory board and comparable boards
./. other taxes
+ unconsolidated income from interest of financial institutes included in the group of consolidated companies

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= net value added at factor costs

Calculation of the value added of financial institutes

569. The value added of financial institutes has been calculated since the XVIII Biennial Report by deducting the input costs corrected for personnel expenditure from the aggregate of interest income and commission income.[2] Analogously to the procedure followed in the case of non-financial institutes, a correction is furthermore carried out for the unconsolidated interest income of the non-financial institutes included in the group of consolidated companies:

Interest received
+ net commissions
./. administrative costs (minus personnel costs)
./. unconsolidated interest income of the consolidated non-financial institutes

---

= net value added at factor costs.

Calculation of the value added of insurance companies

570. Insurance companies' domestic value added is largely calculated using the same method as is used for industrial, service and trade companies. A special item, however, is "interest accruing to insured parties". Insurance companies form reserves in order to cover anticipated damage. This is in part insured parties' capital. The interest generated from this capital forms part of the value added, which is however not posted in the income statement. This part of the value added must therefore be estimated. The domestic value added of insurance companies is thus calculated as follows:

Net profit/loss

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1 Detailed information particularly on the recording of the income from interest of the financial institutes included in the group of consolidated companies can be found in Monopolkommission, XVIII. Hauptgutachten: Mehr Wettbewerb, wenig Ausnahmen, Baden-Baden, 2010, para. 5 (annex A).

2 The concept of "Financial Intermediation Services Indirectly Measured" (FISIM) is used as part of the national accounts in order to calculate financial institutes' value added. This concept can however not be easily transferred to an assessment of microeconomic impacts. The methodology used by the Monopolies Commission to calculate the value added of financial institutes therefore differs from that used in drawing up the national accounts (cf. for more detail on this Monopolkommission, XXII. Hauptgutachten: Wettbewerb 2018, Baden-Baden, 2018, para. 5 (annex B)).

./. extraordinary income
+ personnel costs
+ salaries for members of the supervisory board and comparable boards
+ taxes on income and profit
./. profit from the transfer of losses
./. profit from capital investment, not including profit from land, rights equivalent to real property rights and buildings, including buildings on non-owned land
+ expenditure from capital investment, not including personnel costs included herein
+ profits transferred on the basis of profit pooling, of a profit transfer and partial profit transfer agreement
+ unconsolidated interest income of financial institutes included in the group of consolidated companies
+ interest accruing to insured parties

= net value added at factor costs.

571. The item "interest accruing to insured parties" is estimated as follows:

(underwriting reserves^{+}
+ liabilities from direct insurance business^{+}
./. claims for paid acquisition costs^{+})
/ (balance sheet total^{+abs}
./. subscribed capital unpaid^{+}
./. own shares^{+}
./. claims for paid acquisition costs^{+}
./. net loss^{+})
* (profit from capital investment, not including profit from land, rights equivalent to real property rights and buildings, including buildings on non-owned land
./. expenditure from capital investment, not including personnel costs included herein)

Figures marked with (+) are a two-year average.

1.2 Procedure for estimating domestic value added

572. Procedures for estimating domestic value added are used if the data required to calculate domestic value added are unavailable, or are only available in part. If it is possible to determine the worldwide value added of the group of companies using the published consolidated financial statement, it is possible in these cases to estimate the domestic value added using comparisons in size. Depending on the data available, personnel costs, the number of employees, and/or the business volume, [3] are used as a benchmark for this purpose. The domestic value added may be derived from the worldwide value added of the group of companies on this basis:

$$Value\ added_{domestic}^{estimated} = \frac{\text{Reference value}_{domestic}}{\text{Reference value}_{world}}\ Value\ added_{world}$$

573. These estimation procedures are based on the assumption that the ratio of the domestic reference value to the worldwide reference value corresponds to the ratio of the domestic value added to the worldwide value added. This assumption was examined in the past by evaluating cases in which both worldwide and domestic value addeds were available. Such analyses provided the result that using personnel costs as a reference value comes closest to the actual value added of the domestic group of companies. However, the personnel costs of the domestic group of companies are often not available as well. In the majority of cases, the estimate is therefore based on the mean of the ratio of domestic to total business volume and the ratio of the headcount in Germany to the total number of employees, which also provides acceptable results. Total domestic value added had to be

[3] Business volume is understood for industrial, service and trade companies as turnover, for financial institutes as the balance sheet total, and for insurance companies as gross written premiums.

estimated in 18 cases (2018: 22) in the reporting year 2020 using an estimation procedure on the basis of such ratios.[4]

574. Personnel costs were used as a ratio in three cases (C. H. Boehringer Sohn AG & Co. KG, Rethmann SE & Co. KG, Carl Zeiss AG), the average of the ratio between business volume and headcount in 13 cases (REWE-Gruppe, Roche-Gruppe Deutschland, Airbus-Gruppe Deutschland, HGV Hamburger Gesellschaft für Vermögens- und Beteiligungsmanagement mbH, STRABAG-Gruppe Deutschland, Shell-Gruppe Deutschland, Liebherr-International-Gruppe Deutschland, DEKRA SE, HDI Haftpflichtverband der Deutschen Industrie V.a.G., maxingvest AG, Dirk Rossmann GmbH, United Internet AG, VINCI-Gruppe Deutschland), and exclusively the headcount ratio in two cases (ING-Gruppe Deutschland and Rolls-Royce-Gruppe Deutschland). When the headcount ratio is used to estimate the domestic value added, the value added no longer offers any advantage over the headcount when used as a criterion of size to determine the Top 100. This estimation procedure is therefore only used in cases in which one would otherwise have to accept large companies missing from the Top 100, whilst they would very probably be among the Top 100 if the domestic value added was known.

575. Other estimation methods are used where it was not possible to determine the domestic figures necessary for the estimate procedure based on ratios. Where the majority of domestic value added is generated by a small number of companies in Germany, the value added of the companies in question was added up in these cases (Procter & Gamble-Gruppe Deutschland). The value added of the Amazon-Gruppe Deutschland was also estimated using this method, although the number of combined companies in Germany is comparatively large, at 28 companies.[5] If the vast majority of the domestic business of a group of companies is generated by one single company, the domestic value added is approximated by evaluating an individual financial statement (INA-Holding Schaeffler GmbH & Co. KG, Philip Morris International-Gruppe Deutschland and Infineon Technologies AG).[6]

576. Public data are regularly not available in food retailing for specific reasons of organisational structure. Domestic value added is estimated in these cases on the basis of the domestic sales of the group, weighted with the value added/turnover ratio of the subsidiaries belonging to the group (EDEKA-Gruppe, Schwarz-Gruppe and Aldi-Gruppe). Here domestic sales are based in turn on estimates of the data provider TradeDimensions.[7]

577. The domestic value added of the Generali-Gruppe Deutschland must be regarded as lower bound for the domestic value added. It was impossible to determine the interest accruing to insured parties because of lack of data. Therefore, the stated domestic value added is also an estimate.

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4 These cases are labelled with an * in Table I.1.

5 These cases are labelled with an S in Table 1.1.

6 These cases are labelled with an E in Table 1.1.

7 These cases belong to the cases labelled with an * in Table 1.1.

2 Supplementary tables

Table A.1: Real value added of the Top 100 in the period 1978 to 2020

Year	Real[1] value added of the Top 100 in m EUR	Change compared to previous period in %	Real[1] value added of the total economy in m EUR	Change compared to previous period in %	Share in %
1978	197,716		1,020,635		19.37
1980	207,452	4.9	1,052,307	3.1	19.71
1982	201,516	-2.9	1,038,158	-1.3	19.41
1984	208,458	3.4	1,102,175	6.2	18.91
1986	221,713	6.4	1,157,586	5.0	19.15
1988	231,016	4.2	1,224,068	5.7	18.87
1990	245,912	6.4	1,344,671	9.9	18.29
1992	221,921	-9.8	1,260,589	-6.2	17.60
1994	254,708	14.8	1,298,529	3.0	19.62
1996	257,929	1.3	1,488,655	14.6	17.33
1998	290,655	12.7	1,555,447	4.5	18.69
2000	326,930	12.5	1,629,105	4.7	20.07
2002	280,393	-14.2	1,668,571	2.4	16.80
2004	283,356	1.1	1,727,748	3.5	16.40
2006	318,830	12.5	1,815,480	5.1	17.56
2008	294,483	-7.6	1,891,582	4.2	15.57
2010	297,177	0.9	1,838,154	-2.8	16.17
2012	307,194	3.4	1,927,419	4.9	15.94
2014	310,737	1.2	1,987,206	3.1	15.64
2016	306,246	-1.4	2,057,327	3.5	14.89
2018	314,735	2.8	2,138,270	3.9	14.72[2]
2020	280,795	-10.8	2,005,713	-6.2	14.00

[1] The figures for the respective prices were deflated using the implicit price index of the macroeconomic value added (at previous year's prices, base year: 2015; Source: Own calculations based on data from the Federal Statistical Office, Fachserie 18 Reihe 1.5, p. 53, the calculation is from November 2021). The values differ in comparison to the XXIII Biennial Report because of the 2019 amendment to the national accounts (VGR =*Volkswirtschaftliche Gesamtrechnungen*). It must also be noted when interpreting the figures in constant prices that the implicit price index, which is used to deflate the nominal values, refers to the former Federal territory for the years prior to 1991, and comparisons with the years after 1991 can only be made to a limited degree.

[2] The share the of Top 100 in this figure also differs slightly compared to the XXIII Biennial Report due to the update of the nominal value added of the overall economy.

Source: Own calculations based on data from the Federal Statistical Office as well as on companies' submissions

Table A.2: Shares of shareholders of the Top 100 by shareholder type in 2020

Ranking	Company (legal unit reviewed)	Top 100	Foreign investors	Public	Individuals	Free float	Others
1	Volkswagen AG		18.39	20.00	53.30	8.31	
2	Daimler AG		45.97			54.03	
3	Siemens AG	5.84	13.39		6.00	74.77	
4	Deutsche Telekom AG	18.91	9.09	14.50		57.50	
5	Robert Bosch GmbH				100.00		
6	Deutsche Bahn AG			100.00			
7	Bayerische Motoren Werke AG		15.03		46.30	37.50	1.17
8	Deutsche Post AG	23.10	11.28			64.48	1.14
9	INA-Holding Schaeffler GmbH & Co. KG				100.00		
10	REWE-Gruppe (REWE-Zentral-Aktiengesellschaft)						100.00
11	Fresenius SE & Co. KGaA	7.56	16.52		26.44	48.42	1.06
12	SAP SE	1.63	17.26		12.45	68.66	
13	E.ON SE	17.46	37.98			44.56	
14	Vonovia SE	3.20	52.46			44.34	
15	Bayer AG	2.05	41.19			56.76	
16	Roche-Gruppe Deutschland		100.00				
17	EDEKA-Gruppe (EDEKA Zentrale AG & Co. KG)						100.00
18	Schwarz-Gruppe (Lidl and Schwarz Stiftung & Co. KG)				100.00		
19	Airbus-Gruppe Deutschland[1]	10.93	32.00			57.07	
20	Deutsche Bank AG		34.18			64.01	1.81
21	ZF Friedrichshafen AG			100.00			
22	Allianz SE	3.54	16.27			79.10	1.09
23	Commerzbank AG		29.07	15.60		55.33	
24	C. H. Boehringer Sohn AG & Co. KG				100.00		
25	BASF SE	3.47	18.69			76.00	1.84
26	Aldi-Gruppe (Aldi Einkauf GmbH & Co. oHG)				100.00		
27	Bertelsmann SE & Co. KGaA				100.00		
28	Asklepios Kliniken GmbH & Co. KGaA				100.00		
29	RWE AG	2.40	22.35	7.79		67.46	
30	AXA-Gruppe Deutschland (AXA Konzern AG)		100.00				
31	EnBW Energie Baden-Württemberg AG			93.48		2.00	4.52

Ranking	Company (legal unit reviewed)	Top 100	Foreign investors	Public	Individuals	Free float	Others
32	KfW Bankengruppe			100.00			
33	Münchener Rückversicherungs-Gesellschaft AG	5.28	14.07			80.65	
34	Ford-Gruppe Deutschland (Ford-Werke GmbH)		100.00				
35	thyssenkrupp AG	1.35	40.44		20.93	37.28	
36	Rethmann SE & Co. KG				100.00		
37	HGV Hamburger Gesellschaft für Vermögens- und Beteiligungsmanagement mbH			100.00			
38	Evonik Industries AG	1.71	23.53	58.90		15.86	
39	STRABAG-Gruppe Deutschland (STRABAG AG)		100.00				
40	Vodafone-Gruppe Deutschland (Vodafone GmbH)		100.00				
41	Shell-Gruppe Deutschland (German Shell Holding GmbH)		100.00				
42	Adolf Würth GmbH & Co. KG				100.00		
43	Sana Kliniken AG	24.90				16.20	58.90
44	IBM-Gruppe Deutschland (IBM Deutschland GmbH)		100.00				
45	Merck KGaA	1.10	4.34		70.02	24.54	
46	Carl Zeiss AG				100.00		
47	DZ Bank AG						100.00
48	UniCredit-Gruppe Deutschland (UniCredit Bank AG)		100.00				
49	Sanofi-Gruppe Deutschland		100.00				
50	Otto Group				100.00		
51	Liebherr-International-Gruppe Deutschland		100.00				
52	Hapag-Lloyd AG	13.90	22.50			3.60	60.00
53	PricewaterhouseCoopers Aktiengesellschaft Wirtschafts-prüfungsgesellschaft				100.00		
54	ING-Gruppe Deutschland (ING Holding Deutschland GmbH)		100.00				
55	DEERE-Gruppe Deutschland (John Deere GmbH & Co. KG)		100.00				
56	Henkel AG & Co. KGaA		4.78		63.84	31.38	
57	KPMG AG Wirtschaftsprüfungsgesellschaft				100.00		
58	Deutsche Börse AG	5.25	50.31			44.44	
59	Amazon-Gruppe Deutschland		100.00				
60	Bayerische Landesbank			100.00			
61	Deloitte GmbH Wirtschaftsprüfungsgesellschaft				100.00		
62	EWE AG		26.00	74.00			

Ranking	Company (legal unit reviewed)	Top 100	Foreign investors	Public	Individuals	Free float	Others
63	Ernst & Young GmbH Wirtschaftsprüfungsgesellschaft				100.00		
64	Landesbank Baden-Württemberg			100.00			
65	Philip Morris International-Gruppe Deutschland		100.00				
66	Stadtwerke München GmbH			100.00			
67	Generali-Gruppe Deutschland (Generali Beteiligungs-GmbH)		100.00				
68	B. Braun SE				100.00		
69	Salzgitter AG		17.14	26.50		56.36	
70	DEKRA SE						100.00
71	HDI Haftpflichtverband der Deutschen Industrie V.a.G.[2]						
72	HUK-COBURG[2]						
73	dm-drogerie markt Verwaltungs-GmbH				100.00		
74	maxingvest AG				100.00		
75	Rolls-Royce-Gruppe Deutschland		100.00				
76	Dirk Rossmann GmbH		40.00		60.00		
77	HELLA GmbH & Co. KGaA	2.69	9.96		60.00	24.69	2.66
78	TenneT TSO GmbH		100.00				
79	MAHLE GmbH				100.00		
80	Stadtwerke Köln GmbH			100.00			
81	Procter & Gamble-Gruppe Deutschland		100.00				
82	Wacker Chemie AG	2.42			62.16	35.42	
83	Novartis-Gruppe Deutschland (Novartis Pharma GmbH)		100.00				
84	United Internet AG	6.36	6.80		42.27	39.28	5.29
85	Linde-Gruppe Deutschland (Linde Holding GmbH)		100.00				
86	Infineon Technologies AG	7.80	43.50			48.70	
87	Axel Springer SE		47.60			52.40	
88	Ceconomy AG		18.85		14.33	32.88	33.94
89	Zalando SE	2.93	56.86			40.21	
90	LANXESS AG	11.45	35.79			51.60	1.16
91	Versicherungskammer Bayern VöR			100.00			
92	Adecco-Gruppe Deutschland		100.00				
93	Charité Universitätsmedizin Berlin KöR			100.00			
94	VINCI-Gruppe Deutschland (VINCI Deutschland GmbH)		100.00				

Ranking	Company (legal unit reviewed)	Top 100	Foreign investors	Public	Individuals	Free float	Others
95	Freudenberg & Co. KG				100.00		
96	Debeka-Gruppe[2]						
97	Rhön-Klinikum AG	93.38	2.09			4.53	
98	Drägerwerk AG & CO. KGaA		1.62		67.19	31.19	
99	Telefónica-Gruppe Deutschland		100.00				
100	Vivantes - Netzwerk für Gesundheit GmbH			100.00			

Note: The categories into which the shareholders of the Top 100 are sub-divided are as follows: Top 100: companies from the group of the Top 100, Foreign investors: identified foreign investors, Public: public sector, Individuals: individuals and/or families/family foundations, free float and others.

[1] The structure of the shareholders of the Airbus-Gruppe Deutschland corresponds to that of the shareholders of Airbus SE, although the latter is not located in Germany.

2 The Debeka-Gruppe, HUK-COBURG and the HDI Haftpflichtverband der Deutschen Industrie do not have equity interest comparable to shares, since they are organised as mutual insurance companies. Their equity is therefore formed solely of the taxed company profits and members' contributions. The shareholder structure is thus not shown here.

Source: Own calculations based on the "Orbis" database of the provider Bureau von Dijk (Version: March 2022)

Table A.3: Cross-shareholdings of the Top 100 in 2020

Ranking	Shareholder	Ranking	Company in which share is held	Share
20	Deutsche Bank AG	3	Siemens AG	1.55
		4	Deutsche Telekom AG	1.51
		8	Deutsche Post AG	2.57
		11	Fresenius SE & Co. KGaA	2.53
		12	SAP SE	1.63
		13	E.ON SE	2.46
		14	Vonovia SE	3.20
		15	Bayer AG	2.05
		22	Allianz SE	3.54
		25	BASF SE	2.19
		29	RWE AG	2.40
		33	Münchener Rückversicherungs-Gesellschaft AG	2.10
		35	thyssenkrupp AG	1.35
		38	Evonik Industries AG	1.71
		45	Merck KGaA	1.10
		58	Deutsche Börse AG	2.78
		77	HELLA GmbH & Co. KGaA	1.57
		84	United Internet AG	1.27
		86	Infineon Technologies AG	3.08
		90	LANXESS AG	10.34
22	Allianz SE	3	Siemens AG	3.00
		11	Fresenius SE & Co. KGaA	5.03
		25	BASF SE	1.28
		33	Münchener Rückversicherungs-Gesellschaft AG	1.68
		43	Sana Kliniken AG	14.40
		58	Deutsche Börse AG	1.12
		77	HELLA GmbH & Co. KGaA	1.12
		82	Wacker Chemie AG	2.42
		84	United Internet AG	5.09
		86	Infineon Technologies AG	4.72
		89	Zalando SE	2.93
		90	LANXESS AG	1.11
28	Asklepios Kliniken GmbH & Co. KGaA	97	Rhön-Klinikum AG	93.38
29	RWE AG	13	E.ON SE	15.00
32	KfW Bankengruppe	4	Deutsche Telekom AG	17.40

		8	Deutsche Post AG	20.53
		19	Airbus-Gruppe Deutschland	10.93
33	Münchener Rückversicherungs-Gesellschaft AG	3	Siemens AG	1.29
37	HGV Hamburger Gesellschaft für Vermögens- und Beteiligungsmanagement mbH	52	Hapag-Lloyd AG	13.90
47	DZ Bank	33	Münchener Rückversicherungs-Gesellschaft AG	1.50
		58	Deutsche Börse AG	1.35
96	Debeka-Gruppe	43	Sana Kliniken AG	10.50

Source: Own calculations based on the “Orbis” database of the provider Bureau van Dijk (Version: March 2022)

Table A.4: Personnel cross-links of the Top 100 in 2020 by type of cross-link

Ranking	Company (legal unit under review)	Via own management board[1]	Via members of management board who are members of own supervisory board[2]	…of whom members of management board of financial institutes and insurance companies[3]	Via individuals without management mandate in own supervisory board[4]
1	Volkswagen AG				2
2	Daimler AG		3		4
3	Siemens AG	1	1		5
4	Deutsche Telekom AG	3	1	1	4
5	Robert Bosch GmbH	1			8
6	Deutsche Bahn AG		2	2	2
7	Bayerische Motoren Werke AG	1			7
8	Deutsche Post AG	1	1	1	4
9	INA-Holding Schaeffler GmbH & Co. KG		1		1
11	Fresenius SE & Co. KGaA				2
12	SAP SE	1			1
13	E.ON SE		2		3
14	Vonovia SE	1			3
15	Bayer AG	1			4
16	Roche-Gruppe Deutschland	2			
19	Airbus-Gruppe Deutschland		1		
20	Deutsche Bank AG	1	1		2
21	ZF Friedrichshafen AG		2		5
22	Allianz SE				3
23	Commerzbank AG		1		3
25	BASF SE				4
27	Bertelsmann SE & Co. KGaA		1	1	2
28	Asklepios Kliniken GmbH & Co. KGaA	1			1
29	RWE AG	3			3
30	AXA-Gruppe Deutschland				1
31	EnBW Energie Baden-Württemberg AG				2
32	KfW Bankengruppe	4			2
33	Münchener		1		2

Ranking	Company (legal unit under review)	Via own management board[1]	Via members of management board who are members of own supervisory board[2]	…of whom members of management board of financial institutes and insurance companies[3]	Via individuals without management mandate in own supervisory board[4]
34	Ford-Gruppe Deutschland				2
35	thyssenkrupp AG		1	1	5
37	HGV Hamburger Gesellschaft für Vermögens- und Beteiligungsmanagement mbH	1			
38	Evonik Industries AG				3
42	Adolf Würth GmbH & Co. KG	1			1
44	IBM-Gruppe Deutschland		1		2
45	Merck KGaA		1		1
46	Carl Zeiss AG				2
47	DZ Bank AG	1			
49	Sanofi-Gruppe Deutschland				1
50	Otto Group				2
52	Hapag-Lloyd AG		1		
54	ING-Gruppe Deutschland				1
56	Henkel AG & Co. KGaA		1		7
58	Deutsche Börse AG	1			2
60	Bayerische Landesbank				1
63	Ernst & Young GmbH	1	1		
64	Landesbank Baden-Württemberg				1
68	B. Braun SE				1
69	Salzgitter AG		1	1	2
70	DEKRA SE		1		
71	HDI Haftpflichtverband the Deutschen	1			2
75	Rolls-Royce-Gruppe Deutschland				2
78	TenneT TSO GmbH				1
79	MAHLE GmbH				1
81	Procter & Gamble-Gruppe Deutschland				1
85	Linde-Gruppe Deutschland	1			5
86	Infineon Technologies AG				2
87	Axel Springer SE		1		

Ranking	Company (legal unit under review)	Via own management board[1]	Via members of management board who are members of own supervisory board[2]	…of whom members of management board of financial institutes and insurance companies[3]	Via individuals without management mandate in own supervisory board[4]
88	Ceconomy AG	1			1
90	LANXESS AG	1			1
91	Versicherungskammer Bayern VöR				1
93	Charité Universitätsmedizin Berlin KöR		2		3
94	VINCI-Gruppe Deutschland	1	1		
95	Freudenberg & Co. KG	1			2
97	Rhön-Klinikum AG		1		4
100	Vivantes – Netzwerk für Gesundheit GmbH		1		2

Note: Companies for which no cross-link was identified in 2020 are not listed here.
[1] The figure represents the number of other companies in which members of the management board of the company under review exercise a mandate.
[2] The figure represents the number of other companies in which individuals in the supervisory board of the company under review are members of the management board.
[3] The number stated here is included in the figure in the previous column. A cross-link is counted if an individual is a member of the management board of a financial institute or a bank from the group of the Top 100, and exercises a mandate in the supervisory board of the company in question.
[4] The figure represents the number of other companies in which individuals in the supervisory board of the company in question exercise a mandate in the supervisory board.
Source: Own calculations on the basis of published annual reports

Table A.5: Merger activities of the Top 100 in the reporting period 2020/2021

Ranking	Company (highest-level parent company)	Clearances[1]
1	Volkswagen AG	9
2	Daimler AG	3
3	Siemens AG	2
5	Robert Bosch GmbH (Robert Bosch Industrietreuhand KG)	4
6	Deutsche Bahn AG	4
7	Bayerische Motoren Werke AG	1
9	INA-Holding Schaeffler GmbH & Co. KG	1
10	REWE-Gruppe (REWE-Zentralfinanz EG)	3
11	Fresenius SE & Co. KGaA	3
12	SAP SE	3
13	E.ON SE	19
14	Vonovia SE	3
16	Roche-Gruppe Deutschland (Roche Holding AG)	1
17	EDEKA-Gruppe (EDEKA Zentrale AG & Co. KG)	1
18	Schwarz-Gruppe (Lidl Stiftung & Co. KG; Schwarz Stiftung & Co. KG)	3
19	Airbus-Gruppe Deutschland (Airbus SE)	3
20	Deutsche Bank AG	3
21	ZF Friedrichshafen AG	2
22	Allianz SE	10
23	Commerzbank AG	3
25	BASF SE	7
27	Bertelsmann SE & Co. KGaA	5
29	RWE AG	1
31	EnBW Energie Baden-Württemberg AG	9
35	thyssenkrupp AG	1
36	Rethmann SE & Co. KG	13
38	Evonik Industries AG	1
39	STRABAG-Gruppe Deutschland (STRABAG SE)	7
43	Sana Kliniken AG	2
44	IBM-Gruppe Deutschland (International Business Machines Corp)	1
46	Carl Zeiss AG	2
48	UniCredit-Gruppe Deutschland (UniCredit spa)	3
56	Henkel AG & Co. KGaA	1

58	Deutsche Börse AG	3
60	Bayerische Landesbank	6
62	EWE AG	3
64	Landesbank Baden-Württemberg	2
66	Stadtwerke München GmbH	1
68	B. Braun SE	1
75	Rolls-Royce-Gruppe Deutschland (Rolls-Royce Holdings plc)	1
77	HELLA GmbH & Co. KGaA	1
84	United Internet AG	2
87	Axel Springer SE	1
88	Ceconomy AG	1
93	Charité Universitätsmedizin Berlin KöR	1
94	VINCI-Gruppe Deutschland (VINCI SA)	2

[1] Mergers completed between 1 January 2020 and 31 December 2021 were included where clearance was given in the preliminary or main investigation procedure with or without remedies. Cases were covered in each case where the company observed was either itself the acquirer or the target, or its parent company was the acquirer or the target (cases with no duty to notify are also recorded). Companies from the group of the Top 100 for which no cases were recorded are not included in the table.
Source: Data from the Federal Cartel Office

Table A.6: Development of domestic turnover in the industry (1978–2020)

Year	Real[1] turnover of the 50 largest industrial companies[2] in m EUR	Change in %	Real[1] turnover of all industrial companies[3] in m EUR	Change in %	Share[4] in %
1978	483,288		1,561,394		30.95
1980	554,093	14.7	1,776,900	13.8	31.18
1982	588,567	6.2	1,763,776	-0.7	33.37
1984	614,735	4.4	1,849,930	4.9	33.23
1986	579,989	-5.7	1,801,305	-2.6	32.20
1988	585,962	1.0	1,841,033	2.2	31.83
1990	651,938	11.3	2,008,105	9.1	32.47
1992	581,608	-10.8	1,812,862	-9.7	32.08
1994	528,912	-9.1	1,920,128	5.9	27.55
1996	565,727	7.0	1,922,732	0.1	29.42
1998	594,010	5.0	2,057,802	7.0	28.87
2000	702,171	18.2	2,273,860	10.5	30.88
2002	689,373	-1.8	2,240,290	-1.5	30.77
2004	705,045	2.3	2,197,171	-1.9	32.09
2006	832,185	18.0	2,498,938	13.7	33.30
2008	866,680	4.1	2,744,974	9.8	31.57
2010	827,827	-4.5	2,599,027	-5.3	31.85
2012	987,691	19.3	2,837,780	9.2	34.81
2014	971,340	-1.7	2,742,652	-3.4	35.42
2016	909,956	-6.3	2,706,675	-1.3	33.62
2018	914,319	0.5	2,850,882	5.3	32.07
2020	787,269	-13.9	2,567,766	-9.9	30.66

[1] The figures for the respective prices were deflated using the implicit price index of the macroeconomic value added (at previous year's prices, base year: 2015; Source: Own calculations based on data from the Federal Statistical Office, Fachserie 18 Reihe 1.5, p. 53, the calculation is from November 2021). The values differ in comparison to the XXIII Biennial Report because of the 2019 amendment to the national accounts (VGR =*Volkswirtschaftliche Gesamtrechnungen*). It must also be noted when interpreting the figures in constant prices that the implicit price index, which is used to deflate the nominal values, refers to the former Federal territory for the years prior to 1991, and comparisons with the years after 1991 can only be made to a limited degree.

[2] The data relate to the domestic corporate divisions, including turnover with foreign affiliated companies.

[3] The underlying nominal values correspond to the aggregate turnover of economic sectors B (Mining), C (Manufacturing industry), D (Energy supply), E (Water supply, sewerage, waste management) and F (Construction) in accordance with the turnover tax statistics.

[4] When interpreting the shares, it must be considered that the macroeconomic comparative value was calculated on the basis of the *Klassifikation der Wirtschaftszweige*, 2008 edition (WZ 2008), from the reporting year 2010 onwards, whilst the attribution in the previous periods is based on the 2003 classification (*Klassifikation der Wirtschaftszweige*, 2003 edition (WZ 2003)). Since the conversion entails large numbers of changes, including at the level of economic sectors, comparisons with the preceding periods can only be made to a limited degree.

Source: Own calculations based on data from the Federal Statistical Office as well as on companies' submissions

Table A.7: Development of domestic turnover in trade (1978–2020)

Year	Real[1] turnover of the ten largest trade companies in m EUR	Change in %	Real[1] turnover of all trade companies in m EUR	Change in %	Share[4] in %
1978	79,458		1,049,421		7.57
1980	81,372	2.4	1,128,000	7.5	7.21
1982	84,505	3.8	1,096,967	-2.8	7.70
1984	83,975	-0.6	1,143,451	4.2	7.34
1986	77,677	-7.5	1,127,281	-1.4	6.89
1988	87,031	12.0	1,192,954	5.8	7.30
1990	93,818	7.8	1,356,228	13.7	6.92
1992	90,265	-3.8	1,281,304	-5.5	7.04
1994	99,796	10.6	1,360,107	6.2	7.34
1996	114,640	14.9	1,378,834	1.4	8.31
1998	123,389	7.6	1,448,689	5.1	8.52
2000	140,401	13.8	1,586,412	9.5	8.85
2002	147,471	5.0	1,554,804	-2.0	9.48
2004	174,110	18.1	1,601,420	3.0	10.87
2006	182,735	5.0	1,784,714	11.4	10.24
2008	188,314	3.1	1,902,798	6.6	9.90
2010	179,499	-4.7	1,797,271	-5.5	9.99
2012	185,039	3.1	1,938,699	7.9	9.54
2014	208,396	12.6	1,922,995	-0.8	10.84
2016	205,453	-1.4	1,943,886	1.1	10.57
2018	200,163	-2.6	2,015,166	3.7	9.93
2020	215,760	7.8	1,990,705	-1.2	10.84

[1] The figures in the respective prices were deflated using the implicit price index of the macroeconomic value added (at the previous year's prices, base year: 2015; Source: Own calculations based data from the Federal Statistical Office, Fachserie 18 Reihe 1.5, p. 53, the calculation is from November 2021). The values differ in comparison to the XXIII Biennial Report because of the 2019 amendment to the national accounts (VGR =*Volkswirtschaftliche Gesamtrechnungen*). It must also be noted when interpreting the figures in constant prices that the implicit price index, which is used to deflate the nominal values, refers to the former Federal territory for the years prior to 1991, and comparisons with the years after 1991 can only be made to a limited degree.

[2] The data relate to the domestic corporate divisions, including turnover with foreign affiliated companies.

[3] The underlying nominal values correspond to the aggregate turnover of economic sections G (Trade; Repair and maintenance of other transport equipment) in accordance with the turnover tax statistics.

[4] When interpreting the shares, it must be considered that the macroeconomic comparative value was calculated on the basis of the *Klassifikation der Wirtschaftszweige*, 2008 edition (WZ 2008), from the reporting year 2010 onwards, whilst the attribution in the previous periods is based on the 2003 classification (*Klassifikation der Wirtschaftszweige*, 2003 edition (WZ 2003)). Since the conversion entails large numbers of changes, including at the level of economic sections, comparisons with the preceding periods can only be made to a limited degree.

Source: Own calculations based on data from the Federal Statistical Office as well as of companies' submissions

Table A.8: The development of domestic turnover in the transport and service sector (1978–2020)

Year	Real[1] turnover of the ten largest transport and service companies[2] in m EUR	Change in %	Real[1] turnover of all transport and service companies[3] in m EUR	Change in %	Share[4] in %
1978	25,895		330,551		7.83
1980	29,363	13.4	372,992	12.8	7.87
1982	30,352	3.4	386,647	3.7	7.85
1984	32,095	5.7	414,285	7.1	7.75
1986	29,126	-9.3	448,162	8.2	6.50
1988	30,316	4.1	512,806	14.4	5.91
1990	32,800	8.2	614,880	19.9	5.33
1992	30,556	-6.8	625,847	1.8	4.88
1994	99,978	227.2	652,864	4.3	15.31
1996	103,151	3.2	717,664	9.9	14.37
1998	119,860	16.2	806,248	12.3	14.87
2000	144,090	20.2	918,199	13.9	15.69
2002	145,301	0.8	978,718	6.6	14.85
2004	142,378	-2.0	976,025	-0.3	14.59
2006	152,748	7.3	1,093,802	12.1	13.96
2008	148,591	-2.7	1,153,606	5.5	12.88
2010	135,277	-9.0	1.035.914	-10,2	13.06
2012	141,409	4.5	1.035.650	0,0	13.65
2014	138,284	-2.2	1.030.007	-0,5	13.43
2016	140,998	2.0	1.060.594	3,0	13.29
2018	144,432	2.4	1.124.513	6,0	12.84
2020	124,272	-14.0	1.055.278	-6,2	11.78

[1] The figures in the respective prices were deflated using the implicit price index of the macroeconomic value added (at previous year's prices, base year: 2015; Source: Own calculations on the basis of data from the Federal Statistical Office, Fachserie 18 Reihe 1.5, p. 53, the calculation is from November 2021). The values differ in comparison to the XXIII Biennial Report because of the 2019 amendment to the national accounts (VGR =*Volkswirtschaftliche Gesamtrechnungen*). It must also be noted when interpreting the figures in constant prices that the implicit price index, which is used to deflate the nominal values, refers to the former Federal territory for the years prior to 1991, and comparisons with the years after 1991 can only be made to a limited degree.

[2] The data relate to the domestic corporate divisions, including turnover with foreign affiliated companies.

[3] The underlying nominal values correspond to the aggregate turnover of economic sectors H (Transport and storage), J (Information and communication), L (Real estate activities), M (Professional, scientific and technical activities), N (Administrative and support service activities), R (Arts, entertainment and recreation) and S (Other service activities) in accordance with the turnover tax statistics.

[4] When interpreting the shares, it must be considered that the macroeconomic comparative value was calculated on the basis of the *Klassifikation der Wirtschaftszweige*, 2008 edition (WZ 2008), from the reporting year 2010 onwards, whilst the attribution in the previous periods is based on the 2003 classification (*Klassifikation der Wirtschaftszweige*, 2003 edition (WZ 2003)). Since the conversion entails large numbers of changes, including at the level of economic sections, comparisons with the preceding periods can only be made to a limited degree.

Source: Own calculations on the basis of data from the Federal Statistical Office as well as of companies' submissions

Table A.9: Development of domestic balance sheet totals in the banking industry (1978–2020)

Year	Real[1] balance sheet total of the ten largest financial institutes[2] in bn EUR	Change in %	Real[1] balance sheet total of all financial institutes[3] in bn EUR	Change in %	Share in %
1978	873		2,342		37.28
1980	932	6.8	2,524	7.8	36.93
1982	959	2.9	2,678	6.1	35.82
1984	1,071	11.7	2,927	9.3	36.60
1986	1,168	9.1	3,191	9.0	36.61
1988	1,315	12.5	3,525	10.4	37.31
1990	1,585	20.5	4,395	24.7	36.05
1992	1,570	-0.9	4,136	-5.9	37.95
1994	1,918	22.2	4,620	11.7	41.52
1996	2,417	26.0	5,501	19.1	43.94
1998	3,350	38.6	6,877	25.0	48.72
2000	4,368	30.4	8,400	22.2	52.00
2002	4,276	-2.1	8,487	1.0	50.38
2004	4,104	-4.0	8,597	1.3	47.74
2006	4,713	14.8	9,195	6.9	51.26
2008	4,810	2.1	9,596	4.4	50.13
2010	5,069	5.4	10,311	7.5	49.16
2012	5,554	9.6	9,869	-4.3	56.28
2014	4,657	-16.2	8,767	-11.2	53.12
2016	4,394	-5.6	8,333	-4.9	52.73
2018	3,658	-16.8	7,878	-5.5	46.44
2020	3,835	4.8	8,593	9.1	44.62

[1] The balance sheet totals were deflated using the implicit price index of the macroeconomic value added (at previous year's prices, base year: 2015; Source: Own calculations on the basis of data from the Federal Statistical Office, Fachserie 18 Reihe 1.5, p. 53, the calculation is from November 2021). The values differ in comparison to the XXIII Biennial Report because of the 2019 amendment to the national accounts (VGR =*Volkswirtschaftliche Gesamtrechnungen*). It must also be noted when interpreting the figures in constant prices that the implicit price index , which is used to deflate the nominal values, refers to the former Federal territory for the years prior to 1991, and comparisons with the years after 1991 can only be made to a limited degree.

[2] The consolidated balance sheet total was used up to and including 1996, and since 1998 the non-consolidated balance sheet total of the domestic group units, of the ten largest financial institutes, for the comparison with the macroeconomic comparative value.

[3] The underlying nominal values were taken from the banking statistics of the Deutsche Bundesbank (Bankenstatistik, Fachstatistik, January 2022, p. 106). The balance sheet totals are calculated by the Bundesbank using the individual financial statements of the financial institutes.

Source: Own calculations on the basis of companies' submissions as well as of the banking statistics of the Deutsche Bundesbank

Table A.10: Development in domestic gross written premiums in the insurance sector (1978–2020)

Year	Real[1] gross written premiums of the ten largest insurance companies[2] in mill. EUR	Change in %	Real[1] gross written premiums of all insurance companies[3] in mill. EUR	Change in %	Share in %
1978	37,612				
1980	43,087	14.6			
1982	45,760	6.2			
1984	47,898	4.7			
1986	51,216	6.9			
1988	57,645	12.6			
1990	60,685	5.3	146,636	1.0	41.38
1992	69,172	14.0	148,049	14.6	46.72
1994	83,257	20.4	169,725	5.5	49.05
1996	83,096	-0.2	179,064	5.3	46.41
1998	104,696	26.0	188,480	10.9	55.55
2000	120,892	15.5	209,017	9.1	57.84
2002	136,862	13.2	228,056	7.0	60.01
2004	144,735	5.8	243,952	1.0	59.33
2006	151,307	4.5	246,347	-2.8	61.42
2008	149,997	-0.9	239,453	4.1	62.64
2010	148,667	-0.9	249,342	3.1	59.62
2012	151,922	2.2	257,006	1.7	59.11
2014	153,154	0.8	261,271	0.4	58.62
2016	156,123	1.9	262,383	2.7	59.50
2018	150,008	-3.9	269,388	7.3	55.68
2020	160,817	7.2	289,157	1.0	55.62

[1] The gross written premiums were deflated with the aid of the implicit price index of the macroeconomic value added (at the previous year's prices, base year: 2015; Source: Own calculations on the basis of data from the Federal Statistical Office, Fachserie 18 Reihe 1.5, p. 53, the calculation is from November 2021). The values differ in comparison to the XXIII Biennial Report because of the 2019 amendment to the national accounts (VGR =*Volkswirtschaftliche Gesamtrechnungen*). It must also be noted when interpreting the figures in constant prices that the implicit price index for the years prior to 1991 used to deflate the nominal values refers to the former Federal territory, and comparisons with the years after 1991 can only be made to a limited degree.

[2] The consolidated gross written premiums were used up to and including 1996, and since 1998 the non-consolidated gross written premiums of the domestic corporate divisions, of the ten largest insurance companies, for the comparison with the macroeconomic comparative value.

[3] The underlying nominal values were taken from the primary insurance statistics of the Federal Financial Supervisory Authority (Statistik der BaFin – Erstversicherungsunternehmen – Ergänzende statistische Daten – Annex 1, https://www.bafin.de/DE/PublikationenDaten/Statistiken/Erstversicherung/erstversicherung_node.html;jsessionid=53DA0A79B303908AF398C16A8B831351.2_cid503, retrieved on 21 April 2022). Gross written premiums are calculated by the BaFin using the individual financial statements of the insurance companies.

Source: Own calculations on the basis of companies' submissions, as well as of the primary insurance statistics of the Federal Financial Supervisory Authority

B. Appendix to cross-sector market power trends

1 Estimation of mark-ups

578. In order to determine mark-ups according to equation (4) as the ratio of the output elasticity of a variable production factor and the share of its costs in turnover, production functions need to be estimated using firm-level data. The two-stage control function approach by Ackerberg, Caves and Frazer (ACF) was used for this purpose in the present Report.[8] This assumes a production technology where labour (L) and capital (K) are substitutes, but flexible material input M forms a perfect complement to any given combination of L-K. As a result, there is a fixed ratio between material and the labour-capital input, independent of the output level. Such a "Leontief function" of output Y takes the following form

$$Y_{it} = \min\{F(L_{it}, K_{it})e^{\omega_{it}}, C(M_{it})\}\, e^{\varepsilon_{it}}. \tag{9}$$

Here, ω_{it} indicates the time-specific productivity of firm i and ε_{it} a random shock or measurement error. Assuming that firms minimise cost, optimal input choice leads to $Y_{it} = C(M_{it})e^{\varepsilon_{it}} = F(L_{it}, K_{it})e^{\omega_{it}+\varepsilon_{it}}$, and the production function can be condensed (and for simplification written in log form, indicated by small letters) to read as follows

$$y_{it} = f(l_{it}, k_{it}) + \omega_{it} + \varepsilon_{it}. \tag{10}$$

579. Given that it is not possible to observe either ε_{it} or ω_{it} in the econometric analysis, but the latter is known to the firm itself when it decides on its production and its factor input, productivity ω_{it} is substituted by a "control function". This requires assuming strict monotonicity of material demand in productivity, which can then be inverted:

$$m_{it} = h(l_{it}, k_{it}, \omega_{it}) \quad \Rightarrow \quad \omega_{it} = h^{-1}(l_{it}, k_{it}, m_{it}) \tag{11}$$

580. ACF show how the output elasticities of capital and labour can be identified in this case. The first step consists of estimating output $\phi_{it} = y_{it} - \varepsilon_{it}$, corrected for random shock, in a non-parametric regression. In line with existing studies, the present Report used a third-order polynomial in all input factors, additionally controlling for firm size as well as for a complete set of interactions between the 3-digit industries with the calendar years.

581. The second step consists of a GMM estimation based on the assumption of a Markov process for the development of productivity ω_{it} over time, so that $\omega_{it} = \phi_{it} - f(l_{it}, k_{it})$ and $\omega_{it} = g(\omega_{it-1}) + \xi_{it}$ applies. A Markov process consists of future states being determined by the immediate past. In the case of the productivity development modelled here, it is sufficient to know the productivity of the previous period. Function $g(\omega_{it-1})$ was approximated using a third-order polynomial. Assuming that capital is a dynamic production factor, and hence k_{it} is already determined in the previous period $t-1$, whilst labour is at least partly flexible, the moment conditions of the GMM estimate are as follows

$$E\left[(\xi_{it}(\beta) + \varepsilon_{\mathrm{it}})\begin{pmatrix} 1 \\ l_{it-1} \\ k_{it} \\ \phi_{it-1} \end{pmatrix}\right] = 0. \tag{12}$$

582. Where it is not possible to flexibly adapt the labour input at short notice, for instance because of a high level of protection against dismissal, in addition to the labour of the previous period l_{it-1}, a supplementary moment in l_{it} may help improve the identification of the production function. However, this gives rise to the question with regard to the subsequent mark-up estimate as to whether labour is a suitable, flexible input factor.[9]

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[8] Ackerberg et al., Identification Properties of Recent Production Function Estimators, *supra* note 78.

[9] Cf. van Heuvelen, G.H./Bettendorf, L./Meijerink, G., Estimating Markups in the Netherlands, 2019.

583. The coefficients of the production function identified in the GMM estimate define the output elasticity of the factor of labour, enabling the firm-specific mark-ups to be calculated following equation (4). As shown by De Loecker and Warzynski , two corrections still need to be carried out: Firstly, when calculating the turnover share of the labour costs, the expected turnover must be used, which in turn can be calculated as $p_{it}Y_{it}/e^{\varepsilon_{it}}$, by correcting the turnover observed in the data by the estimated error of the first stage of the estimation. Secondly, the assumption of a Leontief technology requires the marginal costs of the material input to be included in the mark-up calculation as follows

$$\mu_{it}^{*} = \frac{1}{\mu^{-1} + \alpha_{it}^{M}}. \tag{13}$$

1.1 GMM initial values

584. A problem in the GMM estimation is choosing suitable initial values for the coefficients of the production function $f(\cdot)$ at the beginning of the numerical optimisation. The studies that provide information on this point determine the initial values with the aid of a simple OLS estimation of function $y_{it} = \beta_l l_{it} + \beta_k k_{it} + \epsilon_{it}$.[10] These initial values lead to the correct identification of the coefficients within estimates with simulated company data, as used for instance by ACF and Kim, Luo and Su.[11] However, Kim, Luo and Su also show that the estimation method may additionally lead to corner point solutions, so that they suggest amongst other things additional instruments to improve identification.[12]

585. In order to avoid being dependent on the initial value, estimations for this Report used a broad grid of initial value combinations for the second model stage. The grid for the Cobb-Douglas estimation includes 441 different such combinations for β_l and β_k.[13] The additional coefficients β_{ll}, β_{kk} and β_{lk} cause the number of different combinations to rise in the Translog specification to 675.[14] The non-converged models were first removed from all the estimates, after which the estimate with the smallest value of the GMM target function that was to be minimised was selected. In order to rule out corner point solutions, furthermore, only estimates were taken into account which led to plausible output elasticities of between 0 and 1. This ancillary condition can be derived from the respective coefficients of the input factors in Cobb-Douglas specifications. The total distribution of the firm-specific elasticities was additionally calculated for Translog estimates, and then filtered using the upper and lower quartiles. The extent of the dependency of estimated output elasticities on the initial value is presented in section 3 of this Appendix.

1.2 Gross output estimation

586. It is expedient to use as a variable an input factor as possible in order to estimate mark-ups. At the same time, the additional econometric challenges described at the beginning of section 2.2.9 arise when estimating mark-ups with material input. In order to resolve this trade-off, and to adapt the SVA method to GO functions, De Loecker and Scott propose to take serially-correlated input prices into account in the control function of the first

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[10] This regression is of course only suited for estimating a Cobb-Douglas function. A Translog function would for instance additionally require analogous coefficients β_{ll}, β_{kk} and β_{lk} for the squared terms and the interaction term. Only few replication materials of published studies contain this information, and all initial values are simply set to zero in at least one case in order to estimate the Translog function.

[11] Ackerberg et al., Identification Properties of Recent Production Function Estimators, *supra* note 78; Kim, K. il/Luo, Y./Su, Y., A robust approach to estimating production functions: Replication of the ACF procedure, Journal of Applied Econometrics, 34, 2019, pp. 612–619.

[12] Kim et al., A robust approach to estimating production functions: Replication of the ACF procedure, *supra* note 175.

[13] The values are spaced by 0.05 within the interval [0,1].

[14] The grid is coarser in the Translog estimate, and is broken down into steps of 0.5 between -1 and 1 for the linear terms because of the additional dimensions; the initial values of the quadratic terms, and of the interaction term, vary in steps of 1.

estimation stage.[15] They state that this makes it possible to identify the output elasticities. The firm and year-specific wage (calculated as a quotient of personnel costs and employee headcount) is accordingly integrated into the first-stage estimate, in which the expected output is separated from the exogenous shock, including non-observed productivity. Equation (10) is therefore adapted, and is as follows with GO estimates

$$y_{it} = f(l_{it}, k_{it}, m_{it}, w_{it}) + \omega_{it} + \varepsilon_{it}. \quad (14)$$

2 Data preparation

2.1 Official data (AFiD panel)

587. Official firm data from both AFiD panels, i. e. structural surveys in the service sector and in industrial companies for the period from 2008 to 2017, were used in the present Report for all analyses of firm-specific mark-ups, their potential determinants, and impacts. The data were prepared according to the requirements of the analyses to be carried out before the econometric estimation of individual indicators and relationships. This initially involved standardising the mapping of firms to industries over the entire observation period by allocating the respectively most frequent 4-digit classification for all observation years to them. What is more, an update of the *Klassifikation der Wirtschaftszweige* in official statistics required converting the company data of 2008 in manufacturing from the older classification WZ 2003 to the current WZ 2008. This in turn involved using the classification of a later year based on the WZ 2008; where this was not possible due to a lack of repeated observations of the same firm, the WZ 2008 classification was used which occurred most frequently in the overall dataset as the successor of the respective WZ 2003 code.

588. Estimating mark-ups necessitates deflating nominal values such as turnover or cost of production factors in order to be able to compare them over time. Otherwise, a high inflation rate with concomitant rising prices would for example create the impression that production volumes were being expanded. Following Schiersch, as well as in Belitz et al., deflators were calculated for this purpose on the basis of industry-specific time series of nominal and real values from the national accounts statistics of the Federal Statistical Office.[16]

589. Finally, in order to estimate production functions, firm-specific capital stocks had to be determined from the available data. As most studies in the relevant literature, an approach based on the "perpetual inventory method" (PIM) was chosen for this, in which values are calculated for each year using an initial value for the capital stock, as well as information on investments and depreciation rates. The fundamental problem of this method consists in determining the initial value. It is possible to approximate the physical capital stock over an extended period of time using the fixed assets and the annual investments recorded in the balance sheet.[17] But since most company databases – and specifically the AFiD panels designed as rotating random samples – do not observe individual firms over such long periods, there is a need to make an appropriate adjustment of the method in order to determine the capital stock of the first period. This involved calculating the initial capital stock as a mean of two approximated values, similar to the method used in the OECD's Multiprod project:[18] as the product of the firm-

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15 De Loecker/Scott, Estimating market power Evidence from the US Brewing Industry, *supra* note 74.

16 These are data on the production value, on gross value added, on gross fixed assets, on gross fixed capital formation, on depreciation and on purchased materials, corrected for price and stated in respective prices. (cf. Schiersch, A., Frontiers und Laggards - Die Produktivitätsentwicklung deutscher Unternehmen, Produktivität für Inklusives Wachstum 4, 2019; Belitz, H. et al., Wissensbasiertes Kapital in Deutschland: Analyse zu Produktivitäts- und Wachstumseffekten und Erstellung eines Indikatorsystems, DIW Berlin: Politikberatung kompakt 126, 2017; Statistisches Bundesamt, Fachserie 18 Reihe 1.4: Volkswirtschaftliche Gesamtrechnungen Inlandsproduktsberechnung Detaillierte Jahresergebnisse 2018, Wiesbaden, 2019).

17 Mueller for instance points out that a time series of 25 years is required under a mean depreciation rate of 4 percent in order to reliably calculate the capital stock (cf. Mueller, S., Capital Stock Approximation using Firm Level Panel Data, Jahrbücher für Nationalökonomie und Statistik, 228, 2008, pp. 357–371).

18 Berlingieri, G. et al., The Multiprod project: A comprehensive overview, OECD Science, Technology and Industry Working Papers 2017/04, 2017.

specific employee headcount and the average capital intensity in the respective 2-digit industry; and as the average investment amount of a firm discounted by the mean depreciation rate of the industry.

590. The other model variables such as output level, employee headcount and costs for raw, auxiliary and operating materials were taken directly from the data. Table B. provides a descriptive overview of the variables used.

Table B.1: Descriptive statistics of the model variables in official data

Variables	1st percentile	Mean	Median	99th percentile
Manufacturing sector (N = 163.261)				
Y	941,586.05	77,182,048.86	11,950,060.00	795,580,480.00
L	18.00	270.18	80.00	2,402.56
K	1,078,436.38	49,745,326.75	9,600,709.00	552,267,776.00
M	74,764.39	43,094,675.77	4,918,728.00	471,680,608.00
Service sector (N = 764.201)				
Y	236,793.55	8,298,832.20	1,235,656.25	100,255,512.00
L	2.00	66.97	15.00	842.00
K	35,653.36	24,465,325.65	924,195.94	406,581,632.00
M	0.00	2,512,773.10	196,663.77	31,168,578.00

Note: The model variables refer to deflated turnover (Y), employee headcount (L), deflated capital stock (K), as well as deflated costs for raw, auxiliary and operating materials (M).
Source: AFiD panel on industrial firms 2008–2017 (DOI: 10.21242/42221.2017.00.01.1.1.0); AFiD panel structural survey in the service sector 2008–2017 (DOI: 10.21242/47415.2017.00.01.1.1.0); own calculations

2.2 Orbis data

591. Parts of the present Report used both company data from the official statistics, and the "Orbis Europe" company database of the private supplier Bureau van Dijk (BvD). To make sure all analyses can be replicated, the following two sections explain which data preparation steps were carried out prior to the analyses described in the main text.

2.2.1 Balance sheet data

592. Most of the information from the Orbis database that was used to estimate mark-ups originates from a large table containing firms' balance sheet data. Each line of this table corresponds to a financial report which was published by the firm in question at a specific time and recorded by one of the BvD data providers. BvD obtains this information from different data suppliers, and includes both annual reports and for instance also quarterly reports. Furthermore, several reports are available for a number of individual firms containing different data, depending on whether it is an unconsolidated or a consolidated statement of a corporate group. This wide variety of information necessitates several correction steps for the Orbis data in order finally to create a suitable panel of company data that allows estimating mark-ups.

593. Several fundamental data cleaning criteria were therefore applied in order to remove observations from the raw data, which would prevent any further analysis being carried out. Criteria 1 to 4 refer here to individual observations in the data, whilst criteria 5 to 7 relate to groups of observations with the same company ID and the same consolidation code:

1. Observations must contain a BvD ID, a consolidation code, a type of report (filing type), and a date of the report.
2. Only unconsolidated statements are included.
3. Observations must contain information on the following variables: employee headcount, personnel costs, operative turnover and material costs.
4. Statements must refer to a period of 12 months.[19]
5. Firms must show operative turnover of at least 100,000 Euro in at least one year under observation.
6. Firms must have at least two employees in at least one year under observation.
7. Firms must be observed over at least two consecutive years.

594. After these cleaning steps, the data can still not be completely analysed as a company panel as they still contain several observations per year for individual firms. Most of these double entries are caused by the fact that BvD records its datasets both directly from company publications, and indirectly from official annual financial statements (e.g. in the Federal Gazette [*Bundesanzeiger*]), and the information is dated differently due to time-lags in publication. Another reason may be publications made according to different accounting rules (IFRS/GAAP). Since no general criterion can be defined with regard to accounting rules as well as types and times of publication, a selection was made between multiple observations of the same firm within a year by referring in each case to the variables which occur the most frequently over all the years. This leads to the following additional criteria for duplicate entries:

8. Observations with a reporting date which occurs most frequently in other years remain in the dataset.
9. The type of report most frequently observed remains in the dataset.
10. The accounting rule most frequently observed remains in the dataset.

595. After a final elimination of completely identical rows, the dataset takes the form of a company panel with unique observations per firm and year.[20] To enable further analysis, this table was merged with additional information on the respective industry code of each firm from the Orbis database. Since firms with a large number of economic activities are frequently attributed to several industries, only the industries classification of the main activity listed in Orbis was used here.

596. Finally, before performing production function estimations, outlier observations were removed from the dataset. All variables that are used to estimate mark-ups contain implausible individual values. Observations were therefore excluded if the costs for material or personnel, or the amount of the capital relative to turnover, were outside of the 0.25th or 99.75th percentiles.[21] These quantiles were calculated separately for each industry section on the basis of the deflated figures. In order not to exclude an unnecessarily large number of observations from the analysis, individual outliers in the number of employees were furthermore imputed if the values from the previous and subsequent years deviated by more than a factor of 4. Such obvious data errors were replaced in each case by the mean of the previous and subsequent years.[22]

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[19] This step eliminates data from quarterly and other reports. Stock values such as employee headcount could be compared independently of the reporting period; flow variables such as the corresponding personnel costs, by contrast, are only roughly 25 percent of the value of the total annual value in a quarterly report, so that a comparison over time would show deceptive fluctuations.

[20] The attribution of business years to calendar years is unclear because of the different reporting dates, firstly, between firms, and secondly also within firms over time. As is also customary in other studies, all financial data published prior to 1 July of a year were attributed to the previous calendar year.

[21] A similar procedure was for instance also pursued in the following studies: De Loecker et al., The Rise of Market Power and the Macroeconomic Implications, *supra* note 55; Ganglmair, B./Kann, A./Tsanko, I., Markups for Consumers, Jahrbücher für Nationalökonomie und Statistik, 2021.

[22] This only applied to a total of 30 cases. Some of these were however large firms the non-inclusion of which might influence the subsequent results of the analysis.

2.2.2 Shareholders

597. In order to calculate the MHHIΔ described in section 2.3.2, which is used to measure the extent of horizontal shareholding within a market, the detailed information on shareholders contained in the Orbis database had to be processed. The database contains both a table with up-to-date and historical holdings, as well as annually recorded data, showing active holdings at the respective year-end in individual tables. Each of these observations contains an unique identification number and information on the type of shareholder (e.g. bank, insurance company, investment company), as well as on the percentage of its holding.

598. Institutional investors in particular are frequently a part of corporate groups the subsidiaries of which have identification numbers of their own in the Orbis database. If only the direct shareholders in firms were to be used in order to identify common ownership, connections via two subsidiaries of the same corporate group would be disregarded. For instance, holdings of Blackrock Investment Management and Blackrock Vermögensverwaltung UG in competing firms would not be reflected in the MHHIΔ. Therefore the global group parent companies of all shareholders were identified. This involved using the information on the *global ultimate owner* with more than 50 percent of the shares, provided by BvD (GUO50). The shares held by each firm were then attributed to the respective group parent company, and added up within the respective corporate group. This required distinguishing between data on direct and indirect holdings. The Orbis data partly account for holdings of a subsidiary in the overall holdings at group level. The respective overall holdings were used in these cases instead of the total of the individual holdings. By contrast, the total of directly-held shares was also taken into consideration in observations which only contain qualitative information (e.g. “majority holding” which is coded as 50.01 percent).

599. The MHHIΔ was then calculated for each 3-digit industry and each year following equation (7) on the basis of these group-related holdings in firms. This only took holdings of institutional investors into account, i. e. those of shareholders which are designated in the Orbis database as banks, financial corporations, insurance companies, investment companies, states, private equity companies, hedge funds or publicly-traded firms.[23]

3 Dependence of output elasticities on initial values in the production approach

600. The method by Ackerberg, Caves and Frazer (ACF)[24] for estimating production functions requires initial values to be selected at the start of the GMM-stage for all coefficients of the production function. Better values are iteratively determined on this basis, which minimise the objective function, depending on the moment definition. The selection of these initial values can influence the coefficients that are ultimately determined. For this reason, all production functions used in the present Report are estimated via a grid of initial value combinations. This grid comprises 441 combinations in the case of Cobb-Douglas specifications being applied to SVA models, whilst 675 different combinations were used with Translog specifications because of the larger number of coefficients. The initial value grid for GO models consists of 216 different combinations of initial values for the two function specifications.

601. In order to review the robustness of the estimated output elasticities, their distributions over all combinations of initial values were analysed in each two-digit industry. This revealed both in manufacturing and in the service sector that, if one assumes flexible labour (i. e. using only the employee headcount of the previous period as an instrument in the GMM estimation), the variance of the estimated elasticities is considerable in all industries, and they furthermore lie outside of the plausible interval [0.1] in several instances (cf. Figure B.). By contrast, the estimates are much more robust assuming significant adjustment costs of the labour input – also

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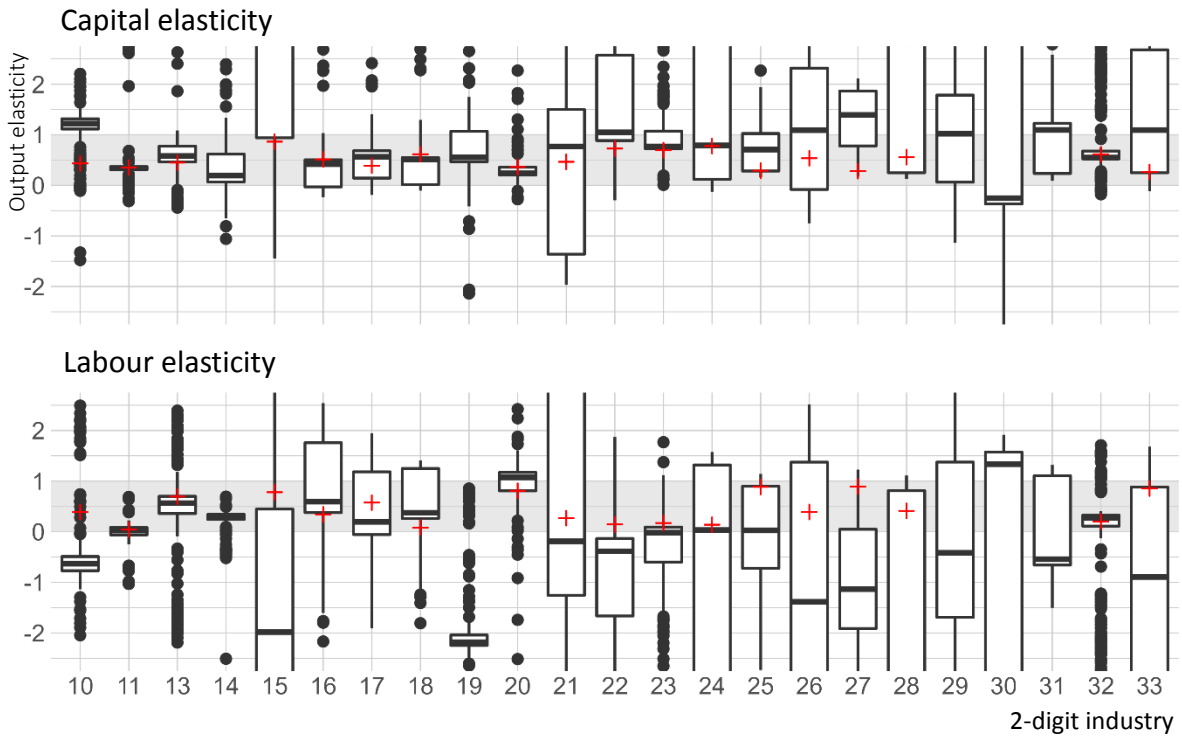
[23] This corresponds to the following classifications in the database: B, F, A, E, S, P, Y, Z.

[24] Ackerberg et al., Identification Properties of Recent Production Function Estimators, *supra* note 78.

allowing current labour to be used as a GMM instrument for identification[25] – and the elasticities hardly vary irrespective of the initial values used (cf. Figure B.2).[26]

Figure B.1: Estimates of the output elasticities vary widely, depending on initial values, when assuming flexible labour

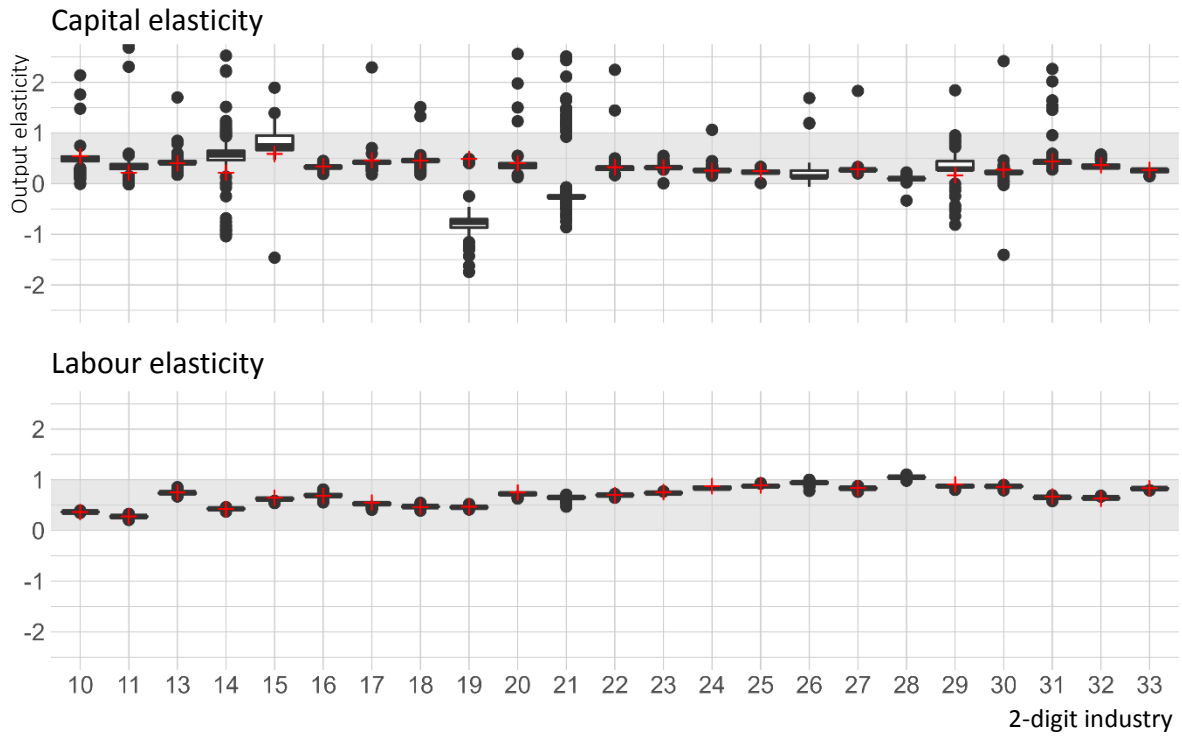


Note: Boxplots of the output elasticities when estimating a Translog function in the manufacturing sector, assuming low adjustment costs of labour input. Elasticities are plausible in the area shaded in grey. Best estimates are labelled by a red cross. The median of the distribution over all firms was used to compare the individual estimates depending on initial values in case of Translog functions.
Source: AFiD panel on industrial firms 2008–2017 (DOI: 10.21242/42221.2017.00.01.1.1.0); AFiD panel structural survey in the service sector 2008–2017 (DOI: 10.21242/47415.2017.00.01.1.1.0); own calculations

[25] Cf. section 3.

[26] Figure I.22 and Figure I.23 each illustrate the distribution of the estimated elasticities in the manufacturing sector for Translog production functions. The results are identical in qualitative terms for Cobb-Douglas functions, as well as for both function types in the service sector.

Figure B.2: The assumption of adjustment costs of labour input leads to robust estimates of output elasticity



Note: Boxplots of the output elasticities when estimating a Translog function in the manufacturing sector, assuming high adjustment costs of the factor of labour. Elasticities are plausible in the area shaded in grey. Best estimates are labelled by a red cross. The median of the distribution over all firms was used to compare the individual estimates depending on initial values in case of Translog functions.

Source: AFiD panel on industrial firms 2008–2017 (DOI: 10.21242/42221.2017.00.01.1.1.0); AFiD panel structural survey in the service sector 2008–2017 (DOI: 10.21242/47415.2017.00.01.1.1.0); own calculations

4 Mark-up development at state level

Figure B.3: Trends in mark-ups hardly vary between federal states

Note: Turnover-weighted means of firm-specific mark-ups based on SVA Translog production functions and dynamic labour input.
Source: AFiD panel on industrial firms 2008–2017 (DOI: 10.21242/42221.2017.00.01.1.1.0); AFiD panel structural survey in the service sector 2008–2017 (DOI: 10.21242/47415.2017.00.01.1.1.0); own calculations

5 Correlation of productivity and mark-ups

602. Without initially trying to identify a causal relationship between total factor productivity and the respective mark-ups at company level, a correlation between the two parameters, taking into consideration year- and firm-specific fixed effects, serves to bring about a better estimation of the potential relationship. The results of the corresponding regression analysis in Table B.2 show that mark-ups and productivity are positively correlated among German firms. A higher mark-up accordingly also means higher productivity on average. A 1-percent increase in the mark-up is accompanied by an average 0.5-percent increase in productivity. This observation initially applies both to the manufacturing and the service sectors. If one however also takes the coefficient of squared productivity in models (2) and (4) of Table B.2 into account, a sign change can be observed which indicates that there is a non-linear relationship, and that the connection is not positive along the entire mark-up distribution. The negative influence on productivity seen with higher price mark-ups is particularly marked in manufacturing, so that the entire relationship becomes negative starting from a mark-up of roughly 1.6. The turning point in the service sector, by contrast, is beyond 2.5; this means that the correlation for the majority of

service-sector firms in the data analysed is positive. Both sectors observed hence show a major difference in the relationship between firm-specific mark-ups and their productivity: Whilst the upper tail of the distribution of mark-ups shows a negative correlation with productivity in the manufacturing sector, the connection is continuously positive in the service sector.[27]

Table B.2: Correlation between total factor productivity and mark-ups

	Manufacturing		Services	
	(1)	(2)	(3)	(4)
$\ln(\text{mark-up}_t)$	0.533 (0.028)***	0.504 (0.026)***	0.356 (0.003)***	0.386 (0.003)***
$\ln(\text{mark-up}_t)^2$		-0.491 (0.038)***		-0.100 (0.002)***
N	124,156	124,156	731,293	731,293
R^2 Adj.	1.000	1.000	0.999	1.000
R^2 Within	0.060	0.081	0.148	0.171
FE: Year	✓	✓	✓	✓
FE: Firm	✓	✓	✓	✓

Note: * p < 0.05; ** p < 0.01; *** p < 0.001; clustered standard errors at the level of firms in parentheses.
Source: AFiD panel on industrial firms 2008–2017 (DOI: 10.21242/42221.2017.00.01.1.1.0); AFiD panel structural survey in the service sector 2008–2017 (DOI: 10.21242/47415.2017.00.01.1.1.0); KLEMS; own calculations

[27] Ganglmair et al. also obtain a positive coefficient of the mark-ups for the service sector on the basis of the private Orbis dataset, and a negative coefficient for manufacturing (cf. Ganglmair et al., Price Markups, Innovation, and Productivity: Evidence from Germany, *supra* note 95, p. 31).